Strong nuclear collectivity in the drip-line nucleus ^{11}Li

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The study of the dynamic properties of exotic nuclei at higher excitation energies (< 10 MeV) is still in its early stages. The SAMURAI-30 experiment aims to explore the isovector response of light nuclei near the neutron drip line,[1] with a particular focus on the Gamow-Teller Giant Resonance (GTGR). This work presents the first investigation of any giant resonance in a drip-line nucleus.

The inverse kinematics ^{11}Li$(p,n)^{11}$Be charge-exchange reaction at 182 MeV/nucleon, combined with missing-mass spectroscopy,[2,3] enabled the study of GTGR over a broad excitation range (up to 50 MeV), free from the Q-value constraints of β decay.[4] Excitation energy spectra were reconstructed using recoil neutrons measured by PANDORA,[5] with decay channels tagged via particle identification at the SAMURAI magnet's focal plane.[6] This setup[7] provided high-statistics (p,n) measurements with minimal gamma background.

Several decay channels of the reaction product ^{11}Be were identified. The kinematical correlations for two selected channels, ^{10}Be + n and ^{9}Be + $2n$, are shown in Fig. 1. Along with the low-energy peaks observed in these channels, a dominant strong collectivity at approximately 19.2 MeV is identified. This peak consistently appears across multiple decay channels. The forward-peaking nature of the resonance strongly suggests that it corresponds to GTGR, in agreement with previous theoretical studies.[8] The multipole decomposition analysis has been completed, and the B(GT) strengths are currently being extracted from the double-differential cross-sectional data.

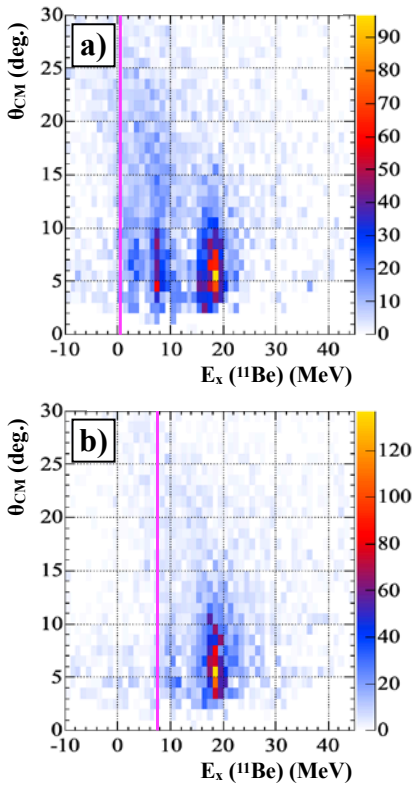

Fig. 1. Empty-cell background-subtracted excitation energy distribution as a function of the center-of-mass angle for ^{10}Be + n (a) and ^{9}Be + $2n$ (b) decay channels. Magenta lines indicate threshold energies of 0.5 MeV and 7.3 MeV.

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DOI:10.34448/RIKEN.APR.58-187