Mass and width of the σ meson at finite density

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The mass and width of the σ meson are studied at finite baryonic density in the framework of a chiral unitary approach which successfully reproduces the meson meson phase shifts and generates the f_0 and σ resonances in vacuum.

There is mounting evidence showing the existence of a light scalar isoscalar meson.However, its nature as a genuine meson state or as a resonance dynamically generated in the $\pi\pi$ scattering is still under debate. A review of the current status of the discussion can be found in ref. [1]. In any case, it is such a broad resonance that its effects are hardly visible in phase shifts or decay plots. The situation could be quite different at finite densities and/or temperatures where the σ could become lighter and narrow [2,3]. Apart from the implications related to chiral symmetry restoration, this topic is of special interest due to the relevance of the $I = J = 0$ channel in the nucleon-nucleon interaction. Any substantial change of this meson properties could alter the in medium nucleon-nucleon interaction and therefore our current understanding of the nuclear matter in heavy ion collision, neutron stars or even in normal nuclei if the changes occur at low densities.

In this talk I will present our study of the σ mass and width at finite densities in the framework of a chiral unitary approach which successfully reproduces the meson meson phase shifts and generates the f_0 and σ resonances in vacuum [4]. This model, which provides a very successful description of a wide range of hadronic phenomenology, uses as input the lowest order Lagrangian of chiral perturbation theory [5] and calculates meson-meson scattering in a coupled channels unitary way. The σ meson is not a basic ingredient on this approach, it is dynamically generated and appears as a pole of the $\pi\pi$ scattering amplitude in the second Riemann sheet.

References

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