

The Design and Construction Status of Injection and Extraction system for CSNS/RCS

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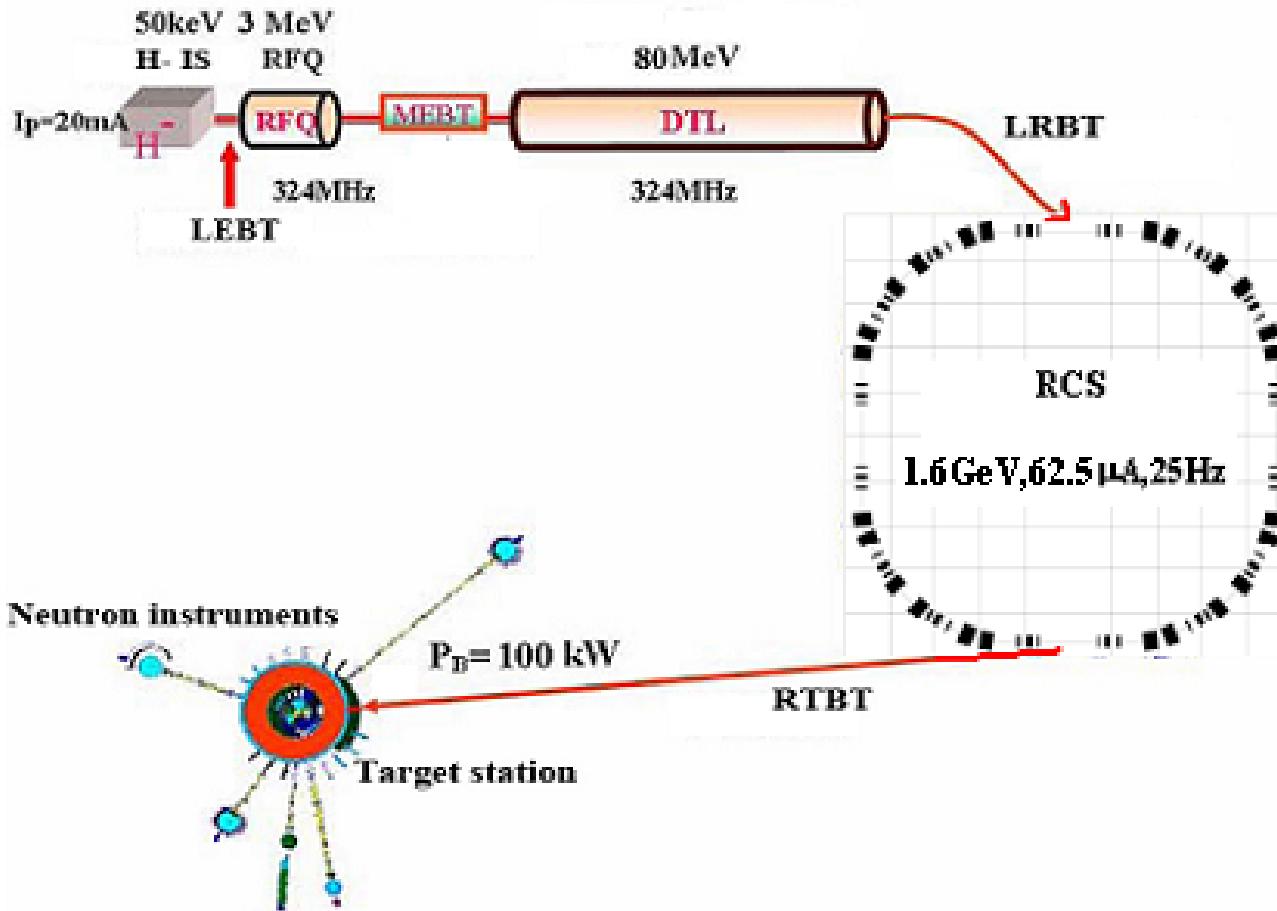
Nov.12, 2014 , East Lansing



Outline

- The introduction to CSNS accelerators
- The design of CSNS/RCS
- The design of injection and extraction system for RCS
- Construction status of injection system
- Construction status of extraction system

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





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)



