Structure of ^{13}Be probed via quasi-free scattering

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Several experiments have attempted to study the spectroscopy of the unbound isotope ^{13}Be via both the missing-mass and invariant-mass technique using charge exchange, fragmentation, proton removal from ^{14}B, and neutron removal from ^{14}Be. Even when considering only the results obtained with the last method,[1–4] interpretation of the excitation spectrum is sparse.

We performed a new measurement of neutron removal from ^{14}Be at the RIBF facility using the SAMURAI spectrometer[5] and its standard detectors, in addition to the MINOS target-tracker system[6] surrounded by gamma detectors from the DALI2 array. For the interpretation of the invariant mass spectrum of ^{13}Be, we adopted a novel method, proposed in Ref. 7), which uses consistent three- and two-body models for ^{14}Be and ^{13}Be, respectively, and can provide predictions for the absolute cross sections, including the positions and weights of the structures of the spectrum, thus reducing ambiguities in the analysis. A part of the complexity of the ^{13}Be continuum spectrum stems from the admixtures of single-particle structures with core-excited components. In this experiment, we were able to measure with high statistics the possible ^{12}Be$(2^+, 1^-)$ core excited component that decays via gamma rays.

The relative energy spectrum of ^{13}Be is shown in Fig. 1. The absolute cross section is determined taking into account the efficiency for invariant-mass measurement and fragment transmission. The spectrum

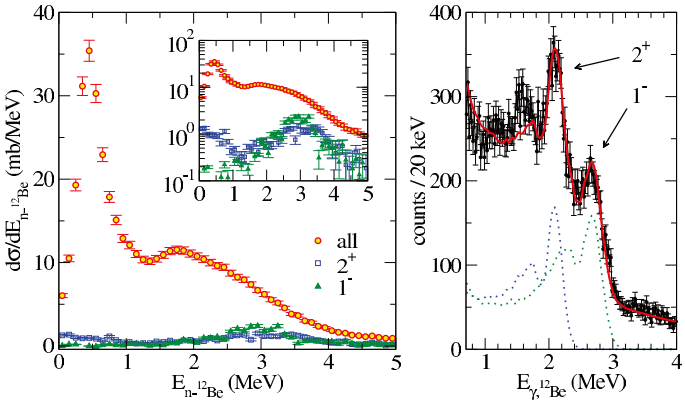

Fig. 1. Left: relative energy spectrum of ^{13}Be and contributions from core excited components. Right: gamma spectrum of ^{12}Be. The two transitions are reproduced by the sum of an exponential background and the response functions (dashed curves) of the DALI2 detector obtained via a GEANT4 simulation.

is characterized by a prominent peak with a maximum at ∼0.48 MeV and a broader structure, peaked at ∼2.3 MeV, extending from ∼1 MeV to ∼5 MeV. The contribution corresponding to ^{12}Be(2^+) and ^{12}Be(1^-) core excited states has been fixed via coincidences with 2.1 and 2.7 MeV gamma transitions, respectively, and is shown for comparison after correcting for gamma-detection efficiency.

The interpretation of the relative energy and transverse momentum spectrum, described more thoroughly in Ref. 8), permitted to pin down the dominant $\ell = 1$ contribution of the resonant peak observed in the low-lying spectrum, in agreement with[2] and at variance with the conclusions of Refs. 3–4), which assigned a dominant $\ell = 0$ content to this peak.

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