

A prototype target-ion source for RIB production in a reactor



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1 Introduction

Beijing neutron rich Isotope Separator On-Line facility(BISOL) has been proposed by China Institute of Atomic Energy and Peking University, China. In this project, a target ion source with 5g UCx target will be installed in one of the CARR reactor's neutron tunnel (neutron flux $8 \times 10^{14} \text{ cm}^{-2} \text{ s}^{-1}$) to produce neutron rich radioactive ion beam . The extracted RIB will be selected and charge bred to $m/q=6$, a superconductor linac will accelerate the RIB from 5keV/u to 150MeV/u. This accelerated RIB will served as projectile to produce radioactive ion beam far from stability line.

One crucial part of the project is the target ion source. The inner diameter of the neutron tunnel is only 170mm. The target ion source has to be compact enough to fit into the tunnel, at the meantime 20kV high voltage has to be applied to the target ion source and more than 20 kW heat from target fission has to be released .

To verify the feasibility of the target ion source, a prototype target ion source has been designed and fabricated at CIAE. The design detail is described.

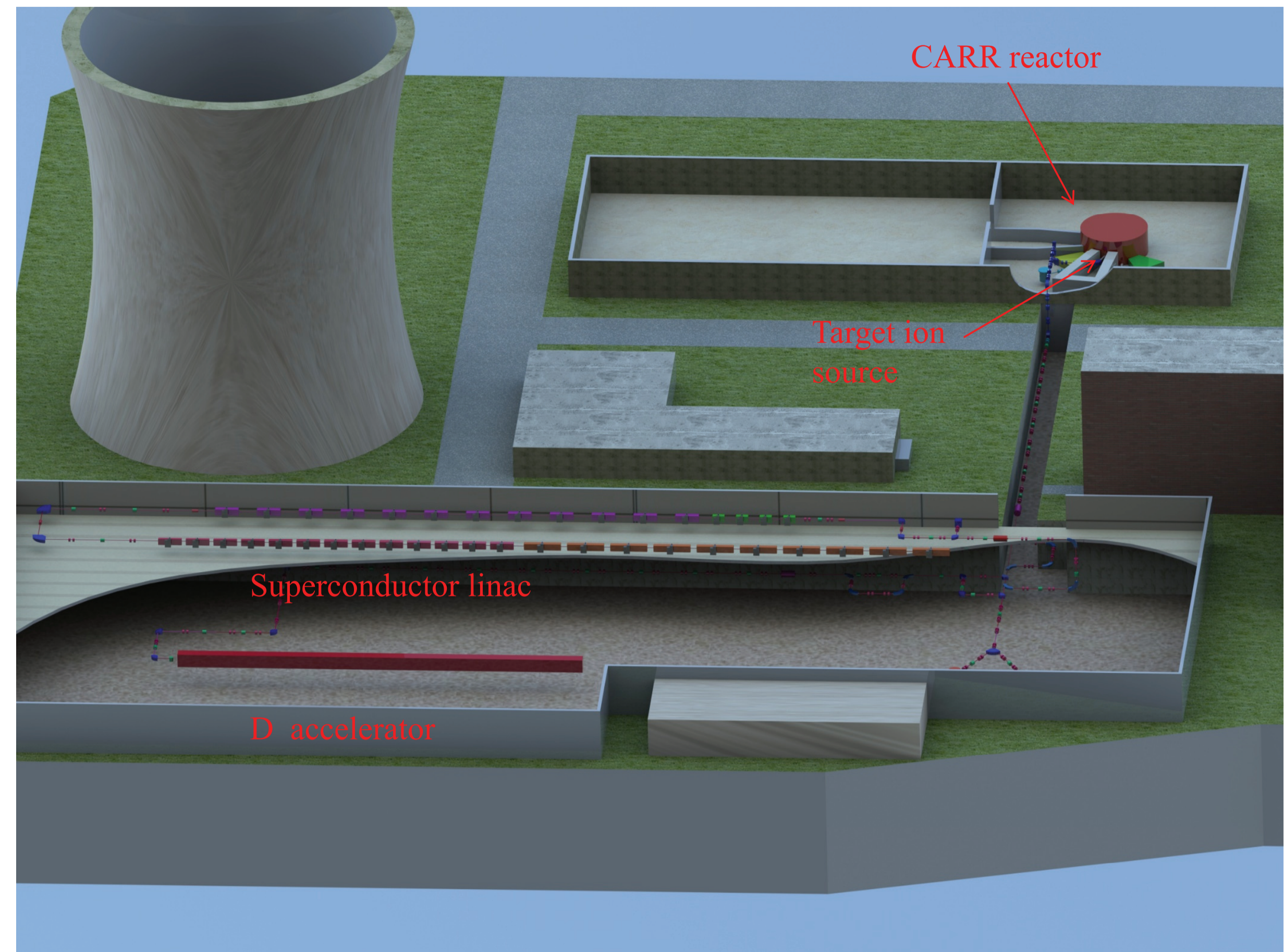
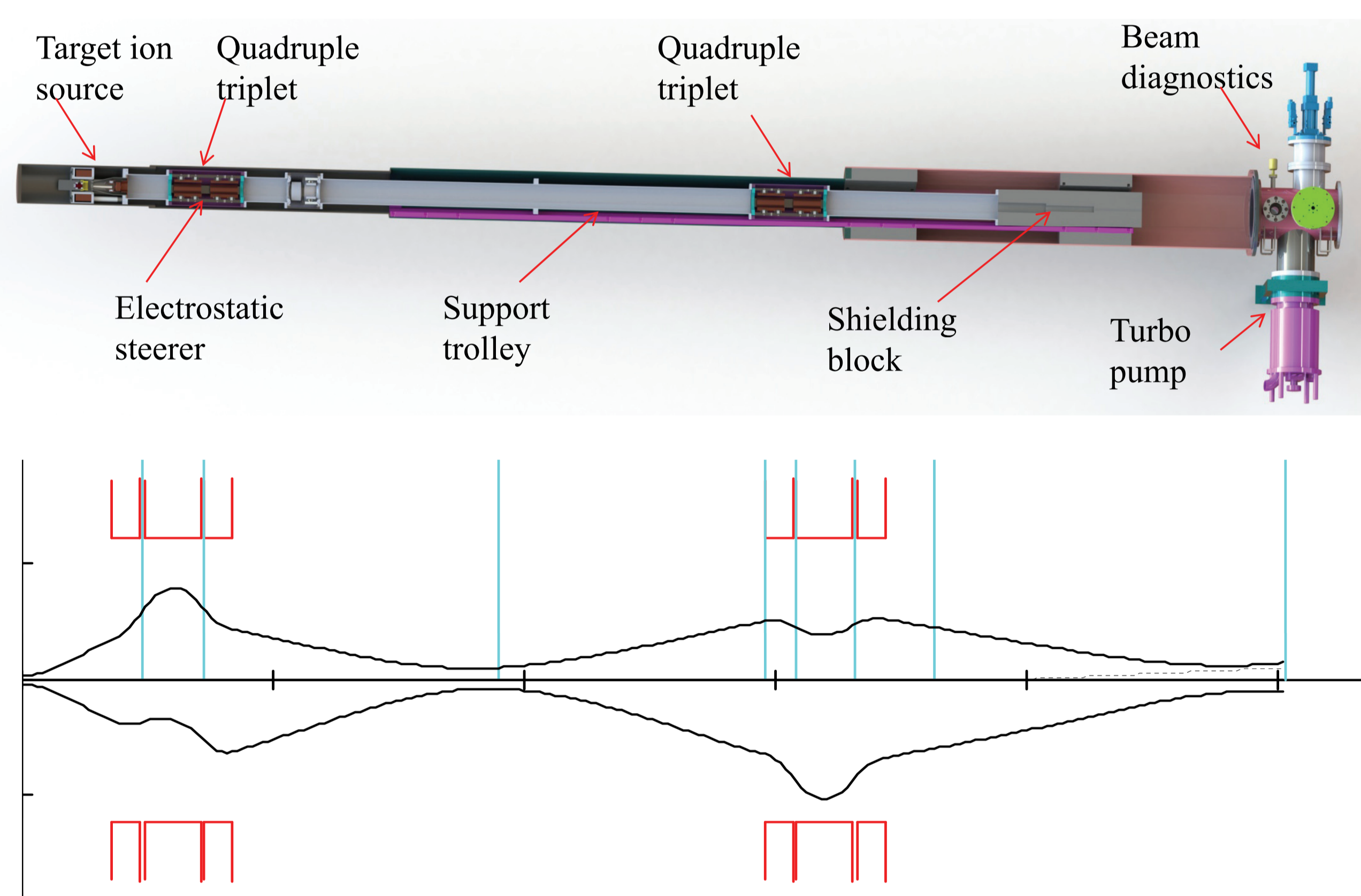


