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Fully heavy Tetraquark states and their production in High energy nuclear collisions

We study the properties of fully-heavy tetraquarks at finite temperature and their production in high-energy nuclear collisions. We obtain the masses and wave functions of the exotic hadron states $cc\bar{c}\bar{c}$ and $bb\bar{b}\bar{b}$ by solving the four-body Schr\"odinger equation in vacuum and strongly interacting matter. In vacuum, the tetraquarks are above the corresponding meson-meson mass threshold, and the newly observed exotic state $X(6900)$ might be a $cc\bar{c}\bar{c}$ state with quantum number $J^{PC} = 0^{++}$ or 1^{+-}. In hot medium, the temperature dependence of the tetraquark masses and the dissociation temperatures are calculated. Taking the wave function at finite temperature, we construct the Wigner function for the tetraquark states and calculate, with coalescence mechanism, the production yield and transverse momentum distribution of $cc\bar{c}\bar{c}$ in heavy-ion collisions at LHC energy. In comparison with nucleon-nucleon collisions, the yield per binary collision is significantly enhanced.

Primary author: ZHAO, Jiaxing (T)

Co-authors: Prof. ZHUANG, Pengfei (Tsinghua University); SHI, Shuzhe (McGill University)

Presenter: ZHAO, Jiaxing (T)