Heavy-ion Fusion Reactions with Neutron-rich Radioactive Ion Beams

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The predicted shell closures forming the 'island of stability' [1-2] are beyond the reach of stable beams [3]. This dictates that future efforts towards the synthesis of super-heavy elements (SHEs) [4] must utilize neutron-rich radioactive ion beams (RIBs). The low intensities of RIBs puts this goal beyond the reach of current facilities. Additionally, the formation of SHEs is inhibited, by several orders of magnitude, by the premature breakup of the di-nuclear system via quasifission [5-9]. To study the competition between fusion and quasifission in heavy-ion reactions induced by RIBs, a high efficiency fission-fragment detector system is needed. The Coincident Fission Fragment Detector (CFFD), a device recently commissioned at the ReA3 facility of the National Superconducting Cyclotron Laboratory, is capable of performing such measurements.

The first ReA3 experiment with the CFFD sought to answer the open question of the role of neutron richness in quasifission. Does an increase in neutron richness of the projectile enhance or hinder the formation of a compound nucleus? Prior work has produced conflicting results [10-14], whilst our work with collaborators at the Australian National University [15], and the recent experiment at ReA3 point to an increase in fusion probability with increasing neutron richness. I will present preliminary results from the ReA3 experiment and also highlight the capabilities of the CFFD.

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