

The Construction Status of CSNS Linac

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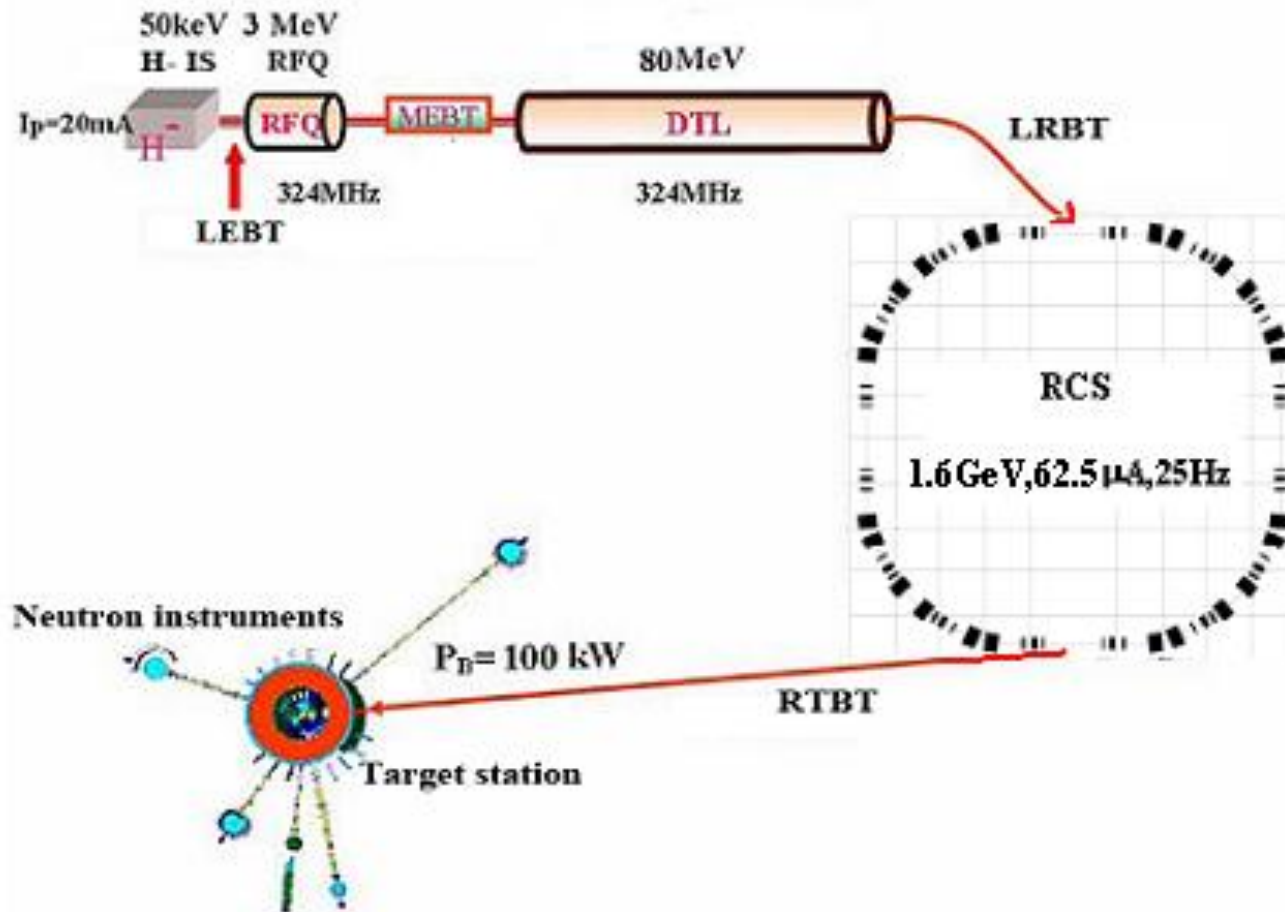
Sep.2, 2014 , Geneva



Outline

- The introduction to CSNS accelerators
- The commissioning of ion source
- The RF conditioning of RFQ
- Construction status of DTL
- Commissioning plan of DTL
- Summary

A Brief Review to CSNS



	CSNS	Upgrade
Beam power (kW)	100	500
Rep. rate (Hz)	25	25
Target number	1	1
Ave. current (μA)	62.5	312
Kinetic energy (GeV)	1.6	1.6
Inj. Energy (MeV)	80	250

China Spallation Neutron Source (CSNS)



大科学装置的布局

长短波
授时系统

兰州重离子
加速器

武汉生物安全
实验室
(P4)

中国西南野生生物
种质资源库

500米口径球面射电
望远镜
(FAST)

北京正负电子对撞机
遥感飞机
中国遥感卫星地面站
子午工程
大天区面积多目标光
纤光谱天文望远镜
(LAMOST)
航空遥感系统

海洋科学综
合考察船

合肥同步辐射
超导托卡马克核
聚变装置
(HT-7, EAST)

强磁场实验装置

神光装置
上海光源
蛋白质科学
研究设施

散裂中子源

China Spallation Neutron Source (CSNS)



China Spallation Neutron Source (CSNS)

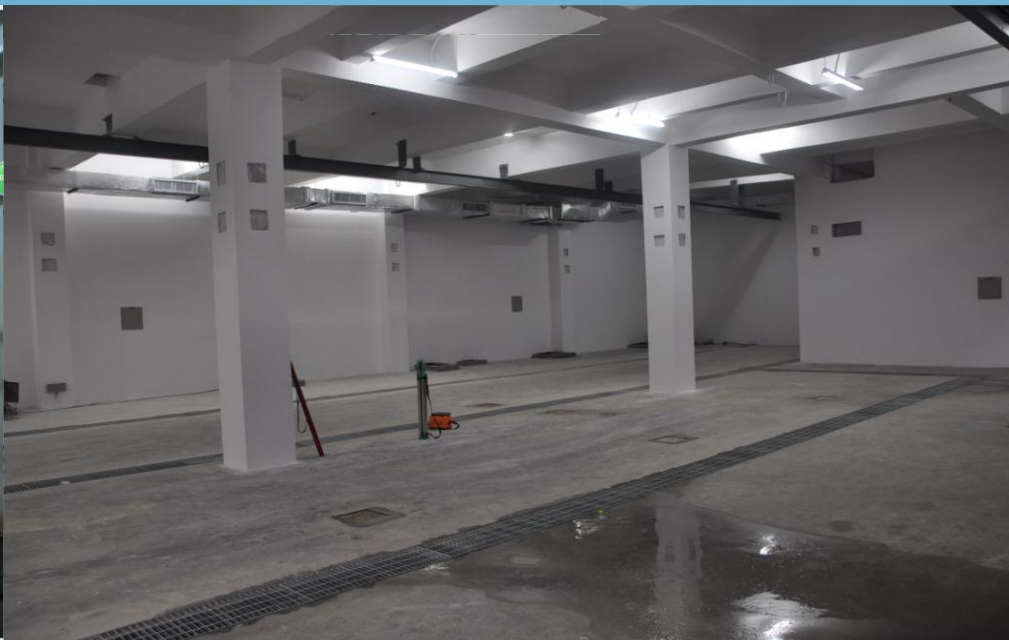
中国散裂中子源工程进展照片 (2014.4)



