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Can very compact and very massive neutron stars both exist?

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The existence of neutron stars with masses of 2 solar masses requires a stiff equation of state at high densities. On the other hand, the necessary appearance also at high densities of new degrees of freedom, such as hyperons and ? resonances, can lead to a strong softening of the equation of state with resulting maximum masses of 1.5 solar masses and radii smaller than 10 km. Hints for the existence of compact stellar objects with very small radii have been found in recent statistical analysis of quiescent low-mass X-ray binaries in globular clusters. We propose an interpretation of these two apparently contradicting measurements, large masses and small radii, in terms of two separate families of compact stars: hadronic stars, whose equation of state is soft, can be very compact, while quark stars, whose equation of state is stiff, can be very massive. In this respect an early appearance of ? resonances is crucial to guarantee the stability of the branch of hadronic stars. Our proposal could be tested by measurements of radii with an error of 1 km, which is within reach of the planned LOFT satellite, and it would be further strengthened by the discovery of compact stars heavier than 2 solar masses.

Reference: A.D., A.Lavagno and G.Pagliara Phys.Rev. D89 (2014) 043014

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