COMMISSIONING OF THE FAIR CONTROL CENTRE

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Abstract

The FAIR Control Centre (FCC) has been purpose-built on the GSI campus to meet the complex operational demands of the FAIR/GSI large scale accelerator facility. It hosts the Main Control Room (MCR), seminar and meeting rooms of various sizes, offices, and dedicated technical rooms.

The 640 m² MCR is an open, collaborative workspace for accelerator experts, experiment teams, and technical staff. It offers a 24/7 ergonomic environment with advanced acoustic and climate control, height-adjustable consoles, and a water-cooled IT infrastructure. In addition to the console displays, the fully digital MCR features ca. 110 m² of high-resolution LED overview displays for system-level visualization.

Construction of the MCR was completed in November 2025. Console installation began on December 8th, followed by IT installation and commissioning in early 2026. Initial operation of the first consoles was performed in late February, with full MCR operation targeted for June 2026. The GSI accelerators will be controlled from the FCC for the beam time starting in September.

We report on the FCC key features and the project status on its path to completion, with an emphasis on commissioning of the MCR.

INTRODUCTION

The Facility for Antiproton and Ion Research (FAIR) is one of the most advanced accelerator complexes currently under construction. Multiple accelerators of different types and experimental areas are integrated into a single scientific infrastructure dedicated to nuclear physics and related areas [1,2]. Commissioning of the FAIR Control Centre (FCC) is one of the key activities scheduled for 2026 according to the FAIR&GSI integrated schedule. This follows the start of the cryogenic plant commissioning that started in 2025 and is part of the staged commissioning plan [3]. The increasing scale and complexity of such facilities require equally advanced operational environments [4]. The functional requirements can be summarized in three key dimensions:

- Operational Control: Real-time monitoring and control of accelerator subsystems and beams
- Coordination Platform: Interaction between operators, machine coordinators, experimenters, and technical experts
- Public and Scientific Interface: Representation of FAIR to visitors, stakeholders, and the public

In terms of general use cases the following scenarios are taken into account [5].

- Commissioning and re-commissioning of the FAIR facility after maintenance periods
- Regular operation of GSI/FAIR accelerators
- Machine development
- Operation of machine-based experiments
- Development and testing of control software

The FCC is designed as an integrated environment that combines operational, technical, and collaborative spaces [5]. Besides the Main Control Room (MCR), which is the main focus of this paper and is discussed in the following sections, the FCC includes meeting and conference rooms, ready rooms for key personnel, IT service areas, and a visitors' gallery. This layout facilitates efficient interaction between operators, machine coordinators, experiment teams, and technical experts. Additionally, MCR personnel have access to lockers conveniently located near the main MCR entrance and to showers located in the basement.

The design follows established best practices from large accelerator laboratories such as CERN, while incorporating specific requirements derived from FAIR's multi-machine operation and high degree of parallelization [6].

The MCR has been designed as the central hub for monitoring, controlling, and coordinating all accelerator operations, experiments, cryogenic and technical infrastructure. It replaces and significantly extends the capabilities of GSI's control room infrastructure, addressing both the increased system complexity and the need for improved human-machine interaction [7].

Maintaining operator performance over long shifts is a critical requirement. Acoustic conditions, lighting, and workspace design directly influence efficiency and error rates. The MCR addresses these challenges through a comprehensive ergonomic design, which is validated during commissioning. Among other measures, this is achieved by reducing the number of visitors in the control room through access control to the MCR and a dedicated visitors' gallery. This space is specifically designed to provide insight into operator activities and the current operational status of the GSI/FAIR facilities without requiring direct access to the MCR. The gallery is located on the north side and is directly connected to the MCR via a large window, allowing visitors to observe operators at work. Some synoptic displays are also visible from this area. In addition, the visitors' gallery is equipped with information screens that provide further insight into the accelerator complex. Dedicated exhibits, such as compact magnets or accelerator components, are also foreseen to enhance the visitor experience.

THE MAIN CONTROL ROOM

The MCR is the core element of the FCC. With its surface area of approximately 640 m² it is about twice as large

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as the former GSI control room. It is designed to host 25 height adjustable operator consoles arranged in three control islands (Fig. 1). The accelerator related work is done using 15 consoles arranged in a large elliptically-shaped island. An additional triangular-shaped table is installed in the middle of the large island. It is equipped with general purpose computers suitable for operational documentation, communication or any other task. The two smaller islands, accommodating 5 consoles each, are meant for the cryogenic and technical infrastructure. They also offer work space for experimental groups, which is especially valuable during experiment setup. At both ends of all islands additional general-purpose tables are installed offering workspace for visitors and shelf space.

The MCR follows the paradigm of a fully digital control room and follows the international norms [8,9]. All relevant accelerator parameters, system states, and alarms are visualized via distributed console displays and a large-scale LED overview display (~110 m²).

