Treating Coulomb exchange contributions in Relativistic Mean Field calculations: why and how?

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Self-consistent mean field methods are very widely used for microscopic studies of nuclear systems. Among them, the so-called Relativistic Mean Field (RMF) approach has become very popular because of its many success in describing nuclear properties with a relatively small number of adjusted parameters and solving self-consistently a set of local Dirac equations. This is possible because the RMF is actually a Hartree approximation, the Fock terms being just dropped and somehow taken care of by the Hartree terms with appropriate meson-nucleon coupling strengths. There is however one feature which is definitely missing, it is the exchange contribution of the Coulomb interaction between protons. In non-relativistic Hartree-Fock calculations with Skyrme-type Hamiltonians the Coulomb exchange effects are not small and they are easily handled by the so-called Slater approximation. In this talk we show that the Slater approximation can be used to accurately evaluate self-consistently Coulomb exchange effects in the RMF approach, thus improving the RMF predictions with practically no extra computational effort.