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Impact of nuclear equation of states on the maximum mass of differentially rotating neutron stars

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One of the key factors influencing the structure and evolution of neutron stars is differential rotation. It plays a crucial role in understanding the behavior of matter in extreme conditions and affects observable properties like gravitational wave signals from Core-collapse supernovae or binary merger events. However, a major uncertainty exists surrounding the equation of state (EoS) used for modeling these astrophysical sources. Despite ongoing debates and controversies regarding the correct form of the EoS, much of the existing work have focused on polytropic models, which provide a simplified framework for exploring the stellar properties. In this study, we extend these efforts by investigating the solution space for nuclear EoS models, which serves as a better alternative for the underlying nuclear physics. We show that, despite the complexities introduced by the EoS, the solution space exhibits all four types of equillibrium solutions predicted by polytropic models, allowing for the determination of maximum possible mass. Our results provide a maximum mass limit which is 2-3 times higher than the maximum mass of non-rotating configurations depending on the stiffness of the EoS considered.

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