Contribution ID: **2** Type: **Talk**

A High-Granularity Timing Detector for the Phase-II upgrade of the ATLAS Calorimeter system: detector concept, design, and readout

Wednesday 16 October 2019 09:30 (22 minutes)

The large increase of pile-up interactions is one of the main experimental challenges for the HL-LHC physics program. A powerful new way to mitigate the effects of pile-up is to use high-precision timing information to distinguish between collisions occurring close in space but well-separated in time. A High-Granularity Timing Detector, based on low-gain avalanche detector technology, is proposed for the ATLAS Phase-II upgrade. Covering the pseudo-rapidity region 2.4–4.0, this device will complement the ATLAS Inner Tracker (ITk) in this region. The time resolution per track targeted for a minimum-ionising particle will be 30 ps on average at the start of lifetime, increasing to 50 ps on average at the end of HL-LHC operation. This high-precision timing information will improve track-to-vertex association and object reconstruction in the forward region. In addition, the HGTD offers unique capabilities for the online and offline luminosity determination, an important requirement for precision physics measurements.

An overview of the requirements, specifications, design, and expected performance of the HGTD will be presented. Some key technical challenges will also be discussed, including the front-end electronics and subsequent readout chain.

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Session Classification: Timing detectors