Covariant density functionals from relativistic Brueckner theory

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Covariant density functional theory provides one of the most successful microscopic frameworks for describing finite nuclei, nuclear matter, and compact-star matter within a unified relativistic formulation. In its density-dependent form, many-body correlations are encoded through effective meson-nucleon vertices that depend on the baryon density. This approach is particularly attractive because it preserves the Lorentz structure of the nuclear self-energy while allowing the functional to incorporate information from microscopic many-body calculations. We have constructed a density-dependent covariant functional based on a Chebyshev expansion and constrained by full-Dirac-space Brueckner single-particle potentials. The scalar and time-like vector components of the microscopic single-particle potentials at the Fermi surface are mapped onto the corresponding Hartree mesonic channels. The resulting parametrization is particularly well suited to Bayesian analyses that combine laboratory and astrophysical constraints, because the Chebyshev representation reduces spurious correlations among the coefficients governing the density dependence of the functional.