博士論文公聴会の公示(物理学専攻)

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論文題目：　Nuclear structure study of heavy actinides via Coulomb excitation of the heaviest target ^{254}Es
（最重量標的 ^{254}Es のクーロン励起による重アクチノイドの核構造研究）

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論文要旨：

Exploring the new elements toward the high end of the nuclear chart is one of the most interested topics in nuclear physics. A long-lived Super Heavy Elements region with proton and neutron number near Z = 114, Z = 120, N = 184 – the so-called "island of stability" (IoS) is predicted to be one of the most promising regions in the nuclear chart still left to be discovered. Currently, the access to the IoS is limited because of very low cross sections with the present experimental techniques. Single-particle orbitals neighboring the deformed shell gaps in the Z = 100 and N = 152 regions are predicted to be linked to the spherical shell in the IoS region. This provides the ability to elucidate the shell structure of the nuclei on the island of stability.

^{254}Es (einsteinium-254, Z=99, N=155) is an isotope in deformed shell gaps region and currently the heaviest target available for Coulomb excitation experiment. Studies in the region of deformed shell gaps can link to the shell structure of nuclei in the IoS. The “safe” Coulomb excitation experiment of ^{254}Es has been performed for the first time at the JAEA-Tokai Tandem accelerator using a ^{58}Ni beam with an energy of 250 MeV. The scattered particles are detected by two CD-silicon detectors placed backward and forward to the target in coincidence with γ rays detected by an array of γ-ray detectors.

Several new peaks with almost equally energy spacing were observed in the γ-ray energy spectrum of ^{254}Es, which indicates a rotational band structure. The level scheme of ^{254}Es was extended to the (15^+) state accordingly. From the γ-ray yields, in conjunction with previously measured spectroscopic data, the electromagnetic matrix elements of transitions are determined, using the coupled channel least-squares search code, GOSIA. From these determined matrix elements, the quadrupole deformation of ^{254}Es was derived to be $\beta_2 = 0.28^{+0.07}_{-0.05}$. The experimentally deduced moment of inertia and the quadrupole deformation were compared with the theoretical calculation based on the cranked relativistic Hartree - Bogoliubov model with NL1 parametrization. It fairly well reproduced the experimental moment of inertia as well as quadrupole deformation and suggests the configuration of the ground-state band to be $\pi 7/2^+[633] \otimes \nu 7/2^+[613]$. The obtained experimental results provided valuable insights into further understanding the single-particle structure of the super-heavy region.