Abstract
The Mainz Energy-recovering Superconducting Accelerator MESA requires superconducting RF systems that provide sufficient energy gain of 50 MeV per turn to an electron beam. The order of two Rossendorf-type cryomodules, containing two 9-cell 1.3 GHz XFEL-like cavities each, has been placed. Besides an overview of the adaptations required for the multipass and high current beam operation of the cryomodules, details about challenges regarding the installation of the cryomodules on the premises of the Institut für Kernphysik at Universität Mainz are given.

ROSSENDORF-TYPE CRYOMODULES
The Rossendorf-type cryomodules are well-characterised and in use at HZDR for more than a decade. A picture of one of the installed modules is shown in Fig. 1. Since then smaller adaptations have been applied to the design for easier assembly and better performance by the manufacturer Research Instruments GmbH [2]. These include an improvement of the liquid nitrogen shield and the use of niobium cavities undergoing the European XFEL preparation process [3].

Due to the small bandwidth of the superconducting RF cavities, microphonics will be an issue for the energy recovery operation mode of MESA. To keep the frequency of the cavities under control, even for fast frequency changes, the tuner requires piezo technology which is not included in the standard Rossendorf type tuner and has to be replaced. Following from the tuner change, some redesign of the cavities’ helium vessel is required. Besides the adaptations of the cryomodule, the coldboxes for the 4 K/2 K liquid helium (LHe) production including control system will also be provided, therefore only a $T = 4$ K LHe liquefier and the subatmospheric pumping units have to be provided by the institute.

SPACE CONSTRAINTS
In contrast to other projects, the facilities for MESA are already available, as they have been in use for a former experimental setup at the MAMI [4] accelerator. As these buildings are about 10 metres underground, the space foreseen is strictly limited, causing challenges in placing the lattice and all accelerator subsystems [5]. Special issues have to be faced for the cryomodules, as the current lattice places the cryomodules partially in apertures of the approx. 3 metres thick walls between the two accelerator halls MESA A/B. The front view sketch of the apertures and simplified insertions are shown in Fig. 2.

While the cryomodules itself fit into the apertures, the electric connections and the piping for the coolants will be an issue. The waveguides required for the RF supply reduce the space available for maintenance work and obstruct the passage to the end of the cryomodule which is located in the walls’ aperture. Due to static reasons, a pedestal is required which will create a dead end, see Fig. 3.

In addition the cabling for RF and temperature diagnostics also hinders the transit, as the shearing forces applied might...
damage the connectors or even the vacuum feedthroughs if the cables are touched due to the limited space (see Fig. 4).

For the alignment of the cryomodule and the cryogenic string within the module access to the ‘dead end’ is a mandatory requirement, or the supports have to be prepared in advance to allow remote control. The piping for the cryogenic supply is not yet fixed, but it may reduce the clearance within the apertures. To perform installation and maintenance work from the top the installation of a platform upon the cryomodule is the only option. This will not be possible if the helium pipe has to pass the aperture. Still without the piping the headroom will already be narrow with 0.8 m.

**SOLUTION**

The present solution of these issues is shown in Fig. 5, which displays the current layout of the MESA accelerator within the caverns. To avoid most of the issues regarding space, the accelerator will be moved partially into the experimental hall and the cryomodules will be easily accessible, as they are no longer placed in the walls’ aperture. The increased space requirement would lead to a considerable reduction of the experimental possibilities. However, at present (Spring 2015), it seems very probable that a significant extension of the facility by another experimental hall will be granted. This would allow to perform all planned experiments at MESA while even offering a further extension of the MESA lattice for instance by an introduction of longer cryomodules with more SRF cavities.

**SUMMARY**

MESA will be the first multiturn SRF ERL. The potential advantage of converting existing buildings for the MESA accelerator causes challenges for the lattice and especially for the complex SRF cryomodules. The issue limited available space within the 3 m thick walls has been resolved by an extension of the lattice by about 4 m. This allows to remove the modules from the critical wall-area, the assembly of the more conventional components which replace the SRF components is feasible. The increased length of the orbit can be handled within the given space constraints. This simplifies the connection of several subsystems, the alignment process and maintenance work.

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REFERENCES


