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Fermion soliton stars

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Fermion soliton stars are a motivated model of exotic compact objects in which a nonlinear self-interacting real scalar field couples to a fermion via a Yukawa term, giving rise to an effective fermion mass that depends on the fluid properties. For the first time, we study this model within General Relativity without approximations, finding static and spherically symmetric solutions. If the scalar potential features asymmetric vacua, the mass and radius of a fermion soliton star are comparable to those of a neutron star for natural model parameters at the GeV scale. Moreover, the asymmetric scalar potential inside the star can provide either a positive or a negative effective cosmological constant in the interior, being thus reminiscent of gravastars or anti-de Sitter bubbles, respectively. Finally, we explore embedding in particle-physics contents, showing that if the fermion is strongly coupled to the scalar field, non-perturbative bound states describing false vacuum pockets are found. Possible connections with dark matter and cosmology are also briefly discussed.

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