List of Cyclotrons

Cyclotrons, Individual Designs

ID	Country	Institution	Machine name
C1	Belgium	UCL, Centre de Recherches du Cyclotron	CYCLONE 110
C2	Belgium	UCL, Centre de Recherches du Cyclotron	CYCLONE 44
C3	Canada	TRIUMF	TRIUMF Cyclotron
C4	China	Institute of Modern Physics (IMP), CAS	HIRFL Injector Cyclotron-SFC
C5	China	Institute of Modern Physics (IMP), CAS	HIRFL Main Cyclotron-SSC
C6	Czech Republic	Nuclear Physics Institute, Czech Academy	U-120M
C7	Finland	University of Jyväskylä Department of Physics	K-130 cyclotron
C8	France	CNRS	Orleans cyclotron
C9	France	GANIL	C01
C10	France	GANIL	C02
C11	France	GANIL	CIME
C12	France	GANIL	CSS1
C13	France	GANIL	CSS2
C14	Germany	Institut für Kernphysik	JULIC
C15	Germany	Hahn-Meitner-Institut Berlin GmbH	PT (former ISL, former VICKSI)
C16	Germany	ZAG Zyklotron AG	Karlsruher Compakt Anlage, KAZ
C17	India	Variable Energy Cyclotron Centre Department of Atomic Energy	Variable Energy Cyclotron
C18	India	Variable Energy Cyclotron Centre Department of Atomic Energy	Kolkata Superconducting Cyclotron
C19	Italy	Istituto Nazionale di Fisica Nucleare Laboratori Nazionali del Sud	LNS Superconducting Cyclotron
C20	Japan	Cyclotron and Radioisotope Center Tohoku University	CYRIC AVF Cyclotron
C21	Japan	Japan Atomic Energy Agency	JAEA AVF Cyclotron
C22	Japan	Research Center for Nuclear Physics	RCNP AVF Cyclotron
C23	Japan	Research Center for Nuclear Physics	RCNP Ring Cyclotron
C24	Japan	RIKEN Nishina Center	AVF Cyclotron
C25	Japan	RIKEN Nishina Center	RRC
C26	Japan	RIKEN Nishina Center	fixed-frequency Ring Cyclotron
C27	Japan	RIKEN Nishina Center	Intermediate-stage Ring Cyclotron
C28	Japan	RIKEN Nishina Center	Superconducting Ring Cyclotron

C29	**Netherland**	**Kernfysisch Versneller Instituut (KVI)**	**AGOR**
C30	**Poland**	**A. Soltan Institute for Nuclear Studies**	**C-30**
C31	**Poland**	**University of Warsaw, Heavy Ion Laboratory**	**U-200P**
C32	**Russia**	**FLNR JINR**	**U-200**
C33	**Russia**	**FLNR JINR**	**U-400M**
C34	**Russia**	**FLNR JINR**	**U-400**
C35	**Russia**	**FLNR JINR**	**IC-100**
C36	**Russia**	**Petersburg Nuclear Physics Institute**	**Gatchina Isochronous Cyclotron**
C37	**Russia**	**SINP MSU**	**R7**
C38	**Serbia**	**Laboratory of Physics, Vinča Institute of Nuclear Sciences**	**VINCY Cyclotron**
C39	**South Africa**	**iThemba LABS**	**Injector Cyclotron 1**
C40	**South Africa**	**iThemba LABS**	**Injector Cyclotron 2**
C41	**South Africa**	**iThemba LABS**	**Separated-Sector Cyclotron**
C42	**Sweden**	**The Svedberg Laboratory**	**Gustaf Werner Cyclotron**
C43	**Switzerland**	**Paul Scherrer Institute**	**Philips Cyclotron Injector 1**
C44	**Switzerland**	**Paul Scherrer Institute**	**PSI Injector 2 Cyclotron**
C45	**Switzerland**	**Paul Scherrer Institute**	**PSI 590 MeV Ring Cyclotron**
C46	**Switzerland**	**Paul Scherrer Institute**	**COMET**
C47	**Taiwan**	**Institute of Nuclear Energy Research**	**TR30/15**
C48	**Ukraine**	**National Science Center "Kharkov Institute of Physics & Technology" (NSC KIPT)**	**Kharkov Compact Cyclotron CV 28**
C49	**USA**	**Indiana University**	**Indiana University Cyclotron**
C50	**USA**	**Lawrence Berkeley National Laboratory**	**88-Inch Cyclotron**
C51	**USA**	**Michigan State University**	**K500**
C52	**USA**	**Michigan State University**	**K1200**
C53	**USA**	**Oak Ridge National Laboratory**	**ORIC**
C54	**USA**	**Texas A&M University**	**Texas A&M K500 Cyclotron**

Commercial Cyclotrons, Manufacturers

ID	Country	Institution	Machine name
CM1	**Belgium**	**Ion Beam Applications**	**C10**
CM2	**Belgium**	**Ion Beam Applications**	**C10/5**
CM3	**Belgium**	**Ion Beam Applications**	**C14+**
CM4	**Belgium**	**Ion Beam Applications**	**C14 SE**
CM5	**Belgium**	**Ion Beam Applications**	**C18/9**

CM6	**Belgium**	**Ion Beam Applications**	**C30**
CM7	**Belgium**	**Ion Beam Applications**	**C70**
CM8	**Belgium**	**Ion Beam Applications**	**C230**
CM9	**USA**	**Siemens Medical Solutions**	**ECLIPSE**
CM10	**Japan**	**Sumitomo Heavy Industries**	**370V**
CM11	**Japan**	**Sumitomo Heavy Industries**	**HM-7S-A**
CM12	**Japan**	**Sumitomo Heavy Industries**	**HM-10S-C**
CM13	**Japan**	**Sumitomo Heavy Industries**	**HM-12**
CM14	**Japan**	**Sumitomo Heavy Industries**	**HM-18**
CM15	**Japan**	**Sumitomo Heavy Industries**	**930**
CM16	**Japan**	**Sumitomo Heavy Industries**	**C235**

Commercial Cyclotrons, Users

ID	Country	Institution	Machine name
CU1	**Belgium**	**UCL, Centre de Recherches du Cyclotron**	**Cyclone 30**
CU2	**Brasil**	**Energetic and Nuclear Research Institute**	**Cyclone 30**
CU3	**Canada**	**TRIUMF**	**TR13**
CU4	**Germany**	**Forschungszentrum Dresden-Rossendorf PET Center**	**Cyclone 18/9**
CU5	**Hungary**	**Institute of Nuclear Research (ATOMKI)**	**MGC-20**
CU6	**Italy**	**European Commission -Institute for Health and Consumer Protection**	**Scanditronix MC40**
CU7	**Japan**	**FUJIFILM RI Pharma Co**	**Cyclone 30**
CU8	**Japan**	**FUJIFILM RI Pharma Co**	**MC-40**
CU9	**Japan**	**National Institute of Radiological Science**	**NIRS-HM-18**
CU10	**Japan**	**National Institute of Radiological Science**	**NIRS-930**
CU11	**Netherland**	**University Medical Center Groningen**	**MC17F**
CU12	**Netherland**	**Technische Universiteit Eindhoven**	**IBA Cyclone 30**
CU13	**Norway**	**SAFE-centre, Univ. of Oslo**	**Scanditronix MC35**
CU14	**USA**	**Johns Hopkins University**	**PETtrace Johns Hopkins**
CU15	**USA**	**National Institutes of Health**	**NIH Cyclotron Corp. CS-30**
CU16	**USA**	**National Institutes of Health**	**NIH GE PETtrace 1**
CU17	**USA**	**National Institutes of Health**	**NIH GE PETtrace 2**
CU18	**USA**	**University of Washington Medical Center**	**Clinical Cyclotron**

FM Cyclotrons

ID	Country	Institution	Machine name
FM1	France	Institut Curie –Centre de Protonthérapie	Synchro-cyclotron SC200
FM2	Russia	Petersburg Nuclear Physics Institute	Synchrocyclotron on 1Gev
FM3	France	DLNP JINR Russia	PHASOTRON

ENTRY NO:C01
Date: 08 FEB 2008
Machine Name: CYCLONE 110
Institution: UCL, Centre de Recherches du Cyclotron
Address: 2, Chemin du Cyclotron 1348 Louvain-la-Neuve, Belgium
Telephone: +32(10)472998
Fax: +32(10)452183
Web Address: http://www.cyc.ucl.ac.be
Person in Charge of Cyclotron: Marc Loiselet
Person Reporting Information: Marc Loiselet
E-mail Address: Marc.Loiselet@uclouvain.be

HISTORY
Designed by: Thomson-CSF
Construction Dates: 1969-1972
First Beam Date: 1972
Characteristic Beams
Protons 20-75 MeV/N 2 10exp14 pps 1500W
deutons 2.3-27 MeV/N 2 10exp14 pps 1500W
heavy ions 0.6-27 MeV/N 1 10exp13 pps
radioactive ions 0.6-5 MeV/N 1 10exp9 pps
Transmission Efficiency (source to extracted beam)
Typical (%): 0.5 - 10
Best (%): 16
Emittance
Emittance Definition: RMS
Vertical (pi mm mrad): 15
Horizontal (pi mm mrad): 23
Longitudinal (dE/E[%] x RF[deg.]): 0.3(%) X 6(deg.)

USES
Basic Research (%): 39.1
Development (%): 2.5
Therapy (%):
Isotope Production (%):
Other Application (%): 48.0
Maintenance (%): 8.1 + 2.3 (unscheduled shutdown)
Beam Tuning (%): included
Total Time (h/year): 3613 (in 2007)

TECHNICAL DATA
(a)Magnet
Type: Compact
Kb (MeV): 110
Kf (MeV): 80
Average Field (min./max. T): 0.6-1.6
Number of Sectors: 4
Hill Angular Width (deg.): variable
Spiral (deg.): 53
Pole Diameter (m): 2.156
Injection Radius (m):
Extraction Radius (m): 0.923
Hill Gap (m): 0.165
Valley Gap (m): 0.405
Trim Coils
Number: 12 X 2 (for upper and lower poles)
Maximum Current (A): 700
Harmonic Coils
Number: 2 X 4 (sectors) X 2 (for upper and lower poles)
Maximum Current (A): 15
Main Coils
Number: 1 X 2 (for upper and lower poles)
Total Ampere Turns: 400000
Maximum Current (A): 1100
Stored Energy (MJ):
Total Iron Weight (tons): 200
Total Coil Weight (tons): 6
Power
Main Coils (total KW): 300
Trim Coils (total, maximum, KW): 100
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 10.6-23
Harmonic Modes: 1, 2, 3, 6
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.): 86
Voltage
At Injection (peak to ground, KV): 35
At Extraction (peak to ground, KV): 35
Peak (peak to ground, KV): 35
Line Power (max, KW): 50
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.01

(c)Injection
Ion Source: Filament / ECR
Source Bias Voltage (kV): 6-15
External Injection: Axial
Buncher Type: double gap sinusoidal
Injection Energy (MeV/n): variable
Component:
Injection Efficiency (%): 5-20
Injector:

(d)Extraction
Elements, Characteristic: Electrostatic deflector
Active magnetic channel
Passive focusing channel
Typical Efficiency (%): 60
Best Efficiency (%): 85

(e)Vacuum
Pumps: Oil diffusion + Cryopumps
Achieved Vacuum (Pa): 10-4

EXPERIMENTAL FACILITIES: LEDA, solid state

detector array; LISOL, Leuven Isotope Separator On Line; DEMON, Detecteur Modulaire de Neutrons ; HIF, Heavy ions Irradiation Facility; LIF, Light ion Irradiation Facility; NIF, Neutron Irradiation Facility
ENTRY NO:C02
Date: 08 FEB 2008
Machine Name: CYCLONE 44
Institution: UCL, Centre de Recherches du Cyclotron
Address: 2, Chemin du Cyclotron 1348 Louvain-la-Neuve, Belgium
Telephone: +32(10)472998
Fax: +32(10)452183
Web Address: http://www.cyc.ucl.ac.be
Person in Charge of Cyclotron: Marc Loiselet
Person Reporting Information: Marc Loiselet
E-mail Address: Marc.Loiselet@uclouvain.be

HISTORY
Designed by: UCL
Construction Dates: 1995-1998
First Beam Date: June 1998
Characteristic Beams
Radioactive ions, 0.4-0.8 Mev/N, 10exp11 pps
Transmission Efficiency (source to extracted beam)
Typical (%): 5
Best (%): 10
Emittance
Emittance Definition: RMS
Vertical (pi mm mrad): 24
Horizontal (pi mm mrad): 13
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year): 0 (in 2007)

TECHNICAL DATA
(a)Magnet
Type: Compact
Kb (MeV): 44
Kf (MeV): 2.0
Average Field (min./max. T): 0.8-1.54
Number of Sectors: 4
Hill Angular Width (deg.): 60-65
Spiral (deg.): -
Pole Diameter (m): 1.56
Injection Radius (m):
Extraction Radius (m): 0.633
Hill Gap (m): 0.12
Valley Gap (m): 0.24

Trim Coils
Number: 12 X 2 (for upper and lower poles)
Maximum Current (A): 20
Harmonic Coils
Number: 2 X 4 (sectors) X 2 (for upper and lower poles)
Maximum Current (A): 10
Main Coils
Number: 1 X 2 (for upper and lower poles)
Total Ampere Turns: 210000
Maximum Current (A): 500
Stored Energy (MJ):
Total Iron Weight (tons): 56
Total Coil Weight (tons): 2
Power
Main Coils (total KW): 52
Trim Coils (total, maximum, KW): 1
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 13.3-17.5
Harmonic Modes: 5, 6
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.): 22
Voltage
At Injection (peak to ground, KV): 20
At Extraction (peak to ground, KV): 20
Peak (peak to ground, KV): 20
Line Power (max, KW): 2
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.01

(c)Injection
Ion Source: ECR
Source Bias Voltage (kV): 7-20
External Injection: axial
Buncher Type: double gap sinusoidal
Injection Energy (MeV/n): variable
Component:
Injection Efficiency (%): 20
Injector:

(d)Extraction
Elements, Characteristic: electrostatic deflector passive magnetic focusing channel
Typical Efficiency (%): 50
Best Efficiency (%): 65

(e)Vacuum
Pumps: Turbopumps + Cryopumps
Achieved Vacuum (Pa): 10-5

EXPERIMENTAL FACILITIES
ARES (Astrophysics Recoil Separator)

ENTRY N° C03
Date: 9th December 2007
Machine name: TRIUMF Cyclotron
Institution: TRIUMF
Address: 4004 Wesbrook Mall, Vancouver BC V6T 2A3
Canada
Telephone: 604.222.1047
Fax: 604.222.1074
Web Address: www.triumf.ca
Person in charge of cyclotron: Paul Schmor
Person reporting information: Yuri Bylinski
E-mail address: bylinsky@triumf.ca

HISTORY
Designed by: In house, various engineering firms
Constructed by: In house, various engineering firms
Construction dates: April 1968 – December 1975
First beam date: December 14, 1975
Characteristic beam, energy and current:
p+ 180 – 520 MeV 210 μA
p+ 65 – 115 MeV 100 μA
Transmission efficiency (source to extracted beam)
Typical (%): 63
Best (%): 70
Emittance
Vertical (π mm mrad): 2
Horizontal (π mm mrad): 2
Longitudinal (dE/E[%] x RF[deg.]): 0.2

USES:
Basic research (%): 62
Development(%): 2
Therapy(%) : 2
Isotope production (%): 21
Other application (%) : 4
Maintenance (%): 7 (shutdowns excluded)
Beam tuning(%): 2
Total time (h/year): 5600

TECHNICAL DATA
(a) Magnet:
Type: Section focused, laminated low carbon steel
Kb (MeV) :
Kf: (MeV) :
Average field (min./max. T): 0.3 – 0.46
Number of magnet sectors: 6
hill angular width (deg.): 35 at inner 200 inches
spiral (max): 70
Pole parameters
Diameter: 17.17
Injection radius (m): 0.25
Extraction radius (m): 3.8 to 7.90
Hill gap (m): 0.528 **Valley gap (m):**
Trim coils
Number: 54
Maximum current (A-turns): 7000
Harmonic coils
Number: 13xN sectors x 2
Maximum current (A-turns): 300
Main coils
Number: 1 x 2
Total current (A-turns): 552,000
Maximum current (A): 18,400
Stored energy (MJ): 16.5
Total iron weight (tons): 4400
Total coil weight (tons): 170
Power
Main coils (total KW): 1380
Trim coils (total, maximum, KW): 68
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 23.05
Harmonic modes: 5
Number of dees: 2
Number of cavities: 80 Mechanically independent segments
Dee angular width (deg.): 180
Voltage * (see comment)
at injection (peak to ground, KV): 96
at extraction (peak to ground, KV): 96
peak (peak to ground, KV): 96
Line Power (max, KW): 2000
Phase Stability (deg.): +/-1
Voltage Stability (%): 0.001

(c) Injection
Ion Source: CUSP
Source Bias Voltage (kV): 12
External Injection: axial injector elements: spiral inflector, electrostatic transport
Buncher Type: 2 cavities (Fundamental frequency and second harmonic bunchers)
Injection Energy (MeV/n): 0.300
Injection Efficiency (%): 95

(d) Extraction
Elements, Characteristic: Stripping in pyrolytic graphite foils, simultaneous extraction to 4 beam lines
Typical Efficiency (%): 99.95
Best Efficiency (%):

(e) Vacuum
Pumps: 2 He cooled cryo-panels (2.8 m square), 6 cryo-pumps, 2 turbo pumps
Achieved Vacuum (Pa): 4×10^{-8}

EXPERIMENTAL FACILITIES:
Proton therapy; proton and neutron irradiation; RIB source and accelerator, low energy (<1.8 MeV/μ) and high energy (< 5 MeV/u) experimental halls (ISAC); pion production targets (10+8 pps)

COMMENTS:
Accelerating voltage is formed by opposite potentials of the dee electrodes and thus is double of the peak to ground voltage. i.e. 192 kV

ENTRY N° C04
Date: Nov. 9th, 2007
Machine name: HIRFL injector cyclotron-SFC
Institution: Institute of Modern Physics (IMP), CAS
Address: Nanchang Road 509, Lanzhou, 730000 .
Telephone: 86 931 4969226
Fax: 86 931 8272100
Web Address: http://www.impcas.ac.cn/
Person in charge of cyclotron: Baowen Wei
Person reporting information: Hongwei ZHAO
E-mail address: zhaohw@impcas.ac.cn

HISTORY
Designed by: Accelerator group of IMP, Lanzhou
Constructed by: Accelerator group of IMP
Construction dates: Upgraded in 1984-1987
First beam date: the first beam after upgrading: 1987
Characteristic beam, energy and current:

^{16}O	8.0 (MeV/n)	1.5×10^{13} (pps)	300 (w)
^{40}Ar	2.35 (MeV/n)	1.2×10^{13} (pps)	176 (w)
^{26}Mg	6.54 (MeV/n)	1.5×10^{12} (pps)	43 (w)
^{129}Xe	2.9 (MeV/n)	1.4×10^{12} (pps)	83 (w)
^{208}Pb	1.1 (MeV/n)	3×10^{11} (pps)	11 (w)
^{238}U	0.807(MeV/n)	8.5×10^{10}(pps)	3(w)

Transmission efficiency (source to extracted beam)
Typical (%): 7-10
Best (%): 15
Emittance
Emittance definition: 50%
Vertical (pi mm mrad): 20
Horizontal (pi mm mrad): 20
Longitudinal (dE/E[%] x RF[deg.]): 1.8 (%) *10°
USES
Basic research (%): 55%
Development(%): 10%
Other application (%) : 15%
Maintenance (%): 10%
Beam tuning(%): 10%
Total time (h/year): 6000

TECHNICAL DATA
(a) Magnet: AVF **Type:** compact
Kb: 69 **Kf:** 30
Average field (min./max. T): 1.6
Number of magnet sectors: 3
hill angular width (deg.):
spiral (max):33 deg
Pole parameters
Diameter: 1.7m
Injection radius (m): 0.025, 0.03
Extraction radius (m): 0.75
Hill gap (m): 0.19 **Valley gap (m):**0.33
Trim coils
Number: 12 x 2
Maximum current (A-turns): 4000
Harmonic coils
Number: 4 x 2
Maximum current (A-turns): 600
Main coils
Number: 1 x 2
Total current (A-turns):
Maximum current (A): 1200
Stored energy (MJ):
Total iron weight (tons): 220
Total coil weight (tons): 16
Power
Main coils (total KW): 260
Trim coils (total, maximum, KW): 170
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 5.5 - 16.5
Harmonic modes: 1, 3
Number of dees: 1
Number of cavities: 1
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV): 80 Max
at extraction (peak to ground, KV): 80 Max
peak (peak to ground, KV): 80 Max
Line Power (max, KW): 60
Phase Stability (deg.): +/- 0.3
Voltage Stability (%): 0.1%

(c) Injection
Ion Source: ECR
Source Bias Voltage (kV): 25
External Injection: axial
Buncher Type: linear buncher
Injection Energy (MeV/n): 0.0015 - 0.0094 MeV/n
Component: Solenoid lens, spiral inflector
Injection Efficiency (%): 30
Injector:

(d) Extraction
Elements, Characteristic: Two electrostatic deflector
Typical Efficiency (%): 30 - 60
Best Efficiency (%): 75

(e) Vacuum
Pumps: Cryogenic pump
Achieved Vacuum (Pa): 4×10^{-6} Pa 8×10^{-6} Pa

REFERENCES: W.L.Zhan et al. 18th ICCA

EXPERIMENTAL FACILITIES
One target station (SFC can share the five target setups of SSC by bypass beam line)

COMMENTS: Laboratory layout attached at next

ENTRY N° C05
Date: Nov. 9th, 2007
Machine name: HIRFL main cyclotron-SSC
Institution: Institute of Modern Physics (IMP), CAS
Address: Nanchang Road 509, Lanzhou, 730000 .
Telephone: 86 931 4969226
Fax: 86 931 8272100
Web Address: http://www.impcas.ac.cn/
Person in charge of cyclotron: Baowen Wei
Person reporting information: Hongwei ZHAO
E-mail address: zhaohw@impcas.ac.cn

HISTORY
Designed by: Accelerator group of IMP, Lanzhou
Constructed by: Accelerator group of IMP
Construction dates: 1978-1988
First beam date: Dec. 1988
Characteristic beam, energy and current:

^{12}C	80 (MeV/n)	5.0×10^{11} (pps)	80 (W)
^{12}C	100 (MeV/n)	2.0×10^{11} (pps)	40 (W)
^{22}Ne	70 (MeV/n)	2.8×10^{11} (pps)	70 (W)
^{36}Ar	69 (MeV/n)	1.4×10^{11} (pps)	55 (W)
^{36}Ar	22 (MeV/n)	2.7×10^{12} (pps)	346 (W)
^{129}Xe	19.5 (MeV/n)	1.6×10^{11} (pps)	65 (W)

Transmission efficiency (source to extracted beam)
Typical (%): 10-30
Best (%): 50
Emittance
Emittance definition: 50%
Vertical (π mm mrad): 10
Horizontal (π mm mrad): 10
Longitudinal (dE/E[%] x RF[deg.]): 0.2 (%) * 40°

USES
Basic research (%): 36.3%
Development(%): 5.7%
Therapy(%) : 24.2%
Isotope production (%):
Other application (%) :
Maintenance (%): 24%
Beam tuning(%): 9.8%
Total time (h/year): 2840.1

TECHNICAL DATA
(a) Magnet: Separated sector **Type:** compact
Kb: 450 **Kf:** 230
Average field (min./max. T): 0.6/1.7
Number of magnet sectors: 4
hill angular width (deg.): 52
spiral (max):
Pole parameters
Diameter: 7.17m
Injection radius (m): 1.0
Extraction radius (m): 3.21
Hill gap (m): 0.1 **Valley gap (m):**
Trim coils
HIRFL Layout
Number: 26
Maximum current (A-turns): 480
Harmonic coils
Number: 9
Maximum current (A-turns): 240
Main coils
Number: 1
Total current (A-turns): 192000
Maximum current (A): 4000
Stored energy (MJ):
Total iron weight (tons): 2000
Total coil weight (tons): 16
Power
Main coils (total KW): 740
Trim coils (total, maximum, KW): 497
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 6.5 - 14.0
Harmonic modes: 2, 4, 6
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 30
Voltage
at injection (peak to ground, KV): 150 Max
at extraction (peak to ground, KV): 180 Max
peak (peak to ground, KV): 180 Max
Line Power (max, KW): 60
Phase Stability (deg.): +/- 0.7
Voltage Stability (%): 0.1%

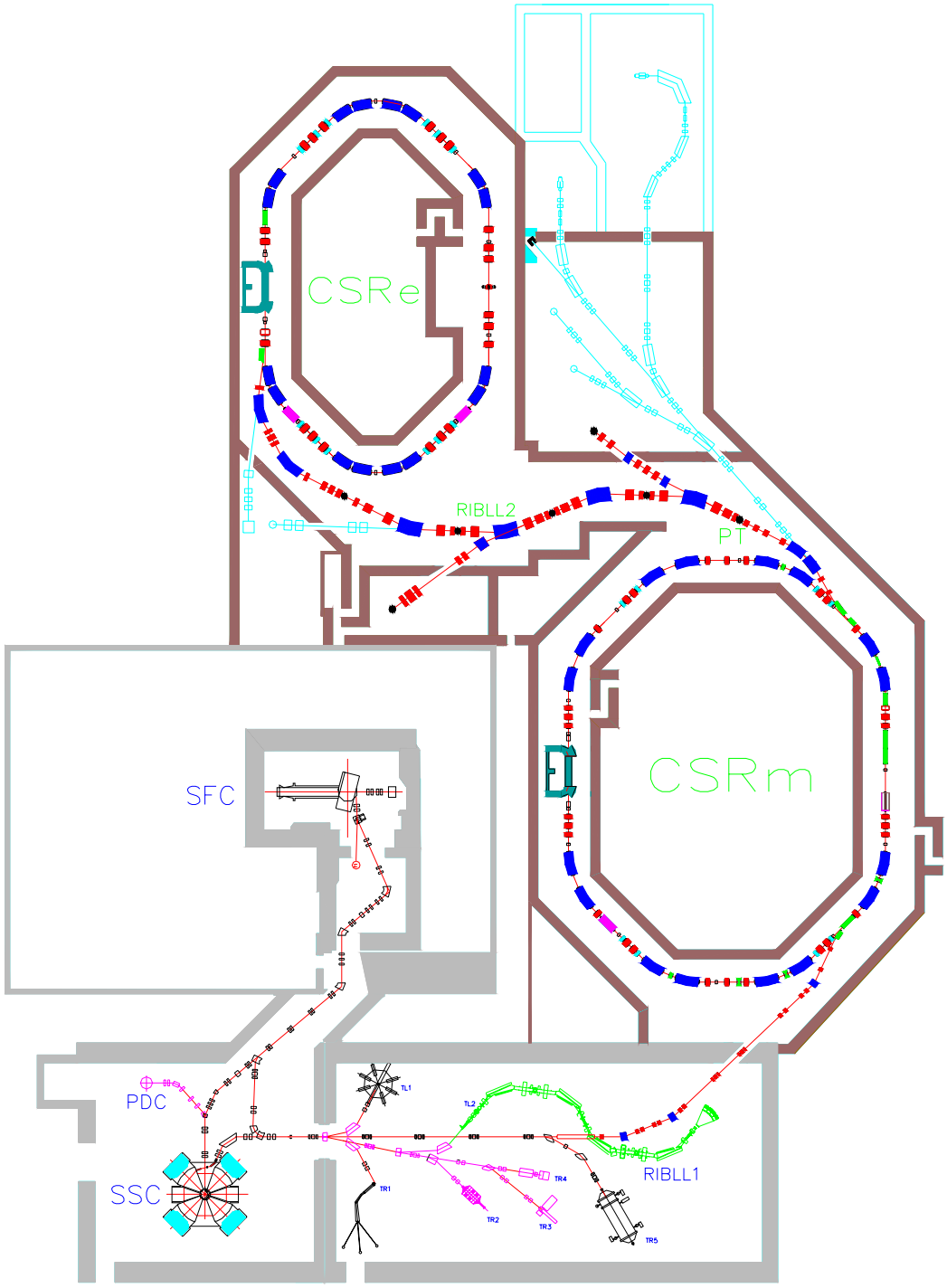
(c) Injection
Ion Source: ECR
Source Bias Voltage (kV): 25
External Injection: axial
Buncher Type: linear buncher
Injection Energy (MeV/n): 0.0015 - 0.0094 MeV/n
Component: Solenoid lens, spiral inflector
Injection Efficiency (%): 30
Injector: HIRFL SFC as an injector

(d) Extraction
Elements, Characteristic: Bump channel, electrostatic deflector, magnetic channels, two bending magnets
Typical Efficiency (%): 30 - 60
Best Efficiency (%): 75

(e) Vacuum
Pumps: Cryogenic pump
Achieved Vacuum (Pa): 2×10^{-5} Pa

REFERENCES: W.L.Zhan, et.al,18th ICCA.

EXPERIMENTAL FACILITIES
There are 6 experimental setups.


CSRe
RIBLL2
PT
CSRm
SFC
PDC
SSC
TL1
TL2
TR1
TR2
TR3
TR4
TR5
RIBLL1

ENTRY N° C06
Date: 09/Nov/2007
Machine name: U-120M
Institution: Nuclear Physics Institute, Czech Academy of Sciences, p. r. i.
Address: 250 68 Rez, Czech Republic
Telephone: +420266173613
Fax: +4202 2094152
Web Address: http://mx.ujf.cas.cz/~ou-www/
Person in charge of cyclotron: J. Stursa
Person reporting information: J. Stursa
E-mail address: stursa@ujf.cas.cz

HISTORY
Designed by: JINR Dubna, Russia
Constructed by: JINR Dubna, Russia
Construction dates:
First beam date: June 1977
Characteristic beam, energy and current:

Ions,	energy(MeV/n),	current(pps),	power(W)
p+	6 - 37	6 x 10^{14}	3000
H-	6 - 37	1.6 x 10^{14}	800
D+	6 - 10	4 x 10^{14}	2000
3He++	6 - 18	1.3 x 10^{14}	1080

Transmission efficiency (source to extracted beam)
Typical (%): 52(H^-)
Best (%): 75
Emittance
Emittance definition:
Vertical (pi mm mrad): 8
Horizontal (pi mm mrad): 30
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 33
Development(%): 2
Therapy(%) :
Isotope production (%): 61
Other application (%) : 2
Maintenance (%): 2
Beam tuning(%):
Total time (h/year): 3500

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 40 **Kf:**
Average field (min./max. T): 1/1.85
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max): 70
Pole parameters
Diameter (m): 1.2
Injection radius (m): 0.026
Extraction radius (m): 0.5
Hill gap (m): 0.082 **Valley gap (m):** 0.12
Trim coils
Number: 18x2
Maximum current (A-turns): 500x5
Harmonic coils
Number: 2xNsectorsx2
Maximum current (A-turns): 200 x 5
Main coils
Number: 1x2
Total current (A-turns): 4 x 105
Maximum current (A): 650
Stored energy (MJ):
Total iron weight (tons): 110
Total coil weight (tons): 11.6
Power
Main coils (total KW): 220
Trim coils (total, maximum, KW): 150
Refrigerator (cryogenic, KW):

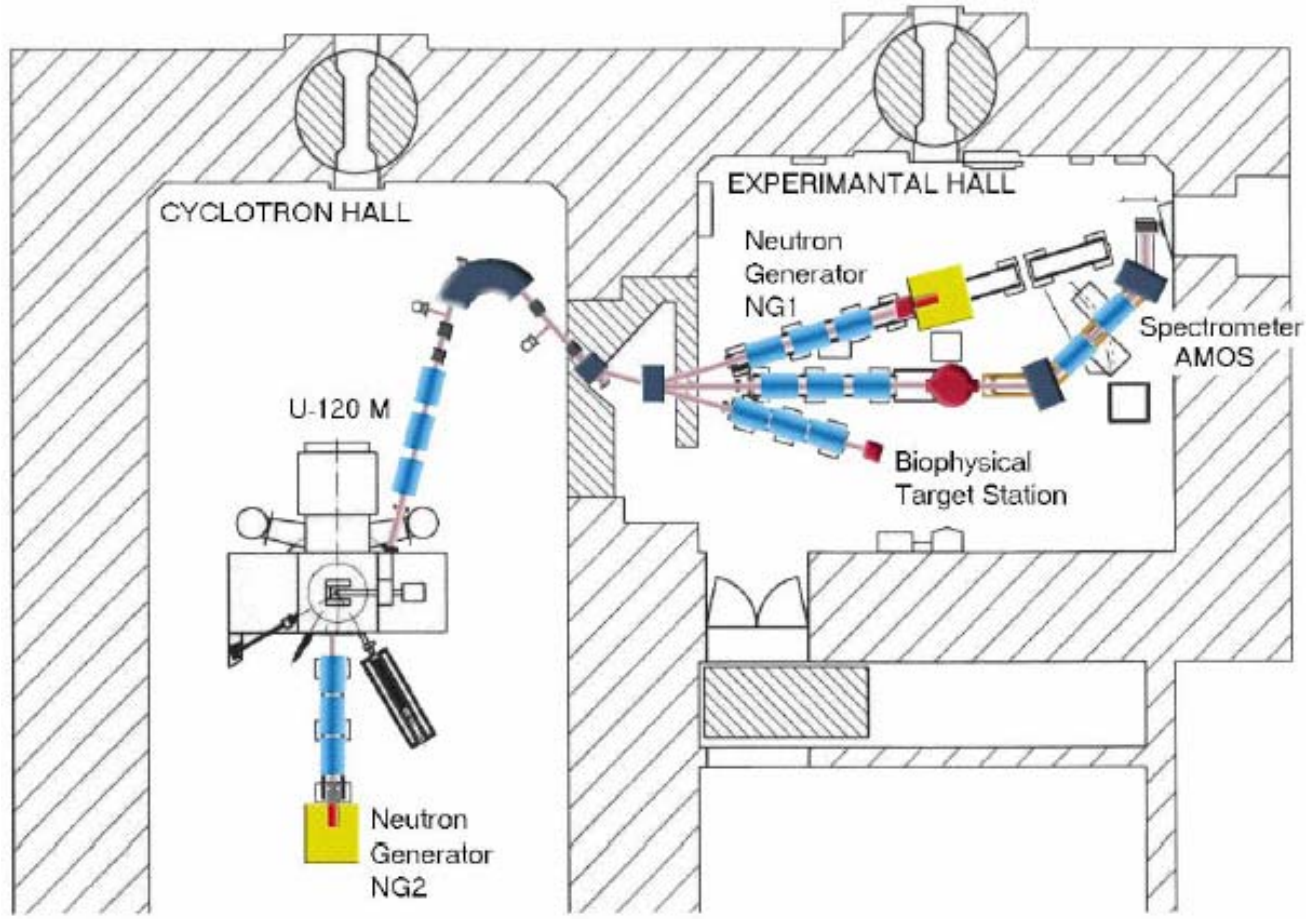
(b) RF
Frequency range (MHz): 10.7 - 26
Harmonic modes: 1
Number of dees: 1
Number of cavities:
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV): 36
at extraction (peak to ground, KV): 36
peak (peak to ground, KV): 36
Line Power (max, KW): 150
Phase Stability (deg.):
Voltage Stability (%): 1

(c) Injection
Ion Source: PIG cold cath. (int.), CUSP (ext.)
Source Bias Voltage (kV): 10 - 30
External Injection: axial
Buncher Type: first harmonic
Injection Energy (MeV/n): 0.03
Component: solenoids
Injection Efficiency (%): 6
Injector:

(d) Extraction
Elements, Characteristic: 3 section electrostatic deflection system (positive ions)/ stripping (H-, D-)
Typical Efficiency (%): 25/99
Best Efficiency (%): 35/100

(e) Vacuum
Pumps: diffusion , turbomolecular pumps
Achieved Vacuum (Pa): 1 x 10^{-4}

EXPERIMENTAL FACILITIES
Achromatic magneto-optical system AMOS, 900, 5m
Fast neutron generators (p+37MeV, D2O, Li targets), 3x10^{12} (n/ster), 3x10^{11} (n/cm2/s)



Layout of Nuclear Physics Institute, Czech Academy

ENTRY N° C07
Date: December 10, 2007
Machine name: K130 cyclotron
Institution: University of Jyväskylä, Department of Physics
Address: P.O. Box 35, FI-40014 University of Jyväskylä, Finland
Telephone: +358-14-2602 400
Fax: +358-14-2602 4001
Web Address: http://www.jyu.fi/science/laitokset/fysiikka/en/research/accelerator/
Person in charge of cyclotron: Pauli Heikkinen
Person reporting information: Pauli Heikkinen
E-mail address: pheikkin@jyu.fi

HISTORY
Designed by: Scanditronix AB, JYFL
Constructed by: Scanditronix AB, JYFL
Construction dates: 1988-1990, Negative ions: 2000
First beam date: January 1992
Characteristic beam, energy and current:
Protons 20 – 60 MeV, 50 μA
Heavy ions 2 – 32.5 MeV/u, 2 μA
Transmission efficiency (source to extracted beam)
Typical (%): 5 – 10
Best (%): 15
Emittance
Emittance definition: rms
Vertical (pi mm mrad): <10
Horizontal (pi mm mrad): <10
Longitudinal (dE/E[%] x RF[deg.]): 10

USES
Basic research (%): 77
Development(%): 5
Therapy(%) :
Isotope production (%): 4
Other application (%) : 10
Maintenance (%): 1.5
Beam tuning(%): 2.5
Total time (h/year): 7500

TECHNICAL DATA
(a) Magnet: normal conducting **Type:** compact
Kb: 130 MeV **Kf:** 90 MeV/u
Average field (min./max. T): 1.77 (1.3-2.1)
Number of magnet sectors: 3
hill angular width (deg.): variable (51-81)
spiral (max): 58
Pole parameters
Diameter: 2.40
Injection radius (m): 0.0131-0.0188
Extraction radius (m): 0.94
Hill gap (m): 0.174 **Valley gap (m):** 0.330
Trim coils
Number: 15
Maximum current (A-turns): 2000
Harmonic coils
Number: 4 sets in valleys
Maximum current (A-turns): 2400
Main coils
Number: 1 pair
Total current (A-turns): 400.000
Maximum current (A): 1000
Stored energy (MJ):
Total iron weight (tons): 308
Total coil weight (tons): 15
Power
Main coils (total kW): 130
Trim coils (total, maximum, kW): 22
Refrigerator (cryogenic, kW):

(b) RF
Frequency range (MHz): 10 - 21
Harmonic modes: 1, 2, 3
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 78
Voltage
at injection (peak to ground, kV):
at extraction (peak to ground, kV):
peak (peak to ground, kV): 50
Line Power (max, kW): 100
Phase Stability (deg.):
Voltage Stability (%):

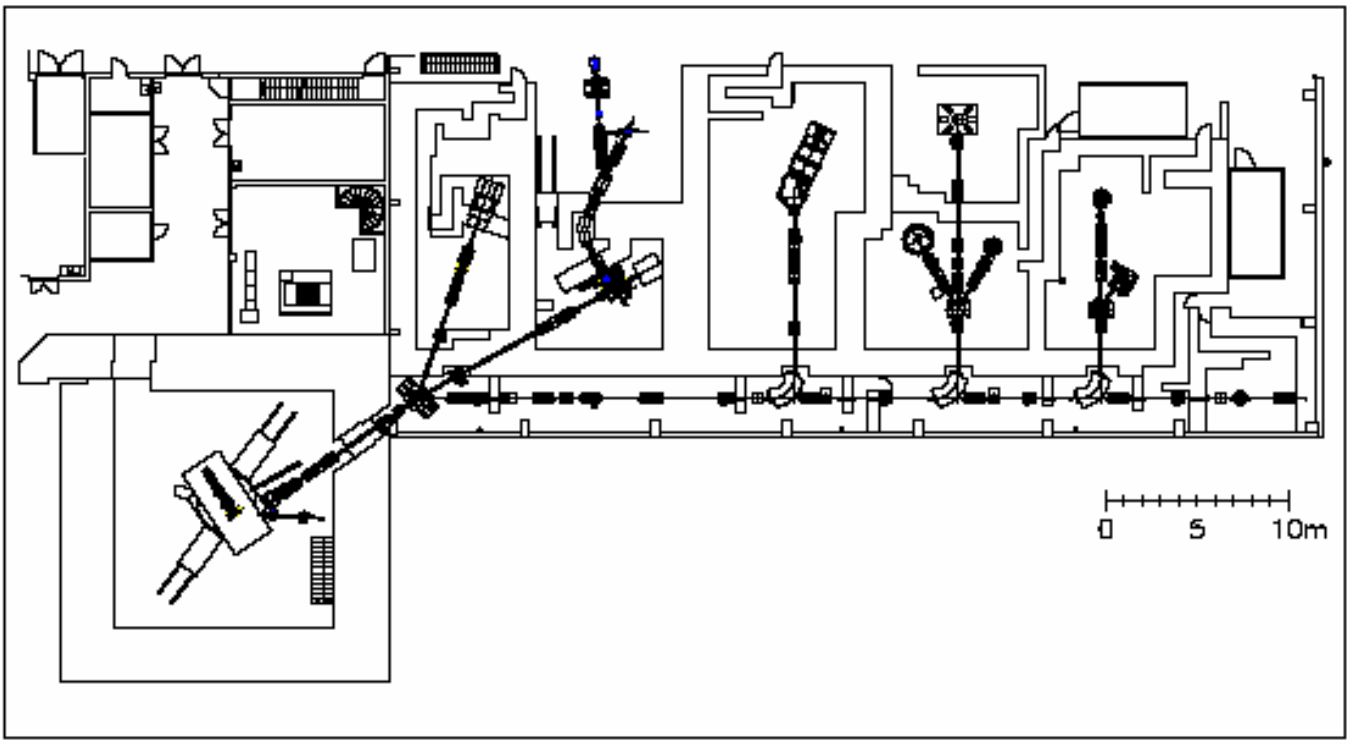
(c) Injection
Ion Source: 6.4 GHz & 14 GHz ECR, Multicusp
Source Bias Voltage (kV): 0 – 20
External Injection: Axial
Buncher Type: single gap (1st and 2nd harmonic)
Injection Energy (MeV/n):
Component:
Injection Efficiency (%): 30 – 70
Injector:

(d) Extraction
Elements, Characteristic:
- Electrostatic deflector, 50 kV
- Electromagnetic channel, 1250 A

Typical Efficiency (%): 50
Best Efficiency (%): 70

(e) Vacuum
Pumps: 2 cryo pumps (5000 l/s)
Achieved Vacuum (Pa): 5 x 10^{-6}

EXPERIMENTAL FACILITIES:
Isotope separator on line IGISOL, gas filled recoil separator RITU, gamma detector arrays, high efficiency neutron detector system HENDES, 1.5 m diam. scattering chamber, chamber for radiation defects studies



Layout of JYFL, University of Jyväskylä, Department of Physics

ENTRY N° C08
Date: 1989
Machine name: Orleans isochronus cyclotron
Institution:CNRS
Address:CERI
Telephone: 33 2 38 25 54 05
Fax: 33 2 38 63 02 71
Web Address:
Person in charge of cyclotron: Briaud
Person reporting information: Briaud
E-mailaddress: briaud@cnrs-orleans.fr

HISTORY
Designed by: CGR MeV
Constructed by: CGR MeV
Construction dates: 1972
First beam date: 1974
Characteristic beam, energy and current:

Protons	5-38MeV	50µA
Deutons	5-25MeV	50µA
Alphas	10-48MeV	30µA

Transmission efficiency (source to extracted beam)
Typical (%):10
Best (%):20
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 60
Development(%): 5
Therapy(%) :
Isotope production (%):20
Other application (%) :10
Maintenance (%): 5
Beam tuning(%):
Total time (h/year): 1800

TECHNICAL DATA
(a) Magnet: compact **Type:**
Kb: **Kf:**
Average field (min./max. T): 1.1/1.9
Number of magnet sectors: 4
hill angular width (deg.): 53
spiral (max):
Pole parameters
Diameter: 1.6
Injection radius (m):internal source
Extraction radius (m): 0.6
Hill gap (m): 0.13 **Valley gap (m):** 0.27

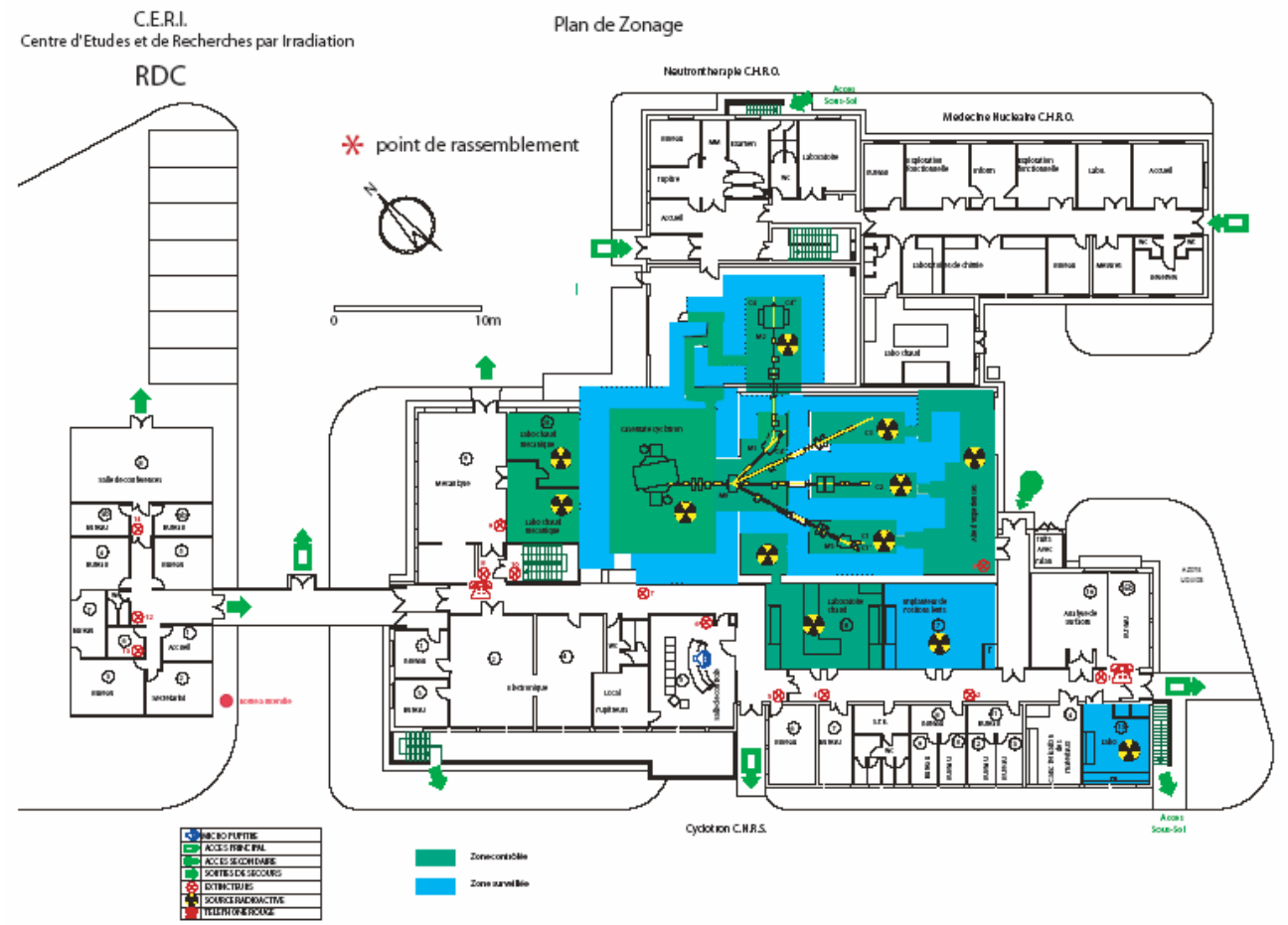
Trim coils
Number: 86
Maximum current (A-turns):
Harmonic coils
Number:4
Maximum current (A-turns):
Main coils
Number: 1
Total current (A-turns):
Maximum current (A): 1000
Stored energy (MJ):
Total iron weight (tons): 110
Total coil weight (tons):
Power
Main coils (total KW):110
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 20-40
Harmonic modes: 1-2-3-4
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 60
Voltage
at injection (peak to ground, KV): 40
at extraction (peak to ground, KV): 40
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.): 0.1
Voltage Stability (%): 10-3

