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CO2 cooling for HEP experiments

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The new generation silicon detectors in High Energy Physics (HEP) Experiments require more efficient cooling of the front-end electronics and the silicon sensors itself. To minimize reverse annealing, the silicon sensors must be cooled down to a temperature of about -5℃. Other important requirements of the new generation cooling systems are a low mass and a maintenance free operation of the hardware inside the detector.

Evaporative CO2 cooling systems are ideal for this purpose as they need smaller tubes than systems with Fluor Carbons. The heat transfer capability of evaporative CO2 is high and CO2 is radiation hard.

CO2 is used as cooling fluid for the LHCb-Velo and the AMS-Tracker cooling systems. A special method for the fluid circulation is developed at NIKHEF in order to get a very stable temperature of both detectors without any active components like valves or heaters inside the detector. This method is called 2-Phase Accumulator Controlled Loop (2PACL) and is a good candidate technology for the design of the future cooling systems for the Atlas and CMS upgrades.

In this paper the design and the test results of the LHCb-VELO CO2 cooling system are discussed and a comparison is made between the use of Fluor Carbons and CO2 in a typical HEP detector application

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