



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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The 289th RIBF Nuclear Physics Seminar

Experimental evidence of α clustering
in the ground state of stable heavy nuclei

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George Gamow, about 90 years ago, famously proposed an explanation of α decay phenomena utilizing the quantum tunneling effect of preformed α particles[1]. Since then, α clusters are considered as a prerequisite in heavy nuclei, but the clear experimental evidence of its existence has not been reported until today. Instead, α clustering at the low-density nuclear surface could be one plausible explanation for the origin of preformed α particles[2]. In a recent experiment studying quasi-free α -knockout reactions on tin isotopes - Sn(p, p α), the existence of α particles on the nuclear surface in the ground state of tin isotopes was clarified. The observed reaction cross sections exhibit a monotonous decrease with increasing mass number ($A = 112$ -124), which agrees with the theoretical prediction[3]. This experimental result supports the close correlation between surface α -clustering and neutron-skin thickness in heavy nuclei. This, in turn, calls for a revision of the correlation between the neutron-skin thickness of heavy neutron-rich nuclei, and the density dependence of the symmetry energy in the nuclear equation of state[4], which at present relies on mean-field theories without considering the α -clustering effect. In the seminar, the experimental spectrum for Sn(p, p α) reactions using Grand Raiden[5] and LAS[6] spectrometers at RCNP (Research Center for Nuclear Physics, Osaka University) are shown. We will discuss in details our results and the future experiments using exotic alpha-unstable beams.

- [1] G. Gamow, Z. Phys. 51 (1928) 204, [2] I. Tonozuka and A. Arima, Nucl. Phys. A 323 (1979) 45, [3] S. Typel, Phys. Rev. C 89 (2014) 064321
[4] X. Roca-Maza et. al., Phys. Rev. Lett. 106 (2011) 252501, [5] M. Fujiwara et. al., Nucl. Instrum. Methods A 422 (1999) 484
[6] Wakasa et. al., Prog. Part. Nucl. Phys. 96, 32-87 (2017)

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via Zoom meeting system

* The talk will be given in English language.

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