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Optimization of light-by-light triggers from 2022 pilot lead-lead run in ATLAS

In addition to standard proton collisions, the ATLAS experiment also collects data from lead interactions. Among these data sets, ultra-peripheral collisions constitute a highly interesting class of events. They provide an opportunity to study rare processes that are impossible to measure in standard hadronic lead-lead collisions. In particular, light-by-light (LbyL) scattering is an example of such a process. Its final state consists of a low-energetic pair of photons with the absence of any other activity in the detector. This phenomenon was first predicted over 80 years ago, but was experimentally discovered only in 2017 at the LHC by the ATLAS experiment based on Run 2 lead-lead data. About 100 events of such a process were observed in the full Run 2 data set. Di-photon events also proved to be a powerful tool for new physics searches involving axion-like particles. A new large sample of lead-lead data is supposed to be collected in the fall of 2023 as part of Run 3 operations at the LHC. It will provide access to more exclusive events, including the LbyL process and its extensions towards new physics searches. Trigger preparations are an important aspect of each data-taking campaign. In particular, small rates of LbyL process in comparison with the huge activity in the detector from other processes imply the development of special triggering techniques. Exclusive pairs of electrons (e+e-) are used to assess trigger performance as they have a fairly similar detector signature as LbyL photons with the advantage of being copiously produced in ultra-peripheral collisions. In the poster, some ideas for the efficient triggering of events with low-pT electrons and photons will be discussed. The first approach involves studies with a dedicated set of triggers deployed in the lead-lead pilot run recorded in November 2022. The data set was reprocessed using dedicated relaxed settings for low-pT photons and electrons. In particular, the estimation of the trigger efficiency and rates of triggers based on the hardware-level selection (so-called level 1) from the pilot run will be discussed.

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