Studying Unstable Light Nuclei with Transfer Reactions

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Motivation

Structure information on unstable, light nuclei is still not well known. We will be using single particle transfer reactions to investigate the structure of light neutron-deficient nuclei. We will then be able to test modern nuclear theories, including ab initio nuclear models and reaction theories, by comparing them with our data.

Reactions Studies:
- Using d(9Be,p) at MARS/TAMU using TexAT chamber
- Using d(9Be,α) at MARS/TAMU using TexAT chamber
- Using d(10B,He) at FSU using surface-edge split-pole spectrograph
- Using d(10B,He) at FSU using RESOUTNE

- During these studies, we will be able to learn about the structure of the ground states of radioactive beams. 10B is thought to have a cluster structure and 9Be, along with 10C, are proton "halo" candidates.

Measurements
- Identify excited states and their widths.
- Determine angular distributions, which we can use to make assignments of spin and parity of the final nuclear state by comparing with reaction theory calculations.
- Calculate absolute cross sections, which will be used to obtain spectroscopic factors by comparing reaction model calculations to our experimental data.

Experiments at TAMU

- The d(10B,He) study will be performed using the Momentum Achromat Recoil Spectrometer (MARS) (Figure 3) because it is capable of producing a B beam at higher energies (15-25 MeV/A) and intensities (>10^4 ions/s).
- We will expand on the current Texas Active Target (TexAT) chamber to house detectors able to detect and identify light ion decay products (Figure 4).
- The d(10B,He) study will use a similar layout at this facility.

Experiments at FSU

- The d(9Be,α) study will be investigated using the new Super-Edge Split-Pole Spectrograph (SE-SPS), circled in red on Figure 5 of the FSU facility. A closer look at SE-SPS is shown in Figure 6.
- The d(10B,He) study will be performed using existing neutron detector systems (i.e. RESOUTNE).