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Mon-Af-Or5-05: Design of the BabyIAXO superconducting detector magnet system

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Searching for axion like particles is one of the top priorities in particle physics. Using helioscopes is a promising technology to detect solar axions. The conceptual design of the state-of-the-art facility, the International Axion Observatory (IAXO), has resulted in a 22 m-long / 660 MJ stored energy, toroidal magnet system comprising 8 racetrack coils. In order to ensure readiness of the technology required for IAXO, a smaller scale but fully functional 10 m-long twin bore demonstrator called BabyIAXO is prepared for construction in the early 2020s. Similar to IAXO, the two magnet bores have to point to the Sun and thus to rotate 360° horizontally and $\pm 25^\circ$ vertically. The 50 MJ detector magnet of BabyIAXO is based on a common-coil layout, comprising two flat racetrack coils of 10 m length spaced by 0.8 m. Using Al-stabilized Rutherford cable with 8 NbTi strands of 1.4 mm diameter, the system can operate at 9.8 kA nominal current with 2 K temperature margin, while producing 2.0 T in the center of detection bores and 3.2 T peak field. The magnet operates in persistent mode by using a thermally activated switch made of NbTi/CuNi matrix wire. The current leads are 'over-current' designed in order to reduce associated heat loads during short charging and long idle periods at full current. Uniquely, a group of two 1-stage GM and three 2-stage PT cryocoolers is used for precooling and maintaining 4.5 K in the coils. In addition, two cryocirculators are used to transfer efficiently the available cooling capacity to cold mass, thermal shield and current leads. While using completely 'dry'cooling conditions, this cryogenic setup ensures cooling down the 15 t cold mass in 18 days. The relevance of design, construction and operational experience gained with BabyIAXO for a fully fletched IAXO system is further discussed.

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