Energy dissipation in multinucleon transfer reactions.

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Nuclear reactions are incredibly complex, involving collisions between composite systems where many-body dynamics determine outcomes. Successful models have been developed to explain particular behaviour of reactions in distinct energy and mass regimes, but a unifying picture remains elusive.

Particular problems have become evident in standard coupled channels approaches to calculating fusion cross sections, with hindrance effects having been identified both above and below the barrier. Inadequacies have been demonstrated [1–3] in these approaches using static internuclear potentials, and have shown the need to address some hidden physics. The dissipation of energy from the relative motion of the collision partners to internal states is known to be important in these processes, but is yet to be successfully incorporated into reaction models.

Multinucleon transfer reactions are a useful tool to examine these aspects, as they span the transition from the quasielastic regime, where the colliding nuclei barely overlap, and the deep inelastic regime, where collisions are violent with significant redistribution of mass and charge between the fragments, as well as large losses of kinetic energy from the relative motion. In this work we examine the onset of dissipation as the bombarding energy approaches the Coulomb barrier, and particularly whether there are important differences in these effects where cluster transfer processes are involved.

Here I will discuss details of my work studying the distribution of excitation energy in transfer reactions involving light-medium mass projectiles on heavy targets. This work provides a phenomenological foundation for the future development of reaction models that can appropriately treat the dissipation effects in nuclear reactions.

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