Characterization of the AGGIE gas-filled separator

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A gas-filled separator has been installed and is in the process of being characterized at the Cyclotron Institute at Texas A&M University. This separator was originally designed at Lawrence Berkeley National Laboratory under the name SASSY II [1] and was an evolution of the previous SASSY gas-filled separator [2]. After being transferred to Yale University and rechristened as SASSYER [3], it was eventually moved to Texas A&M. The device has been renamed again as AGGIE, for Al Ghiorso's Gas-filled Ion Equipment. First characterizations using beam were conducted in 2019 and have continued through this writing.

The device takes advantage of the gas-filled separation technique [2], where a dilute gas (He) is used to provide charge equlibration of fusion-evaporation reaction products. This has the effect of narrowing the product's magnetic rigidity distribution, which can lead to higher transmission efficiencies. This is especially desirable for reactions with small production cross sections. AGGIE consists of two dipole magnets and one quadrupole magnet in a $D_vQ_hD_v$ configuration with a length of approximately 2.5 m. Additional eqiuipment received from Yale included the Multi-wire Avalanche Counter at Yale (MACY), which can be used as an impantation detector; a focal plane array consisting of two adjacent double-sided silicon strip detectors with a total of 120 strips for measuring horizontal position and 40 strips for measuring vertical position; and a set of Mesytec MUX-16 multiplexing electronics which allow all strips to be recorded without requiring dedicated electronics for each. The latter electonics have been successfully integrated into the data acquisition system currently in use by the Heavy Elements Group.

AGGIE was initially characterized using a ^{241}Am source mounted in the target position, and later experiments have utilized nuclear reaction products to determine the influence of magnetic field on transmission. Reactions used for this purpose have included ^{118}Sn(^{40}Ar, xn)$^{158-x}$Er (x =5-6), ^{165}Ho(^{40}Ar, yn)$^{205-y}$At (y = 5-6), and ^{165}Ho(^{35}Cl, 4n)^{196}Po. Average product charge states were estimated according to Eq. 1 in [4]. Beam intensity was monitored via two collimated scattering detectors mounted in the target box at ±30° to the beam axis. The current deposited in the beam dump is also recorded moment-to-moment to provide a relative measure of beam intensity as a function of time.

Combined with increases in beam intensity that have been realized by extracting beam from the K150 cyclotron in first harmonic mode, these studies have shown that the yield of fusion-evaporation products is substantially higher than in similar experiments using the MARS spectrometer [5-9]. These increases in sensitivitvy allow for additional nuclear reaction studies and chemical experiments on the homologs of superheavy elements where AGGIE will act as a physical pre-separator. The latter is especially important, given that there are very few facilities worldwide that are capable of conducting experiments with pre-separated homologs. These characterization experiments are ongoing.

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