China Spallation Neutron Source (CSNS)



China Spallation Neutron Source (CSNS)



China Spallation Neutron Source (CSNS)

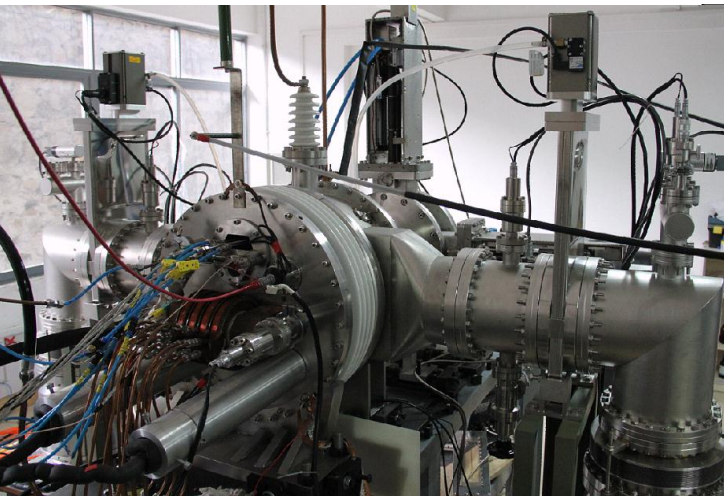


China Spallation Neutron Source (CSNS)

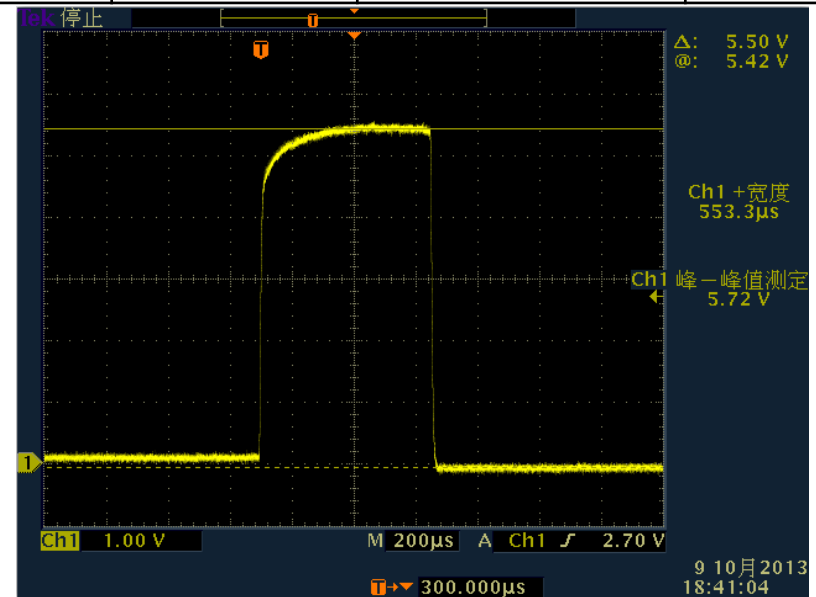


Ion Source Commissioning

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China Spallation Neutron Source



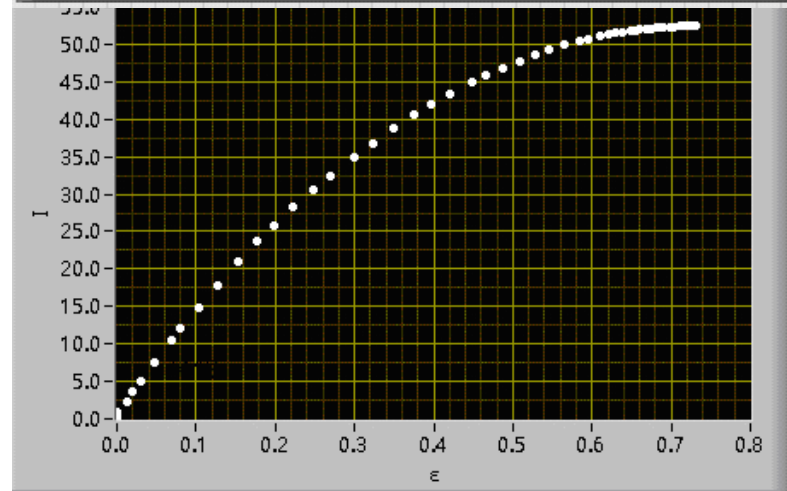
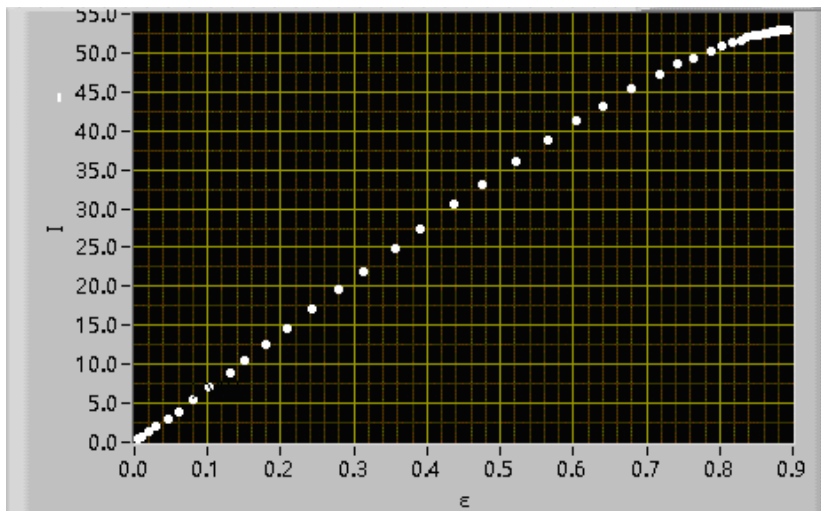
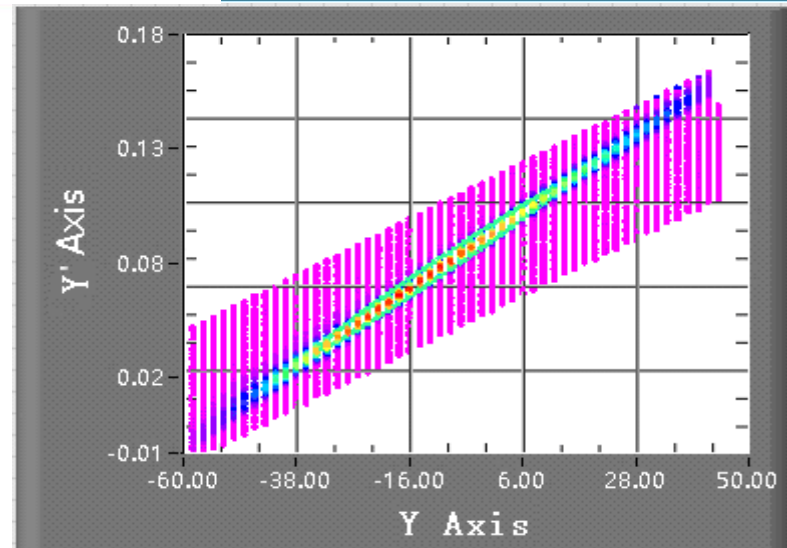
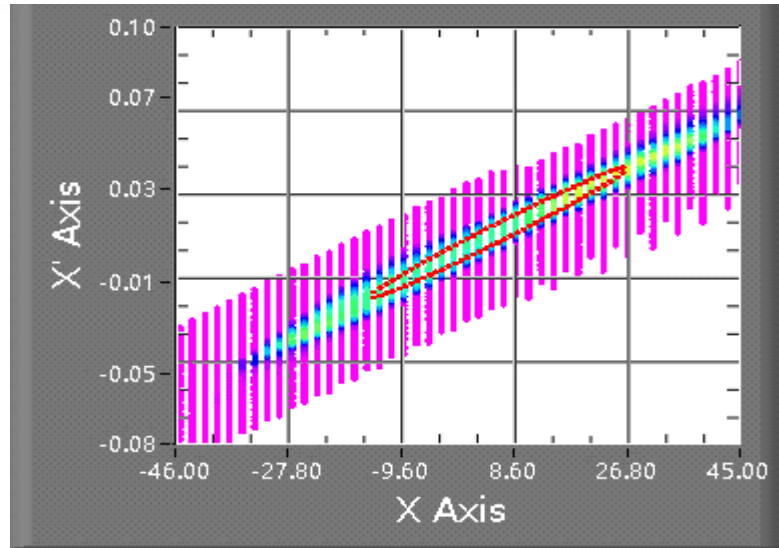
Output energy	50 keV	Temperature of Cs oven	150~170 °C
Repetition rate	25 Hz	Temperature of Cs transport line	~300 °C
Pulse H ⁻ beam width	500 μs	Extraction voltage	17 kV
Pulse H ⁻ beam current	50 mA	Current of Analyzing magnet	
Flux of H ₂	10~12 SCCM	Pulse arc current	
Pulse arc width	600 μs	Chamber vacuum	2~3 × 10 ⁻³ Pa



