Thermal Design of the AMS-100 Cosmic Particle Detector at L2

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The next generation magnetic spectrometer in space, AMS-100, is designed to be operated for at least ten years at the Sun-Earth Lagrange Point 2 *[1]*. Compared to existing experiments like AMS-02 on the ISS, it will improve the sensitivity for the observation of new phenomena in cosmic rays by at least a factor of 1000.
The magnet design for AMS-100 is based on high temperature superconductor tapes, which allow the construction of lightweight solenoids to be operated in thermal equilibrium with the environment at a temperature of about 60 K. The magnet system consists of a central solenoid surrounded by a compensation coil to enable the attitude control within the vicinity of the solar magnetic field.

The main challenge for this kind of spacecraft concept is the thermal design. Similar to the James Webb Space Telescope, a large sunshield is used to shield the cryogenic magnets from direct sunlight. Furthermore, the location of the particle detector inside the central solenoid creates demanding thermal boundaries. This particle detector is operated at a temperature of about 200 K, which will be controlled by a two phase cooling system connected to a dedicated radiator.

Multiple iterations of the design using ESATAN-TMS have led to a thermal model, which fulfills the specifications and details will be shown in this presentation.

[1] S. Schael et al., https://doi.org/10.1016/j.nima.2019.162561