Process circulating water is essential for the normal operation of SSC-Linac and parallel beam supply. The accelerator transformation position is shown in Fig. 1. The process circulating water system is designed according to the beam equipment in Fig. 2. The parameters of process circulating water are provided by the accelerator equipment. The main pipe DN50 leads to the accelerator equipment.

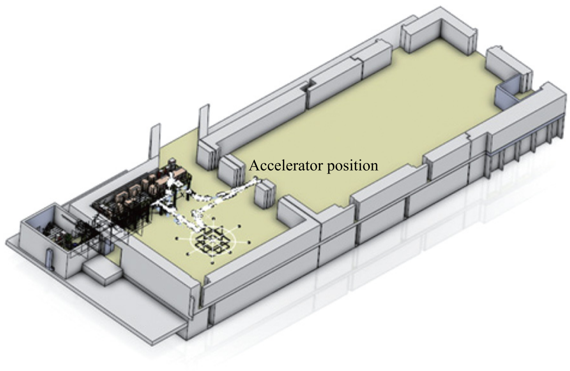

Fig. 1 (color online) Accelerator modification position.

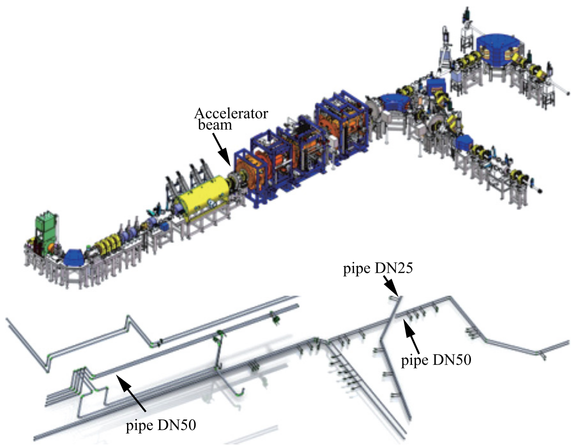

Fig. 2 (color online) Water cooling system design.

In general, the process circulating water takes away the heat generated by the SSC-Linac and the parallel beam supply, ensuring the normal and stable operation of the accelerator system, providing technical support for the acceleration of the U beam to 1.5 MeV/u, and ensuring the insertion of U^{74+} ions into the CSRm.

8 - 38 Upgrade of HIRFL Vacuum Monitoring System Based on EPICS Architecture

Zhang Jianchuan, Zeng Piaopiao, Li Lili and Wu Junxia

The former vacuum monitoring system is designed based on single chip microcontroller and the user interface is written in Java language. This vacuum monitoring system is used to collect the real-time vacuum value of vacuum gauges and fast-closing valve state distributed in SFC, SSC, experimental terminals and other areas of HIRFL to reflect the real-time vacuum environment. This microcontroller-based vacuum monitoring system has been on service for more than 15 years. With the passage of time, the change of on-site environment and the proposal of new monitoring requirements, this system has exposed more and more problems, such as slow refresh of interface data which makes people wonder whether the data is true, incomplete information collected by fast-closing valve, and difficulty in maintenance and upgrading. The requirements for upgrading the vacuum monitoring system are proposed by vacuum personnel. Therefore, the system is upgrade based on PLC controller and EPICS architecture in 2022.

The newly upgraded system hardware adopts Beckhoff PLC controller, and the software interface is based on CSS. The user interface of vacuum monitoring system is shown in Fig. 1. In order to make it clear whether the data is refreshed, a specially designed "heartbeat" signal is designed in the PLC program and then passed to the interface. If the vacuum data is not refreshed in 2 seconds, the display color of the data will change from green to red to give warning information. Meanwhile, a bunch of other functions like the threshold alarm display, waveform display, detailed information of each fast-closing valves are all designed and realized. The upgraded system interface is unified with the CSR vacuum monitoing interface, and has the characteristics of simple maintenance, convenient upgrade and transformation.

Since the system was put into operation in September 2022, it has been running stably and reliably, which provides great convenience for experimental personnel to get a quick and comprehensive understanding of the HIRFL vacuum state.

