Abstract Submitted
for the HAW14 Meeting of
The American Physical Society

Charged-current reactions in the supernova neutrino-sphere[1]
JEREMY HOLT, ERMAL RRAPAJ, Univ of Washington, ALEXANDER BARTL, Technical University of Darmstadt, SANJAY REDDY, Institute for Nuclear Theory, ACHIM SCHWENK, Technical University of Darmstadt — We compute neutrino absorption rates due to charged-current reactions $\nu_e + n \to e^- + p$ and $\bar{\nu}_e + p \to e^+ + n$ in the outer regions of a newly born neutron star called the neutrino-sphere. Using realistic nucleon-nucleon potentials that fit measured scattering phase shifts, we calculate the momentum-, density- and temperature-dependent nucleon self-energies in the Hartree-Fock approximation, which leads to an enhancement of the ν_e cross-section and a suppression of the $\bar{\nu}_e$ cross section. A potential based on chiral effective field theory and a pseudo-potential constructed to reproduce nucleon-nucleon phase shifts are employed. The effect of Hartree-Fock corrections to the nucleon self-energies on the equilibrium proton/electron fraction, and on the charged current rates is studied in detail. We find that for typical ambient conditions in the neutrino-sphere ($T = 5 - 10$ MeV and $\rho = 10^{11} - 10^{13}$ g/cm^3) the difference between the ν_e and $\bar{\nu}_e$ absorption rates are not as large as in previous calculations. Our results have implications for heavy element nucleosynthesis in supernovae and supernova neutrino detection.

[1]US DOE Grant No. DE-FG02-97ER41014

Jeremy Holt
Univ of Washington

Date submitted: 25 Jun 2014 Electronic form version 1.4