①: hydrogen feeding, ②: discharge current: 50A,
③: extraction voltage: 17kV, ④: extraction current:
300mA (electrons and H⁻)

H⁻ beam at ACCT: 55mA, 500 ms and 25 Hz

Emittance Measurement



Emittance vs. beam current. Left: X plane. Right: Y plane. At 0.2 mmrad , current of X plane and Y plane is 15mA and 25mA, respectively.

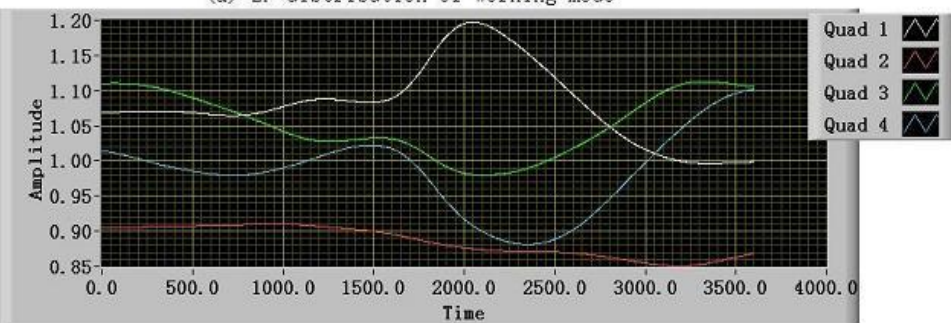
RFQ Tuning

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China Spallation Neutron Source

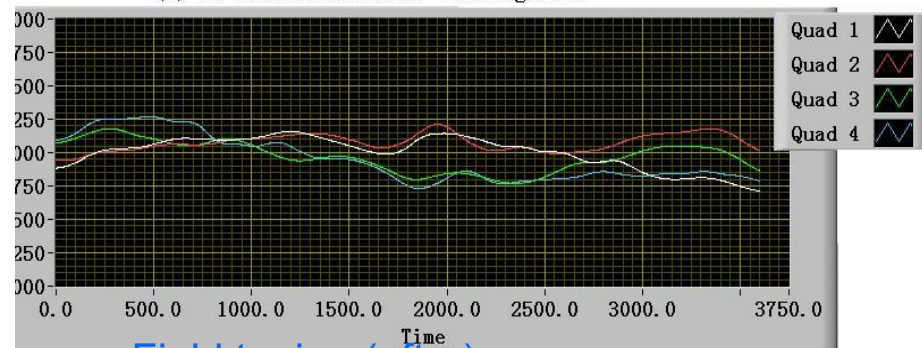
Output energy	3.0 MeV
Repetition rate	25 Hz
Pulse H ⁻ beam width	500 μ s
Pulse H ⁻ beam current	40 mA
RF Freq.	324MHz
Length	3.5



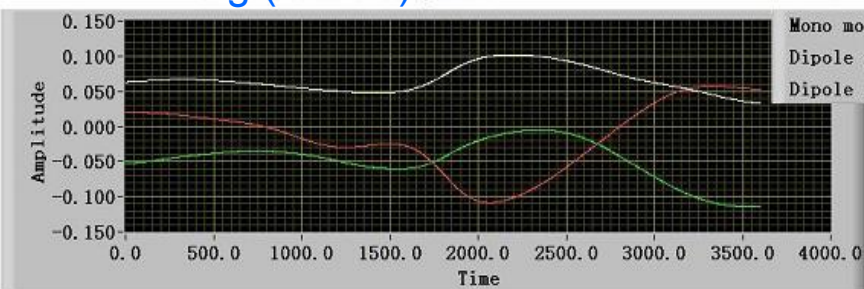
(a) EF distribution of working mode



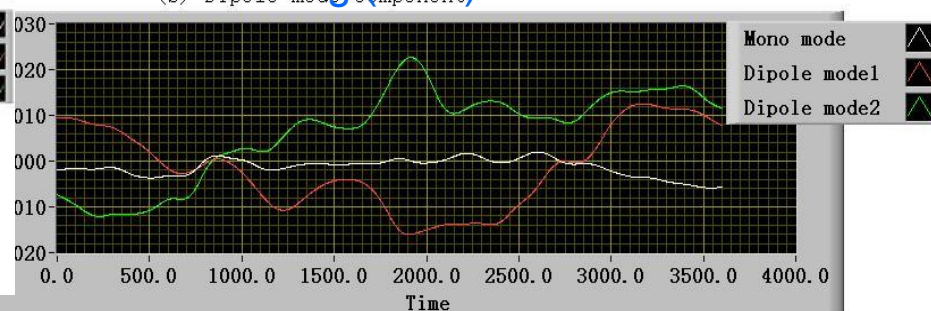
(a) EF distribution of working mode



Field tuning (before)



Field tuning (after)



