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Silicon Sensor Air Cooling for the CBM-STS at FAIR

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As the core detector of the CBM experiment at the under-construction FAIR facility, the Silicon Tracking System (STS) located in the dipole magnet ($1T \cdot m$) provides track reconstruction ($> 95\%$) & momentum determination ($< 2\%$) of charged particles from the beam-target interactions (11 AGeV Au-Au).

Due to the expected non-ionising irradiation damage at the end-of-lifetime ($10^{14} n_{eq}(1MeV)/cm^2$), the innermost silicon microstrip sensors will dissipate up to $6mW/cm^2$ at $\sim -10^{\circ}C$. So, it is crucial to keep the silicon sensors at temperatures $\sim -10^{\circ}C$ at all times to avoid thermal runaway and reverse annealing by introducing minimal material budget in the detector acceptance. Therefore, cold gas (at $\sim -10^{\circ}C$) will be carried via thin carbon-fibre (CF) perforated tubes to directly cool the innermost silicon sensors.

The first part of this contribution will primarily touch upon the thermal aspects. This will include: [1] the CFD Analysis of the sensor cooling concept with a 'toy model', [2] manufacturing of the perforated CF-tubes and, [3] construction of the thermal dummy components (sensors modules and the CF support structure ladders) which will experimentally demonstrate the cooling concept.

The second part of this contribution will focus on the mechanical aspects. This will include: [1] the construction of a mechanical dummy ladder (sensors and CF support structure ladders), [2] its optical metrology, [3] the vibration study conducted at the University of Oxford under the AIDA-2020 project and, [4] the vibration study under gas-flow at GSI Darmstadt.

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