Renormalization of the $f_0(980)$ and $a_0(980)$ scalar resonances in a nuclear medium

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The scalar resonances produced in the scattering of pseudoscalar mesons have been a permanent source of discussion.They are advocated as ordinary $q\bar{q}$ states, $q^2\bar{q}^2$ states, $K\bar{K}$ molecules, glueballs and/or hybrids. The properties of the resonances are modified in the presence of a dense medium. They get a selfenergy which changes the position of the peak, the decay width and in addition introduces new decay channels. The predictions for the modification of these properties are closely related to the hypothesis made on the nature of the resonance. On the other hand, the knowledge of the renormalization of the resonance properties is an essential tool in order to interpret correctly experiments where pairs of pseudoscalar mesons are produced in nuclei close to the energy regions where the resonances appear. This would be the case for the production of two pions which can lead to the ρ resonance in L=1 and isospin I=1, or the σ and the $f_0(980)$ in L=0 and I=0, or the production of $\pi\eta$ which can lead to the $a_0(980)$ resonance in L=0 and I=1.
In this talk, the meson meson interaction in the scalar sector in the presence of a nuclear medium is studied with particular attention to the change of the properties of the $f_0(980)$ and $a_0(980)$ resonances [1]. We use a chiral unitary approach which generates the f_0 and a_0 resonances and reproduces their free properties. The medium effects are incorporated by renormalizing the pion and kaon propagators with their medium selfenergies. This includes the use of modern $\bar{K}$ selfenergies, in which there has been a considerable progress in the last years [2-4].
Our results find that the position of the resonances in the medium is barely changed but their widths are considerably broadened. Several many body corrections generated from higher orders in the chiral Lagrangian plus the contribution from N*(1440)-hole excitations, not considered before in connection with the $\pi\pi$ interaction in the nuclear medium, are also investigated.

References

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