



Contribution ID: 289

Type: **Contributed Oral Presentation**

## Experimental study of neutron-rich ${}^7\text{He}$ and its $3n$ decay

Friday, 30 May 2025 09:10 (15 minutes)

Multiparticle emission, a novel decay mode discovered in proton-rich and neutron-rich nuclei at and beyond the dripline, represents a frontier in nuclear physics. Impressive experimental progress has been made for nuclei unbound by two or three protons [1]. However, multineutron emission remains largely unexplored on the neutron-rich side due to the very limited capability of multineutron detection. Recently, the  $3n$  emitter  ${}^{27}\text{O}$  and the first  $4n$  emitter  ${}^{28}\text{O}$  were observed [2]. The simultaneous detection of these constituent neutrons provides critical insights into the structural properties of these extremely neutron-rich nuclei. Moreover, studying multineutron correlations is crucial for understanding neutron clusters composed purely of neutrons. Low-lying resonance-like structures have been observed in tetraneutron ( ${}^4n$ ) system [3,4], but no distinct peak was found for trineutron ( ${}^3n$ ) system [5]. The existence of these neutron clusters remains controversial between experimental data and theoretical calculations.

The excited state of  ${}^7\text{He}$  is a prospective  $3n$  emitter decaying into  ${}^4\text{He} + 3n$ , as indicated by a missing-mass measurement [6]. However, due to the lack of three-neutron detection, the decay mode of  ${}^7\text{He}$  cannot be elucidated. Therefore, a new measurement with improved resolution, low background and  $3n$  detection is essential to solidly establish the structure of  ${}^7\text{He}$ .

We have carried out a new experimental study of  ${}^7\text{He}$  at RIKEN RIBF facility using the quasi-free one-neutron knock out reaction  ${}^8\text{He}(p, pn){}^7\text{He}$ . The momentum of the charged fragments was analyzed by the SAMURAI spectrometer and its associated detectors. Taking advantage of the large neutron detector array combining the NeuLAND demonstrator from GSI and the existing NEBULA array, multiple neutrons can be detected. This is the first invariant-mass measurement of the  ${}^7\text{He}$  excited state and its  $3n$  emission. The measured  $3n$  correlations also enable the search for a trineutron resonance.

In this talk, our results will be presented.

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### Consent

**Primary author:** HUANG, Siwei (Peking University)

**Co-authors:** YANG, Zaihong (Peking University, China); MARQUES, F.M. (LPC Caen, France); SAMURAI-034 COLLABORATION

**Presenter:** HUANG, Siwei (Peking University)

**Session Classification:** Parallel Session

**Track Classification:** Nuclear Structure