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New observational constraints on Bose-Einstein condansate stars

We evaluate the feasibility of Bose-Einstein condensate stars (BECS) as models for the interior of neutron stars (NSs). BECS are compact objects composed of bosons, formed through the spin-parallel pairing of neutrons. Here, we utilize the astronomical data from GW170817, XMMU J173203.3-344518 (the lightest NS known), and a novel lower limit on NS core heat capacity to scrutinize the compatibility of BECS with these recent observations of NSs. Our specific focus is to constrain the values of the scattering length a, parameter determining the strength of particle interactions in the model. Our analysis suggests that if the stars involved in GW170817 were BECSs, the scattering length of their constituent bosons should fall within the 4 to 10 fm range. Additionally, at a scattering length of a~3.1–4 fm, stars with mass and radius characteristics akin to XMMU J173203.3-344518 are identified. Moreover, we find that the heat capacity depends on the mass and temperature of BECS, and surpasses the established lower bound for NS cores when a>2–5 fm. In summary, our results endorse BECS models with a~4 fm, providing NS observables in agreement with diverse observations and contributing to the understanding of NS interiors.

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