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Massive, magnetized neutron stars as mass gap objects

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Neutron stars (NSs) can have core densities several times that of the nuclear saturation density. One of the open questions in NS physics is the unknown high-density nuclear matter equation of state (EOS). By considering a number of proposed, phenomenological relativistic mean-field EOSs, we construct theoretical models of NSs. Based on our selected models, we find that the emergence of exotic matter at these high densities restricts the masses of NSs to $\simeq 2.2 M_{\odot}$. However, on introducing a magnetic field to the star, along with a model anisotropy, we find that the star's mass increases significantly, placing it within the observational mass gap that separates the heaviest NSs from the lightest black holes. We propose that gravitational wave observations, like GW190814, and other potential candidates within this mass gap, may actually represent massive, magnetized NSs.

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