Phi meson mass and decay width in nuclear matter

D. Cabrera, E. Oset and M.J. Vicente Vacas

Departamento de Física Teórica and IFIC,
Centro Mixto Universidad de Valencia-CSIC,
Institutos de Investigación de Paterna, Apdo. correos 22085,
46071, Valencia, Spain

The ϕ meson spectrum, which in vacuum is dominated by its coupling to the $\bar{K}K$ system, is modified in nuclear matter. Following a $SU(3)$ gauge vector description, we calculate the ϕ meson selfenergy in nuclear matter considering the K and $\bar{K}$ in-medium properties. For the latter we use the results of previous calculations which account for $S-$ and $P-$wave kaon-nucleon interactions based on the lowest order meson-baryon chiral effective lagrangian, and this leads to a dressing of the kaon propagators in the medium. The $S-$wave kaon selfenergy is built from a selfconsistent coupled channel chiral unitary approach to the $\bar{K}N$ interaction, and it accounts for ϕ decay channels of the type $\phi \to KMYh$, the major contribution coming from $Y = \Sigma$, $M = \pi$. The $P-$wave kaon selfenergy is driven by the excitation of $\Lambda - h$, $\Sigma - h$ and $\Sigma^*(1385) - h$ components, and it is responsible for $\phi \to KYh$ decay channels which further modify the in-medium spectrum of the ϕ meson. In addition, a set of vertex corrections is evaluated to fulfill gauge invariance, which involves contact couplings of the ϕ meson to $S-$ and $P-$wave kaon-baryon vertices. Within this scheme the mass shift and decay width of the ϕ meson in nuclear matter are studied. We find an increase of the ϕ decay width of around one order of magnitude at normal nuclear density and a small mass shift to lower energies which stands below 1 % of the size of the ϕ mass in free space.

References

[1] E. Oset and A. Ramos, Nucl. Phys. A **679** (2001) 616 [arXiv:nucl-th/0005046].