ABSTRACT ONLY

THE LENGTH OF THE SLOW STABLE HYBRID STAR BRANCH AND ITS LINKAGE WITH NEUTRON STAR OBSERVATIONS

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The internal composition of neutron stars, one of the densest astronomical objects in the universe, is still unknown. Although in the last decade, with the onset of multi-messenger gravitational wave astronomy, several astrophysical observations placed strong constraints on these compact objects, there is still a lack of understanding of the dense matter equation of state. In this work, we model neutron stars as hybrid stars -composed of an inner core of quark matter and a mantle of hadronic matter-, considering an abrupt and slow first-order hadron-quark phase transition in their core. We model the hadronic phase with a piecewise polytropic fit, and the inner quark core through a Color Flavor Locked superconducting equation of state, with corrections due to the strong coupling constant, within the framework of the MIT Bag model. In the framework of this abrupt and slow scenario, it is possible to obtain an extended branch of stable stellar configurations. It has been shown that the appearance of such branches could resolve the existing tension between current astrophysical observations. We analyze the behavior of this extended stability branch by quantifying and systematically studying, for the first time, its length, relating this quantity to fundamental properties of the hybrid equation of state. This study allows not only a deeper understanding of the extended stability scenario with slow hadron-quark conversions but could help reveal the mystery of the composition of neutron stars and, consequently, clarify the uncertainty about the equation of state of dense matter.

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