Chiral approach to the rho meson in nuclear matter

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In this work, the properties of the ρ meson at rest in cold symmetric nuclear matter are studied. We make use of a chiral unitary approach to pion-pion scattering in the vector-isovector channel, starting from the lowest order Chiral Perturbation Theory (χPT) lagrangian including explicit resonance fields. Low energy chiral constraints are considered by matching our expressions to those of one loop χPT, and unitarity is fulfilled exactly in the frame of the N/D method. To account for the medium corrections, the ρ couples to $\pi\pi$ pairs which are properly renormalized in the nuclear medium. The latter proceeds by dressing the pion propagator with a proper $P-$wave selfenergy driven by the excitation of $p-h$ and $\Delta-h$ components leading to a modified pion spectrum in the medium. The terms where the ρ couples to the hadrons in the $p-h$ or $\Delta-h$ excitations are also considered. These terms arise from direct ρBB and $\rho\pi BB$ vertices which generate a set of vertex corrections necessary to fulfill gauge invariance. In addition, the ρ is allowed to couple to baryonic resonances, particularly to the $S-$wave $N^*(1520)$, and this further contributes to the in-medium ρ spectrum via the excitation of N^*-h components. The main visible effect of the nuclear medium is an enhancement of the ρ width as well as a small shift of the peak to higher energies as the nuclear density increases. We observe that an important source of strength appears in the ρ spectral function at low energies from the direct coupling to the $N^*(1520)$ resonance.

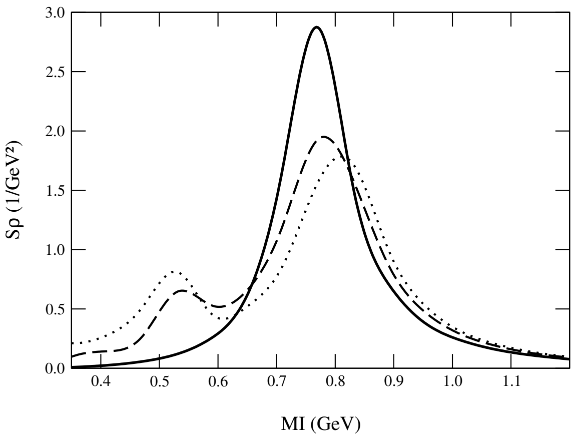

Figure 1: Spectral function of the ρ meson for several values of nuclear matter density. Lines are as follows: solid, dashed and dotted stand respectively for $\rho=0$, $\rho_0/2$ and ρ_0.

References

[1] D. Cabrera, E. Oset and M. J. Vicente Vacas, accepted for publication in Nuclear Physics [arXiv:nucl-th/0011037].