SC dipole magnet for CBM

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The dipole magnet is an essential constituent of the planned CBM experiment [1]. The magnet should host the target, the Micro-Vertex Detector (MVD), and the Silicon Tracking System (STS). It is located in immediate proximity to the RICH detector, where the magnetic field should not exceed 250 Gs. A field integral of 1.0 - 1.1 Tm over a distance of about 1 m is required. The angular acceptance of the magnet should cover 50° in the vertical and 60° in the horizontal direction. The magnet gap must be large enough to permit installation and maintenance of the STS (not less than 1.3×1.3 m^2).

The engineering design of the dipole magnet is presented in Fig. 1. The magnet is supplied with a yoke of magnetically soft steel with low carbon content. The upper and bottom beams form the poles of the magnet. Magnetic shields, reducing the field in the RICH, are installed on the yoke.

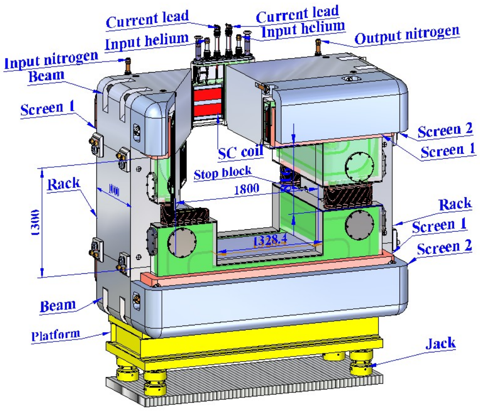

Figure 1: Superconducting dipole magnet

The superconducting (SC) coils have the "Cossack saddle" form, which allows to create a magnet with a minimal size along the beam. The coils are reeled up by a cable with a cross-section of 2×3 mm^2. The cable consists of eight SC wires of 0.5 mm diameter and ten copper wires of 0.75 mm diameter. It is insulated by polyamide film and fibreglass tape. The cross-section ratio of superconductor to copper is 1:6.5. The enhanced copper content in the SC cable allows to overheat the cable up to 35 K at evacuation of the energy stored in the magnet if the SC cable passes to a normal state.

The excitation coils are hosted in the cryostat (Fig. 2) composed of a helium vessel, a nitric screen and a vacuum casing. The helium vessel is fastened in the vacuum casing by supports of fibrous and plastic materials. It is cooled by liquid helium. The thermal flow through the supports (36 pieces) amounts to 3.8 W, the thermal losses through radiation to 0.22 W.

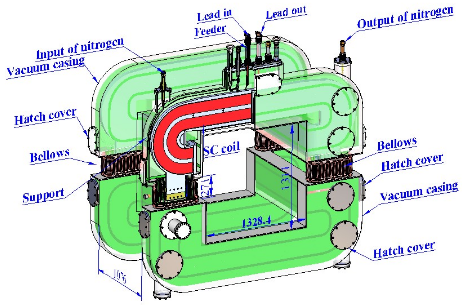

Figure 2: Cryostat of the excitation coils

The nitric screen is cooled down below 70 K. It is fixed on the support of the helium volume. The thermal losses by radiation are 35 W. Inspection plates and hatches of the vacuum casing provide access to the equipment inside. Pump-down of the casing is provided by oil-free vacuum pumps.

The upper cryostat is equipped by a feeder with two current leads (1.5 kA each) for in- and output of the excitation current. The feeder has ports for incoming and outgoing liquid and gaseous helium. The pipelines and the elements of communications going to the helium vessel create thermal losses at the level of 1.8 W [2, 3].

Calculation of the field by the computer codes RADIA and TOSCA showed that a current of 1.0 kA creates a field of 1.15 T. The field distribution along the z axis is presented in Fig. 3. The field does not exceed 250 Gs in the photodetector plane of the RICH [3, 4].

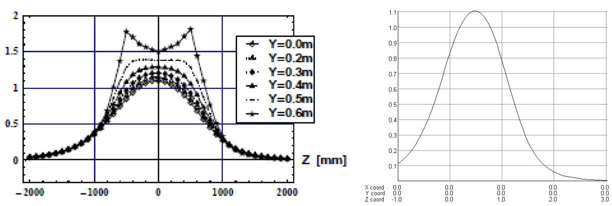

Figure 3: Left: $|B|$ along the beam axis calculated with RADIA. Right: B_y along the beam axis calculated with TOSCA.

References

[1] *CBM Experiment - Technical Status Report*, Darmstadt 2006

[2] E. Litvinenko, *Dipole magnet for CBM*, CBM collaboration meeting, October 2008, Dubna

[3] E. Matyuchevskiy, *Superconducting dipole magnet for CBM*, CBM collaboration meeting, October 2009, Split

[4] A. Malakhov, *CBM superconducting dipole magnet*, CBM collaboration meeting, April 2010, Darmstadt