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Effects of partial restoration of chiral symmetry on particle production in heavy-ion collisions

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QCD predicts that with increasing baryon density the chiral symmetry gets gradually restored due to the disappearance of the scalar $\bar{q}q$ condensate. This should result in the appearance of the parity doublets in the spectrum of hadrons, like (π, σ), (ρ, a_1), $(N, N^*(1535))$ etc. In order to connect this prediction with observables one needs to properly modify relativistic mean fields used in many hadronic transport models which usually resort on Walecka-type descriptions. This talk is based on the paper [1] which represents one of the first such attempts. We apply the linear σ-model with $SU(2)_R \times SU(2)_L$ symmetry in the mirror assignment, that is called the parity-doublet model (PDM) C.E. DeTar, T. Kunihiro, 1989; D. Jido et al., 2001. We implement the PDM model in the Giessen Boltzmann-Uehling Uhlenbeck (GiBUU) transport model as an option in the calculation of relativistic mean fields. Within this chiral approach we study heavy-ion collisions at the beam energy of 1-2A GeV focusing on the production of η mesons. A strong dropping of the Dirac mass of the $N^*(1535)$ in the high-density stage of a collision leads to a considerable enhancement in the production of this resonance as compared to the non-linear Walecka model. As the system expands, the Dirac masses of these abundant soft $N^*(1535)$ resonances gradually increase and ultimately cross the $N\eta$ decay threshold. As a result, an enhanced low-energy η production is observed in the calculations with chiral mean fields. Comparing with TAPS data on η production we find that the chiral model improves the agreement for the m_t-spectra of η's at small m_t in heavy colliding systems. A similar enhancement is also observed in the soft ρ production resulting in slightly larger dilepton yields.

[1] A.B. Larionov, L. von Smekal, Phys. Rev. C 105, 034914 (2022)

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