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Towards the Development of Cooling Demonstrator of the CBM Silicon Tracking System (STS)

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As the core detector of the CBM experiment, the Silicon Tracking System (STS) located in the dipole magnet provides track reconstruction & momentum determination of charged particles from beamtarget interactions.

Due to the expected irradiation damage (fluence - 10^{14} neq (1MeV)/cm²), the silicon microstrip sensors will dissipate < 6 mW/cm² at -10°C. Thus it is imperative to keep the sensors at or below -10°C at all times to avoid thermal runaway and reverse annealing by forced N₂ cooling. The corresponding electronics connected via microcables are placed outside detector acceptance and bi-phase CO₂ cooling will be used to remove ~ 40kW power dissipated.

To experimentally verify the aforementioned concepts under realistic mechanical constraints, a thermal demonstrator comprising upto 3 half-layers of STS is under development. This contribution will describe the recent R&D on several sub-components, such as CO₂ cooling plant and corresponding distribution system, optimised CO₂ heat exchanger plates, dummy silicon heaters and electronics board, thermal enclosure etc.

R&D on the feasibility of NOVEC mono-phase cooling as a backup for electronics cooling and using air nozzles for sensor cooling will also be mentioned. In addition, future plans on the demonstrator integration and design will be also presented.

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