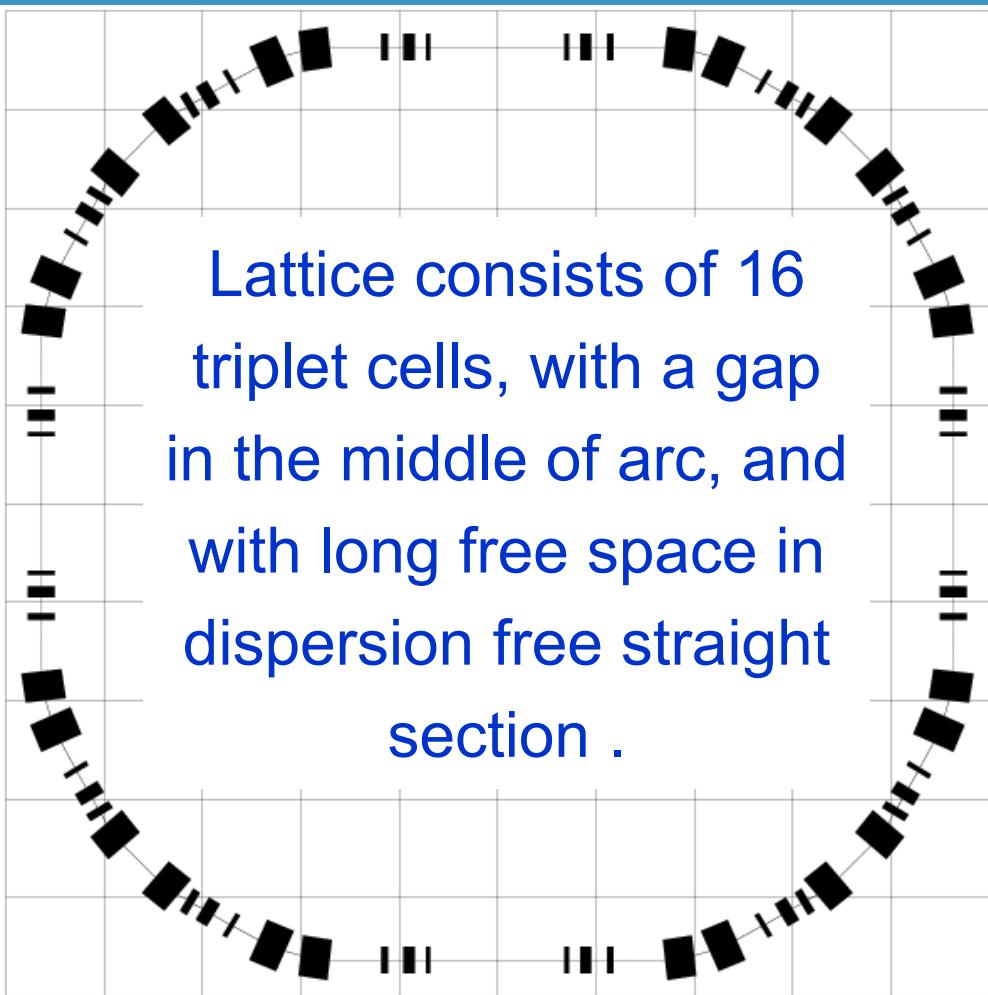
Planned commissioning Schedule

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

The RCS Design

散裂中子源

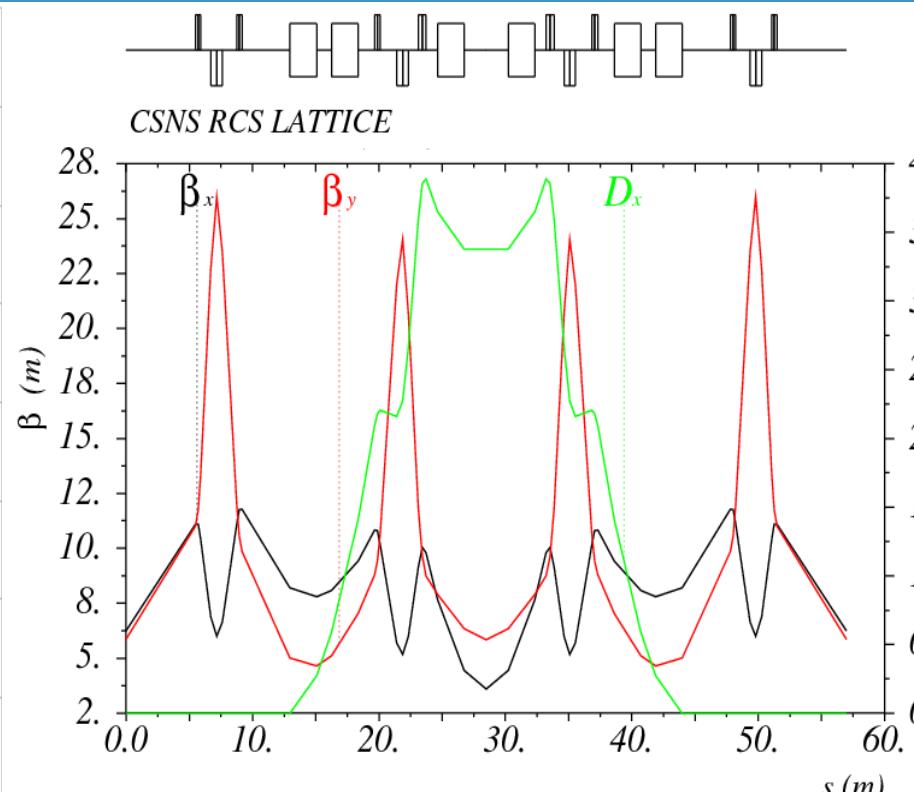
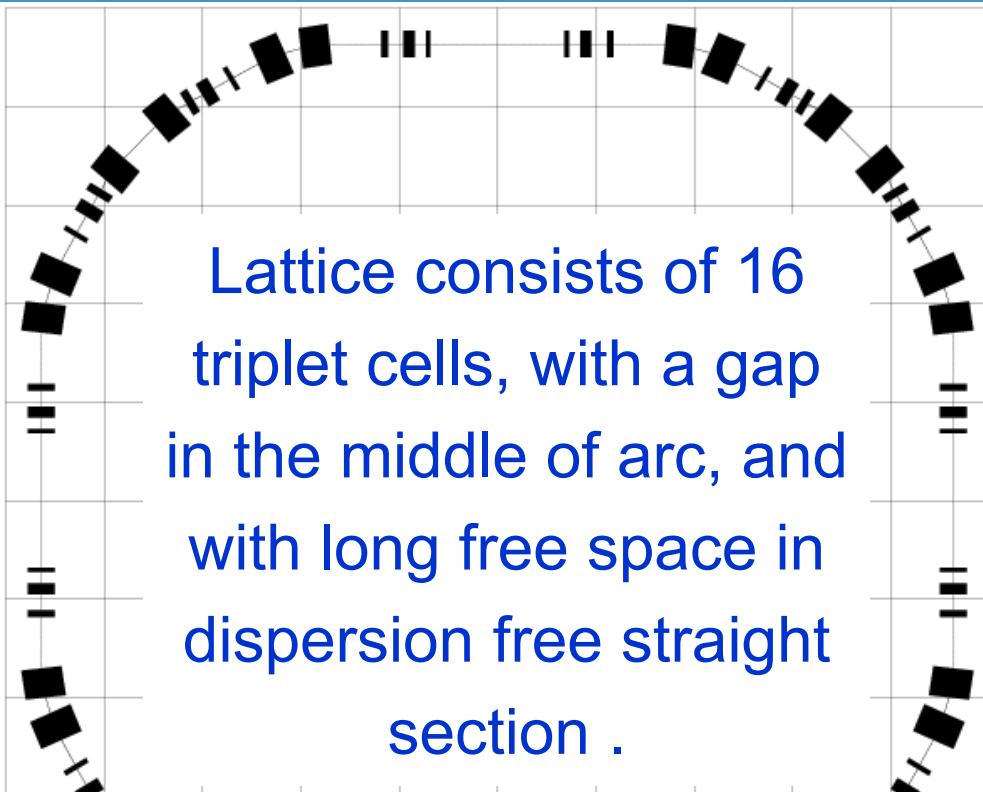
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The RCS Design

散裂中子源

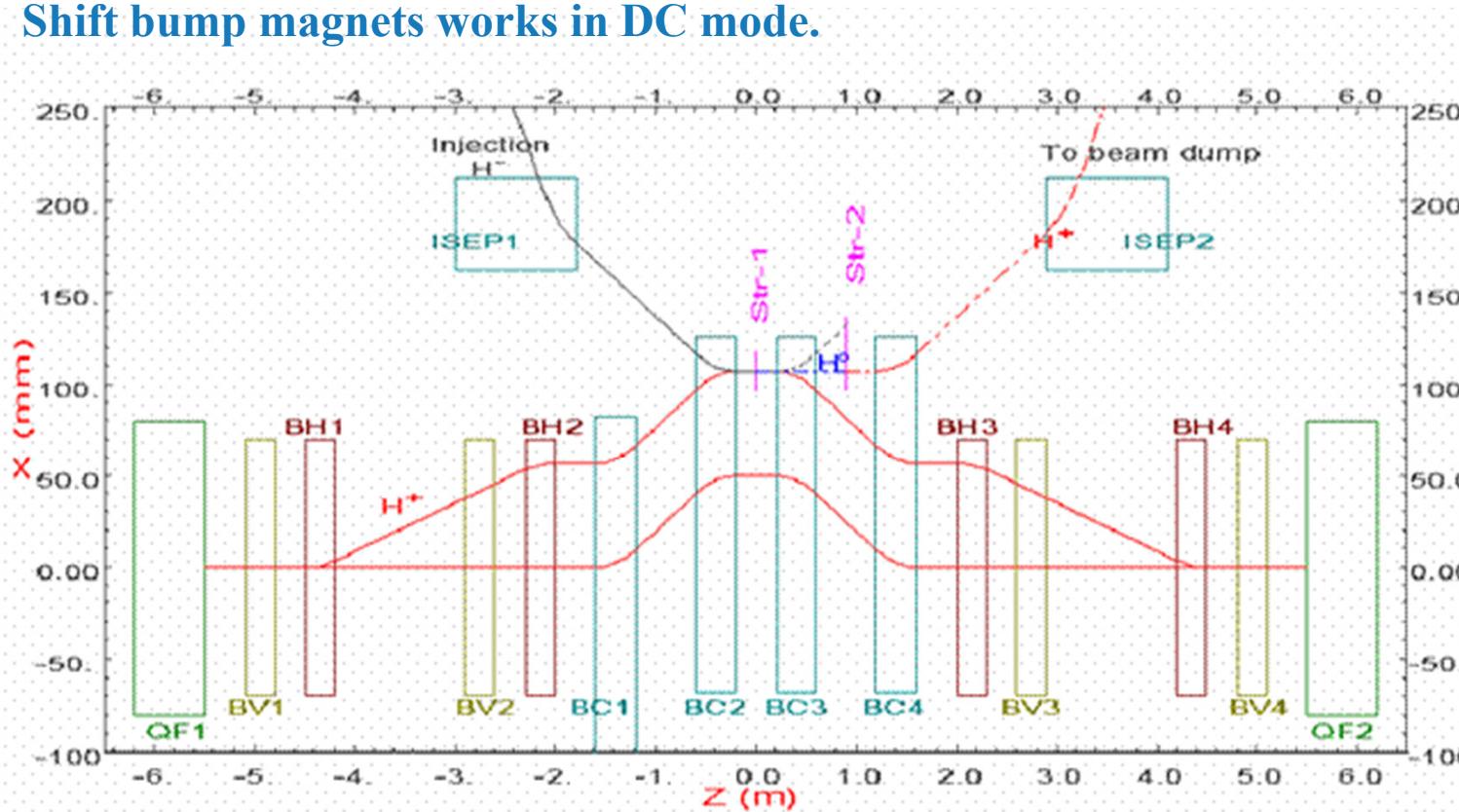
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- Four-fold symmetry - Separated functions
- Triplet structure - Small magnet aperture
- Dispersion-free long uninterrupted straight - For collimation & injection/extraction
- Straight at arc with large dispersion - high efficiency mom. collimation
- The all-triplet structure is not good for chromaticity correction and dynamic aperture

