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Type: **Invited Presentation**

Heavy-flavour and quarkonium measurements from pp to AA collisions

Heavy quarks (i.e. charm and beauty), produced in the early stages of high-energy hadronic and nuclear collisions through hard-scattering processes, serve as exceptional probes for investigating Quantum Chromodynamics (QCD) in extreme conditions and for rigorous perturbative QCD (pQCD) tests. Their large masses ensure that the heavy-quark production at the early stage is calculable within pQCD, making them sensitive tools to explore the properties of the Quark-Gluon Plasma (QGP) formed in heavy-ion collisions, as well as cold nuclear matter effects in proton-nucleus (pA) and nucleus-nucleus (AA) collisions.

This invited talk will present a comprehensive overview of recent experimental results on heavy-flavour hadron production and quarkonium measurements across various collision systems, from pp to AA interactions. We will discuss key observables obtained from a wide range of experiments. The presentation will highlight how these measurements shed light on in-medium energy loss, dissociation mechanisms, regeneration, and modification of hadronization processes within the hot and dense medium. We will also explore the opportunities these data offer for refining our understanding of pQCD dynamics, cold nuclear matter effects and those QGP-like phenomena observed in high-multiplicity pp collisions. The discussion will emphasize the critical role of these probes in advancing our knowledge of the strong interaction and the fundamental properties of the QGP.

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