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## Light and Heavy Meson Production in Small Collision Systems at the LHC

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Recent results from the LHC on oxygen–oxygen (O-O) and xenon–xenon (Xe-Xe) collisions open a new window for investigating the interplay of cold nuclear matter (CNM) and quark–gluon plasma (QGP) effects in small collision systems. Building upon recent theoretical work on particle production dynamics in heavy ion reactions, we present an updated study of light and heavy hadron modification relative to the proton-proton baseline in these systems for selected centralities. Our analysis combines perturbative QCD and hydrodynamic simulations to quantify initial-state effect, collisional energy loss, and medium-induced radiative corrections. We will present theoretical predictions at both midrapidity and forward rapidity that can be confronted with ALICE, ATLAS, CMS, and LHCb measurements. Through comparison to the available data, we will discuss the relative importance of CNM and QGP effects in O-O and Xe-Xe systems and the role of the heavy quark mass. Our analysis aims to clarify the onset of collective and deconfined behavior in small systems and to provide new insights into the transport properties of matter.

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