The Construction Status of CSNS Linac

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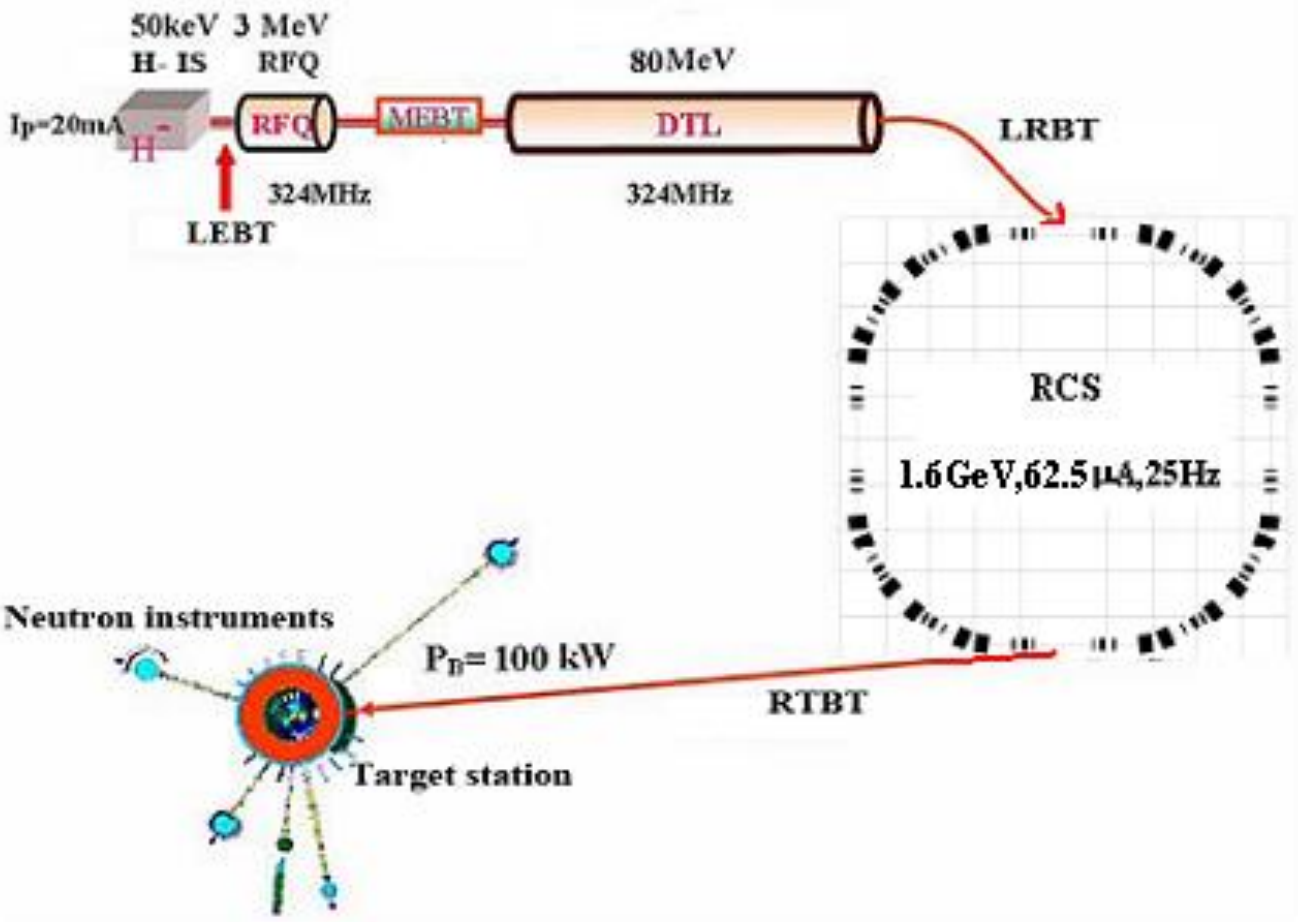
CSNS CHINESE ACADEMY OF SCIENCES

Outline

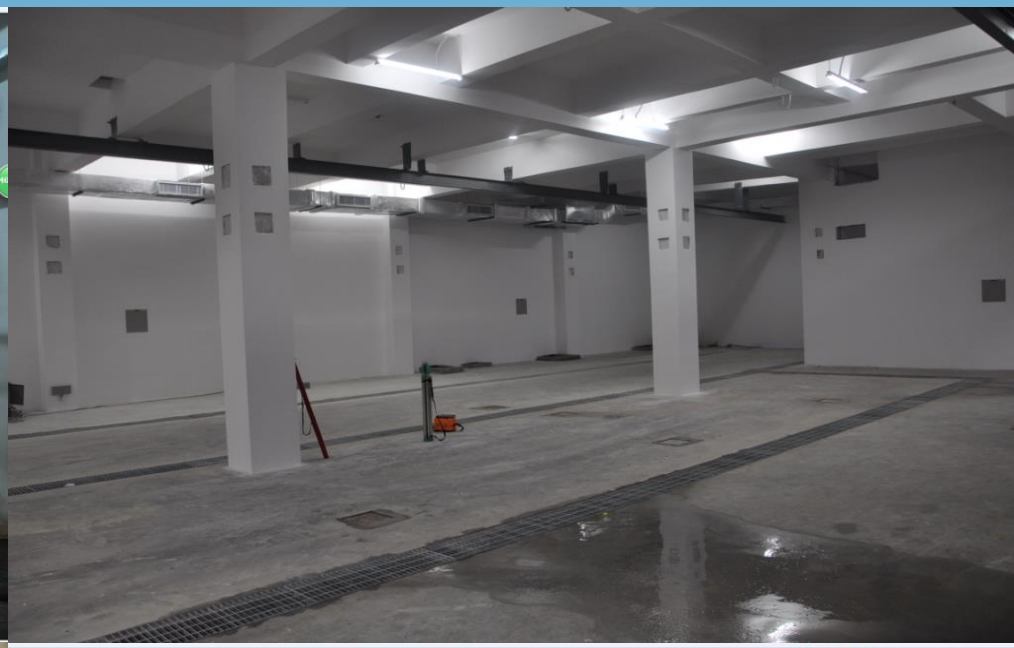
- The introduction to CSNS accelerators
- The commissoning of ion source
- The RF conditioning of RFQ
- Construction status of DTL
- Commissioning plan of DTL
- Summary

