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Modeling Neutron Star Stability with a Modified Tolman-Oppenheimer-Volkoff Equation JAMES O'BRIEN, SPASEN CHAYKOV, Wentworth Institute of Technology — The Tolman-Oppenheimer-Volkoff (TOV) equation represents the solution to the Einstein field equations where the source of curvature is given by the stress-energy tensor of a perfect fluid. In flat space it has the form $T_{\mu\nu} = (\rho + p)U_\mu U_\nu + p\eta_{\mu\nu}$ and the convention for curved space-time is to just replace the Minkowski metric with $g_{\mu\nu}$. For our research we instead use a modified stress-energy tensor of the form $T_{\mu\nu} = (\rho + p)U_\mu U_\nu + pg_{\mu\nu} + \pi_{\mu\nu}$ where the anisotropic $\pi_{\mu\nu}$ is a symmetric, traceless rank two tensor which obeys $U^\mu \pi_{\mu\nu} = 0$. The motivation is that such a term in the stress-energy tensor can account for effects due to the curvature of space-time and would not be present in the tensor describing flat space.The final revised TOV equation is of the form $-r^2 p' = GM\rho[1 + \frac{p-2q}{\rho}][1 + \frac{4\pi r^3(p-2q)}{M}][1 - \frac{2GM}{r}]^{-1} - 2r^2 q' - 6rq$ where the primes indicate differentiation with respect to the radial coordinate and the q terms arise from the components of $\pi_{\mu\nu}$. The equation was then solved numerically with both a polytropic and a MIT bag model equations of state. The result is a changed prediction for the stability range of neutron stars.

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