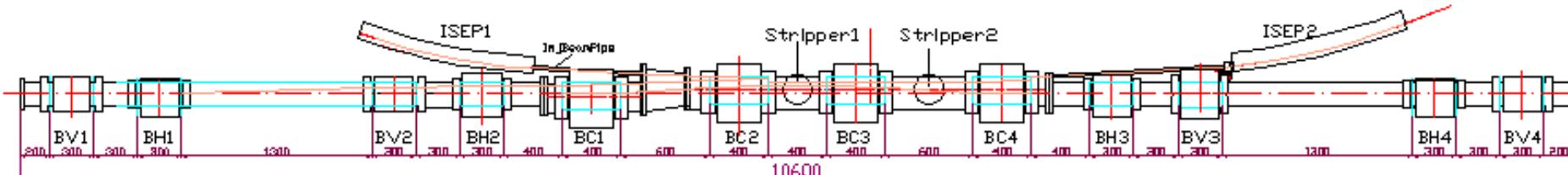
Beam injection

- H- stripping and painting method are used to match the small emittance beam from linac to large emittance beam in RCS.
- The injection is performed in a 11 m long straight section,
- Four horizontal painting magnets (BH), four vertical painting magnets (BV) , and four shift orbit bump magnets (BC).
- Shift bump magnets works in DC mode.

