Contribution ID: **221** Type: **Oral talk (15 min + 5 min questions)**

Neutron star properties with density dependent baryonic interactions

Wednesday, 13 July 2022 17:30 (20 minutes)

Neutron stars (NS) are hydrostatically equilibrium stars, the matter of which consists mainly of neutrons and has a density of the order of the nuclear one. In NS a wide range of extreme states of matter is realized, therefore study of NS is important not only for astrophysics, but also for nuclear physics. Renewed interest in NS physics has been inspired by first registration of gravitational signal from the merger of two NS [1]. In recent years radii and masses of a number of NS were measured and NS with large masses were discovered.
Although in the simplest version the matter of NS consists of neutrons, protons, electrons, and muons, it is well known that at densities several times higher than the saturation density of nuclear matter, hyperons can arise. When the density increases, Λ-hyperons are supposed to be the first to appear, and we study NS consisting of nucleons, leptons, and Λ-hyperons. In this work we focus on the properties of ΛN-interaction, known from studies of hypernuclei, and their influence on the characteristics of NS.
In order to calculate the equation of state of NS matter we use the self-consistent Skyrme-Hartree-Fock (SHF) model - generally accepted method for describing baryonic systems [2,3]. Within this model there are two alternative ways to describe nonlinear effects: dependence on nucleon density (ρ^α) and three-body ΛNN force. These two options are equivalent in symmetric matter if α = 1 and work equally good for hypernuclei. However they are nonequivalent in NS matter and this choice can play a crucial role in calculation of NS characteristics [4]. The choice of α in the density dependence case also can affect these characteristics significantly.
In the present work we examine a number of sets of parameters of hyperon-nucleon and hyperon-hyperon potentials. We calculate different characteristics of NS such as mass, radius and tidal deformability and investigate their dependence on the properties of interactions.

The speaker is a student or young scientist

Yes

Section

1. Neutrino physics and nuclear astrophysics

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Session Classification: Neutrino physics and nuclear astrophysics