Constraining nuclear matter parameters with GW170817

Zack Carson,[1] Andrew W. Steiner,[2,3] and Kent Yagi[1]

[1] *Department of Physics, University of Virginia, Charlottesville, Virginia 22904, USA*

[2] *Department of Physics and Astronomy, University of Tennessee, Knoxville, TN 37996, USA*

[3] *Physics Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA*

The tidal measurement of gravitational waves from the binary neutron star merger event GW170817 allows us to probe nuclear physics that suffers less from astrophysical systematics compared to neutron star radius measurements with electromagnetic wave observations. A recent work [1] found strong correlation among neutron-star tidal deformabilities and certain combinations of nuclear parameters associated with the equation of state. These relations were then used to derive bounds on such parameters from GW170817 assuming that the relations and neutron star masses are known exactly. Here, we expand on this important work by taking into account several new considerations [2]: (1) a broader class of equations of state; (2) correlations with the mass-weighted tidal deformability that was directly measured with GW170817; (3) how the relations depend on the binary mass ratio; (4) the uncertainty from equation of state variation in the correlation relations; (5) adopting the updated posterior distribution of the tidal deformability measurement from GW170817 [3]. Upon these new considerations, we find GW170817 90% confidence intervals on nuclear parameters (the incompressibility K_0, its slope M_0 and the curvature of symmetry energy $K_{\rm sym,0}$ at nuclear saturation density) which are more conservative than previously found with systematic errors more properly taken into account.

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[3] B. P. Abbott *et al.* (LIGO Scientific, Virgo), Phys. Rev. **X9**, 011001 (2019), arXiv:1805.11579 [gr-qc].