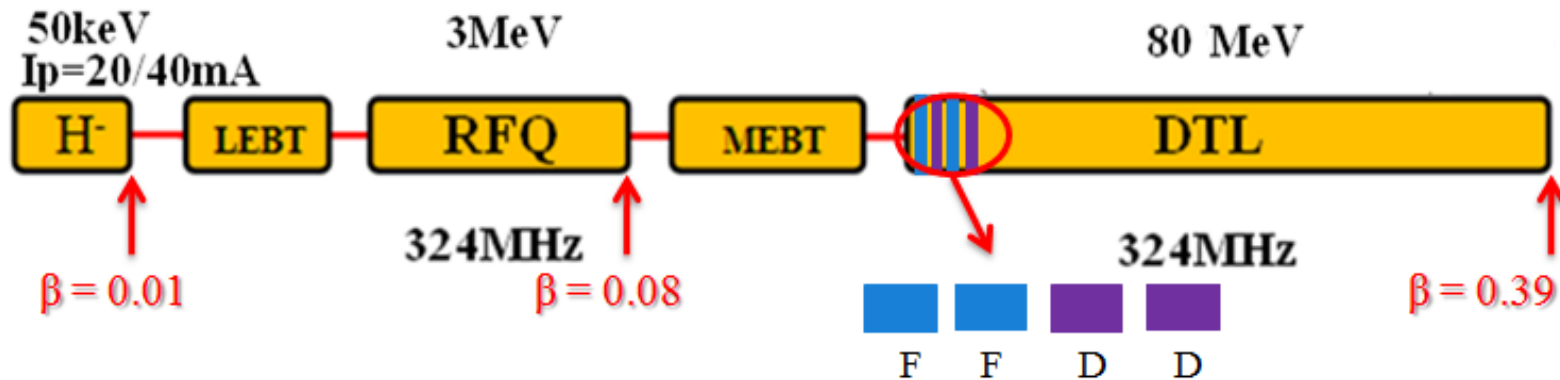
RFQ Conditioning

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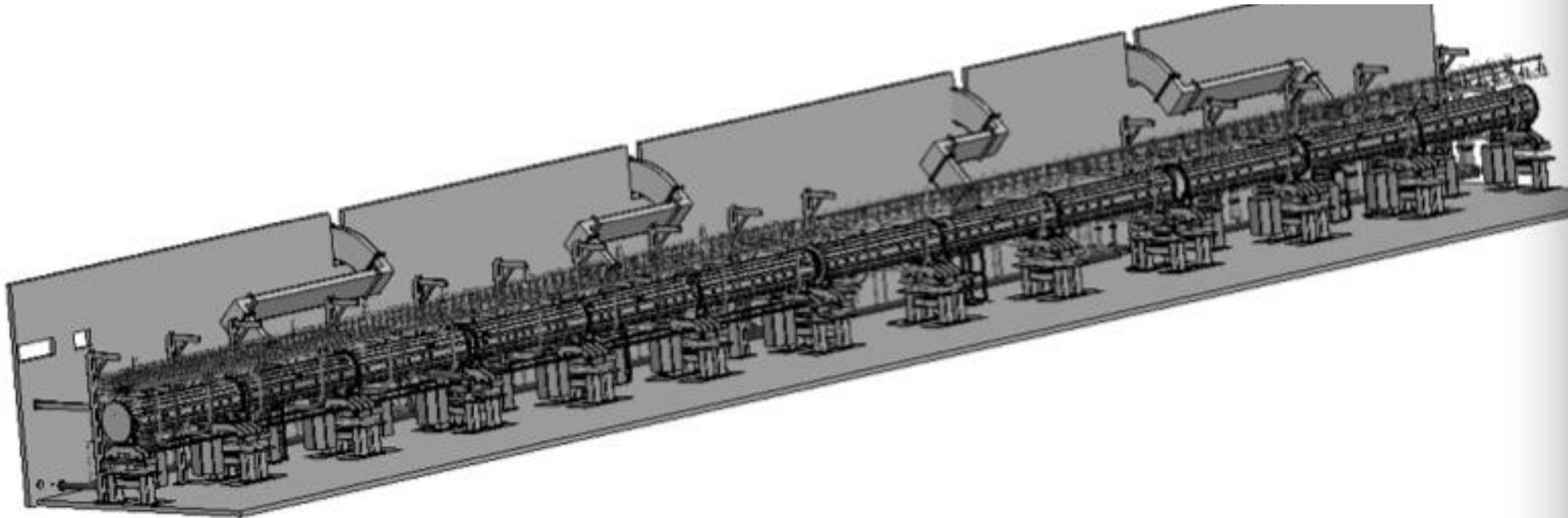
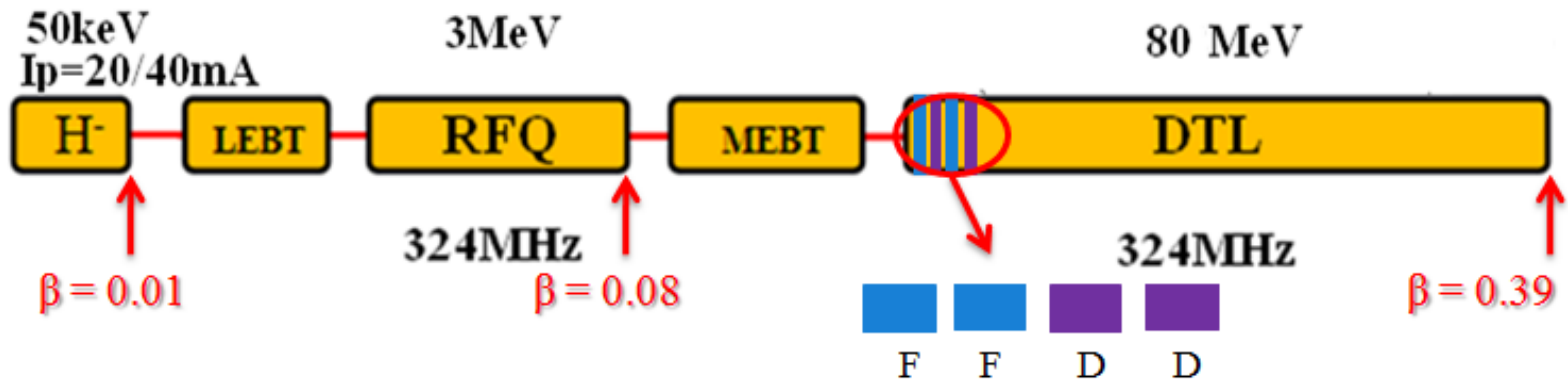
437kW @700 μ s/25pps.
Input RF frequency is near
324.16MHz,
Two power couplers' VSWR are
2.09 and 2.03,