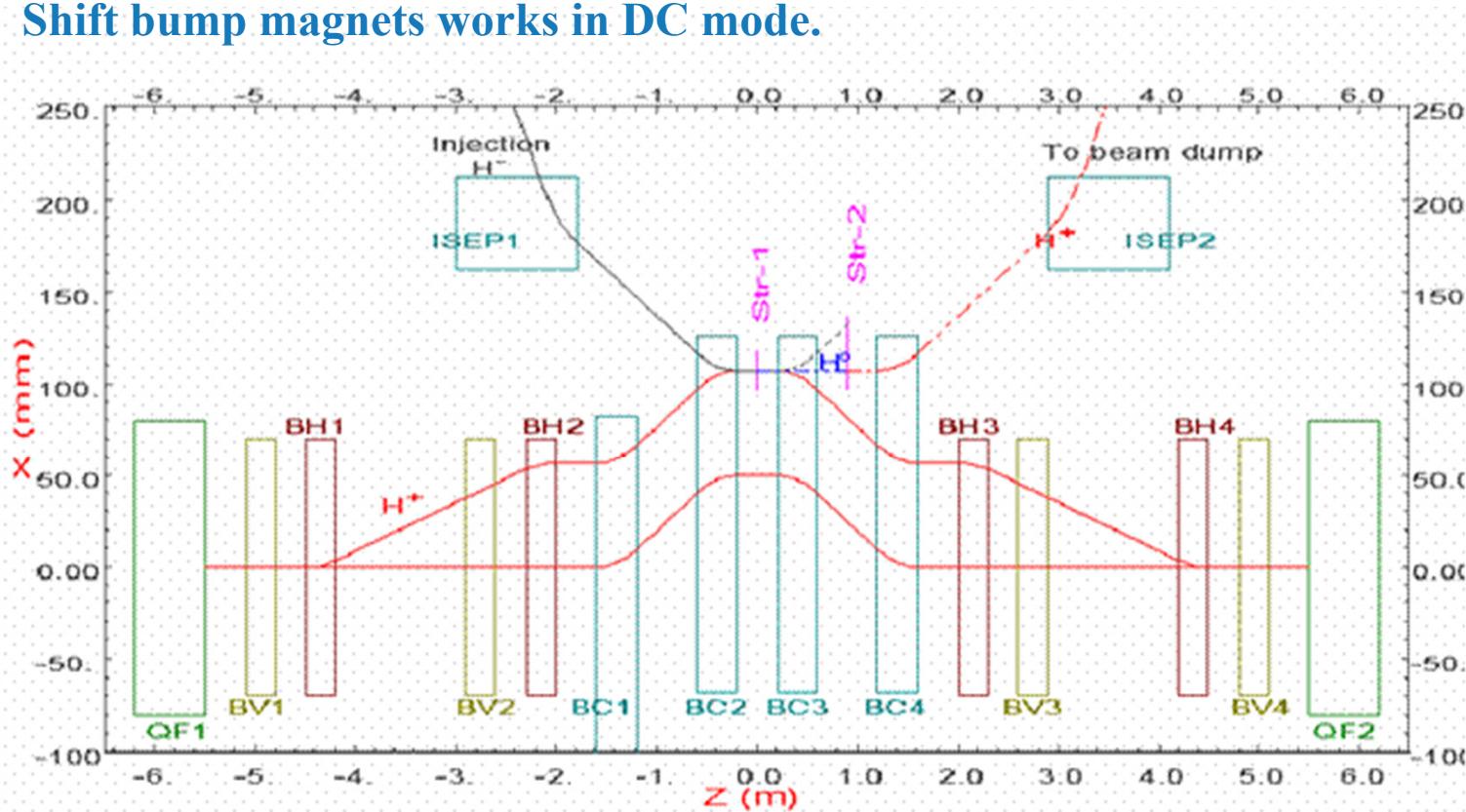


Beam injection

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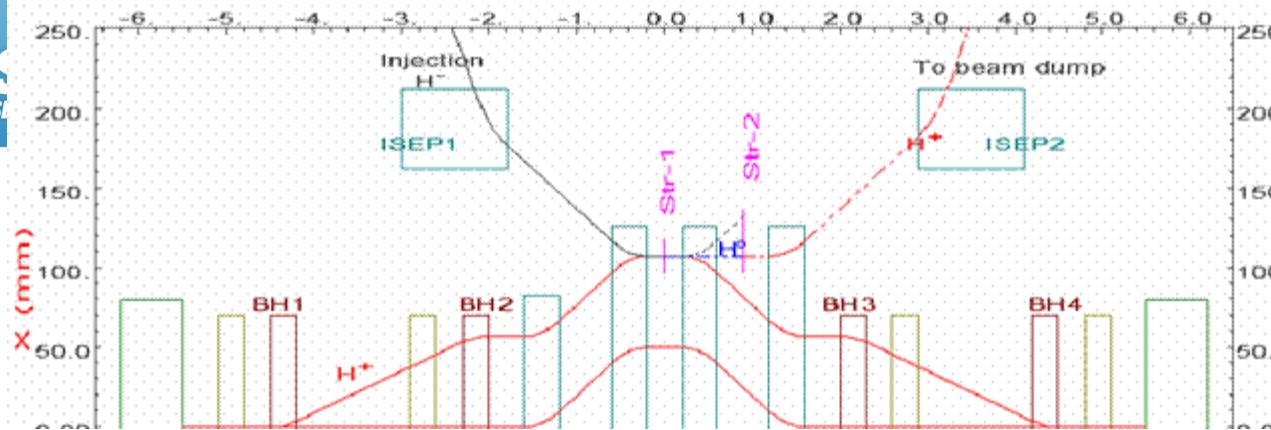
- Shift bump magnets works in DC mode.



The collection of dump beams

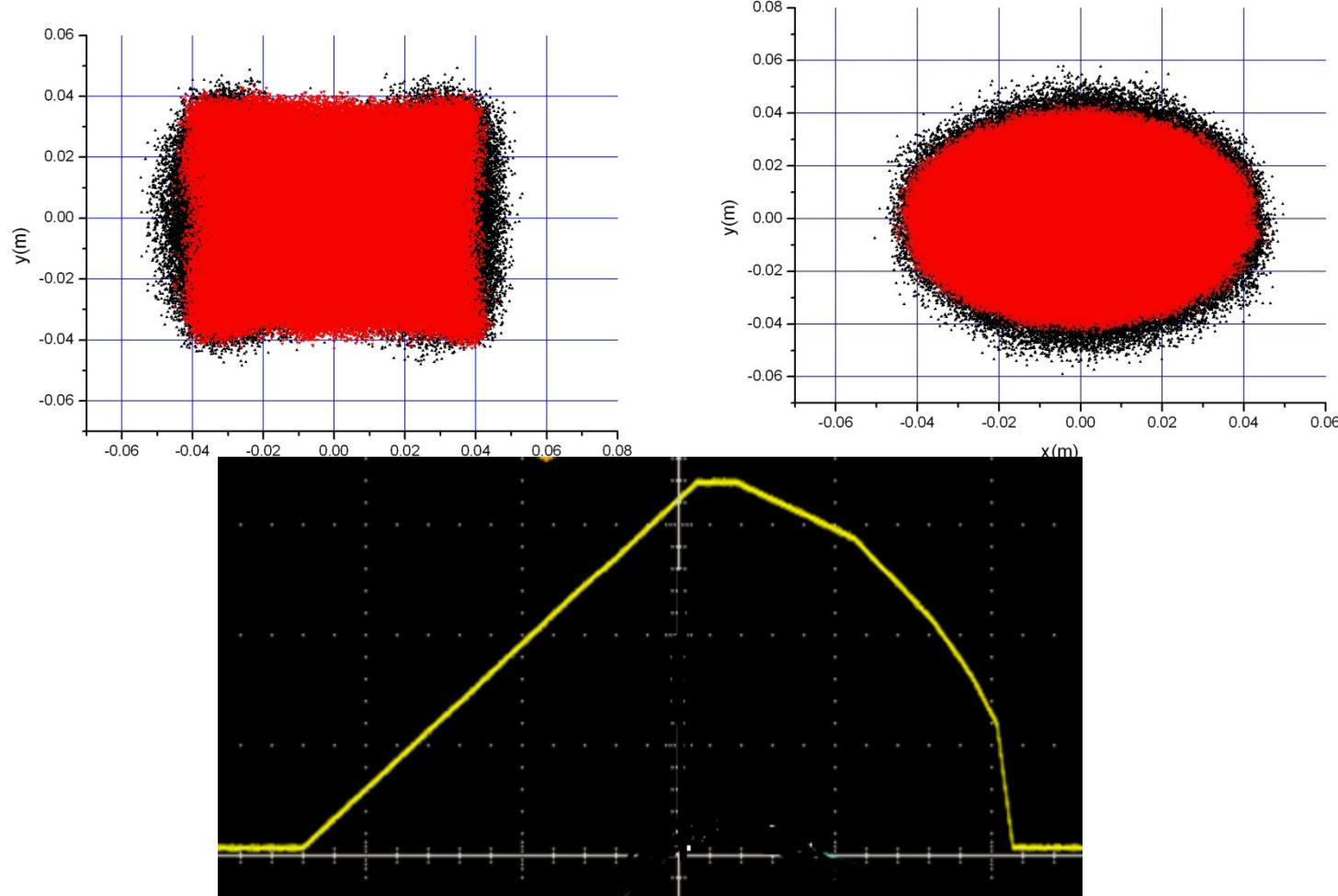
- Depending on the thickness of stripping foil, a little part of H- can not converted, and bulk of them are H⁰, a small fraction of them are H-. To control these particles, the second stripping foil is adopted.
- The bulk of H⁰ are converted into proton and sent to injection dump through BC4 and a septum to dump.
- The small part of H- escape from main foil stripping, will mostly stripped by the second foil and absorbed by a local absorber (benefits from very small beam power).
- The stripped electrons will be moved by the field of shift bump magnet, and collected by a collector.

The



- Depending on the thickness of stripping foil, a little part of H^- can not be converted, and the bulk of them are H^0 , a small fraction of them are H^- . To control these particles, the second stripping foil is adopted.
- The bulk of H^0 are converted into proton and sent to injection dump through BC4 and a septum to dump.
- The small part of H^- escape from main foil stripping, will mostly stripped by the second foil and absorbed by a local absorber (benefits from very small beam power).
- The stripped electrons will be moved by the field of shift bump magnet, and collected by a collector.