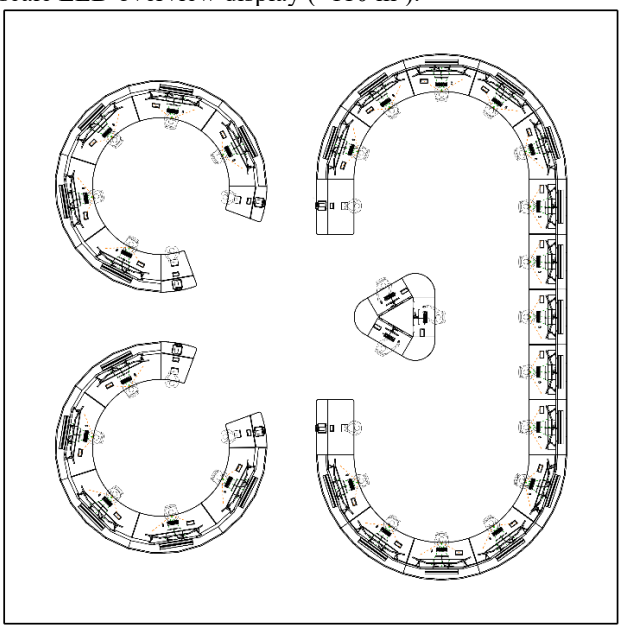

Figure 1: The layout of the Main Control Room. The 25 consoles are arranged in three islands. The large one on the east side and two smaller ones on the west side of the MCR.

Furthermore, the MCR is built without pillars obstructing the line of sight. This ensures a high level of situational awareness across all operational roles.

The overall concept of the MCR ensures efficient

- Coordination between operators and machine coordinators
- Interaction with experiment teams during beam setup
- Handling of abnormal conditions and fault scenarios.

In addition, ergonomics and operator performance have been central design drivers. The MCR includes:

- Height-adjustable consoles supporting seated and standing operation
- Optimized viewing angles and display arrangements
- Large window facing west
- Indirect adjustable electric light
- Advanced acoustic treatment targeting low noise levels and high speech intelligibility
- Stable climate conditions for continuous 24/7 operation

These features aim to minimize operator fatigue and reduce the likelihood of human error during complex operational tasks.

The acoustic concept was verified by a computer simulation. It includes the design and choice of materials of the floor, ceiling, walls as well as an active sound masking system. Approximately 70 speakers are installed in the 5 m high ceiling as part of an active sound-masking system. The sound levels are automatically adjusted based on measurements from four ceiling-mounted microphones. In addition, the speaker system is used for general announcements and for text-to-speech messages generated by the alarm system.

To meet the stringent environmental requirements of the MCR, the heat generated by IT equipment installed in the consoles is removed directly via water cooling and does not contribute to the thermal load of the air-conditioning system. For this purpose, each console is equipped with an air–water heat exchanger. The air used to cool the computers is drawn through the heat exchanger by multiple low-noise fans, whose speed can be adjusted according to the heat load. The cooled air is then released into the room, providing additional cooling for the monitors. Furthermore, the air circulating within the consoles can be disinfected using UV lamps installed beneath the heat exchangers, enhancing the overall safety of the working environment.

The hardware compartment housing the IT equipment is accessible from both the front and rear. On the rear side, 1.2 m high acoustic panels are installed as part of the overall acoustic design of the MCR.

All 25 consoles are height adjustable contributing further to the ergonomic concept. The electrical drives are equipped with safety features preventing injuries. If encountering an obstacle, the drives stop automatically and move back, so the obstacle can be removed.

MCR COMMISSIONING

The overall FCC project schedule foresees completion and handover to users in Q3 2026. Considering the specific requirements of the MCR ‑ particularly the installation and commissioning of a substantial amount of custom-built furniture and IT hardware ‑ its readiness for equipment installation was scheduled for November 2025. According to that, the tendering process for the console furniture was designed for delivery and start of installation in December 2025. By 12 December 2025, 80% of the console furniture had been installed, paving the way for the installation of IT hardware. Controls integration work continued into early 2026. By mid-February 2026, the console installation and their outfitting with controls computers were completed. By the end of February all the chairs including special 24/7 chairs were delivered and put into the MCR. This effort allowed to reach an important milestone – a test run from the

Figure 2: Photographs of the Main Control Room (MCR) taken on 9 March 2026 after completion of the test run. The left image shows the large console island in the foreground and the west-side window in the background. Banners are temporarily installed in the wall panel openings designated for the future installation of LED overview displays.

new main control room. Starting 26 February 2026, the beam operation in CRYRING [10] was fully controlled from the MCR. Operators working 24/7 shifts, together with machine and controls experts, used five operational consoles to manage access to the machine areas, set up beams, conduct machine studies, and perform extensive testing of new control software [11]. The test run was successfully completed on 9 March 2026. The Fig. 2 shows the MCR at the end of the test run. This intermediate milestone ensures that the MCR will be fully operational by summer 2026. The tendering process for the LED overview displays, to be installed on three walls of the MCR, is at an advanced stage.

SUMMARY

The construction and commissioning of the FCC and in particular the MCR is progressing according to the overall GSI/FAIR commissioning schedule. The construction of the MCR is completed. It is equipped with the console furniture and the most of the IT hardware. All chairs including the 28 special control room chairs are delivered. The MCR commissioning is in advanced state. The electrical and IT infrastructure in the MCR is completed. Further infrastructure such as telephones, printers and copy machines are ordered and expecting delivery soon. The construction work in the rooms adjacent to the MCR such as the operator kitchen, small meeting room and the visitors' gallery is being finalized.

The recent test run allowed for testing of the IT hardware and infrastructure and the successful preliminary validation of the overall MCR concept.

The status of the tendering process for the video walls is encouraging. The system is expected to be operational before the beam time in September 2026.

The FCC building is expected to be handed over to the users in early Q3 2026. The new main control room is expected to be fully operational before the beam time in September 2026.

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