Table 1 The desorption yields of oxygen-free copper bombarded with different energy and different intensity Xe^{10+} and O^{1+} beam.

Particle type	Beam Intensity/μA	Beam Energy/keV	Pressure difference/mb($\times10^{-8}$)	Desorption yields/molecules/ion
Xe^{10+}	4	1 000	1.52	42
		1 500	3.11	85
		2 000	3.10	86
		2 500	6.97	193
O^{1+}	5	100	3.78	10
		150	4.83	13
		200	4.97	14
		250	6.57	18

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6 - 28 Vacuum System Predesign of Beam Lines and Terminals in HIAF Project

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The HIAF(High Intensity heavy ion Accelerator Facility)project has been proposed by IMP(Institute of Modern Physics Chinese Academy) since 2009. The facility is being designed to provide intense beams of primary and radioactive ion for a wide range of research fields[1]. The complex which latest layout is shown in Fig. 1 includes several parts: BRing SRing, BRing injection beam line BRing extraction beam line, SRing injection beam line low energy nuclear structure spectrometer low energy irradiation terminal, high energy external target terminal, radioactive isotope beam terminal and HFRS as well.

To obtain UHV/XHV (ultra-high vacuum/extreme high vacuum)in ion accelerator is to reduce the beam loss which caused by the beams colliding with the residual gas. According to the requirements of physical design, it is needed to be considered that the problem of vacuum transition where the beam lines linked to synchrotron. Therefore, to achieve transition from UHV to XHV, the vacuum system of injection and extraction beam lines adopt the pattern of baking section and non-baking(conventional) section. The vacuum degree of baking part is as equal as the CSR vacuum system, which pressure is a mean of 6×10^{-9} Pa[2]. And the other vacuum systems all belong to the conventional ones with the design of vacuum degree 1×10^{-6} Pa.

Generally the vacuum system is mainly divided into two parts: 5 conventional systems and 3 compounded ones BRing injection vacuum system whose layout is shown in Fig. 2 is being proposed for instance because of the similar system structure method.

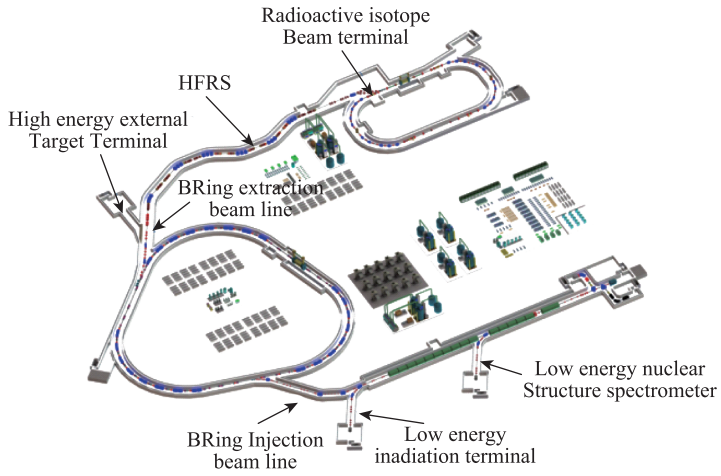

Fig. 1 (color online) Layout of HIAF complex.

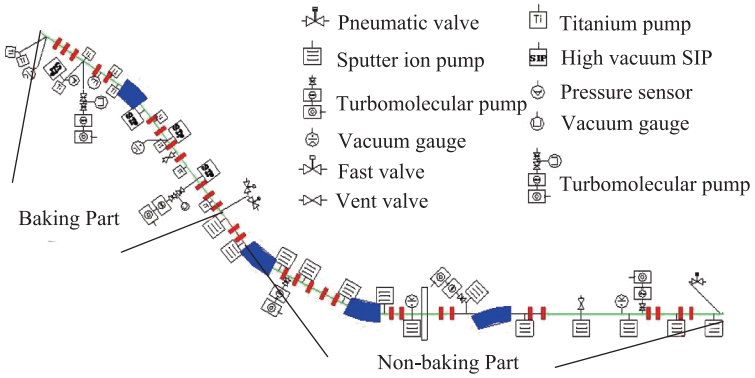

Fig. 2 (color online) Layout of BRing injection vacuum system.

BRing injection vacuum system is just a line with a total length of 66 m including baking part about 20 m, and conventional part rest. According to the distribution of beam diagnostic components and magnets, vacuum elements distribution has been determined already. The system line mainly contains 17 SIPs (sputter ion pump), 5 sets TMP (turbo molecular pump unit), 10 TSP(Titanium sublimation pump), 5 sets vacuum gauge, 4 kinds of ultra-high vacuum valve, *etc.*

Domestic SIP whose pumping speed is 200 L/s will be posed at the conventional section and import SIP with a 400 L/s pumping speed and TSP(3 00 L/s to H_2) used in baking part. According to the position and the speed of main pumps, the pressure distribution of BRing injection vacuum system is being calculated with VAKTRAK software, which are shown in Figs. 3 and 4. There is a fast closing valve with a close speed 15 ms installing at the conventional section nearby baking part. And two pressure sensors are installed at 20 m front and behind respectively, which would send signal to the fast closing valve controller when local pressure rises upon than the setting threshold value. So, it can protect the synchrotron vacuum systems at the first time when the terminal vacuum bursts.

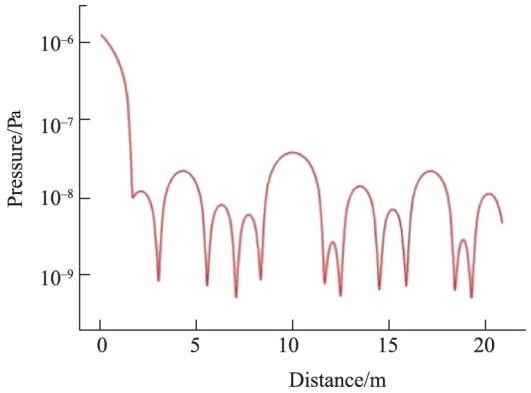

Fig. 3 (color online) Pressure distribution of baking section of BRing injection vacuum system.

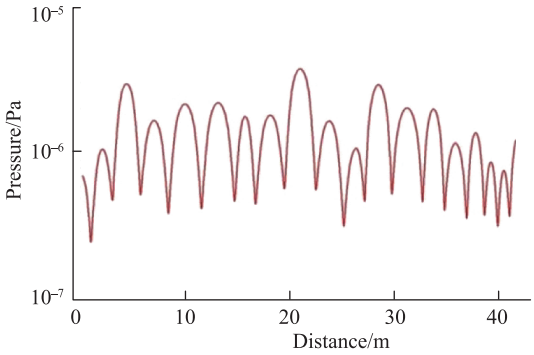

Fig. 4 (color online) Pressure distribution of conventional Section of BRing injection vacuum system.

At present, the HIAF project is in the stage of feasibility study. After that, the specific design work will be further developed, mainly including the general layout design of vacuum system, vast number of vacuum chamber design related to beam diagnostic components.

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