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Search for α clustering in ^{14}O

α clustering is a well-known phenomenon in light nuclei where two neutrons and two protons strongly correlate to constitute an α particle as a building block of atomic nuclei. A linear alignment of the α clusters, referred to as linear-chain cluster state (LCCS), has been of great interest since 1950s but until now there is no clear experimental evidence demonstrating the existence of such a state. Recently, it was theoretically pointed out that excess nucleons in non-4N nuclei occupy molecular orbitals between α clusters and the excess nucleons may stabilize LCCS. A candidate of LCCS in ^{14}C was experimentally proposed by H. Yamaguchi et al. [1].

It is an interesting issue whether the similar LCCS also exists in the mirror nucleus ^{14}O or not. The excess neutrons are replaced by protons in this case, and thus the energy shifts between ^{14}C and ^{14}O due to the Coulomb force should reflect spatial distribution of the excess nucleons. Therefore, it is expected to reveal the structure of the LCCS candidate by measuring its energy in ^{14}O and comparing it with that in ^{14}C and theoretical calculation.

Since ^{14}O is an unstable nucleus, it must be generated as a secondary particle. We conducted the experiment to search for α cluster states in ^{14}O at CRIB facility of CNS, the Univ. of Tokyo in June 2019. In this experiment, we injected a ^{10}C secondary beam at 36 MeV into the He gas target at 650 Torr, and measured the resonant elastic scattering of α+^{10}C with the Si detectors at 0 and $\pm$9 degrees by the thick target method. We will report details of the experiment and results in the talk.

References

[1] H. Yamaguchi et. al. Experimental investigation of a linear-chain structure in the nucleus ^{14}C $Phys.Lett.B$, 766:11, 2017

Primary author: OKAMOTO, Shintaro (Dept. of Phys., Kyoto Univ.)

Co-authors: SAKAUE, Akane (Dep. of Phys. Kyoto Univ.); KOHDA, Asahi (RCNP, Osaka Univ.); MANICO, Gianluca (INFN); PIZZONE, Giulio (INFN); Mr SHIMIZU, Hideki (CNS, Univ. of Tokyo); YAMAGUCHI, Hidetoshi (Center for Nuclear Study, the University of Tokyo); INABA, Kento (Dep. of Phys. Kyoto Univ.); SAKANASHI, Kohsuke (Dep. of Phys. Osaka Univ.); COGNATA, Marco (INFN); SFERRAZZA, Michele (Université Libre de Bruxelles); MA, Nanru (Center for Nuclear Study); ITAGAKI, Naoyuki (YITP, Kyoto Univ.); DESCOUVEMONT, Pierre (Université Libre de Bruxelles); PALMERINI, Sara (INFN); HAYAKAWA, Seiya; CHERUBINI, Silvio (INFN); KAWABATA, Takahiro (Dep. of Phys. Osaka Univ.); DOI, Takanobu (Dep. of Phys. Kyoto Univ.); FUJIKAWA, Yuki (Dep. of Phys. Kyoto Univ.)

Presenter: OKAMOTO, Shintaro (Dept. of Phys., Kyoto Univ.)

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