Injection painting Scheme

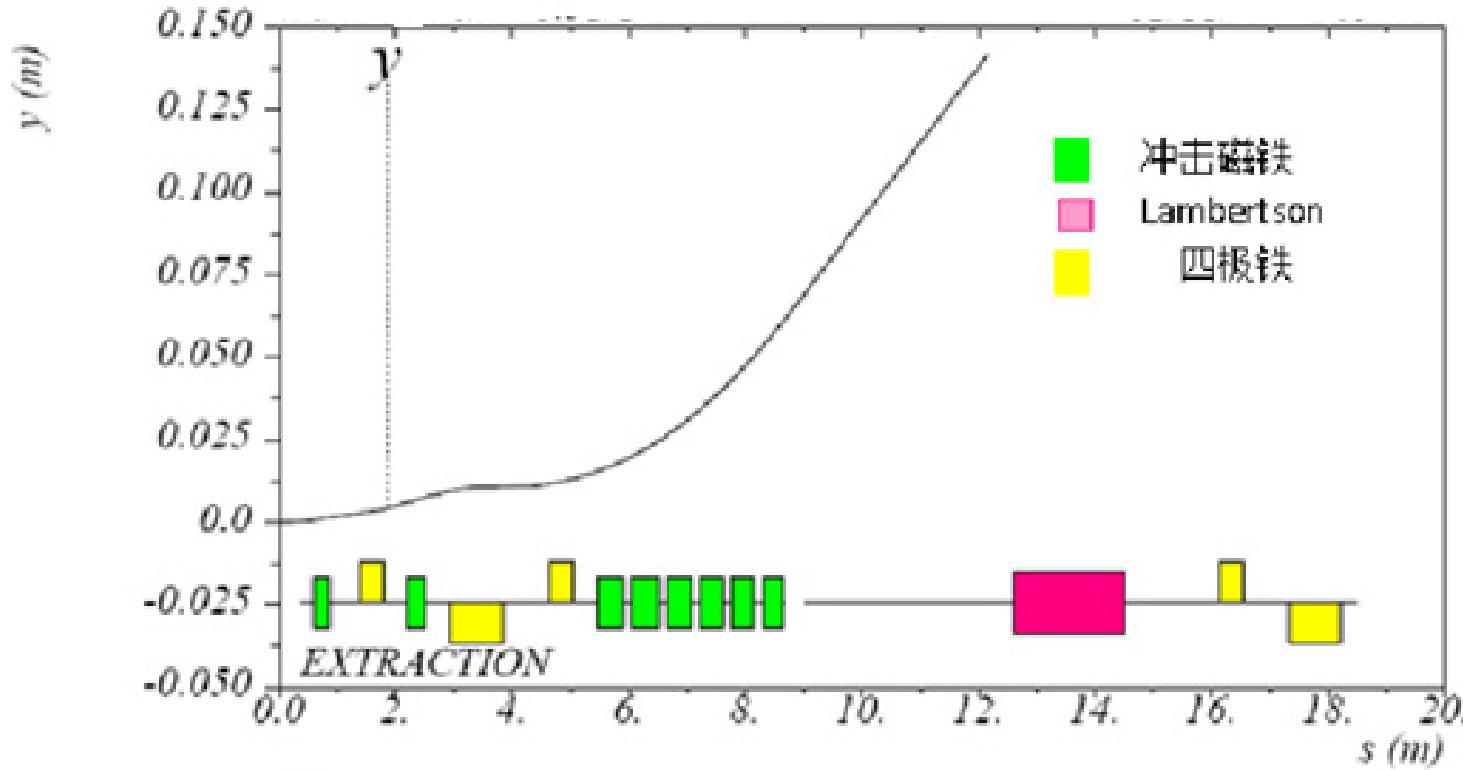


Both correlated painting and anti-correlated scheme are available

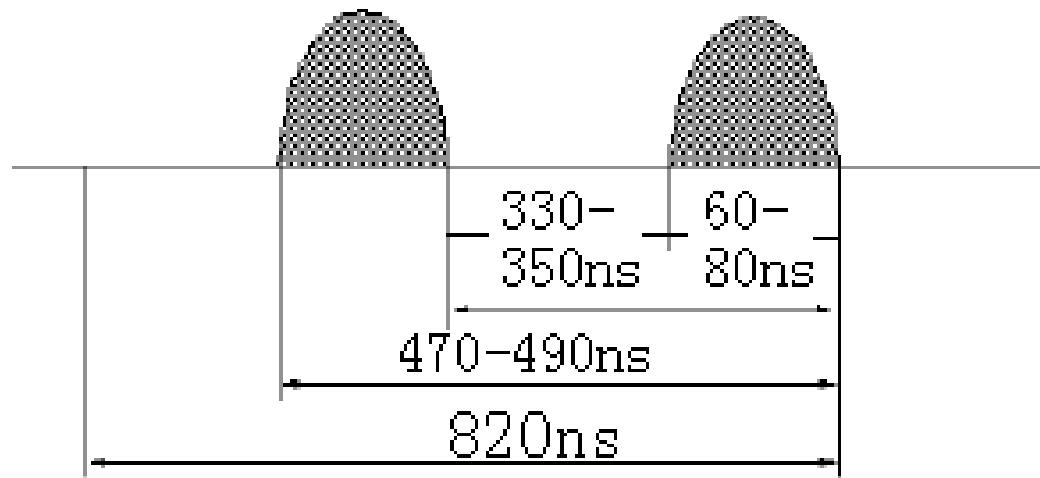


The Extraction Scheme of RCS

散裂中子源
Neutron Source



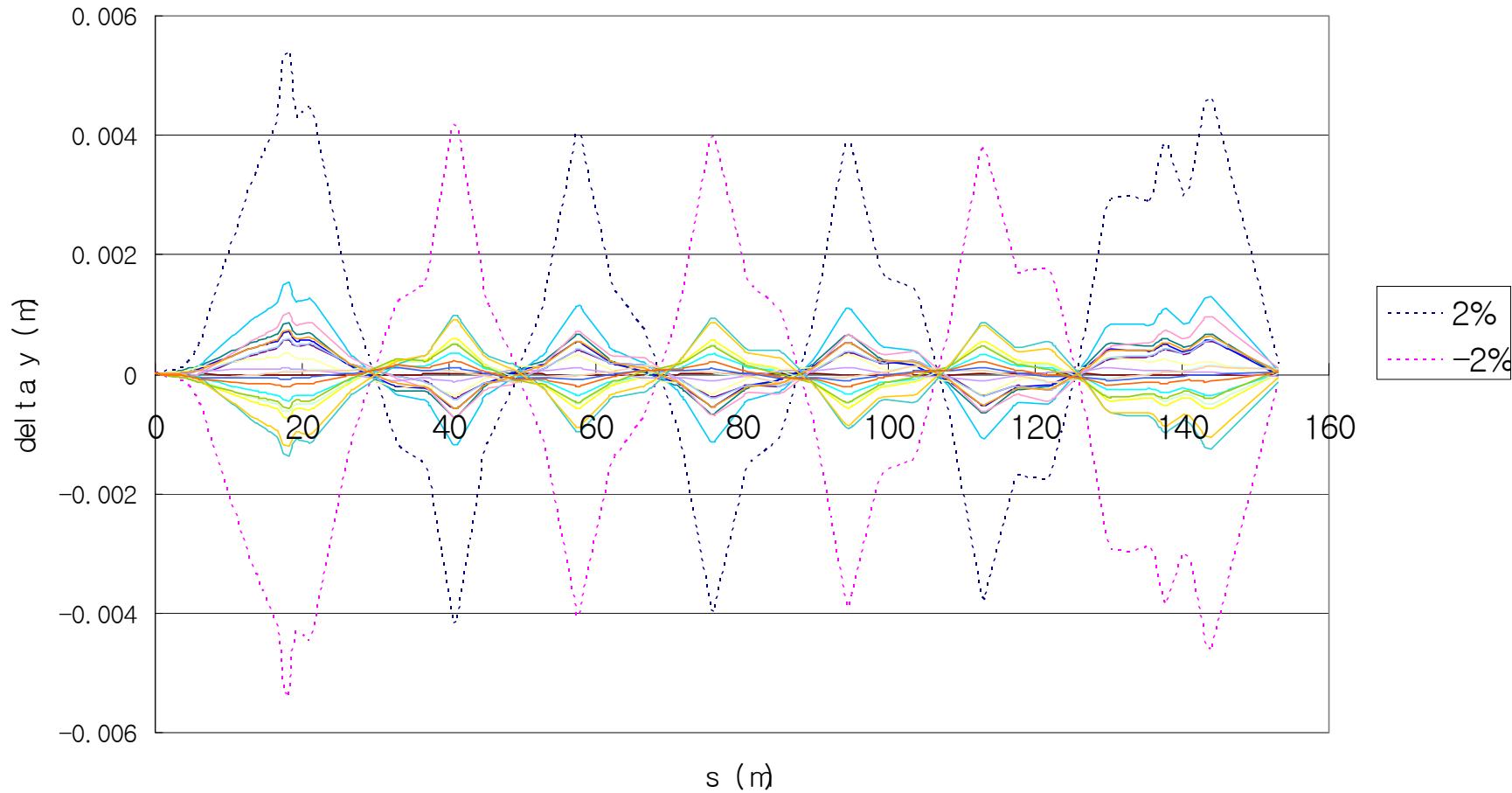
- Two 1.6GeV proton bunches are extracted by one-turn extraction from RCS in each RCS cycle.
- The beam is vertically kicked by a series of kicker to a horizontal bending Lambertson type septum.



