Contribution ID: **66** Type: **Contributed Oral**

C1Or4B-03: The Cryogenic System for the Mainz Energy-recovering Superconducting Accelerator (MESA)

Monday 19 May 2025 16:45 (15 minutes)

The Mainz Energy-recovering Superconducting Accelerator (MESA) is an electron accelerator currently under construction at the Institute of Nuclear Physics, Johannes Gutenberg University Mainz, Germany. MESA is designed as a superconducting multi-turn energy recovery linac (ERL) to provide high-intensity, low-energy electron beams for precision electron scattering experiments testing the limits of the Standard Model of particle physics.

The accelerator incorporates several cryogenic components, each with specific cooling requirements. Particle acceleration is achieved through two superconducting radiofrequency (SRF) cryomodules, utilizing XFEL/TESLA-type cavities at 1.3 GHz, which must be cooled to 1.8 K. This requires up to 8 g/s of helium at 16 mbar. Additionally, the P2 experiment requires cooling a superconducting solenoid to 4 K and liquefying hydrogen in the target at 15 K, with 4 kW of cooling power supplied by the helium circuit. Both the solenoid and cryomodules are thermally shielded using liquid nitrogen. A cryogenic system was designed to provide and distribute helium and nitrogen throughout the accelerator.

The refrigerators are placed in a surface building, while the accelerator is placed in an underground area 10m below surface. Multiple (multi) transfer lines are connecting the surface equipment to the underground equipment. The cryogenic system consists further of three distribution valve boxes, a sub-atmospheric electric heater and an sub-atmospheric compressor to feed the 16mbar helium back into the compressor circuit of the liquefier.

To meet these demands, the existing helium liquefier was upgraded to provide the required liquid helium mass flow and manage potential impurities introduced through the 16 mbar pressure system. A refrigerator with 4 kW cooling power at 15 K was installed for the P2 target cooling.

Currently, the most complex components like the liquefier, the refrigerator and the cryomodules and parts of the transferlines are already installed and commissioned, while other components are still in manufacturing stage. The commissioning of the cryogenic system is planned in mid-2025.

This paper introduces shortly the MESA accelerator and discusses the design and current status of the MESA cryogenic system, focusing on key components such as the cryomodules, the P2 experiment, valve boxes, transfer lines, and the 16 mbar pumping system.

Author: STENGLER, Timo (Johannes Gutenberg-Universität Mainz)

Co-authors: SIMON, Daniel (Johannes Gutenberg-Universität Mainz); HUG, Florian (Johannes Gutenberg-Universität Mainz); DERKING, Hendrie (Cryoworld BV); AULENBACHER, Kurt (Johannes Gutenberg-Universität Mainz)

Presenters: DERKING, Hendrie (Cryoworld BV); STENGLER, Timo (Johannes Gutenberg-Universität Mainz)

Session Classification: C1Or4B - Large Scale Cryogenic Systems II: Operation & Design II