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Recent results on light-by-light scattering in Pb+Pb and hard processes in p+Pb and Pb+Pb collisions from the ATLAS Experiment at the LHC

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Relativistic heavy-ion collision events containing rare final states involving high transverse momentum objects provide in situ probe which allow characterization of the hot, dense QCD matter formed in these collisions. When compared with comparable yields in proton-lead and proton-proton collisions, hadronic jets and quarkonia (both for charm and bottom quarks) are observed to have significantly modified yields and fragmentation properties in lead-lead collisions. Details of these modifications carry information about the interaction of partons with the medium as well as the properties of the medium. By comparison, yields of photons and massive electroweak bosons in lead-lead and proton-lead collisions are found to be essentially unmodified compared to expectations, including isospin effects. With increasing integrated luminosities, these measurements can be used to measure nuclear parton distribution functions and other geometric aspects of the initial state. This talk will present the most recent results on quarkonia, jet, heavy flavor and electroweak boson production, measured in Pb+Pb and p+Pb collisions. The talk also covers the recent results on the observation of the light-by-light scattering process in lead-lead collisions at $\sqrt{s_{NN}} = 5.02$ TeV. The analysis is conducted using 1.73 nb^{-1} of data collected in November 2018 by the ATLAS experiment at the LHC. Light-by-light scattering event candidates are selected in events with two photons produced exclusively, with small diphoton transverse momentum and small acoplanarity. After applying all selection criteria, 59 candidate events are observed for a background expectation of 12 ± 3 events. An excess of events over the expected background is found with an observed significance of 8.2 standard deviations. The fiducial cross section is also measured and compared to the theoretical predictions.

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