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# A CANDIDATE OF TETRA-NEUTRON STATE POPULATED BY ${}^4\text{He}({}^8\text{He}, {}^8\text{Be})4n$ REACTION

**K. Kisamori, RIKEN Nishina Center, Wako, Japan**

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K. Kisamori<sup>1,2</sup>, S. Shimoura<sup>1</sup>, S. Michimasa<sup>1</sup>, H. Miya<sup>1,2</sup>, S. Ota<sup>1</sup>, M. Assie<sup>3</sup>, H. Baba<sup>2</sup>, T. Baba<sup>4</sup>, D. Beaumel<sup>2,3</sup>, M. Dozono<sup>2</sup>, T. Fujii<sup>1,2</sup>, N. Fukuda<sup>2</sup>, S. Go<sup>1,2</sup>, F. Hammache<sup>3</sup>, E. Ideguchi<sup>5</sup>, N. Inabe<sup>2</sup>, M. Itoh<sup>6</sup>, D. Kameda<sup>2</sup>, S. Kawase<sup>1</sup>, T. Kawabata<sup>4</sup>, M. Kobayashi<sup>1</sup>, Y. Kondo<sup>7,2</sup>, T. Kubo<sup>2</sup>, Y. Kubota<sup>1</sup>, M. Kurata-Nishimura<sup>2</sup>, C. S. Lee<sup>1,2</sup>, Y. Maeda<sup>8</sup>, H. Matsubara<sup>1,2</sup>, K. Miki<sup>5</sup>, T. Nishi<sup>9,2</sup>, S. Noji<sup>10</sup>, S. Sakaguchi<sup>11,2</sup>, H. Sakai<sup>2</sup>, Y. Sasamoto<sup>1</sup>, M. Sasano<sup>2</sup>, H. Sato<sup>2</sup>, Y. Shimizu<sup>2</sup>, A. Stoltz<sup>10</sup>, H. Suzuki<sup>2</sup>, M. Takaki<sup>1</sup>, H. Takeda<sup>1</sup>, M. Tsumura<sup>4</sup>, T. Uesaka<sup>2</sup>, K. Yako<sup>1</sup>, Y. Yanagisawa<sup>2</sup>, R. Yokoyama<sup>1</sup>

1 Center for Nuclear Study, the University of Tokyo, Bunkyo-ku, Japan

2 RIKEN Nishina Center, Wako, Japan

3 IPN Orsay, Orsay, France

4 Department of Physics, Kyoto University, Sakyo-ku, Japan

5 Research Center for Nuclear Physics, Osaka University, Ibaraki, Japan

6 Cyclotron and Radioisotope Center, Tohoku University, Sendai, Japan

7 Department of Physics, Tokyo Institute of Technology, Meguro-ku, Japan

8 Faculty of Engineering, University of Miyazaki, Miyazaki, Japan

9 Department of Physics, the University of Tokyo, Bunkyo-ku, Japan

10 National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, USA

11 Faculty of Science, Kyushu University, Fukuoka, Japan

12 National Institute of Radiological Science, Inage-ku, Japan

Tetra-neutron system has attracted considerable attention since candidates of bound tetra-neutron system were reported [1]. While recount of latest theoretical paper using ab-initio calculations [2] suggests that bound tetra-neutron does not exist, the possibility of the tetra-neutron system forming a resonance state at low excitation energy is still an open and fascinating question.

We performed missing-mass spectroscopy of the tetra-neutron system via an exothermic double-charge exchange reaction  ${}^4\text{He}({}^8\text{He}, {}^8\text{Be})4n$ . The incident beam energy of  ${}^8\text{He}$  was 186 MeV/u. The experiment was carried out at the RI Beam Factory at RIKEN using the SHARAQ spectrometer with the liquid He target system. The  ${}^8\text{He}$  beam had a large mass excess, which enabled us to produce the  $4n$  system in small momentum transfer of less than 20 MeV/c. In order to obtain the missing-mass spectrum, we measured momentum of the incident beam of  ${}^8\text{He}$  with the High-Resolution-Beamline and momenta of outgoing two  $\alpha$  particles, which were the decay products of the  ${}^8\text{Be}$  ejectile, with the SHARAQ spectrometer. To obtain the events with good signal-to-noise ratio, two  $\alpha$  particles from the  ${}^8\text{Be}$  were detected in coincidence at forward direction.

We obtained 27 events in the missing-mass spectrum of tetra-neutron system including background events, which were negligible small. The spectrum had a strength with  $3.6\sigma$  significance level at the low excitation energy region in comparison with the theoretical curve assuming the direct decay to the two correlated di-neutron pairs. The mean energy of the strength was  $0.83 \pm 0.25(\text{stat.}) \pm 1.25(\text{sys.})$  MeV and upper limit of width was 2.6 MeV (FWHM). The result suggests a possible resonant state of the tetra-neutron system. The detail of the experiment and its result will be reported.

## REFERENCES

[1] F. M. Marques, et al, Phys. Rev. C 65, 044006 (2002)

[2] S. C. Pieper, et al, Phys. Rev. Lett. 90, 252501 (2003)