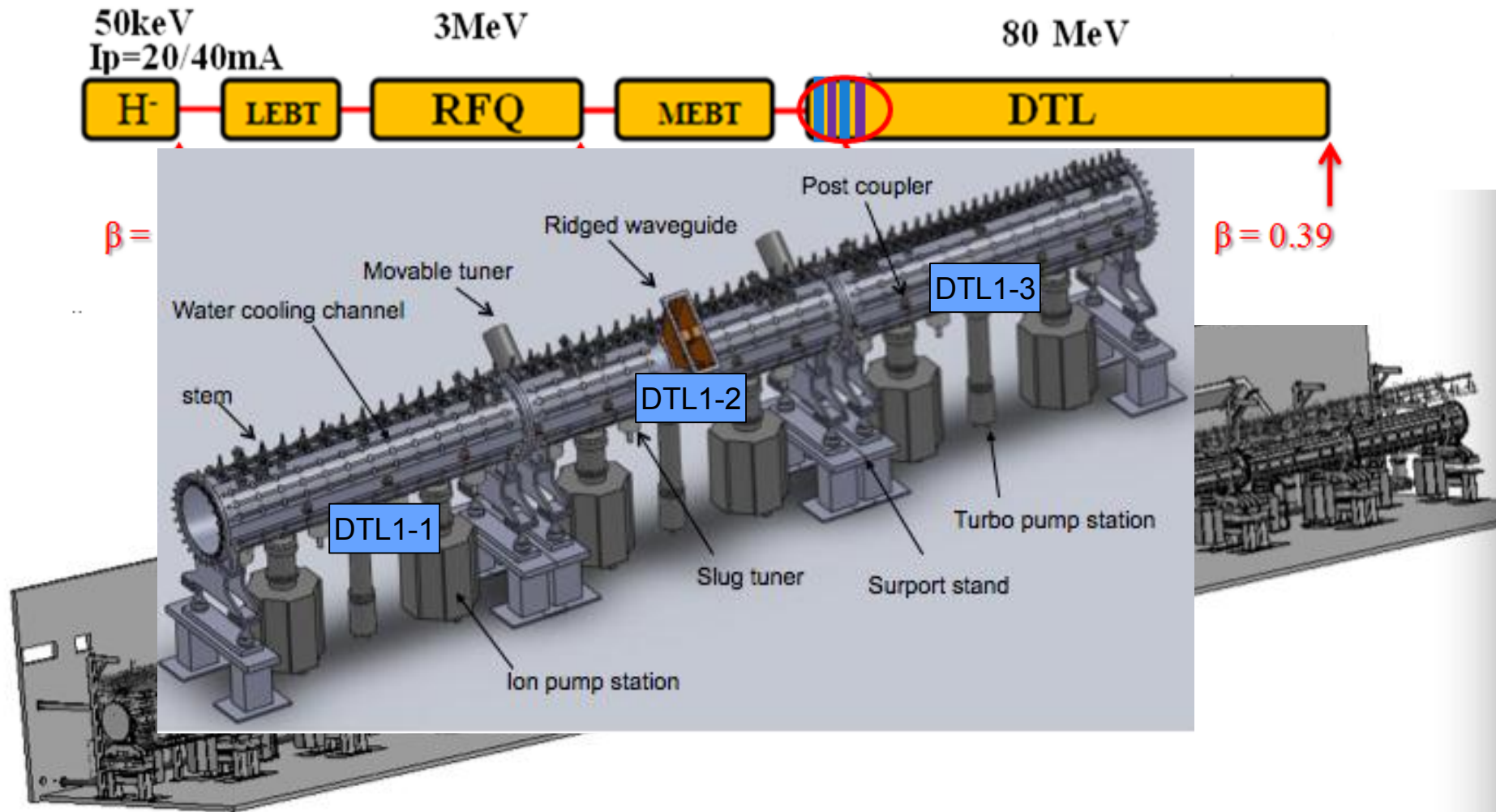


	DTL	
Length	35.44	m
Frequency	324	MHz
Beam energy	3-80.1	MeV
Number of Tanks	4	
Copper RF power	5.3	MW
Peak current	15	mA
Aperture radius	8-12	mm
Number of Cells	161	

DTL Layout

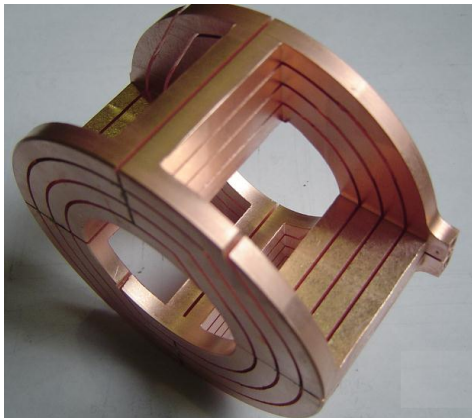
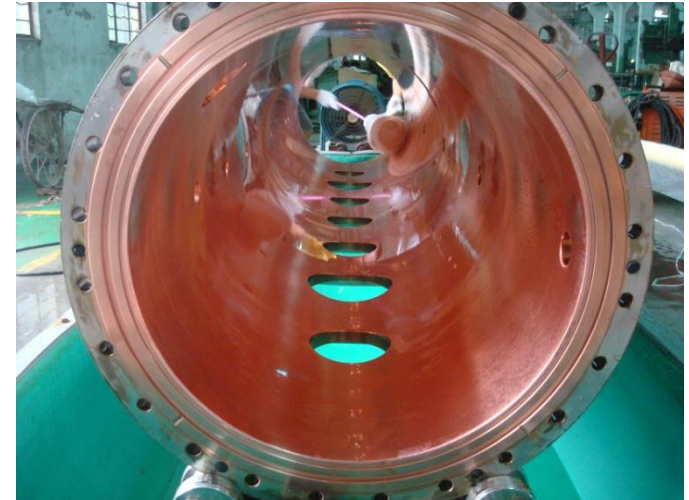


DTL Layout

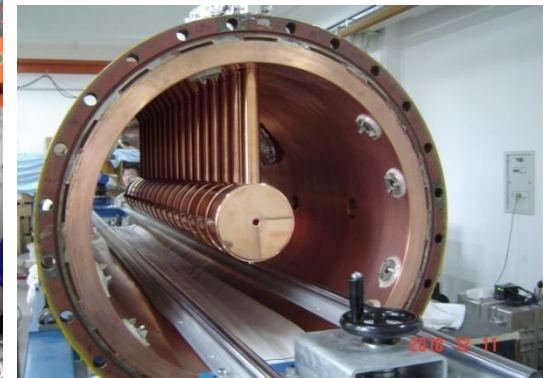
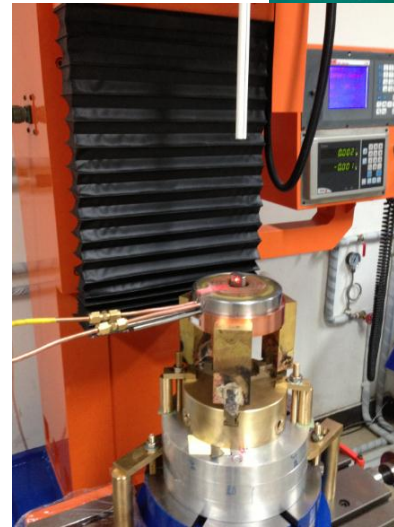


