Energy release from hadron-quark phase-transition in neutron stars

W. Lin,[1] B.A. Li,[1] J. Xu, C.M. Ko, and D.H. Wen[2]

[1]*Department of Physics and Astronomy, Texas A&M University-Commerce, Commerce, Texas*

[2]*Department of Physics, South China University of Technology, Guangzhou 510641, China*

Using an isospin- and momentum-dependent effective interaction for the baryon octet and the MIT bag model to describe, respectively, the hadronic and quark phases of neutron stars [1], we have investigated the maximum available energy for gravitational wave emission owing to the microcollapse triggered by the hadron-quark phase transition in neutron stars [2]. Moreover, the frequency and damping time of the first axial w mode of gravitational waves have been studied for both hadronic and hybrid neutron stars. Since the most uncertain part of the equation of state of a neutron star is the density dependence of the nuclear symmetry energy in the neutron-rich nucleonic matter and the bag constant in the quark matter within the MIT bag model, we have studied their effects on the energy release as well as the frequency and damping time of the first axial w mode of gravitational waves from neutron stars. We have found that the energy release is much more sensitive to the bag constant than to the density dependence of the nuclear symmetry energy. Also, the frequency of the w mode has been found to be significantly different with or without the hadron-quark phase transition and to depend strongly on the bag constant. Moreover, the effects of the symmetry energy and bag constant on the damping time have been found to be appreciable but not as strong as those on the frequency. We have further found that the effect of the symmetry energy on the frequency becomes stronger with a larger value of the bag constant that leads to a higher hadron-quark transition density. While the predicted frequency of the w mode is significantly above the bands of operating frequencies of the existing gravitational wave detectors, our results have indicated that the frequency of the w mode can indeed carry important information about the internal structure of neutron stars and the properties of dense neutron-rich matter.

[1] J. Xu, L.W.Chen, C.M. Ko, and B.A. Li, Phys. Rev. C **81**, 055803 (2010).

[2] W. Lin, B.A. Li, J. Xu, C.M. Ko, and D.H. Wen, Phys. Rev. C **83**, 045802 (2011)