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Expected performances of the IDEA Dual-Readout fully projective fiber calorimeter

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Traditional energy measurements in hadron detection have always been spoiled by the non-compensation problem. Hadronic showers develop an electromagnetic component, from neutral mesons'decays, over-imposed on the non-electromagnetic one. As the calorimeter samples the two with different responses, fluctuations between them directly spoil the hadronic energy resolution. This sets an unsurmountable limit in hadronic and jet energy measurements in the current high-energy physics experiments. Future electron-positron colliders, proposed for the post-LHC era, all aim at measuring the Higgs boson couplings with an order-of-magnitude better precision than the LHC measurements. As a consequence, for a significant measurement of the Higgs boson couplings to the IVBs, it is mandatory to statistically separate the 4-jets final states from $H \to ZZ^*$ and $H \to WW^*$, where the only discriminant is the W/Z invariant mass.

A promising solution to the problem comes from dual-readout calorimetry. This calorimetric technique is capable of measuring the electromagnetic component on an event-by-event basis and correcting energy measurements for its fluctuations. The performance obtained with this method makes a dual-readout calorimeter especially suitable for high-precision experiments at future leptonic colliders. The IDEA detector proposed for the Circular electron positron Collider (CepC) and the Future Circular Collider (FCC-ee) currently adopts a dual-readout calorimeter for all the energy measurements.

First results with GEANT4 simulations of the IDEA dual-readout fully projective calorimeter will be presented. While electromagnetic performances show already a good agreement with test-beam data, results for hadrons are under investigation and indicate that a resolution of $\sigma/E \simeq 30\%/\sqrt{E}$ is reachable. Eventually, physics events concerning jets final states ($e^+e^- \to jj$) and the reconstruction of complex final states through the use of Machine Learning algorithms will be presented.

On the hardware side, a new silicon photomultiplier based readout has opened the possibility to sample light from each fiber independently. This feature, coupled with a fully projective calorimeter, leads to an unprecedented 2-dimensional spatial and angular resolution and, together with timing information, may provide sensible powerful input to particle-flow algorithms. First results concerning the calorimeter spatial and angular resolution and particle identification capabilities will be presented as well.

Primary author: PEZZOTTI, Lorenzo (Università di Pavia and INFN (IT))

Co-authors: FERRARI, Roberto (INFN Pavia (IT)); GAUDIO, Gabriella (INFN-Pavia)

Presenter: PEZZOTTI, Lorenzo (Università di Pavia and INFN (IT))

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