

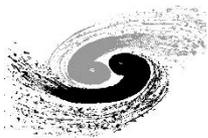


# Development and Operation of Vacuum System for Rapid Cycling Synchrotron to Target Beam Transfer Line of China Spallation Neutron Source

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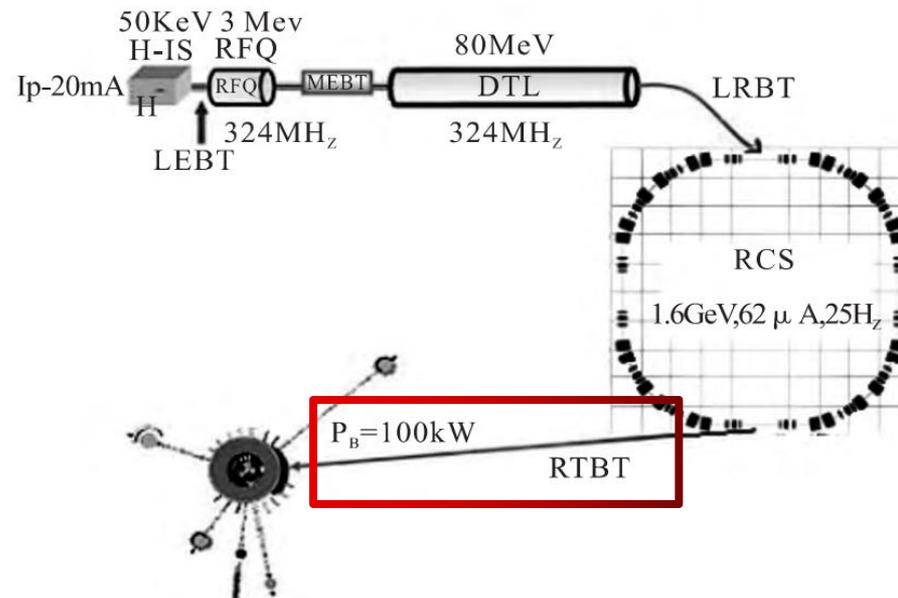
Vacuum IHEP

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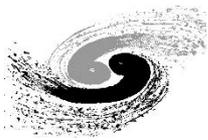


# Introduce

- The CSNS has been in operation for over three years, during this period, the beam power has been gradually improved from 10KW to 100KW.
- RTBT is an important part of CSNS, which connects RCS and target station. The RTBT is about 145 meters long.