A Brief Review to CSNS

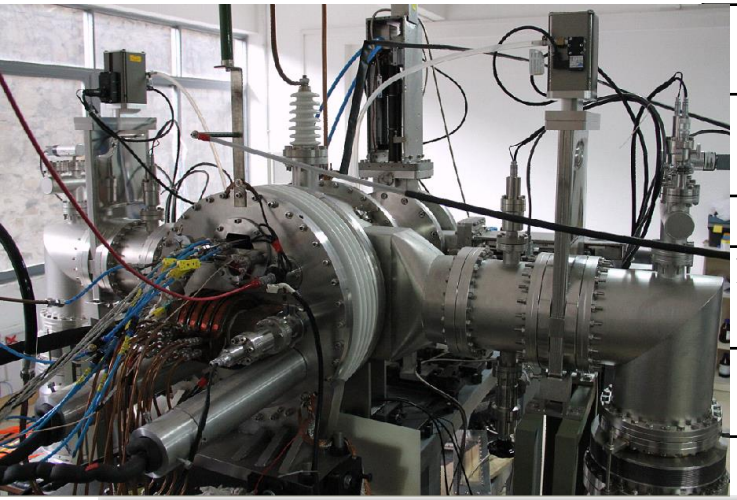


	CSNS	Upgrade
Beam power (kW)	100	500
Rep. rate (Hz)	25	25
Target number	1	1
Ave. current (μA)	62.5	312
Kinetic energy (GeV)	1.6	1.6
Inj. Energy (MeV)	80	250

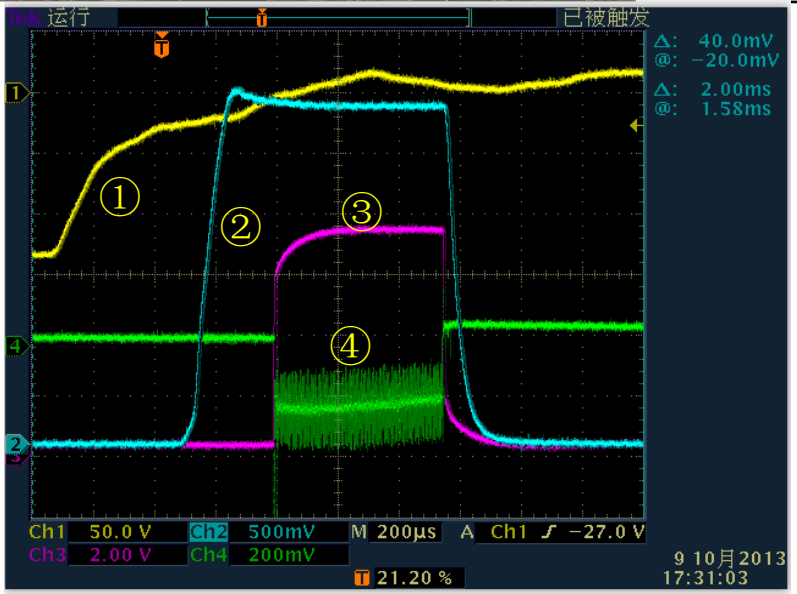
China Spallation Neutron Source (CSNS)



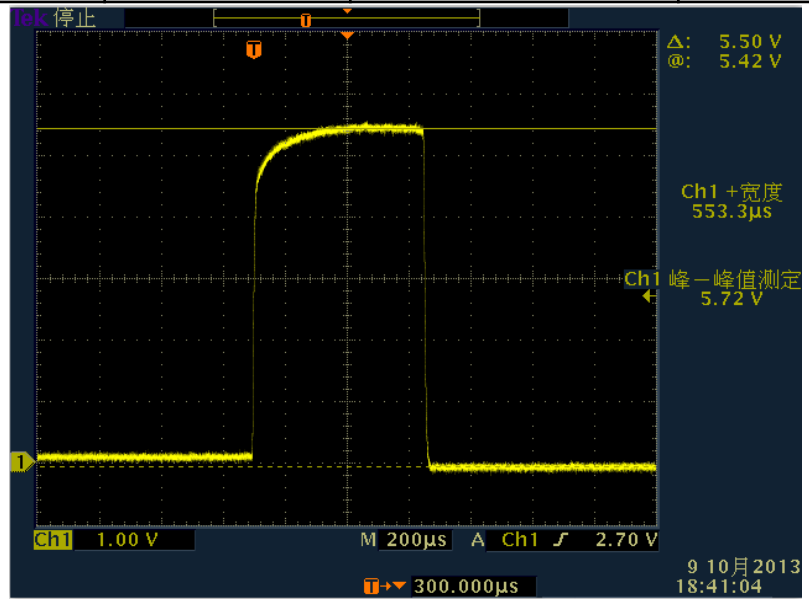
Ion Source Commissioning



Output energy	50 keV	Temperature of Cs oven	150~170 ºC
Repetition rate	25 Hz	Temperature of Cs transport line	~300 ºC
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