(c) Injection
Ion Source: PIG internal
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: electrostatic
Typical Efficiency (%): 55
Best Efficiency (%): 60

(e) Vacuum
Pumps: oil diffusion 2*8000l/s
Achieved Vacuum (Pa): 8. 10-6



Layout of Orleans isochronus cyclotron

ENTRY N° C09
Date: 1 Feb 2008
Machine name: C01
Institution: GANIL
Address: B.P 5027-14076 CAEN Cedex 5-FRANCE
Telephone: (33)0231454647
Fax: (33)0231454665
Web Address: www.ganil.fr
Person in charge of cyclotron: G. Senecal
Person reporting information: P. BertrandE-mail **address:** savalle@ganil.fr, bertrand@ganil.fr

HISTORY
Designed by: GANIL
Construction dates: 1976-1980
Constructed by GANIL
First beam date: 1980
Characteristic beam, energy and current:

C12	1 (MeV/n)	1.E14 (pps)	1 (W)
Ar36	1 (MeV/n)	1.E14 (pps)	1 (W)
U238	0.3 (MeV/n)	1.E11 (pps)	<1 (W)

Transmission efficiency (source to extracted beam)
Typical (%):50
Best (%):65
Emittance
Emittance definition: 90%
Vertical (pi mm mrad): 40
Horizontal (pi mm mrad): 40
Longitudinal (dE/E[%] x RF[deg.]): 0.5*6

USES
Basic research (%): 65
Development(%): 10
Therapy(%) : 0
Isotope production (%): 0
Other application (%) : 0
Maintenance (%): 10
Beam tuning(%): 15
Total time (h/year): 3000

TECHNICAL DATA
(a) Magnet: **Type**: compact
Kb: 28 **Kf:** 28
Average field (min./max. T): 1.565/1
Number of magnet sectors: 1
hill angular width (deg.):
spiral (max): none
Pole parameters
Diameter:
Injection radius (m): 0.076
Extraction radius (m): 0.488
Hill gap (m): 0.021 **Valley gap (m):**
Trim coils
Number: 6*2
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number: 1*2
Total current (A-turns):
Maximum current (A): 1000
Stored energy (MJ):
Total iron weight (tons):
Total coil weight (tons):
Power
Main coils (total KW): 500
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 7 to 13.45
Harmonic modes: 3
Number of dees: 1
Number of cavities: 1
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV): 50 to 90
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW): 30
Phase Stability (deg.): 0.1
Voltage Stability (%):0.01

(c) Injection
Ion Source: ECR4
Source Bias Voltage (kV): 100
External Injection: axial
Buncher Type: two harmonic buncher
Injection Energy (MeV/n): <0.024
Component: Spiral inflector
Injection Efficiency (%): 65
Injector:

(d) Extraction
Elements, Characteristic:
1 electrostaic deflector, 1 electrostatic quadrupole
Typical Efficiency (%): 90
Best Efficiency (%): 100

(e) Vacuum
Pumps: 3 cryopumps
Achieved Vacuum (Pa): 5.10-6

EXPERIMENTAL FACILITIES :
Injector of SSC1, IRRSUD

ENTRY N° C10
Date: 1 Feb 2008
Machine name: C02
Institution: GANIL
Address: B.P 5027-14076 CAEN Cedex 5-FRANCE
Telephone: (33)0231454647
Fax: (33)0231454665
Web Address: www.ganil.fr
Person in charge of cyclotron: G. Senecal
Person reporting information: P. Bertrand
address: savalle@ganil.fr, bertrand@ganil.fr

HISTORY
Designed by: GANIL
Constructed by GANIL
Construction dates: 1976-1980
First beam date: 1980
Characteristic beam, energy and current:
C12 1 (MeV/n) 5E13 (pps) 100 (w)
U238 0.3 (MeV/n) 1E+11 (pps) <1 (w)
Transmission efficiency (source to extracted beam)
Typical (%):20
Best (%):30
Emittance
Emittance definition: 90%
Vertical (pi mm mrad): 40
Horizontal (pi mm mrad): 40
Longitudinal (dE/E[%] x RF[deg.]): 0.5*6

USES
Basic research (%): 65
Development(%): 10
Therapy(%) : 0
Isotope production (%): 0
Other application (%) : 0
Maintenance (%): 10
Beam tuning(%): 15
Total time (h/year): 3000

TECHNICAL DATA
(a) Magnet: compact **Type**: compact
Kb: 28 **Kf:** 28
Average field (min./max. T): 1.565/1
Number of magnet sectors: 1
hill angular width (deg.):
spiral (max): none
Pole parameters
Diameter:
Injection radius (m): 0.036
Extraction radius (m): 0.488
Hill gap (m): 0.021 **Valley gap (m):**
Trim coils
Number: 6*2
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number: 1*2
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons):
Total coil weight (tons):
Power
Main coils (total KW): 500
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 7 to 13.45
Harmonic modes: 3
Number of dees: 1
Number of cavities: 1
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV): 50 to 90
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW): 30
Phase Stability (deg.): 0.1
Voltage Stability (%):0.01

(c) Injection
Ion Source: ECR4M
Source Bias Voltage (kV): 25
External Injection: axial
Buncher Type: two harmonic buncher
Injection Energy (MeV/n): <0.0054
Component: 1 Muller inflector
Injection Efficiency (%): 25
Injector:

(d) Extraction
Elements, Characteristic:
1 electrostaic deflector, 1 electrostatic quadrupole
Typical Efficiency (%): 90
Best Efficiency (%): 100

(e) Vacuum
Pumps3 cryopumps
Achieved Vacuum (Pa): 5.10-6

EXPERIMENTAL FACILITIES :
Injector of SSC1 , IRRSUD

ENTRY N° C11
Date: 1 Feb 2008
Machine name: CIME
Institution: GANIL
Address: B.P 5027-14076 CAEN Cedex 5-FRANCE
Telephone: (33)0231454647
Fax: (33)0231454665
Web Address: www.ganil.fr
Person in charge of cyclotron: G. Senecal
Person reporting information: A. Savalle
address: savalle@ganil.fr, bertrand@ganil.fr

HISTORY
Designed by: GANIL
Constructed by GANIL
Construction dates: 1994-1998
First beam date: april 1998 RIB : September 2001
Characteristic beam, energy and current:
RIB 1,2-25 (MeV/n) <5.10**11 (pps)
Transmission efficiency (source to extracted beam)
Typical (%): 25
Best (%): 40
Emittance
Emittance definition:
Vertical (pi mm mrad): 20
Horizontal (pi mm mrad): 20
Longitudinal (dE/E[%] x RF[deg.]): 0.3*10

USES
Basic research (%): 50
Development(%): 25
Therapy(%) :
Isotope production (%):
Other application (%) :
Maintenance (%): 15
Beam tuning(%): 10
Total time (h/year): 3000

TECHNICAL DATA
(a) Magnet: compact **Type:**
Kb: 265 **Kf:**
Average field (min./max. T): 1.56/0.75
Number of magnet sectors: 4
hill angular width (deg.): 44
spiral (max): none
Pole parameters
Diameter: 3.5
Injection radius (m): 0.034/0.045
Extraction radius (m): 1.5
Hill gap (m): 0.12 **Valley gap (m):** 0.3
Trim coils
Number: 11*2planes
Maximum current (A-turns): 400
Harmonic coils
Number: 2
Maximum current (A-turns): 200
Main coils
Number: 1*2planes
Total current (A-turns): 272000
Maximum current (A): 900
Stored energy (MJ):
Total iron weight (tons): 550
Total coil weight (tons): 4.5
Power
Main coils (total KW): 100
Trim coils (total, maximum, KW): 40
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 9.6 – 14.4
Harmonic modes: 2,3, 4, 5, 6
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 40
Voltage
at injection (peak to ground, KV): 100
at extraction (peak to ground, KV): 95
peak (peak to ground, KV):
Line Power (max, KW): 42*2
Phase Stability (deg.): 0.1
Voltage Stability (%):0.02

(c) Injection
Ion Source: ECR
Source Bias Voltage (kV): 34
External Injection: axial
Buncher Type: saw tooth type
Injection Energy (MeV/n):
Component: Muller (Ri=0.034m)/ spiral(Ri=0.045m) inflector
Injection Efficiency (%): 60
Injector:

(d) Extraction
Elements, Characteristic:
2 electrostatic deflectors 17 deg. 80 KV/cm2
magnetostatic channels 16 deg. CM1 = 5.2T/m; CM2 = 12.9T/m
Typical Efficiency (%): 60
Best Efficiency (%): 80

(e) Vacuum
Pumps: 1 cryogenic panel, 2 turbomolecular
Achieved Vacuum (Pa): 5.10-6

REFERENCES: M.Lieuvin et al. ”Commissioning of SPIRAL, the GANIL radioactive beam facility”, Int. conf. on Cyclotrons and their Applications, East Lansing, USA, may 2001

EXPERIMENTAL FACILITIES :
9 experiment rooms of the GANIL facility

ENTRY N° C12
Date: 1 Feb 2008
Machine name: CSS1
Institution: GANIL
Address: B.P 5027-14076 CAEN Cedex 5-FRANCE
Telephone: (33)0231454647
Fax: (33)0231454665
Web Address: www.ganil.fr
Person in charge of cyclotron: G. Senecal
Person reporting information: P. Bertrand
address: savalle@ganil.fr, bertrand@ganil.fr

HISTORY
Designed by: GANIL
Constructed by GANIL
Construction dates: 1976-1982
First beam date: nov 1982
Characteristic beam, energy and current:

C12	13.7 (MeV/n)	2E13 (pps)	500 (w)
U238	5.5 (MeV/n)	5E10 (pps)	<1 (w)

Transmission efficiency (source to extracted beam)
Typical (%): 90
Best (%): 100
Emittance
Emittance definition: 90%
Vertical (pi mm mrad): 7
Horizontal (pi mm mrad): 7
Longitudinal (dE/E[%] x RF[deg.]): 0.2*4

USES
Basic research (%): 70
Development(%): 5
Therapy(%) :
Isotope production (%):
Other application (%) :
Maintenance (%): 15
Beam tuning(%): 10
Total time (h/year): 5000

TECHNICAL DATA
(a) Magnet: **Type:** separeted sectors
Kb: 380 **Kf:** 380
Average field (min./max. T): 0.95/0.39
Number of magnet sectors: 4
hill angular width (deg.): 52
spiral (max): none
Pole parameters
Diameter: 7
Injection radius (m): 0.81
Extraction radius (m): 3
Hill gap (m): 0.01 **Valley gap (m):**
Trim coils
Number: 32*4*2 (42 power supply)
Maximum current (A-turns):
Harmonic coils
Number: 4*2
Maximum current (A-turns):
Main coils
Number: 1*2
Total current (A-turns): 190000
Maximum current (A): 1850
Stored energy (MJ):
Total iron weight (tons): 1700
Total coil weight (tons): 14
Power
Main coils (total KW): 950
Trim coils (total, maximum, KW): 140
Refrigerator (cryogenic, KW): none

(b) RF
Frequency range (MHz): 7 – 13.45
Harmonic modes: 5
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 34
Voltage
at injection (peak to ground, KV): 160
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW): 100
Phase Stability (deg.): 0.1
Voltage Stability (%):0.01

(c) Injection
Ion Source:
Source Bias Voltage (kV):
External Injection: radial
Buncher Type: harmonic 1
Injection Energy (MeV/n): 1
Component: 4 mag. Channels , 1 inflector
Injection Efficiency (%): 100
Injector: C01 or C02

(d) Extraction
Elements, Characteristic:
1 electrostatic deflector 4 magnetic channels
Typical Efficiency (%): 90
Best Efficiency (%): 98

(e) Vacuum
Pumps: 8 cryopumps and 4 turbopumps
Achieved Vacuum (Pa): 6 10-6

EXPERIMENTAL FACILITIES :
Injector of SSC2 , Medium Energy room (SME) + 9 expetimental rooms

ENTRY N° C13
Date: 1 Feb 2008
Machine name: CSS2
Institution: GANIL
Address: B.P 5027-14076 CAEN Cedex 5-FRANCE
Telephone: (33)0231454647
Fax: (33)0231454665
Web Address: www.ganil.fr
Person in charge of cyclotron: G. Senecal
Person reporting information: A. Savalle
address: savalle@ganil.fr, bertrand@ganil.fr

HISTORY
Designed by: GANIL
Constructed by GANIL
Construction dates: 1976-1982
First beam date: 1982
Characteristic beam, energy and current:
C12 95 MeV.A 2E13 pps
U238 24 MeV.A 1E10 pps
Transmission efficiency (source to extracted beam)
Typical (%): 90
Best (%): 100
Emittance
Emittance definition:
Vertical (pi mm mrad): 5
Horizontal (pi mm mrad): 5
Longitudinal (dE/E[%] x RF[deg.]): 0.3*6

USES
Basic research (%): 70
Development(%): 5
Therapy(%) : 0
Isotope production (%):
Other application (%) :
Maintenance (%): 15
Beam tuning(%): 10
Total time (h/year): 5000

TECHNICAL DATA
(a) Magnet: separeted sectors **Type:**
Kb: 380 **Kf:** 380
Average field (min./max. T): 0.95/0.39
Number of magnet sectors: 4
hill angular width (deg.): 52
spiral (max): none
Pole parameters
Diameter: 7
Injection radius (m): 1.2
Extraction radius (m): 3
Hill gap (m): **Valley gap (m):**
Trim coils
Number: 32*4sec*2Planes (42 power supply)
Maximum current (A-turns):
Harmonic coils
Number: 4*2 planes
Maximum current (A-turns):
Main coils
Number: 4*2
Total current (A-turns): 190000
Maximum current (A): 1850
Stored energy (MJ):
Total iron weight (tons): 1700
Total coil weight (tons): 14
Power
Main coils (total KW): 950
Trim coils (total, maximum, KW): 140
Refrigerator (cryogenic, KW): none

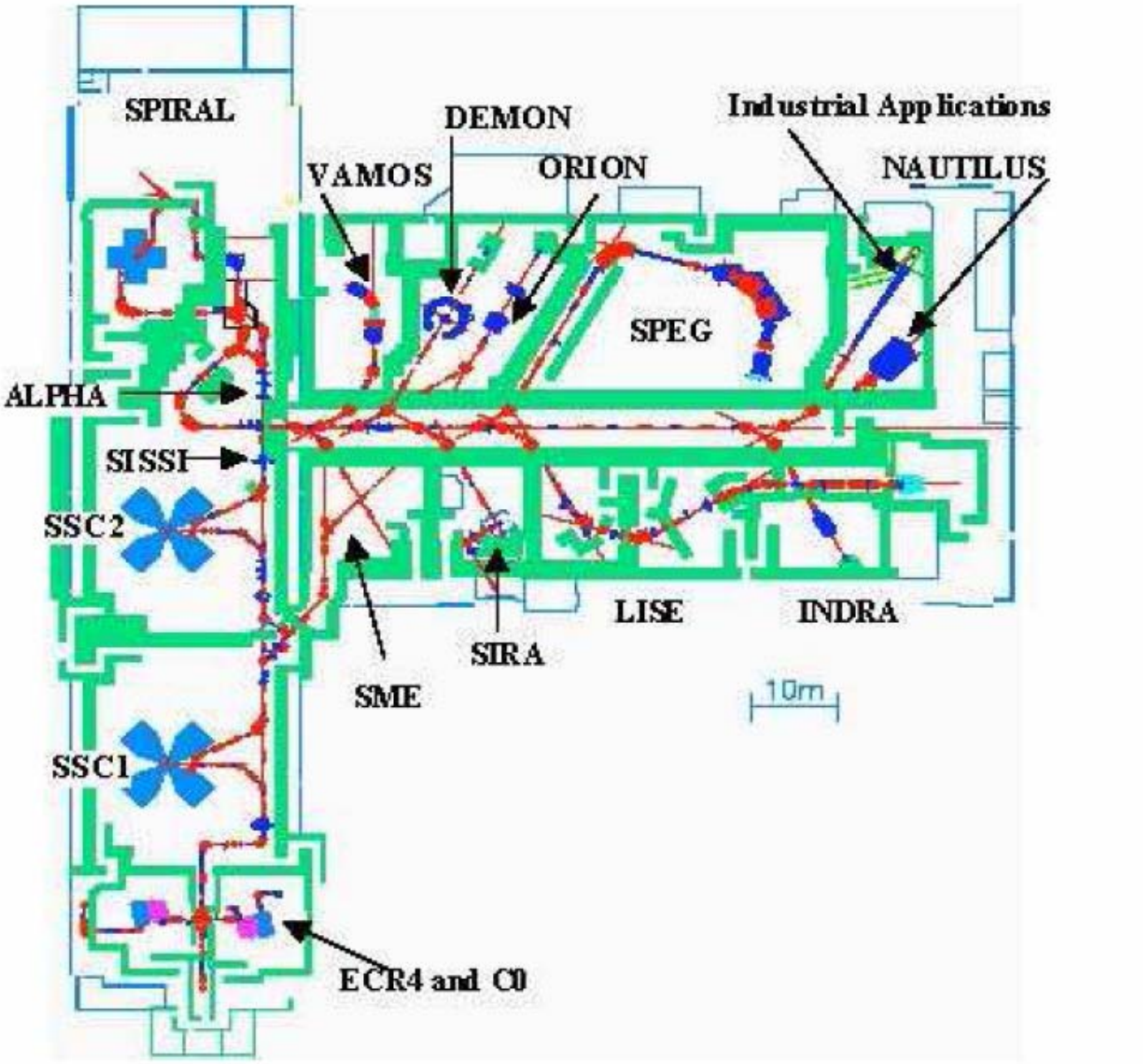
(b) RF
Frequency range (MHz): 7 – 13.45
Harmonic modes: 2
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 34
Voltage
at injection (peak to ground, KV): 220
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW): 100
Phase Stability (deg.): 0.1
Voltage Stability (%):0.01

(c) Injection
Ion Source:
Source Bias Voltage (kV):
External Injection: radial
Buncher Type:
Injection Energy (MeV/n): 3.7- 13.7
Component: 4 mag. Channels , 1 inflector
Injection Efficiency (%): 100
Injector: CSS1

(d) Extraction
Elements, Characteristic:
1 electrostatic deflector 4 magnetic channels
Typical Efficiency (%): 90
Best Efficiency (%): 100

(e) Vacuum
Pumps: 8 cryopumps and 4 turbopumps
Achieved Vacuum (Pa): 6 10-6

EXPERIMENTAL FACILITIES :
9 experiment rooms of the GANIL. + Facility Production of radioactive beams using fragmentation and ISOL techniques


SPIRAL
DEMON
Industrial Applications
VAMOS
ORION
NAUTILUS
SPEG
ALPHA
SISSI
SSC2
LISE
INDRA
SIRA
SME
10m
SSC1
ECR4 and C0

ENTRY N° C14
Date: 12.11.2007
Machine name: JULIC
Institution: Institut für Kernphysik
Address: Forschungszentrum Jülich GmbH
Leo Brandt Straße,52428 Jülich, Germany
Telephone: +49 2461 61 3097
Fax: +49 2461 61 2854
Web Address: www.fz-juelich.de/ikp
Person in charge of cyclotron: R.Gebel
Person reporting information: R.Gebel
E-mail address: r,gebel@fz-juelich.de

HISTORY
Designed by: AEG
Constructed by: AEG
Construction dates: 1966-1968
First beam date: 1968
Characteristic beam, energy and current:
45 MeV H^-, 75 MeV D^- (10 μA unpol., 1 μA pol.)
Transmission efficiency (source to extracted beam)
Typical (%): 5
Best (%): 15
Emittance
Emittance definition: RMS
Vertical (pi mm mrad): 6.4
Horizontal (pi mm mrad): 3.2
Longitudinal (dE/E[%] x RF[deg.]): 0.3

USES
Basic research (%): 95
Development(%): 1
Therapy(%): 0
Isotope production (%): 1
Other application (%) : 0
Maintenance (%): 2
Beam tuning(%): 1
Total time (h/year): 7500

TECHNICAL DATA
(a) Magnet: **Type:** solid pole
Kb: 180 **Kf:**
Average field (min./max. T): (0.95/1.35)
Number of magnet sectors: 3
hill angular width (deg.): 60
spiral (max): 20
Pole parameters
Diameter: 3.3 m
Injection radius (m): 0.03
Extraction radius (m): 1.54
Hill gap (m): 0.084 **Valley gap (m):** 0.24
Trim coils
Number: 9
Maximum current (A-turns): 960
Harmonic coils
Number: -
Maximum current (A-turns):
Main coils
Number: 1
Total current (A-turns): 151200
Maximum current (A): 360
Stored energy (MJ):
Total iron weight (tons): 700
Total coil weight (tons): 12
Power
Main coils (total KW): 50
Trim coils (total, maximum, kW): 12
Refrigerator (cryogenic, KW): -

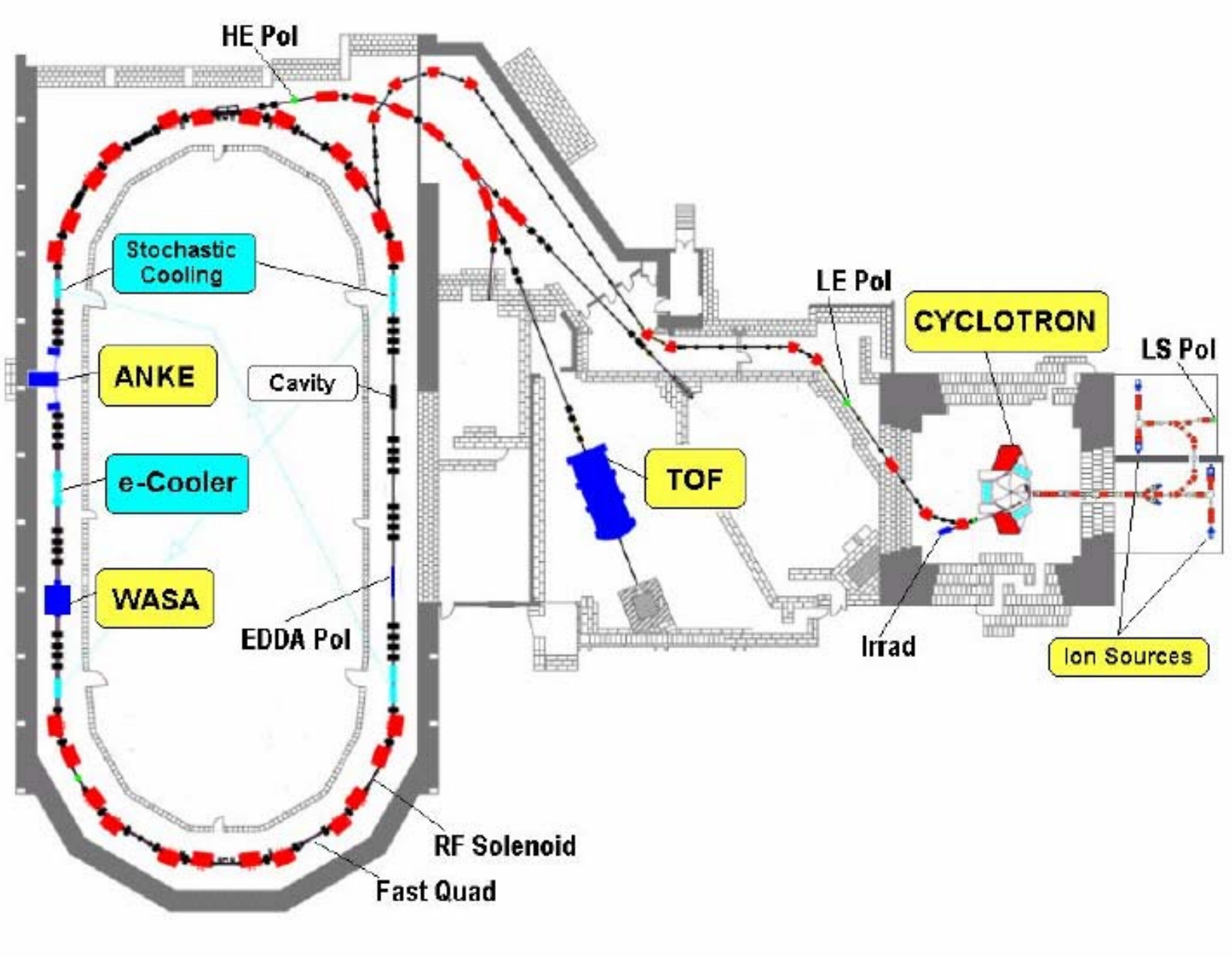
(b) RF
Frequency range (MHz): 20-30
Harmonic modes: 3
Number of dees: 3
Number of cavities:
Dee angular width (deg.): 40
Voltage
at injection (peak to ground, KV): 45
at extraction (peak to ground, KV): 30
peak (peak to ground, KV):
Line Power (max, KW): 100
Phase Stability (deg.): <0.5
Voltage Stability (%): <0.05

(c) Injection
Ion Source:
2 multicusp ion sources, polarized ion sources
Source Bias Voltage (kV): 4.5/n
External Injection: yes
Buncher Type: harmonic, sawtooth
Injection Energy (MeV/n): 0.0045/n
Component: hyperboloid inflector
Injection Efficiency (%): 30
Injector: -

(d) Extraction
Elements, Characteristic:
Electrostatic deflector, focusing channel,
Multiturn extraction
Typical Efficiency (%): 60
Best Efficiency (%): 75

(e) Vacuum
Pumps: 2 TMP (each 2800 l/s),
3 Cryo pumps (each 10000 l/s)
Achieved Vacuum (mbar): $<2.0 \cdot 10^{-7}$

EXPERIMENTAL FACILITIES
Cooler synchrotron facility COSY/Jülich


HE Pol
Stochastic Cooling
ANKE
Cavity
e-Cooler
WASA
EDDA Pol
RF Solenoid
Fast Quad
LE Pol
CYCLOTRON
LS Pol
TOF
Irrad
Ion Sources

ENTRY N° C15
Date: January 2008
Machine name: PT (former ISL, former VICKSI)
Institution: Hahn-Meitner-Institut Berlin GmbH
Address: Glienicker Str. 100
Telephone: ++49-30-8062-2415
Fax: ++49-30-8062-2097
Web Address: www.hmi.de/pt
Person in charge of cyclotron: A. Denker
Person reporting information: A. Denker
E-mail address: denker@hmi.de

HISTORY
Designed by: in house, Scanditronix and other
Constructed by: in house, Scanditronix and other
Construction dates: design: 1973-74
construction: 1974-76
First beam date: June 1977
Characteristic beam, energy and current:
p 72 MeV 6E12 pps
in principle also other beams possible…..
Transmission efficiency (source to extracted beam)
Typical (%): 10%
Best (%): 30%
Emittance
Emittance definition: normalised
Vertical (pi mm mrad): 0.4 pi mm mrad
Horizontal (pi mm mrad): 0.4 pi mm mrad
Longitudinal (dE/E[%] x RF[deg.]): 0.1 x 6

USES
Basic research (%):
Development(%):
Therapy(%) : 100%
Isotope production (%):
Other application (%) :
Maintenance (%): outside beam time
Beam tuning(%):
Total time (h/year): ~ 1200

TECHNICAL DATA
(a) Magnet: **Type:** separated sector
Kb: 132 **Kf:**
Average field (min./max. T): 0.89 T max
Number of magnet sectors: 4
hill angular width (deg.): 50
spiral (max): -
Pole parameters
Diameter: -
Injection radius (m): 0.43 m
Extraction radius (m): 1.71 m
Hill gap (m): 0.06 m **Valley gap (m):** open
Trim coils
Number: 9 x 2
Maximum current (A-turns): 100 A turns
Harmonic coils
Number: 3 x n_sector x 2
Maximum current (A-turns): 150 A turns
Main coils
Number: 1 x 2
Total current (A-turns): 2000 x 30 A turns
Maximum current (A): 2000 A
Stored energy (MJ): -
Total iron weight (tons): 360 t
Total coil weight (tons): 6 t
Power
Main coils (total KW): 400 kW
Trim coils (total, maximum, KW): 60 kW
Refrigerator (cryogenic, KW): -

(b) RF
Frequency range (MHz): 10-20 MHz
Harmonic modes: 2-8
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 26
Voltage
at injection (peak to ground, KV): 140 kV
at extraction (peak to ground, KV): 100 kV
peak (peak to ground, KV): 140 kV
Line Power (max, KW): 200 kW
Phase Stability (deg.): < 0.1°
Voltage Stability (%): < 0.05%

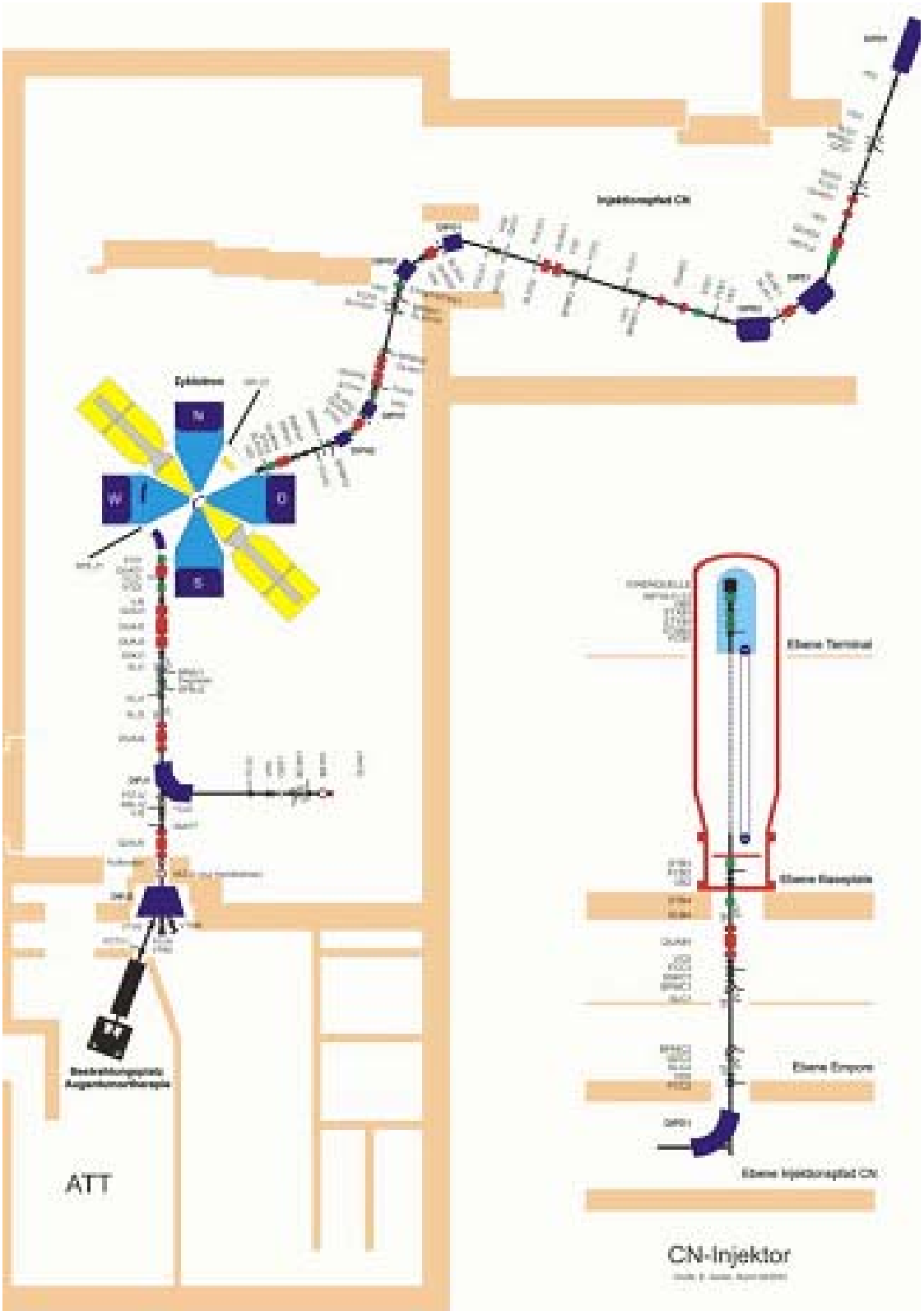
(c) Injection
lon Source: external injector: Van-de-Graaff
Source Bias Voltage (kV):
External Injection: radial
Buncher Type: external, 60% in 6°
Injection Energy (MeV/n): 0.09 – 4 MeV/u
Component: 2 magnetic, 1 electrostatic
Injection Efficiency (%): > 70%
Injector: 5.5 MV Van-de-Graaff

(d) Extraction
Elements, Characteristic: 2 magnetic, 1 electrostatic
Typical Efficiency (%): 95%
Best Efficiency (%): 100%

(e) Vacuum
Pumps: 2 cryogenic, 2 turbomolecular
Achieved Vacuum (Pa): 1e5 Pa

EXPERIMENTAL FACILITIES
treatment area for eye tumours, dosimetry check, quality control, energy analysis

COMMENTS: The facility undergoes the transformation from a flexible, multi-ion and energy variable facility for basic and applied research to a dedicated eye tumour facility**.**


Injektionsgebäude CN
Zyklotron
N
W
O
S
Elsene Terminal
Elsene Ebene plate
Elsene Empore
Elsene Injektionsgebäude CN
ATT
CN-Injektor

ENTRY N° C16
Date: 14 Feb 2008
Machine Name: Karlsruher Compakt Anlage, KAZ
Institution: ZAG Zyklotron AG
Address: D-76344 Eggenstein-Leopoldshafen, Hermannvon.
Helmholtz-Platz 1
Telephone: +49-7247-823383
Fax: +49-7247-823156
Web Address:
www.zyklotron-ag.de <http://www.zyklotron-ag.de/>
Person in Charge of Cyclotron: H.Schweickert
Person Reporting Information: H.Schweickert
E-mail Address: Hermann.Schweickert@zyklotron-ag.de

HISTORY
Designed by: TCC, The Cyclotron Corporation, CP42H
Construction Dates: 1979 - 1982
First Beam Date: 1983
Characteristic Beams
ions / energy(MeV/N)/current(pps)/power(w)
p 42 1.25 E15 8400
Transmission Efficiency (source to extracted beam)
Typical (%): 80
Best (%): 90
Emittance
Emittance Definition: 90%
Vertical (pi mm mrad): 10
Horizontal (pi mm mrad): 10
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%): 5
Development (%):10
Therapy (%):
Isotope Production (%): 30
Other Application (%): 30
Maintenance (%): 3
Beam Tuning (%): 2
Total Time (h/year): ca. 5000

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV): 42
Kf (MeV):
Average Field (min./max. T): 1.84
Number of Sectors: 3
Hill Angular Width (deg.):
Spiral (deg.): 64
Pole Diameter (m): 1.20
Injection Radius (m):
Extraction Radius (m): 0.53
Hill Gap (m): 0.05
Valley Gap (m): 0.12
Trim Coils
Number: 3x2
Maximum Current (A-turns):
Harmonic Coils
Number: 2xNsectorsx2
Maximum Current (A-turns):
Main Coils
Number: 1x2
Total Ampere Turns: 184000
Maximum Current (A): 365
Stored Energy (MJ):
Total Iron Weight (tons): 35
Total Coil Weight (tons): 3
Power
Main Coils (total KW): 100
Trim Coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 26.5
Harmonic Modes: 1
Number of Dees: 1
Number of Cavities:
Dee Angular Width (deg.):90
Voltage
At Injection (peak to ground, KV):
At Extraction (peak to ground, KV):
Peak (peak to ground, KV): 35
Line Power (max, KW): 100
Phase Stability (deg.):
Voltage Stability (%): 0.01

(c)Injection
Ion Source: internal cold cathode penning
Source Bias Voltage (kV): 1.200
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d)Extraction
Elements, Characteristic: Charge exchange Foil efficiency
Typical Efficiency (%): 90
Best Efficiency (%): 95

(e)Vacuum
Pumps: 4 diffusion pumps
Achieved Vacuum (Pa): 1.33*E10-5

ENTRY N° C17
Date: 08 November 2007 16:39:49
Machine Name: Variable Energy Cyclotron
Institution: Variable Energy Cyclotron Centre, Department of Atomic Energy.
Address: 1/AF, BIDHAN NAGAR, CALCUTTA-700064,INDIA
Telephone: +91 33 2337-1230
Fax: +91 33 2334-6871
Web Address: http://veccal.ernet.in
Person in Charge of Cyclotron: Bikash Sinha
Person Reporting Information: C. Mallik /R. K. Bhandari
E-mail Address: : mallik@veccal.ernet.in bhandari@veccal.ernet.in

HISTORY
Designed by: in house
Constructed by : in house
Construction Dates: 1969-77
First Beam Date: June 1977 (Internal), July 1978 (External)
Characteristic Beams

Ions	Energy(MeV)	Current(pps)
Proton	7-20 MeV	3E13
Deuteron	14 MeV	5E12
Alpha	25-80 MeV	3E13
Oxygen	115-180 MeV	1.2E12
Neon	140-240 MeV	3E11
Sulphur	230 MeV	3E10
Argon	280-350 MeV	5E10

Transmission Efficiency (source to extracted beam)
Typical (%): 1.5 for external ECR Source
Best (%): 5
Emittance
Emittance Definition:
Vertical (pi mm mrad): 17 (90%)
Horizontal (pi mm mrad): 22 (90%)
Longitudinal (dE/E[%] x RF[deg.]): 0.8x30

USES
Basic Research (%): 40
Development (%): 15
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%): 30
Beam Tuning (%): 15
Total Time (h/year): 6000(Average)
TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV): 130
Kf (MeV): 70
Average Field (min./max. T): 1.7
Number of Sectors: 3
Hill Angular Width (deg.): 60
Spiral (deg.): 55 max
Pole Diameter (m): 2.24
Injection Radius (m): 0
Extraction Radius (m): 0.99
Hill Gap (m): 0.19
Valley Gap (m): 0.30
Trim Coils
Number: 17x2
Maximum Current (A-turns): 2000
Harmonic Coils
Number: 5xNsectorsx2
Maximum Current (A-turns): 300
Main Coils
Number: 1x2
Total Ampere Turns: 400000
Maximum Current (A): 2000
Stored Energy (MJ):
Total Iron Weight (tons): 275
Total Coil Weight (tons): 10
Power
Main Coils (total KW): 230
Trim Coils (total, maximum, KW): 250
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 5.5-15.5
Harmonic Modes: 1,3
Number of Dees: 1 with Dummy Dee
Number of Cavities: 1
Dee Angular Width (deg.):180
Voltage
At Injection (peak to ground, KV): 50
At Extraction (peak to ground, KV): 50
Peak (peak to ground, KV): 50
Line Power (max, KW): 300
Phase Stability (deg.):
Voltage Stability (%): 0.2

(c)Injection
Ion Source: PIG, ECRIS
Source Bias Voltage (kV): 8-10
External Injection: axial
Buncher Type: First harmonic,Double Drift
Injection Energy (MeV/n): 0.003-0.004 (typical)
Component: 90degree Analysing magnet, glaser lenses, Quadrupoles, 2x45 degree Dipoles
source bias voltage: 8-10kV
Injection Efficiency (%): 30 to 40
Injector: Mirror Inflector

(d)Extraction
Elements, Characteristic: 2 Electrostatic deflectors
Typical Efficiency (%): 25
Best Efficiency (%): 40

(e)Vacuum
Pumps: Oil Diffusion, Cryopump on Dee tank
Achieved Vacuum (Pa): 5E-4 (typical)

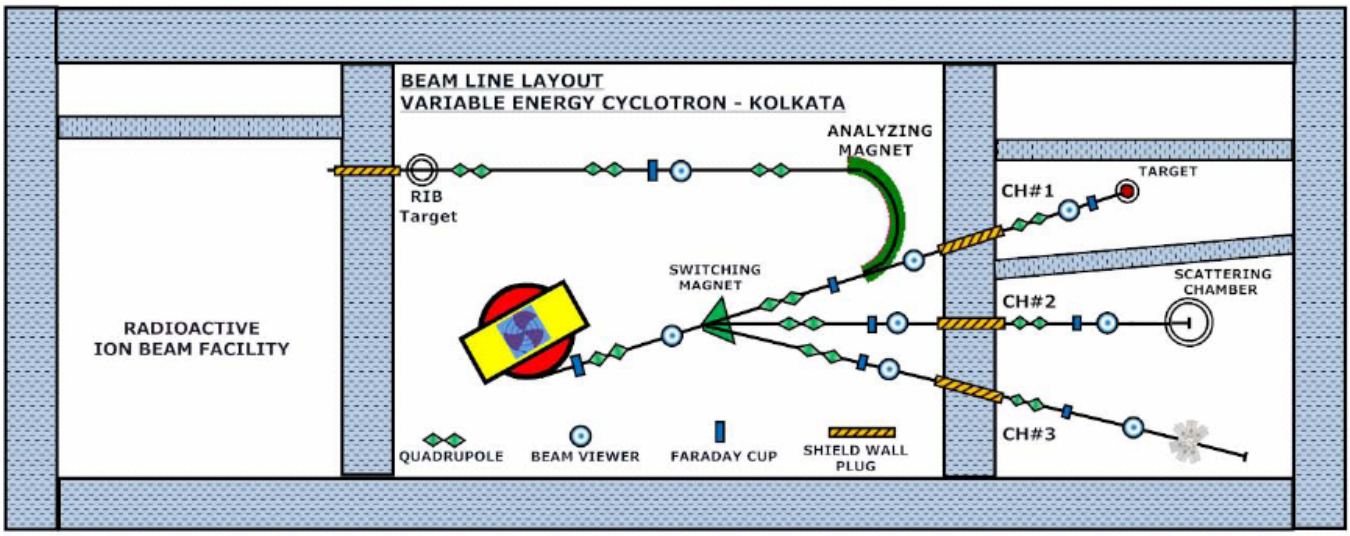
REFERENCES
Conf. Proceedings of Intl. Cyclotron Conferences

EXPERIMENTAL FACILITIES

915mm Scattering chamber, Target and Detector Lab., Radiochemistry, Radio-Isotope Lab., ISOL System, Rabbit, Online Data analysing computer. RIB facility,Indian National Gamma Array Facility

COMMENTS

Cyclotron has been delivering heavy Ion beams to experimentalists. A number of sub-systems are being upgraded presently. After the upgradation work the cyclotron will also deliver light ion beams for Radioactive Ion Beam Facility.



ENTRY N° C18
Date: 08 November 2007
Machine Name: Kolkata Superconducting Cyclotron
Institution: Variable Energy Cyclotron Centre, Department of Atomic Energy.
Address: 1/AF, BIDHAN NAGAR, KOLKATA-700064,INDIA
Telephone: +91 33 2337-1230
Fax: +91 33 2334-6871
Web Address: http://veccal.ernet.in
Person in Charge of Cyclotron: Bikash Sinha
Persons Reporting Information: R. K. Bhandari / C. Mallik
E-mail Address: bhandari@veccal.ernet.in , mallik@veccal.ernet.in

HISTORY
Designed by: Design adapted from MSU and Texas A&M K500 cyclotron
Construction Dates: 1997-2007
Constructed by : in house
First Beam Date: Scheduled to be commissioned April 2008
Characteristic Beams
Ions Energy(MeV) Current(pps)

Transmission Efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance Definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year):

TECHNICAL DATA
(a)Magnet
Type: compact superconducting
Kb (MeV): 520
Kf (MeV): 160
Average Field (min./max. T): 3.0/4.9
Number of Sectors: 3
Hill Angular Width (deg.): 60
Spiral (deg.): 118 (magnetic)
Pole Diameter (m): 1.42
Injection Radius (m): 0.008
Extraction Radius (m): 0.67
Hill Gap (m): 0.0635
Valley Gap (m): 0.914

Trim Coils square coils, horizontal axis
Number: (13x3 sectors)+1circular x 2
Maximum Current (A-turns): 400x20/2
Harmonic Coils
Number: 2xNsectorsx2
Maximum Current (A-turns): 400x20/2
Main Coils
Number: 2x2
Total Ampere Turns: 4.4E6
Maximum Current (A): 800
Stored Energy (MJ): 18
Total Iron Weight (tons): 90
Total Coil Weight (tons): 7
Power
Main Coils (total KW): 0
Trim Coils (total, maximum, KW): 130
Refrigerator (cryogenic, KW): 0.25

(b)RF
Frequency Range (MHz): 9-27.5
Harmonic Modes: 1
Number of Dees: 3
Number of Cavities: 3
Dee Angular Width (deg.): 60
Voltage
At Injection (peak to ground, KV): 90
At Extraction (peak to ground, KV): 90
Peak (peak to ground, KV): 90
Line Power (max, KW): 300
Phase Stability (deg.): 0.5
Voltage Stability (%): 0.01

(c)Injection
Ion Source: Two 14 GHz ECR ion sources
Source Bias Voltage (kV): 2-20
External Injection: axial
Buncher Type: First harmonic,Double Drift
Injection Energy (MeV/n): 0.0005-0.0007
Component: 4x 90° magnet, solenoid lenses, quadrupoles, 1x45 degree Dipoles
Injection Efficiency (%):
Injector: Spiral Inflector

(d)Extraction
Elements, Characteristic: Electrostatic deflectors(2), moveable magnetic passive Channels(8), compensating bars (2), active combined function magnet(1)
Typical Efficiency (%):
Best Efficiency (%):

(e)Vacuum
Pumps: 3 cryopanels and 3 TMP
Achieved Vacuum (Pa):

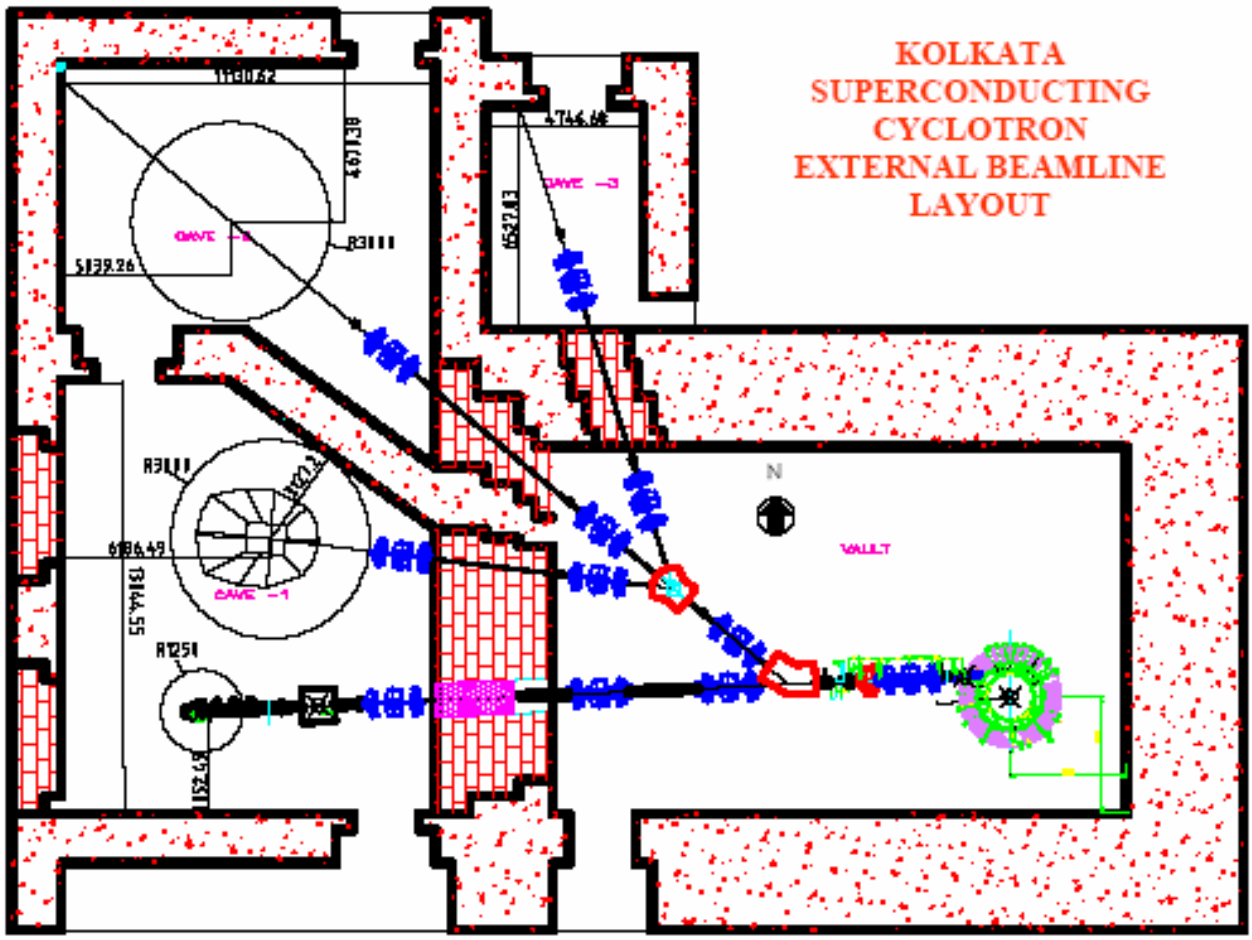
REFERENCES Proceedings of Intl. Cyclotron Conference (2001, 2004, 2007)

EXPERIMENTAL FACILITIES

Multipurpose scattering chamber, 4π charged particle detector array, 4π neutron multiplicity detector, High energy gamma detector array, superconducting penning ion trap, Irradiation facility for nuclear chemistry and condensed matter physics

COMMENTS

The superconducting magnet of the Cyclotron has been commissioned and field mapping completed. Installation of other systems/components is going on. Beam trials are expected during April 2008.