DTL: Features

- Electroplating Tank
- Compact Electro-Quadrupole Magnets:
 - Advanced fabrication technology
 - OFC (Oxygen Free copper)DT
- Q-Magnet measurement
- High accuracy alignment



Q-magnet hollow coil



Tank Status

- Each physical tank consists of 3 mechanical segments.
- 6 segments have been completed, and the other 6 will be completed at the end of 2014.
- The DT installation of the first tank will begin at the beginning of September



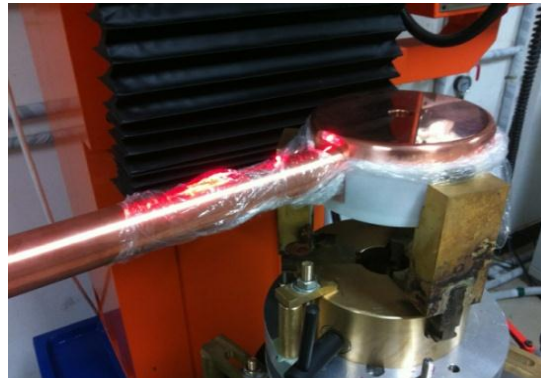
Cleaning after electroplating
and polishing



Tank fabrication

Quadrupole field measurement

The magnetic field of the Q-magnet was measured several times by a rotating coil during the fabrication process.



- The first measurement is done just after the construction of the magnet.
- The next two measurements are done before and after EBW of DT.
- Final step for fine polishing is a Iteration process.

Drift Tube Status

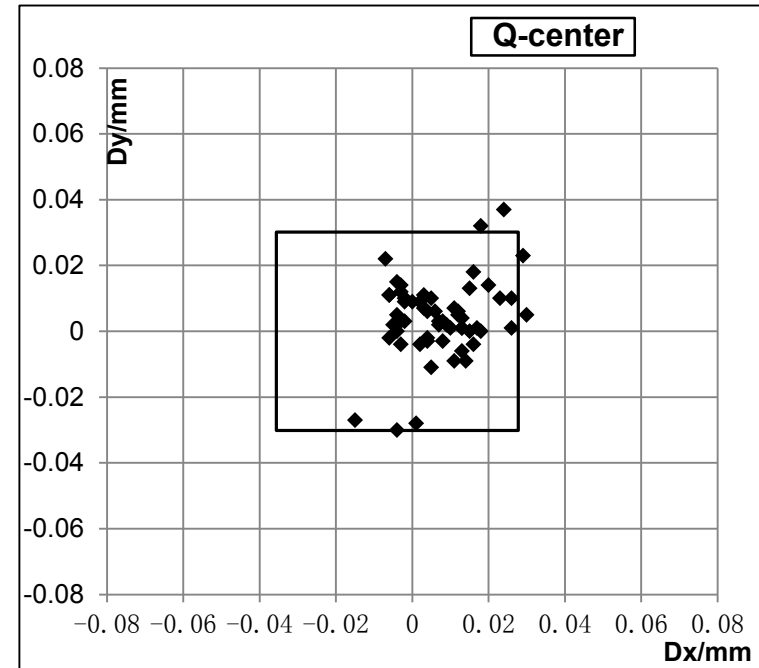
- 63 drift tubes for DTL1 have been completed.
- For the other 3 tanks, half of totally 126 DTs have been completed, and the rest will be completed at the end of Feb. 2015



Quadrupole field measurement

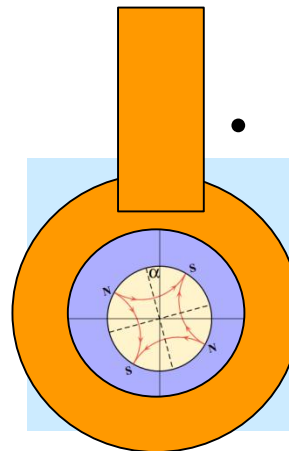
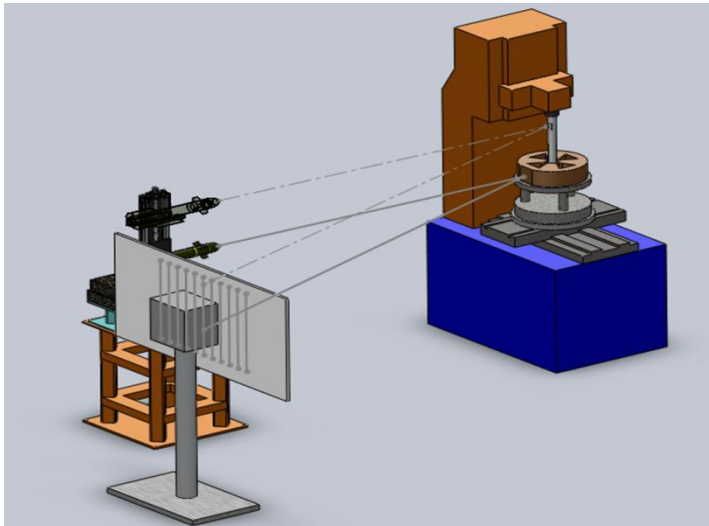
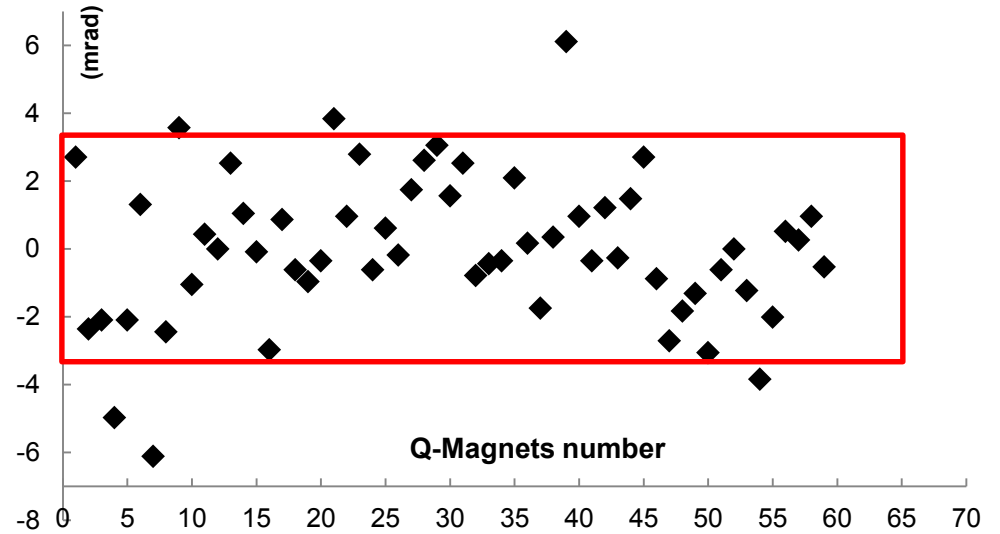
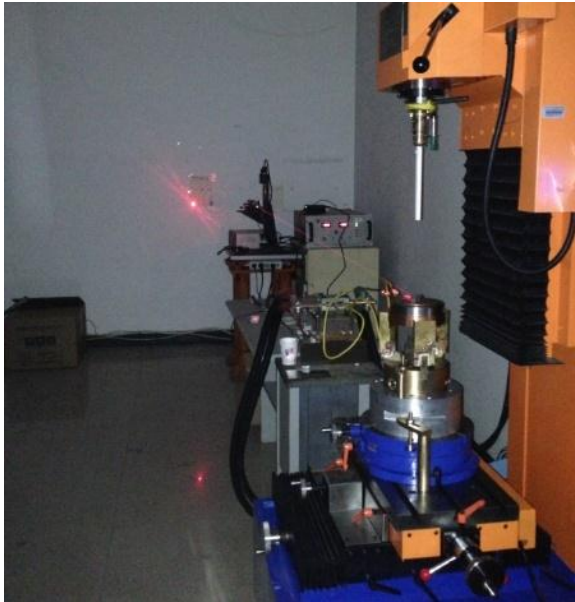
- the higher order multipole components less than 0.3%
- The deviation :less than $\pm 30\mu\text{m}$

