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Probing hadron-quark phase transition in twin stars using f-modes

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There could be a deconfined quark phase at the ultra-high density core of the neutron stars. The nature of the deconfinement transition is a matter of debate. Whether it exhibits a jump in the thermodynamic variables or represents, a crossover is a question addressed in laboratory experiments and compact star observations. A suitable construction of the hybrid equations of state (EoS) can lead to the existence of twin stars, and their presence can be verified from astrophysical observations. We describe the neutron star matter by a hybrid EoS model mimicking the pasta phase in the mixed phase arising due to consideration of surface tension effects. We then use the hybrid EoS to investigate the properties of the twin stars' fundamental oscillation mode (f-mode). We demonstrated the asteroseismology problem and its difficulty involving f-mode and twin stars. Our investigations suggest that the detection of gravitational waves emanating from the f-modes with the third-generation gravitational wave detectors offers a promising scenario for confirming the existence of the twin stars. We also estimate the various uncertainties associated with the determination of the mode parameters and conclude that these uncertainties make the situation more challenging to identify the nature of the hadron-quark phase transition.

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