ENTRY N° C19
Date: 9 Nov 2007
Machine name: LNS Superconducting Cyclotron
Institution: Istituto Nazionale di Fisica Nucleare, Laboratori Nazionali del Sud
Address: via S. Sofia 62, 95123 Catania, Italy
Telephone: +39-095-542111
Fax: +39-095-7141815
Web Address: www.lns.infn.it
Person in charge of cyclotron: Danilo Rifuggiato
Person reporting information: Danilo Rifuggiato
E-mail address: rifuggiato@lns.infn.it

HISTORY
Designed by: F. Resmini
Constructed by: in house
Construction dates: start in 1981, assembled in 1993
First beam date: 1994
Characteristic beam, energy and current:

H2+	80 AMeV	10 enA
13C4+	45 AMeV	1000 enA
112Sn31+	43.5 AMeV	5 enA
197Au36+	23 AMeV	5 enA

Transmission efficiency (source to extracted beam)
Typical (%): 6
Best (%): 15
Emittance
Emittance definition: 90%
Vertical (pi mm mrad): 1
Horizontal (pi mm mrad): 2
Longitudinal (dE/E[%] x RF[deg.]): 4.5

USES
Basic research (%): 35
Development(%): 5
Therapy(%): 15
Isotope production (%):
Other application (%): 15
Maintenance (%): 10
Beam tuning (%): 20
Total time (h/year): 4500

TECHNICAL DATA
(a) Magnet: Superconducting **Type:** compact
Kb: 800 **Kf:** 200
Average field (min./max. T): 2.2/4.8
Number of magnet sectors: 3
hill angular width (deg.): 60
spiral (max): 69
Pole parameters
Diameter (m): 1.8
Injection radius (m): 0.018
Extraction radius (m): 0.87
Hill gap (m): 0.086 **Valley gap (m):** 0.916
Trim coils
Number: 20
Maximum current (A-turns): 4000
Harmonic coils
Number: 4
Maximum current (A-turns): 4000
Main coils
Number: 2
Total current (A-turns): 6.5E6
Maximum current (A): 1950, 1950
Stored energy (MJ): 45
Total iron weight (tons): 176
Total coil weight (tons): 9.6
Power
Main coils (total KW): 0
Trim coils (total, maximum, KW): 100
Refrigerator (cryogenic, KW): 0.180 at 4.2 K

(b) RF
Frequency range (MHz): 15-48
Harmonic modes: 2
Number of dees: 3
Number of cavities: 3
Dee angular width (deg.): 60
Voltage
at injection (peak to ground, KV): 100
at extraction (peak to ground, KV): 120
peak (peak to ground, KV): 120
Line Power (max, KW): 50
Phase Stability (deg.): 0.5
Voltage Stability (%): 0.01

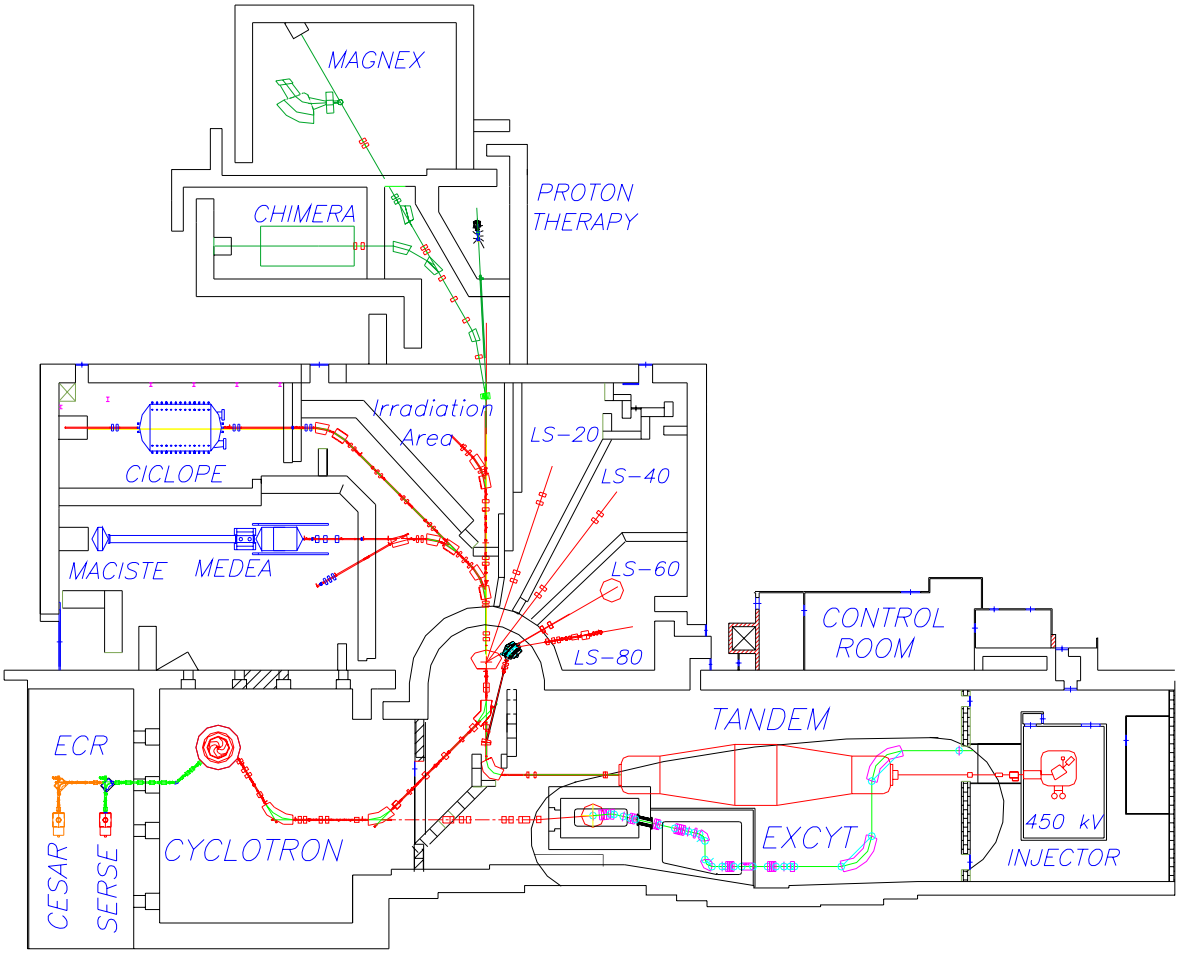
(c) Injection
Ion Source: 2 ECR sources
Source Bias Voltage (kV): 26
External Injection: axial
Buncher Type: single drift
Injection Energy (MeV/n): 0.010-0.026*q/A
Component: magn. quad. and solenoids, dipoles
Injection Efficiency (%): 15
Injector:

(d) Extraction
Elements, Characteristic: 2 electrost.defl., 7 passive magnetic channels
Typical Efficiency (%): 30
Best Efficiency (%): 65

(e) Vacuum
Pumps: rotative, turbomolecular, cryo-split
Achieved Vacuum (Pa): 2*10E-4

REFERENCES: L. Calabretta and D. Rifuggiato, Status and future plans at LNS Catania, Proc. of the XVI Int. Conf. On Cyclotr. and their Appl, 2001, p. 79

EXPERIMENTAL FACILITIES: Chimera and Medea (4pi detectors), Catana (proton therapy facility), Magnex (magnetic spectrometer)


MAGNEX
CHIMERA
PROTON
THERAPY
Irradiation
Area
LS-20
LS-40
LS-60
LS-80
CICLOPE
MACISTE
MEDEA
CONTROL
ROOM
TANDEM
ECR
CYCLOTRON
CESAR
SERSE
EXCYT
450 kV
INJECTOR

ENTRY N° C20
Date: 6 Dec. 2007
Machine name: CYRIC AVF Cyclotron
Institution: CYRIC, Cyclotron and Radioisotope Center, Tohoku University
Address: Aramaki , Aoba, Sendai, 980-8578, Japan
Telephone: +81-(0)22-217-7800
Fax: +81-(0)22-217-7997
Web Address: http://www.cyric.tohoku.ac.jp/
Person in charge of cyclotron: Tsutomu Shinozuka
Person reporting information: Tsutomu Shinozuka
E-mail address: shino@cyric.tohoku.ac.jp

HISTORY
Designed by: Sumitomo Heavy Industry and CYRIC, Tohoku University
Constructed by: Sumitomo Heavy Industry and CYRIC, Tohoku University
Construction dates: 1998-2000
First beam date: March 6 2000
Characteristic beam, energy and current:

P	10-90 (MeV)	10 micro A	(900W)
d	10-55 (MeV)	10 microA	
4He	20-110 (MeV)	5 microA	
12C	6-12 (MeV/u)	1 microA	
H-	10-50(MeV)	300 microA (goal)	
		30 microA (present) (1.5 kW)	

Transmission efficiency (source to extracted beam)
Typical (%): 50
Best (%): 80
Emittance
Vertical (pi mm mrad): 12
Horizontal (pi mm mrad): 15
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 40
Development(%): 10
Therapy(%) : 0
Isotope production (%): 20
Other application (%) : 20
Maintenance (%): 5
Beam tuning(%): 5
Total time (h/year): 4100

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 110 (MeV) **Kf:** 90 (MeV)
Average field (min./max. T): 1.66/1.96
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max): 53
Pole parameters
Diameter: 2.16
Injection radius (m): 0.025
Extraction radius (m): 0.93
Hill gap (m): 0.166 **Valley gap (m):** 0.405
Trim coils
Number: 12 x 2
Maximum current (A-turns): 1500
Harmonic coils
Number: 8x2 (Upper and Lower)
Maximum current (A-turns): 1000
Main coils
Number: 1 x 2 (Upper and Lower)
Total current (A-turns):
Maximum current (A): 900
Stored energy (MJ):
Total iron weight (tons): 220
Total coil weight (tons): 9
Power
Main coils (total KW): 230
Trim coils (total, maximum, KW): 80
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 10.6 – 22.0
Harmonic modes: 1st, 2nd and 3rd
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 86
Voltage
peak (peak to ground, KV): 60
Line Power (max, KW): 70x2
Phase Stability (deg.):0.5
Voltage Stability (%): 0.1

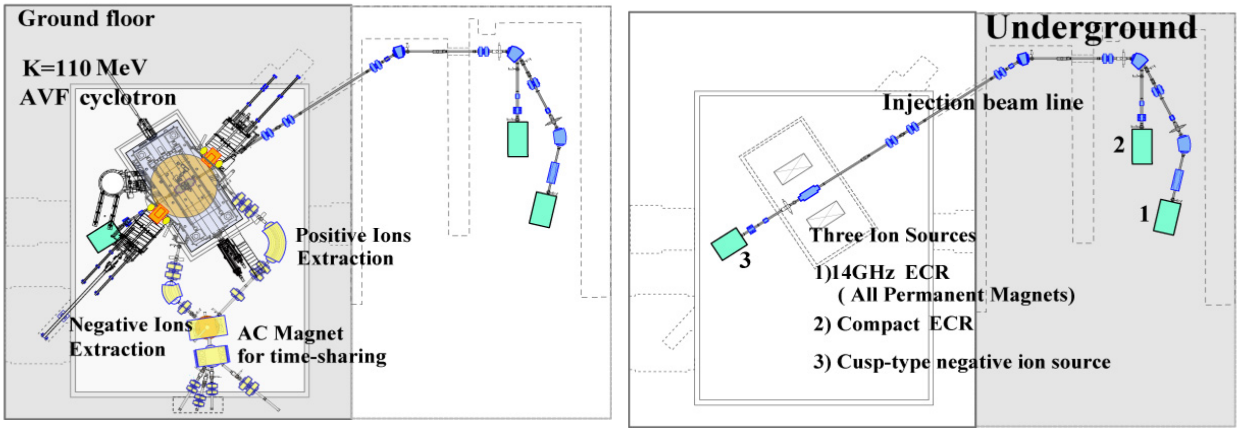
(c) Injection
Ion Source: Ext. sources (ECR x 2, multi-cusp for H-)
Source Bias Voltage (kV):
External Injection: axial
Buncher Type: single-gap, saw-tooth
Injection Energy (MeV/n): 0.003-0.02
Component: 90-deg, BM and other 3 BMs, Q(6), solenoid(4), spiral-inflector
Injection Efficiency (%): 30
Injector:

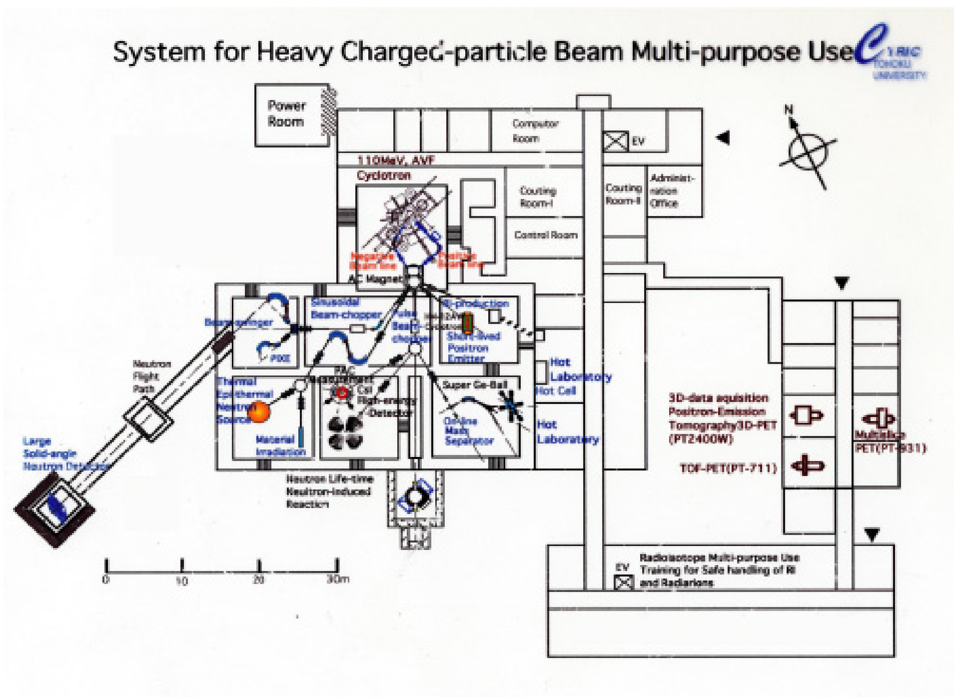
(d) Extraction
Elements,Characteristic:ES-deflector and stripper foil
Typical Efficiency (%): 60 deflector, 90 for stripper
Best Efficiency (%): 85

(e) VacuumPumps:
CRYO x 4 (4000 l/s for N2) TMP(2000 l/s x 6)
Achieved Vacuum (Pa): 1.0E-4

REFERENCES: T.Shinozuka CYRIC Annual Report 2000 (2001) 19

EXPERIMENTAL FACILITIES
10 target stations: short/long lived RI production, omline mass-separator, fast neutron time of facility, fast neutron beam source**, g**eneral purpose, bio-physics etc. small cyclotron(12 MeV proton) for PET RI production.


Ground floor
K=110 MeV
AVF cyclotron
Positive Ions
Extraction
Negative Ions
Extraction
AC Magnet
for time-sharing
Underground
Injection beam line
Three Ion Sources
1)14GHz ECR
(All Permanent Magnets)
2) Compact ECR
3) Cusp-type negative ion source
1
2
3


System for Heavy Charged-particle Beam Multi-purpose Use
CYRIC
TOHOKU UNIVERSITY
Power Room
Computer Room
110MeV, AVF
Cyclotron
Counting Room-I
Counting Room-II
Administration Office
Control Room
EV
N
AC Magnet
Sinusoidal Beam-chopper
Pulse Beam-chopper
RI-production
Short-lived Positron Emitter
PIXE
Neutron Flight Path
Large Solid-angle Neutron Detector
Thermal Epithermal Neutron Source
Material Irradiation
Super Ge-Ball
On-line Mass Separator
Hot Laboratory
Hot Cell
Hot Laboratory
Neutron Life-time
Neutron-induced Reaction
3D-data aquisition
Positron-Emission
Tomography3D-PET
(PT2400W)
TOF-PET(PT-711)
Multislice
PET(PT-931)
Radioisotope Multi-purpose Use
Training for Safe handling of RI
and Radiations
0
10
20
30m

ENTRY N° C21
Date: 12 Feb. 2008
Machine name: JAEA AVF Cyclotron
Institution: Japan Atomic Energy Agency
Address: 1233 Watanuki, Takasaki, Gunma 370-1292, Japan
Telephone: +81-27-346-9630
Fax: +81-27-346-9690
Web Address: http://www.jaea.go.jp
Person in charge of cyclotron: T. Nara
Person reporting information: W. Yokota
E-mail address: yokota.wataru@jaea.go.jp

HISTORY
Designed by: Sumitomo Heavy Industries, Ltd.
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 1988-1991
First beam date: 17 March, 1991
Characteristic beam, energy and current:

H^+	90 MeV/N	10 eμA
$^4He^{2+}$	30	10
$^{12}C^{5+}$	18.3	1.0
$^{40}Ar^{13+}$	11.5	0.045
$^{129}Xe^{23+}$	3.5	0.20
$^{197}Au^{31+}$	2.5	0.038

Transmission efficiency (source to extracted beam)
Typical (%): 15
Best (%): 30
Emittance
Emittance definition: 80 %
Vertical (pi mm mrad): 13
Horizontal (pi mm mrad): 9
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 13
Development(%): 10
Therapy(%); 0
Isotope production (%): 2
Other application (%) : 55
Maintenance (%): 0
Beam tuning(%): 20
Total time (h/year): 3459

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 110 **Kf:** 95
Average field (min./max. T): 1.67
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max): 53
Pole parameters
Diameter: 2.156
Injection radius (m): 0.013, 0.016, 0.019 (h=1,2,3)
Extraction radius (m): 0.923
Hill gap (m): 0.166 **Valley gap (m):** 0.405
Trim coils
Number: 12 x 2
Maximum current (A-turns): 800 A
Harmonic coils
Number: 8 x 2
Maximum current (A-turns): 50 A
Main coils
Number: 1 x 2
Total current (A-turns): 432000
Maximum current (A): 900
Stored energy (MJ):
Total iron weight (tons): 220
Total coil weight (tons): 5
Power
Main coils (total KW): 250
Trim coils (total, maximum, KW): 52
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 10.6-22.0
Harmonic modes: 1,2,3
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 86
Voltage
at injection (peak to ground, KV): 60
at extraction (peak to ground, KV): 57
peak (peak to ground, KV): 60
Line Power (max, KW): 50
Phase Stability (deg.): +-0.5
Voltage Stability (%): +-0.1

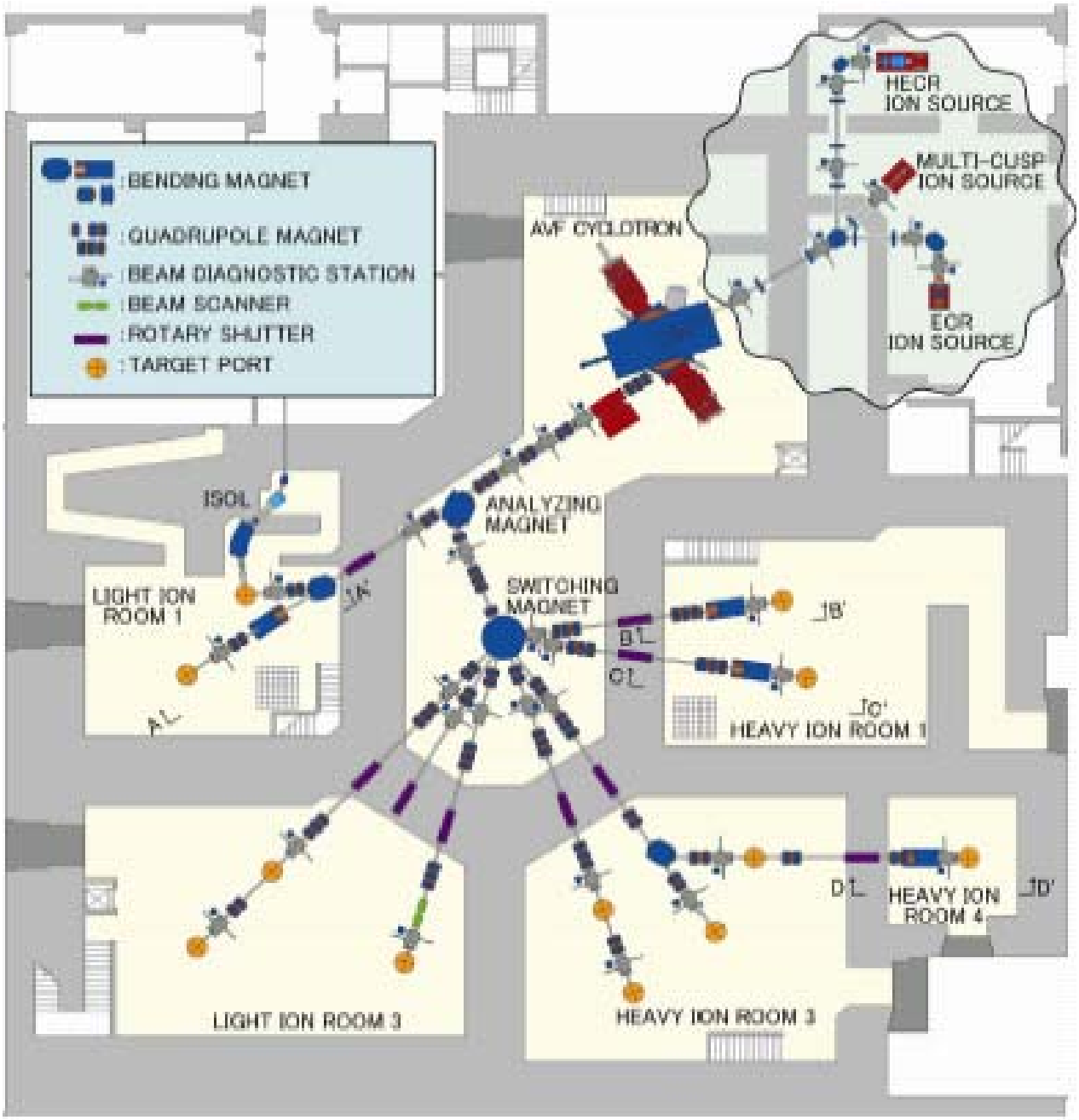
(c) Injection
Ion Source: Multi-cusp x 1, ECR x 2
Source Bias Voltage (kV): 3-20
External Injection: axial
Buncher Type: twin gaps, sine wave
Injection Energy (MeV/n): 0.017 (max.)
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic:
Electrostatic deflector:60kV, Electromagnetic coil:1430A,
Passive-type field gradient corrector
Typical Efficiency (%): 60
Best Efficiency (%): 95

(e) Vacuum
Pumps: cryo(4000L/s) x 2, TMP(2000L/s) x 2
Achieved Vacuum (Pa): 1.2e-5 Pa

REFERENCES:
Y.Nakamura, et. al, JAERI-Review 2004-025, pp.310-312 (2004).K.Arakawa, et. al, Proc. 13th Int. Conf. on Cyclotrons and their Applications, pp.119-122 (1992).

EXPERIMENTAL FACILITIES: Wide-area ion irradiation chamber, Positron emitting tracer imaging system (PETIS), Heavy ion microbeam System, Quasi-monoenergetic neutron source, Beam chopping system (pulsed type + sinusoidal type), Beam scanner


: BENDING MAGNET
: QUADRUPOLE MAGNET
: BEAM DIAGNOSTIC STATION
: BEAM SCANNER
: ROTARY SHUTTER
: TARGET PORT
HECR
ION SOURCE
MULTI-CUSP
ION SOURCE
ECR
ION SOURCE
AVF CYCLOTRON
ISOL
ANALYZING
MAGNET
SWITCHING
MAGNET
LIGHT ION
ROOM 1
A'
B'
C'
HEAVY ION ROOM 1
D'
HEAVY ION
ROOM 4
LIGHT ION ROOM 3
HEAVY ION ROOM 3

ENTRY N° C22
Date: 11 Feb 2008
Machine name: RCNP AVF Cyclotron
Institution: Research Center for Nuclear Physics
Address:10-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan
Telephone: +81-6-6879-8830
Fax: +81-6-6879-8899
Web Address: http://www.rcnp.osaka-u.ac.jp
Person in charge of cyclotron: Kichiji Hatanaka
Person reporting information: Kichiji Hatanaka
E-mail address: hatanaka@rcnp.osaka-u.ac.jp

HISTORY
Designed by: RCNP, Osaka University
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 1971-1973
First beam date: 1974
Characteristic beam, energy and current:

H+	80 MeV/N	5 e-μA
3He2+	53	5
4He2+	35	5
18O6+	13.7	6
86Kr23+	8.5	0.1

Transmission efficiency (source to extracted beam)
Typical (%): 5
Best (%): 10
Emittance
Emittance definition: RMS
Vertical (pi mm mrad): 5
Horizontal (pi mm mrad): 5
Longitudinal (dE/E[%] x RF[deg.]): 0.1 x 6

USES
Basic research (%): 43
Development(%): 31
Therapy(%) : 0
Isotope production (%): 0
Other application (%) : 4
Maintenance (%): 16
Beam tuning(%): 6
Total time (h/year): 7000

TECHNICAL DATA
(a) Magnet: **Type:** Normal Conductor
Kb: 140 **Kf:** 80
Average field (min./max. T): max. 1,6
Number of magnet sectors: 3
hill angular width (deg.):
spiral (max): 52
Pole parameters
Diameter (m): 2.3
Injection radius (m): 0.016
Extraction radius (m): 1.0
Hill gap (m): 0.207 **Valley gap (m):** 0.347
Trim coils
Number: 16 x 2
Maximum current (A-turns): 3000
Harmonic coils
Number: 3/sector x 2
Maximum current (A-turns): 1000
Main coils
Number: 1 x 2
Total current (A-turns): 4x10^5
Maximum current (A): 1430
Stored energy (MJ):
Total iron weight (tons): 400
Total coil weight (tons): 13
Power
Main coils (total KW): 450
Trim coils (total, maximum, KW): 265
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 6-18
Harmonic modes: 1, 3
Number of dees: 1
Number of cavities: 1
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV): 100
at extraction (peak to ground, KV): 100
peak (peak to ground, KV): 100
Line Power (max, KW): 400
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.1

(c) Injection
Ion Source: Atomic beam PIS, 10GHz & 18GHz ECRIS
Source Bias Voltage (kV): 20kV max.
External Injection: Axial Injection
Buncher Type: f+2f+3f Mesh Buncher
Injection Energy (MeV/n):
Component: Spiral Inflector
Injection Efficiency (%): 12
Injector:

(d) Extraction
Elements, Characteristic: 2 Electrostatic Deflectors
Typical Efficiency (%): 50-100
Best Efficiency (%): 100

(e) Vacuum
Pumps: Diffusion Pumps
Achieved Vacuum (Pa): 4x10^-5

EXPERIMENTAL FACILITIES
Injector to the Ring Cyclotron, Magnetic Spectrometer, RI Production System for Nuclear Chemistry

COMMENTS
Upgraded in 2004. A flat-topping system and new beam line to experimental halls of Ring Cyclotron were added.

ENTRY N° C23
Date: Feb. 12, 2008
Machine name: RCNP Ring Cyclotron
Institution: Research Center for Nuclear Physics
Address:10-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan
Telephone: +81-6-6879-8830
Fax: +81-6-6879-8899
Web Address: http://www.rcnp.osaka-u.ac.jp
Person in charge of cyclotron: Kichiji Hatanaka
Person reporting information: Kichiji Hatanaka
E-mail address: hatanaka@rcnp.osaka-u.ac.jp

HISTORY
Designed by: RCNP, Osaka University
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 1986-1991
First beam date: 1991
Characteristic beam, energy and current:

H+	420 MeV/N	1 e-μA
3He2+	150	0.5
4He2+	100	0.5
18O6+	60	0.06

Transmission efficiency (source to extracted beam)
Typical (%): 80
Best (%): 100
Emittance
Emittance definition: RMS
Vertical (pi mm mrad): 1
Horizontal (pi mm mrad): 1
Longitudinal (dE/E[%] x RF[deg.]): 0.05 x 10

USES
Basic research (%): 43
Development(%): 31
Therapy(%) : 0
Isotope production (%): 0
Other application (%) : 4
Maintenance (%): 16
Beam tuning(%): 6
Total time (h/year): 7000

TECHNICAL DATA
(a) Magnet:
Type: Normal Conductor
Kb: 400 **Kf:** 400
Average field (min./max. T): max. 0.76
Number of magnet sectors: 6
hill angular width (deg.): 22-27.5
spiral (deg.): 30
Pole parameters
Diameter (m):
Injection radius (m): 2.0
Extraction radius (m): 4.0
Hill gap (m): 0.06 **Valley gap (m):**
Trim coils
Number: 36 x 2
Maximum current (A-turns): 500
Harmonic coils
Number: 2/sector x 2
Maximum current (A-turns): 500
Main coils
Number: 1/sector x 2
Total current (A-turns): 1.4x10^5
Maximum current (A): 900
Stored energy (MJ):
Total iron weight (tons): 2200
Total coil weight (tons): 32
Power
Main coils (total KW): 440
Trim coils (total, maximum, KW): 350
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 30-52
Harmonic modes: 6, 10, 12, 18
Number of dees: 3
Number of cavities: 3
Dee angular width (°): Single Gap
Voltage
at injection (peak to ground, KV): 200
at extraction (peak to ground, KV): 500
peak (peak to ground, KV): 500
Line Power (max, KW): 250/cavity
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.01

(c) Injection
Ion Source:
Source Bias Voltage (kV):
External Injection: Radial
Buncher Type: 6 and 10 Harmonic Rebuncher
Injection Energy (MeV/n): 7.5-65
Component: 2 Magnetic & 2 Electrostatic (ES) Channels
Injection Efficiency (%): 100
Injector: RCNP AVF Cyclotron

(d) Extraction
Elements, Characteristic: 2 Magnetic & 2ES Channels
Typical Efficiency (%): 80
Best Efficiency (%): 100

(e) Vacuum
Pumps: Cryo Pumps
Achieved Vacuum (Pa): 1.5x10^-5

EXPERIMENTAL FACILITIES
Double-arm Magnetic Spectrometer, 100 m TOF tunnel and Beam Swinger, RI Beam Separator, UCN Source, White Neutron Source

COMMENTS
A variable frequency Flat-topping system is equipped.

ENTRY N° C24
Date: Feb. 12, 2008
Machine Name: RIKEN AVF CYCLOTRON
Institution: RIKEN
Address: Wako, Saitama 351-0198, Japan
Telephone: +81-48-462-1111
Fax: +81-48-461-5301
Web Address: http://www.rarf.riken.go.jp
Person in Charge of Cyclotron: Kase, M.
Person Reporting Information: Kase, M.
E-mail Address: mkase@riken.jp

HISTORY
Designed by: RIKEN/SHI
Construction Dates: 1987-1989
First Beam Date: April 1989
Characteristic Beams

ions / energy(MeV/N)		/current(pps)	/power(w)
p	4-14.5	6e13	40-150
d	4-9.5	6e13	80-200
12C,14N,16O,20Ne	4-7	1e13	300
40Ar	4.5-5.2	3e12	100

Transmission Efficiency (source to extracted beam)
Typical (%): 10
Best (%): 20
Emittance
Emittance Definition: RMS
Vertical (pi mm mrad): 0.9
Horizontal (pi mm mrad): 0.9
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%): 14
Development (%):
Therapy (%):
Isotope Production (%): 6
Other Application (%): 81 (Injection to RRC C-23)
Maintenance (%):
Beam Tuning (%):
Total Time (h/year): 3300

TECHNICAL DATA
(a)Magnet
Type: AVF
Kb (MeV): 70q**2/A**2
Kf (MeV):
Average Field (min./max. T): 0.5-1.7
Number of Sectors: 4
Hill Angular Width (deg.):
Spiral (deg.): 50
Pole Diameter (m): 1.726
Injection Radius (m): 0.0163
Extraction Radius (m): 0.714
Hill Gap (m): 0.128
Valley Gap (m): 0.300
Trim Coils
Number: 9x2
Maximum Current (A-turns): 70-300
Harmonic Coils
Number: 4xNsectorsx2
Maximum Current (A-turns):
Main Coils
Number: 1x2
Total Ampere Turns: 320000
Maximum Current (A): 1113
Stored Energy (MJ):
Total Iron Weight (tons): 102
Total Coil Weight (tons): 5.3
Power
Main Coils (total KW):
Trim Coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 12-24
Harmonic Modes: 2,3
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.):85
Voltage
At Injection (peak to ground, KV):
At Extraction (peak to ground, KV):
Peak (peak to ground, KV): 50
Line Power (max, KW): 30*2
Phase Stability (deg.): +-0.2
Voltage Stability (%): +-0.05

(c)Injection
Ion Source: ECR, PIS
Source Bias Voltage (kV): Max. 10
External Injection: axial
Buncher Type: saw tooth(1,2,3f)
Injection Energy (MeV/n):
Component: solenoid, spiral inflector
Injection Efficiency (%): 20-30
Injector:

(d)Extraction
Elements, Characteristic: electrostatic deflector, magnetic channel,passive focusing channel efficiency
Typical Efficiency (%): 40
Best Efficiency (%): 70

(e)Vacuum
Pumps: 1500l/s TMP,400l/s cryogenic,6500l/s cryogenic
Achieved Vacuum (Pa): 1.5e-10

REFERENCES:
A.Goto et.al., Proc. 12th Int. Cyclo. Conf. (1989) p51; A.Goto et.al., ibid, (1989) p439

EXPERIMENTAL FACILITIES

ENTRY NO: C25
Date: Feb. 12, 2008
Machine Name: RIKEN RING CYCLOTRON
Institution: RIKEN
Address: WAKO, SAITAMA 351-0198, Japan
Telephone: +81-48-462-1111
Fax: +81-48-461-5301
Web Address: http://www.rarf.riken.go.jp
Person in Charge of Cyclotron: Kase, M.
Person Reporting Information: Kase, M.
E-mail Address: mkase@riken.jp

HISTORY
Designed by: RIKEN
Construction Dates: 1980-1986
First Beam Date: Dec 16, 1986
Characteristic Beams

ions	energy(MeV/N)	current(pps)	power(w)
p	210	2e11	60
d,12C,20Ne	135	1-3e12	
40Ar	95	4e11	300
40Ar	24	1.3e13	2000
136Xe	26	6e11	350

Transmission Efficiency (source to extracted beam)
Typical (%): 70
Best (%): 90
Emittance
Emittance Definition: RMS
Vertical (pi mm mrad): 0.7
Horizontal (pi mm mrad): 0.7
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%): 51
Development (%): 4
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%): 24
Beam Tuning (%): 21
Total Time (h/year): 6730

TECHNICAL DATA
(a)Magnet
Type: straight sector
Kb (MeV): 540q**2/A**2
Kf (MeV):
Average Field (min./max. T): 0.97
Number of Sectors: 4
Hill Angular Width (deg.): 50
Spiral (deg.):
Pole Diameter (m):
Injection Radius (m): 0.89
Extraction Radius (m): 3.56
Hill Gap (m): 0.08
Valley Gap (m):
Trim Coils
Number: 26*4x2
Maximum Current (A-turns): 230-600
Harmonic Coils
Number: xNsectorsx2
Maximum Current (A-turns):
Main Coils
Number: 4x2
Total Ampere Turns: 128000
Maximum Current (A): 1072
Stored Energy (MJ):
Total Iron Weight (tons): 2100
Total Coil Weight (tons): 16
Power
Main Coils (total KW):
Trim Coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 18-45
Harmonic Modes: 5,9,10,11
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.):23.5
Voltage
At Injection (peak to ground, KV):
At Extraction (peak to ground, KV):
Peak (peak to ground, KV): 300
Line Power (max, KW): 300*2
Phase Stability (deg.): +-0.2
Voltage Stability (%): +-0.015

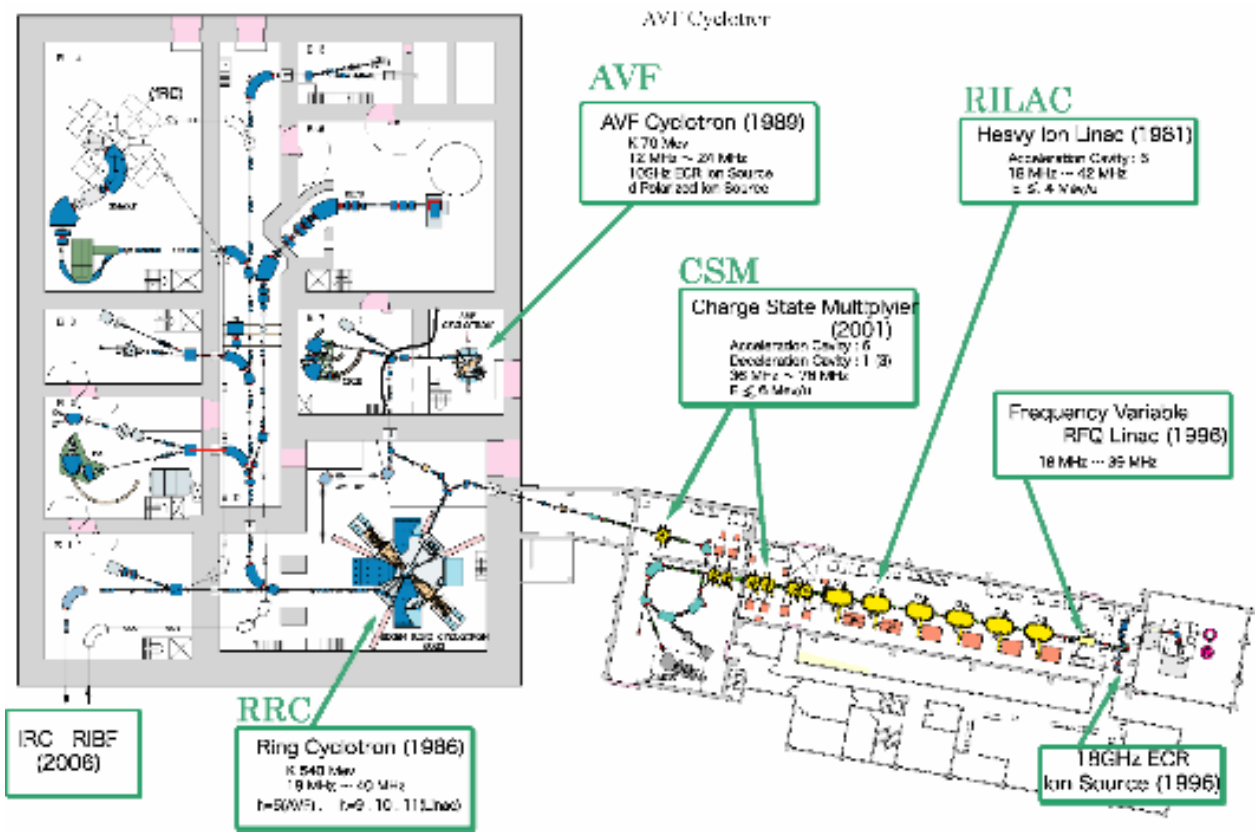
(c)Injection
Ion Source:
Source Bias Voltage (kV):
External Injection: radial
Buncher Type:
Injection Energy (MeV/n): 0.5-7
Component: magnetic channel, electrostatic channel
Injection Efficiency (%): 70
Injector: 715 cyclotron, heavy ion linac

(d)Extraction
Elements, Characteristic: electrostatic channel magnetic channel efficiency
Typical Efficiency (%): 80
Best Efficiency (%): 100

(e)Vacuum
Pumps: 5000l/s(cryogenic)*4,10000l/s(cryogenic)*10
Achieved Vacuum (Pa): 8e-11

REFERENCES
Y.Yano Proc. 13th Int. Cyclo. Conf. (1992)p.102.

EXPERIMENTAL FACILITIES
14 target stations: projectile fragment separator (RIPS) QQD-QD spectrometer (SMART)


AVF Cyclotron
AVF
AVF Cyclotron (1989)
RILAC
Heavy Ion Linac (1981)
CSM
Charge State Multiplier (2001)
Frequency Variable RFQ Linac (1996)
18 MHz ~ 38 MHz
IRC RIBF (2006)
RRC
Ring Cyclotron (1986)
18GHz ECR Ion Source (1996)

ENTRY NO: C26
Date: Feb. 12, 2008
Machine name: fixed-frequency Ring Cyclotron
Institution: RIKEN Nishina Center
Address: Wako, Saitama 351-0198, Japan
Telephone: +81-48-462-1111
Fax: +81-48-461-5301
Web Address: http://www.nishina.riken.jp
Person in Charge of Cyclotron: Kase, M.
Person Reporting Information: Kase, M.
E-mail Address: mkase@riken.jp

HISTORY
Designed by: RIKEN
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 2002-2006
First beam date: Sep. 29th, 2006
Characteristic beam, energy and current:
238U71+ 50.2MeV/n 2.8pnA
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%): 88
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development():
Therapy();
Isotope production ():
Other application ( ) :
Maintenance ():
Beam tuning():
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:** straight sector
Kb: 570*q^2/A^2 **Kf:**
Average field (min./max. T): 1.68
Number of magnet sectors: 4
hill angular width (deg.): 58
spiral (max):
Pole parameters
Diameter:
Injection radius (m): 1.55
Extraction radius (m): 3.30
Hill gap (m): 0.05 **Valley gap (m):**
Trim coils
Number: 10*2*4
Maximum current (A-turns): 100, 200
Harmonic coils
Number: *Nsectors*2
Maximum current (A-turns):
Main coils
Number: 2*4
Total current (A-turns): 650*70*2*4
Maximum current (A): 650
Stored energy (MJ):
Total iron weight (tons): 1480
Total coil weight (tons):
Power
Main coils (total KW): 240
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 54.75
Harmonic modes: 12
Number of dees: 2 (main) + 1 (flattop)
Number of cavities: 2 (main) + 1 (flattop)
Dee angular width (deg.):
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 500 (main), 180 (flattop)
Line Power (max, KW): 100 (main), 30 (flattop)
Phase Stability (deg.): +-0.1
Voltage Stability (%): +-5E-2

(c) Injection
Ion Source:
Source Bias Voltage (kV):
External Injection: radial
Buncher Type:
Injection Energy (MeV/n): 10.4
Component: magnetic channel, electrostatic channel
Injection Efficiency (%):
Injector: RRC

(d) Extraction
Elements, Characteristic: magnetic channel, electrostatic channel
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps: cryopumps(10m^3/s)*6
Achieved Vacuum (Pa): 1.5E-6

REFERENCES:
T. Mitumoto et al., Proc. 17th Int. Conf. on Cyclotrons and Their Applications (2005) 384.

EXPERIMENTAL FACILITIES

ENTRY NO: C27
Date: Feb. 12, 2008
Machine name: Intermediate-stage Ring Cyclotron
Institution: RIKEN Nishina Center
Address: Wako, Saitama 351-0198, Japan
Telephone: +81-48-462-1111
Fax: +81-48-461-5301
Web Address: http://www.nishina.riken.jp
Person in Charge of Cyclotron: Kase, M.
Person Reporting Information: Kase, M.
E-mail Address: mkase@riken.jp

HISTORY
Designed by: RIKEN
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 1998-2006
First beam date: Nov. 25th, 2006
Characteristic beam, energy and current:
86Kr34+ 114MeV/n
238U86+ 114MeV/n
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%): 67
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development():
Therapy();
Isotope production ():
Other application ( ) :
Maintenance ():
Beam tuning():
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type: straight sector**
Kb: 980q^2/A^2 **Kf:**
Average field (min./max. T): 1.9
Number of magnet sectors: 4
hill angular width (deg.): 53
spiral (max):
Pole parameters
Diameter:
Injection radius (m): 2.77
Extraction radius (m): 4.15
Hill gap (m): 0.08 **Valley gap (m):**
Trim coils
Number: 20*4*2
Maximum current (A-turns): 400, 500, 600
Harmonic coils
Number: *Nsectors*2
Maximum current (A-turns):
Main coils
Number: 6 + 5
Total current (A-turns): 450*396
Maximum current (A): 450A
Stored energy (MJ):
Total iron weight (tons): 2800
Total coil weight (tons):
Power
Main coils (total KW): 100
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 18-40.5 (main), 72-121.5 (flattop)
Harmonic modes: 7
Number of dees: 2 (main) + 1 (flattop)
Number of cavities: 2 (main) + 1 (flattop)
Dee angular width (deg.):
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 600 (main), 150 (flattop)
Line Power (max, KW): 150 (main),
Phase Stability (deg.): +-0.1
Voltage Stability (%): +-5E-2

(c) Injection
Ion Source:
Source Bias Voltage (kV):
External Injection: radial
Buncher Type:
Injection Energy (MeV/n): 45.9
Component: magnetic channel, electrostatic channel
Injection Efficiency (%):
Injector: RRC, fRC

(d) Extraction
Elements, Characteristic: magnetic channel, electrostatic channel
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps: cryopumps(10m^3/s)*12, cryopumps(4m^3/s)*2, TMP
Achieved Vacuum (Pa): 1.0E-6

REFERENCES:
J. Ohnishi et al., Proc. 17th Int. Conf. on Cyclotrons and Their Applications (2005) 197.