Rotating coil measurement



Deviations between the mechanical center
and the magnetic center

Rotating angle



- Quadrupole rotation $\alpha < \pm 3\text{mrad}$

RF properties



Network analyzer



Pick-ups



Tank No.	meas.(calc.)	m/c(%)	freq.(MHz)
DTL1-1	70099(78023)	90	405.03

Bead-pull Measurement System

- Network Analyzer
- Bead-Pull Support
- Bead-Pull motor control
- NA Control and Data acquisition program

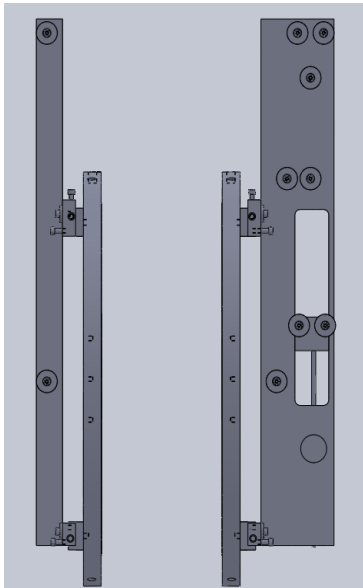
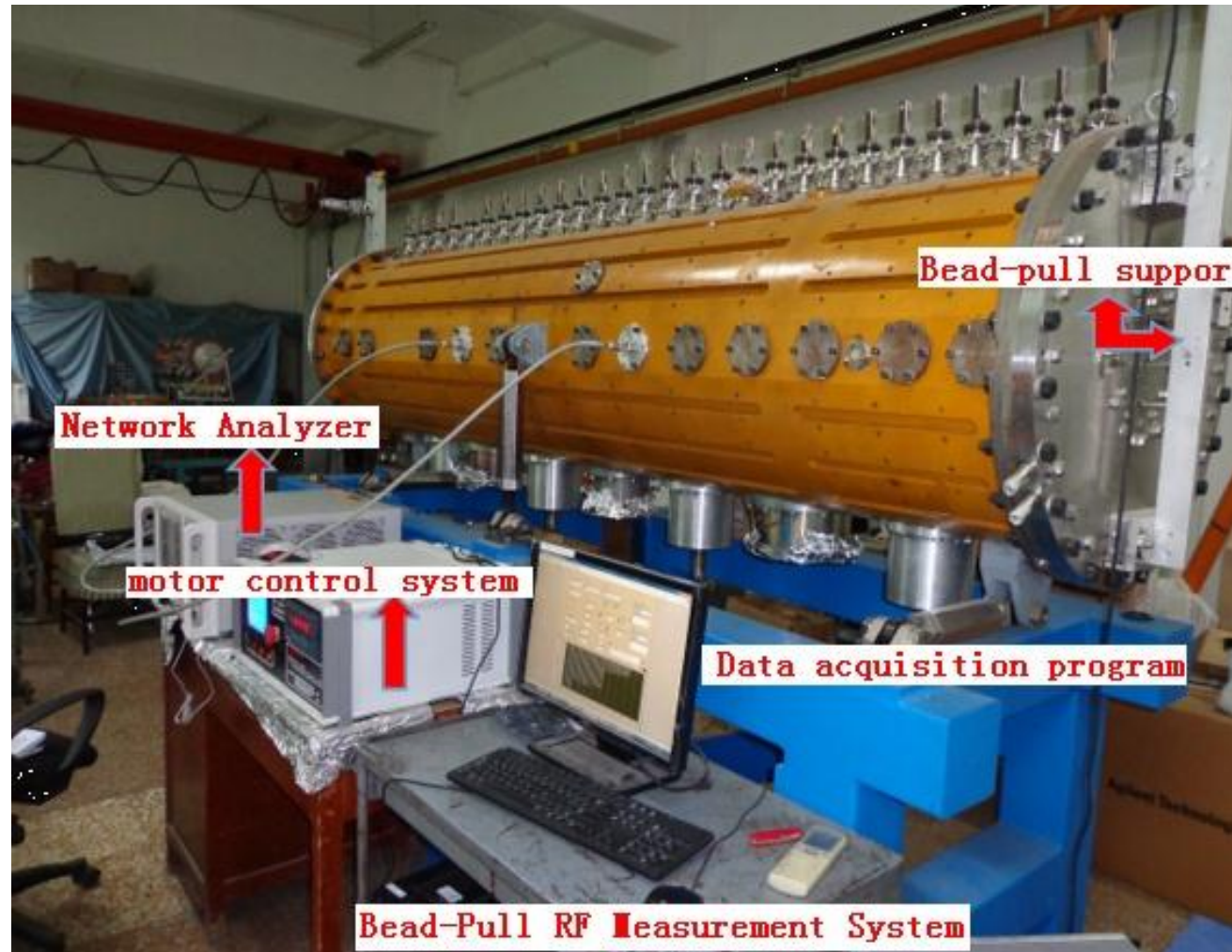


Diagram of Bead-Pull support structure



Bead-Pull RF Measurement System

RF windows

The CSNS DTL requires four RF windows at 324MHz. Each window will transmit up to 80 kW of average power and 2 MW peak power at 25 Hz with 620 microsecond pulses. The RF windows designed and manufactured by Thales, will test at the full average power for 24 hours to ensure no problems with such a power level.