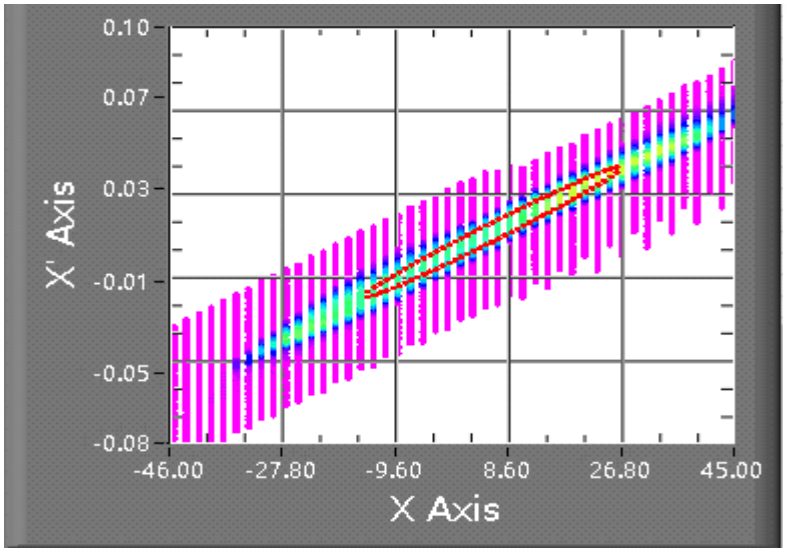


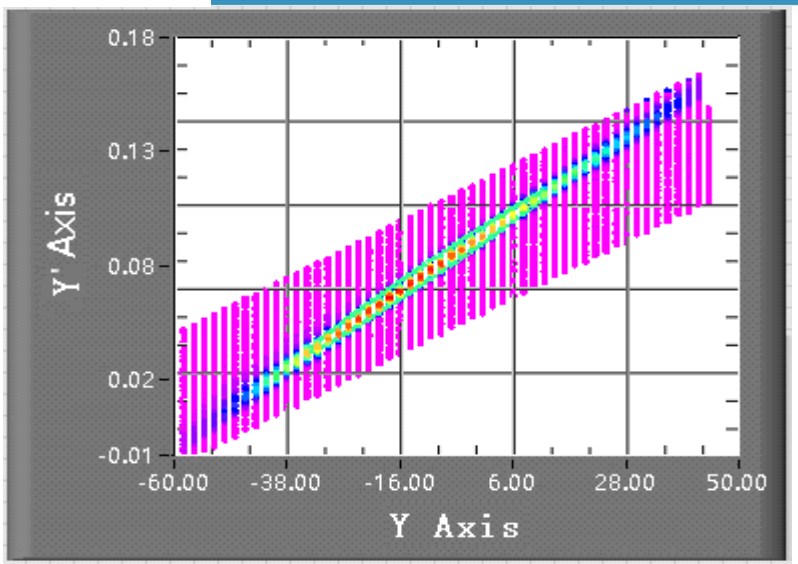
①: hydrogen feeding, ②: discharge current: 50A, ③: extraction voltage:17kV, ④: extraction current: 300mA (electrons and H^-)

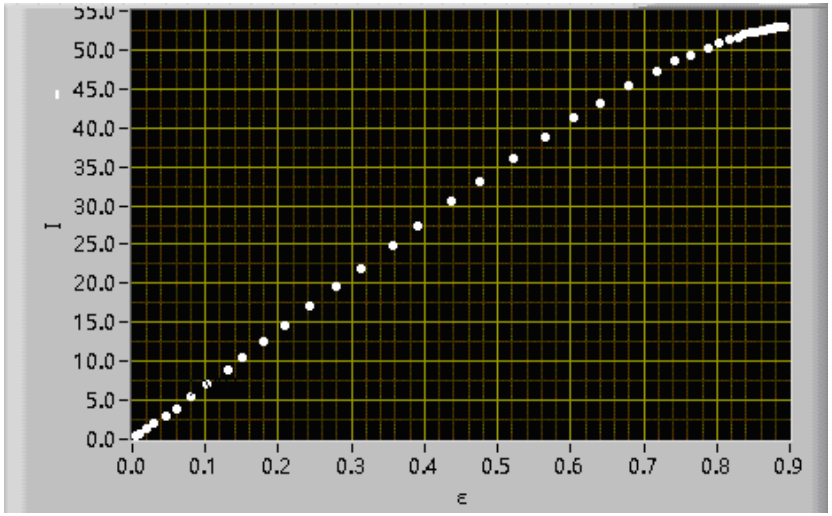


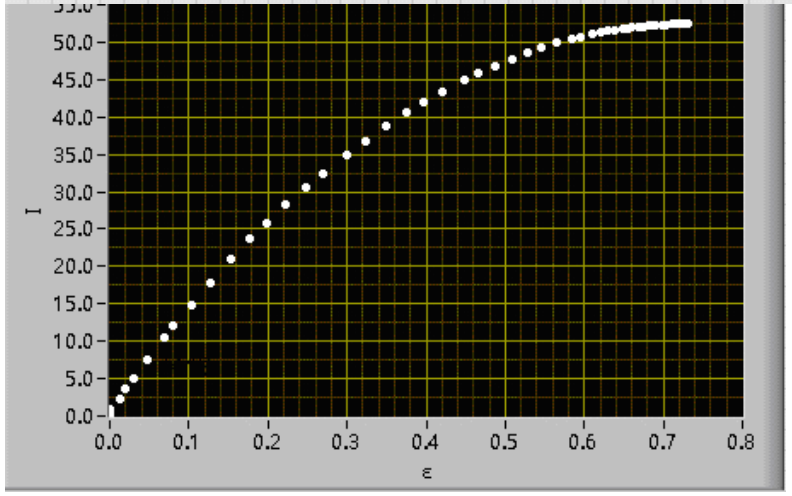
H^- beam at ACCT: 55mA, 500 ms and 25 Hz

