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The Equation of State of Neutron Stars

Self gravitating objects such as neutron stars are restricted to a maximum mass because of general relativity. Finding the equation of state of neutron stars would determine the maximum mass of a self gravitating object and allow the behavior of matter at densities higher than nuclear density to be studied. To find the maximum allowable mass of a self gravitating object, the Tolman-Oppenheimer-Volkoï¬€ (TOV) equation with corrections for general relativity coupled with the mass equation of a sphere with variable density was numerically dependent variables were the central pressure and the mass of the star. The values of the parameters of the TOV equation, determined by observation, were allowed to assume a range of values and therefore the solutions of the TOV equation yielded a range of candidates for equations of state for neutron stars. Each candidate yielded its own maximum mass. The most massive observed neutron star is PSRJ1614-2230 with a mass of 1.97 +- 0.04 M s. Any candidate which yielded a maximum mass lower than this was discarded as unphysical for the equation of state. The remaining candidates formed a range of physically acceptable equations of state for neutron stars.