ENTRY NO: C40
Date: 21 Feb 2005 11:37:45
Machine Name: Gustaf Werner Cyclotron
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History
Designed By: in house
Construction Dates: 1946-51, 1977-86
First Beam Date: 1951, 1986
Characteristic Beams

ions	/ energy(MeV/N)	/current(pps)
p	178	3×10^{12}
p	98	4×10^{13}
$^{14}N^{7+}$	45	2×10^{10}
$^{129}Xe^{27+}$	8.33	1×10^{9}

secondary beam facility:
neutrons via ^{7}Li(p,n) reaction:

n	20-175	$(1\text{-}3)\times10^{5}$ per cm^2

Transmission Efficiency (source to extracted beam)
Typical (%): 5
Best (%):
Emittance
Emittance Definition:
Vertical (pi mm mrad):
Horizontal (pi mm mrad):
Longitudinal (dE/E[%] x RF[deg.]):
USES
Basic Research (%): 5
Development (%):
Therapy (%): 65
Isotope Production (%): 20
Other Application (%): 0
Maintenance (%): 5
Beam Tuning (%): 5
Total Time (h/year): 4300

TECHNICAL DATA
(a)Magnet
Type: compact
Kb (MeV): 192
Kf (MeV):
Average Field (min./max. T): 1.75/0.6
Number of Sectors: 3
Hill Angular Width (deg.): varies
Spiral (deg.): 55
Pole Diameter (m): 2.8
Injection Radius (m): 0.019
Extraction Radius (m): 1.175
Hill Gap (m): 0.2
Valley Gap (m): 0.38
Trim Coils
Number: 13
Maximum Current (A-turns): ca 5000
Harmonic Coils
Number: 2 sets of 3 coils
Maximum Current (A-turns): ca 8000
Main Coils
Number: 2
Total Ampere 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
Acceleration
Frequency Range (MHz): 12.3 – 24.0
Harmonic Modes: 1,2,3
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
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: spiral inflectors
Injection Efficiency (%): 5 - 10
Injector:

(d)Extraction
Elements, Characteristic isochr. mode: precessional extraction El. stat. defl. 65 kV, aperture 5 mm, septum 0.5 mm, El. magn. channel 4.7 kA, 5 mm septum passive focusing channel Synchrocyclotron mode: regenerative extraction Same plus passive peeler, regenerator
Typical Efficiency (%): 50
Best Efficiency (%): 80

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

REFERENCES
S. Holm, Status Report on the Gustaf Werner Cyclotron in Uppsala, Proc. 13th Int. Cycl. Conf, Vancouver 1992 p. 106.
A. Montelius et al., The narrow proton beam therapy unit at the the Svedberg Laboratory in Uppsala, Acta Oncologica 30 (1991) 739.
S. Lorin et al., Development of a compact proton scanning system in Uppsala with a moveable second magnet, Phys. Med. Biol. 45 (2000) 1151.
S. Pomp et al., The New Uppsala Neutron Beam Facility, Proc. Int. Conf. on Nuclear Data for Science and Technology, Santa Fe, N.M., USA, Sept. 26-Oct. 1 2004, paper 285 (to be published).

EXPERIMENTAL FACILITIES
Narrow-beam and Broad-beam proton treatment facilities.
Neutron beam with SCANDAL (Scattering Neutron Detection Assembly), Medley (studies of neutron-induced light charge particle production), and facility for testing of electronics for neutron-induced single-event effects and for other irradiations.
Radionuclide production facility.
Proton irradiation facility.
Light ion radiation facility for radiobiology.
Heavy ion radiation facility for materials research.