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Investigating U238 Deformation via Dilepton Production in Relativistic Heavy-Ion Collisions

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Due to their weak coupling to the strongly interacting matter produced in relativistic heavy-ion collisions, dileptons serve as a sensitive probe of the initial geometry of the colliding nuclei. In this study, we investigate the influence of initial nuclear quadrupole deformation, characterized by the parameter β2, on dilepton production in U+U collisions at √sNN = 193 GeV. The analysis is carried out using a modified multiphase transport model in which partonic interactions are described by the Nambu–Jona-Lasinio model. We observe a clear linear dependence of dilepton yields on β2 in both the low-mass region (LMR, < 1 GeV/c2) and intermediate-mass region (IMR, 1–3 GeV/c2) of the dilepton spectrum for the most central collisions. Also, dilepton production in the IMR region exhibits a stronger sensitivity to nuclear deformation than in the LMR, reflecting the dominance of earlier partonic processes in this mass range. These results suggest that precise measurements of dilepton yields in relativistic heavy-ion collisions can provide a viable means to determine the deformation parameter β2 of 238U.

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