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EFT for rotating neutron stars with WIMPS and strong sigma(-) repulsion in the pc-GR theory

On the scope of the pseudo-complex General Relativity (pc-GR), we investigate the role of many-body correlations in the maximum mass of rotating neutron stars with degrees of freedom of hyperons and weakly interacting massive dark matter particles (WIMPs) in their composition. In the baryon sector, we consider the effective relativistic QHD-model with parameterized couplings, which represents an extended compilation of other effective models found in the literature. Our model exhausts the whole fundamental baryon octet and simulates corrections to the minimal Yukawa couplings by considering many-body nonlinear self-couplings and meson-meson interaction terms involving scalar-isoscalar, vector-isoscalar, and scalar-isovector components. Following recent experimental results, we consider in our calculations the extreme case where the Sigma(-) experiences such a strong repulsion that it does not appear at all in nuclear matter. The dark mater sector consists of Standard Model (SM) gauge singlet Dirac fermions originated in the Higgs portal of dark matter. In our approach, we decouple the physical Higgs from the dark Higgs. This assumption also decouples dark matter from ordinary matter and transforms the fermion singlet system to a non-interacting Fermi gas of WIMPs. There is a residual interaction of the fermion singlets with the dark Higgs. However, after symmetry breaking in the dark sector, the fermion singlets acquire a mass, which we shall treat as a free parameter. In the pc-GR, the field equations have an extra term, associated to the nature of spacetime, of repulsive character, which is believed to halt the gravitational attractive collapse of matter distributions in the evolution process of compact stars. This additional extra term arises from micro-scale phenomena due to vacuum fluctuations, which simulate the presence of dark energy in the Universe. In this contribution, we explore the presence of this additional term and study the role of dark energy in the structure of neutron stars composed by nucleons, hyperons, mesons, and dark matter held together by the presence of the nuclear and gravitational interactions superimposed to the repulsive background of dark energy. The corresponding version of the Tolman-Oppenheimer-Volkoff equations in the pc-GR formalism is solved and the mass-radius relations as well as the maximum mass of the star are determined for different parameter configurations. Star rotation is implemented via the Lorene Code.

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