Abstract Submitted
for the APR11 Meeting of
The American Physical Society

How perfect is a neutron fluid?[1] DAN FU, ARAM MEKJIAN, Rutgers University — A perfect fluid has the lowest shear viscosity allowed by the uncertainty principle which also involves a study of the entropy density. Kinetic theory based on the Chapman-Enskog approach is used to obtain both the classical and quantum values of the viscosity of a neutron fluid. The interaction potential used in the study is an attractive square well with an inner hard core. The classical scattering angle and the phase shifts are calculated for this potential. The entropy density is based on the Sakur-Tetrode law plus corrections coming from two particle interactions obtained from a Beth-Ulhenbeck expression. Using these results for the viscosity and entropy density, the perfect fluid aspects of a neutron fluid are addressed. The viscosity to number density is also proportional to Planck's constant. The proportionality constant, called alpha, is found to be of the order of 1 in a quantum description of a neutron fluid. The value of the viscosity for a neutron fluid is near its unitary limit. For air at STP alpha is 7500, for water alpha is 300. The results for neutron matter suggest a near perfect fluid behavior.

[1]Supported by DOE-Grant DE-FG02Er-40987

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Date submitted: 13 Jan 2011 Electronic form version 1.4