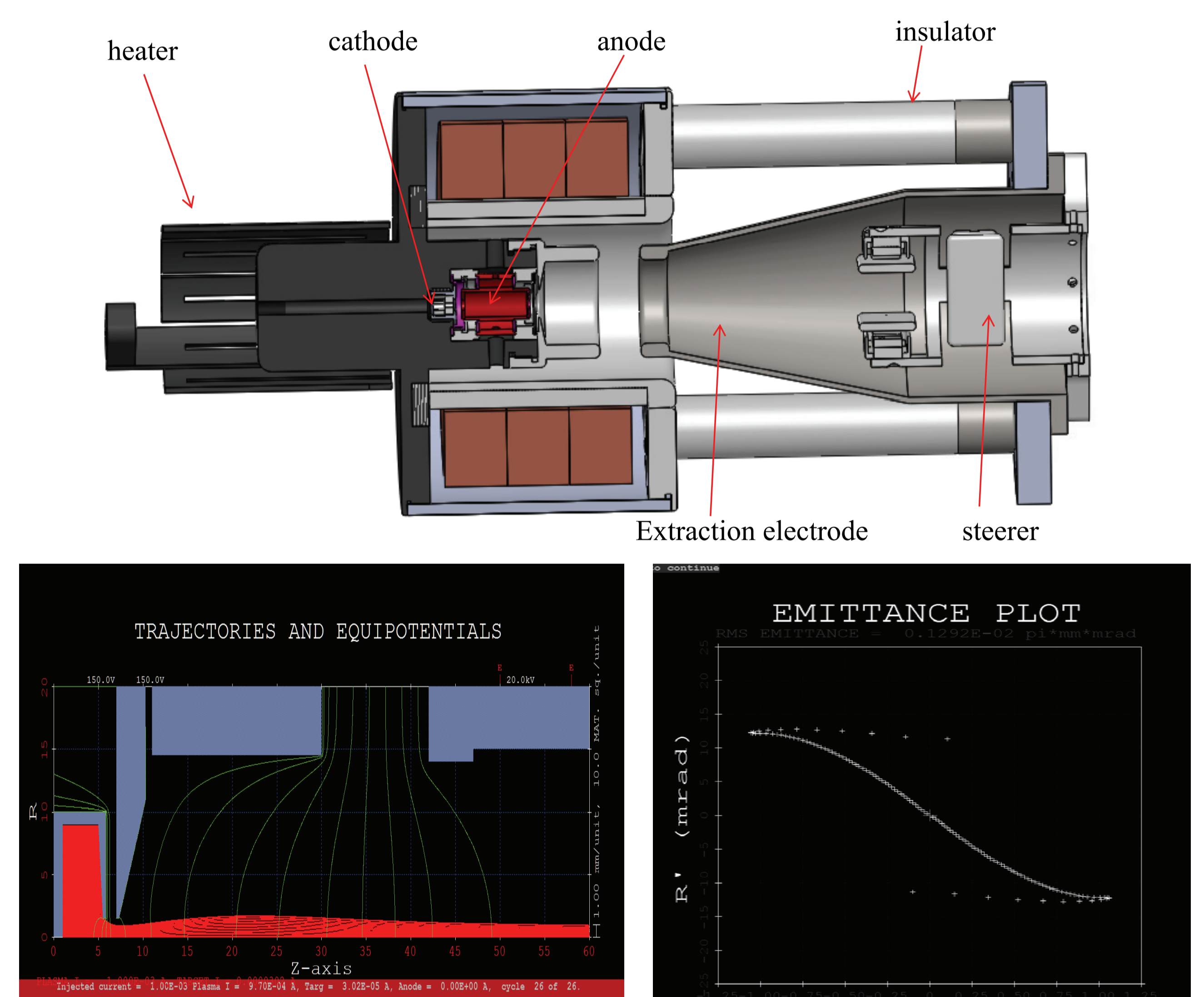
Fig. 1 The layout of BISOL

2 Prototype target ion source test bench



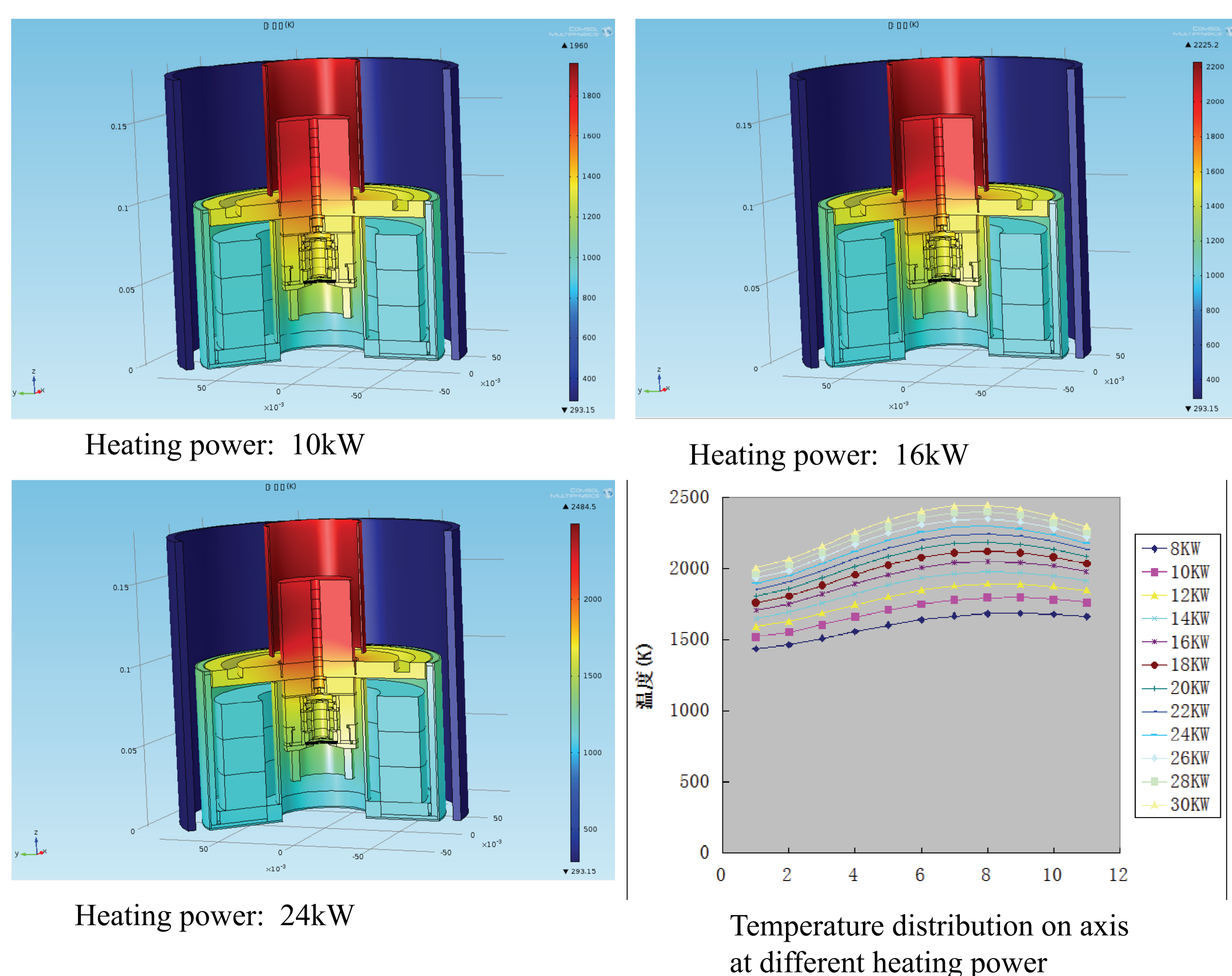
Specification :	beam energy	20keV
	maximum radial size	150mm
	beam intensity	> 1uA
	vacuum	10^{-3} Pa
	ionization	surface, FEBIAD, laser
	heat release	>10kW
	emittance	< 20 mm mrad

