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Spectral analysis of the quiescent low-mass X-ray binary in the globular cluster M30

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We present a recent Chandra observation of the quiescent low-mass X-ray binary containing a neutron star, located in the globular cluster M30. We fit the thermal emission from the neutron star to extract its mass and radius. We find no evidence of flux variability between the two observations taken in 2001 and 2017, so we analyze them together to increase the signal to noise. We perform simultaneous spectral fits using standard light-element composition atmosphere models (hydrogen or helium), including absorption by the interstellar medium, correction for pile-up of X-ray photons on the detector, and a power-law for count excesses at high photon energy. Using a Markov-chain Monte Carlo approach, we extract mass and radius credible intervals for both chemical compositions of the atmosphere: $R_{\rm NS} = 7.94^{+0.76}_{-1.21}$ km and $M_{\rm NS} = 0.79^{+0.40}_{-0.28}$ $\rm M_\odot$ assuming pure hydrogen, and $R_{\rm NS} = 10.50^{+2.88}_{-2.03}$ km and $M_{\rm NS} = 1.07^{+0.71}_{-0.51}$ $\rm M_\odot$ for helium, where the uncertainties represent the 90% credible regions. The small radii are difficult to reconcile with most current nuclear physics models (especially for nucleonic equations of state) and with other measurements of neutron star radii, with recent preferred values generally in the 11-14 km range. We discuss possible sources of systematic uncertainty that may result in an underestimation of the radius, identifying the presence of surface temperature inhomogeneities as the most relevant bias.

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