ENTRY NO: C28
Date: Feb. 12, 2008
Machine name: Superconducting Ring Cyclotron
Date: Feb. 12, 2008
Machine name: fixed-frequency Ring Cyclotron
Institution: RIKEN Nishina Center
Address: Wako, Saitama 351-0198, Japan
Telephone: +81-48-462-1111
Fax: +81-48-461-5301
Web Address: http://www.nishina.riken.jp
Person in Charge of Cyclotron: Kase, M.
Person Reporting Information: Kase, M.
E-mail Address: mkase@riken.jp

HISTORY
Designed by: RIKEN
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 2001-2006
First beam date: Dec 28, 2006
Characteristic beam, energy and current:
86Kr34+ 345MeV/n 32pnA
238U86+ 345MeV/n 0.2pnA
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%): 63
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development():
Therapy();
Isotope production ():
Other application ( ) :
Maintenance ():
Beam tuning():
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type: straight sector**
Kb: 2600q^2/A^2 **Kf:**
Average field (min./max. T): 3.8
Number of magnet sectors: 6
hill angular width (deg.): 25
spiral (max):
Pole parameters
Diameter:
Injection radius (m): 3.56
Extraction radius (m): 5.36
Hill gap (m): **Valley gap (m):**
Trim coils
Number: 4*2*6 (Superconducting), 22*2***6 (Normal)**
Maximum current (A-turns): 300**0,**
Harmonic coils
Number: *Nsectors*2
Maximum current (A-turns):
Main coils
Number: 2*6
Total current (A-turns): 5000*396*2*6
Maximum current (A): 5000
Stored energy (MJ): 235
Total iron weight (tons): 8300
Total coil weight (tons):
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW): 700

(b) RF
Frequency range (MHz): 18-38
Harmonic modes: 6
Number of dees: 4 (main) + 1 (flattop)
Number of cavities: 4 (main) + 1 (flattop)
Dee angular width (deg.):
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 600 (main),
Line Power (max, KW): 150 (main),
Phase Stability (deg.): +-0.1
Voltage Stability (%): +-5E-2

(c) Injection
lon Source:
Source Bias Voltage (kV):
External Injection: radial
Buncher Type:
Injection Energy (MeV/n): 114
Component: magnetic channel, electrostatic channel
Injection Efficiency (%):
Injector: RRC, IRC

(d) Extraction
Elements, Characteristic: magnetic channel, electrostatic channel
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps: 16*cryopump(10m^3/s), 2*cryopumps(2.3m^3/s), TMP
Achieved Vacuum (Pa): 3.0E-6

REFERENCES:
H. Okuno et al., Proc. 17th Int. Conf. on Cyclotrons and Their Applications (2005) 373.

ENTRY N° C29
Date: 12 November 2007
Machine name: AGOR
Institution: Kernfysisch Versneller Instituut (KVI)
Address: Zernikelaan 25, 9747AA Groningen, the Netherlands
Telephone: +31503633599
Fax: +31503634003
Web Address: www.kvi.nl
Person in charge of cyclotron: dr. S. Brandenburg
Person reporting information: dr. S. Brandenburg
E-mail address: brandenburg@kvi.nl

HISTORY
Designed by: IPN Orsay (France) and KVI
Constructed by: IPN Orsay (France) and KVI
Construction dates: 1986-1994 design and construction IPN Orsay; 1994 - 1995 transport and reassembly at KVI
First beam: april1994 IPN Orsay; january 1996 KVI
Characteristic beam, energy and current:

protons	120 - 190 MeV	6e12 pps
Q/A = 0.5	35 - 90 MeV	6e11 pps
Q/A = 0.25	10 - 30 MeV	6e12 pps
Q/A = 0.1	6 MeV	6e11 pps

Transmission efficiency (source to extracted beam)
Typical (%): 15 %
Best (%): 30 % for protons and α-particles
Emittance
Emittance definition: FWHM
Vertical (pi mm mrad): 6
Horizontal (pi mm mrad): 3
Longitudinal (dE/E[%] x RF[deg.]): 0.2 % x 15 °RF

USES
Basic research (%): 60 %
Development(%): 10 %
Therapy(%) : 0 %
Isotope production (%): 0 %
Other application (%) : 10 %
Maintenance (%): 15 %
Beam tuning(%): 10 %
Total time (h/year): 3000 hours/year

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 600 **Kf:** 200
Average field (min./max. T): 1.7 - 4.1 T
Number of magnet sectors: 3
hill angular width (deg.): 54°
spiral (max): 70°
Pole parameters
Diameter: 1.9 m
Injection radius (m): 0.015 m
Extraction radius (m): 0.89 m
Hill gap (m): 0.07 m **Valley gap (m):** 1.68 m
Trim coils
Number: 15 sets of six coils (on each hill sector)
Maximum current (A-turns): 3000 A-turns
Harmonic coils
Number: 4 sets
Maximum current (A-turns): 3000 A turns
Main coils
Number: 2
Total current (A-turns): 5.1e6 and 1.2 e6
Maximum current (A): 1800 and 900
Stored energy (MJ): 56
Total iron weight (tons): 330
Total coil weight (tons): 30 incl. cryostat
Power
Main coils (total kW): < 1 kW
Trim coils (total, maximum, kW): 30 kW
Refrigerator (cryogenic, kW): electric power 250 kW; cooling power 50 W at 4 K and 600 W at 80 K, additional liquid He production 50 liter/hour

(b) RF
Frequency range (MHz): 24 - 62 MHz
Harmonic modes: 2; 3 and 4
Number of dees: 3
Number of cavities: 3
Dee angular width (deg.): 60°
Voltage
at injection (peak to ground, kV): 80 kV
at extraction (peak to ground, kV): 100 kV
peak (peak to ground, kV): 100 kV
Line Power (max, KW): <60 kW per cavity
Phase Stability (deg.): 0.1°
Voltage Stability (%): 10^{-4}

(c) Injection
Ion Source: multicups for protons, 14.5 GHz ECR for heavy ions, polarized protons and deuteron source
Source Bias Voltage (kV): 10 -35 kV
External Injection: axial
Buncher Type: double gap sinusoidal
Injection Energy (MeV/n): 0.002 - 0.03
Component:
Injection Efficiency (%): 30 %

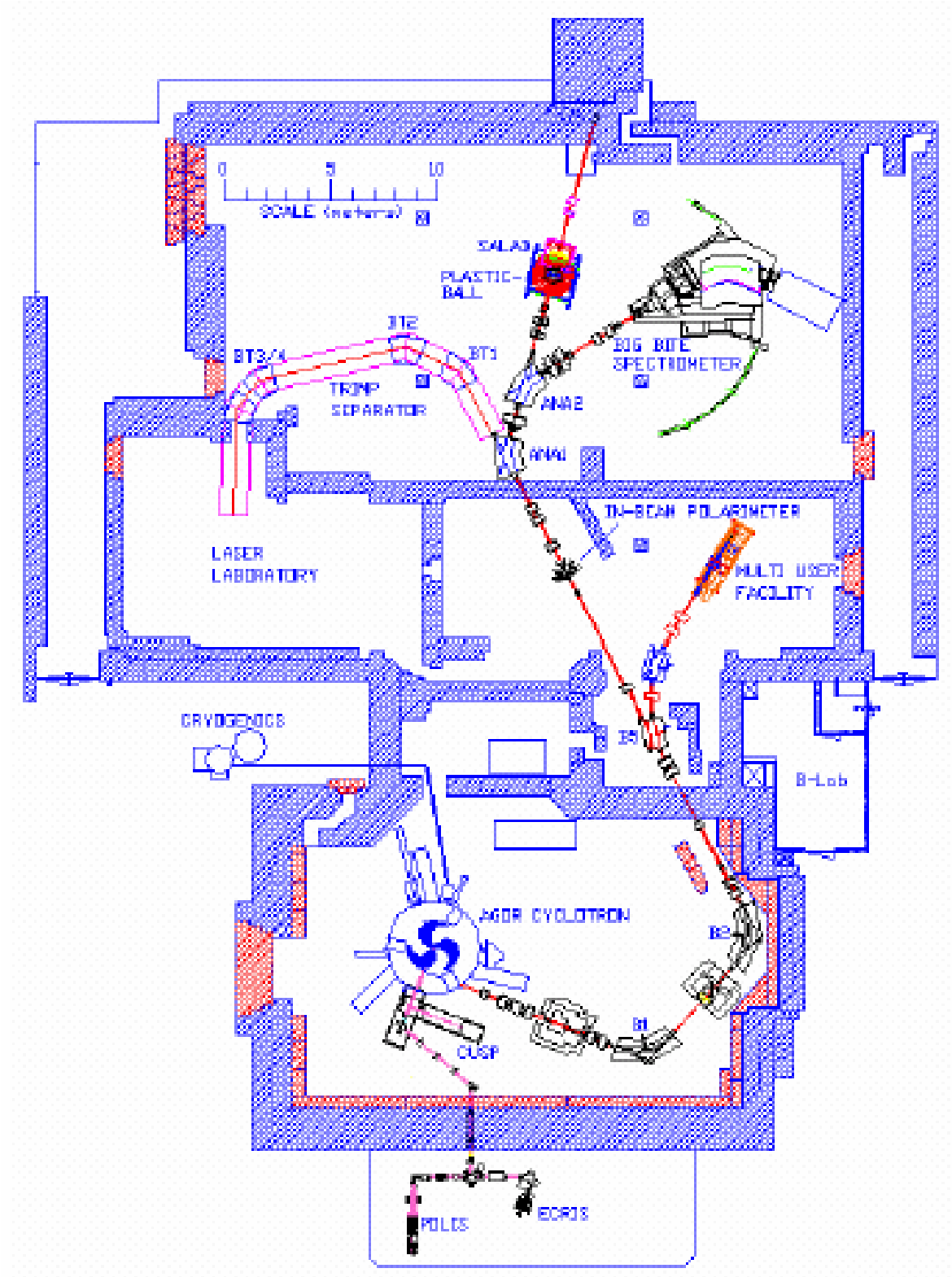
(d) Extraction
Elements, Characteristic:
ESD; electrostatic; 4 movements; 55 kV; 10.5 MV/m
EMC1; electromagnetic; room temperature;
EMC2; electromagnetic; superconducting;
QPOLE; electromagnetic; superconducting;
Typical Efficiency (%): 70 %
Best Efficiency (%): 90 %

(e) Vacuum
Pumps: 2 1500 l/s turbo molecular pumps; 3 1000 l/s cryogenic pumps
Achieved Vacuum (Pa): 3 x 10^{-5}

REFERENCES: H.W. Schreuder et al.; Proc. 15th Conf. on Cyclotrons and their Applications, IOP Bristol (1999) pg. 592 and references therein

EXPERIMENTAL FACILITIE

QQD magnetic spectrometer + focal plane polarimeter fragment separator + low energy setup irradiation setup scattering chamber diameter 1.2 m



ENTRY N° C30
Date: 06-02-2008
Machine name: C-30
Institution: SINS (A. Sołtan Institute for Nuclear Studies)
Address: 05-400 Otwock-Świerk
Telephone: +48 22 718 0554
Fax: +48 22 7793481
Web Address:
Person in charge of cyclotron: dr E.Pławski
Person reporting information: dr E.Pławski
E-mail address: plawski@ipj.gov.pl

HISTORY
Designed by: 1983
Constructed by:
Construction dates: time 6 years
First beam date: 1989 (1991-full energy)
Characteristic beam, energy and current:
H^-, 28 MeV
Transmission efficiency (source to extracted beam)
Typical (%): 80%
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 90%
Development(%):
Therapy(%) :
Isotope production (%): 10%
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year): 500h/y

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 30 MeV/A **Kf:** 50 MeV/A
Average field (min./max. T):
Number of magnet sectors: 4
hill angular width (deg.): 45º
spiral (max): 0
Pole parameters
Diameter: 1.05 m
Injection radius (m):
Extraction radius (m): 0.42 max
Hill gap (m): 0.02 **Valley gap (m):** 0.1
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number: 2
Total current (A-turns): 164000
Maximum current (A): 300
Stored energy (MJ):
Total iron weight (tons): 38
Total coil weight (tons): 1.38
Power
Main coils (total KW): 65
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 52.3
Harmonic modes: 2
Number of dees: 2
Number of cavities:
Dee angular width (deg.): 45º
Voltage
at injection (peak to ground, KV): 50
at extraction (peak to ground, KV): 48
peak (peak to ground, KV):
Line Power (max, KW): RF=25KW in pulse
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source: internal PIG
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: stripping on Al foil
Typical Efficiency (%): 80%
Best Efficiency (%):

(e) Vacuum
Pumps: 2* 2500l/s, oil diffusion pumps
Achieved Vacuum (Pa):

REFERENCES:
Nukleonika 2007;52(1);3-5
Nukleonika 2007;52(1);17-27

COMMENTS
Cyclotron RF is operated in pulse mode.

ENTRY N° C31
Date: 9 Nov 2007
Machine name: U-200P
Institution: University of Warsaw, Heavy Ion Laboratory
Address: Pasteura 5 A, 02-093 Warszawa, Poland
Telephone: +48 (22) 8222 123, +48 (22) 55 46 342
Fax: +48 (22) 659 27 14
Web Address: www.slcj.uw.edu.pl
Person in Charge of Cyclotron: Jaroslaw Choinski
Person Reporting Information: Jaroslaw Choinski
E-mail Address: jch@nov.slcj.uw.edu.pl

HISTORY
Designed by: Designed based on Dubna U-200 cyclotron modified and put into operation by the Heavy Ion Laboratory staff
Constructed by: the staff of: the Heavy Ion Laboratory (HIL), the Institute of Nuclear Research (INS) in Swierk, the Joint Institute for Nuclear Research (JINR) in Dubna
Construction Dates: 1988-1992
First Beam Date: Nov. 1993 (internal beam), Apr. 1994 (extracted beam)
Characteristic Beams
Ion / Energy [MeV] / Extracted current [enA]
11B+2 55 20
12C+3 112 80
16O+3 80 1400
20Ne+5 190 100
40Ar+7 172 40
Transmission Efficiency (source to extracted beam)
Typical (%): 2%
Best (%): 17%
Emittance
Emittance Definition: RMS
Vertical (pi mm mrad): ~32
Horizontal (pi mm mrad): ~34
Longitudinal (dE/E[%] x RF[deg.]): 1% x 30 deg. (harmonic number dependent)

USES
Basic Research (%): 75
Development (%): 10
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%): 10
Beam Tuning (%): 5
Total Time (h/year): ~3000

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV): max. 160
Kf (MeV): 35
Average Field (min./max. T): 1.7 / 2.7
Number of Sectors: 4
Hill Angular Width (deg.): 42
Spiral (deg.):
Pole Diameter (m): 2
Injection Radius (m): 0.04
Extraction Radius (m): 0.60 - 0.86
Hill Gap (m): 0.026
Valley Gap (m): 0.15
Trim Coils
Number: 10
Maximum Current (A-turns): 600
Harmonic Coils
Number:
Maximum Current (A-turns):
Main Coils
Number: 1
Total Ampere Turns: 546000
Maximum Current (A): 1200
Stored Energy (MJ):
Total Iron Weight (tons): 240
Total Coil Weight (tons):
Power
Main Coils (total KW): 300
Trim Coils (total, maximum, KW): 30
Refrigerator (cryogenic, KW): 3 x 5.5

(b)RF
Frequency Range (MHz): 12 - 20
Harmonic Modes: 1, 2, 3, 4, 5, 6
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.): 45
Voltage
At Injection (peak to ground, KV): 70
At Extraction (peak to ground, KV): 67
Peak (peak to ground, KV): 70
Line Power (max, KW): 60
Phase Stability (deg.): 1
Voltage Stability (%): 1.4

(c)Injection
Ion Source: ECR
Source Bias Voltage (kV): 11
External Injection: axial
Buncher Type: sine wave
Injection Energy (MeV/n): beam dependent
Component:
Injection Efficiency (%): 70
Injector: electrostatic mirror

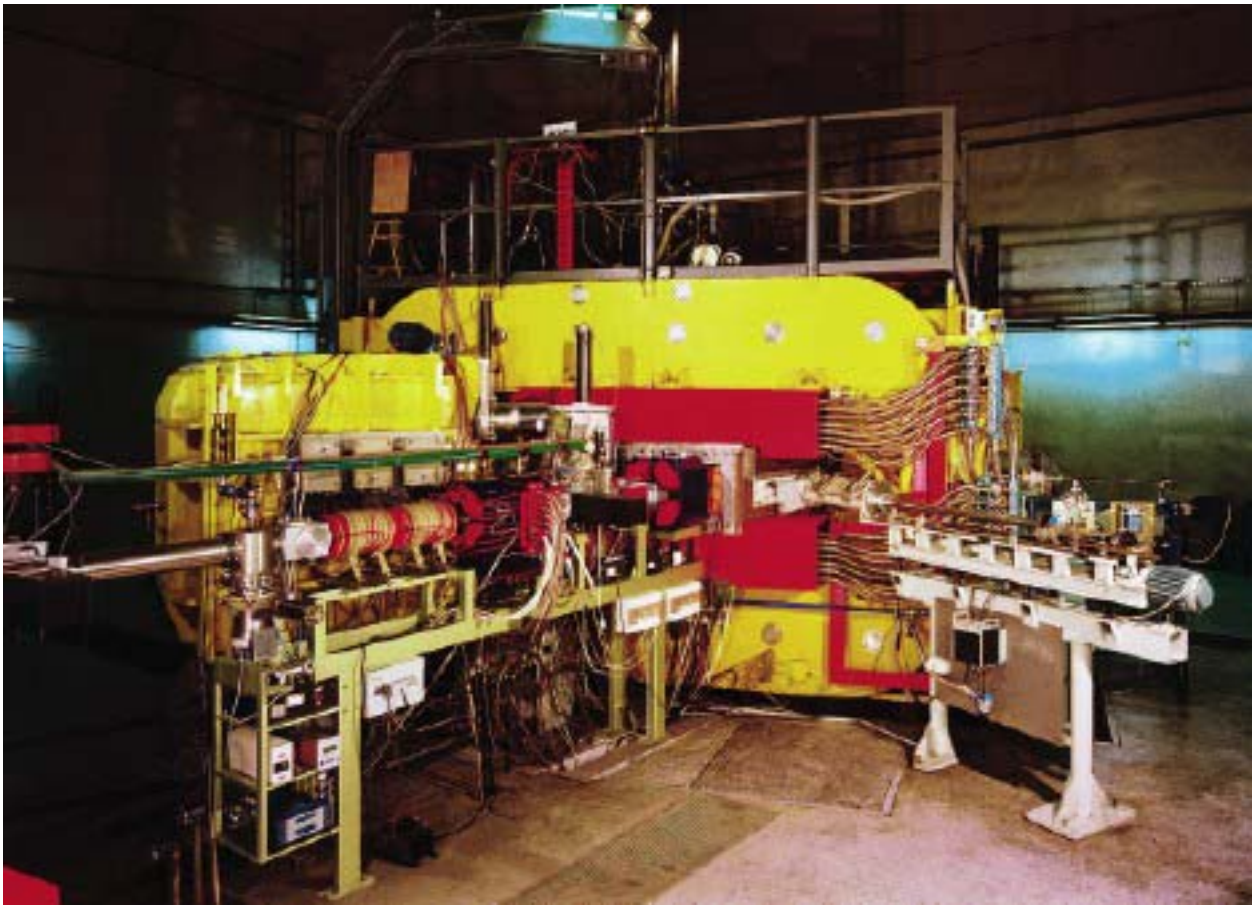
(d)Extraction
Elements, Characteristic: stripper, adjustable
Typical Efficiency (%): beam and charge state dependent
Best Efficiency (%): 87

(e)Vacuum
Pumps: cryogenic
Achieved Vacuum (Pa): 0.000133

REFERENCES:
FINUPHY, Handbook on Interdisciplinary Use of European Nuclear Physics Facilities, 2004, pp. 163-172

EXPERIMENTAL FACILITIES

- "JANOSIK", a multidetector system to study Giant Dipole Resonances.
- "OSIRIS II", a ball consisting of 12 BGO-shielded high-purity Ge detectors.
- "CUDAC", Coulomb Excitation chamber equipped with an array of silicon detectors-PIN diodes.
- "IGISOL", Scandinavian-type ion guide separator on-line.
- Large universal 80 cm scattering chamber, "SYRENA".
- Internal and external irradiation chambers for material research with target cooling possibilities.



ENTRY NO: C32
Date: 12 Feb 2008
Machine Name: U-200
Institution: FLNR JINR
Address: 141980 Moscow region, Dubna, Joliot Curie 6, Russia
Telephone: +7 (09621) 62261
Fax: +7 (09621) 65083
Web Address: www.jinr.ru
Person in Charge of Cyclotron: Yu.Ts.Oganesian
Person Reporting Information: G.G. Gulbekian
E-mail Address: post@flnr.jinr.ru

HISTORY
Designed by: FLNR JINR
Construction Dates: 1966-67
First Beam Date: 1968
Characteristic Beams

ions	energy(MeV/N)	current(pps)	power(W)
4He1+	9	3x10+14	1800
12C3+	9	3x10+13	540

Transmission Efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance Definition:
Vertical (pi mm mrad): 10
Horizontal (pi mm mrad): 30
Longitudinal (dE/E[%] x RF[deg.]): 1%

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%): 50
Other Application (%): 50
Maintenance (%):
Beam Tuning (%):
Total Time (h/year): 500

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV):
Kf (MeV):
Average Field (min./max. T): 2/1.93
Number of Sectors: 4
Hill Angular Width (deg.): 45
Spiral (deg.):
Pole Diameter (m): 2
Injection Radius (m):
Extraction Radius (m):
Hill Gap (m): 0.03
Valley Gap (m): 0.15
Trim Coils
Number: 7x2
Maximum Current (A-turns):
Harmonic Coils
Number: 2xNsectorsx2
Maximum Current (A-turns):
Main Coils
Number: 1x2
Total Ampere Turns: 3.6x10 5
Maximum Current (A): 1300
Stored Energy (MJ):
Total Iron Weight (tons):
Total Coil Weight (tons):
Power
Main Coils (total KW): 350
Trim Coils (total, maximum, KW): 20
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 12-21.8
Harmonic Modes: 2-4
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.):42
Voltage
At Injection (peak to ground, KV):
At Extraction (peak to ground, KV):
Peak (peak to ground, KV): 75
Line Power (max, KW): 180-240
Phase Stability (deg.):
Voltage Stability (%): 1

(c)Injection
Ion Source: PIG
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d)Extraction
Elements, Characteristic: Stripping foil
Typical Efficiency (%):
Best Efficiency (%):

(e)Vacuum
Pumps: oil pumps
Achieved Vacuum (Pa): 2.7e-4

REFERENCES
1.Entry NC43 in Proc. of the 13th Int. Conf.,Cyclotrons and Their Applications, Vancoover,1992,p. 821
2.Gikal B.N. in JINR Preprint 9-83-311,1983

ENTRY NO: C33
Date: 12 Feb 2008
Machine Name: U-400M
Institution: FLNR JINR
Address: 141980 Moscow region, Dubna, Joliot Curie 6, Russia
Telephone: +7 (09621) 62261
Fax: +7 (09621) 65083
Web Address: www.jinr.ru
Person in Charge of Cyclotron: Yu. Ts. Oganessian
Person Reporting Information: G. G. Gulbekian
E-mail Address: post@flnr.jinr.ru

History
Designed by: FLNR JINR
Construction Dates: 1987-1990
First Beam Date: 1991
Characteristic Beams

ions	energy(MeV/N)	current(pps)	power(W)
7Li2+	35	6*10 E13	2350
11B3+	32	4*10 E13	225
12C4+	47	4*10 E13	3610
18O5+	33	2.5*10 E13	2376
36S10+	33	6*10 E11	114
40Ar12+	40	7*10 E11	180

Transmission Efficiency (source to extracted beam)
Typical (%): 20
Best (%):
Emittance
Emittance Definition:
Vertical (pi mm mrad): 17
Horizontal (pi mm mrad): 50
Longitudinal (dE/E[%] x RF[deg.]): 0.5%

USES
Basic Research (%): 60
Development (%): 20
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%): 10
Beam Tuning (%): 10
Total Time (h/year): 3000

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV):
Kf (MeV):
Average Field (min./max. T): 1.95
Number of Sectors: 4
Hill Angular Width (deg.): 45
Spiral (deg.): 40 deg
Pole Diameter (m): 4
Injection Radius (m):
Extraction Radius (m): 1.75
Hill Gap (m): 0.1
Valley Gap (m): 0.5
Trim Coils
Number: 15x2
Maximum Current (A-turns):
Harmonic Coils
Number: 5xNsectorsx2
Maximum Current (A-turns):
Main Coils
Number: 1x2
Total Ampere Turns: 1.26*10 6
Maximum Current (A): 2500
Stored Energy (MJ):
Total Iron Weight (tons): 2100
Total Coil Weight (tons): 115
Power
Main Coils (total KW): 750
Trim Coils (total, maximum, KW): 120
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 15 - 25
Harmonic Modes: 2-4
Number of Dees: 4
Number of Cavities: 4
Dee Angular Width (deg.):
Voltage
At Injection (peak to ground, KV):
At Extraction (peak to ground, KV):
Peak (peak to ground, KV): 150
Line Power (max, KW): 4x100
Phase Stability (deg.):
Voltage Stability (%): 0.1

(c)Injection
Ion Source: ECR DECRIS14-2
Source Bias Voltage (kV):
External Injection: axial
Buncher Type: sine
Injection Energy (MeV/n):
Component:
Injection Efficiency (%): 20
Injector:

(d)Extraction
Elements, Characteristic: Stripping foil
Typical Efficiency (%): 70
Best Efficiency (%):

(e)Vacuum
Pumps: 6 oil pumps with nitrogen traps
Achieved Vacuum (Pa): 4*10-5
REFERENCES 1. Entry NC44 in Proc. of the 13th Int. Conf.,Cyclotrons and Their Application, Vancouver, 1992, p.822
2.B.Gikal, G.Gulbekian, V.Kutner in Proc. of Int. Conf., Cyclotrons and Their Application, Caen, 1998, pp. 587-591
EXPERIMENTAL FACILITIES
COMBAS, FOBOS, ACCULINNA, DRIBs

ENTRY NO: C34
Date: 12 Feb 2008
Machine Name: U-400
Institution: FLNR JINR
Address: 141980 Moscow region, Dubna, Joliot Curie 6, Russia
Telephone: +7 (09621) 62261
Fax: +7 (09621) 65083
Web Address: www.jinr.ru
Person in Charge of Cyclotron: Yu. Ts. Oganessian
Person Reporting Information: G. G. Gulbekian
E-mail Address: post@flnr.jinr.ru

HISTORY
Designed by: FLNR JINR
Construction Dates: 1975-1978
First Beam Date: 16.10.78
Characteristic Beams

ions	energy(MeV/N)	current(pps)	power(W)
7Li1+	8,6	6 x 10 E13	578
22Ne2+	4,5	2 x 10 E13	317
48Ca5+	5,4	7 x 10 E12	207
84Kr8+	3	6,3 x 10 E11	25
208Bi19+	3,4	3,6 x 10 E10	4

Transmission Efficiency (source to extracted beam)
Typical (%): 35
Best (%): 60
Emittance
Emittance Definition:
Vertical (pi mm mrad): 40
Horizontal (pi mm mrad): 80
Longitudinal (dE/E[%] x RF[deg.]): 1 %

USES
Basic Research (%): 70
Development (%): 8
Therapy (%):
Isotope Production (%):
Other Application (%): 12
Maintenance (%): 9
Beam Tuning (%): 1
Total Time (h/year): 5000

TECHNICAL DATA

(a)Magnet
Type: compact
Kb (MeV):
Kf (MeV):
Average Field (min./max. T): 21.1/ 1.98
Number of Sectors: 4
Hill Angular Width (deg.): 45
Spiral (deg.): 0
Pole Diameter (m): 4
Injection Radius (m): 0,05
Extraction Radius (m): 1,2 - 1,8
Hill Gap (m): 0,042
Valley Gap (m): 0,3
Trim Coils
Number: 10x2
Maximum Current (A-turns): 500 A
Harmonic Coils
Number: 4xNsectorsx2
Maximum Current (A-turns): 500 A
Main Coils
Number: 1x2
Total Ampere Turns:
Maximum Current (A): 2500
Stored Energy (MJ):
Total Iron Weight (tons): 2100
Total Coil Weight (tons):
Power
Main Coils (total KW): 850
Trim Coils (total, maximum, KW): 56
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 5,42-12,2
Harmonic Modes: 2
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.):42
Voltage
At Injection (peak to ground, KV): 25
At Extraction (peak to ground, KV):
Peak (peak to ground, KV): 80
Line Power (max, KW): 140
Phase Stability (deg.):
Voltage Stability (%):

(c)Injection
Ion Source: ECR4M
Source Bias Voltage (kV): 0,2
External Injection: axial
Buncher Type: linear, since
Injection Energy (MeV/n):
Component: selenoids
Injection Efficiency (%): 20-60
Injector:

(d)Extraction
Elements, Characteristic: Stripping foil efficiency
Typical Efficiency (%): 25-100
Best Efficiency (%):

(e)Vacuum
Pumps: 5 oil pumps with nitrogen traps
Achieved Vacuum (Pa): 2,7 x 10 -5

REFERENCES
1. Yu. Ts. Oganessian et al. in Proc. of IVAll-Union Accelerator Conf., Dubna, 1985 pp. 47-53
2. Yu. Ts.Oganessian et al. in FLNR Scientific Report 1995 - 1996, Dubna,1997 pp. 267-276
3. Yu. Ts. Oganessian, G.G. Gulbekyan, B.N. Gikal, I.V. Kalagin et al. in Proc. of APAC 2004 Int. Conf., Gyeongju, Korea, 2004 pp. 52-54

EXPERIMENTAL FACILITIES
VASSILISSA, GFRS, CORSET - DEMON, U-600, MSP-144, DRIBs

ENTRY NO: C35
Date: 12 Feb 2008
Machine Name: IC-100
Institution: FLNR JINR
Address: 141980 Moscow region, Dubna, Joliot Curie 6, Russia
Telephone: +7 (09621) 62261
Fax: +7 (09621) 65083
Web Address: www.jinr.ru
Person in Charge of Cyclotron: Yu. Ts. Oganessian
Person Reporting Information: G. G. Gulbekian
E-mail Address: post@flnr.jinr.ru

HISTORY
Designed by: FLNR JINR
Construction Dates: 2003 - 2005
First Beam Date: 2006
Characteristic Beams

ions	energy(MeV/N)	current(pps)	power(W)
40Ar7+	1.1	1.8*10E12	13
86Kr15+	1.1	8.5*10E11	13
132Xe23+	1.1	3*10E11	7

Transmission Efficiency (source to extracted beam)
Typical (%): 7
Best (%): 8
Emittance
Emittance Definition:
Vertical (pi mm mrad): 25
Horizontal (pi mm mrad): 25
Longitudinal (dE/E[%] x RF[deg.]): 2%

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year):

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV):
Kf (MeV):
Average Field (min./max. T): 1.78 - 1.93
Number of Sectors: 4
Hill Angular Width (deg.): 56
Spiral (deg.): 0
Pole Diameter (m): 1.05
Injection Radius (m): 0.019
Extraction Radius (m): 0.47
Hill Gap (m): 0.02
Valley Gap (m): 0.11
Trim Coils
Number: x2
Maximum Current (A-turns):
Harmonic Coils
Number: xNsectorsx2
Maximum Current (A-turns):
Main Coils
Number: 1x2
Total Ampere Turns: 145000
Maximum Current (A): 575
Stored Energy (MJ):
Total Iron Weight (tons): 43
Total Coil Weight (tons):
Power
Main Coils (total KW): 94
Trim Coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 19.8 – 20.6
Harmonic Modes: 4;6
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.):34
Voltage
At Injection (peak to ground, KV): 12 - 15
At Extraction (peak to ground, KV): 35 - 50
Peak (peak to ground, KV): 50
Line Power (max, KW): 30
Phase Stability (deg.):
Voltage Stability (%):

(c)Injection
Ion Source: ECR DECRIS-SC
Source Bias Voltage (kV):
External Injection: axial
Buncher Type: sine
Injection Energy (MeV/n):
Component: Solenoids
Injection Efficiency (%): 25
Injector:

(d)Extraction
Elements, Characteristic: Deflector Magnetic channels efficiency
Typical Efficiency (%): 50 - 60
Best Efficiency (%):

(e)Vacuum
Pumps: Turbopumps
Achieved Vacuum (Pa): 4*10-6

REFERENCES
1. B. N. Gikal, S. N. Dmitriev, G. G. Gul'bekyan, P. Yu. Apel' et al., ISSN 1547-4771, Physics of Particles and Nuclei Letters, 2008, Vol. 5, No. 1, pp. 33–48.

ENTRY N° C36
Date: 5 Dec 2007
Machine name: Gatchina Isochronous Cyclotron
Institution: Petersburg Nuclear Physics Institute
Address: 188300 Gatchina, Leningrad district, Russia
Telephone: 8 813 71 30857
Fax: +7 813 71 30346
Web Address: http://www.pnpi.spb.ru/
Person in charge of cyclotron: N.K.Abrossimov
Person reporting information:G.A.Riabov
E-mail address: riabov@mail.pnpi.spb.ru

HISTORY
Designed by: 1990-1992, upgrade 2005-2006
Constructed by:
Construction dates: 1990-1992, 2007
First beam date:
Characteristic beam, energy and current:
H^-, 80 MeV, 100μA
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%):
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year):

TECHNICAL DATA
(a) Magnet: Iron **Type:** H-tipe
Kb: **Kf:**
Average field (min./max. T): 1.352, 1.465
Number of magnet sectors: 4
hill angular width (deg.): 42.75-51
spiral (max): 65
Pole parameters
Diameter: 2.05
Injection radius (m):
Extraction radius (m): 0.9
Hill gap (m): 0.170 **Valley gap (m):** 0.386
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number: 16
Maximum current (A-turns):
Main coils
Number: 2×210
Total current (A-turns): $3.15*10^5$
Maximum current (A): 750
Stored energy (MJ):
Total iron weight (tons): 220
Total coil weight (tons): 12.8
Power
Main coils (total KW): 120
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 41.2
Harmonic modes: 2
Number of dees: 2
Number of cavities:
Dee angular width (deg.): 60
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 60
Line Power (max, KW): 2*40
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source:
Source Bias Voltage (kV):
External Injection: axial
Buncher Type:
Injection Energy (MeV/n): 0.026
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: stripping
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps: 2 Cryo-pumps, 2*5000 l/s
Achieved Vacuum (Pa):

REFERENCES:
N.K.Abrossimov, G.A.Riabov
Construction of Gatchina Isochronous Cyclotron
PNPI XXX. High Energy Physics Division. Main Scientific Activities, 1997-2001. Gatchina 2002, p.15-26

EXPERIMENTAL FACILITIES
Medical isotope production. P-therapy of the ocular melanoma.

ENTRY N° C37

Date: 05.12.2007
Machine name: R7
Institution: SINP MSU, (Russia)
Address: SINP MSU, 1/2, Leninskie Gory, Moscow, Russia, 119991
Telephone: (095) 939-18-18
Fax: (095) 939- 08-96
Web Address: http:// www.sinp.msu.ru
Person in charge of cyclotron: E. Kiryanov
Person reporting information: E. Kiryanov
E-mail address: WG@anna19.sinp.msu.ru

HISTORY

Designed by: NII EFA, Leningrad, USSR
Constructed by: NII EFA, Leningrad, USSR
Construction dates:
First beam date: 1958
Characteristic beam, energy and current:
H_2^+, D^+, He_3^{++}, He_4^{++}; 7,5 MeV/nucleon, 10 μA
Transmission efficiency (source to extracted beam)
Typical (%): 20 - 50
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES

Basic research (%): 30
Development(%): 10
Therapy(%) : -
Isotope production (%): 15
Other applicationn (%) : 20
Maintenance (%): 15
Beam tuning(%): 10
Total time (h/year): 1400

TECHNICAL DATA

(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T): 15 T
Number of magnet sectors: -
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter: 120 cm
Injection radius (m): -
Extraction radius (m): 0,53
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number: 4
Maximum current (A-turns):
Main coils 430 A/ 336×2
Number:
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons): 120
Total coil weight (tons): 10
Power
Main coils (total KW): 60
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF

Frequency range (MHz): 11,6
Harmonic modes: 1, 3
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV): 40
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection

Ion Source:
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction

Elements, Characteristic:
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum

Pumps:
Achieved Vacuum (Pa): $7\ 10^{-4}$

REFERENCES:

Л.А. Саркисян, Е.Ф. Кирьянов, Ю.А. Воробьев. Вестн. МГУ, сер. физ. 1979 г., № 2, с.63.
Л.А. Саркисян, Е.Ф. Кирьянов, Ю.А. Воробьев. ПТЭ, №1, 1979, с.19

ENTRY N° C38
Date: November 1, 2007
Machine name: VINCY Cyclotron
Institution: TESLA Accelerator Installation, Laboratory of Physics, Vinča Institute of Nuclear Sciences
Address: P. O. Box 522, 11001 Belgrade, Serbia
Telephone: +381-11-244-7700 or +381-11-806-6521
Fax: +381-11-244-7963
Web address: http://www.tesla-sc.org
Person in charge of cyclotron: Dr. Nebojša Nešković, Head of TESLA Project
Person reporting information: Ms. Jelena Cagić, Scientific Secretary of TESLA Project
E-mail address: mjelena@vin.bg.ac.yu

HISTORY
Designed by: Vinča Institute of Nuclear Sciences, Belgrade, Serbia, and Joint Institute for Nuclear Research, Dubna, Russia
Constructed by: Vinča Institute of Nuclear Sciences, Belgrade, Serbia, and Joint Institute for Nuclear Research, Dubna, Russia
Construction dates: September 1992 – June 1998 and January 2008 – June 2009 (estimated)
First beam date: June 30, 2009 (estimated)
Characteristic beam, energy and current:
65 MeV H^+, 28 MeV $^4He^{2+}$, 120 MeV $^{40}Ar^{15+}$
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition: 90 %
Vertical (π mm mrad): 8-34 (estimated)
Horizontal (π mm mrad): 10-38 (estimated)
Longitudinal (dE/E (%) × RF (deg)):

USES
Basic research (%): 20 (planned)
Development (%): 10 (planned)
Therapy (%): 10 (planned)
Isotope production (%): 20 (planned)
Other application (%): 10 (planned)
Maintenance (%): 15 (planned)
Beam tuning (%): 15 (planned)
Total time (h/year): 5,000 (planned)

TECHNICAL DATA
(a) Magnet
Type: Compact
K_b: 134 MeV
K_f: 73 MeV
Average field (min.-max.) (T): 1.29-1.94
Number of magnet sectors: 4
Hill angular width (deg): 42
Spiral (max.)(deg): 0
Pole parameters
Diameter (m): 2
Injection radius (m): 0.033
Extraction radius (m): 0.84
Hill gap (m): 0.036
Valley gap (m): 0.19
Trim coils
Number: 2 × 10
Maximum current (A): 300
Number of Ampere-turns (A-turns): 48,600
Harmonic coils
Number: 2 × (4 + 4)
Maximum current (A): 300
Number of Ampere-turns (A-turns): 12,000
Main coils
Number: 2
Maximum current (A): 1,000
Number of Ampere-turns (A-turns): 512,000
Stored energy (MJ):
Total iron weight (t): 240.3
Total main coil weight (t): 22.5
Power
Main coils (KW): 131
Trim coils (KW): 36
Refrigerator (cryogenic) (KW):

(b) RF
Frequency range (MHz): 17-31
Harmonic modes: 1, 2, 3 and 4
Number of dees: 2
Number of cavities: 2
Dee angular width (deg): 34 (average)
Voltage
Injection (peak to ground) (KV): 100
Extraction (peak to ground) (KV): 96.3-88.5
Peak (peak to ground) (KV): 100
Line power (max.) (KW): 50
Phase stability (deg): ±0.5
Voltage stability (%): 0.05

(c) Injection
Ion source: volume positive or negative light ion source or electron cyclotron resonance heavy ion source
Source bias voltage (kV): 40 for pVINIS and 25 for nVINIS
External injection: axial
Buncher type: two-grid sinusoidal
Injection energy (MeV/n): 0.002 - 0.025
Component
Injection efficiency (%):
Injector:

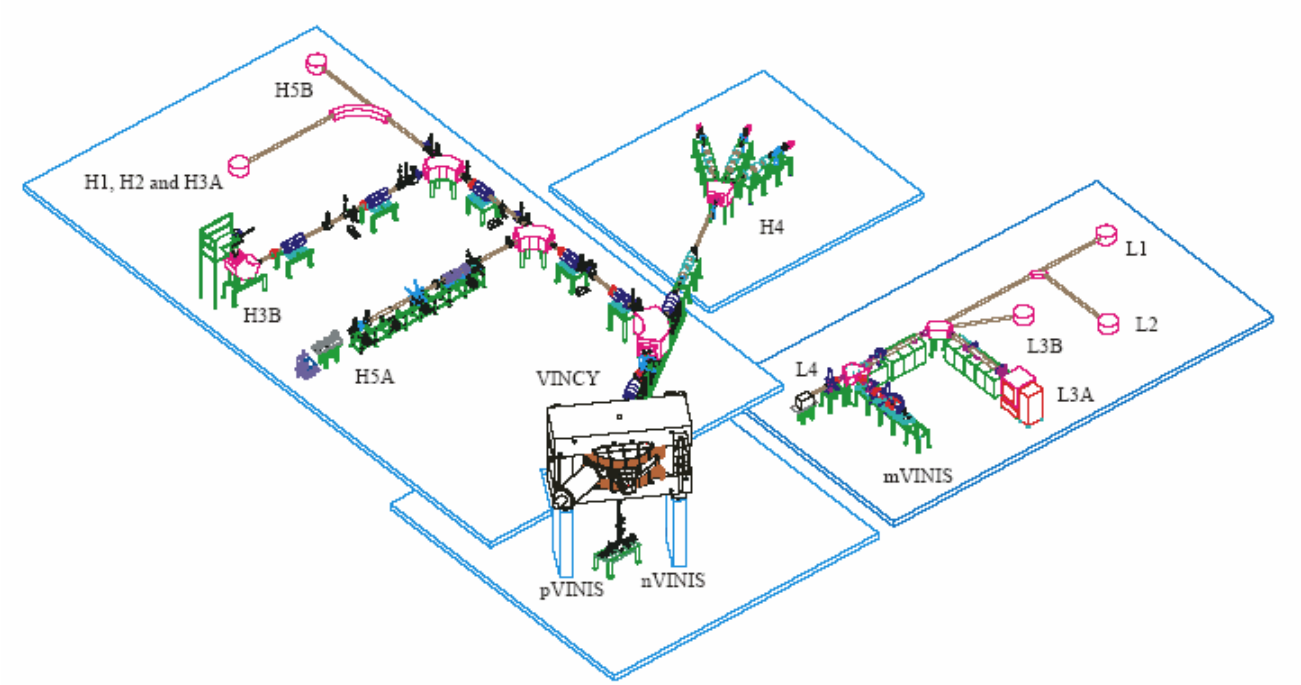
(d) Extraction
Elements: foil stripping, electrostatic deflection system
Typical efficiency (%):
Best efficiency (%):

(e) Vacuum
Pumps: two 10,000 l/s cryopumps, four 920 l/s turbopumps and one 210 l/s turbopump
Achieved vacuum (Pa): 3×10^{-5} (estimated)

REFERENCES: N. Nešković et al., Nukleonika 48, Suppl. 2 (2003) S135; N. Nešković et al., Proceedings of

the 17. Interantional Conference on Cyclotrons and their Applications (Particle Accelerator Society of Japan, Tokyo, 2005), p. 191.

EXPERIMENTAL FACILITIES: solid target irradiation systems for production of radionuclides, channel for production of radionuclides, channel for proton therapy, and channel for radiation research



Layout of the TESLA Accelerator Installation: VINCY Cyclotron, mVINIS Ion Source, nVINIS Ion Source, pVINIS Ion Source, L1 – channel for physics of multiply charged ions, L2 – channel for surface physics, L3A – channel for modification of materials, L3B – channel for analysis of materials, H1 – channel for nuclear spectroscopy, H2 – channel for heavy ion nuclear reactions, H3A – channel for physics of thin crystals, H3B – channel for radiation research, H4 – channel for production of radioisotopes, H5A – channel for proton therapy, and H5B – channel for neutron research.

