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High and low density behavior of coupling constants within different relativistic mean field models

Numerous calculations have established that relativistic mean-field (RMF) models provide a reliable tool for realistic description of the bulk properties of finite nuclei and nuclear matter. In addition to this successful low-energy phenomenology, these models are often extrapolated into regimes of high density and temperature to extract the nuclear equation of state or calculate masses, radii and other properties of compact stars.
RMF theory is easily applicable, however not parameter free, therefore it is reasonable to retain the basic structure of this theory but provide a more direct access to many-body dynamics through adjustment of free parameters to the more fundamental Dirac-Brueckner-Hartree-Fock (DBHF) calculations. This is done to obtain coupling constants of the nonlinear RMF model, as well as of the density dependent RMF model. In the latter case new functional forms of density dependence are proposed in order to investigate their effects on the low and high density extrapolations of coupling constants. Results of the fit of all models to the DBHF data are compared with the aim to examine the reliability and justifiability of such extrapolations. This knowledge is very important for compact star structure calculations or for constraining the high density equation of state.

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