Towards ultra-high granularity calorimetry

Viatcheslav Borshchov[1], Constantin Loizides[2], Thomas Peitzmann*[3], Mateusz Ploskon[4], Dieter Röhrich[5], Marco van Leeuwen[6], and Nigel Watson[7]

[1]*Research and Production Enterprise "LTU" LLC, Kharkiv, Ukraine*
[2]*Oak Ridge National Laboratory, Oak Ridge, Tennessee, United States*
[3]*Institute for Subatomic Physics of Utrecht University, Utrecht, Netherlands*
[4]*Lawrence Berkeley National Laboratory, Berkeley, California, United States*
[5]*Department of Physics and Technology, University of Bergen, Bergen, Norway*
[6]*Nikhef, National Institute for Subatomic Physics, Amsterdam, Netherlands*
[7]*School of Physics and Astronomy, University of Birmingham, United Kingdom*

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Within the ALICE collaboration there is a proposal to develop and build a forward calorimeter, FoCal, including a SiW electromagnetic part with several layer of extremely high granularity [1]. In the context of the R&D for this calorimeter, and as part of the general R&D effort in the CALICE collaboration, a SiW calorimeter based on monolithic active pixel sensors with a pixel pitch of $\approx 30\,\mu$m is being developed. A first prototype with ≈ 40 million pixels has been constructed using MIMOSA sensors and has successfully been tested in beam [2], showing good energy linearity and resolution and extremely high position resolution and two-shower separation capabilities. This provided a proof of principle of digital pixel calorimetry only, because the MIMOSA sensors are too slow to use in a collider experiment.

Very recently we have constructed a second full pixel prototype using ALPIDE sensors, which have been developed at CERN for the ALICE ITS upgrade.

*Electronic address: t.peitzmann@uu.nl; Corresponding author

These sensors are fast enough to be used in the ALICE FoCal upgrade, and first tests show excellent calorimetric performance.

We intend to go further with this development to explore the possibilities of still faster sensors for calorimetric purposes that could be used in a standard modern collider experiment. This would be of interest for detectors at future hadron and electron-positron colliders, and also for EIC. Further development could be based on a next generation of the ALPIDE technology, but we will also explore what other pixel sensors could be suitable.

The detector concept in development for FoCal has been shown to have excellent performance for direct photon measurement, requiring in particular the separation of close-by em showers. The performance for other applications of the detector have not really been explored so far. In parallel to the technological R&D, we will study the possible performance of such a technology for jet measurements, in particular with suitably adapted particle flow algorithms. A very similar detector concept using the same technology is the basis for a development of a proton CT scanner for medical applications [3].

References

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