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## Beta Decay of the Halo Nucleus, $^{31}\text{Ne}$

Historically, the  $N=20$  region of the nuclear chart has played a significant role in our understanding of nuclear structure. In this mass region, deformed excited states from neutron occupations in the  $\nu f_{7/2}$  orbital are observed to compete with normal configurations in the  $sd$ -shell leading to so-called intruder-states. Interestingly, this large evolution of shell structure is not a general feature for all nuclei in the  $sd$ -shell but rather focused around a nexus of nuclei colloquially referred to as the island of inversion (IoI). On the extreme neutron side of the IoI, lies  $^{31}\text{Na}$  where, to date, no negative-parity excited states have been observed above the positive-parity ground state which would help confirm the placement of the  $\nu f_{7/2}$  orbital. Thus, studying the  $\beta$ -delayed  $\gamma$ -ray spectroscopy of  $^{31}\text{Ne}$ , which has a negative-parity ground-state, will directly populate these critical states and bring new information to the table which has so far not been available.

Here, we will present the experiment to study the  $\beta$ -decay of  $^{31}\text{Ne}$ . This work was carried out at the NSCL. A  $^{31}\text{Ne}$  beam was selected by the A1900 separator following the fragmentation of a 140-MeV/nucleon  $^{48}\text{Ca}$  beam impinging on a  $\sim 700\text{-mg/cm}^2$   $^9\text{Be}$  target. To maximize transmission of the exotic fragments to the Beta-Counting Station (BCS), the fully 5% transmission capability of the A1900 was used. Various Si detectors and timing information in the BCS allowed for event-by-event identification of individual fragments entering the system. At the center of the BCS, fragments were implanted into a thick DSSD where these identified implant events were time-correlated to individual decay-events. The BCS was placed at the center of an array of sixteen Clover-style HPGe, and fifteen  $\text{LaBr}_3$  detectors for subsequent  $\gamma$ -ray detection released during the decay process.

Due to the high momentum acceptance, complete separation of  $^{31}\text{Ne}$  from its neighboring nucleus  $^{30}\text{Ne}$  is complicated, however separation has been achieved and verified through half-analysis.  $^{31}\text{Ne}$  has been proposed to have a significant  $p$ -wave neutron-halo component in its ground state configuration and present results indicate an extremely high  $\beta$ -delayed neutron branch for the decay of  $^{31}\text{Ne}$  with a few possible  $\gamma$ -ray transitions in  $^{31}\text{Na}$  present. The results will be presented from isotope identification and separation verification to observed  $\gamma$ -ray spectra and level schemes compared to shell-model calculations.

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