

Superconducting dipole magnet for the Compressed Baryonic Matter (CBM) experiment at FAIR*

P. Akishin¹, A. Bychkov¹, E. Floch², Yu. Gusakov¹, V. Ivanov¹, P. Kurilkin¹, V. Ladygin¹, H. Leibrock², A. Malakhov¹, G. Moritz², C. Muehle², W.F.J. Müller², W. Niebur², I. Pschorn², P. Senger², A. Shabunov¹, P. Schwangruber², Y. Xiang², C. Will²

¹JINR, Dubna, ²GSI, Darmstadt

The CBM superconducting dipole magnet is a central part of the detector system. The target station and the Silicon Tracking System are placed in the magnet gap. The magnet has to provide the vertical magnetic field with a bending power of 1 Tm on the length 1m from the target. A perspective view of the magnet is shown in figure 1.

The magnet gap has a height of 140 cm and a width of 250 cm in order to accommodate the STS with a polar angle acceptance of $\pm 25^\circ$ and a horizontal acceptance of $\pm 30^\circ$. The magnet is of the H-type with a warm iron yoke/pole and cylindrical superconducting coils in two separate cryostats like the SAMURAI magnet at RIKEN [1, 2]. The potted coil has 1749 turns. The wire – similar to the CMS wire – has Nb-Ti filaments embedded in a copper matrix, and is soldered in a copper stabilizer with a total Cu/SC ratio of about 13 in the conductor. The operating current and the maximal magnetic field in the coils are 686 A and 3.25 T, respectively. The coil case made of stainless steel contains 20 liters of liquid helium for one coil. The vertical force in the coils is about 250 tons. The cold mass is suspended from the room temperature vacuum vessel by six suspension links. Six cylindrical support struts compensate the vertical forces.

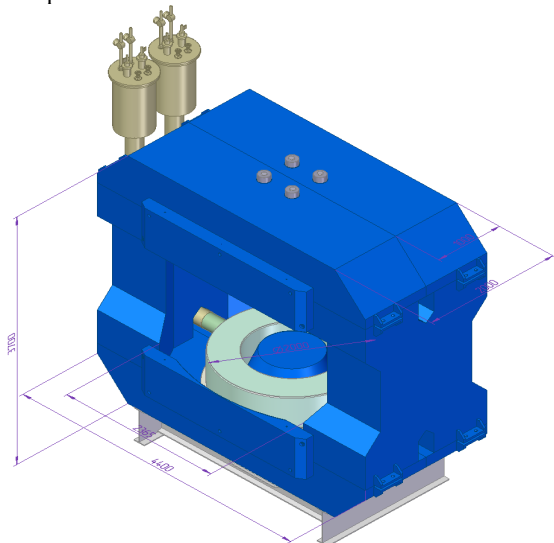


Fig.1: View of the CBM superconducting dipole magnet

The energy stored in the magnet is about 5 MJ. The magnet will be self-protecting. However, in order to limit the temperature rise to 100 K in case of a quench, the energy will be dumped in an external resistor. The parameters of the magnet are listed in table 1.

Table 1: Parameters of the magnet

Type	H-type, superconducting magnet
Number of turns	1749 turns/coil
Windings of coil	impregnated close coiling
Maximum current	686 A
Magnetomotive force	1.2 MA turns/coil
Current density	48 A/mm ²
Central field	1.08 T
Field integral at T m	1 Tm
Maximum field at coil	3.25 T
Inductance	396 – 150 H
Stored energy	5.15 MJ
Coil	
inner diameter	1.37 m (at 4 K)
outer diameter	1.82 m (at 4 K)
cross section	149.2 x 168 mm ² (at 4 K)
weight	1644 kg/coil
Pole	
shape	circular type
gap	1.4 m
diameter	2.0 m
height	0.5 m
Yoke	
width	4.4 m
depth	2.0 m
height	3,7 m
weight	250 tons

References

- [1] H. Sato et al., "Design of large-gap superconducting dipole magnet for SAMURAI spectrometer" RIKEN Accel. Prog. Rep. 43, 180 (2010).
- [2] H. Sato "Superconducting Dipole Magnet for SAMURAI" Proc of SAMURAI workshop 2011.

*Supported by the BMBF, JINR Dubna, and by EU/FP7 Hadronphysics3