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The Quark-Hadron Phase Transition in Neutron Stars and Protoneutron Stars JACOB ROARK, Kent State Univ - Kent — Neutron stars have masses between 1.4 and 3 $M_{\odot}$, all packed into a sphere just 12 to 13 km across. Consequently, neutron stars exhibit some the of highest material densities in the universe, averaging around $7{\times}10^{17}$ kg/m^3, over three times the density of an atomic nucleus. Under such astronomical pressures, some very interesting, novel states of matter can be achieved, such as quark matter. In this project, the quark-hadron phase transition was studied in the constext of neutron stars and protoneutron stars, along with the possibility of a mixture of phases. An effective model based on the spontaneous breaking of chiral symmetry was employed to achieve this data, along with a mean field approximation. In each case, the point at which phase transitions no longer occur (the critical point) was found, characterized by temperature and baryon chemical potential. For neutron stars, the critical point was found to occur at T=168.82 MeV and μ_B=230.05 MeV and at T=168.86 MeV and μ_B=226.50 MeV when allowing for a mixture of phases. For protoneutron stars, the critical point was found to occur at T=168.82 MeV and μ_B=247.25 MeV and at T=168.00 MeV and μ_B=315.50 MeV when allowing for a mixture of phases.

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