Experimental study on neutron-neutron correlation in Borromean nuclei via the (p, pn) reaction at intermediate energy with the SAMURAI spectrometer

Y. Kubota,[*1,*2] A. Corsi,[*3] G. Authelet,[*3] H. Baba,[*2] C. Caesar,[*4] D. Calvet,[*3] A. Delbart,[*3] M. Dozono,[*1] J. Feng,[*5] F. Flavigny,[*6] J.-M. Gheller,[*3] J. Gibelin,[*7] A. Gillibert,[*3] K. Hasegawa,[*8] T. Isobe,[*2] Y. Kanaya,[*9] S. Kawakami,[*9] D. Kim,[*10] Y. Kiyokawa,[*1] M. Kobayashi,[*1] N. Kobayashi,[*11] T. Kobayashi,[*8] Y. Kondo,[*12] Z. Korkulu,[*13] S. Koyama,[*11] V. Lapoux,[*3] Y. Maeda,[*9] F. M. Marqués,[*7] T. Motobayashi,[*2] T. Miyazaki,[*11] T. Nakamura,[*12] N. Nakatsuka,[*14,*2] Y. Nishio,[*15] A. Obertelli,[*3] A. Ohkura,[*15] N. A. Orr,[*7] S. Ota,[*1] H. Otsu,[*2] T. Ozaki,[*12] V. Panin,[*2] S. Paschalis,[*4] E. C. Pollacco,[*3] S. Reichert,[*16] J.-Y. Roussé,[*3] A. Saito,[*12] S. Sakaguchi,[*15] M. Sako,[*2] C. Santamaria,[*3] M. Sasano,[*2] H. Sato,[*2] M. Shikata,[*12] Y. Shimizu,[*2] Y. Shindo,[*15] L. Stuhl,[*2] T. Sumikama,[*8] M. Tabata,[*15] Y. Togano,[*12] J. Tsubota,[*12] T. Uesaka,[*2] Z. Yang,[*5] J. Yasuda,[*15] K. Yoneda,[*2] and J. Zenihiro[*2]

Dineutron correlation is one of the symbolic phenomena expected to appear in neutron drip-line nuclei. It has been studied using different approaches, such as the transfer reaction and the break up reaction. However, currently available data seem to be insufficient to study the neutron-neutron correlation in terms of (i) the decomposition of high-angular-momentum components, (ii) the extraction of a core excitation, (iii) and the effect of final state interactions (FSIs).[1] In this study, (i) the MINOS[2] was used for higher luminosity, (ii) γ rays were detected to tag the core excitation, (iii) and the quasi-free (p, pn) reaction was employed to minimize the FSI.

The experiment was performed at RIBF. Secondary beams were produced and separated by the BigRIPS, by projectile fragmentation of a ^{48}Ca primary beam at 345 MeV/nucleon with a typical intensity of 400 particle nA in a 20-mm or a 30-mm thick Be target. They were detected and identified using plastic scintillators at the focal planes F3, F5, F7, and F13 and multi-wire drift chambers (MWDCs) at F13 (BDC). The sufficient number of beam particles required, which are large enough as indicated, is listed in Table 1. The ratio of ^{3}H in the beam at F13 was typically 14%.

Figure 1 shows a schematic view of the experimental setup. The reaction point in a 15-cm thick liquid hydrogen target was determined from the tracks of charged particles reconstructed from signals from the MINOS TPC and the BDC. The momenta of decay neutrons, a knocked-out neutron, and a recoil proton were determined respectively by the NEBULA,[3] the WINDS,[4] and a recoil proton detector (RPD) setup consisting of an MWDC and a plastic scintillator array. The charged fragments were identified and momentum analyzed by the SAMURAI spectrometer[5] using the two MWDCs (FDC1 and FDC2) followed by the hodoscopes (HODF and HODP). γ rays emitted from the excited core were detected by the DALI2.[6]

Table 1. Number of beam particles on the target. $\Delta p/p$ denotes the momentum acceptance of the BigRIPS.

Beam	Energy [MeV/nucleon]	$\Delta p/p$ [%]	Number of beam particles Required	Obtained
^{11}Li	246	3.2	9.5×10^{9}	1.6×10^{10}
^{14}Be	265	3.2	1.8×10^{9}	2.3×10^{9}
^{17}B	277	3.2	8.6×10^{7}	1.6×10^{9}
^{19}B	224	3.2	4.3×10^{7}	9.8×10^{6}

Data analysis is currently in progress.

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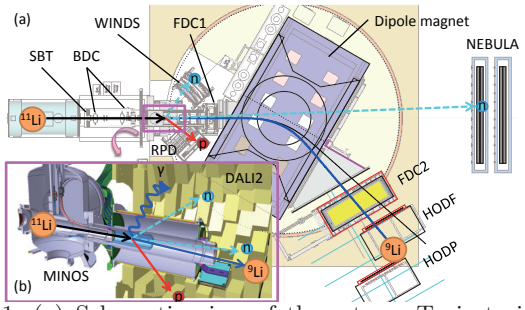

Fig. 1. (a) Schematic view of the setup. Trajectories of particles are shown by arrows. (b) Schematic view of the MINOS surrounded by the DALI2.

*1 Center for Nuclear Study, University of Tokyo
*2 RIKEN Nishina Center
*3 CEA, Saclay
*4 Department of Physics, Technische Universität Darmstadt
*5 Department of Physics, Peking University
*6 IPN Orsay
*7 LPC Caen
*8 Department of Physics, Tohoku University
*9 Department of Applied Physics, University of Miyazaki
*10 Department of Physics, Ehwa Womans University
*11 Department of Physics, University of Tokyo
*12 Department of Physics, Tokyo Institute of Technology
*13 MTA Atomki
*14 Department of Physics, Kyoto University
*15 Department of Physics, Kyushu University
*16 Department of Physics, Technische Universität München

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