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# (Single-layer) particle tracking with Timepix3 for radiation field characterization and interaction point reconstruction within MoEDAL during PbPb collisions in 2018

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**(Single-layer) particle tracking with Timepix3 for radiation field characterization and interaction point reconstruction within MoEDAL during PbPb collisions in 2018**
*The MoEDAL collaboration*

MoEDAL-MAPP [1,2] is an LHC experiment dedicated to search for physics beyond the standard model through detection of exotic particles, amongst others magnetic monopoles (MM) or highly electrically charged objects (HECOs). These are searched for by a background-free detection of the unique signature of a penetrating particle with large ionizing power, comparable to relativistic ions (β ˜ 1) of nuclear charge Z > 5. Towards the end of 2018, 2 Timepix3 [3] detectors with 500 µm thick silicon sensors were installed [4]. These were, at that time, the only active detectors. Their aim is to provide the measurement of radiation levels (as a measure of delivered luminosity) and –by analysis of observed traces left in the single layer device –the information of particle direction, particle arrival time (with precision of <2 ns) and particle dE/dX - permanently and temporally resolved.

In the present contribution, we extend previous methodology [5] for single-layer particle tracking with Timepix3 using random forest regression to improve the stability and accuracy of the impact angle and dE/dX assignment, required in particular for relativistic particles with high energy loss in the sensor. These algorithms have been evaluated by irradiation at different angles in an ion fragments beam created by 385 GeV/c Pb beam hitting a beryllium target at the SPS (CERN). By fitting a superposition of Landau curves to the measured dE/dX spectra, fragments up to nuclear charges of Z=4 and Z=9 could be resolved for perpendicular particle impact and particle impact at grazing angle, respectively (Figure 1).

These algorithms are then applied to data taken at a distance of ˜1.1 m from and with almost unobstructed view to IP8 during PbPb collisions in 2018. We will present a complex characterization of the radiation environment showing the radiation levels as a function of time, as well as the evolution of dE/dX spectra and particle directions with time during and outside of collision periods (Figure 2). We will derive methodology to determine the beam spot length from the particle directionality maps during collisions, finding the width of the interaction region to be Δ(IP)z = (12.88 ± 0.02) cm.

**References:**
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