The bunch length is about **60~80ns**, and the space between two bunch is about **330~350ns**. The rise time of kicker is required to be less than **265ns** and flat top field need to be kept more than **550ns**.

Effects of flat top field error malfunction of kickers

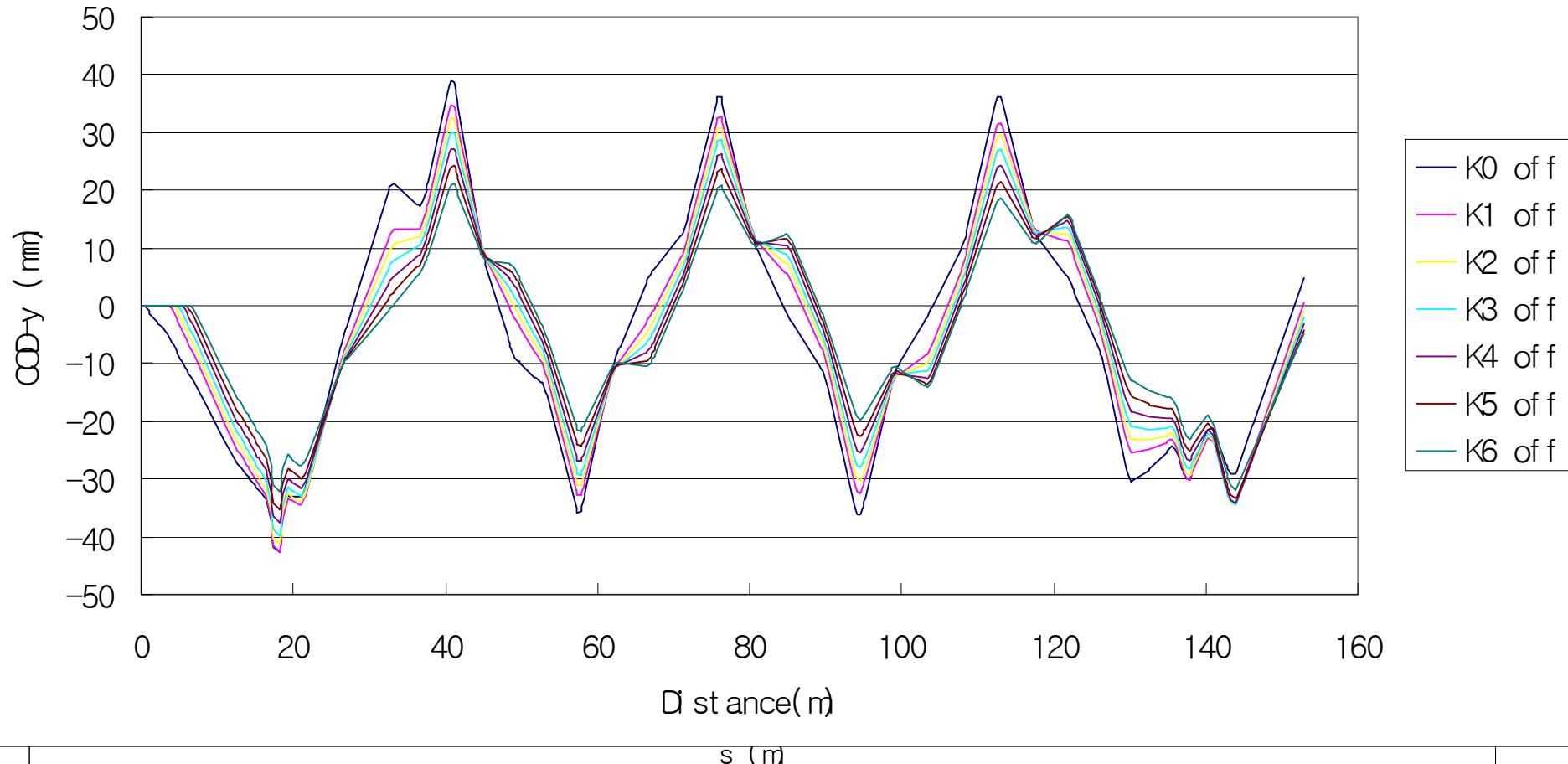
3 sigma = 2%



The statistics of 20 groups of random errors

Effects of flat top field error malfunction of kickers

3 sigma = 2%



The statistics of 20 groups of random errors

The Construction Status

- The prototype painting PS are used for Horizontal painting magnet, and the vertical painting PS will be soon completed;
- The totally 8 painting magnets has been delivered to CSNS site, and now the field measurement has been making;
- The first kicker magnet, as prototype, has been tested, and the other kicker magnet are now under installation in the CSNS site;
- The PS for the first kicker has been tuned and tested, and the other 7 PS are now under mass production

