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Microfabrication Activities in the Engineering Office of the PH-DT Group at CERN

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Micro-technologies are being investigated within the Engineering Office of the Detector Technologies Group (PH-DT) in the CERN Physics Department. This effort aims at developing novel types of detectors and implementing alternative approaches to on-detector services benefitting from standard microfabrication techniques. Recently, a new type of scintillation detector based on microfluidics has been demonstrated. It is being considered as potential candidate for particle tracking and beam monitoring devices in High Energy Physics and medical applications. A similar microfluidic approach has been adopted to develop ultra-thin silicon on-detector active cooling systems. Such systems have been selected for the thermal management of the NA62 GigaTracKer pixel detectors and for the 2018 major upgrade of the LHCb VeLo vertex detector. They are also studied for the most inner layers of the ALICE ITS upgrade. A third application aims at studying the heat transfer of superfluid Helium II in a network of microchannels embedded in a glass substrate in view of an improved insulation for the LHC supraconducting magnets.

To meet the requirements of Particle Physics experiments, these devices need to be as thin and light as possible resulting in membranes of the order of 50 μm or less. The fracture mechanics of thin silicon layers is not well understood and it is currently being studied within the Engineering Office through experimental testing and Finite Element Analysis (FEA). In order to better understand the mechanics of such small silicon membranes, test devices are fabricated in the class 100 MEMS cleanroom at the EPFL Center of MicroNanoTechnology and they are characterized at CERN. The experimental results are then compared with the FEA analysis performed in ANSYS.

This paper will review the microsystems engineering efforts of the PH-DT group through the description of the projects and studies ongoing at CERN.

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