Investigations of the unbound states in 20C

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Carbon isotopes (Z=6), which exhibit the first spin-orbit shell gap originating from the splitting of the 1p1/2–1p3/2 orbitals, provide an excellent ground for studying the evolution of proton spin-orbit splitting toward the neutron dripline. Neutron-rich carbon isotopes have been extensively investigated over the last decade. Measurements of transition probabilities B(E2;2+→0+) up to 20C have revealed an increase in collectivity from 16C to 20C, interpreted as enhanced mixing between unperturbed neutron and proton 2+ excitations, driven by a reduction of the proton spin-orbit splitting.

More recently, neutron-rich 16,18,20C were studied via proton removal reactions from nitrogen isotopes. Cross sections populating the ground and 2+1 states indicated an increasing proton component of the 2+1 state, supporting a moderate reduction of the proton spin-orbit splitting. These studies also predicted a mixed-symmetry 2+ state at an excitation energy of around 7 MeV, expected to be strongly populated in proton removal reactions. As this state lies above the neutron separation energy, it is unbound and predominantly decays by neutron emission.

In this work, we report on an investigation of unbound states in 20C, populated via proton removal from 21N. The radioactive 21N beam was produced by the BigRIPS separator at RIBF and impinged on a carbon target. The unbound states in 20C were analyzed using the SAMURAI spectrometer via invariant mass spectroscopy. In this report, the experimental setup, the data analysis as well as the preliminary results will be presented.