The πρ cloud contribution to the ω width in nuclear matter

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Medium modifications of hadrons at finite temperature and density are key to the understanding of the phase structure of QCD matter. Dilepton measurements in heavy-ion collisions have established that the ρ meson undergoes a strong broadening that ultimately melts its resonance structure close to the QCD phase transition temperature, as predicted by many-body theory in hot/dense hadronic matter [1]. For the ω meson, indirect measurements of its absorptive width in photo-induced production experiments off nuclei also indicate a large broadening in nuclear matter, by about 150 MeV or so over its vacuum value of only ~8 MeV [2,3]. This large effect has been difficult to understand theoretically, especially when working to linear order in density using the so-called T-ρ approximation.

In the present work [4], we have evaluated the ω width in nuclear matter by calculating the modifications to its selfenergy due to in-medium decays into a pion and ρ-meson, schematically given by

$$\Pi_\omega = \int v_{\pi\rho\omega} D_\rho D_\pi v_{\pi\rho\omega} ,$$

where $v_{\pi\rho\omega}$ is the πρω vertex function. The key point here is the use of in-medium π and ρ propagators, $D_{\pi,\rho}$, taken from our previous work on in-medium ρ-mesons [5]. It turns out that the resulting ω width in nuclear matter reaches values of about 150-200 MeV at nuclear saturation density, see left panel of Fig. 1. These values, along with the 3-momentum dependence displayed in the right panel of Fig. 1, are in approximate agreement with the experimentally extracted values. The largest theoretical uncertainty is

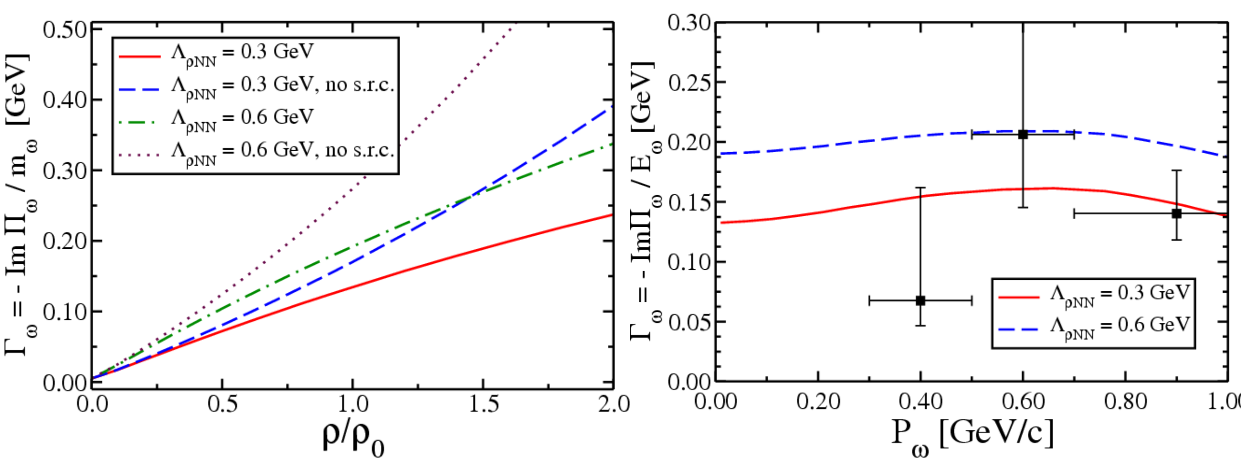

FIG. 1. The on-shell width of the ω(782) meson in cold nuclear matter as a function of nuclear density at vanishing 3-momentum (left), and as a function of 3-momentum at nuclear saturation density, ρ_0=0.16fm^{-3} (right). The various curves illustrate the uncertainty due to different parameters in the ρNN^{-1} selfenergy. The experimental data in the left panel are extracted from absorption measurements of w photoproduction off nuclei [2]

associated with the thus far not well constrained parameters of the ρNN interaction vertex, which correspond to t-channel ρ exchange processes in ωN → πN scattering. The resulting large ω width in nuclear matter based on existing in-medium π and ρ properties is encouraging and further corroborates the quantum-many body approach as a suitable tool to evaluate hadron properties in medium.

[1] R. Rapp, J. Wambach and H. van Hees, in *Relativistic Heavy-Ion Physis (R. Stock, ed.)*, Landolt-Börnstein (Springer), New Series, vol. **I/23A** (2010) 4-1; e-print arXiv:0901.3289 [hep-ph].

[2] M. Kotulla *et al.* [CBELSA/TAPS Collaboration], Phys. Rev. Lett. **100**, 192302 (2008).

[3] M.H. Wood *et al.* [CLAS Collaboration], Phys. Rev. Lett. **105**, 112301 (2010).

[4] D. Cabrera and R. Rapp, Phys. Lett. **B 729**, 67 (2014).

[5] R. Rapp and J. Wambach, Eur. Phys. J. A **6**, 415 (1999).