η nucleus optical potential in a chiral unitary approach

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The nuclear medium effects on the meson properties are interesting and have been investigated extensively. The recent discovery of the deeply bound state of π^- in Pb reveals an upward shift of the pion mass about 20 MeV, and confirms the repulsive S-wave interaction of the π^- in nuclear matter. The low energy magnitudes of the η-N interaction and the properties of η in the medium are still open questions. The η mesic nuclei are expected to provide such information and they are searched at several experimental facilities. We study the properties of η in the nuclear medium theoretically.

The self-energy of the η is given by the summation of the effective in-medium ηN interaction with the nucleons in the Fermi sea. We evaluate the interaction in a chiral unitary approach. The base model is developed in our previous paper [1], where the Bethe-Salpeter equation is considered with eight coupled channels including two $\pi\pi N$ states, and both the elastic and inelastic π-N scattering are reproduced successfully, even at the η-N threshold or $N^*(1535)$ region. We incorporate the Pauli blocking, the baryon binding potentials and the meson self-energies to this model. The self-consistent η self-energy is obtained by iterating the Bethe-Salpeter equation with η self energy obtained in the previous step. Fig 1 shows the obtained η self-energy for zero momentum. This

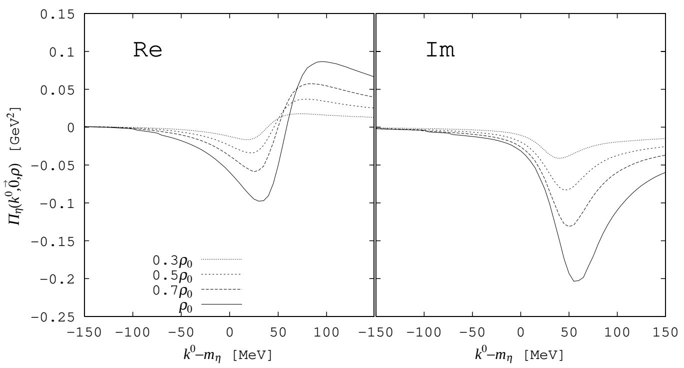

Figure 1: η self-energy for the zero momentum as a function of energy.

result is very different from one in a simple "$T\rho$" approximation. Both the Pauli blocking and the hadron dressing effects are important. The corresponding optical potential is $-54 - i29$ MeV for normal nuclear density. This potential supports bound η nuclear state albeit with a very large width. We will report on our formulation and results in detail at the conference.

References

[1] T. Inoue, E. Oset and M.J. Vicente Vacas, Phys. Rev. **C65**(2002)035204