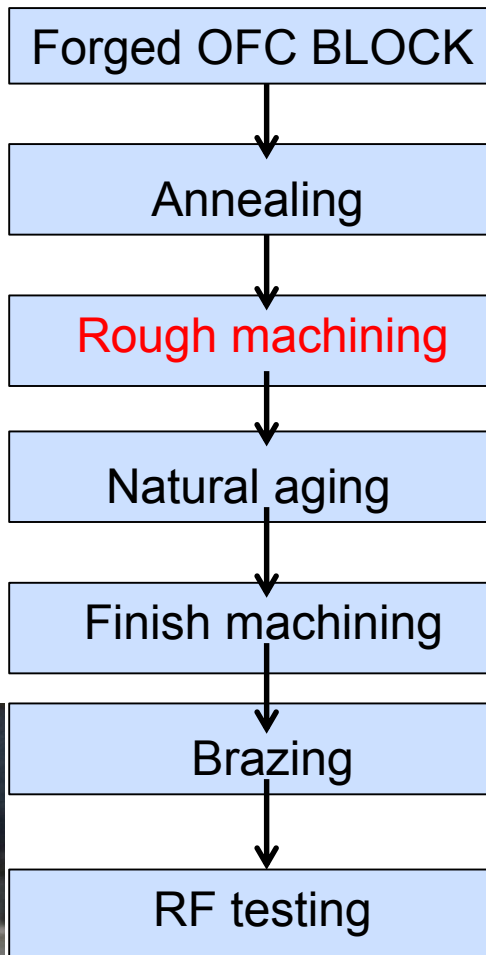


Frequency	324MHz
Peak power	2MW
VSWR(:1)	<1.05
Max.Average power	~100kW
Repetition rate	25Hz
RF on Pulse length	620μs

Ridged Waveguide



Cold model



OFC Block

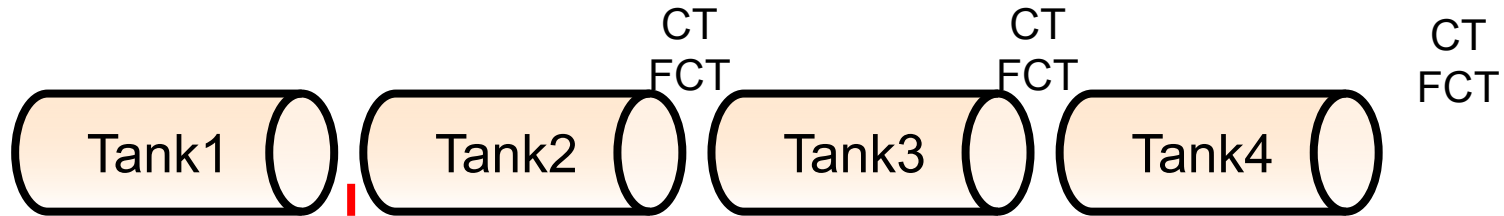


Flange



DTL Commissioning Plan

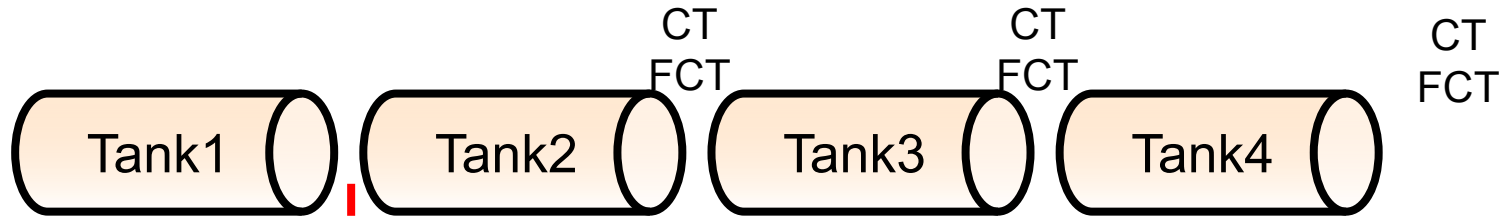
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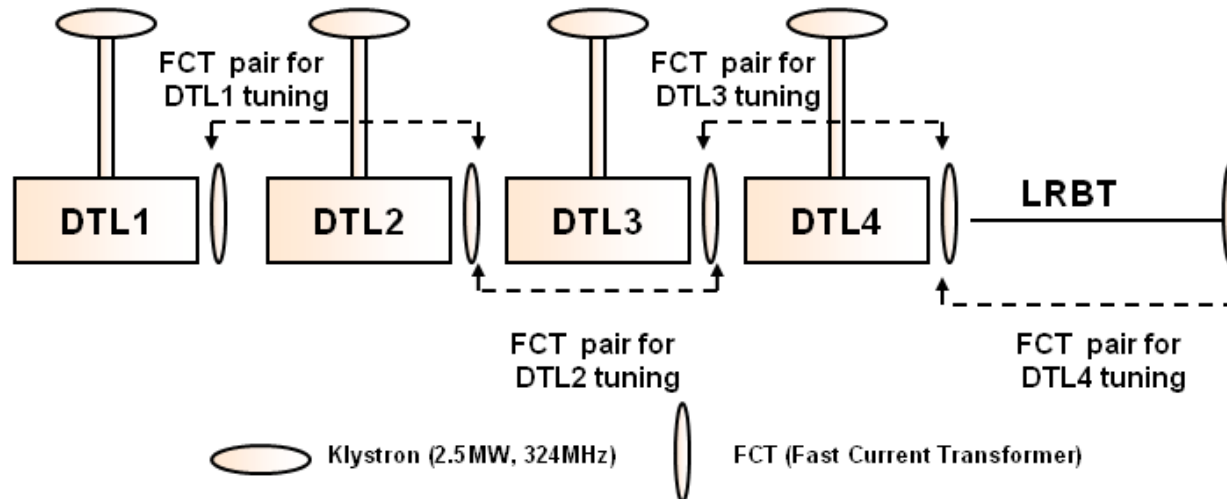
Temporal Beam Diagnostic system:
1BPM,1CT,2FCT,1 QEM,1 x-y steering magnet,1EM,1WS
1 Energy degrader /Faraday cup,1 Beam dump(0.163kW)

DTL Commissioning Plan

散裂中子源
China Spallation Neutron Source



Temporal Beam Diagnostic system:
1BPM,1CT,2FCT,1 QEM,1 x-y steering magnet,1EM,1WS
1 Energy degrader /Faraday cup,1 Beam dump(0.163kW)



Planned commissioning Schedule

IS+LEBT	Nov. 15, 2014-Dec.31, 2015	1.5 months
RFQ+MEBT	Feb. 15, 2015-Mar. 31, 2015	1.5 month
DTL1	Aug. 1, 2015-Sep. 30, 2015	2 months
DTL2-4+LRBT	July. 1, 2016-Sep. 30, 2015	3 months
RCS	Oct. 1, 2016-Jul. 31, 2017	10 months
RTBT	Aug. 1, 2017-Aug. 31, 2017	1 month
First beam on target	Aug. 1, 2017-Aug. 31, 2017	
Beam power to 10kW	Aug. 1, 2017-Sep 30. 2017	
CSNS to acceptance goal	Dec. 31, 2017	
Official acceptance	Mar. 2018	
Beam power to 100kW	Mar.1,2018-Mar.1,2021	3 years

Summary

- The commissioning of ion source has been successfully performed.
- The RF conditioning for RFQ has been successfully done.
- There is delay on the DTL construction, but still on the schedule for official acceptance.
- The beam commission for DTL tank-1 will start on the May, 2015, and the beam commissioning for whole DTL will be completed on the Sep., 2016.

Thanks for your attention!