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Searching for echoes of criticality in OO collisions with ALICE

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Lattice QCD calculations predict the existence of a crossover between a deconfined, thermalised partonic phase and the hadronic phase under conditions of exact baryon–antibaryon symmetry. Fourth-order baryon-number susceptibilities show significant deviations from the hadron resonance gas across the crossover, carrying information on residual criticality associated with the chiral phase transition. Ratios of these susceptibilities correspond to baryon-number cumulant ratios, making them ideal observables to probe the nature of the phase transition at the LHC, where the baryon chemical potential is compatible with zero.

Recent results from the ALICE Collaboration in OO collisions suggest that phenomena typically associated with a deconfined phase, such as geometry-driven hydrodynamic flow, also emerge in light-ion interactions. This highlights the need for detailed measurements to characterise the system created in such collisions.

The first measurement of net-proton cumulant ratios up to the fourth order in OO collisions at $\sqrt{s_{NN}} = 5.36$ TeV is presented. These quantities, serving as proxies for net-baryon cumulants, provide new insight into a possible crossover in light-ion collisions. Comparisons of multiplicity-dependent results with pp collisions, where no phase transition is expected, and with models describing a non-critical baseline, enable a quantitative assessment of criticality in light-ion systems and the onset of the crossover at the LHC.

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