

# Measurement of residual nuclei with active-target TPCs and Si detectors/アクティブ標的 TPC および Si 半導体検出器を用いた残留核の測定

Friday, 15 November 2024 15:30 (30 minutes)

Time Projection Chambers (TPCs) and silicon (Si) semiconductor detectors are useful to examine residual nuclei in nuclear reaction.

We developed MAIKo and MAIKo+, which are TPC-based active target systems [1]. They enable tracking of low-energy charged particles over a large solid angle by using gas as both the detection medium and target. We utilize them to study triple-alpha reaction, which is one of the most important in nucleosynthesis in the universe. We inject a neutron beam into the MAIKo(+) active targets filled with a detection gas containing carbon, and measure 3 alpha particles emitted from excited states of residual carbon nuclei. A test measurement was conducted at the OKTAVIAN neutron beam facility in Osaka University, and it showed significant potential to measure residual nuclei in nuclear reactions [2].

We also developed a Si detector array SAKRA to detect decay particles from residual nuclei. It has particle-identification capabilities via pulse shape analysis. We demonstrated that SAKRA is capable to distinguish protons from alpha particles at  $E > 2$  MeV and alpha particles from carbon nuclei at  $E > 5$  MeV, and useful to examine decay processes of residual nuclei and to clarify their internal structures. We employed SAKRA to search for alpha cluster states in  $^{24}\text{Mg}$  [3].

In this talk, we will report the performance of MAIKo(+) and SAKRA, and present their application in our recent experimental works.

## References

- [1]. T. Furuno, T. Kawabata *et al.*, "Performance test of the MAIKo active target", Nucl. Instrum. Methods Phys. Res. A **908**, 215 (2018).
- [2]. T. Furuno *et al.*, "Measurement of  $^{12}\text{C}(n, n')$  reaction cross section to determine triple-alpha reaction rate in high-density environments", EPJ Web of Conf. **260**, 11010 (2022).
- [3]. Y. Fujikawa, T. Kawabata *et al.*, "Search for the  $6\alpha$  condensed state in  $^{24}\text{Mg}$  using the  $^{12}\text{C} + ^{12}\text{C}$  scattering", Phys. Lett. B **848**, 138384 (2023).

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**Session Classification:** Applications of Nuclear Data/核データの応用