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FAIR Realisation – Superconducting Magnets Production Start

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Introduction

The realisation phase of the pilot project of FAIR - the SIS100 synchrotron was started in January 2012, when the manufacturing contract for the dipole series was signed with Babcock Noell. In parallel to the preparation for manufacturing the first dipole, urgent designed work was done for the quadrupole and corrector magnets as well as planning the cryogenic test facilities at GSI. The same work was concentrated on the Super Fragment Separator. In addition significant success was achieved in collaboration work by manufacturing and testing a first SIS300 dipole model magnet.

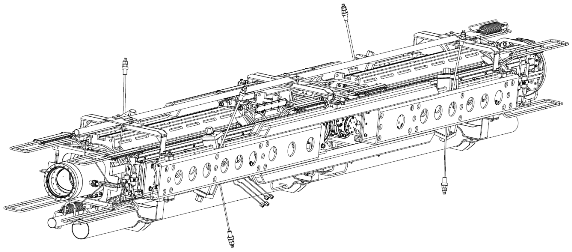

Figure 2: CAD Model of the cold mass of the SIS100 quadrupole doublet module, type 3-F2, including suspension system.

Superconducting Magnets

Rapidly-Cycling Magnets for SIS100

Dipoles The design phase of a First of Series magnet (FoS) finished with the FDR in October 2012 and the production of the magnet has started with the manufacturing of the most critical component: the superconducting single layer coil (see Fig. 1). It will be ready for testing in spring 2013. After a successful test of this first dipole the series production will start.

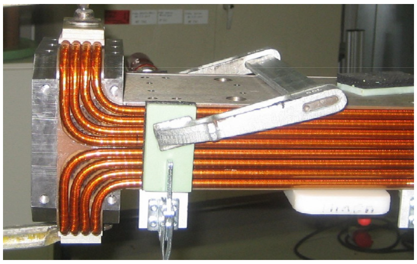

Figure 1: Winding of a copper dummy-coil of the SIS100 FoS dipole

Quadrupole Modules The SIS100 Quadrupole module contains two superconducting quadrupole magnets, corrector magnets and other devices such as BPM in the common quadrupole module cryostat [1, 2]. In the SIS100 accelerator ring, 9 standard types and 3 special types (at the injection, extraction and high radiation area), 84 modules in total will be installed.

The production of the module will be conducted as the German-Russian In-Kind contribution to FAIR. GSI will provide the superconducting wires and the all devices except the magnets. The AC-losses and the hydraulic resistances were recalculated based on the final design of the magnet components [3, 4]. The mechanical stability of the QP-doublet modules versus thermal and mechanical load was investigated. The assembly of the components, its mounting and operation procedure were analysed with FE models. The component stability during mounting was investigating, together with the cold mass suspension and its stability at 4 K (see also Fig. 2). A first series doublet will be build next, tested at JINR/Dubna and to be operated at GSIs prototype test facility, and at a test string setup (dipole and quadrupole doublet module as minimum). The final design of all different series SIS100 quadrupole doublet module types is actually under preparation. A tender for preparing CAD models to production plans is running, which will be based on the development results of the first doublet (type 3-F2).

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Rapidly-Cycling Magnets for SIS300

The first prototype of a SIS300 curved dipole has been tested at INFN-LASA in Milan, Italy [7, 8]. At the moment a second enhanced collared coil is built in frame of the European CRISP project. At IHEP in Protvino, Russia, a second SIS300 prototype quadrupole with enhanced low loss cable is built and tested. (We acknowledge the support of the European Community-Research Infrastructure Activity under the FP7 program CRISP [Grant agreement no: 283745] Work Package 5). A first prototype of the steering dipole is ready to be tested (see Fig. 3).

Magnets for the Super-FRS

Superferric dipole The superferric dipoles are no longer an In-Kind contribution from FAIR collaboration

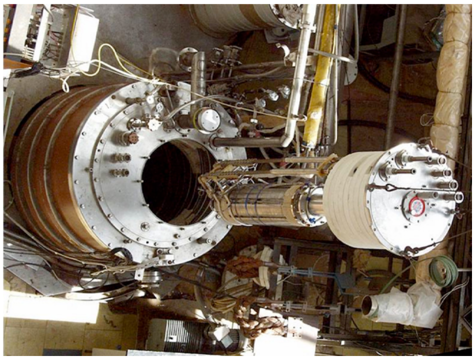

Figure 3: Insertion of the SIS300 prototype quadrupole into the test cryostat

partners, but will be purchased via a FAIR call for tender. The necessary specifications are under preparation and shall be ready until summer 2013.

Superconducting multiplets The superferric multiplets are a GSI In-Kind contribution to the FAIR-Project. The specifications for the different magnets, as well as the integrated modules are nearly finished and the call for tender is in preparation and will start in early 2013.

Planning for Testing

The general testing strategy was defined this year: SIS100 dipoles will be tested in the now currently erected series test facility at GSI, SIS100 quadrupole units are foreseen to be tested in collaboration with JINR and the Super-FRS magnet will be tested at CERN.

Prototype Test Facility Activities

The first SIS100 dipole magnet will be tested at the prototype test facility this year. So all required upgrade activities were started last year in particular: a new power converter has been procured and new HTS current leads were ordered with their production already started.

Series Test Facility Activities

The SIS100 series test facility will be constructed in SH2/SH3 at GSI. In the hall, 3 test benches for the series production SIS100 dipole magnets and the string test facility, which demonstrates the SIS100 accelerator construction and the system operation, will be installed. For the infrastructures such as power converters and cryo-plant, an utilitly building (SH5) will be errected. Necessary preparations are ongoing with the commissioning of the facility foreseen in the middle of 2014. Full scale tests will be start 2014 and continue until 2017.

Testing Super-FRS Magnets at CERN

The site of test was identified (building 180) and the infrastructure is refurbished. The collaboration committee will guide this process.

Electrical Systems and Magnet Protection

The coil design and 3D quench calculations were continued; both machines (SIS100 and SuperFRS) will use dump resistors as protection devices with their preliminary values defined. Bridge detectors for FAIR were successfully tested on a SIS100 dipole, and now the series is being tendered. For the SIS100 correctors special mutual inductance detectors are foreseen and will be tested on the SIS100 sextupole magnet currently fabricated at JINR.

The electrical safety systems for measuring insulation parameters for the SIS100 magnets are projected and shall be developed together with collaboration partners. Paschen tests were performed on the SIS100 prototype dipole performed in the range of 10^{-4} to 10^{-1} mBar. As the machine is not Paschen tight, appropriate interlocks are foreseen for the cryostat vacuum system.

Conclusion

In 2012 we achieved important results in preparing manufacturing and testing of the first fast ramped superconducting magnets of the SIS100, the Super-FRS and the SIS300 - core components of the FAIR project.

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