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Different modern methods for constructing equilibrium models of uniformly rotating compact stars

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In recent years we have collected essential information on the integral parameters of neutron stars from multi-messenger observations of binary neutron-star mergers. In the light of these observations, we investigate the effects of rapid rotation on the structure and observable parameters of rapidly rotating relativistic compact stellar models based on the angular velocity and on the equations of state. We construct uniformly rotating stellar solutions to quartic order in the angular velocity in a Hartle–Thorne slow-rotation expansion, while for rapidly rotating stars, we solve the coupled system of non-linear elliptic PDEs that are associated with the Einstein field equations by implementing multi-domain spectral methods in the LORENE/rotstar codes. The multipole moments are extracted from the numerical stellar solutions are compared with the quartic-order slow-rotation approximation in the low spin-frequency regime.

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