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What is the nature of the HESS J1731-347 compact object?

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Once further confirmed in future analyses, the radius and mass measurement of HESS J1731-347 with $M = 0.77^{+0.20}_{-0.17}\ M_\odot$ and $R = 10.4^{+0.86}_{-0.78}$ km will be among the lightest and smallest compact object ever detected. This raises a lot of questions about its nature and opens up the window for different theories to explain the measurements. We use the latest data on the mass, radius, and surface temperature together with the multi-messenger observations of neutron stars to investigate the possibility that HESS J1731-347 is the lightest observed neutron star, a strange star, a hybrid star with an early deconfinement phase transition, or a dark matter admixed compact star. The nucleonic and quark matter models are modeled within the most up-to-date realistic EoSs with a self-consistent calculation of the pairing gaps in quark matter.

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