Emittance Measurement





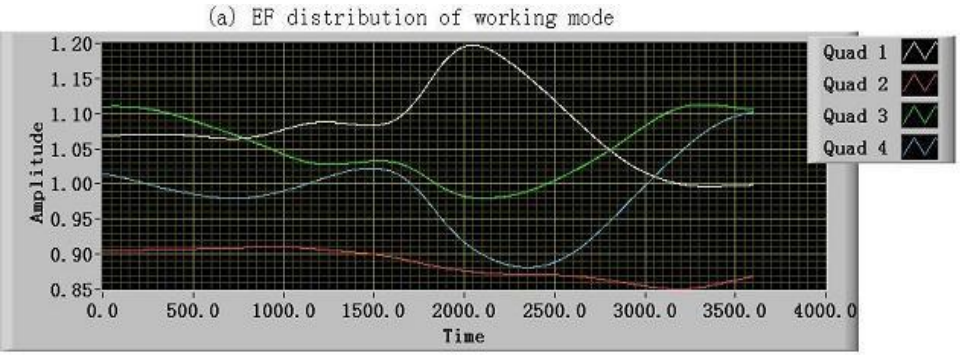




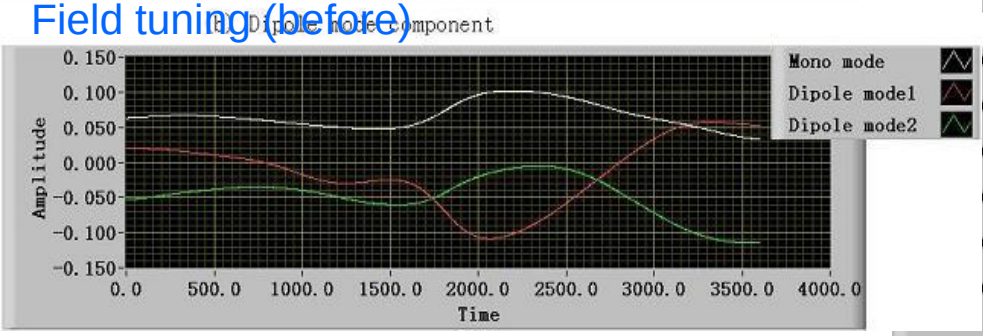
Emittance vs. beam current. Left: X plane. Right: Y plane. At 0.2□mmmrad, current of X plane and Y plane is 15mA and25mA, respectively.

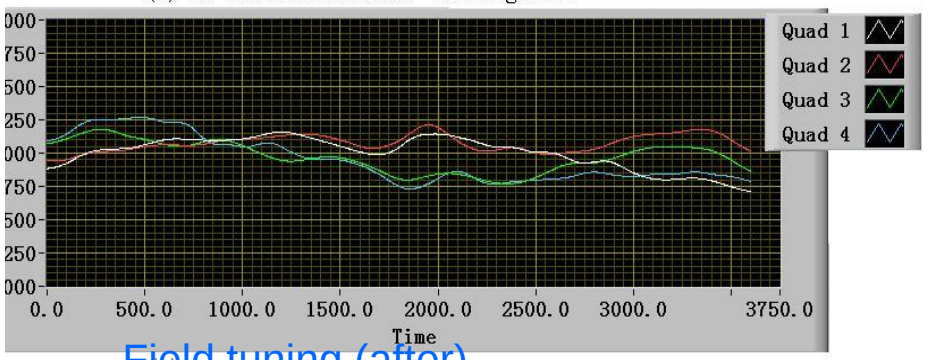
RFQ Tuning

Output energy	3.0 MeV
Repetition rate	25 Hz
Pulse H^- beam width	500 μs
Pulse H^- beam current	40 mA
RF Freq.	324MHz
Length	3.5

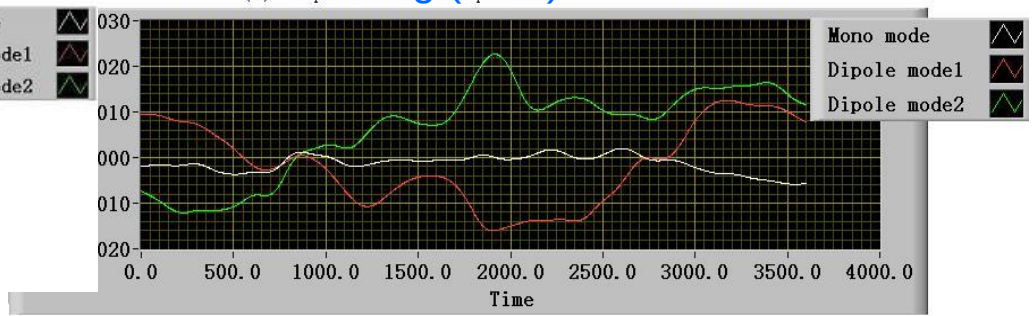


Field tuning (before)



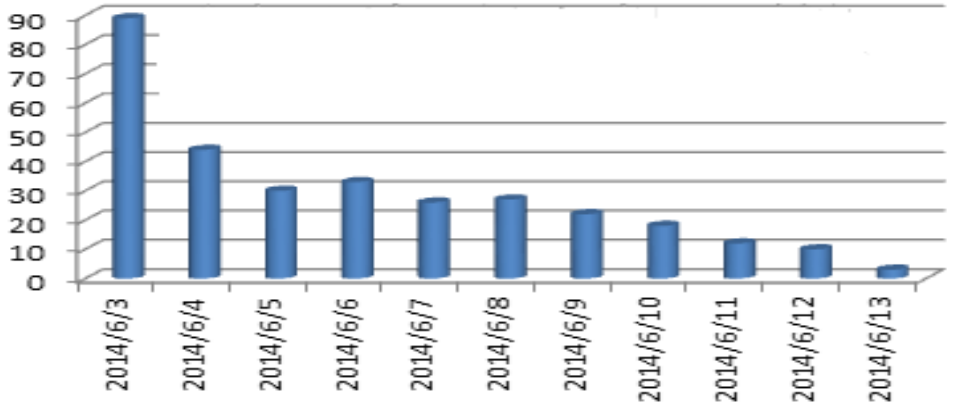


Field tuning (after)

