The tidal deformability of an anisotropic compact star: Implications for GW170817

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We use gravitational wave (GW) [1–3] and electromagnetic (EM) [4] observations of GW170817 to constrain the extent of pressure anisotropy in it. While it is quite likely that the pressure inside a neutron star is mostly isotropic, certain physical processes or characteristics, such as phase transitions [5, 6] in nuclear matter or the presence of strong magnetic fields [7, 8], can introduce pressure anisotropy. In this work [13], we show that anisotropic pressure in neutron stars can reduce their tidal deformability [9] substantially. For the anisotropy-pressure model of Bowers and Liang [10] and a couple of relativistic EOSs – DDHδ [11] and GM1 [12] – we demonstrate that this reduction in spherical neutron stars with masses in the range of 1 to 2 $M_{\odot}$ can be 23% to 46%. This suggests that certain EOSs that are ruled out by GW170817 observations, under assumptions of pressure isotropy, can become viable if the stars had a significant enough anisotropic pressure component, but do not violate causality. We also show [13] how the inference of the star radius can be used to rule out certain EOSs (such as GM1) for high enough anisotropic pressure because their radii are larger than what the observations find.

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