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Study of the relationship between potential energy levels and shape changes of uranium and thorium nuclei in the CNS method with their fission energy and neutron flux

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The connection between the worlds of theoretical and experimental nuclear physics gives us a more complete and realistic perspective, and in fact, the two complement and cover each other, which is why, over time, nuclear models have been completed, from the liquid drop to the shell and rotational model [1,2]. The Nielsen-Strotinsky model, on which the CNS code is based, is a micro-macroscopic method that adds shell effects and Strotinsky corrections to macroscopic calculations, and therefore can predict the behavior of nuclei well [3,4]. The Monte Carlo method, on which the MCNPX code is based, is also a statistical method that performs laboratory and experimental nuclear calculations with very good accuracy [5]. For example, calculating the energy released from fission and calculating the flux and dose of neutrons and gamma rays emitted from the nucleus can be done with good accuracy with this code [6]. In this study, in the theoretical section, we used the CNS model and calculated the energy parameters and axial dipole deformation with increasing spin for uranium and thorium isotopes [7]. Then, in order to investigate its practical effects, we equated this spin increase in the rotational model with nuclear fission and the amount of energy released due to fission, as well as the neutron flux after fission in the MCNP code (which is also determined in the CNS code based on the passage of fission barriers). At energies close to the ground state spins and higher spins, as well as energies close to the fission barrier spins, i.e. the spin range 12^+ to 18^+ and from this range to higher spins in the CNS code, the energy deposited in cells containing different isotopes in the MCNPX code increased. Then, the results of the MCNPX code were compared with the CNS code and it was found that the two methods are in very good agreement.

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