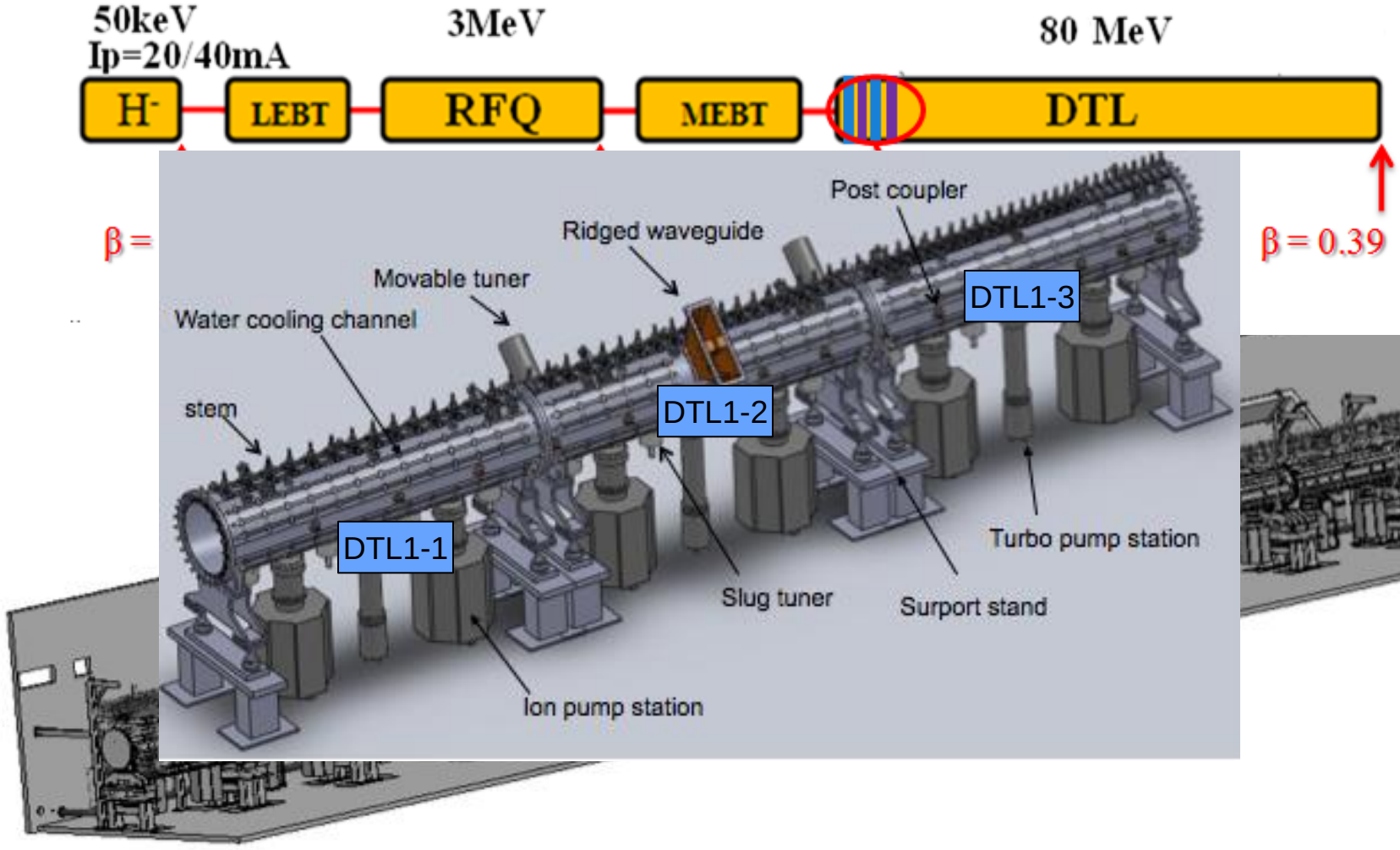


RFQ Conditioning

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

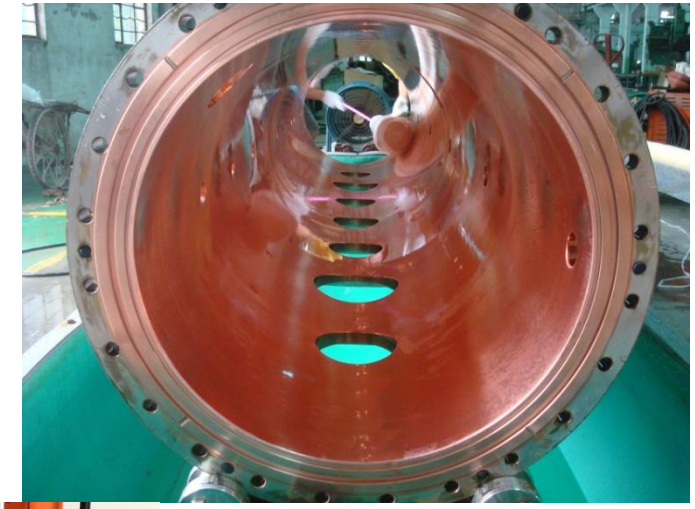


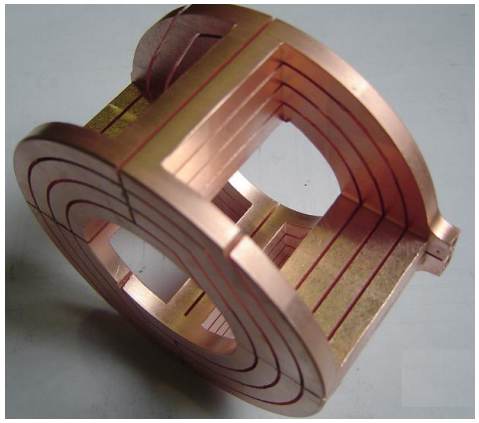
DTL Layout


50keV
Ip=20/40mA
3MeV
80 MeV
H-
LEBT
RFQ
MEBT
DTL
β =
β = 0.39
Post coupler
Ridged waveguide
Movable tuner
Water cooling channel
stem
DTL1-3
DTL1-2
DTL1-1
Turbo pump station
Slug tuner
Surport stand
Ion pump station

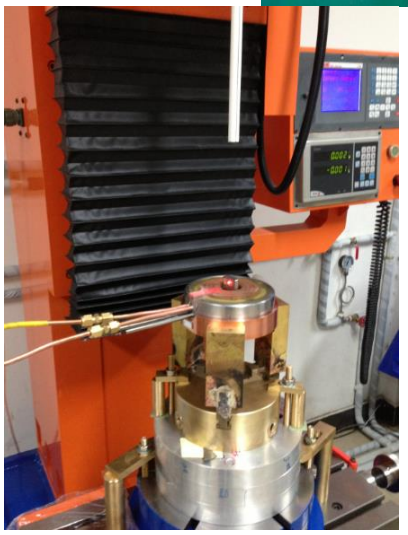
DTL: Features

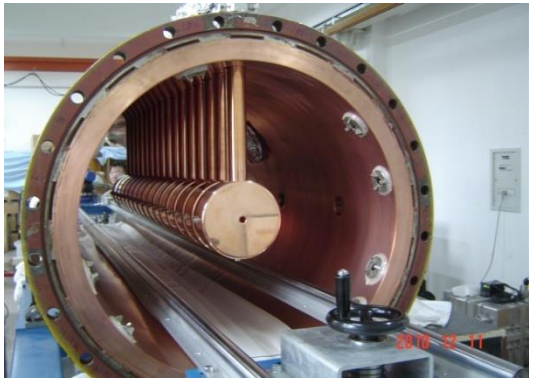
- Electroplating Tank
- Compact Electro-Quadrupole Magnets:
  - Advanced fabrication technology
  - OFC (Oxygen Free copper)DT
- Q-Magnet measurement
- High accuracy alignment





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

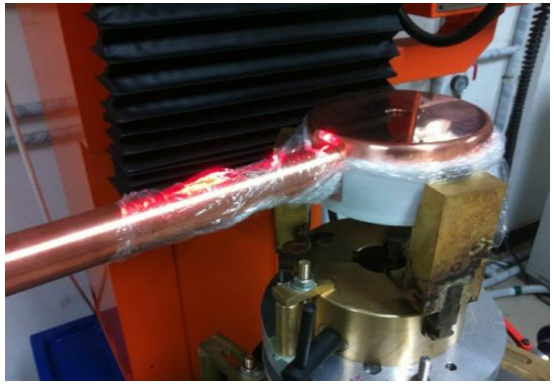
Tank fabrication

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.

