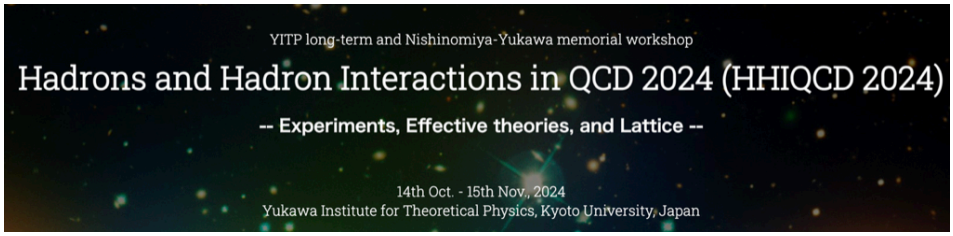

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Investigating the Σ potential in nuclear matter toward solving the hyperon puzzle of neutron stars

Thursday, October 31, 2024 3:00 PM (30 minutes)

The hyperon puzzle of neutron stars refers to the problem that most of the equations of state with hyperons are not sufficiently stiff to support the observed massive neutron stars. One promising solution to the puzzle is that the three-body forces between a hyperon and medium nucleons produces such strong repulsion that Λ's do not appear in neutron stars. The Λ single-particle potential [1] (Λ potential) in nuclear matter that fulfills the solution is calculated from chiral effective field theory with the three-body forces estimated via the decuplet saturation. To test the feasibility of the solution, the repulsive Λ potential at high densities should be verified by using experimental data. The consistency with the heavy-ion collision [2] and hypernuclear [3] data has been verified by one of the authors.

In this talk, we will discuss the Σ potential, which can be calculated based on the same interactions as the Λ potential. By using the low-energy constants that reproduce the empirical value of the Λ potential, the Σ potential at the saturation density is found to vary by several tens of MeV, ranging from repulsion to attraction. Interestingly, it turns out that the low-energy constants can be chosen in such a way that Λ's do not appear in neutron stars, and the empirical value of the Σ potential at the saturation density, 30 ± 20 MeV [4], is reproduced.

[1] D. Gerstung, N. Kaiser, and W. Weise, Eur. Phys. J. A **56** (2020) 175.
[2] Y. Nara, A. Jinno, K. Murase, and A. Ohnishi, Phys. Rev. C **106** (2022) 044902.
[3] A. Jinno, Y. Nara, K. Murase, and A. Ohnishi, Phys. Rev. C **108** (2023) 065803.
[4] A. Gal, E.V. Hungerford, and D.J. Millener, Rev. Mod. Phys. **88** (2016) 035004.

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