

Simultaneous Softening of σ and ρ Mesons associated with Chiral Restoration

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Complex poles of the unitarized π - π scattering amplitude in nuclear matter are studied [1]. Partial restoration of chiral symmetry is modeled by the decrease of in-medium pion decay constant f_π^* .

For large chiral restoration ($f_\pi^*/f_\pi \ll 1$), 2nd sheet poles in the scalar (σ) and the vector (ρ) mesons are both dictated by the Lambert W function and show universal softening as f_π^* decreases. In-medium π - π cross section receives substantial contribution from the soft mode and exhibits a large enhancement in low-energy region. Fate of this universality for small chiral restoration ($f_\pi^*/f_\pi \sim 1$) is discussed.

Implication of the results with the recent experimental observations on the medium modifications of ρ and σ is also discussed.

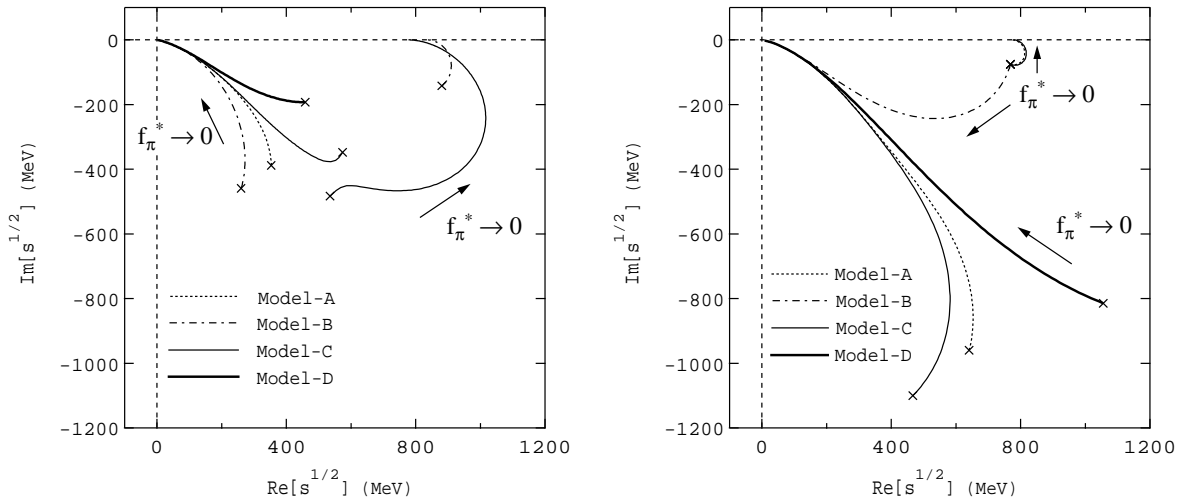


Figure 1: The shift of the pole position in the $I=J=0$ channel (left panel) and $I=J=1$ channel (right panel) associated with the decrease of f_π^* . Unitarization by the N/D method is applied for four chiral models (Model A: the ρ -model, Model B: the σ -model, Model C: the degenerate ρ - σ model [2], Model D: the leading order chiral perturbation). Two kinds of flows are found: one toward the origin (soft mode) and the other toward bare masses on the real axis. Crosses are the pole positions in the vacuum.

References

- [1] K. Yokokawa, T. Hatsuda, A. Hayashigaki and T. Kunihiro, hep-ph/0204163.
- [2] K. Igi and K. Hikasa, Phys. Rev. **D59**, 034005 (1999).