Contribution ID: **55**   Type: **Regular talk**

Using an Optical Processing Unit for tracking and calorimetry at the LHC

Thursday, 22 October 2020 11:00 (20 minutes)

Experiments at HL-LHC and beyond will have ever higher read-out rate. It is then essential to explore new hardware paradigms for large scale computations. In this work we consider the Optical Processing Units (OPU) from LightOn, which compute random matrix multiplications on large datasets in an analog, fast and economic way, fostering faster machine learning results on a dataset of reduced dimension. We consider two case studies.

1) "Event classification": high energy proton collision at the Large Hadron Collider have been simulated, each collision being recorded as an image representing the energy flux in the detector. The task is to train a classifier to separate a Susy signal from the background. The OPU allows fast end-to-end classification without building intermediate objects (like jets). This technique is presented, compared with more classical particle physics approaches.

2) "Tracking": high energy proton collisions at the LHC yield billions of records with typically 100,000 3D points corresponding to the trajectory of 10.000 particles. Using two datasets from previous tracking challenges, we investigate the OPU potential to solve similar or related problems in high-energy physics, in terms of dimensionality reduction, data representation, and preliminary results.

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Session Classification: Workshop

Track Classification: 6 ML infrastructure : Hardware and software for Machine Learning