3 target ion source



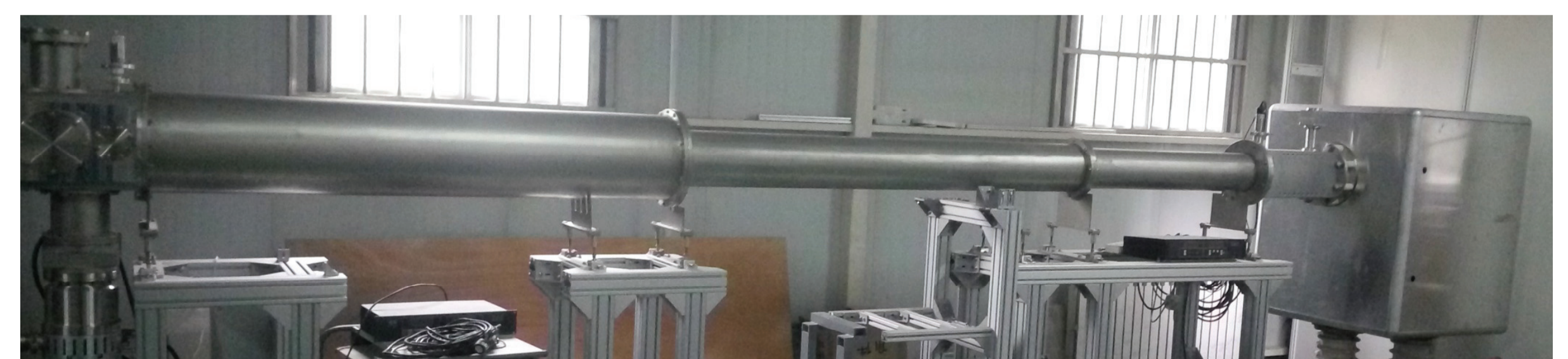
A special extraction system has been designed. Simulation shows that the beam is well focused. A pair of electrostatic plate is installed inside the ground electrode to steer the beam. The source can produce RIB in surface ionization mode or plasma mode. By injecting laser, it can also work as a laser ion source.

4 thermal simulation



The thoriated tungsten cathode is used to supply electrons. For different heating power, the cathode position can be changed to adapted the temperature.

5 current status



The fabrication of the target ion source has been finished, the vacuum chamber's inner size is identical to the neutron tunnel in CARR reactor. So far, the vacuum of the test bench has reached 10^{-3} Pa . The HV cable for quadruple and steerer are connected through SHV connectors at the end plate. A Wien filter will be installed inside the beam line to measure the mass spectrum of extracted beam. At the end vacuum chamber, Faraday cup and BPM are installed to measure the beam.

6 Conclusion

The experiment will begin at the end of 2017. As the first step, configuration of the target ion source will be improved according to the experimental results to obtain high ionization efficiency, reliability. Further improvement on the mechanical aspect to ease the target change will be carried out later.