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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 (roughly the size of Manhattan). 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 which hadrons effectively dissolve and quark deconfinement occurs. In this project, the quark-hadron phase transition was studied in the context of neutron stars and protoneutron stars (in which lepton fraction must be conserved). The possibility of a mixture of phases was also considered in each case. 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. This data was then compared to results from previous studies and limits provided by QCD.

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