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Microfabricated silicon substrates for pixel detectors assembly and thermal management

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At CERN, the Detector Technologies (DT) group of the Experimental Physics (EP) department is actively investigating a number of innovative solutions for heat management and detector module assembly in HEP experiments. Among these, recent research carried out at EP-DT has focused on the development of microfluidic devices to cool silicon pixel detectors. In this respect, continuous advances in microengineering have opened the door to smaller and more efficient cooling devices capable of handling increasing power densities with a minimum mass penalty.
In 2014, the NA62 experiment has pioneered the use of a silicon microfluidic system with single-phase liquid C_6F_{14} for the thermal management of its GigaTracKer (GTK) pixel detectors. Following the NA62 success, LHCb became the first LHC experiment to adopt a similar solution. The future upgrade of the LHCb's Vertex Locator (VeLo) will combine multiple silicon plates with embedded microchannels with an evaporative CO_2 system to cool fifty-two pixel detector modules dissipating a total of about 2 kW.
This paper will present the implementation of this novel approach for the construction and thermal management of the NA62 GTK and LHCb VeLo pixel detectors. Future developments such as 3D-printed microfluidics and microchannels embedded into monolithic pixel detectors will also be discussed.

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