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The (d,p) reaction on ^{11}Be using ISS: Bringing clarity to the structure of ^{12}Be

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The available data on ^{12}Be are ambiguous and limited despite numerous attempts via direct and indirect reactions. For the three previous (d,p) reactions[1-3], their reaction energies and angular coverage were not optimized so the data could not be easily interpreted in terms of well-tested reaction mechanisms. For another, these measurements provided limited information on the unbound excited states and did not achieve good enough Q-value resolution to isolate the 0_2^+ and 2_1^+ states which are just 150 keV part. To resolve this situation, a new ^{11}Be(d,p) measurement has been carried out using ISS at ISOLDE at an energy of 9.78 MeV/u. The 0_2^+ and 2_1^+ states have been isolated owing to the good resolution of ISS. The neutron $1s_{1/2}$ spectroscopic factor of the 0_2^+ level has been determined, which will allow for its matter radius extraction, and hence, if it has a two-neutron halo structure, similar to the ^{11}Li ground state. The recently observed 0^- state [4] has been confirmed and its width and excitation energy have been precisely determined, located just 40 keV above Sn. The spectroscopic factors of states below 5 MeV have also been determined and suggestions of the spin-parities of the unbound states will been made. In particular, a new resonance at ˜4.2 MeV has been observed for the first time in ^{12}Be. The new results will be compared with shell model calculations incorporating effective interactions, Gamow shell model (GSM) calculations [5] and Gamow coupled-channel method (GCC) calculations [6] incorporating the continuum coupling effects.

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