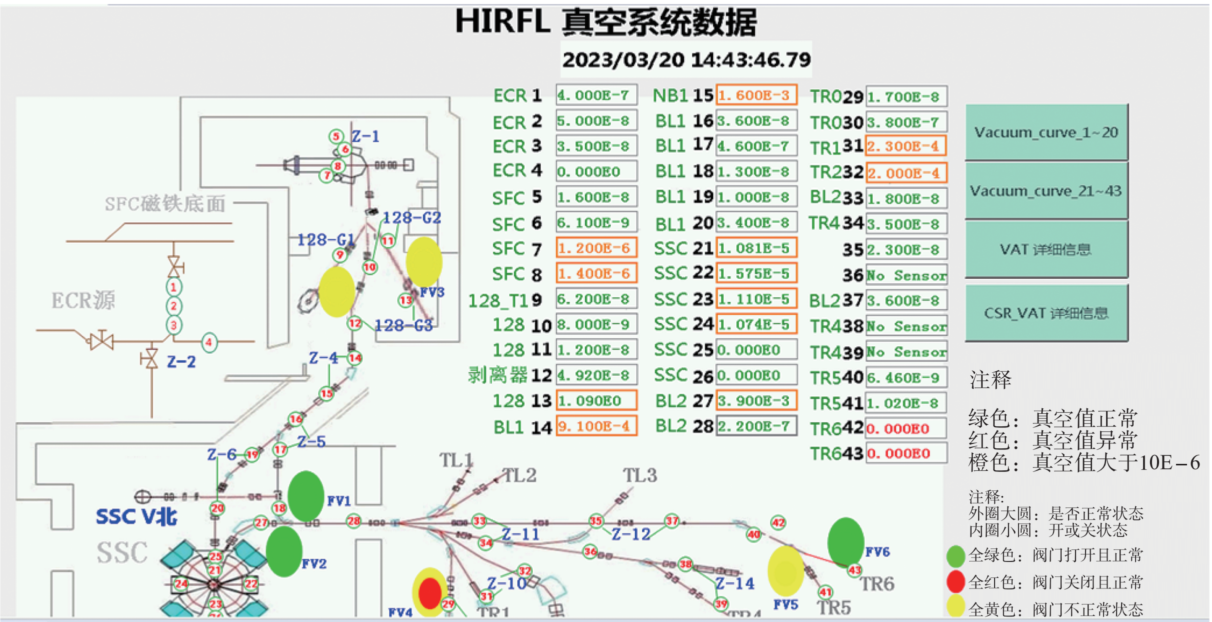

Fig. 1 (color online) User interface of HIRFL vacuum monitoring system.

8 - 39 Progress of Control and Network Group in 2022

Zhang Wei and Yue Min

In 2022, the control group completed some projects include HIAF projects and some renovation projects on HIRFL. In particular, we completed some subsystems design, test and hardware product of HIAF. At same time, we are developing some new technology for HIRFL, such as application of virtual AP technology in HIRFL. We carried out the following works:

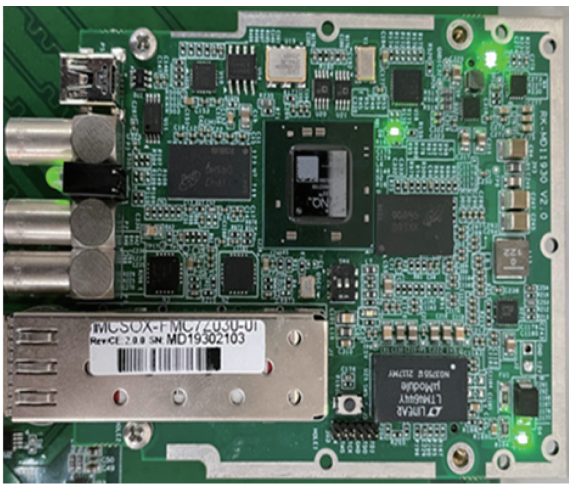

Fig. 1 (color online) Picture of the terminal node.

1. High-precision timing is the key to precise control of the equipments for HIAF, which determines the accuracy and precision of the operation between the equipment. Based on the standard time synchronization protocol, a terminal node for the HIAF timing system was developed. The synchronization precision is better than 60 ps and the synchronization accuracy is better than 2 ns. At present, the design has been completed, and the test results show that the synchronization precision of the terminal node meets the design requirements, and the reference trigger output jitter is less than 50 ps. Figure 1 is the picture of the terminal node board.

2. The HIAF control network undertakes the operation of the whole HIAF facility and the big data transmission for each experimental terminal. The system is designed based on three-level (core, aggregation, access) network architecture, and achieves 40 Gbps backbone network.

The core level adopts two switches for virtualization deployment. All the aggregation nodes are deployed by double aggregation switches, and all the access switches are linked to the aggregation switch by double links to ensure data reliability to the greatest extent. The access switch adopts the mode of 10 Gigabit uplink and Gigabit downlink to ensure high data throughput. The architecture of the HIAF control network is shown in Fig. 2.