ENTRY N° C39
Date: 23 October 2007
Machine name: iThemba LABS Injector Cyclotron 1
Institution: iThemba LABS
Address: PO Box 722, Somerset West, 7129, South Africa
Telephone: +27 21 8431000
Fax: +27 21 8433525
Web Address: http://www.tlabs.ac.za
Person in charge of cyclotron: JL Conradie
Person reporting information: JL Conradie
E-mail address: lowry@tlabs.ac.za

HISTORY
Designed by: National Accelerator staff
Constructed by: National Accelerator staff
Construction dates: 1978 - 1983
First beam date: December 1983
Characteristic beam, energy and current:
Ions / energy(MeV/N)/current(pps)
p 3.15 2.5E15
p 8.0 8.2E13
d 1.9 1.9E13
He 2.5 9.3E12
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition: RMS
Vertical (pi mm mrad): 10
Horizontal (pi mm mrad): 15
Longitudinal (dE/E[%] x RF[deg.]): 0.042

USES
Basic research (%): 10
Development(%): 0
Therapy(%) : 35
Isotope production (%): 40
Other application (%) :
Maintenance (%): 3
Beam tuning(%): 12
Total time (h/year): 7000

TECHNICAL DATA
(a) Magnet: **Type:** sector magnets
Kb: 8 **Kf:** 8
Average field (min./max. T): 0.3-1.0
Number of magnet sectors: 4
hill angular width (deg.): 45
spiral (max):
Pole parameters
Diameter: 1.16
Injection radius (m):
Extraction radius (m): 0.476
Hill gap (m): 0.156 **Valley gap (m):** 0.250
Trim coils
Number: 5x2
Maximum current (A-turns): 180
Harmonic coils
Number: 2xNsectorsx2
Maximum current (A-turns): 20
Main coils
Number: 1x2
Total current (A-turns): 154560
Maximum current (A): 690
Stored energy (MJ): 0.1
Total iron weight (tons): 54.5
Total coil weight (tons): 1.85
Power
Main coils (total KW): 46
Trim coils (total, maximum, KW): 9
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 8.6 -26
Harmonic modes: 2 and 6
Number of dees: 2
Number of cavities: 4
Dee angular width (deg.): 90
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 60
Line Power (max, KW): 2x25
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.1

(c) Injection
Ion Source: PIG
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: electrostatic channel, 2x magnetic channels
Typical Efficiency (%): 57
Best Efficiency (%): 96

(e) Vacuum
Pumps: turbo 4.8 cub m/s, roots 350 cub m/h and rotary vanes
Achieved Vacuum (Pa): 1.5e-3

REFERENCES: Proc 10th Int. Conf. on Cyclotrons (1984) 67,94,373 Proc 11th Int Conf on Cyclotrons (1986) 9,109

ENTRY N° C40
Date: 23 October 2007
Machine name: iThemba LABS Injector Cyclotron 2
Institution: iThemba LABS
Address: PO Box 722, Somerset West, 7129, South Africa
Telephone: +27 21 8431000
Fax: +27 21 8433525
Web Address: http://www.tlabs.ac.za
Person in charge of cyclotron: JL Conradie
Person reporting information: JL Conradie
E-mail address: lowry@tlabs.ac.za

HISTORY
Designed by: National Accelerator staff
Constructed by: National Accelerator staff
Construction dates: 1989 - 1993
First beam date: December 1993
Characteristic beam, energy and current:

Ions	/ energy(MeV/N)	/current(pps)
p	3.15	5.1E14
p	8.0	8.2E13
40Ar8+	0.36	2.1E12
129Xe22+	0.32	5.7E10

Transmission efficiency (source to extracted beam)
Typical (%): 15
Best (%): 30
Emittance
Emittance definition: RMS
Vertical (pi mm mrad): 10
Horizontal (pi mm mrad): 15
Longitudinal (dE/E[%] x RF[deg.]): 0.042

USES
Basic research (%): 80
Development(%): 9
Therapy(%) : 0.5
Isotope production (%): 0.5
Other application (%) :
Maintenance (%): 3
Beam tuning(%): 7
Total time (h/year): 4000

TECHNICAL DATA
(a) Magnet: **Type:** sector magnets
Kb: 8 **Kf:** 8
Average field (min./max. T): 0.3-1.0
Number of magnet sectors: 4
hill angular width (deg.): 45
spiral (max):
Pole parameters
Diameter: 1.16
Injection radius (m):
Extraction radius (m): 0.476
Hill gap (m): 0.156 **Valley gap (m):**0.250
Trim coils
Number: 6x2
Maximum current (A-turns): 200
Harmonic coils
Number: 2xNsectorsx2
Maximum current (A-turns): 20
Main coils
Number: 1x2
Total current (A-turns): 154560
Maximum current (A): 690
Stored energy (MJ): 0.1
Total iron weight (tons): 54.5
Total coil weight (tons): 1.85
Power
Main coils (total KW): 46
Trim coils (total, maximum, KW): 12
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 8.6 - 26
Harmonic modes: 2 and 6
Number of dees: 2
Number of cavities: 4
Dee angular width (deg.): 90
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 60
Line Power (max, KW): 2x25
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.1

(c) Injection
Ion Source: ECR and Polarized ion source
Source Bias Voltage (kV): 9-20
External Injection: axial
Buncher Type: Double-gap, sine wave
Injection Energy (MeV/n): 1.4e-3 – 20e-3
Component: 3 spiral inflectors (interchangeable)
Injection Efficiency (%): 55 - 70
Injector:

(d) Extraction
Elements, Characteristic: electrostatic channel, 2 x magnetic channels
Typical Efficiency (%): 70
Best Efficiency (%): 90

(e) Vacuum
Pumps: turbo 2.2 cub m/s, cryopump 10 cub m/s and 2 LN cr
Achieved Vacuum (Pa): 1.7e-5

REFERENCES: Proc. 11th Int. Conf. on Cyclotrons and their Appl. (1986)515 Proc. 15th Int. Conf. on Cyclotrons and their Appl. (1998)625

ENTRY N° C41
Date: 23 October 2007
Machine name: iThemba LABS Separated-Sector Cyclotron
Institution: iThemba LABS
Address: PO Box 722, Somerset West, 7129, South Africa
Telephone: +27 21 8431000
Fax: +27 21 8433525
Web Address: http://www.tlabs.ac.za
Person in charge of cyclotron: JL Conradie
Person reporting information: JL Conradie
E-mail address: lowry@tlabs.ac.za

HISTORY
Designed by: National Accelerator staff
Constructed by: National Accelerator staff
Construction dates: 1979 - 1985
First beam date: October 1985
Characteristic beam, energy and current:

Ions	/ energy(MeV/N)	/current(pps)
p	200	1.87E13
p	66	1.87E15
18O4+	4.7	3.1E11
129Xe22+	6.1	1.4E10

Transmission efficiency (source to extracted beam)
Typical (%): 99.8
Best (%): 100
Emittance
Emittance definition: RMS
Vertical (pi mm mrad): 2.7
Horizontal (pi mm mrad): 0.8
Longitudinal (dE/E[%] x RF[deg.]): 0.07

USES
Basic research (%): 17
Development(%): 0.8
Therapy(%) : 16
Isotope production (%): 27.7
Other application (%) : 0
Maintenance (%): 17
Beam tuning(%): 8.5
Total time (h/year): 8477

TECHNICAL DATA
(a) Magnet: **Type:** sector magnets
Kb: 200 **Kf:** 200
Average field (min./max. T): 0.517 (0/1.2560)
Number of magnet sectors: 4
hill angular width (deg.): 34
spiral (max):
Pole parameters
Diameter: 4.43
Injection radius (m): 0.952
Extraction radius (m): 4.156
Hill gap (m): 0.066 **Valley gap (m):** inf
Trim coils
Number: 29 x 2
Maximum current (A-turns): 500
Harmonic coils
Number: 2xNsectors x 2
Maximum current (A-turns):
Main coils
Number: 1x2
Total current (A-turns): 80 000
Maximum current (A): 1600
Stored energy (MJ): 1.5
Total iron weight (tons): 1400
Total coil weight (tons): 5.8
Power
Main coils (total KW): 650
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 6 - 26
Harmonic modes: 4 and 12
Number of dees: 2
Number of cavities: 4
Dee angular width (deg.): 49
Voltage
at injection (peak to ground, KV): 184
at extraction (peak to ground, KV): 230
peak (peak to ground, KV): 230
Line Power (max, KW):2 x 80
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.1

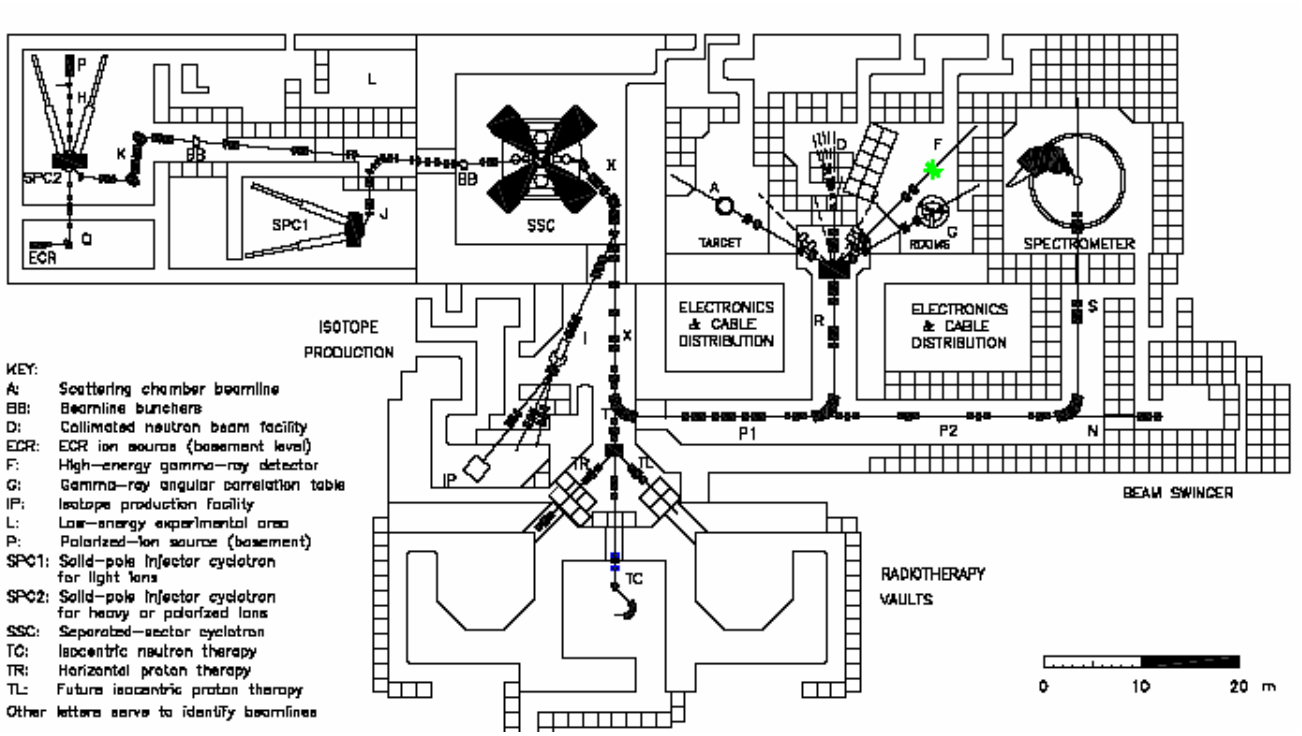
(c) Injection
lon Source:
Source Bias Voltage (kV):
External Injection: radial
Buncher Type: Double gap, sine wave
Injection Energy (MeV/n): 1.4 - 8
Component: 2 bending magnets, 1 magnetic inflection channel
Injection Efficiency (%): 100
Injector: solid pole injector cyclotrons SPC1, SPC2

(d) Extraction
Elements, Characteristic: 2 septum magnets
Typical Efficiency (%): 99.8
Best Efficiency (%): 100

(e) Vacuum
Pumps: 4 Rotary vane 120 cub m/h, 4 Roots 350 cub m/h, 6 turbo pumps and 2 cryopumps
Achieved Vacuum (Pa): 7e-5

REFERENCES:
Proc. 11th Conf on Cyclotrons and their Appl. (1986)p6
Proc. 12th Conf. on Cyclotrons and their Appl.(1989)p80

EXPERIMENTAL FACILITIES : A 66 Mev isocentric gantry for neutron therapy, a fixed horizontal beamline for proton therapy, a high- energy gamma-ray detectors array, a 1.5m scattering chamber, a neutron beam facility, and a K600 QDD magnet spectrometer.


P
H
L
K
BB
SPC2
SPC1
J
Q
ECR
BB
SSC
X
A
TARGET
D
F
G
ROOMS
SPECTROMETER
ELECTRONICS & CABLE DISTRIBUTION
ELECTRONICS & CABLE DISTRIBUTION
R
S
ISOTOPE PRODUCTION
I
X
T
P1
P2
N
IP
TR
TL
TC
BEAM SWINGER
RADIOTHERAPY VAULTS
0
10
20 m
KEY:
A: Scattering chamber beamline
BB: Beamline bunchers
D: Collimated neutron beam facility
ECR: ECR ion source (basement level)
F: High-energy gamma-ray detector
G: Gamma-ray angular correlation table
IP: Isotope production facility
L: Low-energy experimental area
P: Polarized-ion source (basement)
SPC1: Solid-pole injector cyclotron for light ions
SPC2: Solid-pole injector cyclotron for heavy or polarized ions
SSC: Separated-sector cyclotron
TC: Isocentric neutron therapy
TR: Horizontal proton therapy
TL: Future isocentric proton therapy
Other letters serve to identify beamlines

ENTRY N° C42
Date: Nov 10th, 2007
Machine name: Gustaf Werner Cyclotron
Institution: The Svedberg Laboratory
Address: Box 533, S-75121 Uppsala, Sweden
Telephone: +46-184713845
Fax: +46-184713833
Web Address: www.tsl.uu.se
Person in charge of cyclotron: Bengt Lundström
Person reporting information: Bengt Lundström
E-mail address: bengt.lundstrom@tsl.uu.se

HISTORY
Designed by: in house
Constructed by: in house
Construction dates: 1946-51, 1977-86
First beam date: 1951,1986
Characteristic beam, energy and current

p	180 MeV	200 nA
p	98 MeV	6 μ A
14N7+	45MeV/A	$8*10^9$ pps
129Xe27+	8.33 MeV/A	$7*10^8$ pps

Transmission efficiency (source to extracted beam)
Typical (%): 1
Best (%): 5
Emittance
Emittance definition: rms
Vertical (pi mm mrad): 9
Horizontal (pi mm mrad): 9
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) : 70
Isotope production (%): 5
Other application (%) :20
Maintenance (%):
Beam tuning(%): 5
Total time (h/year): ca 2700

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 200 MeV/A **Kf:** 100 MeV/A
Average field (min./max. T): 1.75 /0.6
Number of magnet sectors: 3
hill angular width (deg.): varies
spiral (max): 55 deg
Pole parameters
Diameter: 2.8 m
Injection radius (m): 0.038
Extraction radius (m): 1.175
Hill gap (m): 0,2 **Valley gap (m):** 0.38
Trim coils
Number: 13 pairs
Maximum current (A-turns): ca 5000
Harmonic coils
Number: 2 sets
Maximum current (A-turns): ca 8000
Main coils
Number: 1x2
Total current (A-turns): 814000
Maximum current (A): 1000
Stored energy (MJ): 9
Total iron weight (tons): 600
Total coil weight (tons): 50
Power
Main coils (total KW): 275
Trim coils (total, maximum, KW): 70
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 12.3-25
Harmonic modes: 1,2,3,4
Number of dees: 2
Number of cavities:
Dee angular width (deg.): 72-42
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 50
Line Power (max, KW): 280 kW
Phase Stability (deg.): +/- 0.5
Voltage Stability : +/- 0,1 %

(c) Injection
Ion Source: int PIG, ext ECR
Source Bias Voltage (kV): 20
External Injection: axial
Buncher Type: h=1 double gap
Injection Energy (MeV/n):
Component:
Injection Efficiency (%): 5
Injector:

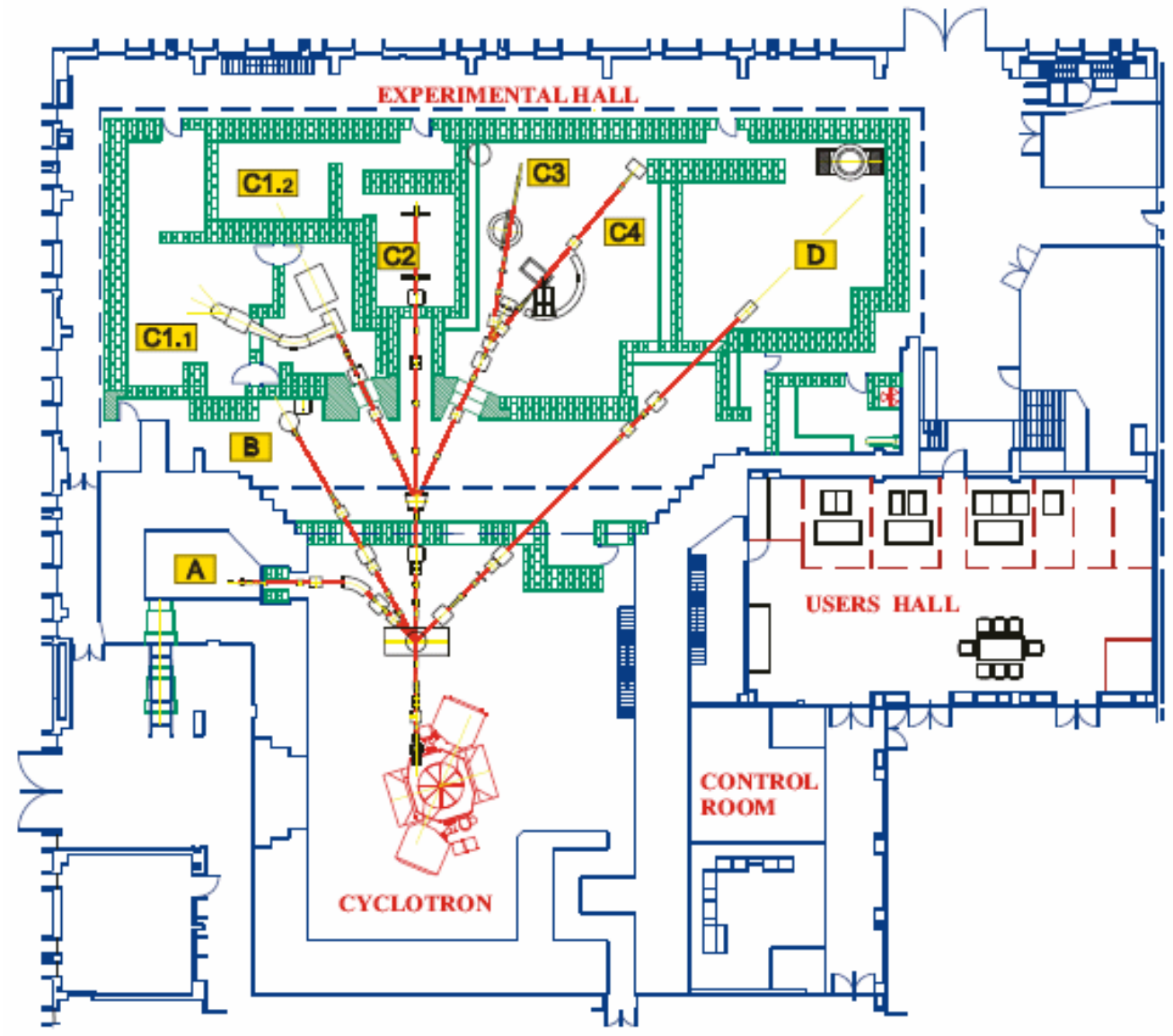
(d) Extraction
isochronous mode: precessional
Synchrocyclotron mode: regenerative
Elements, Characteristic:
El. stat. deflector 65 kV (0.5 mm septum, 5 mm gap)
Electromagnetic channel 5000 A
Regenerative mode: peeler, regenerator
Typical Efficiency (%): 50
Best Efficiency (%): 75

(e) Vacuum
Pumps: 2+1 diff pumps, 2 Meissner traps
Achieved Vacuum (Pa): 10^{-5}

REFERENCES:
S. Holm 13th Int.Conf, Vancouver 1992 p. 106

EXPERIMENTAL FACILITIES
1) Quasi-monoenergetic neutron beam
2) White spectrum neutron beam

COMMENTS
Combination of synchrocyclotron (protons > 100 MeV) and isochronous cyclotron.After decomissioning of CELSIUS fundamental research has been stopped and main activities are now patient therapy with protons combined with applied activities with neutron beams, often in beam sharing mode.



ENTRY N° C43
Date: November 10. 2007
Machine Name: PSI Philips Cyclotron "Injector 1"
Institution: Paul Scherrer Institute
Address: CH-5232 Villigen PSI, Switzerland
Telephone: ++41-56-310 40 73
Fax: ++41-56-310 33 83
Web Address: www.psi.ch
Person in Charge of Cyclotron: Mike Seidel
Person Reporting Information: Mike Seidel
E-mail Address: mike.seidel@psi.ch

HISTORY
Designed by: Philips, Eindhoven, NL
Construction Dates: 1970-73
First Beam Date: 1974
Characteristic Beams
p 72 MeV
Heavy Ions k=120
Transmission Efficiency (source to extracted beam)
Typical (%):
Best (%): 93
Emittance
Emittance Definition: rms
Vertical (pi mm mrad): 2
Horizontal (pi mm mrad): 3
Longitudinal (dE/E[%] x RF[deg.]): 0.5

USES
Basic Research (%):
Development (%):
Therapy (%): 20
Isotope Production (%):
Other Application (%): 80
Maintenance (%):
Beam Tuning (%):
Total Time (h/year): 2500

TECHNICAL DATA
(a)Magnet
Type: H-Magnet with spiral shims
Kb (MeV): 135
Kf (MeV): 135
Average Field (min./max. T): 1.65
Number of Sectors: 4
Hill Angular Width (deg.):
Spiral (deg.): 55
Pole Diameter (m): 2.5
Injection Radius (m): 0.015
Extraction Radius (m): 1.05
Hill Gap (m): 0.24
Valley Gap (m): 0.45
Trim Coils
Number: 2 x 12
Maximum Current (A-turns): 250 A
Harmonic Coils
Number: 2 x 2 x 4
Maximum Current (A-turns): 200 A
Main Coils
Number: 2
Total Ampere Turns: 1.5 e5
Maximum Current (A): 700
Stored Energy (MJ):
Total Iron Weight (tons): 470
Total Coil Weight (tons): 20
Power
Main Coils (total KW):
Trim Coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 4.6 - 17
Harmonic Modes: 1, 3
Number of Dees: 1
Number of Cavities:
Dee Angular Width (deg.): 180
Voltage
At Injection (peak to ground, KV): 20 - 100
At Extraction (peak to ground, KV):
Peak (peak to ground, KV):
Line Power (max, KW): 100
Phase Stability (deg.): 0.1 - 1
Voltage Stability (%): 0.01 - 1

(c)Injection
Ion Source: Livingston
Source Bias Voltage (kV):
External Injection: axial
Buncher Type: 2 gaps
Injection Energy (MeV/n): < 14 keV
Component: ECR, e.m.quads, spherical deflector, el. stat. mirror, buncher
Injection Efficiency (%): < 25
Injector:

(d)Extraction
Elements, Characteristic: el. stat. extr. channel, el. magn. extr. channel
Typical Efficiency (%): 60
Best Efficiency (%): 93

(e)Vacuum
Pumps: Diff. + Cryo 77K / 24K
Achieved Vacuum (Pa): 5 e-5

REFERENCES
P.A. Schmelzbach et al., 14th Int. Cycl. Conf., Cape Town, (1995)404

EXPERIMENTAL FACILITIES
gas-jet target, material irradiation, OPTIS eye cancer treatment
COMMENTS Part time Operation, PSI internal use only

ENTRY N° C44
Date: November 10. 2007
Machine Name: PSI Injector 2 Cyclotron
Institution: Paul Scherrer Institute
Address: CH-5232 Villigen PSI, Switzerland
Telephone: ++41-56-310 33 93
Fax: ++41-56-310 33 83
Web Address: www.psi.ch
Person in Charge of Cyclotron: Mike Seidel
Person Reporting Information: Mike Seidel
E-mail Address: mike.seidel@psi.ch

HISTORY
Designed by: PSI
Construction Dates: 1978-83
First Beam Date: 1984
Characteristic Beams
p, 72 MeV, 2.2 mA, 160 kW
Transmission Efficiency (source to extracted beam)
Typical (%):
Best (%):

Emittance
Emittance Definition: rms
Vertical (pi mm mrad): 1
Horizontal (pi mm mrad): 1
Longitudinal (dE/E[%] x RF[deg.]): 0.1

USES
Basic Research (%): 75
Development (%): 10
Therapy (%):
Isotope Production (%): parasitic
Other Application (%):
Maintenance (%): 9
Beam Tuning (%): 5
Total Time (h/year): 6000

TECHNICAL DATA
(a)Magnet
Type: separated sectors
Kb (MeV): 72
Kf (MeV): 72
Average Field (min./max. T): 0.33-0.36
Number of Sectors: 4
Hill Angular Width (deg.): 27
Spiral (deg.): 0
Pole Diameter (m): 7
Injection Radius (m): 0.44
Extraction Radius (m): 3.3
Hill Gap (m): 0.035
Valley Gap (m):
Trim Coils
Number: 2 x 11
Maximum Current (A-turns): 40 A
Harmonic Coils
Number: 2 x 4
Maximum Current (A-turns): 200 A
Main Coils
Number: 4 x 2
Total Ampere Turns: 3.4 e4
Maximum Current (A): 400
Stored Energy (MJ):
Total Iron Weight (tons): 4 x 180
Total Coil Weight (tons): 4 x 0.96
Power
Main Coils (total KW):
Trim Coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 50.633
Harmonic Modes: 10
Number of Dees:
Number of Cavities: 2 + 2 flattop used for acc.
Dee Angular Width (deg.):
Voltage
At Injection (peak to ground, KV): 125
At Extraction (peak to ground, KV): 250
Peak (peak to ground, KV):
Line Power (max, KW): 2 x 180
Phase Stability (deg.): 0.01
Voltage Stability (%): 0.03

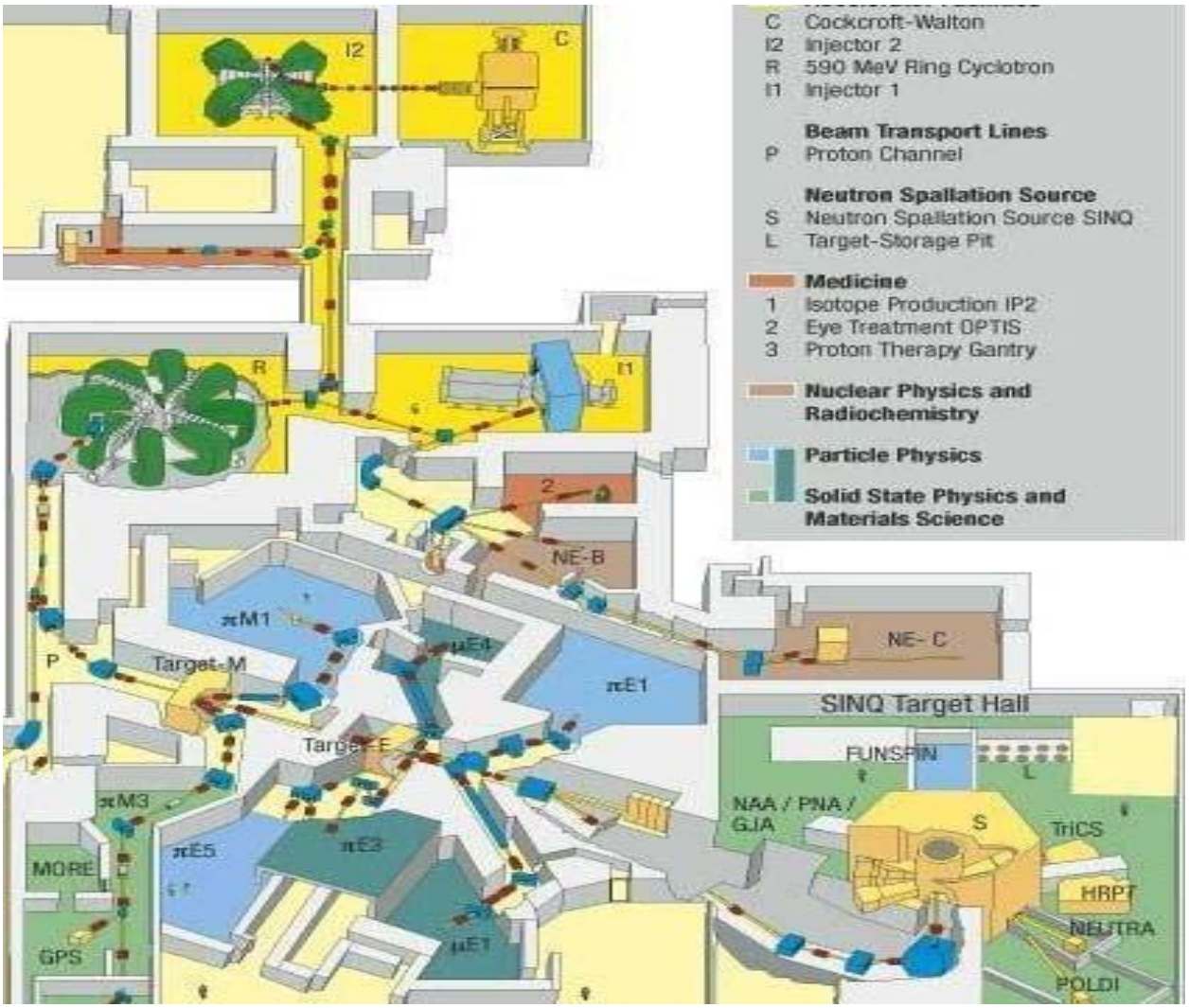
(c)Injection
Ion Source: Multiscusp
Source Bias Voltage (kV): 60
External Injection: radial, conical injection shim
Buncher Type: 1 + 3 harm., sinus
Injection Energy (MeV/n): 0.870
Component:
Injection Efficiency (%): 20
Injector: Cockcroft-Walton

(d)Extraction
Elements, Characteristic: el. stat channel, septum magnet
Typical Efficiency (%): 99.97
Best Efficiency (%):

(e)Vacuum
Pumps: cryo + turbopumps
Achieved Vacuum (Pa): 1.3 e-4

REFERENCES
Contributions to these Proceedings by Mike Seidel, Joachim Grillenberger, L. Stingelin

EXPERIMENTAL FACILITIES
Injector for the PSI Ring Cyclotron, Isotope production with splitted beam


C Cockcroft-Walton
I2 Injector 2
R 590 MeV Ring Cyclotron
I1 Injector 1
Beam Transport Lines
P Proton Channel
Neutron Spallation Source
S Neutron Spallation Source SINQ
L Target-Storage Pit
Medicine
1 Isotope Production IP2
2 Eye Treatment OPTIS
3 Proton Therapy Gantry
Nuclear Physics and Radiochemistry
Particle Physics
Solid State Physics and Materials Science
I2
C
1
R
I1
2
NE-B
NE- C
πM1
μE4
πE1
P
Target-M
Target-E
SINQ Target Hall
FUNSPIN
L
πM3
NAA / PNA / GJA
S
TriCS
πE5
πE2
MORE
HRPT
NEUTRA
μE1
GPS
POLDI

ENTRY N° C45
Date: November 10. 2007
Machine Name: PSI 590 MeV Ring Cyclotron
Institution: Paul Scherrer Institute
Address: CH-5232 Villigen PSI, Switzerland
Telephone: ++41-56-310 33 93
Fax: ++41-56-310 33 83
Web Address: www.psi.ch
Person in Charge of Cyclotron: Mike Seidel
Person Reporting Information: Mike Seidel
E-mail Address: mike.seidel@psi.ch

HISTORY
Designed by: H.A. Willax + PSI-team
Construction Dates: 1968-74
First Beam Date: 1974
Characteristic Beams
p, 590 MeV, <=2 mA, 1.2 MW
Transmission Efficiency (source to extracted beam)
Typical (%): 99.97
Best (%):
Emittance
Emittance Definition: rms
Vertical (pi mm mrad): 1
Horizontal (pi mm mrad): 1
Longitudinal (dE/E[%] x RF[deg.]): 0.4

USES
Basic Research (%): 70
Development (%): 3
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%): 11
Beam Tuning (%): 5
Total Time (h/year): 6000

TECHNICAL DATA
(a)Magnet
Type: separated sectors
Kb (MeV): 592
Kf (MeV): 592
Average Field (min./max. T): 0.58 - 0.78
Number of Sectors: 8
Hill Angular Width (deg.): 18
Spiral (deg.): 35
Pole Diameter (m): 9
Injection Radius (m): 2.1
Extraction Radius (m): 4.45
Hill Gap (m): 0.05 - 0.09
Valley Gap (m):
Trim Coils
Number: 2 x 18
Maximum Current (A-turns): 30 / 200 A
Harmonic Coils
Number: 2 x 5 + 2x8
Maximum Current (A-turns): 200 A
Main Coils
Number: 2 x 8
Total Ampere Turns: 1.5 e5
Maximum Current (A): 930
Stored Energy (MJ):
Total Iron Weight (tons): 1960
Total Coil Weight (tons): 28
Power
Main Coils (total KW): 620
Trim Coils (total, maximum, KW): 30
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 50.633
Harmonic Modes: 6
Number of Dees:
Number of Cavities: 4 + 1 flattop
Dee Angular Width (deg.):
Voltage
At Injection (peak to ground, KV): 500 (650)
At Extraction (peak to ground, KV): 630 (820)
Peak (peak to ground, KV): 730 (950)
Line Power (max, KW): 4 x 520
Phase Stability (deg.): 0.01
Voltage Stability (%): 0.03

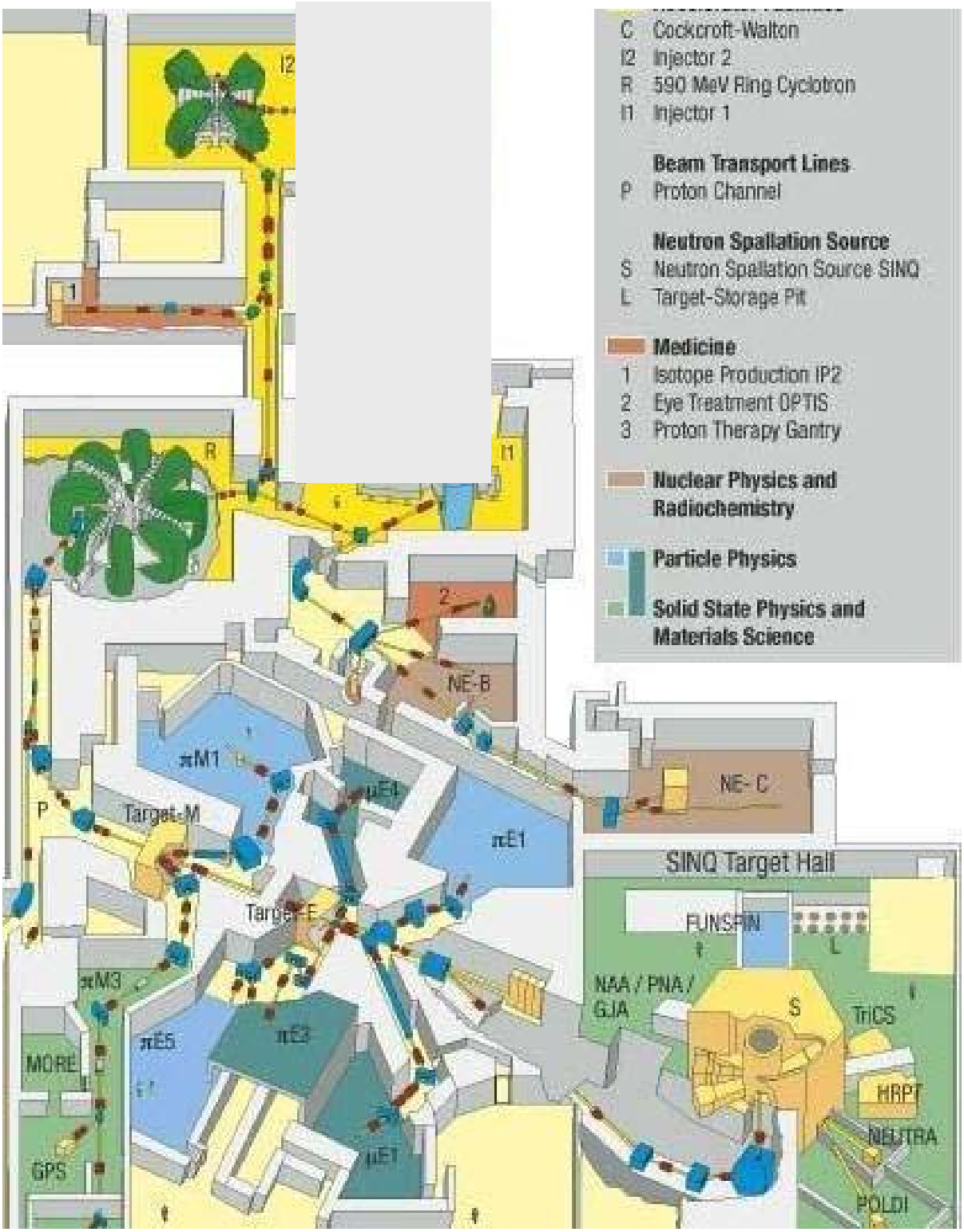
(c)Injection
Ion Source:
Source Bias Voltage (kV):
External Injection: radial, magnetic channel and el. stat. inflector
Buncher Type:
Injection Energy (MeV/n): 72
Component:
Injection Efficiency (%): 99.93
Injector: PSI Injector 2 Cyclotron

(d)Extraction
Elements, Characteristic: el. stat. channel, septum magnet
Typical Efficiency (%): 99.97
Best Efficiency (%): 99.98

(e)Vacuum
Pumps: Kryo + Turbopumps
Achieved Vacuum (Pa): 2.7 e-4

REFERENCES
Contribution to these Proceedings by Mike Seidel

EXPERIMENTAL FACILITIES
pi- and mu-meson areas, n-Spallation Source SINQ,


C Cockcroft-Walton
I2 Injector 2
R 590 MeV Ring Cyclotron
I1 Injector 1
Beam Transport Lines
P Proton Channel
Neutron Spallation Source
S Neutron Spallation Source SINQ
L Target-Storage Pit
Medicine
1 Isotope Production IP2
2 Eye Treatment OPTIS
3 Proton Therapy Gantry
Nuclear Physics and Radiochemistry
Particle Physics
Solid State Physics and Materials Science
I2
1
R
I1
2
NE-B
NE-C
πM1
μE4
πE1
P
Target-M
Target-E
SINQ Target Hall
FUNSPIN
L
πM3
NAA / PNA / GJA
S
TriCS
πE5
πE3
MORE
HRPT
NEUTRA
μE1
GPS
POLDI

ENTRY N° C46
Date: 12.12.2007
Machine name: COMET
Institution: Paul Scherrer Insitut
Address: 5232 Villigen-PSI, Switzerland
Telephone: 0041 56 310 2111
Fax: 0041 56 310 2199
Web Address: www.psi.ch
Person in charge of cyclotron: J.M. Schippers
Person reporting information: J.M. Schippers
E-mail address: marco.schippers@psi.ch

HISTORY
Designed by: Henry Blosser (NSCL), ACCEL instr.
Constructed by: ACCEL Instruments GmbH (D)
Construction dates: 2002-2004
First beam date: April 1, 2005
Characteristic beam, energy and current:
250 MeV protons, 500 nA (1000 nA possible)
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition: contains 95% of particles
Vertical (pi mm mrad): 5
Horizontal (pi mm mrad): 3
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 0
Development(%): 5
Therapy(%) : 95
Isotope production (%): 0
Other application (%) : component irradiations
Maintenance (h): 500
Beam tuning(%): 50
Total time (h/year): 3000

TECHNICAL DATA
(a) Magnet: sc **Type:** cylindrical yoke
Kb: **Kf:**
Average field (min./max. T): 2.4/3.8 T
Number of magnet sectors: 4
hill angular width (deg.): 45
spiral (max):
Pole parameters
Diameter: 1.6 m
Injection radius (m): internal source
Extraction radius (m): 0.8
Hill gap (m): 0.05 **Valley gap (m):**
Trim coils
Number: 0, only trim rods
Maximum current (A-turns):
Harmonic coils
Number: 0
Maximum current (A-turns):
Main coils
Number: 1 pair
Total current (A-turns):
Maximum current (A): 158
Stored energy (MJ):
Total iron weight (tons): 90
Total coil weight (tons):
Power
Main coils (total KW): 0.1 (sc)
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW): 23

(b) RF
Frequency range (MHz): 72
Harmonic modes: 2
Number of dees: 4
Number of cavities:
Dee angular width (deg.): 40
Voltage
at injection (peak to ground, KV): 100
at extraction (peak to ground, KV): 100
peak (peak to ground, KV):
Line Power (max, KW): 125
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source: cold cathode PIG, internal source
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic:
Typical Efficiency (%): 80
Best Efficiency (%): 85

(e) Vacuum
Pumps: 8 Turbo
Achieved Vacuum (Pa): 5E-7 mb

REFERENCES:
A. Geisler et al., Proc. 17th Int. Conf. Cycl. And Apll, Tokyo, Japan, ed. A. Goto and Y. Yano, Particle Acc. Soc. of Japan, 2005 , pag. 178-182.
B. J.M. Schippers et al., Nuclear Instruments and Methods in Physics Research B 261 (2007) 773–776

ENTRY N° C47
Date: Feb. 12, 2008
Machine name: TR30/15
Institution: Institute of Nuclear Energy Research
Address: No. 1000, Wunhua Rd., Jiaan Village, Longtan Township, Taoyuan County 32546, Taiwan (R.O.C.)
Telephone: 886-2-82317717□886-3-4711400 ext.7141
Fax: 886-3-4711416
Web Address: http://www.iner.gov.tw
Person in charge of cyclotron: Wuu-Jyh Lin
Person reporting information: Ting Shien Duh
E-mail address: tsduh@iner.gov.tw

HISTORY
Designed by: TRIUMF, CANADA
Constructed by: EBCO, CANADA
Construction dates: 1991 - 1993
First beam date: May, 1993
Characteristic beam, energy and current:
Proton, 15-30 MeV, 800 uA
Deutron, 7.5 – 15 MeV, 150 uA
Transmission efficiency (source to extracted beam)
Typical (%): 20
Best (%): 22
Emittance 0.34 π mm-mrad
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%): 4
Therapy(%) :
Isotope production (%): 35
Other application (%) :43
Maintenance (%): 15
Beam tuning(%):3
Total time (h/year): 8760

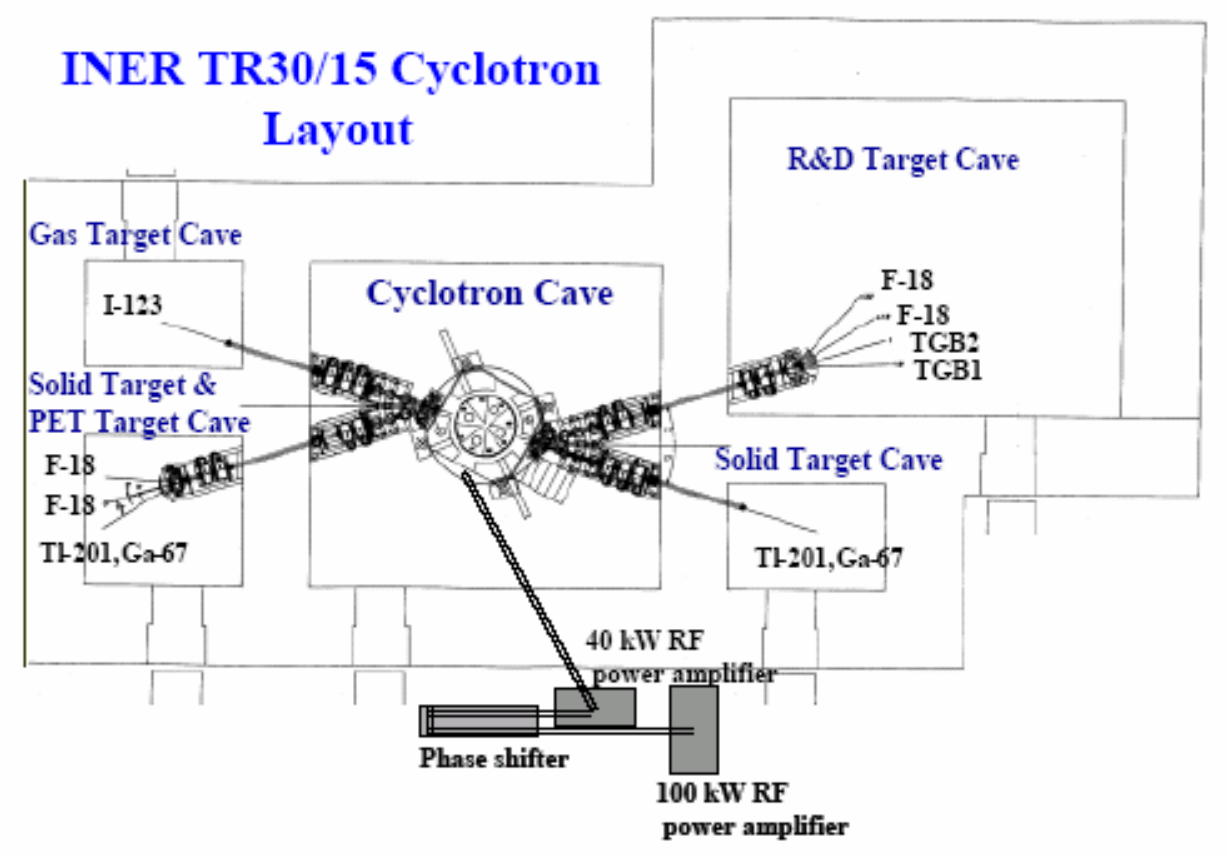
TECHNICAL DATA
(a) Magnet: **Type: sector**
Kb: **Kf:**
Average field (min./max. T): 1.2 (0.55/1.9)
Number of magnet sectors: 4
hill angular width (deg.): 45
spiral (max):
Pole parameters
Diameter: 1.52
Injection radius (m):
Extraction radius (m):0.661
Hill gap (m):0.04 **Valley gap (m):**0.15
Trim coils (for deuteron mode only)
Number: 8
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number: 2
Total current (A-turns): 7.2×10^4
Maximum current (A): 500
Stored energy (MJ):
Total iron weight (tons): 46
Total coil weight (tons):
Power
Main coils (total KW):32
Trim coils (total, maximum, KW):19.2
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 73.129
Harmonic modes: 4
Number of dees: 2
Number of cavities: 1
Dee angular width (deg.): 45
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 50
Line Power (max, KW):244
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
lon Source: 12 mA H^- multi-cusp source
Source Bias Voltage (kV): -25
External Injection:
Buncher Type: drift tube
Injection Energy (MeV/n): 0.025
Component: Einzel lens Buncher-SQQ
Injection Efficiency (%): 20(at 1 mA) –30 (at 0.33 mA)
Injector: 90 degree ± 8 kV inflector

(d) Extraction
Elements, Characteristic: stripping carbon foils
Typical Efficiency (%): 95-96
Best Efficiency (%):

(e) Vacuum
Pumps: Cryo pumps
Achieved Vacuum (Pa): 2.67×10^{-5}


INER TR30/15 Cyclotron Layout
R&D Target Cave
Gas Target Cave
Cyclotron Cave
F-18
F-18
TGB2
TGB1
I-123
Solid Target &
PET Target Cave
F-18
F-18
Tl-201,Ga-67
Solid Target Cave
Tl-201,Ga-67
40 kW RF
power amplifier
Phase shifter
100 kW RF
power amplifier

ENTRY N° C48
Date: 12 February, 2008
Machine name: Kharkov Compact Cyclotron CV 28
Institution: National Science Center "Kharkov Institute of Physics & Technology" (NSC KIPT)
Address: 61108 Kharkov, Ukraine
Telephone: +38 057 335 44 44
Fax: +38 057 335 44 44
Web Address: http://www.kipt.kharkov.ua
Person in charge of cyclotron: Dr. Yuri Petrusenko
Person reporting information: Dr. Yuri Petrusenko
E-mail address: petrusenko@kipt.kharkov.ua

HISTORY
Designed by: The Cyclotron Corporation, Berkeley, Calif., USA
Constructed by: The Cyclotron Corporation, Berkeley,
Construction dates: 1970
First beam date:1975-Forschungszentrum Juelich, (D)
2010 - Expected second beam date at NSC KIPT
Characteristic beam, energy and current:
p 2-24 MeV, extern 70 □A
d 3-14 MeV, extern 100 □A
3He 5-36 MeV, extern 70 □A
4He 6-28 MeV, extern 50 □A
Transmission efficiency (source to extracted beam)
Typical (%): 60
Best (%): 80
Emittance
Emittance definition:
Vertical (pi mm mrad): 15
Horizontal (pi mm mrad): 15
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%, estimated**):** 30
Development (%, estimated**):** 30
Therapy():
Isotope production (%, estimated**):** 40
Other application ( ) :
Maintenance ():
Beam tuning():
Total time (h/year): 2000 (estimated)

TECHNICAL DATA
(a) Magnet: **Type:** Compact
Kb: **Kf:**
Average field (min./max. T): 1,85T
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter (m): 0.96
Injection radius (m):
Extraction radius (m): 0.42
Hill gap (m): 0.05**Valley gap (m):** 0.1
Trim coils
Number: 4
Maximum current (A-turns):
Harmonic coils
Number: 2 sets of 3
Maximum current (A-turns):
Main coils
Number: 1
Total current (A-turns):
Maximum current (A): 450
Stored energy (MJ):
Total iron weight (tons): 23
Total coil weight (tons):
Power
Main coils (total KW): 60
Trim coils (total, maximum, KW): 50
Refrigerator (cryogenic, KW):

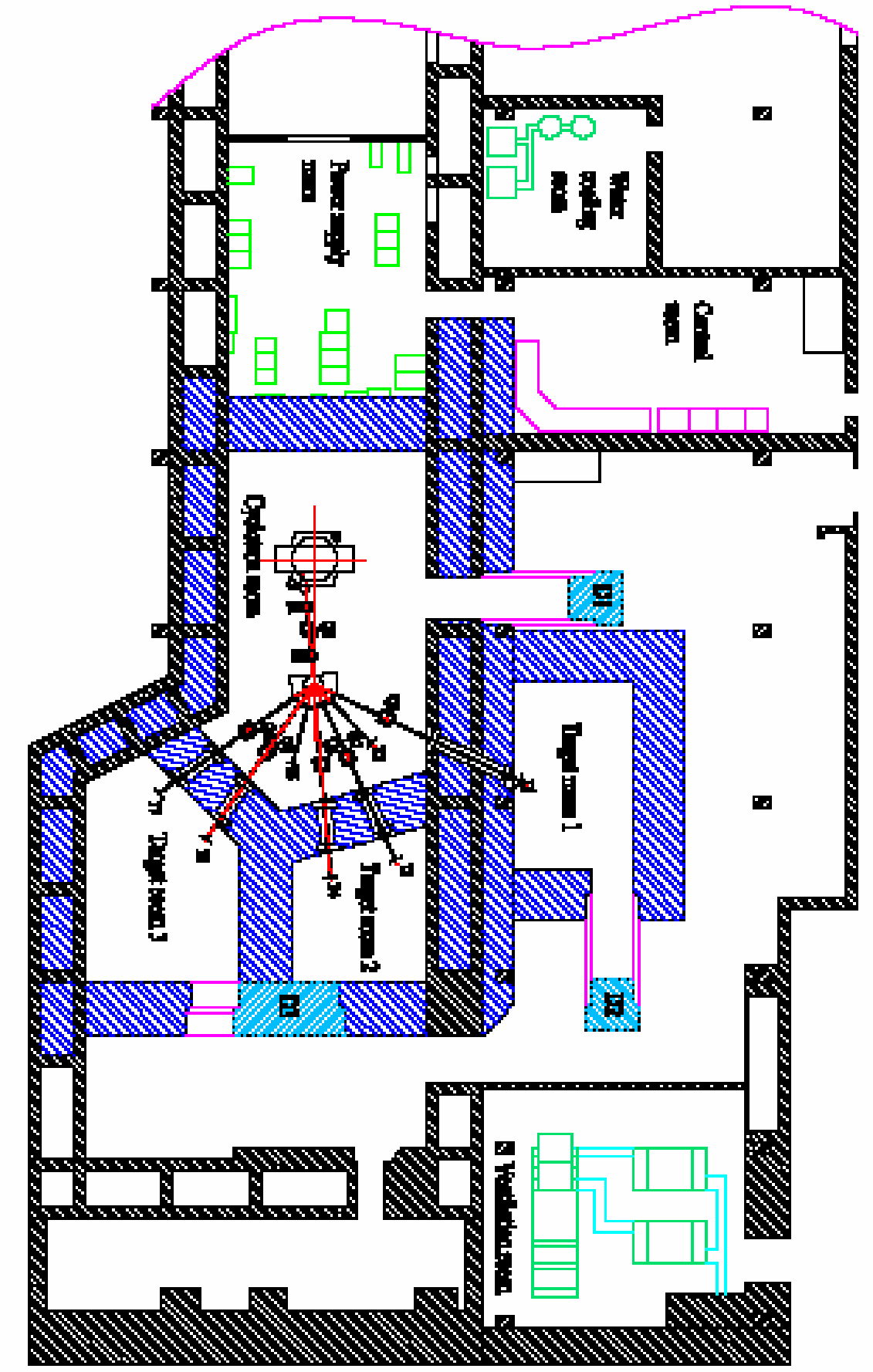
(b) RF
Frequency range (MHz): 6 to 26
Harmonic modes: fundamental
Number of dees: 2
Number of cavities:
Dee angular width (deg.): 90
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 30
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability ():

(c) Injection
Ion Source: "cold cathode" Penning mode
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extractмon
Elements, Characteristic: dc electrostatic deflector and magnet channel
Typical Efficiency (%): 60
Best Efficiency (%): 80

(e) Vacuum
Pumps:
Achieved Vacuum (Pa): $6*10^{-5}$

EXPERIMENTAL FACILITIES
Radiation Materials Science, Nuclear Physics, Isotope Production
COMMENTS
Compact Cyclotron CV 28 has been transferred by Forschungszentrum Juelich, Germany to National Science Center "Kharkov Institute of Physics & Technology" (NSC KIPT), Kharkov, Ukraine at the end of 2006.



