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Progress Towards the Thermal Management of the CBM Silicon Tracking System

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As the core tracking detector of the CBM experiment, the Silicon Tracking System (STS) located in the dipole magnet (1 Tm) aims to provide track reconstruction (efficiency ≈ 95%) & momentum determination (Δp/p ~ 2%) of charged particles from beam-target interactions (Au-Au at 10 MHz).

Due to the expected irradiation damage (NI dose - 1 x 10ˆ14 neq/cm²), the sensors will dissipate some power (~ 1mW/cm²) and have to be kept at or below -5℃ at all times by complete removal of the heat dissipated by the front-end and read-out electronics boards (~ 40kW). The heat must be removed to avoid thermal runaway and reverse annealing of the irradiated silicon sensors. To achieve this, the STS will be operated in a thermal insulation box and will use bi-phase CO2 cooling system for the electronics.

To efficiently utilise the available CO2 enthalpy:
a) thermal measurements between different thermal interfaces will be shown by using higher thermal conductivity interface materials to replace all the space that otherwise would be occupied by air.
b) operational parameters (e.g. CO2 mass flow, inlet pressure) for an optimised cooling plate design and corresponding Finite Element Analysis results will be presented.

Additionally, for detector operation while maintaining the needed thermal environment with the given space constraints for STS integration, a high-density thermally insulating feedthrough system for all services is needed. In this presentation, the assembly and thermal tests for HV-LV feedthrough panels will be shown.

This is part of an effort towards building a cooling demonstrator for two STS half-stations to show that the CBM-STS cooling concept is viable. The respective future plan for its completion followed by the initial construction R&D will be presented.

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