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Relativistic Consistent Angular-Momentum Projected Shell-Model: Relativistic Mean Field

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Abstract: We develop a relativistic nuclear structure model, relativistic consistent angular-momentum projected shell-model (RECAPS), which combines the relativistic mean-field theory with the angular-momentum projection method. In this new model, nuclear ground-state properties are first calculated consistently using relativistic mean-field (RMF) theory. Then angular momentum projection method is used to project out states with good angular momentum from a few important configurations. By diagonalizing the hamiltonian, the energy levels and wave functions are obtained. This model is a new attempt for the understanding of nuclear structure of normal nuclei and for the prediction of nuclear properties of nuclei far from stability. In this paper, we will describe the treatment of the relativistic mean field. A computer code, RECAPS-RMF, is developed. It solves the relativistic mean field with axial-symmetric deformation in the spherical harmonic oscillator basis. Comparisons between our calculations and existing relativistic mean-field calculations are made to test the model. These include the ground-state properties of spherical nuclei ^{16}O and ^{208}Pb, the deformed nucleus ^{20}Ne. Good agreement is obtained.

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Key words: relativistic consistent angular-momentum projected shell-model, relativistic mean field, projected shell model, PECAPS-RMF

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