ENTRY N° C49
Date: February 2008
Machine name: Indiana University Cyclotron Facility
Institution: Indiana University
Address: Milo B. Sampson Ln, Bloomington, IN 47408
Telephone: +1 (812) 855-9365
Fax: +1 (812) 855-6645
Web Address: http://www.iucf.indiana.edu/
Person in charge of cyclotron: V. Derenchuk
Person reporting information: V. Derenchuk
E-mail address: vderench@indiana.edu

HISTORY
Designed by: R.E. Pollock
Constructed by: Indiana University
Construction dates: 1968-1774
First beam date: August 1975
Characteristic beam, energy and current:
…Protons 208 MeV 0.1pA–200nA.
Transmission efficiency (15MeV to extracted beam)
Typical (%): 50–70%
Best (%): 90%
Emittance
Emittance definition: RMS
Vertical (pi mm mrad): 2.0
Horizontal (pi mm mrad): 3.0
Longitudinal (dE/E[%] x RF[deg.]): 0.1% × 4deg

USES
Basic research (%): 0%
Development(%): 0%
Therapy(%) : 2 shifts/day
Isotope production (%): 0%
Other application (%): 10%
Maintenance (%): every weekend
Beam tuning(%): each maintenance
Total time (h/year): 6240 h

TECHNICAL DATA
(a) Magnet: **Type:** Separated Sector
Kb(MeV): 215 **Kf(MeV):** 215
Average field (min./max. T): 1.3 / 1.65 T
Number of magnet sectors: 4
hill angular width (deg.): 36
spiral (max): n/a
Pole parameters
Diameter:
Injection radius (m): 1.01
Extraction radius (m): 3.3
Hill gap (m): 0.076 **Valley gap (m):** ∞
Trim coils
Number: 21×2
Maximum current (A-turns): 950
Harmonic coils
Number: 4 ×2 and 1×"Figure8"
Maximum current (A-turns): 40
Main coils
Number: 4×2
Total current (A-turns): 62,000
Maximum current (A): 1000
Stored energy (MJ):
Total iron weight (tons): 2200
Total coil weight (tons): 10
Power
Main coils (total KW): 275
Trim coils (total, maximum, KW): 120
Refrigerator (cryogenic, KW): n/a

(b) RF
Frequency range (MHz): 35.58 (fixed)
Harmonic modes: 4
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 38
Voltage
at injection (peak to ground, KV): 130
at extraction (peak to ground, KV): 200
peak (peak to ground, KV): 200
Line Power (max, KW): 200
Phase Stability (deg.): 0.1
Voltage Stability (%): 8E-5

(c) Injection
Ion Source: Microwave
Source Bias Voltage (kV): 20
External Injection: Radial
Buncher Type: RF-chopper+RFQ+K-15
Injection Energy (MeV/n): 15 MeV
Component: Electrostatic inflector
Injection Efficiency (%): 90%
Injector: K-15 cyclotron

(d) Extraction
Elements, Characteristic:
70kV Electrostatic septum + Magnetic deflector
Typical Efficiency (%): 75%
Best Efficiency (%): 100%

(e) Vacuum
Pumps: 4 cryogenic, 2 diffusion
Achieved Vacuum (Pa): 0.002

REFERENCES:
[1] R.E. Pollock, IUCF Status Report, IEEE Trans. Nucl. Sci. NS-26 (1995);
[2] V.Anferov *et. al*, Indiana University Cyclotron operation for proton therapy facility, Cyclotrons 2007, WEYCR04 (2007)

EXPERIMENTAL FACILITIES
a) Radiation Effects Research Program
b) Bio-Medical Research line (in planning)

ENTRY N° C50
Date: 8 Feb 2008
Machine name: 88-Inch Cyclotron
Institution: Lawrence Berkeley National Laboratory
Address: 1 Cyclotron Rd, MS88 Berkeley, CA 94720
Telephone: 510-486-7826
Fax: 510-486-7983
Web Address: http://cyclotron.lbl.gov/
Person in charge of cyclotron: Claude M. Lyneis
Person reporting information: Claude M. Lyneis
E-mail address: cmlyneis@lbl.gov

HISTORY
Designed by: LBNL
Constructed by: LBNL
Construction dates: 1959-1962
First beam date: 1962
Characteristic beam, energy and current (pps):

Protons	1-55 MeV/n	1.6x10e14
16O6+	10 MeV/n	2x10e13
40Ar9+	5 MeV/n	2x10e13
48Ca10+	6 MeV/n	6x10e12
86Kr19+	5 MeV/n	2.5x10e12
129Xe28+	5 MeV/n	6.9 x10e11
124Xe34+	10 MeV/n	2.9x10e11
124Xe42+	16 MeV/n	8.7x10e8
238U+47	4.5 MeV/n	8x10e9

Transmission efficiency (source to extracted beam)
Typical (%): 10 **Best (%):** 30
Emittance
Emittance definition: 90%
Vertical (pi mm mrad): 22 pi mm mRad
Horizontal (pi mm mrad): 16 pi mm mRad
Longitudinal (dE/E[%] x RF[deg.]):.3x30 deg dE/E x RF deg

USES
Basic research (%): 40
Development (%): 5
Therapy (%); 0
Isotope production (%): 0
Other application (%) : 37
Maintenance (%): 7
Beam tuning (%): 11
Total time (h/year): 5200

TECHNICAL DATA
(a) Magnet: **Type:** Compact
Kb(MeV): 160 **Kf(MeV):** 70
Average field (min./max. T): 1.7
Number of magnet sectors: 3
hill angular width (deg.): 60
spiral (deg): 55
Pole parameters
Diameter(m): 2.24
Injection radius (m): 0
Extraction radius (m): 1
Hill gap (m): .19 **Valley gap (m):**.3
Trim coils
Number: 17x2
Maximum current (A-turns):2000
Harmonic coils
Number: 5xN sectors x 2
Maximum current (A-turns): 200
Main coils
Number: 1x2
Total current (A-turns): 600000
Maximum current (A): 3000
Stored energy (MJ):
Total iron weight (tons): 290
Total coil weight (tons): 10
Power
Main coils (total KW): 450
Trim coils (total, maximum, KW): 580
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 5.5-16.0
Harmonic modes: 1,3,5,7
Number of dees: 1
Number of cavities: 1
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV): 50
at extraction (peak to ground, KV): 50
peak (peak to ground, KV): 50
Line Power (max, KW): 300
Phase Stability (deg.):
Voltage Stability (%): .2

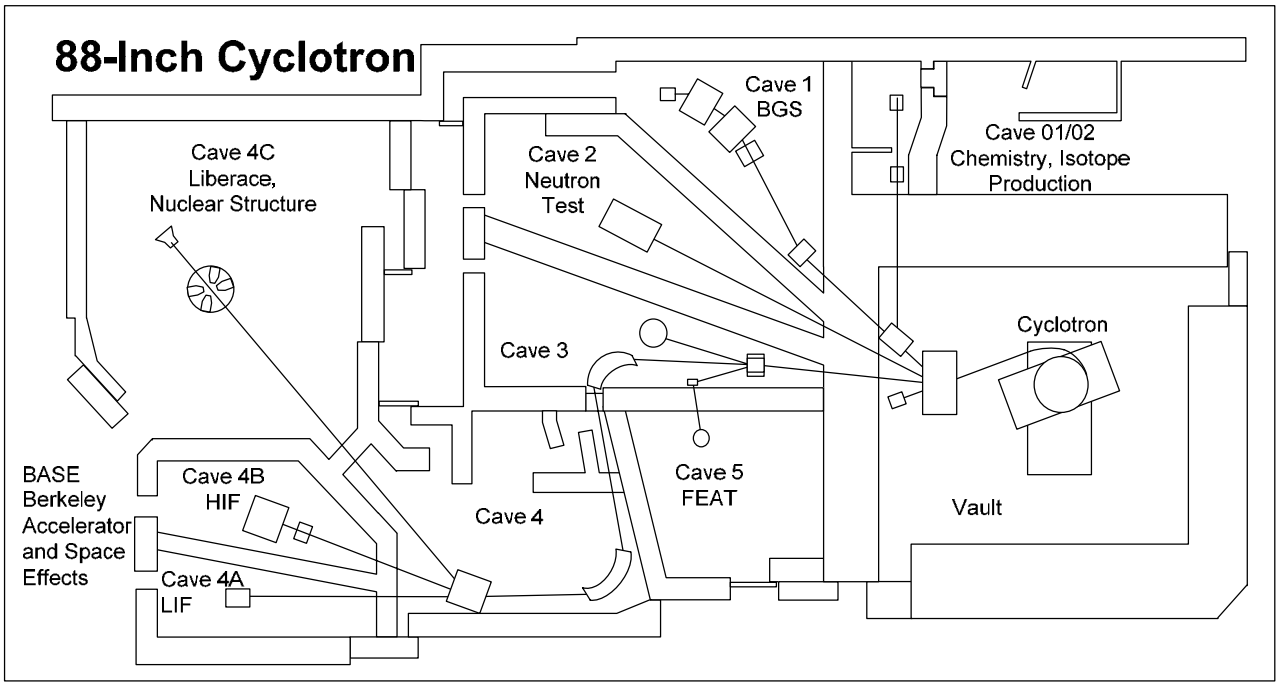
(c) Injection
Ion Source: 3 ECR
Source Bias Voltage (kV): 10-18
External Injection: axial
Buncher Type: first and second harmonic
Injection Energy (MeV/n): .001-.01
Components: Magnetic solenoids, Quadrupoles, bends, buncher (fundamental and harmonic)
Injection Efficiency (%): 30-50
Injector: gridded electrostatic mirror

(d) Extraction
Elements, Characteristic: 3 section electrostatic deflector, 108 degree, 90kV across 6.35 mm , channel shape control all electrodes are moveable
Typical Efficiency (%): 60
Best Efficiency (%): 90

(e) Vacuum
Pumps: Diffusion pumps with LN baffle, 3 Cryo panels
Achieved Vacuum (Pa): **4x10-5 Pa**

REFERENCES: Proceedings of the Cyclotron Conferences, NIM 154 (1978) p. 1-7

EXPERIMENTAL FACILITIES
BGS Berkeley Gas Separator, FEAT Facility for Exotic Atom Trapping Particle Gamma-ray Facility, BASE Berkeley Accelerator Space Effects Facility, LIBERACE Livermore Berkeley Collaboration


88-Inch Cyclotron
Cave 1
BGS
Cave 01/02
Chemistry, Isotope
Production
Cave 4C
Liberace,
Nuclear Structure
Cave 2
Neutron
Test
Cyclotron
Cave 3
Cave 5
FEAT
BASE
Berkeley
Accelerator
and Space
Effects
Cave 4B
HIF
Cave 4
Vault
Cave 4A
LIF

ENTRY N° C51
Date: 5 November 2007
Machine Name: K500
Institution: Michigan State University
Address: NSCL/ Cyclotron Laboratory, E. Lansing, 48824 MI
Telephone: 517-355-9671
Fax: 517-353-5967
Web Address: www.nscl.msu.edu
Person in Charge of Cyclotron: C.K. Gelbke
Person Reporting Information: P.S. Miller
E-mail Address: miller@nscl.msu.edu

HISTORY
Designed by: Michigan State University
Construction Dates: 77-81 (rebuilt 95-99)
First Beam Date: 8/82 (rebuilt 7/98)
Characteristic Beams

ions	energy(MeV/N)	current(pnA)
16O3+	13.05	1500
40Ar7+	12.34	400
48Ca8+	12.23	300
124Xe20+	12.25	137
124Sn19+	10.83	30
238U69+	7.68	10

Transmission Efficiency (source to extracted beam)
Typical (%): 15
Best (%): 21.5
Emittance
Emittance Definition: 50%
Vertical (pi mm mrad): 5 - 12
Horizontal (pi mm mrad): 5 - 8
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year):

TECHNICAL DATA
(a)Magnet
Type: compact superconducting
Kb (MeV): 500
Kf (MeV): 160
Average Field (min./max. T): 3.0-5.0
Number of Sectors: 3
Hill Angular Width (deg.): 60
Spiral (deg.): 120
Pole Diameter (m): 1.42
Injection Radius (m): 0.015
Extraction Radius (m): 0.66
Hill Gap (m): 0.0635
Valley Gap (m): 0.914
Trim Coils (square coil. Axis horizontal)
Number: (13x3 sectors)
Maximum Current (A-turns): 400x20/2
Harmonic Coils
Number: 2 (trim coil #1, #12)
Maximum Current (A-turns): 400x20/2
Main Coils
Number: 2x2
Total Ampere Turns: 5E6
Maximum Current (A): 800
Stored Energy (MJ): 18
Total Iron Weight (tons): 91
Total Coil Weight (tons): 7
Power
Main Coils (total KW): 0
Trim Coils (total, maximum, KW): 100
Refrigerator (cryogenic, KW): 1300

(b)RF
Frequency Range (MHz): 11-27
Harmonic Modes: 2
Number of Dees: 3
Number of Cavities: 3
Dee Angular Width (deg.):60
Voltage
At Injection (peak to ground, KV): 70
At Extraction (peak to ground, KV): 70
Peak (peak to ground, KV): 70
Line Power (max, KW): 300
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.01

(c)Injection
Ion Source: ECR
Source Bias Voltage (kV): 30 kV max
External Injection: axial
Buncher Type: 2 grid, h=1
Injection Energy (MeV/n): 4 to 6 keV/n typical
Component: solenoid and electrostatic lenses, electric and magnetic dipoles
Injection Efficiency (%): 30% to 50%
Injector: none

(d)Extraction
Elements, Characteristic: electrostatic deflectors (2), 7 mm gap, 100 kV/cm, moveable passive magnetic dipole and 2 compensators, movable focusing bars (8) and compensators (2) precessional
Typical Efficiency (%): 75
Best Efficiency (%): 90

(e)Vacuum
Pumps: 3 cryopanels, 7K, Cu+charcoal, 1 TMP
Achieved Vacuum (Pa): 5.2E-5

REFERENCES
R.C. York et. al., Proc. 15th Int. Conf. on Cyclotrons, E. Baron and M.Lieuvin, eds. (1999)687

EXPERIMENTAL FACILITIES
See K1200 cyclotron data for coupled cyclotron experimental facilities.

ENTRY N° C52
Date: 5 November 2007
Machine Name: K1200
Institution: Michigan State University
Address: NSCL/ Cyclotron Laboratory, E. Lansing, Mi 48824
Telephone: 517-355-9671
Fax: 517-353-5967
Web Address: www.nscl.msu.edu
Person in Charge of Cyclotron: C. K. Gelbke
Person Reporting Information: P. S. Miller
E-mail Address: miller@nscl.msu.edu

HISTORY
Designed by: Michigan State University 1976-86
Construction Dates: 80-87
First Beam Date: 6/88; Coupled Cyc. 10/2000
Characteristic Beams

ions	energy(MeV/N)	current(pnA)
16O8+	150	125
18O8+	20	125
48Ca20+	140	80
78Kr34+	150	25
86Kr34+	140	20
124Xe48+	140	10
124Sn45+	120	1.5
209Bi63+	80	1
238U69+	80	0.2

Transmission Efficiency (source to extracted beam)
Typical (%): 7
Best (%): 10 (coupled cyc. system)
Emittance
Emittance Definition: 50%
Vertical (pi mm mrad): 3-8
Horizontal (pi mm mrad): 2-5
Longitudinal (dE/E[%] x RF[deg.]): 0.07 (%) x 30°

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%):
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year):

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV): 1200
Kf (MeV): 400
Average Field (min./max. T): 3.0 - 5.3
Number of Sectors: 3
Hill Angular Width (deg.): 60
Spiral (deg.): 176
Pole Diameter (m): 2.197
Injection Radius (m): 0.32
Extraction Radius (m): 1.03
Hill Gap (m): 0.076
Valley Gap (m): 0.914
Trim Coils (square coil, axis horizontal)
Number: (21x3 sectors)
Maximum Current (A-turns): 400x20/2
Harmonic Coils (use trim coils)
Number: 3 (trim coil #1,5,21)
Maximum Current (A-turns): 400x20/2
Main Coils
Number: 2x2
Total Ampere Turns: 7E6
Maximum Current (A): 900
Stored Energy (MJ): 60
Total Iron Weight (tons): 240
Total Coil Weight (tons): 20
Power
Main Coils (total KW): 0
Trim Coils (total, maximum, KW): 100
Refrigerator (cryogenic, KW): 1300

(b)RF
Frequency Range (MHz): 9-27
Harmonic Modes: 1
Number of Dees: 3
Number of Cavities: 3
Dee Angular Width (deg.):60
Voltage
At Injection (peak to ground, KV): 150
At Extraction (peak to ground, KV): 169
Peak (peak to ground, KV): 169
Line Power (max, KW): 920
Phase Stability (deg.): 1
Voltage Stability (%): 0.01

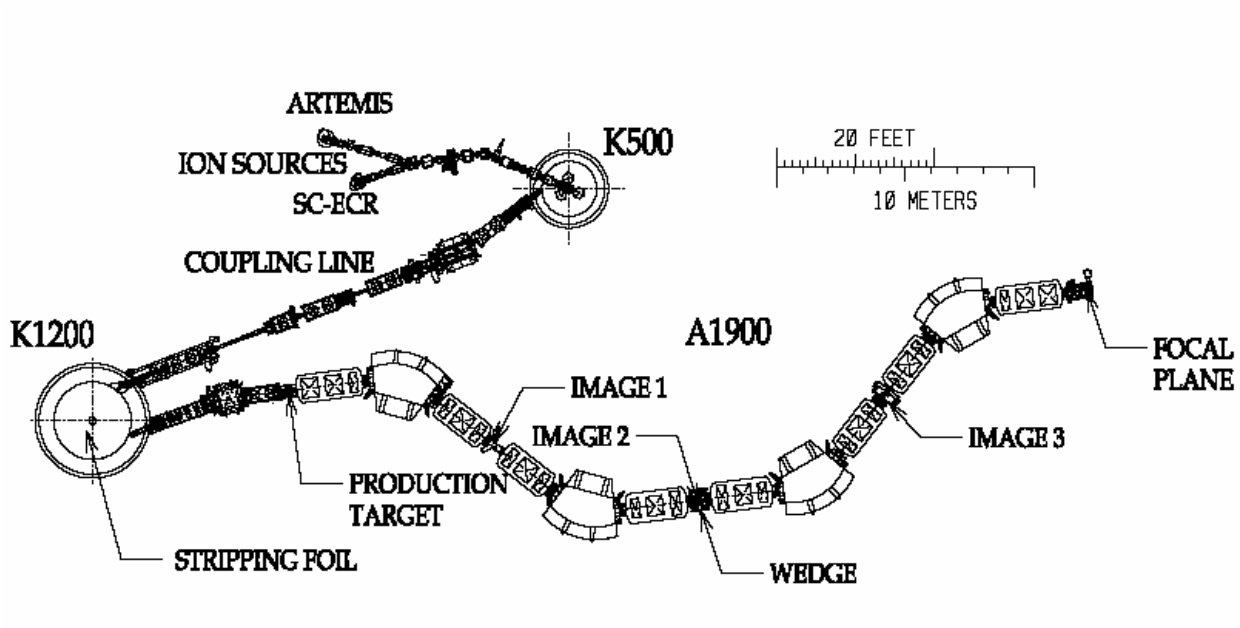
(c)Injection
Ion Source: ECR
Source Bias Voltage (kV): 30 kV max
External Injection: radial
Buncher Type: none
Injection Energy (MeV/n): approx. Efinal/11
Component: K500 cyc., internal stripper foil
Injection Efficiency (%): 65%
Injector: K500 Cyclotron

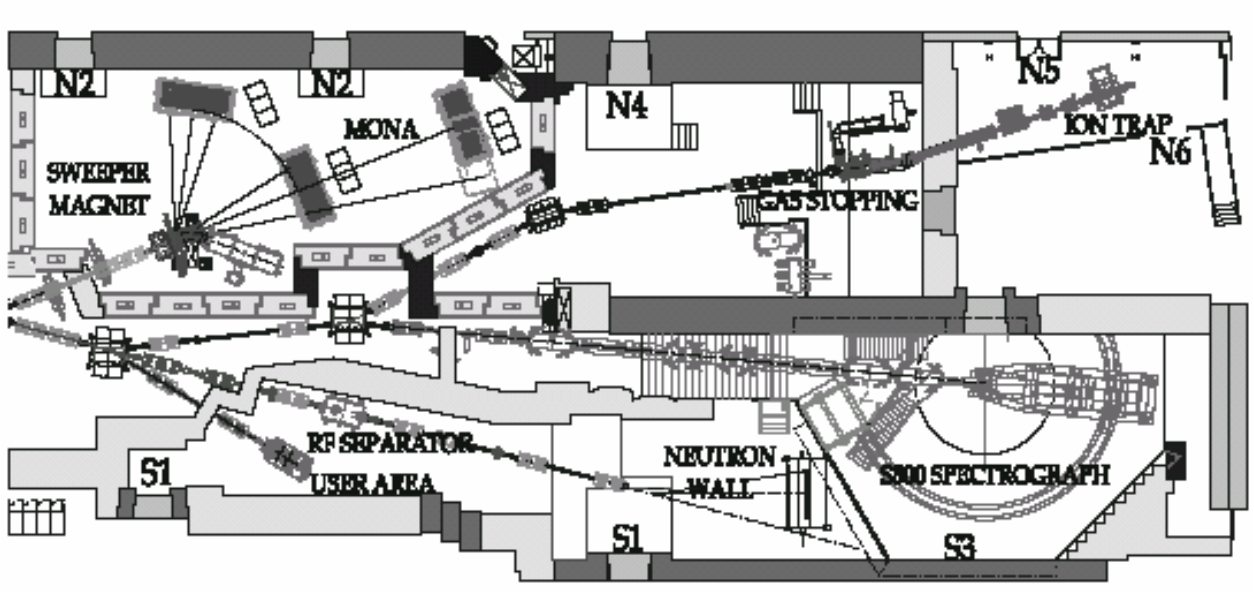
(d)Extraction
Elements, Characteristic: electrostatic deflectors (2), 6mm gap, 130 kV/cm; movable passive magnetic dipole and 2 compensators, movable focusing bars (8) and compensators (5), precessional
Typical Efficiency (%): 70
Best Efficiency (%): 90
(e)Vacuum
Pumps: 2 cryopanels, 7K, Cu+charcoal, 2500 l/s/panel, 3 TMP's
Achieved Vacuum (Pa): 9.3e-5

REFERENCES
MSU Reports MSUCP 29 (June 80) and MSUCP35 (June 81) MSUCP-939 (July 94) "The K500 x K1200" Proc. 11th Int. Conf. on Cyclotrons (1986)157

EXPERIMENTAL FACILITIES

Magnetic spectrometer S800, Segmented Germanium Array, RF Separator, Modular Neutron Array, Neutron Wall, Sweeper magnet, Gas stopping target, Low energy beam ion transport, Ion trap.





ENTRY N° C53
Date: 2/6/08
Machine name: Oak Ridge Isochronous Cyclotron (ORIC)
Institution: Oak Ridge National Laboratory
Address: P.O. Box 2008, MS 6368, Oak Ridge, TN 37831
Telephone: (865) 574-4759
Fax: (865) 574-1268
Web Address:
http: //www.phy.ornl.gov/hribf/accelerator/oricweb/
Person in charge of cyclotron: B. Alan Tatum
Person reporting information: B. Alan Tatum
E-mail address: tatumba@ornl.gov

HISTORY
Designed by: ORNL
Constructed by: ORNL
Construction dates: 1959-1962
First beam date: 1963
Characteristic beam, energy and current:

Proton	54 MeV	50euA
Deuteron	50 MeV	30euA
Alpha	105 MeV	20euA

Transmission efficiency (source to extracted beam)
Typical (%): 60
Best (%): 80
Emittance
Emittance definition:
Vertical (pi mm mrad): 30 (radial)
Horizontal (pi mm mrad): 10 (axial)
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 70
Development(%): 10
Therapy(%) : 0
Isotope production (%): 0
Other application (%) : 0
Maintenance (%): 10
Beam tuning(%): 10
Total time (h/year): 2000

TECHNICAL DATA
(a) Magnet: **Type:** Conventional Isochronous
Kb: 105 MeV/A **Kf:** 75 MeV/A
Average field (min./max. T): 1.92T
Number of magnet sectors: 3
hill angular width (deg.): 72 deg at extraction
spiral (max): 30 deg
Pole parameters
Diameter: 1.93 m
Injection radius (m):
Extraction radius (m): .80
Hill gap (m): .19m Valley gap (m): .71
Trim coils
Number: 10x2
Maximum current (A-turns): 7200
Harmonic coils
Number: 4xNsectorsx2
Maximum current (A-turns):
Main coils
Number: 1x2
Total current (A-turns): 1,600,000
Maximum current (A): 5000
Stored energy (MJ): ~10
Total iron weight (tons): 200
Total coil weight (tons): 9
Power
Main coils (total KW): 1750
Trim coils (total, maximum, KW): 250
Refrigerator (cryogenic, KW): not applicable

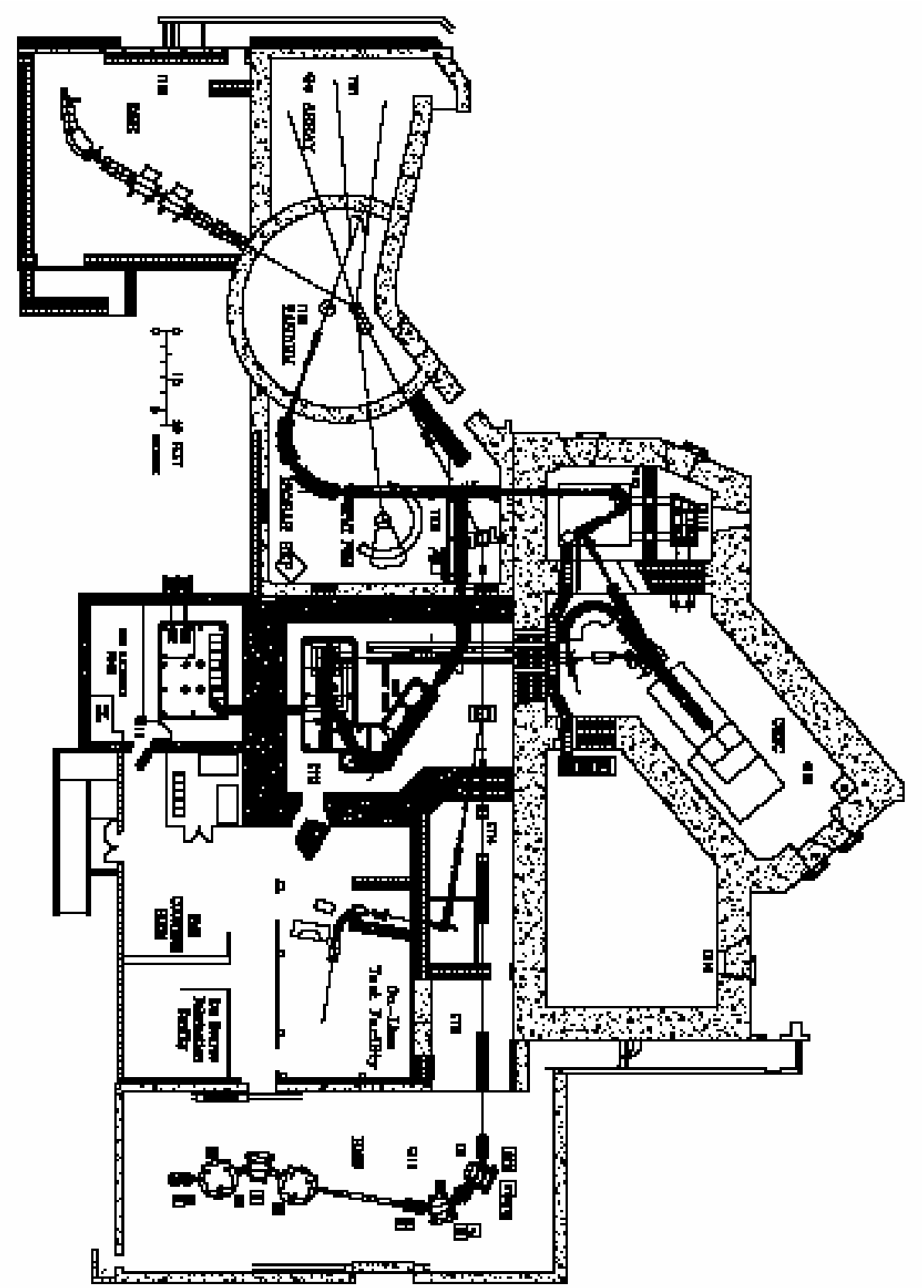
(b) RF
Frequency range (MHz): 6.8-20.1
Harmonic modes: 1,3
Number of dees: 1
Number of cavities: 1
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV): N/A
at extraction (peak to ground, KV): 60
peak (peak to ground, KV): 60
Line Power (max, KW): 200
Phase Stability (deg.): ±1
Voltage Stability (%): 0.05%

(c) Injection
Ion Source: Penning
Source Bias Voltage (kV): 5
External Injection: not applicable
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector: none

(d) Extraction
Elements, Characteristic: Electrostatic Deflector, Coaxial Magnetic Channel, Iron-Compensated Lower Magnetic Channel
Typical Efficiency (%): 55
Best Efficiency (%): 85

(e) Vacuum
Pumps: 3 diffusion, 1 cryogenic
Achieved Vacuum (Pa): 2.66×10^{-4}

EXPERIMENTAL FACILITIES
Recoil Mass Spectrometer (RMS), Daresbury Recoils Separator, Enge Spectrograph, CLARION Array, High Power Target Laboratory



(HPTL)

ENTRY NO: C54
Date: 15 Feb 2005 15:04:31
Machine Name: Texas A&M K500 Cyclotron
Institution: Texas A&M University
Address: Cyclotron Institute, College Station 77843
Telephone: 979/845-1411
Fax: 979/8451899
Web Address: http://cyclotron.tamu.edu
Person in Charge of Cyclotron: R. E. Tribble
Person Reporting Information: D. P. May
E-mail Address: may@comp.tamu.edu
History
Designed by: Michigan State & Texas A&M
Construction Dates: 1982-1988
First Beam Date: June 15, 1988
Characteristic Beams
ions / energy(MeV/N)/current(pps)/power(w)
16O8+ 60 1.3E11 20
40Ar13+ 40 7.2E11 185
84Kr27+ 40 2.3E8 0.12
197Au33+ 10.5 3.3E1 0 11
Transmission Efficiency (source to extracted beam)
Typical (%): 6
Best (%): 12.9
Emittance
Emittance Definition: RMS
Vertical (pi mm mrad): 5
Horizontal (pi mm mrad): 5
Longitudinal (dE/E[%] x RF[deg.]):
USES
Basic Research (%): 41
Development (%): 12
Therapy (%): 0
Isotope Production (%): 0
Other Application (%): 18
Maintenance (%): 18
Beam Tuning (%): 11
Total Time (h/year): 8000
TECHNICAL DATA
(a)Magnet
Type: Compact superconducting
Kb (MeV): 520
Kf (MeV): 160
Average Field (min./max. T): 3.1/4.9
Number of Sectors: 3
Hill Angular Width (deg.): 60
Spiral (deg.): 169.4
Pole Diameter (m): 1.42
Injection Radius (m): 0.008
Extraction Radius (m): 0.67
Hill Gap (m): 0.0635
Valley Gap (m): 0.914
Trim Coils
Number: 13x2
Maximum Current (A-turns): 4000
Harmonic Coils
Number: 2xNsectorsx2
Maximum Current (A-turns): 4000
Main Coils
Number: 2x2
Total Ampere Turns: 4.4E6
Maximum Current (A): 800
Stored Energy (MJ): 16.9
Total Iron Weight (tons): 100
Total Coil Weight (tons):
Power
Main Coils (total KW):
Trim Coils (total, maximum, KW): 200
Refrigerator (cryogenic, KW): 0.2
(b)RF
Acceleration
Frequency Range (MHz): 9-28
Harmonic Modes: 1, 2
Number of Dees: 3
Number of Cavities: 6
Dee Angular Width (deg.):60
Voltage
At Injection (peak to ground, KV): 20-90
At Extraction (peak to ground, KV): 20-90
Peak (peak to ground, KV): 20-90
Line Power (max, KW): 240
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.01
(c)Injection
Ion Source: 6.4 GHz High-B ECRIS
Source Bias Voltage (kV): 2-15
External Injection: axial
Buncher Type: 1st & 2nd harm., 1 gap
Injection Energy (MeV/n): 0.0005-0.007
Component: 3 dipoles, 5 solenoids
Injection Efficiency (%): 10-25
Injector:
(d)Extraction
Elements, Characteristic: 2 electrostatic deflectors, 5 passive
moveable magnetic channels, and 1 passive fixed magnetic
channel.
Typical Efficiency (%): 50-60
Best Efficiency (%): 90
(e)Vacuum
Pumps: 3 turbos & 3 internal LHe cryopanels
Achieved Vacuum (Pa): 1.0E-5
REFERENCES
EXPERIMENTAL FACILITIES
Neutron Ion Multidetector (NIMROD), BaF2 Array, MDM-2
Spectrometer, Momentum Achromat Recoil Spectrometer
(MARS), Radiation Effects Facility
COMMENTS

ENTRY N° CM1
Date: 12-02-2008
Machine Name: IBA C10 Cyclotron
Institution: Ion Beam Applications (IBA)
Address: Chemin du Cyclotron 3 - 1348 Louvain-La-Neuve Belgium
Telephone: +32-10-475811Fax Number: +32-10-475810
Web Address: www.iba-worldwide.be
Person in Charge of Cyclotron: S. Zaremba
Person Reporting Information: W. Kleeven
Email Address: info-cyclo@iba-group.com

HISTORY
Designed by: Ion Beam Applications (IBA)
Construction Date: 2003-2004
First Beam Date: November 2004
Characteristic Beams
ion proton; energy 10 MeV; current 100 microA; power 1 kWatt
Transmission Efficiency (source to extracted beam)
Typical (%): 60 %
Best (%): 65 %
Emittance
Emittance definition:
Vertical (pi mm mrad): -
Horizontal (pi mm mrad): -
Longitudinal (dE/E[%] x RF[deg.]): -

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%): 100 %
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year):

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV/A): 10 MeV/A
Kf (MeV/A): 10 MeV/A
Average Field (min./max. T): 1.35 (0.4/1.9) T
Number of Sectors: 4 Hill
angular width (deg.): 54 deg
Spiral (deg.): 0 deg
Pole diameter (m): 0.76 m
Injection Radius (m): 0.02 m
Extraction Radius (m): 0.35 m
Hill Gap (m): 0.03
Valley Gap (m): 0.8
Trim Coils
Number: 0
Maximum Current (A-turns): N/A
Harmonic Coils
Number: 0
Maximum Current (A-turns): N/A
Main Coils Number: 2
Total Ampere Turns: 112000
Maximum Current (A): 200
Stored Energy (MJ): 0.015 MJ
Total Iron Weight (tons): 12 Tons
Total Coil Weight (tons): 1.25 Tons
Power
Main Coils (total KW): 17 kWatt
Trim Coils (total, maximum, KW): N/A
Refrigerator (cryogenic, KW): N/A

(b)RF
Frequency Range (MHz): 40 MHz
Harmonic Mode: 2
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.): 30 deg
Voltage
At Injection (peak to ground, KV): 32 kV
At Extraction (peak to ground, KV): 32 kV
Peak (peak to ground, KV): 32 kV
Line Power (max, KW): 10 kW
Phase Stability (%): 0.1
Voltage Stability (%): 0.1

(c)Injection
Ion Source: PIG
Source Bias Voltage (kV): N/A
External Injection: N/A
Buncher Type: N/A
Injection Energy (MeV/n): N/A
Component: N/A
Injection Efficiency (%): N/A
Injector: N/A

(d)Extraction
Elements, Characteristic: Stripping
Typical Efficiency (%): 100 %
Best Efficiency (%): 100 %

(e)Vacuum
Pumps: 1 ODP
Achieved Vacuum (Pa): 5*10-5

COMMENTS
self-shielded version available

ENTRY N° CM2
Date: 12-02-2008
Machine Name: Cyclone 10/5
Institution: Ion Beam Applications (IBA)
Address: chemin du cyclotron, 31348 Louvain neuve, Belgium la
Telephone: + 32 10 47 58 11
Fax Number: + 32 10 475810
Web Address: www.iba-worldwide.com
Person in Charge of Cyclotron: Yves Jongen
Person Reporting Information: Geets jean-michel
Email Address: info-cyclo@iba-group.com

HISTORYDesigned by: IBA
Construction Date: 1989
First Beam Date: 1990
Characteristic Beams
10 MeV proton 100 microA external
5 MeV deuton 50 microA
Transmission Efficiency (source to extracted beam)
Typical (%): 55
Best (%): 60
Emittance
Emittance definition: -
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%): 100
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year):

TECHNICAL DATA
(a)Magnet Type: compact
Kb (MeV/A): 10
Kf (MeV/A): 10
Average Field (min./max. T): 1.3 (0.4/1.9)
Number of Sectors: 4
Hill angular width (deg.): 54
Spiral (deg.): 0
Pole diameter (m): 0.76
Injection Radius (m): 0.02
Extraction Radius (m): 0.35
Hill Gap (m): 0.03
Valley Gap (m): 0.80
Trim Coils Number: 0
Maximum Current (A-turns): N/A
Harmonic Coils Number: 0
Maximum Current (A-turns):N/A
Main Coils Number: 2
Total Ampere Turns: 112000
Maximum Current (A): 200
Stored Energy (MJ):
Total Iron Weight (tons): 12
Total Coil Weight (tons): 1.25
Power
Main Coils (total KW): 17
Trim Coils (total, maximum, KW): -
Refrigerator (cryogenic, KW): -

(b)RF
Frequency Range (MHz): 40
Harmonic Mode: 2 p/ 4 d
Number of Dees: 2
Number of Cavities: 2
Dee Angular Width (deg.): 30
Voltage
At Injection (peak to ground, KV): 32
At Extraction (peak to ground, KV): 32
Peak (peak to ground, KV): 32
Line Power (max, KW): 10
Phase Stability (%):0.1
Voltage Stability (%): 0.1

(c)Injection
Ion Source: 2 internal PIG
Source Bias Voltage (kV): N/A
External Injection: N/A
Buncher Type: N/A
Injection Energy (MeV/n): N/A
Component:
Injection Efficiency (%):
Injector:

(d)Extraction
Elements, Characteristic: carbon stripper
Typical Efficiency (%): 100
Best Efficiency (%):

(e)Vacuum Pumps: oil diffusion pump
Achieved Vacuum (Pa): 1 e-5

REFERENCES
EPAC 1990, Y Jongen et al., Nice 1990

COMMENTS
(2007) 22 units sold, self-shielded version available

ENTRY N° CM3
Date: 12-02-2008
Machine name: Cyclone 14 +
Institution: Ion Beam Application
Address: ch cyclotron, 3
1348 louvain la neuve, Be
Telephone: +32 10 475 811
Fax: + 32 475 810
Web Address: www.iba-worldwide.com
Person in charge of cyclotron: IBA TG
Person reporting information: Geets Jean-michel
E-mail address: info-cyclo@iba-group.com

HISTORY
Designed by: IBA
Constructed by: 1996
Construction dates: 1997
First beam date: 1997
Characteristic beam, energy and current:
P 14 MeV 5.e15 pps 14 kW
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development():
Therapy();
Isotope production (): 100 %
Other application ( ) :
Maintenance ():
Beam tuning():
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 18 **Kf:** 18
Average field (min./max. T): 1.15
Number of magnet sectors: 4
hill angular width (deg.): 56
spiral (max): 0
Pole parameters
Diameter: 1.08
Injection radius (m): 0
Extraction radius (m):
Hill gap (m): 0.03
Valley gap (m): 0.65
Trim coils
Number: 0
Maximum current (A-turns):
Harmonic coils
Number: 0
Maximum current (A-turns):
Main coils
Number: 1X 2
Total current (A-turns): 86400
Maximum current (A): 120
Stored energy (MJ):
Total iron weight (tons): 24
Total coil weight (tons): 2
Power
Main coils (total KW): < 10
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 83
Harmonic modes: 4
Number of dees: 2
Number of cavities : 2
Dee angular width (deg.): 30
Voltage
at injection (peak to ground, KV): 45
at extraction (peak to ground, KV):
peak (peak to ground, KV): 45
Line Power (max, KW): < 25
Phase Stability (deg.):
Voltage Stability (): 5 e.-3

(c) Injection
lon Source: PIG
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: internal target
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps: oil diffusion
Achieved Vacuum (Pa): 2 e-3

REFERENCES:

EXPERIMENTAL FACILITIES

2 units at IBt- Belgium

ENTRY N° CM4
Date: 12-02-2008
Machine name: Cyclone 14 SE
Institution: Ion Beam Application
Address: ch cyclotron, 3
1348 louvain la neuve, Be
Telephone: +32 10 475 811
Fax: + 32 475 810
Web Address: www.iba-worldwide.com
Person in charge of cyclotron: Lambert Bernard
Person reporting information: Geets Jean-michel
E-mail address: info-cyclo@iba-group.com

HISTORY
Designed by: IBA
Constructed by: IBA
Construction dates: Jan 98- Dec 2000
First beam date: Dec 2000
Characteristic beam, energy and current:
P 14 MeV 5 mA 70 kW
Transmission efficiency (source to extracted beam)
Typical (%): 75
Best (%): 80
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development():
Therapy();
Isotope production (): 100 %
Other application ( ) :
Maintenance ():
Beam tuning():
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 14 **Kf:** 14
Average field (min./max. T): 1.1 (1.8/ 0.3)
Number of magnet sectors: 4
hill angular width (deg.): 45
spiral (max): 0
Pole parameters
Diameter: 1.08
Injection radius (m): 0.02
Extraction radius (m): 0.48
Hill gap (m): 0.04 – 0.015
Valley gap (m): 0.67
Trim coils
Number: 0
Maximum current (A-turns):
Harmonic coils
Number: 2X2
Maximum current (A-turns): 300
Main coils
Number: 1X 2
Total current (A-turns): 126000
Maximum current (A): 175
Stored energy (MJ): 0.03
Total iron weight (tons): 20
Total coil weight (tons): 2
Power
Main coils (total KW): 22
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 67
Harmonic modes: 4
Number of dees: 2
Number of cavities : 4
Dee angular width (deg.): 40
Voltage
at injection (peak to ground, KV): 45
at extraction (peak to ground, KV): 55
peak (peak to ground, KV): 55
Line Power (max, KW): < 100
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.1

(c) Injection
Ion Source: PIG
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic:
Self-extraction principle
Typical Efficiency (%): 75
Best Efficiency (%): 80

(e) Vacuum
Pumps: oil diffusion
Achieved Vacuum (Pa): 2 e-3

REFERENCES:
EPAC 2000, Self-extraction in a compact high intensity cyclotron, Kleeven et al.
Cyclotron 2001, the self-extrcating cyclotron, Lucas et al.
Cyclotron 2001, Magnetic field calculation and shimming of the self-extracting cyclotron, Jongen et al.

