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Shell Effect of Superheavy Nuclei in Self-consistent Mean-Field Models

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Abstract: We analyze in detail the numerical results of superheavy nuclei in deformed relativistic mean-field model and deformed Skyrme-Hartree-Fock model. The common points and differences of both models are systematically compared and discussed. Their consequences on the stability of superheavy nuclei are explored and explained. The theoretical results are compared with new data of superheavy nuclei from GSI and from Dubna and reasonable agreement is reached. Nuclear shell effect in superheavy region is analyzed and discussed. The spherical shell effect disappears in some cases due to the appearance of deformation or superdeformation in the ground states of nuclei, where valence nucleons occupy significantly the intruder levels of nuclei. It is shown for the first time that the significant occupation of valence nucleons on the intruder states plays an important role for the ground state properties of superheavy nuclei. Nuclei are stable in the deformed or superdeformed configurations. We further point out that one cannot obtain the octupole deformation of even-even nuclei in the present relativistic mean-field model with the σ, ω and ρ mesons because there is no parity-violating interaction and the conservation of parity of even-even nuclei is a basic assumption of the present relativistic mean-field model.

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