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Constraining baryon annihilation in the hadronic phase of heavy-ion collisions via event-by-event fluctuations

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We point out that the variance of net-baryon distribution normalized by the Skellam distribution baseline, $\kappa_2[B-\bar{B}]/B+\bar{B}$, is sensitive to the possible modification of (anti)baryon yields due to $B\bar{B}$ annihilation in the hadronic phase. The corresponding measurements can thus place stringent limits on the magnitude of the $B\bar{B}$ annihilation and its inverse reaction. We perform Monte Carlo simulations of the hadronic phase in Pb-Pb collisions at the LHC via the recently developed subensemble sampler + UrQMD afterburner and show that the effect survives in net-proton fluctuations, which are directly accessible experimentally. The available experimental data of the ALICE Collaboration on net-proton fluctuations disfavors a notable suppression of (anti)baryon yields in $B\bar{B}$ annihilations predicted by the present version of UrQMD if only global baryon conservation is incorporated. On the other hand, the annihilations improve the data description when local baryon conservation is imposed. The two effects can be disentangled by measuring $\kappa_2[B+\bar{B}]/B+\bar{B}$, which at the LHC is notably suppressed by annihilations but virtually unaffected by baryon number conservation.

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