EXPERIMENTAL FACILITIES
IBA isotopes production facility, Fleurus, Belgium

ENTRY N° CM5
Date: 12-02-2008
Machine Name: Cyclone 18/9
Institution: Ion Beam Applications (IBA)
Address: chemin du cyclotron, 31348 Louvain la **Neuve, Belgium**
Telephone: + 32 10 47 58 11
Fax Number: + 32 10 47 58 10
Web Address: www.iba-worldwide.com
Person in Charge of Cyclotron: Yves Jongen
Person Reporting Information: Geets Jean-Michel
Email Address: info-cyclo@iba-group.com

HISTORY
Designed by: IBA
Construction Date: 03/92
First Beam Date: 1992
Characteristic Beams
18 MeV proton 100 - 150 microA
9 MeV deuton 50 microA
Transmission Efficiency (source to extracted beam)
Typical (%): 55
Best (%): 60
Emittance
Emittance definition: -
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%): 5
Development (%):
Therapy (%):
Isotope Production (%): 95
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year):

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV/A): 18
Kf (MeV/A): 18
Average Field (min./max. T): 1.35 (0.35/1.9)
Number of Sectors: 4
Hill angular width (deg.): 57
Spiral (deg.): 0
Pole diameter (m): 1.08
Injection Radius (m): 0.03
Extraction Radius (m): 0.48
Hill Gap (m): 0.03
Valley Gap (m): 0.67
Trim Coils Number: 0
Maximum Current (A-turns): N/A
Harmonic Coils Number: 0
Maximum Current (A-turns): N/A
Main Coils Number: 2
Total Ampere Turns: 112000
Maximum Current (A): 200
Stored Energy (MJ): -
Total Iron Weight (tons): 20
Total Coil Weight (tons): 2
Power Main Coils (total KW): 15
Trim Coils (total, maximum, KW): -
Refrigerator (cryogenic, KW): -

(b)RF
Frequency Range (MHz): 42
Harmonic Mode: 2p/ 4d
Number of Dees: 2
Number of Cavities: 4
Dee Angular Width (deg.): 30
Voltage
At Injection (peak to ground, KV): 32
At Extraction (peak to ground, KV): 32
Peak (peak to ground, KV): 32
Line Power (max, KW): 10
Phase Stability (%): 0.1
Voltage Stability (%): 0.1

(c)Injection Ion Source: 2 PIG internal
Source Bias Voltage (kV): 0
External Injection: N/A
Buncher Type: N/A
Injection Energy (MeV/n): N/A
Component:
Injection Efficiency (%):
Injector:

(d)Extraction Elements,
Characteristic: carbon stripper
Typical Efficiency (%): 100
Best Efficiency (%): 100

(e)Vacuum Pumps: 4 x Oil diffusion
Achieved Vacuum (Pa): 7 e-5

REFERENCES
EPAC 1990, Y Jongen, Nice 1990

EXPERIMENTAL FACILITIESCOMMENTS
(2007) 90 units sold, self-shielded version available

ENTRY N° CM6
Date: 12-02-2008
Machine Name: Cyclone 30
Institution: Ion Beam Applications (IBA)
Address: chemin du cyclotron, 31348 Louvain la Neuve, Belgium
Telephone: + 32 10 47 58 11
Fax Number: + 32 10 475810
Web Address: www.iba-worldwide.com
Person in Charge of Cyclotron: Yves Jongen
Person Reporting Information: Geets jean-michel
Email Address: info-cyclo@iba-group.com

HISTORY
Designed by:
Construction Date: 1986
First Beam Date: 1986
Characteristic Beams
15- 30 MeV proton 400- 750- 1200 microA
Transmission Efficiency (source to extracted beam)
Typical (%): 30
Best (%): 35
Emittance
Emittance definition:
Vertical (pi mm mrad): 10
Horizontal (pi mm mrad): 5
Longitudinal (dE/E[%] x RF[deg.]): 1

USES Basic Research (%): 5
Development (%):
Therapy (%):
Isotope Production (%): 95
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year):

TECHNICAL DATA
(a)Magnet Type: compact
Kb (MeV/A): 30
Kf (MeV/A): 30
Average Field (min./max. T): 1(0.12/ 1.7)
Number of Sectors: 4
Hill angular width (deg.): 54-58
Spiral (deg.): 0
Pole diameter (m): 1.6
Injection Radius (m): 0.03
Extraction Radius (m): 0.5 - 0.75
Hill Gap (m): 0.03
Valley Gap (m): 0.1
Trim Coils Number: 0
Maximum Current (A-turns): N/A
Harmonic Coils Number: 0
Maximum Current (A-turns): N/A
Main Coils Number: 2
Total Ampere Turns: 60 000
Maximum Current (A): 110
Stored Energy (MJ):
Total Iron Weight (tons): 45
Total Coil Weight (tons): 4
Power Main Coils (total KW): 7.2
Trim Coils (total, maximum, KW): N/A
Refrigerator (cryogenic, KW): N/A

(b)RF
Frequency Range (MHz): 66
Harmonic Mode: 4
Number of Dees: 2
Number of Cavities: 4
Dee Angular Width (deg.): 30
Voltage
At Injection (peak to ground, KV): 50
At Extraction (peak to ground, KV): 50
Peak (peak to ground, KV): 50
Line Power (max, KW): 40
Phase Stability (%): 0.1
Voltage Stability (%): 0.1

(c)Injection
Ion Source: multicusp
Source Bias Voltage (kV): 30
External Injection:
axial Buncher Type: wire
Injection Energy (MeV/n): 0.03
Component:
Injection Efficiency (%): 35
Injector: inflector

d)Extraction
Elements, Characteristic: carbon stripper
Typical Efficiency (%): 100
Best Efficiency (%):

(e)Vacuum Pumps: cryo pump 4000l/s (N2)
Achieved Vacuum (Pa): 1 E-5

REFERENCES
ACC92, Y Jongen et al., St-Petersburg 1992EPAC 1990, Y Jongen et al., Nice 1990

COMMENTS
(2007) 24 units in operation

ENTRY N° CM7
Date: 12-02-2008
Machine name: Cyclone 70
Institution: Ion Beam Applications (IBA)
Address: Chemin du Cyclotron 3,
1348 Louvain-La- Neuve, Belgium
Telephone: +32 10 47 58 11
Fax: +32 10 47 58 10
Web Address: www.iba-worldwide.com
Person in charge of cyclotron: Yves Jongen
Person reporting information: Wiel Kleeven
E-mail address: info-cyclo@iba-group.com

HISTORY
Designed by: IBA
Constructed by: IBA
Construction dates: facility under construction, '06-'08
First beam date: planned end of 2008
Characteristic beam, energy and current:
30-70 MeV, 750 µA H-minus
15-35 MeV, 50 µA D-minus
35 MeV, 50 µA H2+
70 MeV, 70 µA alpha
Transmission efficiency (source to extracted beam)
Typical (%): not yet known
Best (%): not yet kown
Emittance:
Emittance definition:
Vertical (pi mm mrad): not yet known
Horizontal (pi mm mrad): not yet known
Longitudinal (dE/E[%] x RF[deg.]): not yet known

USES
Basic research (%): yes, not yet known
Development(%): not yet known
Therapy(%) : no
Isotope production (%): yes, not yet known
Other application (%) : yes, not yet known
Maintenance (%): not yet known
Beam tuning(%):not yet known
Total time (h/year): not yet known

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 70 **Kf:** 70
Average field (min./max. T): 1.0
Number of magnet sectors: 4
hill angular width (deg.): 56
spiral (max): 0
Pole parameters
Diameter: 2.48
Injection radius (m): 0.03
Extraction radius (m): variable
Hill gap (m): 0.03 **Valley gap (m):** 0.8
Trim coils
Number: 3
Maximum current (A-turns): 300 A
Harmonic coils
Number: 0
Maximum current (A-turns):
Main coils
Number: 2
Total current (A-turns): 62100
Maximum current (A): 260
Stored energy (MJ):
Total iron weight (tons): 120 T
Total coil weight (tons): 4 T
Power
Main coils (total KW): 60
Trim coils (total, maximum, KW): 54
Refrigerator (cryogenic, KW): na

(b) RF
Frequency range (MHz): 30.4
Harmonic modes: 2 (H-minus), 4 (other particles)
Number of dees: 2
Number of cavities: 4
Dee angular width (deg.): 30
Voltage
at injection (peak to ground, KV): 65
at extraction (peak to ground, KV): 70
peak (peak to ground, KV): 70
Line Power (max, KW): 150
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.1

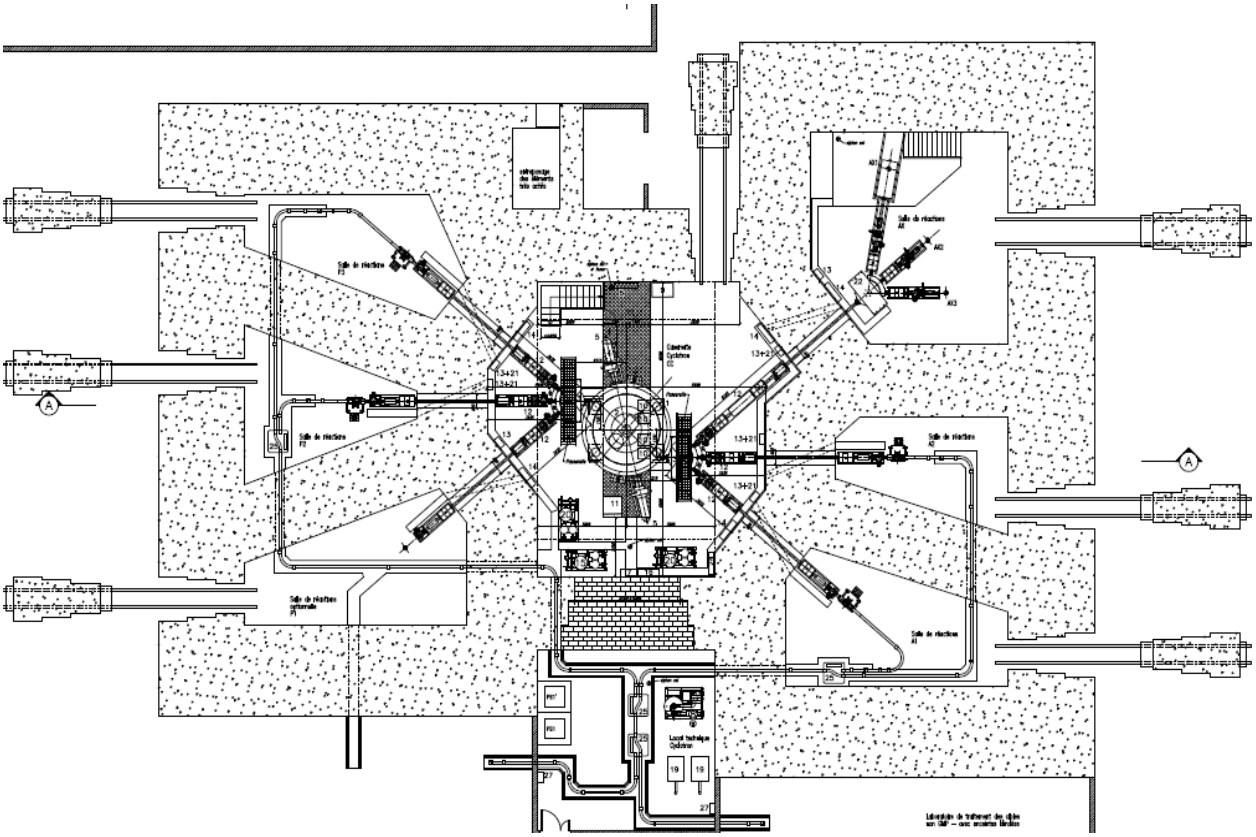
(c) Injection
Ion Source: ECR & multicusp
Source Bias Voltage (kV): 20 kV & 40 kV
External Injection: axial/spiral inflector
Buncher Type: 2-gap
Injection Energy (MeV/n): 40 keV
Component:
Injection Efficiency (%): 30
Injector:

(d) Extraction
Elements,
Characteristic: stripping (H-,D-), ESD (H2+,alpha)
Typical Efficiency (%): not yet known
Best Efficiency (%): not yet known

(e) Vacuum
Pumps: 4* cryopumps
Achieved Vacuum (Pa):

REFERENCES: 18th International Conference on Cyclotrons and their Applications, 2007
1) IBA C70 Cyclotron Development MOZCR06,
2) Extraction Simulations for the IBA C70 Cyclotron MOPPRB14, (IBA, Louvain-la-Neuve)
3) Injection and Central Region Design for the IBA C70 cyclotron MOPPRB15, (IBA, Louvain-la-Neuve)
4) Magnetic Field Design and Calculations for the IBA C70 Cyclotron TUPPRA06
5) The Magnetic Field Mapping System for the IBA C70 Cyclotron TUPPRA07, (IBA, Louvain-la-Neuve)

EXPERIMENTAL FACILITIES
ARRONAX ; http://www.arronax-nantes.fr/



ENTRY N° CM8
Date: 12-02-2008
Machine name: C230
Institution: Ion Beam Applications
Address: Chemin du Cyclotron, 3
B-1348 Louvain-la-Neuve
Telephone: +32 10 475811
Fax: +32 10 475810
Web Address: http://www.iba-worldwide.com
Person in charge of cyclotron: Patrick Verbruggen
Person reporting information: Patrick Verbruggen
E-mail address: patrick.verbruggen@iba-group.com

HISTORY
Designed by: IBA
Constructed by: IBA
Construction dates:
First beam date:
Characteristic beam, energy and current:
230MeV 500nA proton beam
Transmission efficiency (source to extracted beam)
Typical (%): 40%
Best (%): 50%
Emittance
Emittance definition: 1 sigma
Vertical (pi mm mrad): 5.5
Horizontal (pi mm mrad): 4
Longitudinal (dE/E[%] x RF[deg.]): +/-7

USES
Basic research (%): 0
Development(%): 0
Therapy(%): 97
Isotope production (%): 0
Other application (%): 0
Maintenance (%): 2
Beam tuning(%): 1
Total time (h/year): 5000

TECHNICAL DATA
(a) Magnet: **Type:** Compact
Kb: 235 **Kf:** 230
Average field (min./max. T): 1.7 / 2.15
Number of magnet sectors: 4
hill angular width (deg.): 54°
spiral (max): 60°
Pole parameters
Diameter: 2.24
Injection radius (m): 0.02
Extraction radius (m): 1.056
Hill gap (m): 0.096 / 0.009 Valley gap (m): 0.6
Trim coils
Number: 0
Maximum current (A-turns):
Harmonic coils
Number: 8
Maximum current (A-turns): 828
Main coils
Number: 2
Total current (A-turns): 523720
Maximum current (A): 800A
Stored energy (MJ): 2.2
Total iron weight (tons): 210T
Total coil weight (tons): 20T
Power
Main coils (total KW): 200kW
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 106MHz
Harmonic modes: 4
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 30°
Voltage
at injection (peak to ground, KV): 55kV
at extraction (peak to ground, KV): 150kV
peak (peak to ground, KV): 150kV
Line Power (max, KW): 100kW
Phase Stability (deg.): NA
Voltage Stability (%): 5.e-2

(c) Injection
Ion Source: internal PIG source
Source Bias Voltage (kV): 0
External Injection: NA
Buncher Type: NA
Injection Energy (MeV/n): NA
Component:
Injection Efficiency (%): NA
Injector:

(d) Extraction
Elements, Characteristic: electrostatic deflector 18MV/m, passive gradient corrector, permanent magnet quadrupole doublet.
Typical Efficiency (%): 60%
Best Efficiency (%): 70%

(e) Vacuum
Pumps: Oil diffusion pumps (optional cryogenic pumping)
Achieved Vacuum (Pa): 1.e-4

ENTRY N° CM9
Date: 26/Feb/08
Machine Name: ECLIPSE**Institution:** Siemens Medical Solutions USA, Inc
Address: 810 Innovation Dr., Knoxville, TN, 37934
Telephone: +1-865-218-2000
Fax Number: +1-865-218-3000**Web Address:** www.siemens.com/mi
Person in Charge of Cyclotron: Michael Reitermann**Person Reporting Information:** Rudi Verbruggen
Email Address: rudi.verbruggen@siemens.com

HistoryDesigned by: SIEMENS**Construction Date:** September 1990
First Beam Date: December 1991**Characteristic Beamsion energy current power (W)** H-
11 MeV 120 µA 1320
Transmission Efficiency (source to extracted beam) Typical (%): 17 % **Best (%):** 20 %**EmittanceEmittance definition**: **Vertical (pi mm mrad): -Horizontal (pi mm mrad): -Longitudinal (dE/E[%] x RF[deg.]):** -

USESBasic Research (%): Development (%): Therapy (%): Isotope Production (%): 100 %**Other Application (%): Maintenance (%): Beam Tuning (%): Total Time (h/year):** 500 – 2800

TECHNICAL DATA(a)MagnetType: compact**Kb (MeV/A):** 11MeV/A**Kf (MeV/A):** 11 MeV/A**Average Field (min./max. T):** 1.2 T **Number of Sectors:** 4**Hill angular width (deg.):** 56 dg
Spiral (deg.): 0 deg**Pole diameter (m):** 0.90 **Injection Radius (m):** N/A
Extraction Radius (m): 0.40**Hill Gap (m):** 0.015**Valley Gap (m):** 0.40**Trim CoilsNumber:** 0**Maximum Current (A-turns):** N/A**Harmonic CoilsNumber:** 0**Maximum Current (A-turns):** N/A**Main CoilsNumber:** 1**Total Ampere Turns:** 37,400
Maximum Current (A): 300 **Stored Energy (MJ):** N/A**Total Iron Weight (tons):** 10 Tons**Total Coil Weight (tons):** 1 Ton**PowerMain Coils (total KW):** 3 kWatt**Trim Coils (total, maximum, KW):** N/A**Refrigerator (cryogenic, KW):** N/A

(b)RFFrequency Range (MHz): 72 MHzHarmonic Mode: 4**Number of Dees:** 4**Number of Cavities:** 4**Dee Angular Width (deg.):** 30 deg**VoltageAt Injection (peak to ground, KV):** 20 **At Extraction (peak to ground, KV):** 20 **Peak (peak to ground, KV):** 20 **Line Power (max, KW):** 10 kW**Phase Stability (%):** N/A**Voltage Stability (%):** N/A

(c)InjectionIon Source: PIG**Source Bias Voltage (kV):** 15 kV**External Injection:** N/A**Buncher Type:** N/A**Injection Energy (MeV/n):** N/A**Component:** N/A**Injection Efficiency (%):** N/A**Injector:** N/A

(d)ExtractionElements, Characteristic: Stripping**Typical Efficiency (%):** 100 %**Best Efficiency (%):** 100 %**(e)VacuumPumps: Achieved Vacuum (Pa):** $5*10^{-5}$

COMMENTS The Eclipse HP and RD are 11 MeV proton-only, self-shielded, cyclotron systems for commercial PET isotope production. Over 190 systems have been sold worldwide.

ENTRY N° CM10
Date: 15/Dec/07
Machine name: 370V
Institution: Sumitomo Heavy Industries, Ltd.
Address: ThinkPark Tower, 1-1, Osaki 2-chome
Shinagawa-ku, Tokyo 141-6025, Japan
Telephone: +81-3-6737-2000
Fax: +81-3-6866-5104
Web Address: www.shi.co.jp/quantum/index.htm1
Person in charge of cyclotron: Y.kumata
Person reporting information: Y.kumata
E-mail address: Yko_kumata@shi.co.jp

HISTORY
Designed by: Sumitomo Heavy Industries, Ltd.
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 1995
First beam date: 1996
Characteristic beam, energy and current:
p:2MeV 5uA, p:17MeV 50uA, d:9MeV 40uA
4He2+:4.5MeV/n 5uA, 3He2+:8MeV/n 10uA
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%):
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T): 0.55/1.66
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter:
Injection radius (m):
Extraction radius (m): 0.37
Hill gap (m): 0.07 **Valley gap (m):** 0.12
Trim coils
Number: 5 pairs
Maximum current (A-turns):
Harmonic coils
Number: 4 pairs
Maximum current (A-turns):
Main coils
Number:
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons):
Total coil weight (tons):
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 17-38MHz
Harmonic modes: 1 and 3
Number of dees: 1
Number of cavities: 1
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
lon Source: Livingston
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: Electrostatic deflector + gradient corrector
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps:
Achieved Vacuum (Pa):

ENTRY N° CM11
Machine name: HM-7S-A
Institution: Sumitomo Heavy Industries, Ltd.
Address: ThinkPark Tower, 1-1, Osaki 2-chome Shinagawa-ku, Tokyo 141-6025, Japan
Telephone: +81-3-6737-2000
Fax: +81-3-6866-5104
WebAddress: www.shi.co.jp/quantum/index.html
Person in charge of cyclotron: Y.kumata
Person reporting information: Y.kumata
E-mail address: Yko_kumata@shi.co.jp

HISTORY
Designed by: Sumitomo Heavy Industries, Ltd.
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 2006
First beam date: 2006
Characteristic beam, energy and current:

Ions	**/ energy(MeV/N)**	**/current (pps) / power (w)**
H-	7.5	70micro-ampere
D-(option)	3.75	30micro-ampere

Transmission efficiency (50mm radius to extracted beam)
Typical (%): 50
Best (%): 60
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%):100
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: **Kf:**
Average field (min./max. T): 1.69
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter (m): 0.610
Injection radius (m):
Extraction radius (m):0.233
Hill gap (m): 0.025 Valley gap (m): 0.090
Trim coils
Number: None
Maximum current (A-turns):
Harmonic coils
Number: None
Maximum current (A-turns):
Main coils
Number: 1x 2
Total current (A-turns): 74800
Maximum current (A): 180
Stored energy (MJ):
Total iron weight (tons): 5.4
Total coil weight (tons): 0.6
Power
Main coils (total KW): 9.6
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 51.5
Harmonic modes: 2(H-) / 4(D-)
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 45
Voltage
at injection (peak to ground, KV): 34
at extraction (peak to ground, KV): 34
peak (peak to ground, KV): 34
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source: PIG
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: Carbon foil, Stripping
Typical Efficiency (%): 100
Best Efficiency (%):

(e) Vacuum
Pumps: Cryopump
Achieved Vacuum (Pa): 2*10-5 Pa

COMMENTS
Clinical PET Facilities

ENTRY N° CM12
Date: 15/Dec/07
Machine name: HM-10S-C
Institution: Sumitomo Heavy Industries, Ltd.
Address: ThinkPark Tower, 1-1, Osaki 2-chome
Shinagawa-ku, Tokyo 141-6025, Japan
Telephone: +81-3-6737-2000
Fax: +81-3-6866-5104
Web Address: www.shi.co.jp/quantum/index.html
Person in charge of cyclotron: Y.kumata
Person reporting information: Y.kumata
E-mail address: Yko_kumata@shi.co.jp

HISTORY
Designed by: Sumitomo Heavy Industries, Ltd.
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates:
First beam date:
Characteristic beam, energy and current:
Ions / energy(MeV/N) /current (pps) / power (w)

H-	10	70micro-ampere
D-(option)	5	15micro-ampere

Transmission efficiency (50mm radius to extracted beam)
Typical (%): 50
Best (%): 60
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%): 100
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: **Kf:**
Average field (min./max. T): 1.65
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter (m): 0.680
Injection radius (m):
Extraction radius (m): 0.268
Hill gap (m): 0.025 **Valley gap (m):**0.090
Trim coils
Number: None
Maximum current (A-turns):
Harmonic coils
Number: None
Maximum current (A-turns):
Main coils
Number: 1x2
Total current (A-turns): 74016
Maximum current (A): 180
Stored energy (MJ):
Total iron weight (tons): 8.5
Total coil weight (tons): 0.8
Power
Main coils (total KW): 8
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 50.5
Harmonic modes: 2(H-) / 4(D-)
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 45
Voltage
at injection (peak to ground, KV): 35
at extraction (peak to ground, KV): 35
peak (peak to ground, KV): 35
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source: PIG
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: Carbon foil , Stripping
Typical Efficiency (%): 100
Best Efficiency (%):

(e) Vacuum
Pumps: Diffusion pump
Achieved Vacuum (Pa): 2*10-5 Pa

COMMENTS
Clinical PET Facilities

ENTRY N° CM13
Date: 15/Dec/07
Machine name: HM-12
Institution: Sumitomo Heavy Industries, Ltd.
Address: ThinkPark Tower, 1-1, Osaki 2-chome
Shinagawa-ku, Tokyo 141-6025, Japan
Telephone: +81-3-6737-2000
Fax: +81-3-6866-5104
Web Address: www.shi.co.jp/quantum/index.htm1
Person in charge of cyclotron: K.kumata
Person reporting information: K.kumata
E-mail address: Yko_kumata@shi.co.jp

HISTORY
Designed by: Sumitomo Heavy Industries, Ltd
Constructed by: Sumitomo Heavy Industries Ltd.
Construction dates: 1993
First beam date: 1996
Characteristic beam, energy and current:
p: 12MeV 150uA
d: 6MeV 40uA
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%):
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T): 1.5
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max): 0deg
Pole parameters
Diameter: 0.8m
Injection radius (m):.3
Extraction radius (m): 04
Hill gap (m): 0.036 **Valley gap (m):** 0.144
Trim coils
Number: 2 pairs
Maximum current (A-turns):
Harmonic coils
Number: none
Maximum current (A-turns):
Main coils
Number:
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons):
Total coil weight (tons):
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 45MHz
Harmonic modes: 2 and 4
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 45
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
lon Source: PIG
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: stripping (carbon foil)
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps:
Achieved Vacuum (Pa):

ENTRY N° CM14
Date: 15/Dec/07
Machine name: HM-18
Institution: Sumitomo Heavy Industries, Ltd.
Address: ThinkPark Tower, 1-1, Osaki 2-chome
Shinagawa-ku, Tokyo 141-6025, Japan
Telephone: +81-3-6737-2000
Fax: +81-3-6866-5104
Web Address: www.shi.co.jp/quantum/index.htm1
Person in charge of cyclotron: Y.kumata
Person reporting information: Y.kumata
E-mail address: Yko_kumata@shi.co.jp

HISTORY
Designed by: Sumitomo Heavy Industries, Ltd.
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 1989
First beam date: 1990
Characteristic beam, energy and current:
p: 18MeV 90uA
d: 10MeV 50uA
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%):
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T): 1.56
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max): 0deg
Pole parameters
Diameter: 1.04m
Injection radius (m):
Extraction radius (m): 0.43
Hill gap (m): 0.036 **Valley gap (m):** 0.154
Trim coils
Number: 4 pairs
Maximum current (A-turns):
Harmonic coils
Number: none
Maximum current (A-turns):
Main coils
Number:
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons):
Total coil weight (tons):
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 45MHz
Harmonic modes: 2 and 4
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 45
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source: PIG
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: stripping (carbon foil)
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps:
Achieved Vacuum (Pa):

ENTRY N° CM15
Date: 15/Dec/07
Machine name: 930
Institution: Sumitomo Heavy Industries, Ltd.
Address: ThinkPark Tower, 1-1, Osaki 2-chome
Shinagawa-ku, Tokyo 141-6025, Japan
Telephone: +81-3-6737-2000
Fax: +81-3-6866-5104
Web Address: www.shi.co.jp/quantum/index.htm1
Person in charge of cyclotron: Y.kumata
Person reporting information: Y.kumata
E-mail address: Yko_kumata@shi.co.jp

HISTORY
Designed by: Sumitomo Heavy Industries, Ltd.
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates:
First beam date:
Characteristic beam, energy and current:
p: 90MeV 10uA, d: 50MeV 20uA
40Ar8+: 195MeV 3uA
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%):
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: 110MeV/A **Kf:** 95MeV/A
Average field (min./max. T): 1.64
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter: 2.16m
Injection radius (m):
Extraction radius (m): 0.923
Hill gap (m): 0.166 **Valley gap (m):** 0.405
Trim coils
Number: 12 pairs
Maximum current (A-turns):
Harmonic coils
Number: 8 pairs
Maximum current (A-turns):
Main coils
Number:
Total current (A-turns): 408,000
Maximum current (A): 900
Stored energy (MJ):
Total iron weight (tons): 220
Total coil weight (tons): 9
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 11-22MHz
Harmonic modes: 1, 2 and 3
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 90 .
Voltage
at injection (peak to ground, KV): 60
at extraction (peak to ground, KV): 60
peak (peak to ground, KV):
Line Power (max, KW): 2*70
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
lon Source:
Source Bias Voltage (kV): 20
External Injection: axial
Buncher Type: Krystron and sawtooth
Injection Energy (MeV/n):
Component:
Injection Efficiency (%): 20
Injector:

(d) Extraction
Elements, Characteristic: Electrostatic deflector + magnetic channel + gradient corrector
Typical Efficiency (%): 60-70
Best Efficiency (%):

(e) Vacuum
Pumps: 4 sets of cryopumps + 1 turbomolecular pump
Achieved Vacuum (Pa): 5*10-5

ENTRY N° CM16
Date: 15/Dec/07
Machine name: C235
Institution: Sumitomo Heavy Industries, Ltd.
Address: ThinkPark Tower, 1-1, Osaki 2-chome
Shinagawa-ku, Tokyo 141-6025, Japan
Telephone: +81-3-6737-2000
Fax: +81-3-6866-5104
Web Address: www.shi.co.jp/quantum/index.htm1
Person in charge of cyclotron: Y.kumata
Person reporting information: Y.kumata
E-mail address: Yko_kumata@shi.co.jp

HISTORY
Designed by:
Constructed by: Sumitomo Heavy Industries, Ltd.
Construction dates: 1997
First beam date: 1998
Characteristic beam, energy and current:
p: 235MeV 300nA
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(100);
Isotope production (%):
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T): 2.2
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter:
Injection radius (m):
Extraction radius (m): 1.07
Hill gap (m): elliptical Valley gap (m): 0.6
Trim coils
Number: none
Maximum current (A-turns):
Harmonic coils
Number: none
Maximum current (A-turns):
Main coils
Number:
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons):
Total coil weight (tons):
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 106MHz
Harmonic modes: 4
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 30 deg.
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source: Livingston
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: Electrostatic deflector gradient corrector + permanent quadrupoles
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps:
Achieved Vacuum (Pa):

ENTRY N° CU1
Date: 11 Feb 2008
Machine Name: Cyclone 30
Institution: UCL, Centre de Recherches du Cyclotron
Address: 2, Chemin du Cyclotron 1348 Louvain-la-Neuve, Belgium
Telephone: +32(10)472998
Fax: +32(10)452183
Web Address: http://www.cyc.ucl.ac.be
Person in Charge of Cyclotron: Marc Loiselet
Person Reporting Information: Marc Loiselet
E-mail Address: Marc.Loiselet@uclouvain.be

HISTORY
Designed by: IBA
Construction Dates:
First Beam Date:
Characteristic Beams
30 MeV proton 350 microA
Transmission Efficiency (source to extracted beam)
Typical (%): 30
Best (%): 35
Emittance
Emittance Definition:
Vertical (pi mm mrad): 10
Horizontal (pi mm mrad): 5
Longitudinal (dE/E[%] x RF[deg.]): 1

USES
Basic Research (%): 50
Development (%):
Therapy (%):
Isotope Production (%): 50
Other Application (%):
Maintenance (%):
Beam Tuning (%):
Total Time (h/year):

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV): 30
Kf (MeV/A): 30
Average Field (min./max. T): 1(0.12/ 1.7)
Number of Sectors: 4
Hill Angular Width (deg.): 54-58
Spiral (deg.): 0
Pole Diameter (m): 1.6
Injection Radius (m): 0.03
Extraction Radius (m): 0.5 - 0.75
Hill Gap (m): 0.03
Valley Gap (m): 0.1
Trim Coils
Number: 0
Maximum Current (A-turns): N/A
Harmonic Coils
Number: 0
Maximum Current (A-turns): N/A
Main Coils
Number: 2
Total Ampere Turns: 60 000
Maximum Current (A): 110
Stored Energy (MJ):
Total Iron Weight (tons): 45
Total Coil Weight (tons): 4
Power
Main Coils (total KW): 7.2
Trim Coils (total, maximum, KW): N/A
Refrigerator (cryogenic, KW): N/A

(b)RF
Frequency Range (MHz): 66
Harmonic Modes: 4
Number of Dees: 2
Number of Cavities: 4
Dee Angular Width (deg.): 30
Voltage
At Injection (peak to ground, KV): 50
At Extraction (peak to ground, KV): 50
Peak (peak to ground, KV): 50
Line Power (max, KW): 40
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.1

(c)Injection
Ion Source: multicusp
Source Bias Voltage (kV): 30
External Injection: axial
Buncher Type: wire
Injection Energy (MeV/n): 0.03
Component:
Injection Efficiency (%): 35
Injector: inflector

d)Extraction
Elements, Characteristic: carbon stripper
Typical Efficiency (%): 100
Best Efficiency (%):

(e)Vacuum
Pumps: cryo pump 4000l/s (N2)
Achieved Vacuum (Pa): 1 E-5

ENTRY N° CU2
Date: 12 Feb 2008
Machine name: Cyclone 30 Cyclotron
Institution: Energetic and Nuclear Research Institute
Address: Av. Prof. Lineu Prestes, 2242 – Cidade Universitária, São Paulo - SP - Brasil
Telephone: +55 11 3133-9000
Fax: +55 11 3812-3546
Web Address: http://www.ipen.br
Person in charge of cyclotron: Valdir Sciani
Person reporting information: Hylton Matsuda
E-mail address: hmatsuda@ipen.br

HISTORY
Designed by: IBA - Ion Beam Applications - Belgium
Constructed by: IBA – Ion Beam Applications - Belgium
Construction dates: 1997-1998
First beam date: 1998
Characteristic beam, energy and current:
H-/H+, 15-30 MeV, 350 µA
Transmission efficiency (source to extracted beam)
Typical (%): 10%
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad): <5
Horizontal (pi mm mrad): <10
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 1
Development(%):
Therapy(%):
Isotope production (%): 75
Other application (%):
Maintenance (%): 2
Beam tuning(%): 22
Total time (h/year): 1500

TECHNICAL DATA
(a) Magnet: **Type:** Compact
Kb: **Kf:**
Average field (min./max. T): 0.12 / 1.7
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter:
Injection radius (m):
Extraction radius (m):
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number: 1 x 2
Total current (A-turns):
Maximum current (A): 120
Stored energy (MJ):
Total iron weight (tons): 45
Total coil weight (tons): 4
Power
Main coils (total KW): 7.2
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW): 9

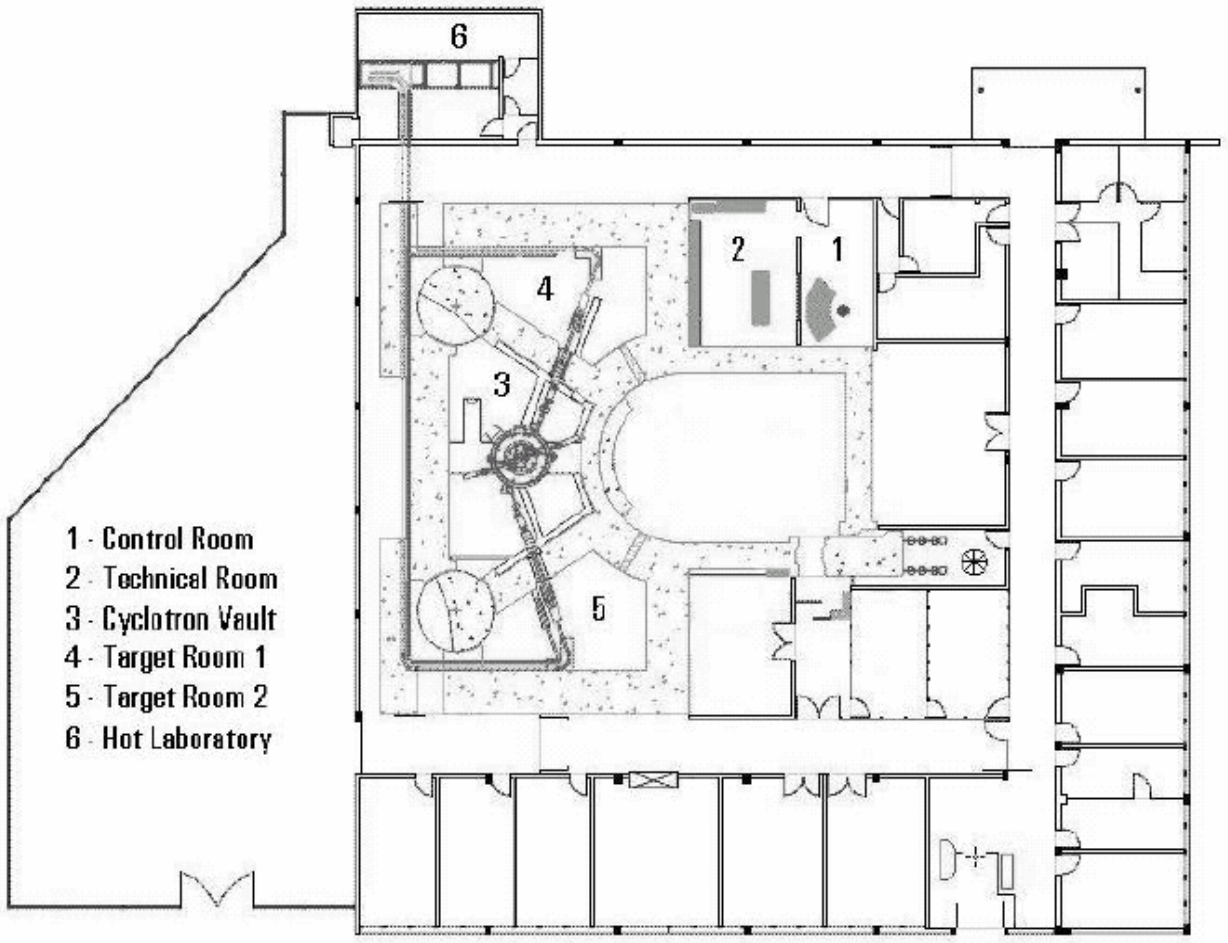
(b) RF
Acceleration
Frequency range (MHz): 65.5
Harmonic modes: 4
Number of dees: 2
Number of cavities:
Dee angular width (deg.): 30
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source: Multicusp
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector: Axial

(d) Extraction
Elements, Characteristic: Carbon stripper foil
Typical Efficiency (%): 70
Best Efficiency (%): 95

(e) Vacuum
Pumps: Cyclotron: cryopumps (2), Beam lines: diffusion pumps (3), Ion source: diffusion pumps (1)
Achieved Vacuum (Pa): 1E-05

EXPERIMENTAL FACILITIES
External beam lines (2), target stations (4)


6
2
1
4
3
5
1 - Control Room
2 - Technical Room
3 - Cyclotron Vault
4 - Target Room 1
5 - Target Room 2
6 - Hot Laboratory

ENTRY N° CU3
Date: Feb 2007
Machine Name: TR13
Institution: TRIUMF
Address: 4004 Wesbrook Mall, Vancouver BC, CANADA
Telephone: 604-222-7529
Fax: 604-222-1074
Web Address: www.triumf.ca
Person in Charge of Cyclotron: Ken Buckley
Person Reporting Information: Ken Buckley
E-mail Address: Ken.Buckley@triumf.ca

HISTORY
Designed by: TRIUMF & Ebco Technologies Ltd.
Construction Dates: 1992
First Beam Date: 1993
Characteristic Beams
protons 13 MeV, 100 microAmp
Transmission Efficiency
Typical (%): 6
Best (%):
Emittance
Emittance Definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%): 93
Other Application (%):
Maintenance (%): 7
Beam Tuning (%):
Total Time (h/year): total beam time in 2006: ca. 700

TECHNICAL DATA
(a)Magnet
Type: compact, deep valley design
Kb (MeV):
Kf (MeV):
Average Field (min./max. T): 1.3
Number of Sectors: 4
Hill Angular Width (deg.):
Spiral (deg.):
Pole Diameter (m): 1.08
Injection Radius (m):
Extraction Radius (m): 0.445 - 0.465
Hill Gap (m): 0.031
Valley Gap (m): 0.665
Trim Coils
Number:
Maximum Current (A-turns):
Harmonic Coils
Number:
Maximum Current (A-turns):
Main Coils
Number: 2
Total Ampere Turns:
Maximum Current (A): 200
Stored Energy (MJ):
Total Iron Weight (tons): 20
Total Coil Weight (tons): 2
Power
Main Coils (total KW): 24
Trim Coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 41.8, fixed frequency
Harmonic Modes: protons: 2 deuterons: 4
Number of Dees: 2
Number of Cavities:
Dee Angular Width (deg.): 30
Voltage
At Injection (peak to ground, KV):
At Extraction (peak to ground, KV):
Peak (peak to ground, KV): 32
Line Power (max, KW): 10
Phase Stability (deg.):
Voltage Stability (%):

(c)Injection
Ion Source: 2×PIG IS (one for p, one for d)
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d)Extraction
Elements, Characteristic: carbon stripper foils
Typical Efficiency (%): (40 - 60)
Best Efficiency (%): 70

(e)Vacuum
Pumps:
4 x Edwards ODP diff stack 160/700p
1 x Edwards ODP diff stack 100/300p for external beam transport line
Achieved Vacuum (Pa): stand-by: 7E-05

ENTRY N° CU4
Date: 30.10.2007
Machine Name: CYCLONE 18/9
Institution: Forschungszentrum Dresden-Rossendorf/PET Center
Postal Address: PF 51 01 19, 01314 Dresden, Germany
Site Address: Bautzner Landstr. 128, 01328 Dresden, Germany
Telephone: +49 (0)351 260 - 2221 or - 3269
Fax: +49 (0)351 260 3232
Web Address: http://www.fzd.de
Person in Charge of Cyclotron: Dipl.-Ing. Stephan Preusche
Person Reporting Information: Dipl.-Ing. Stephan Preusche
E-mail Address: s.preusche@fzd.de

HISTORY
Designed by: Ion Beam Applications, s.a., Belgium
Construction Dates:
First Beam Date: Routine operation for radionuclide production since 1996
Characteristic Beams
p, 18 MeV, 30 µA on the targets
d, 9 MeV, 18 µA on the targets
Transmission Efficiency
Typical (%): From internal probe to targets outside the yoke → p: 25; d: 20
Best (%): p: 30; d: 28
Emittance
Emittance Definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%):
Development (%):
Therapy (%):
Isotope Production (%): 93
Other Application (%):
Maintenance (%): 7
Beam Tuning (%):
Total Time (h/year): total beam time in 2006: ca. 700

TECHNICAL DATA
(a)Magnet
Type: compact, deep valley design
Kb (MeV):
Kf (MeV):
Average Field (min./max. T): 1.3
Number of Sectors: 4
Hill Angular Width (deg.):
Spiral (deg.):
Pole Diameter (m): 1.08
Injection Radius (m):
Extraction Radius (m): 0.445 - 0.465
Hill Gap (m): 0.031
Valley Gap (m): 0.665
Trim Coils
Number:
Maximum Current (A-turns):
Harmonic Coils
Number:
Maximum Current (A-turns):
Main Coils
Number: 2
Total Ampere Turns:
Maximum Current (A): 200
Stored Energy (MJ):
Total Iron Weight (tons): 20
Total Coil Weight (tons): 2
Power
Main Coils (total KW): 24
Trim Coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b)RF
Frequency Range (MHz): 41.8, fixed frequency
Harmonic Modes: protons: 2 deuterons: 4
Number of Dees: 2
Number of Cavities:
Dee Angular Width (deg.): 30
Voltage
At Injection (peak to ground, KV):
At Extraction (peak to ground, KV):
Peak (peak to ground, KV): 32
Line Power (max, KW): 10
Phase Stability (deg.):
Voltage Stability (%):

(c)Injection
Ion Source: 2×PIG IS (one for p, one for d)
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d)Extraction
Elements, Characteristic: carbon stripper foils
Typical Efficiency (%): (40 - 60)
Best Efficiency (%): 70

(e)Vacuum
Pumps: 4 x Edwards ODP diff stack 160/700p
1 x Edwards ODP diff stack 100/300p for external beam transport line
Achieved Vacuum (Pa): stand-by: 7E-05

COMMENTS

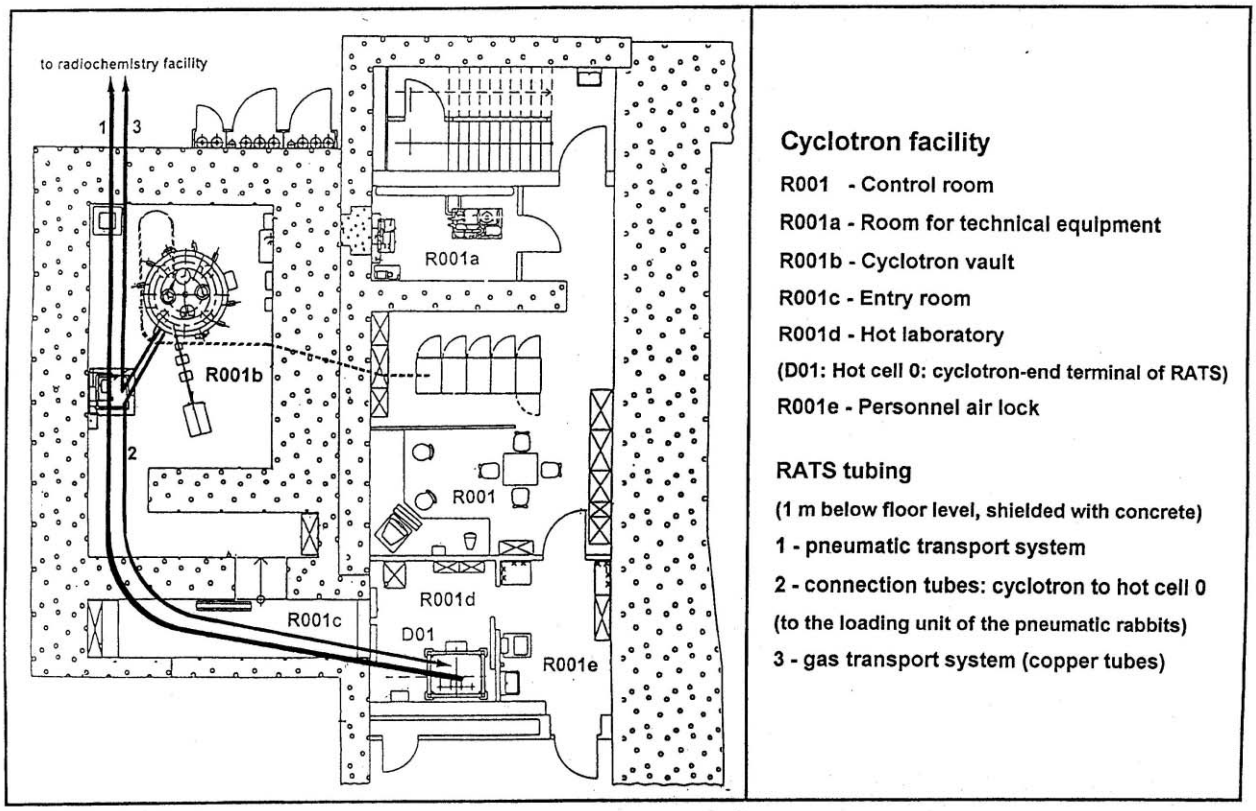
1. Premises

Cyclotron building and radiochemistry/radiopharmaceutical/ nuclear medicine buildings are separated by 500 meters.

