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The impact of the crust equation of state on the analysis of GW170817

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The detection of GW170817, the first neutron star-neutron star merger observed by advanced LIGO and Virgo, and its following analyses represent the first contributions of gravitational wave data to understanding dense matter. Imposing a lower limit on the maximum mass value and parametrizing the high density section of the equation of state of both neutron stars through spectral decomposition led to an estimate of the stars' radii of $R_1 = 11.9^{+1.4}_{-1.4}$ km and $R_2 = 11.9^{+1.4}_{-1.4}$ km. These values do not, however, take into account the uncertainty owed to the arbitrary choice of the crust low-density equation of state, which was fixed to reproduce the SLy equation of state model. We here re-analyze GW170817 data and establish that different crust models do not strongly impact the mass or tidal deformability of a neutron star, making it impossible to distinguish between low density models through GW analysis. However, the crust does have an effect on radius. We predict the systematic error due to this effect using neutron star structure equations, and compare the prediction to results from full parameter estimation runs. For GW170817, this systematic error affects the radius estimate by 0.3 km, approximately 3% of the neutron stars' radii.

Summary

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