

Axion contribution to the mass profiles of neutron stars

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Abstract

An effective Lagrangian for the interaction between a pseudo-scalar (axion-like) field and massive fermions is considered. At high density and non-zero temperature axions can be produced through bremsstrahlung. If the axion-neutron interaction is greater than a certain value we can have a mean free path smaller than the size of a neutron star. The influence of such trapped axions on the mass-radius function of the neutron star is investigated by solving numerically the Tolman-Oppenheimer-Volkoff equations. We show that causality limits the applicability of the trapping regime. We find specific ranges of central densities in a neutron star and temperatures for which axions give a conspicuous contribution to the neutron-star mass. For other densities and temperatures axions do not have a significant effect on the structure of a neutron star. Since we use an effective approach, our results can be easily applied to specific realistic axion models extending our toy model, if interactions due to additional Standard Model particles (e.g. neutrinos) are included.