➔ Radionuclide transport system (RATS): Pneumatic transport system for liquids, Copper tubes for gases

Layout of the Rossendorf PET cyclotron facility RATS = Radionuclide transport system

2. Production of non-standard radionuclides: Y-86, Cu-64, Co-56



ENTRY N° CU5
Date: 18.01.2008
Machine name: MGC-20
Institution: Institute of Nuclear Research (ATOMKI)
Address: Bem ter 18/c., H-4026 Debrecen, Hungary
Telephone: +36 (52) 509-200
Fax: +36 (52) 416-181
Web Address: www.atomki.hu
Person in charge of cyclotron: F. Tarkanyi
Person reporting information: Z. Kormany
E-mail address: kormany@atomki.hu

HISTORY
Designed by: NIIEFA, St. Petersburg, Russia
Constructed by: NIIEFA, St. Petersburg, Russia
Construction dates: 1984-85
First beam date: Nov. 1985
Characteristic beam, energy and current:
proton, 18 MeV, 40 μA
alpha, 20 MeV, 20 μA
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad): 15
Horizontal (pi mm mrad): 30
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 38
Development(%): 5
Therapy(%) :
Isotope production (%): 6
Other application (%) : 16
Maintenance (%): 24
Beam tuning(%): 11
Total time (h/year): 1600

TECHNICAL DATA
(a) Magnet: **Type:** compact
Kb: 20 MeV/A **Kf:**
Average field (min./max. T): 1.4/0.7
Number of magnet sectors: 3
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter(m): 1.03
Injection radius (m):
Extraction radius (m): 0.45
Hill gap (m): 0.072 **Valley gap (m):** 0.12
Trim coils
Number: 4 x 2
Maximum current (A-turns): 15 A
Harmonic coils
Number: 2 sets x 2
Maximum current (A-turns): 15 A
Main coils
Number: 1 x 2
Total current (A-turns):
Maximum current (A): 400
Stored energy (MJ):
Total iron weight (tons): 25
Total coil weight (tons):
Power
Main coils (total KW): 32
Trim coils (total, maximum, KW): 1
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 8 – 24
Harmonic modes: 1, 3
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 30
Line Power (max, KW): 80
Phase Stability (deg.):
Voltage Stability (%): 0.1

(c) Injection
Ion Source: internal, Livingstone-Jones
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: electrostatic deflector, passive magnetic channel
Typical Efficiency (%): 40
Best Efficiency (%): 50

(e) Vacuum
Pumps: oil diffusion
Achieved Vacuum (Pa): 2E-04

ENTRY N° CU6
Date: 14 Feb 2007
Machine Name: Scanditronix MC40
Institution: European Commission -Institute for Health and Consumer Protection T. P. 500
Address: Ispra (VA) 21020 Italy
Telephone: ++390332785194
Fax: ++390332789385
Web Address:
Person in Charge of Cyclotron: Uwe Holzwarth
Person Reporting Information: Uwe Holzwarth
E-mail Address: uwe.holzwarth@jrc.it

HISTORY
Designed by: Scanditronix
Construction Dates:
First Beam Date: 1982
Characteristic Beams
ions / energy(MeV/N)/current(pps)/power(w)
protons 39 MeV 60 uA max
deuterons 20 MeV 60 uA max
alphas 39 MeV 30 uA max
Transmission Efficiency (source to extracted beam)
Typical (%): 65
Best (%): 85
Emittance
Emittance Definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic Research (%): 5
Development (%): 35
Therapy (%): 0
Isotope Production (%): 35
Other Application (%):
Maintenance (%): 15
Beam Tuning (%):10
Total Time (h/year): 2100

TECHNICAL DATA
(a)Magnet
Type:
Kb (MeV): 0.05
Kf (MeV): 0.08
Average Field (min./max. T): 1.79
Number of Sectors: 3
Hill Angular Width (deg.):
Spiral (deg.):
Pole Diameter (m): 1.35
Injection Radius (m): 0
Extraction Radius (m): 0.51
Hill Gap (m): 0.1
Valley Gap (m): 0.18
Trim Coils
Number: 8x2
Maximum Current (A-turns):
Harmonic Coils
Number: 4xNsectorsx2
Maximum Current (A-turns):
Main Coils
Number: 1x2
Total Ampere Turns:
Maximum Current (A): 890
Stored Energy (MJ):
Total Iron Weight (tons): 60
Total Coil Weight (tons): 2.276
Power
Main Coils (total KW): 150
Trim Coils (total, maximum, KW): 13
Refrigerator (cryogenic, KW): 400

(b)RF
Acceleration
Frequency Range (MHz): 12.5 -28
Harmonic Modes: 1,2
Number of Dees: 2
Number of Cavities:2
Dee Angular Width (deg.): 90
Voltage 8.5 – 35.5 kV
At Injection (peak to ground, KV):
At Extraction (peak to ground, KV):
Peak (peak to ground, KV):
Line Power (max, KW): 25
Phase Stability (deg.):
Voltage Stability (%): 0.1

(c)Injection
Ion Source: cold cathode plasma ion source
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d)Extraction
Elements, Characteristic:
Typical Efficiency (%):
Best Efficiency (%):

(e)Vacuum
Pumps: 2 x Leybold TURBOVAC 3500
Achieved Vacuum (Pa): 2e10-6 mbar

ENTRY N° CU7
Date: 1/28/08
Machine name: Cyclone 30 (two machines)
Institution: FUJIFILM RI Pharma Co., Ltd.
Address: 453-1, Shimo-Okura, Matsuo-machi, Sanmu-shi, Chiba, 289-1592, Japan
Telephone: 81-479-86-4721
Fax: 81-479-86-5112
Web Address: http://fri.fujifilm.co.jp
Person in charge of cyclotron: Yoshikazu Hirunuma
Person reporting information: Asaki Yamamoto
E-mail address: yasaki@ffri.co.jp

HISTORY
Designed by: Ion Beam Applications (IBA)
Constructed by:
Construction dates: 1991 / 2005
First beam date: 1991 / Sep. 2005Mar.
Characteristic beam, energy and current:
H-, 30MeV, 350uA ……..
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%): 95
Other application (%) :
Maintenance (%): 5
Beam tuning(%):
Total time (h/year): 4000 / 4500

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T):
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter:
Injection radius (m):
Extraction radius (m):
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number:
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons):
Total coil weight (tons):
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz):
Harmonic modes:
Number of dees:
Number of cavities:
Dee angular width (deg.):
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source:
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic:
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps:
Achieved Vacuum (Pa):

ENTRY N° CU8
Date: 1/28/08
Machine name: MC-40
Institution: FUJIFILM RI Pharma Co., Ltd.
Address: 453-1, Shimo-Okura, Matsuo-machi, Sanmu-shi, Chiba, 289-1592, Japan
Telephone: 81-479-86-4721
Fax: 81-479-86-5112
Web Address: http://fri.fujifilm.co.jp
Person in charge of cyclotron: Yoshikazu Hirunuma
Person reporting information: Asaki Yamamoto
E-mail address: yasaki@ffri.co.jp

HISTORY
Designed by: Scanditronix
Constructed by:
Construction dates: 1984
First beam date: Nov. 1984
Characteristic beam, energy and current:
p, 30MeV, 180uA ……..
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%): 95
Other application (%) :
Maintenance (%): 5
Beam tuning(%):
Total time (h/year): 3000

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T):
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter:
Injection radius (m):
Extraction radius (m):
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number:
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons):
Total coil weight (tons):
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz):
Harmonic modes:
Number of dees:
Number of cavities:
Dee angular width (deg.):
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source:
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic:
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps:
Achieved Vacuum (Pa):

ENTRY N° CU9
Date: 25 Oct 2007
Machine name: NIRS-HM-18
Institution: National Institute of Radiological Science
Address: Anagawa, Inage-ku, Chiba, 263-8555, Japan
Telephone: +81-(0)43-206-3173
Fax: +81-(0)43-206-6146
Web Address:
Person in charge of cyclotron: T. Honma
Person reporting information: T. Honma
E-mail address: honma_t@nirs.go.jp

HISTORY
Designed by: Sumitomo Heavy Industries
Constructed by: Sumitomo Heavy Industries
Construction dates: 1994
First beam date: Mar. 1994
Characteristic beam, energy and current:
p: 18MeV, 2.E+14
d: 9MeV, 2.E+14
Transmission efficiency (source to extracted beam)
Typical (%): 95
Best (%): 100
Emittance
Emittance definition:
Vertical (pi mm mrad): 55
Horizontal (pi mm mrad): 27
Longitudinal (dE/E[%] x RF[deg.]):

USES
Isotope production (%): 90
Maintenance (%): 5
Beam tuning(%): 5
Total time (h/year): 1300

TECHNICAL DATA
(a) Magnet: room temp., **Type:** H-type
Average field (T): 1.56
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max): 0
Pole parameters
Diameter: 1.08
Injection radius (m):
Extraction radius (m): 0.46
Hill gap (m): 0.036 **Valley gap (m):** 0.154
Trim coils
Number: 4
Maximum current (A-turns): 1600
Harmonic coils
Number: 0
Maximum current (A-turns):
Main coils
Number: 1
Total current (A-turns): 9.72E+4
Maximum current (A): 180
Stored energy (MJ):
Total iron weight (tons): 27
Total coil weight (tons):
Power
Main coils (total KW): 24.3
Trim coils (total, maximum, KW): 2.82

(b) RF
Frequency range (MHz): 45
Harmonic modes: 2, 4
Number of dees: 2
Number of cavities: 1
Dee angular width (deg.): 35
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 25
Line Power (max, KW):
Phase Stability (deg.): 0.5
Voltage Stability (%): 0.1

(c) Injection
Ion Source: cold-cathode PIG

(d) Extraction
Elements, Characteristic: carbon-foil, charge-exchange
Typical Efficiency (%): 90
Best Efficiency (%): 100

(e) Vacuum
Pumps:
Achieved Vacuum (Pa): TMP 1000l/s x1, CRYO x2

EXPERIMENTAL FACILITIES
3-port for internal,
2-port for external.

COMMENTS
NIRS-Cyclotron Facility

ENTRY N° CU10
Date: 25 Oct 2007
Machine name: NIRS-930 Cyclotron
Institution: National Institute of Radiological Science
Address: Anagawa, Inage-ku, Chiba, 263-8555, Japan
Telephone: +81-(0)43-206-3173
Fax: +81-(0)43-206-6146
Web Address:
Person in charge of cyclotron: T. Honma
Person reporting information: T. Honma
E-mail address: honma_t@nirs.go.jp

HISTORY
Designed by: Thomson-CSF (CGR-MeV)
Constructed by: Thomson-CSF (CGR-MeV)
Construction dates: 1972-1973
First beam date: Dec. 1973
Characteristic beam, energy and current:
p 6-70(MeV), 1.2E+14(pps), 700(W)
d : 6-25(MeV/u), 2.E+14(pps), 900(W)
3He : 6-48(MeV/u), 3.E+13(pps), 700(W)
4He : 6-25(MeV/u), 3.E+13(pps), 700(W)
H.I.: 12C4+, 6-12(MeV/u), 7.E+12(pps), 700(W)
Transmission efficiency (source to extracted beam)
Typical (%): 60
Best (%): 85
Emittance
Emittance definition: 90 %
Vertical (pi mm mrad): 12
Horizontal (pi mm mrad): 15
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 15
Development(%): 5
Therapy(%) : 0
Isotope production (%): 40
Other application (%) : 15
Maintenance (%): 10
Beam tuning(%): 15
Total time (h/year): 1600

TECHNICAL DATA
(a) Magnet: Room Temp. **Type:** H-type
Kb: 110 MeV, **Kf:** 90 MeV(Proton)
Average field (min./max. T): 0.35 / 1.65
Number of magnet sectors: 4
hill angular width (deg.):
spiral (max): 53
Pole parameters
Diameter: 2.15
Injection radius (m): 0.025
Extraction radius (m): 0.93
Hill gap (m): 0.166 Valley gap (m): 0.405
Trim coils
Number: 12
Maximum current (A-turns): 3.6E+5
Harmonic coils
Number: 8
Maximum current (A-turns): 1000
Main coils
Number: 1
Total current (A-turns): 3.6E+5
Maximum current (A): 1100
Stored energy (MJ):
Total iron weight (tons): 200
Total coil weight (tons):
Power
Main coils (total KW): 80
Trim coils (total, maximum, KW): 22
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 10.7-21.4
Harmonic modes: 1, 2
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 86
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV): 45
peak (peak to ground, KV): 45
Line Power (max, KW): 60
Phase Stability (deg.): 0.5
Voltage Stability (%): 0.2

(c) Injection
Ion Source: ECR(for external)
Source Bias Voltage (kV):
External Injection: Axially-Injection
Buncher Type: Double gap, sin-wave
Injection Energy (MeV/n): 0.005-0.02
Component: 90-deg. BMx2, ESQ-doublet, ESQ-triplet, Solenoid (4)
Injection Efficiency (%): 30(Max)
Injector: Spiral-inflector

(d) Extraction
Elements, Characteristic:
ES-deflector, Magnetic-channel, Gradient-corrector
Charge exchange (H^-, D^-)
Typical Efficiency (%): 60
Best Efficiency (%): 85

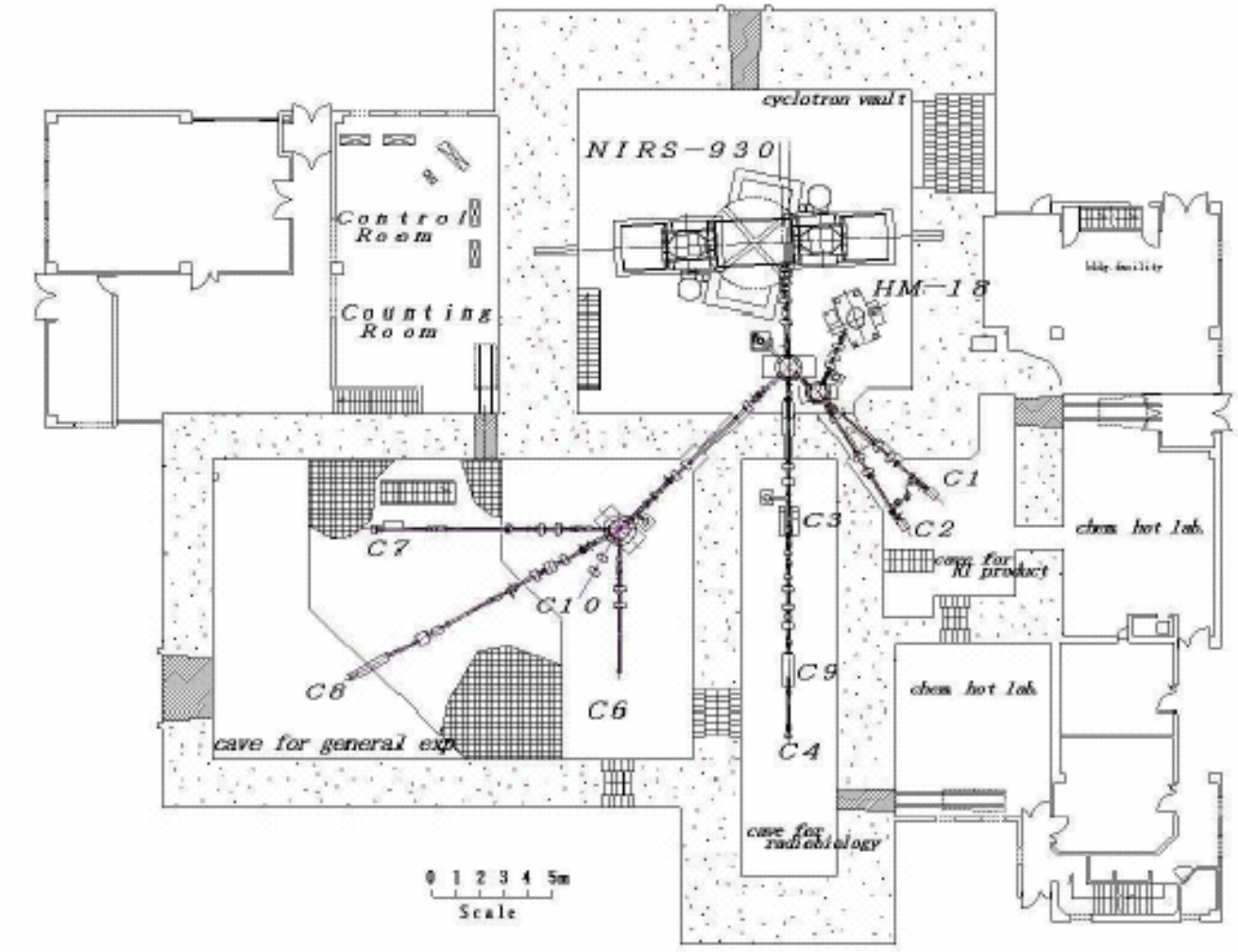
(e) Vacuum
Pumps: TMP(2000 l/s x6), CRYO x 2
Achieved Vacuum (Pa): 2.E-4

REFERENCES: H.Ogawa,et.al, IEEE Trans. NS26-No2, (1978)p1988

EXPERIMENTAL FACILITIES
9-Beam line & target stations

COMMENTS
NIRS-Cyclotron Facility

PLAN VIEW OF FACILITY



ENTRY N° CU11
Date: FEB 06, 2008
Machine name: MC17F
Institution: University Medical Center Groningen
Address: Hanzeplein 1, 9713 GZ Groningen, NL
Telephone: +31 50 261 2205
Fax: +31 50 361 9207
Web Address: www.ngmb.umcg.nl
Person in charge of cyclotron: A.M.J. Paans
Person reporting information: A.M.J. Paans
E-mail address: a.m.j.paans@ngmb.umcg.nl

HISTORY
Designed by: Scanditronix
Constructed by: Scanditronix
Construction dates: 1990
First beam date: April, 1991
Characteristic beam, energy and current:
Proton, 17 MeV, 80 μA.
Deutron, 8.5 MeV, 50 μA.
Transmission efficiency (source to extracted beam)
Typical (%): p 80%, d 70%
Best (%): p, 90%, d 80%
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 0
Development(%):0
Therapy(%) : 0
Isotope production (%): 46% (2006)
Other application (%) :
Maintenance (%): 20% (2006)
Beam tuning(%):
Total time (h/year): 2000

TECHNICAL DATA
(a) Magnet: **Type:** R
Kb: **Kf:**
Average field (min./max. T): 1.3/1.7 T
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter: 70 cm
Injection radius (m):na
Extraction radius (m):32 cm
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number:
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons): 20
Total coil weight (tons):
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 24 fixed
Harmonic modes:
Number of dees:
Number of cavities:
Dee angular width (deg.):
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
lon Source:
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: electrostatic, magnetic channel
Typical Efficiency (%): 85%
Best Efficiency (%): 90%

(e) Vacuum
Pumps: oil diffusion
Achieved Vacuum (Pa): 1. E-06

EXPERIMENTAL FACILITIES
PET scanners and microPET scanner

ENTRY N° CU12
Date: 16 Feb 2008
Machine Name: TU/e cyclotron, IBA Cyclone 30
Institution: Technische Universiteit Eindhoven (TU/e)/ AccTec BV
Address: Den Dolech, P.O. Box 513
TU/e Eindhoven Cyclotron Building
NL - 5600 MB Eindhoven
Telephone: + 31 40 2474048
Fax: + 31 40 2438060
Web Address: http://www.tue.nl /de_universiteit/tue_holding_bv/
Person in Charge of Cyclotron: M.J.A. de Voigt
Person Reporting Information: M.J.A.de Voigt
E-mail Address: acctecbv@tue.nl
m.j.a.de.Voigt@tue.nl

HISTORY
Designed by: IBA, Louvain-la-Neuve (B)
Construction Dates:
First Beam Date: 2003
Characteristic Beams
15- 30 MeV proton 500 microA
Transmission Efficiency (source to extracted beam)
Typical (%): 30
Best (%): 35
Emittance
Emittance Definition:
Vertical (pi mm mrad): 10
Horizontal (pi mm mrad): 5
Longitudinal (dE/E[%] x RF[deg.]): 1

USES
Basic Research (%): 10
Development (%): 0
Therapy (%): 0
Isotope Production (%): 80
Other Application (%): 0
Maintenance (%): 7
Beam Tuning (%): 3
Total Time (h/year): 3000

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV): 30
Kf (MeV/A): 30
Average Field (min./max. T): 1(0.12/ 1.7)
Number of Sectors: 4
Hill Angular Width (deg.): 54-58
Spiral (deg.): 0
Pole Diameter (m): 1.6
Injection Radius (m): 0.03
Extraction Radius (m): 0.5 - 0.75
Hill Gap (m): 0.03
Valley Gap (m): 0.1
Trim Coils
Number: 0
Maximum Current (A-turns): N/A
Harmonic Coils
Number: 0
Maximum Current (A-turns): N/A
Main Coils
Number: 2
Total Ampere Turns: 60 000
Maximum Current (A): 110
Stored Energy (MJ):
Total Iron Weight (tons): 45
Total Coil Weight (tons): 4
Power
Main Coils (total KW): 7.2
Trim Coils (total, maximum, KW): N/A
Refrigerator (cryogenic, KW): N/A

(b)RF
Frequency Range (MHz): 66
Harmonic Modes: 4
Number of Dees: 2
Number of Cavities: 4
Dee Angular Width (deg.): 30
Voltage
At Injection (peak to ground, KV): 50
At Extraction (peak to ground, KV): 50
Peak (peak to ground, KV): 50
Line Power (max, KW): 40
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.1

(c)Injection
Ion Source: multicusp
Source Bias Voltage (kV): 30
External Injection: axial
Buncher Type: wire
Injection Energy (MeV/n): 0.03
Component:
Injection Efficiency (%): 35
Injector: inflector

d)Extraction
Elements, Characteristic: carbon stripper
Typical Efficiency (%): 100
Best Efficiency (%):

(e)Vacuum
Pumps: cryo pump 4000l/s (N2)
Achieved Vacuum (Pa): 1 E-5

ENTRY N° CU13

Date: 19th February 2008
Machine name: Scanditronix MC35
Institution: SAFE-centre, Univ. of Oslo
Address: P.O.Box 1038 – Blindern,
N-0315 Oslo, Norway
Telephone: +47 228 55 076
Fax:
Web Address: www.safe.uio.no
Person in charge of cyclotron: Jon Petter Omtvedt
Person reporting information: Jon Petter Omtvedt
E-mail address: j.p.omtvedt@kjemi.uio.no

HISTORY

Designed by:
Constructed by:
Construction dates: 1978
First beam date: 15th August 1979
Characteristic beam, energy and current:
Protons: 2-35 MeV, 30 μA (max)
Deuterons: 4-18 MeV, 30 μA (max)
He-3: 6-45 MeV, 3 μA (max)
He-4: 8-35 MeV, 10 μA (max)
Transmission efficiency (source to extracted beam)
Typical (%): p: 65%, d: 60%, He-3: 58%, He-4: 58%
Best (%): p: 80%, d: 65%, He-3: 65%, He-4: 65%
Emittance
Emittance definition: x x´ π; y y´π
Vertical (pi mm mrad): 12 π mm mrad
Horizontal (pi mm mrad): 3 π mm mrad
Longitudinal (dE/E[%] x RF[deg.]):

USES

Basic research (%): 70%
Development(): 5%
Therapy();
Isotope production (): 10%
Other application ( ) : 5%
Maintenance (): 5%
Beam tuning(): 5%
Total time (h/year): 1500

TECHNICAL DATA

(a) Magnet: **Type:** H
Kb: **Kf:**
Average field (min./max. T): 0.5 – 2 T
Number of magnet sectors: 3
hill angular width (deg.): 60
spiral (max):
Pole parameters
Diameter: 1,2 m
Injection radius (m): 0
Extraction radius (m): 0,5 m
Hill gap (m): 0.1 **Valley gap (m):** 0.18
Trim coils
Number: 8
Maximum current (A-turns): 80 A
Harmonic coils
Number: 4
Maximum current (A-turns): 20 A
Main coils
Number: 28
Total current (A-turns): 810 A
Maximum current (A): 810 A
Stored energy (MJ):
Total iron weight (tons): 53
Total coil weight (tons): 2
Power
Main coils (total KW): 130
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF

Frequency range (MHz): 10-25
Harmonic modes: 2
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 45
Voltage
at injection (peak to ground, KV): 50
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.): < 0.5%
Voltage Stability (): < 1.0%

(c) Injection

Ion Source: Reflex Arc (PIG)
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction

Elements, Characteristic: Electrostatic deflector
Typical Efficiency (%): 60%
Best Efficiency (%): 85%

(e) Vacuum

Pumps: 2
Achieved Vacuum (Pa): 1.0×10^{-8}

ENTRY N° CU14
Date: December 3, 2007
Machine name: PETtrace Johns Hopkins
Institution: Johns Hopkins University
Address: c/o Robert F. Dannals, Division of Nuclear Medicine, Johns Hopkins Medicine, 600 North Wolfe Street, Baltimore, Maryland USA 21287
Telephone: 410-955-2916
Fax:
Web Address: http://pet.rad.jhmi.edu/
Person in charge of cyclotron: Robert F. Dannals, Ph.D.
Person reporting information: same
E-mail address: rfd@jhu.edu

HISTORY
Designed by: General Electric
Constructed by:
Construction dates:
First beam date: January 2000
Characteristic beam, energy and current:
18 MeV protons, 9 MeV deuterons
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) :
Isotope production (%):
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year):

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T):
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter:
Injection radius (m):
Extraction radius (m):
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number:
Total current (A-turns):
Maximum current (A):
Stored energy (MJ):
Total iron weight (tons):
Total coil weight (tons):
Power
Main coils (total KW):
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz):
Harmonic modes:
Number of dees:
Number of cavities:
Dee angular width (deg.):
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
lon Source:
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic:
Typical Efficiency (%):
Best Efficiency (%):

(e) Vacuum
Pumps:
Achieved Vacuum (Pa):

ENTRY N° CU15
Date: December 4, 2007
Machine name: NIH Cyclotron Corp. CS-30
Institution: National Institutes of Health
Address: Bldg 10, Rm 1C450, MSC 1180
Bethesda, Maryland 20892
Telephone: (301) 496-0345
Fax: (301) 402-6361
Web Address: www.nih.gov
Person in charge of cyclotron: Paul Plascjak
Person reporting information: Paul Plascjak
E-mail address: pp5s@nih.gov

HISTORY
Designed by: Cyclotron Corporation
Constructed by: Cyclotron Corporation
Construction dates: 1985
First beam date: 1986
Characteristic beam, energy and current:

P	26.5 MeV	200 μA int.	60 μA ext.
d	14.8 MeV	300 μA int,	100 μA ext.
He-3	38.1 MeV	135 μA int,	60 μA ext.
He-4	29.6 MeV	90 μA int,	40 μA ext.

Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%): 5%
Therapy(%) :
Isotope production (%): 90%
Other application (%) :
Maintenance (%): 5%
Beam tuning(%):
Total time (h/year): 1000

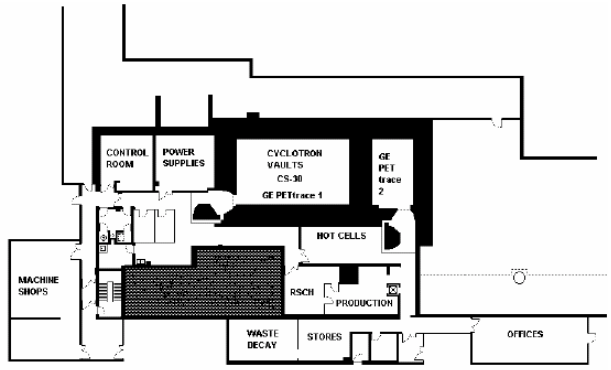
TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T):
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter:
Injection radius (m):
Extraction radius (m):
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):

REFERENCES:
IEEE Trans. Nucl. Sci. NS-14, 70-71 (1967)
IEEE Trans. Nucl. Sci. NS-16, 500-503 (1969)
Eleventh Intl. Conf. on Cyclotrons and Their Appl, Ionics Publ. pp 685-688, Tokyo (1987)

EXPERIMENTAL FACILITIES

Internal target system. External beam line, 5 legs, multiple target changer. Targets: [C-11]-CO_2, [N-13]-NH_3 aq, O-15, [F-18]-HF, [F-18]-F_2, powder cup.

Shared 6 radiochemistry hot cells and 4 minicells.



B-3 Level
Cyclotrons and Radiochemistry

ENTRY N° CU16
Date: December 4, 2007
Machine name: NIH GE PETtrace 1
Institution: National Institutes of Health
Address: Bldg 10, Rm 1C450, MSC 1180
Bethesda, Maryland 20892
Telephone: (301) 496-0345
Fax: (301) 402-6361
Web Address: www.nih.gov
Person in charge of cyclotron: Paul Plascjak
Person reporting information: Paul Plascjak
E-mail address: pp5s@nih.gov

HISTORY
Designed by: GE/Scanditronix
Constructed by: GE/Scanditronix
Construction dates: 1999
First beam date: 2000
Characteristic beam, energy and current:
H- 16.5 MeVp 75 μA ext.
D- 8.4 MeVd 60 μA ext.
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%): 5%
Therapy(%) :
Isotope production (%): 90%
Other application (%) :
Maintenance (%): 5%
Beam tuning(%):
Total time (h/year): 1000

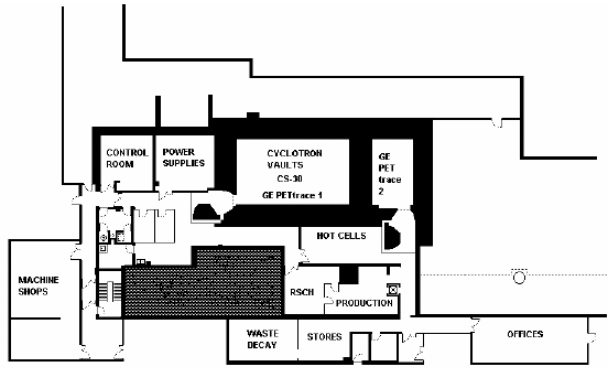
TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T):
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter:
Injection radius (m):
Extraction radius (m):
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):

EXPERIMENTAL FACILITIES

6 external target ports, dual extraction:

[C-11]-CO_2, [N-13]-NH_3 aq, [F-18]-HF, [C-11](CH_3), plate tgt, cup tgt.

Shared 6 radiochemistry hot cells and 4 minicells.



B-3 Level
Cyclotrons and Radiochemistry

ENTRY N° CU17
Date: December 4, 2007
Machine name: NIH GE PETtrace 2
Institution: National Institutes of Health
Address: Bldg 10, Rm 1C450, MSC 1180
Bethesda, Maryland 20892
Telephone: (301) 496-0345
Fax: (301) 402-6361
Web Address: www.nih.gov
Person in charge of cyclotron: Paul Plascjak
Person reporting information: Paul Plascjak
E-mail address: pp5s@nih.gov

HISTORY
Designed by: GE/Scanditronix
Constructed by: GE/Scanditronix
Construction dates: 2007
First beam date: 2007
Characteristic beam, energy and current:
H- 16.5 MeVp 100 μA ext.
D- 8.4 MeVd 60 μA ext.
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

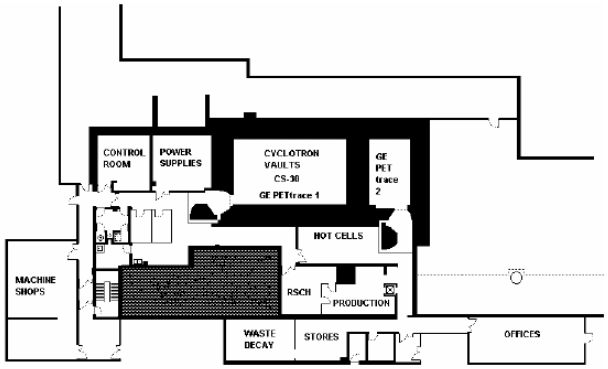
USES
Basic research (%):
Development(%): 5%
Therapy(%) :
Isotope production (%): 90%
Other application (%) :
Maintenance (%): 5%
Beam tuning(%):
Total time (h/year): 1000

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T):
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter:
Injection radius (m):
Extraction radius (m):
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):

REFERENCES:

EXPERIMENTAL FACILITIES

6 external target ports, dual extraction:
[C-11]-CO_2, O-15, (2) [F-18]-HF, [F-18]-F_2 (via O-18).
Shared 6 radiochemistry hot cells and 4 minicells.



B-3 Level
Cyclotrons and Radiochemistry

ENTRY N° CU18
Date: 20-NOV-07
Machine name: Clinical Cyclotron
Institution: University of Washington Medical Center
Address: Radiation Oncology, Room NN-136, 1959 NE Pacific Street, Seattle WA 98195-6043, USA
Telephone: (206) 598-4136
Fax: (206) 598-6218
Web Address: http://www.radonc.washingon.edu
Person in charge of cyclotron: R. Risler
Person reporting information: R. Risler
E-mail address: risler@u.washington.edu

HISTORY
Designed by: Scanditronix AB, Uppsala, Sweden
Constructed by: Scanditronix
Construction dates: 1981/82
First beam date: Factory: June 82, Facility: June 83
Characteristic beam, energy and current:
Protons: 28 to 50.5 MeV, 80uA extracted at 50.5 MeV
He4++: 28 to 47.4 MeV, 60 µA extracted
Transmission efficiency (source to extracted beam)
Typical (%): 65
Best (%):
Emittance
Emittance definition: 50%
Vertical (pi mm mrad): protons : 14
Horizontal (pi mm mrad): protons: 12
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 1
Development(%): 4
Therapy(%) : 80
Isotope production (%): 4
Other application (%): 1
Maintenance (%): 5
Beam tuning(%): 5
Total time (h/year): 1500

TECHNICAL DATA
(a) Magnet: **Type:** Compact H Frame
Kb: 51 MeV **Kf:**
Average field (min./max. T): 1.75/2.05
Number of magnet sectors: 3
hill angular width (deg.):
spiral (max): 55 deg.
Pole parameters
Diameter (m): 1.55
Injection radius (m):
Extraction radius (m): 0.57
Hill gap (m): 0.115 **Valley gap (m):** 0.205
Trim coils
Number: 10 pairs
Maximum current (A-turns):
Harmonic coils
Number: 4 sets of 3 pairs
Maximum current (A-turns):
Main coils
Number: 1 pair
Total current (A-turns): 288000
Maximum current (A): 900
Stored energy (MJ):
Total iron weight (tons): 90
Total coil weight (tons):
Power
Main coils (total KW): 120
Trim coils (total, maximum, KW): 3
Refrigerator (cryogenic, KW):

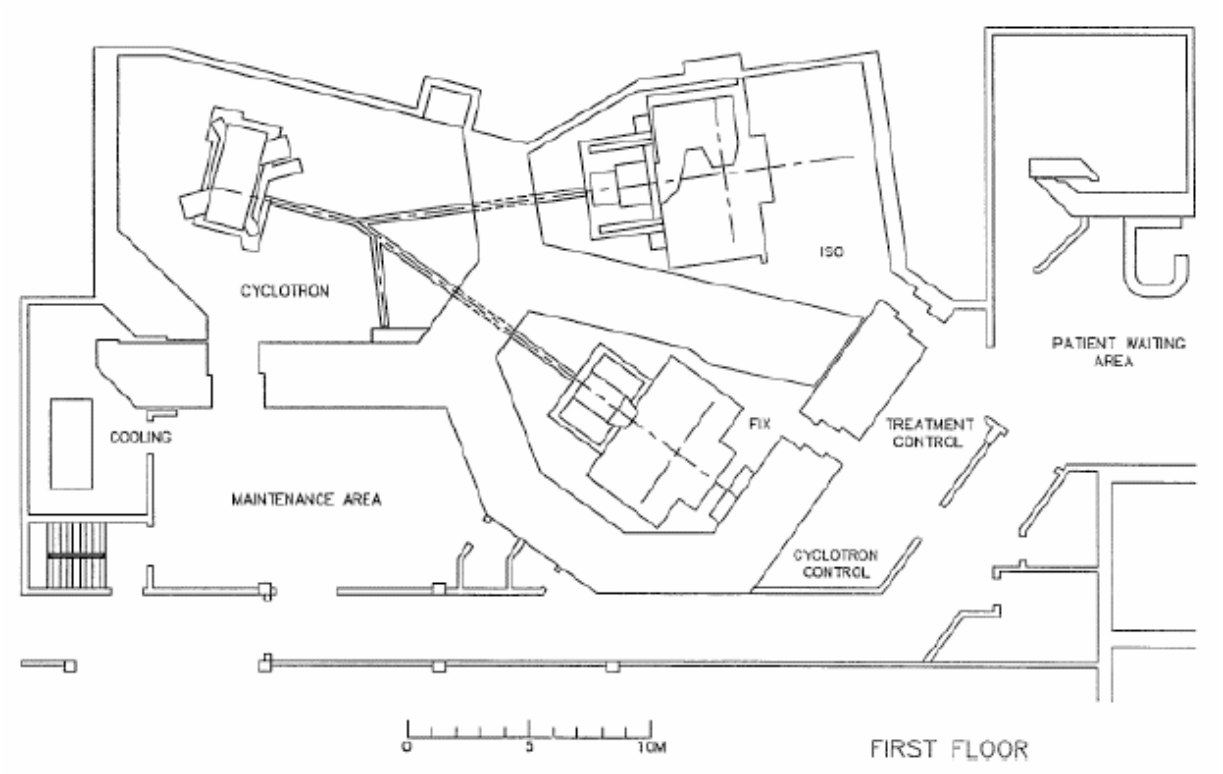
(b) RF
Frequency range (MHz): 19.5 to 26.0
Harmonic modes: 1,2
Number of dees: 2
Number of cavities: 2
Dee angular width (deg.): 90
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV): 40
Line Power (max, KW): 60
Phase Stability (deg.): 0.1
Voltage Stability (%): 0.1

(c) Injection
Ion Source: Dual Chimney, Internal PIG
Source Bias Voltage (kV): 0
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: Electrostatic Deflector, 46 kV max, Electromagnetic Channel, two passive focusing channels
Typical Efficiency (%): 85 (protons)
Best Efficiency (%): 90

(e) Vacuum
Pumps: Two oil diffusion pumps, 2 x 4300 l/s
Achieved Vacuum (Pa): 3.10E-04

REFERENCES: R.Risler et al. these proceedings


CYCLOTRON
ISO
PATIENT WAITING AREA
COOLING
FIX
TREATMENT CONTROL
MAINTENANCE AREA
CYCLOTRON CONTROL
0
5
10M
FIRST FLOOR

ENTRY N° FM1
Date: 4th feb 2008
Machine name: synchro-cyclotron SC200
Institution: Institut Curie –Centre de Protonthérapie
Address: Campus Orsay – Bat 101-F-91898 Orsay
Telephone: 33 1 69 29 87 00
Fax: 33 1 69 07 55 00
Web Address: http://protontherapie.curie.info/en/
Person in charge of cyclotron: Samuel Meyroneinc
Person reporting information: Samuel Meyroneinc
E-mail address: samuel.meyroneinc@curie.net

HISTORY
Designed by: Institut Physique Nucléaire d'Orsay (IN2P3/CNRS)
Constructed by: Institut Physique Nucléaire d'Orsay
Construction dates: 1970-1977
First beam date: 1977
Characteristic beam, energy and current:
201 MeV –protons up to 2 micro amperes
Transmission efficiency (source to extracted beam)
Typical (%): 70
Best (%): 75
Emittance:
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%): 0
Development(%): 0
Therapy(%): 92%
Isotope production (%): 0
Other application (%) :
Maintenance (%): 4 %
Beam tuning(%): 4 %
Total time (h/year): 2880

TECHNICAL DATA
(a) Magnet: **Type:**
Kb: **Kf:**
Average field (min./max. T): 1.53 – 1.6.
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter: 3.2
Injection radius (m): 0.01
Extraction radius (m): 1.4
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):

Main coils
Number: 4
Total current (A-turns): 630 000
Maximum current (A): 630
Stored energy (MJ):
Total iron weight (tons): 900
0Total coil weight (tons): 200
Power:
Main coils (total KW): 360
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 25.6 , 19,2
Harmonic modes:
Number of dees: 2
Number of cavities: 0
Dee angular width (deg.):
Voltage
at injection (peak to ground, KV):
at extraction (peak to ground, KV):
peak (peak to ground, KV):
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
lon Source: PIG hot filament
Source Bias Voltage (kV):
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: Electromagnetic channel, magnetic channels (5)
Typical Efficiency (%): 70
Best Efficiency (%): 75

(e) Vacuum
Pumps: oil diffusion galileo 16 kl/s
Achieved Vacuum (Pa): 5. 10-6

COMMENTS :
http://protontherapie.curie.info/en/

ENTRY N° FM2
Date: 5, Dec. 2007
Machine name: Synchrocyclotron on 1Gev
Institution: Petersburg Nuclear Physics Institute
Address:188300. Gatchina, Leningrad region, Russia
Telephone: 8 813 71 30857
Fax: +7813 71 30346
Web Address: http://www.pnpi.spb.ru/
Person in charge of cyclotron: N.K.Abrossimov
Person reporting information: G.A.Riabov
E-mail address: riabov@mail.pnpi.spb.ru

HISTORY
Designed by: Efremov Institute
Constructed by:
Construction dates: 1959-1965
First beam date: Nov. 1967
Characteristic beam, energy and current:
Extracted P-beam, E=1000 MeV, 1μA
Sec. beams:π-μ mesons,n-neutrons, p-variable energy
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):

USES
Basic research (%):
Development(%):
Therapy(%) : 12 %
Isotope production (%):
Other application (%) :
Maintenance (%):
Beam tuning(%):
Total time (h/year): 2500

TECHNICAL DATA
(a) Magnet: Iron **Type:** H-tipe
Kb: **Kf:**
Average field (max /min.. T): 1.9-1.78
Number of magnet sectors:
hill angular width (deg.):
spiral (max):
Pole parameters
Diameter: 6.85m
Injection radius (m):
Extraction radius (m): 3.15m
Hill gap (m): **Valley gap (m):**
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number: 2×132
Total current (A-turns): $1.3*10^6$
Maximum current (A): 4800
Stored energy (MJ):
Total iron weight (tons): 7800
Total coil weight (tons): 120 (Al)
Power
Main coils (total KW): 1000
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz): 29-13.3
Harmonic modes: 1
Number of dees: 1
Number of cavities:
Dee angular width (deg.): 180
Voltage
at injection (peak to ground, KV): 10
at extraction (peak to ground, KV):
peak (peak to ground, KV): 10
Line Power (max, KW):
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source: internal

(d) Extraction
Elements, Characteristic: Regenerative extraction with the iron channel
Typical Efficiency (%): 30%
Best Efficiency (%):

(e) Vacuum
Pumps: 2p. on $2*10^4$ l/s, 3p. on $4*10^3$ l/s
Achieved Vacuum (Pa): $2.7*10^{-4}$

REFERENCES:
N.K.Abrossimov, A.A.Vorobyov, G.A.Riabov.
Status of PNPI Synchrocyclotron.
PNPI XXX. High Energy Physics Division.
Main Scientific Activities 1997-2001, Gatchina 2002.
. p 6-14.

EXPERIMENTAL FACILITIES
Proton spectrometer with resolution 10^{-3}; π-μ channels;
3-proton beam lines;P therapy;TOF neutron spectrometer
On-line short lived isotope production facility

ENTRY N° FM3
Date: 5 Dec. 2007
Machine name: PHASOTRON
Institution: DLNP JINR Russia
Address: Dubna Joliot Curie 6 Moscow Reg.
Telephone: 7 49621 65887
Fax: 7 49621 66666
Web Address:
Person in charge of cyclotron: M.Kazarinov
Person reporting information: L.Onischenko
E-mail address: olm@jinr.ru

HISTORY
Designed by:DLNP and Efremov Institute(NIIEFA)
Constructed by:NIIEFA and LES (Leningrad)
Construction dates:1979-1985
First beam date: Febr.1985
Characteristic beam, energy and current:
Protons 660MeV 3.2mcA (2*E13pps)…..
Transmission efficiency (source to extracted beam)
Typical (%):
Best (%):
Emittance
Emittance definition:2sigma
Vertical (pi mm mrad): 33
Horizontal (pi mm mrad): 54
Longitudinal (dE/E[%] x RF[deg.]): 0.5%*120deg.

USES
Basic research (%):
Development(%):
ProtonTherapy 90%
Isotope production (%):
Other application (%) :
Maintenance (%): 10%
Beam tuning(%):
Total time (h/year):1000

TECHNICAL DATA
(a) Magnet: H **Type:**compact
Kb:660 **Kf:**
Average field (min./max. T):1.19/1.63 T
Number of magnet sectors: 4
hill angular width (deg.):30/70
spiral (max): 77deg.
Pole parameters
Diameter: 6m
Injection radius (m):0.025
Extraction radius (m):2.7
Hill gap 0.12/0.3m **Valley gap** 0.3/0.8/0.5m
Trim coils
Number:
Maximum current (A-turns):
Harmonic coils
Number:
Maximum current (A-turns):
Main coils
Number: 2
Total current (A-turns):
Maximum current (A): 4000A
Stored energy (MJ):
Total iron weight (tons): 7000t
Total coil weight (tons): 165t
Power
Main coils (total KW): 700kW
Trim coils (total, maximum, KW):
Refrigerator (cryogenic, KW):

(b) RF
Frequency range (MHz):18.6-14.4
Harmonic modes: 1
Number of dees: 1
Number of cavities:
Dee angular width (deg.): 180deg
Voltage
at injection (peak to ground, KV): 40
at extraction (peak to ground, KV):28
peak (peak to ground, KV):
Line Power (max, KW): 300
Phase Stability (deg.):
Voltage Stability (%):

(c) Injection
Ion Source: Internal PIG source
Source Bias Voltage (kV): 0.5cont./1.0kV pulsed mode
External Injection:
Buncher Type:
Injection Energy (MeV/n):
Component:
Injection Efficiency (%):
Injector:

(d) Extraction
Elements, Characteristic: Regenerative type, current magnetic channel
Typical Efficiency (%):50
Best Efficiency (%):60

(e) Vacuum
Pumps: 5 diffusion pumps
Achieved Vacuum (Pa):1*E-6mm.Hg

EXPERIMENTAL FACILITIES
TRITON,DUBTO,muSR, 6 cabin hadron therapy complex