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gamma-UPC: Automated generation of exclusive photon-photon processes in ultraperipheral proton and nuclear collisions

The automated generation of arbitrary exclusive final states produced via photon fusion in ultraperipheral high-energy collisions of protons and/or nuclei is implemented in the MadGraph5_aMC@NLO and HelacOnia Monte Carlo codes. Cross sections are calculated in the equivalent photon approximation using γ fluxes derived from electric dipole and charge form factors, and incorporating hadronic survival probabilities. Multiple examples of $\gamma\gamma$ cross sections computed with this setup, named gamma-UPC, are shown for proton-proton, proton-nucleus, and nucleus-nucleus ultraperipheral collisions (UPCs) at the Large Hadron Collider and Future Circular Collider. Total photon-fusion cross sections for the exclusive production of spin-0,2 resonances (quarkonium, ditauonium, and Higgs boson; as well as axions and gravitons), and for pairs of particles ($J/\psi J/\psi$, WW, ZZ, $Z\gamma$, $t\bar{t}$, HH) are presented. Differential cross sections for exclusive dileptons and light-by-light scattering are compared to LHC data. This development paves the way for the upcoming automatic event generation of any UPC final state with electroweak corrections at next-to-leading-order accuracy and beyond.

Authors: D'ENTERRIA, David (CERN); SHAO, Huasheng (Centre National de la Recherche Scientifique (FR))

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