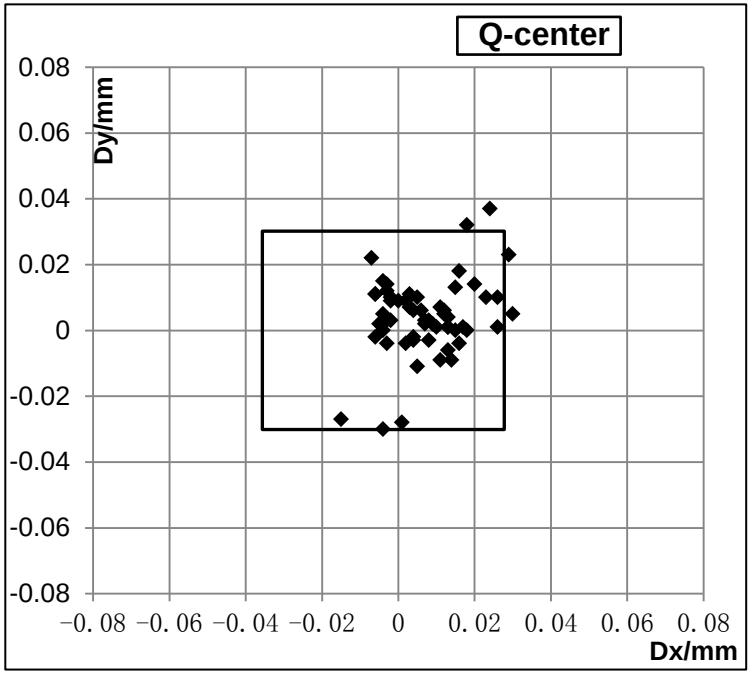
Drift Tube Status

- 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

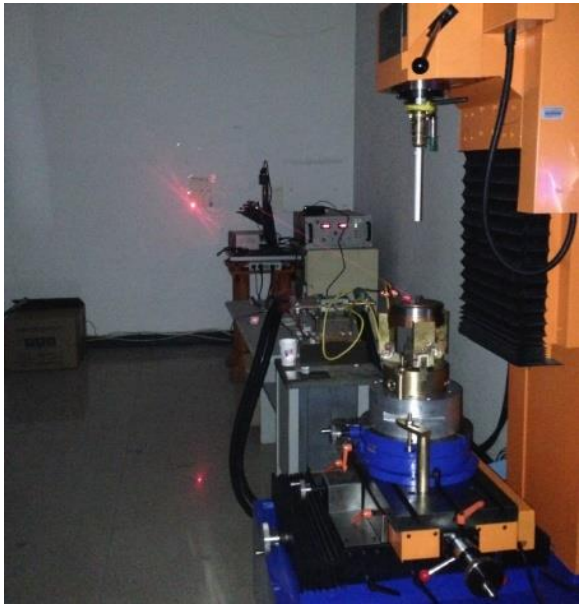
- the higher order multipole components less than 0.3%
- The deviation :less than ±30μm

