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Decoupling the collision energy when tracking quantum number balance in small systems at LHC Run 3 with ALICE

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Balance functions have been extensively used to elucidate the time evolution of quark production in heavy-ion collisions. Early models predicted two stages of quark production, one for light quarks and one for the heavier strange quark, separated by a period of isentropic expansion. This led to the notion of clocking particle production and tracking radial flow effects, which drive the expansion of the system. Recent successful light-ions runs at the LHC pave the way for decoupling the potential center of mass energy contribution to such clocking and tracking.

Balance functions of identified particles in different multiplicity classes of pp, O-O, and Ne-Ne collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV recorded by the ALICE experiment during LHC Run 3 are reported. The results track the balancing of electric charge, baryon number, and strangeness by measuring how the widths and integrals of the charge, baryon number, and strangeness balance functions evolve across multiplicity classes. The different collision systems focus on system size impact decoupling the center of mass energy influence. Results from pp and p-O collisions at $\sqrt{s_{\rm NN}} = 13.6$ TeV, and 9.62 TeV, respectively, will also be shown and will provide a glimpse of the energy impact in the smallest and intermediate system sizes. Presented models comparisons will allow to constrain particle production mechanisms as well as systems evolution dynamics.

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