Painting Pulse Power Supply

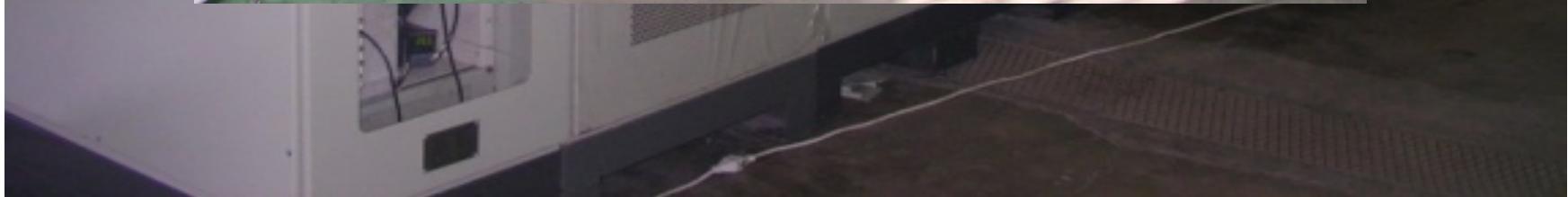
散裂中子源
China Spallation Neutron Source



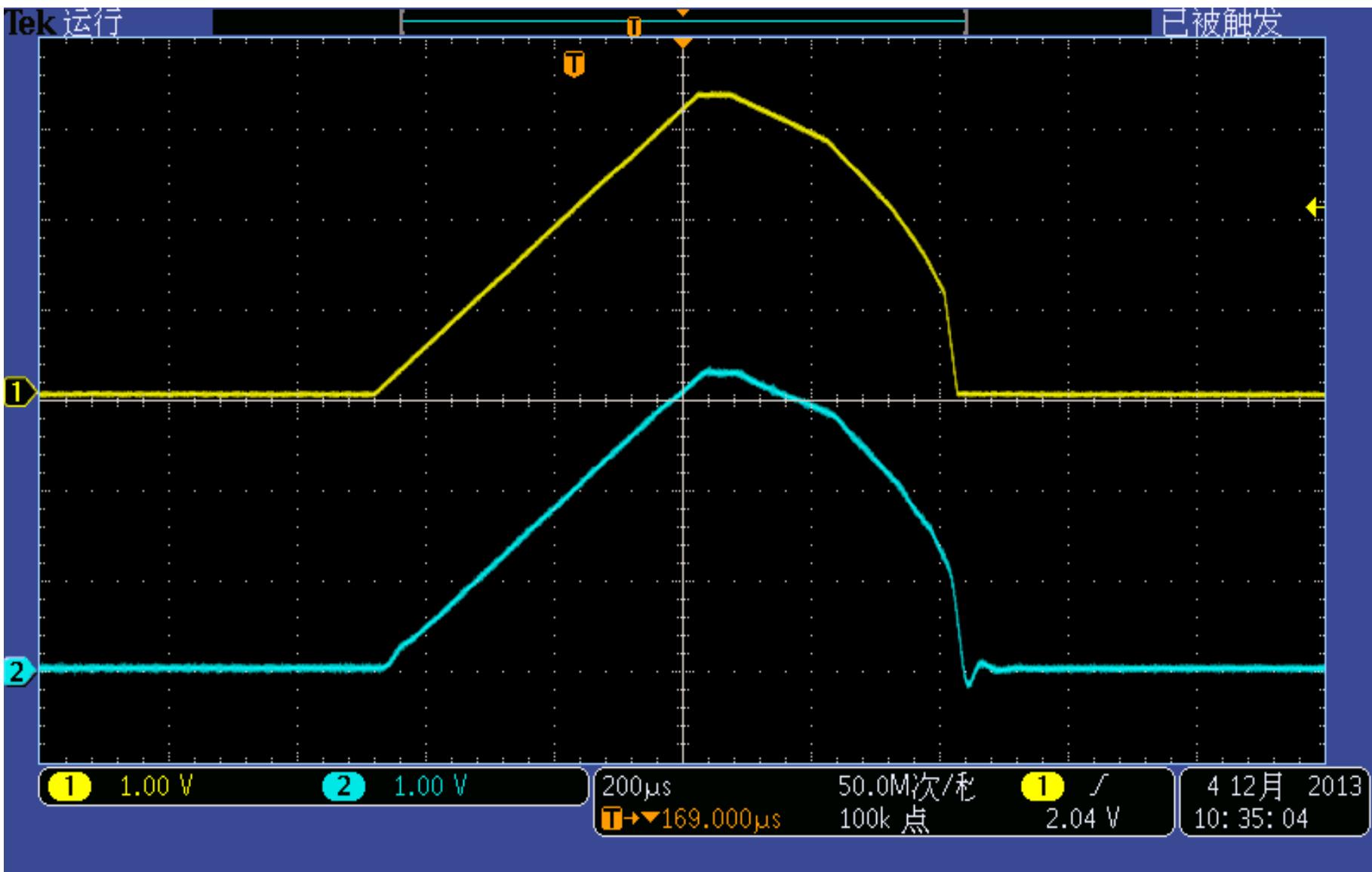
Painting Pulse Power Supply

散裂中子源

China Spallation Neutron Source



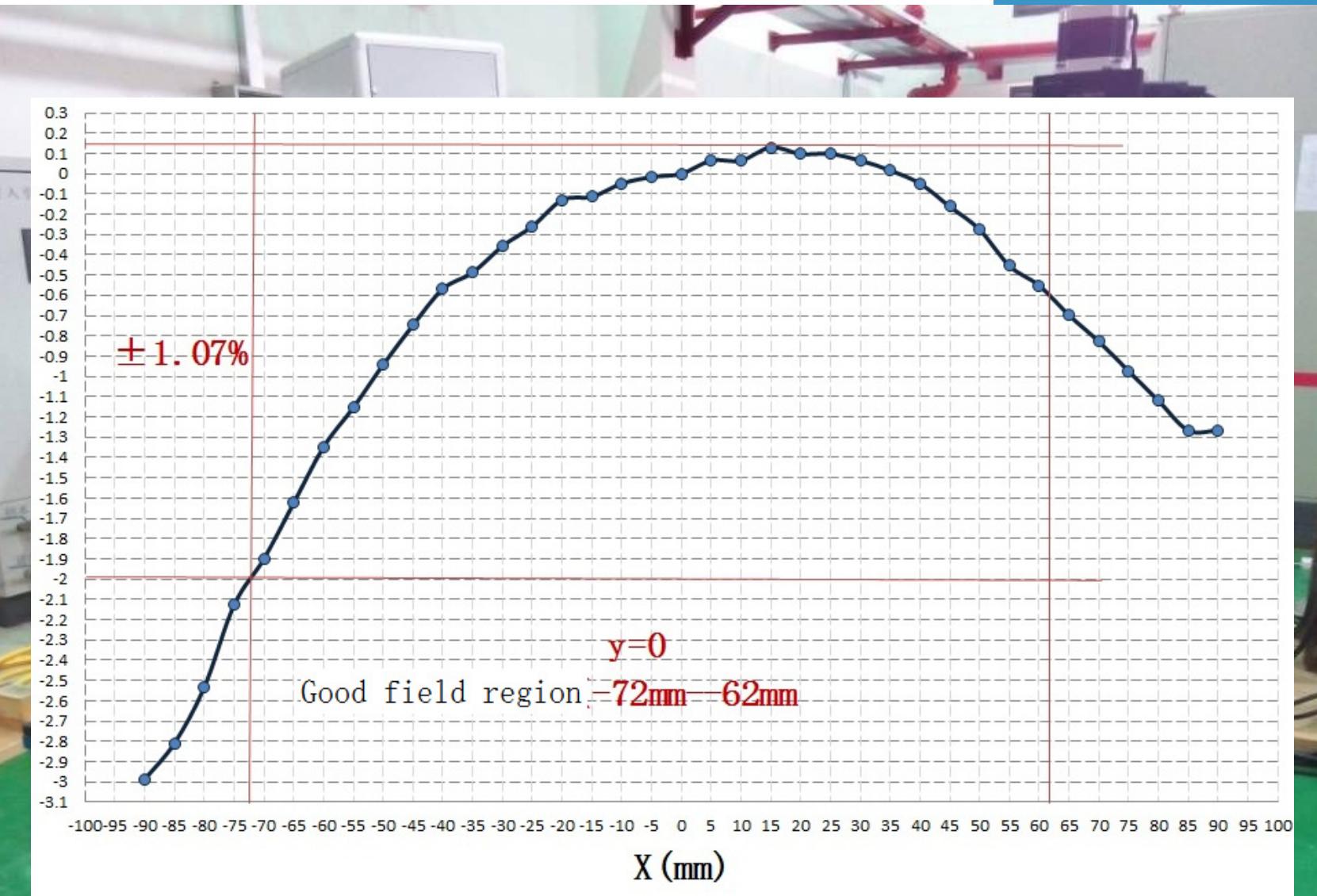
The Setting and output waveform for painting PS