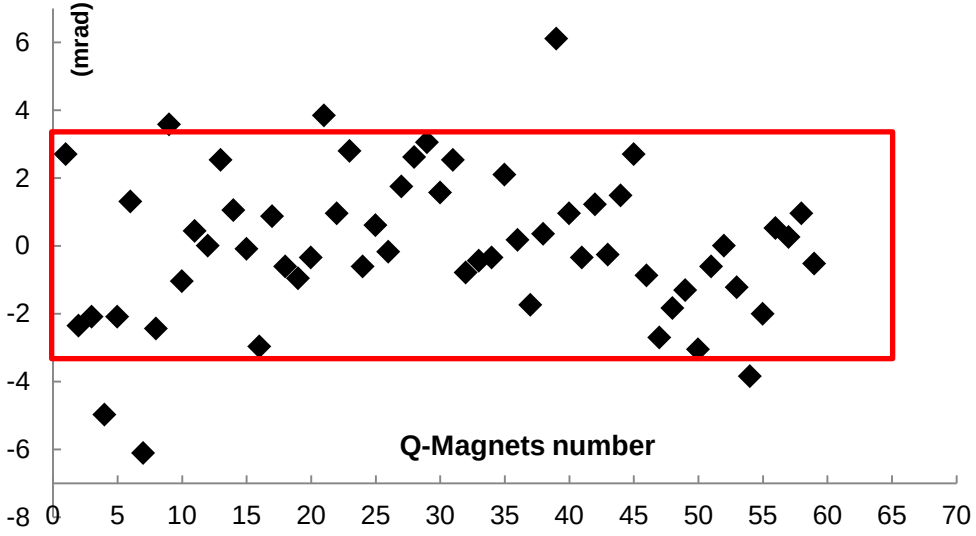
Rotating coil measurement

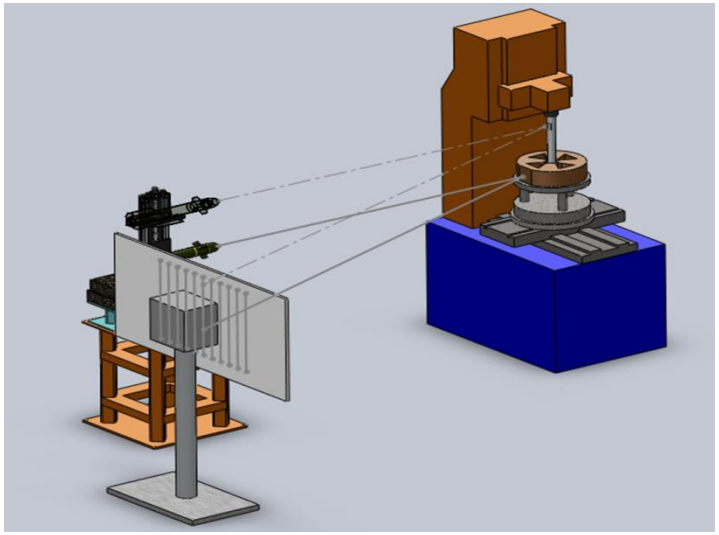


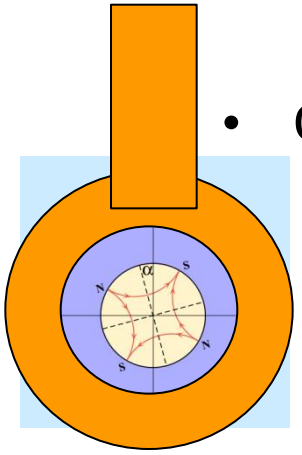
Deviations between the mechanical center and the magnetic center

Rotating angle



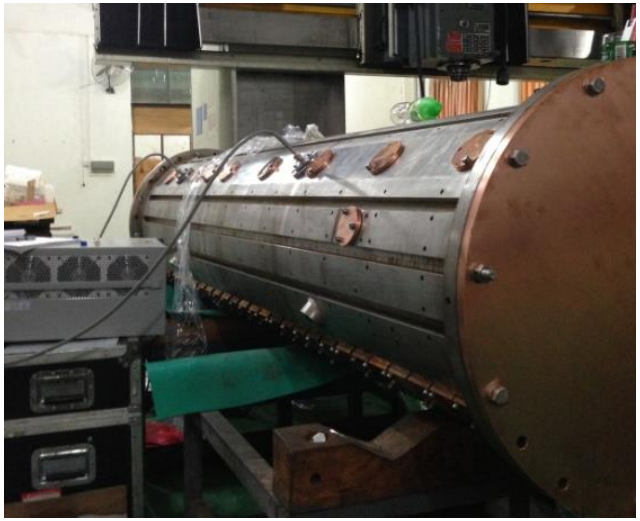






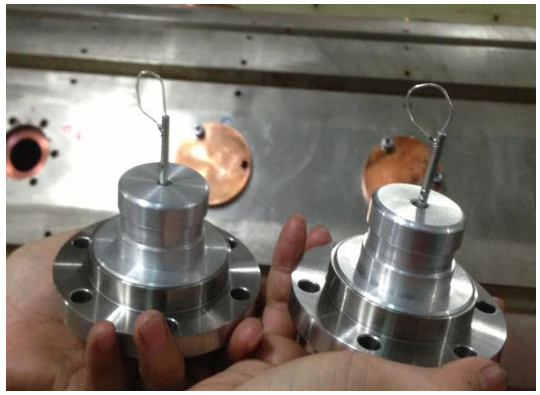
- Quadrupole rotation α< ± 3mrad

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

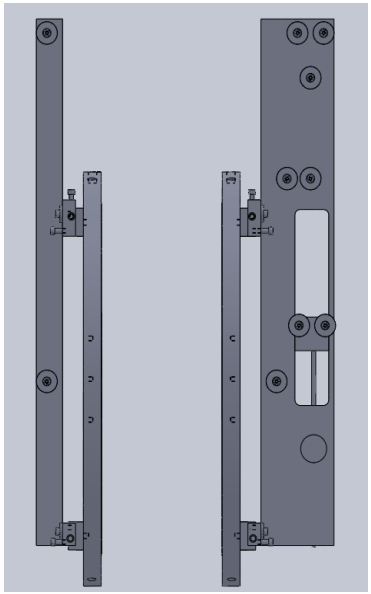
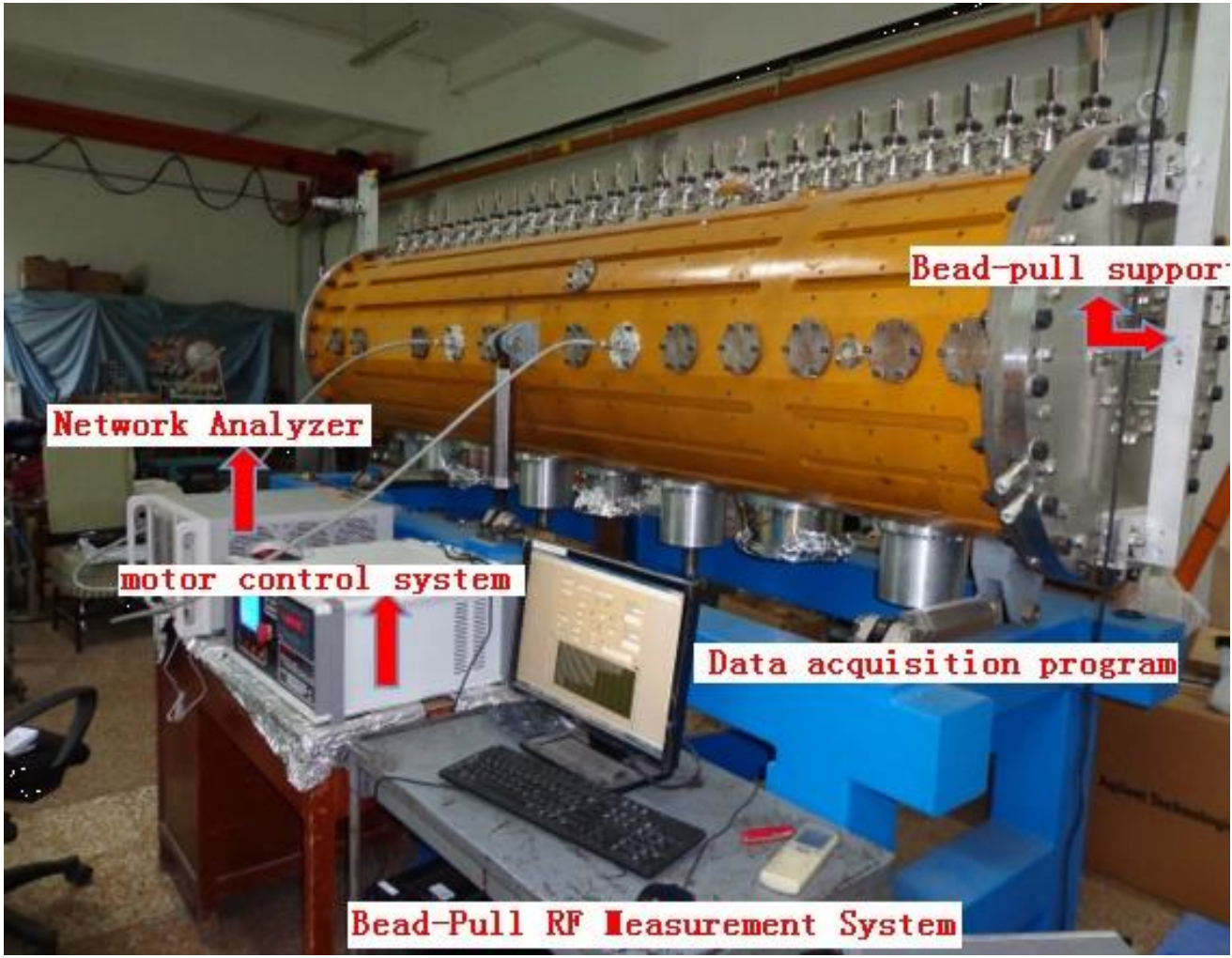