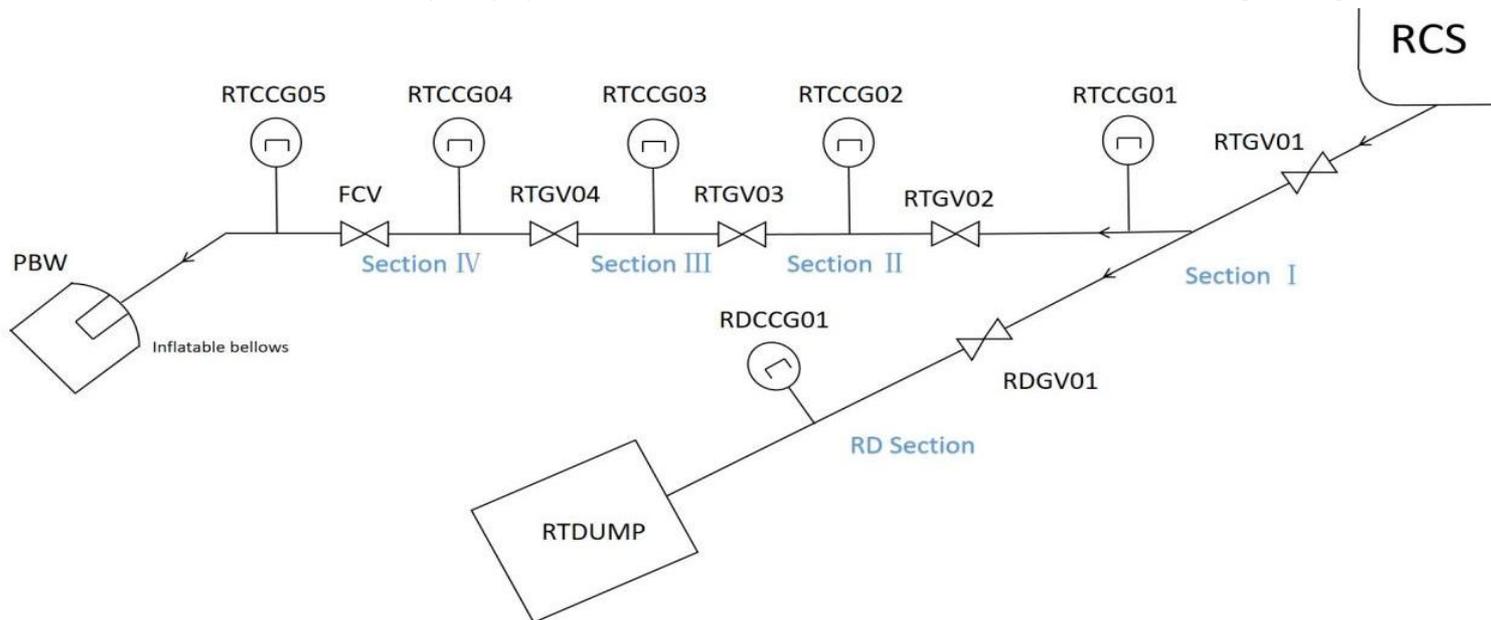


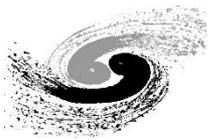
Schematic layout of CSNS facilities



# Section Division

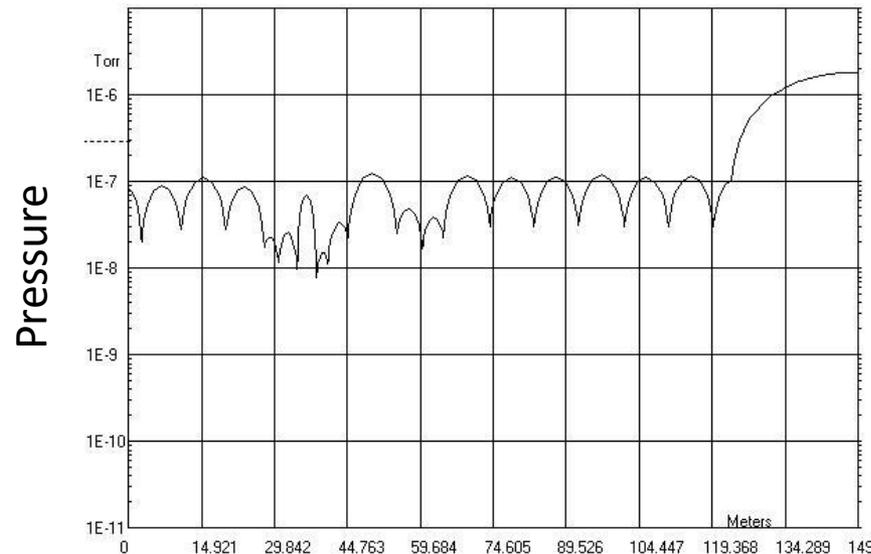
- RTBT has five all metal gate valves, which divide the vacuum system into five independent sections. A section is about 30 to 40 meters long.
- Each section is equipped with one cold cathode gauge (CCG).



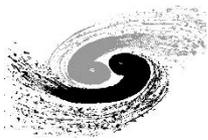


# Distribution of Vacuum Production Device

- The operating pressure of RTBT is lower than  $10^{-5}$  Pa.
- Because the 24m area in front of the beam window is a high radiation area, vacuum equipment can not be installed in this area, and only a 1000L / s turbomolecular pump is used to pump air outside the shielding wall.
- In other areas, a sputtering ion pump is installed every 6 meters. Finally, 26 sputtering ion pumps were set up.

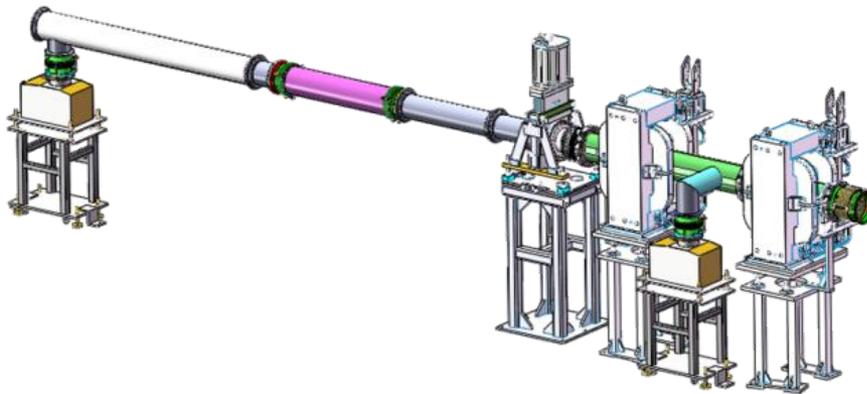


Rtbt pressure distribution



# Mechanical Structure

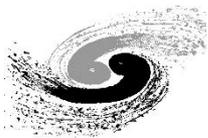
- Most of the vacuum pipes are 168mm and 192mm in diameter
- The connection between RTBT vacuum chambers adopts quick disassembly flange, and the sputter ion pump bracket and turbo molecular pump bracket adopt movable form to reduce the time of equipment installation, disassembly and transportation.



