Skyrme energy functional and neutron star matter

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The effective density-dependent Skyrme interaction has been frequently used in non-relativistic mean field theories for decades. Currently there are close to two hundred parameterizations of the Skyrme interaction, based on different emphasis and selection of experimental data, as well as on modifications of the original Skyrme functional. Each of these parameterizations yields a different Equation of State (EoS) for dense matter leading to different predictions of neutron star properties. It is obviously desirable to limit the number of the Skyrme parameter sets as much as possible and provide a recommended set(s) which would yield not only more reliable predictions of compact star properties but also be ready for use in modeling finite nuclei. Widely differing observations, both from nuclear physics and astrophysics, provide significant constraints on the EoS. In this talk known constraints on properties of symmetric, beta-equilibrium and pure neutron matter will be critically discussed and results of their consistent application to 195 different Skyrme parameterizations given [1]. These findings will be compared with predictions of relativistic mean field models and of modern realistic potentials, including the new quark-model-based Oxford potential [2]. Finally, some predictions of 'pasta' phase in neutron stars and core-collapse supernova matter, based on Skyrme interactions, will be presented.

[1] M. Dutra, O. Lourenco, J.S.S. Martins, A.Delfino, J.R.Stone and C.Providencia, to be submitted to PRC, 2010
[2] *Nucleon-Nucleon Interactions from the Quark model*
C. Downum, J.Stone, T.Barnes, E. Swanson and I.Vidana, arXiv:1001.3320