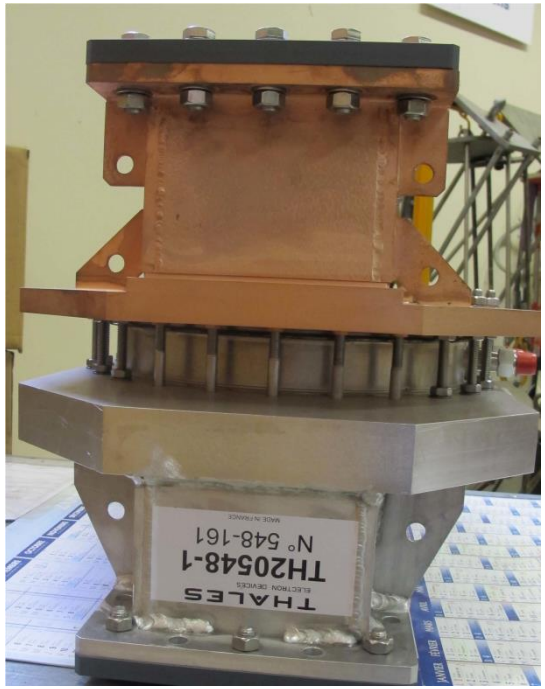
Diagram of Bead-Pull support structure



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.



Parameters	
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

Forged OFC BLOCK

↓

Annealing

↓

Rough machining

↓

Natural aging

↓

Finish machining

↓

Brazing

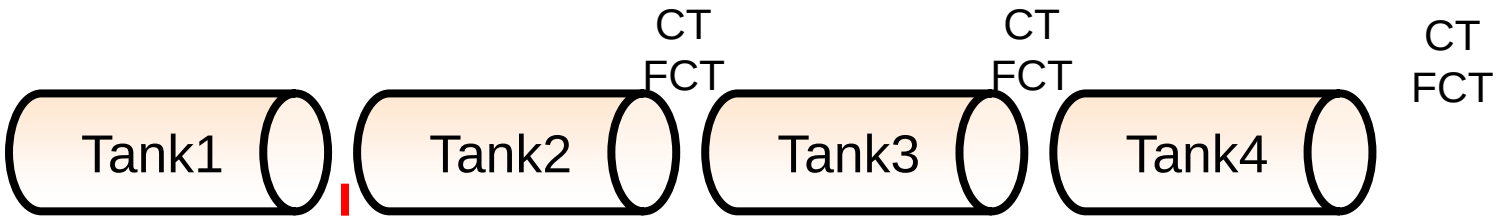
↓

RF testing

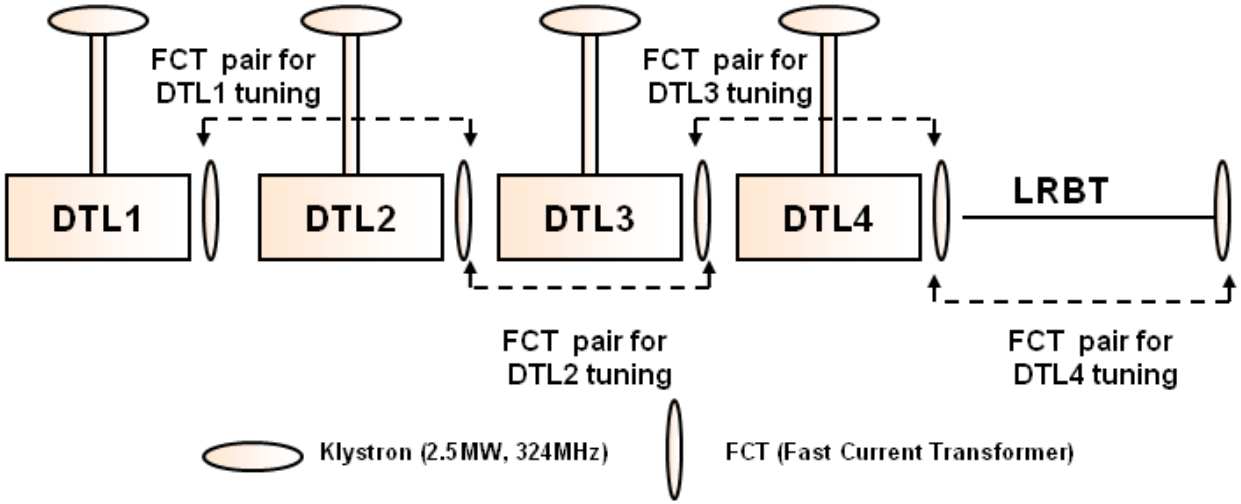
OFC Block

Flange

DTL Commissioning Plan



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!