The Painting Magnet and Field measurement



The Painting Magnetand Field measurement



The Kicker and Power Supply



The Waveform of Kicker PS

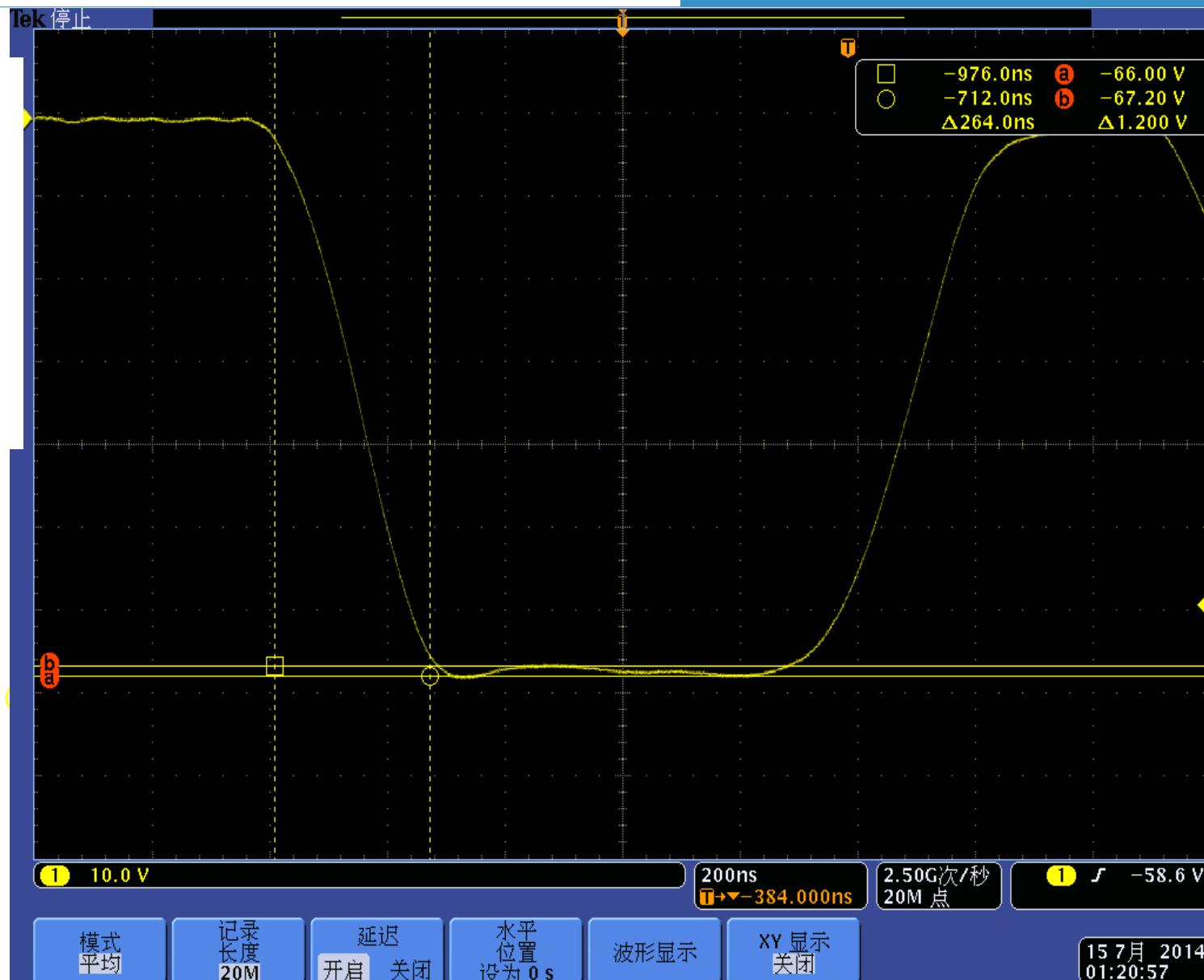
散裂中子源

China Spallation Neutron Source

Rise time:
264ns

The flat top:
600ns

The flatness:
 $\pm 0.98\%$



模式
平均

记录
长度
20M

延迟
开启
关闭

水平
位置
设为 0 s

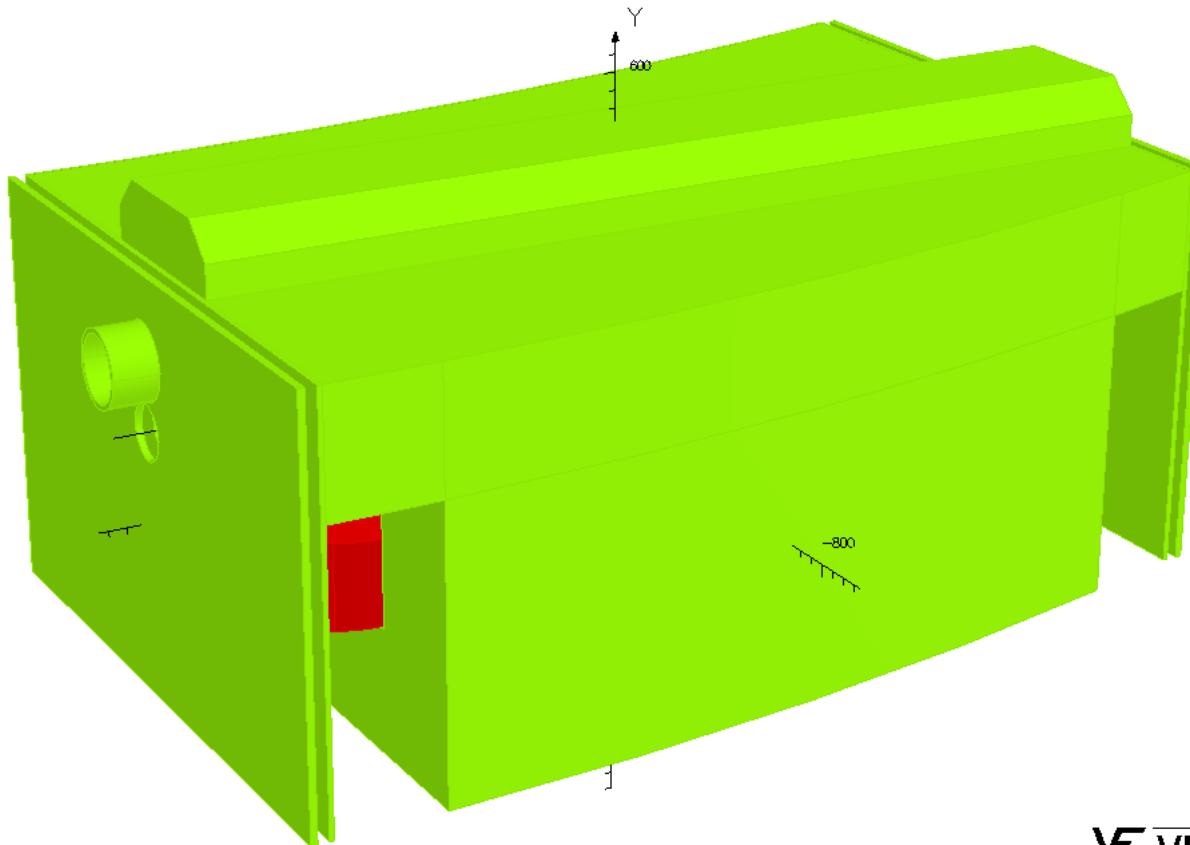
波形显示

XY 显示
关闭

15 7月 2014
01:20:57

Lambertson: under fabrication

12/??/2009 20:48:27



 VECTOR FIELDS

Leakage stray field: 0.47‰, 0.7mrad impact to circulating beam.

Thanks for your attention!