Ab initio Relativistic Field Theory for Asymmetric Nuclear Matter, Exotic Nuclei, and Neutron Stars

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The density dependent relativistic DDRH field theory is used to describe baryon-baryon interactions in a nuclear environment. Using a meson exchange picture the modifications of interaction vertices by the surrounding medium are described by vertex functionals depending on the baryon field operators. The role of meson-meson correlations for the formation of scalar and vector mesons is discussed. The approach preserves covariance of the field equations and thermodynamical consistency. An *ab initio* description is achieved by using Dirac-Brueckner theory to derive the vertex functionals. The equation of state for infinite nuclear matter is found to resemble closely the variational results of the Urbana group. Calculations including vacuum polarization show a strong dynamically generated repulsion in the vector meson channel, increasing with density. Extensions to the strangeness sector allow to investigate SU(3) flavor dynamics in infinite hypermatter. Finite nuclei and hypernuclei are described accurately. Neutron skins in Ni and Sn nuclei are investigated. PDR modes are discussed as signatures for the skin thicknesses. The PDR transitions are found to be excitations of a genuine character, clearly distinguishable from the GDR. The theory indicates that close to the driplines the static mean-field dynamics is replaced by a new kind of correlation dynamics. An important consequence is the dissolution shell structures. Low energy transfer and high energy breakup reactions are discussed as tools for studying the spectroscopy of exotic nuclei. Neutron star matter in beta equilibrium is studied including the full SU(3) baryon octet. The mass-radius relations for several free space BB interactions are discussed. The results agree well with the constraints set by recent atomic red shift measurements in neutron stars.