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Probing the lead wave function with proton-nucleus and photon-nucleus collisions with CMS

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Mapping the wave functions of heavy nuclei (and protons) over a very wide range of x and Q^2 is a major goal of heavy ion physics. Not only is the average wave function of interest but the spectrum of fluctuations is important as a boundary condition for nuclear-nuclear collisions. CMS has measured transverse energy production from 5.02 TeV p-Pb collisions over 13 units of rapidity as a function of several different centrality estimators. These data show very strong auto-correlations between $dE_t/d\eta$ and the η range used to define centrality that are not well produced by current event generators. The collaboration has also studied ultra-peripheral proton-lead and lead-lead collisions. For ultra-peripheral pPb collisions CMS has measured the production of exclusive rho and upsilon mesons over a wide range of rapidity and transverse momenta. These data complement and extend earlier e-p measurements at HERA and LHC measurements on coherent vector meson photoproduction by ALICE and CMS. Finally the collaboration has recorded a significant sample of photonuclear di-jet events from ultra-peripheral PbPb collisions. These are sensitive to the gluon density in the nucleus at low x and moderate Q^2 .

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