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Nuclear Reaction Studies and Chemistry Experiments with Self-Assembled Monolayers Using the AGGIE Gas-Filled Separator

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The Heavy Elements Group at Texas A&M University is focused on the study of fusion-evaporation reactions to understand compound nucleus survival, the use of functionalized detector surfaces to tune interactions with surfaces, and the development of strong external collaborations. In recent years, we have measured excitation functions of the ^{44}Ca + ^{154,156,157,160}Gd reactions [1] to understand the role of neutron number on survival, which appears to be the most important factor affecting the success of fusion-evaporation reactions. More recently, we have also studied the ^{48}Ti + ^{156,157,158,160}Gd, ^{162,163,164}Dy reactions using the AGGIE gas-filled separator to better understand the influence of projectiles with atomic numbers greater than 20. These studies will continnue with another study of ^{52}Cr projectiles reacting with similar targets.

Our group has also pioneered the use of self-assembled monolayers (SAMs) as new surfaces for chemical studies of heavy elements. SAMs are composed of organic compounds that have been carefully chosen to form a single molecular layer on an Au surface. After spectroscopic characterization of the surfaces using a variety of techniques, we have successfully employed them in an experiment to study the adsorption of Er, Po, and At. Future experiments will focus on short-lived Hg isotopes and ^{254}No.

Our recent research has been enhanced by highly effective collaborations. Prof. Patrick Steinegger's group has traveled to Texas A&M three times for experiments, and these included the use of isothermal vacuum chromatography to chemically study nuclides with half-lives less than 1 s [2]. More recently, we have worked with Prof. Pavel Bartl's group at Czech Technical University in Prague to study the interaction of Po and Hg on various SAMs at the Nuclear Physics Institute in Řež, Czech Republic.

A number of upgrades are also planned for the Cyclotron Institute and AGGIE. In 2026, we will add a new commercial ion source for the K150 cyclotron to increase the available beam intensities. Also in 2026, we will add a new refrigeration system to provide liquid He for cryopanels in the K150 cyclotron to improve its vacuum. Finally, we are in the process of increasing the maximum field of the final AGGIE dipole to increase our maximum magnetic rigidity.

This talk will discuss our most recent results and future plans.

References

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[2] G. Tiebel *et al.*, J. Phys. Chem. C **130**, 3058 (2026). doi:10.1021/acs.jpcc.5c06930