Partial assembly diagram of the RTBT

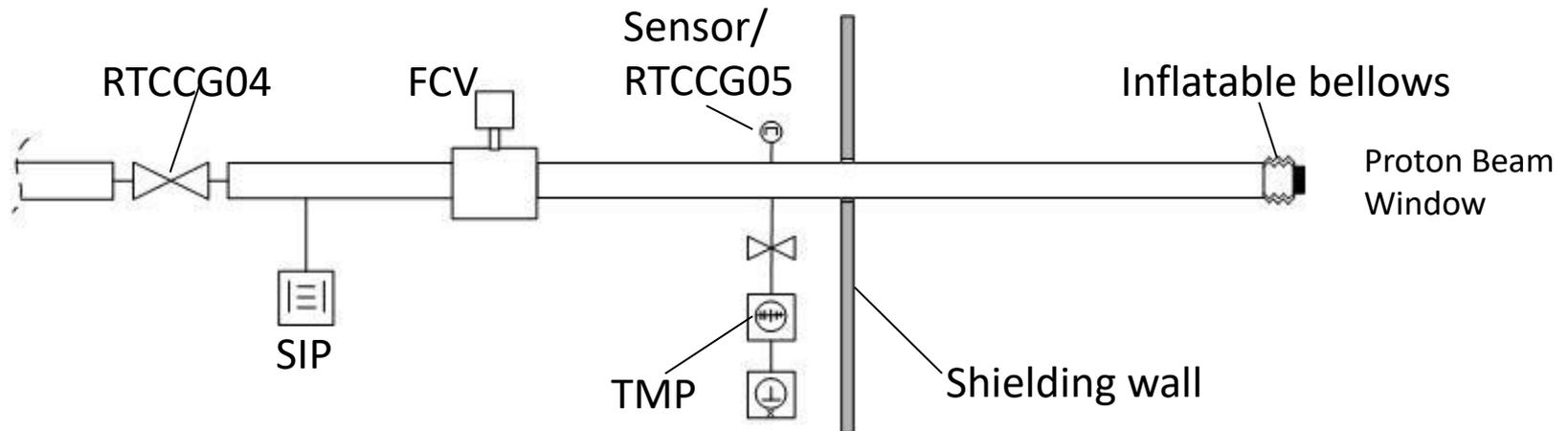


Quick detachable chain

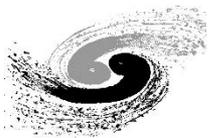


# Fast Closing Valve Protection System

The DN200 fast closing valve is installed in the front 24m of the spallation target. Once the proton beam window or inflatable bellows sealing device leaks, the fast closing valve(FCV) can be closed within 40ms to avoid exposure of other sections

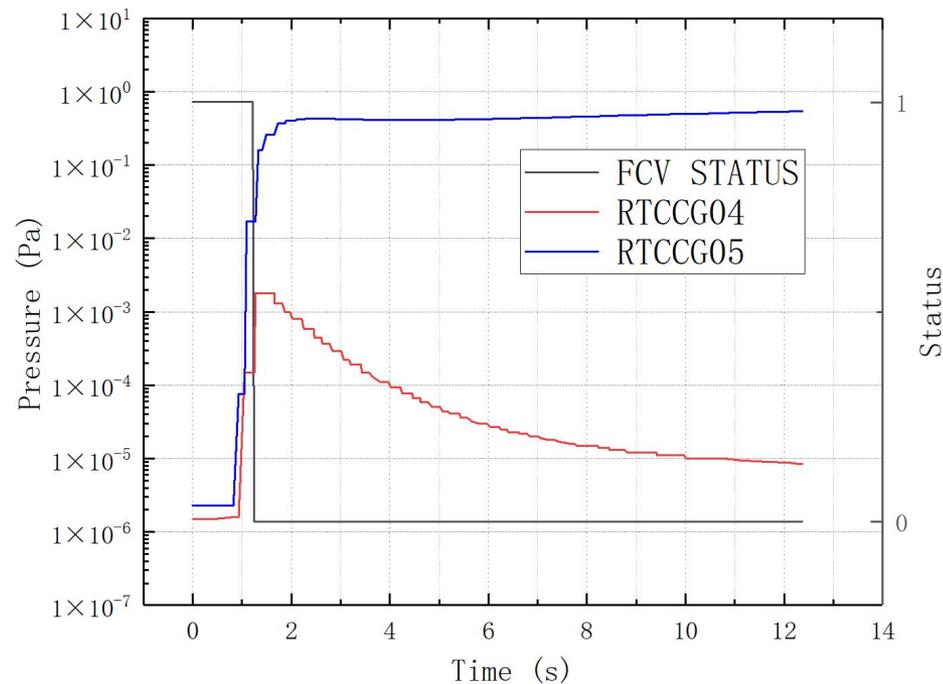


Schematic diagram of FCV system

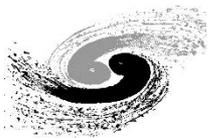


# Fast Closing Valve Protection System

In an accident of airborne shock, FCV was shut down in time to protect the vacuum system



Response curve of fast closing valve and related vacuum gauge



# Vacuum Operating Parameters

The RTBT vacuum system is stable and reliable and achieves the expected effect after four years of operation.

## Pressure of RTBT at 100KW

Sections	I	II	III	IV	RTDUMP
Pressure /Pa	$2.0 \times 10^{-7}$	$1.5 \times 10^{-7}$	$2.5 \times 10^{-7}$	$1.6 \times 10^{-5}$	$1.7 \times 10^{-7}$

