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Operational experience with the combined solenoid/dipole magnet system of the COMPASS Experiment at CERN

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In 2015, the first ever polarized Drell-Yan experiment was performed at the COMPASS spectrometer at CERN. A 190 GeV/c pion beam with an intensity of 108 pions/s interacted with a transversely polarized NH3 target. The hydrogen nuclei in the solid-state NH3 are polarized by dynamic nuclear polarization (DNP) in a 2.5 T longitudinal magnetic field, while the target material is cooled down to below 100 mK. Transverse polarization is obtained by rotating the magnetic field and thus making use of the superposition of the magnetic fields generated by a solenoid as well as a dipole magnet, which are both superconducting and integrated in a common cryostat. The main solenoid coil comprises three sections and is complemented with 16 superconducting shim coils. It provides a 2.5 T magnetic field along the particle beam axis. The magnet has a large aperture, which is essential for the COMPASS spectrometer acceptance. The Solenoid has inner and outer radii of 340 mm and 361 mm, respectively. Over the volume of the target cells, the homogeneity is better than 10-4. Besides this homogeneous solenoidal magnetic field necessary for the DNP, in addition a saddle type dipole coil enclosing the solenoid is required, providing 0.63 T transverse magnetic field used in the frozen-spin mode to keep the polarization during data taking. It has inner and outer radii of 420 mm and 452 mm, respectively. The system is slightly over 2 m in length. One of the operational difficulties is the interaction between the main coil sections and the large forces that are involved. The stored energy of the system at nominal current, i.e. 650 A for the main solenoid – and 590 A for the dipole circuit, are 2.58 MJ and 0.468 MJ, respectively. The operational experience with this unique system and its controls will be presented.

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