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Assessing lattice QCD charm space diffusion coefficient and thermalization time by mean of D meson observables at LHC

Thursday 2 October 2025 15:00 (20 minutes)

A key objective in heavy-flavour studies is to quantify the interaction between heavy quarks (HQs) and the quark-gluon plasma (QGP) via the spatial diffusion coefficient $D_s(T)$. Recent lattice QCD results with dynamical fermions suggest a notably low value of $2\pi TD_s \approx 1$ at T_c for charm quarks—much lower than quenched QCD and phenomenological models, which predict $2\pi TD_s \approx 3.5-5$. This raises questions about compatibility with experimental observables like R_{AA}, and flow coefficients v_2, v_3 for D mesons.
Using an event-by-event Langevin approach, we show that such low D_s values match experimental data only if the drag coefficient $A(p) = \tau_{th}^{-1}(p)$ has strong momentum dependence while a momentum-independent thermalization time fails to reproduce observed behavior. Moreover, a short $\tau_{th} \approx 1.5 fm/c$ reduces sensitivity to initial charm-quark momentum up to $p_T \approx M_c$, hinting at a universal dynamical attractor.

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