



国立研究開発法人理化学研究所 仁科加速器科学研究センター
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78Ni revealed as a doubly magic stronghold against nuclear deformation

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⁷⁸Ni, which has 28 protons ($Z = 28$) and 50 neutrons ($N = 50$), 14 additional neutrons to the last stable nickel isotope ⁶⁴Ni, is one of the most intriguing isotopes in the chart of nuclei. It is the most neutron-rich, exotic “doubly magic” nucleus that can be produced at present state-of-the-art facilities. So far, no spectroscopic information for ⁷⁸Ni has been obtained. In this work, excited states of ⁷⁸Ni have been investigated at the Radioactive Isotope Beam Factory, RIBF, by measuring their de-excitation γ rays after one and two-proton knock-out reactions from ⁷⁹Cu and ⁸⁰Zn beams. To achieve a high γ -ray yield, the detection system comprised of a 10 cm-thick liquid hydrogen target with a recoil proton tracking system, MINOS, and a surrounding NaI(Tl) based γ -ray detection array, DALI2.

Eventually, 310 and 222 events with at least one detected γ -ray with more than 300 keV with the (p,2p) and the (p,3p) reactions, respectively, were obtained. As a result, at least two excited 2+ states and other higher lying states were found. This casts a question about the nature of the shell closure in ⁷⁸Ni and reveals the possibility for shape coexistence.

The experimentally deduced level scheme was interpreted by comparison with several state-of-the-art theoretical predictions: Large-scale shell model, beyond mean-field, and ab initio calculations. Though the doubly magic nature was confirmed, at the same time, the shell gap is anticipated to vanish beyond ⁷⁸Ni. In addition to the γ -ray analysis, particularly small inclusive cross sections of ⁷⁹Cu(p,2p)⁷⁸Ni and ⁸⁰Zn(p,3p)⁷⁸Ni were observed compared to neighboring nuclei. To investigate this phenomenon, the cross sections to the excited states and the ground state deduced experimentally were compared with reaction theory based on a DWIA formalism.

In this seminar, the structural information of ⁷⁸Ni will be discussed in detail with the obtained level scheme and the recent theoretical calculations.

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* The talk will be given in English language.

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