Understanding the interplay between sub–barrier breakup of ^{6,7}Li and above-barrier suppression of complete fusion

D.H. Luong,[1] D.J. Hinde,[1] M. Dasgupta,[1] and M. Evers[1]

[1] *Department of Nuclear Physics, The Australian National University, ACT 0200, Australia*

With the discovery of halo nuclei, and recent intensive development of radioactive ion beams (RIBs) around the world, there is renewed interest in studying interaction of weakly-bound light nuclei as a basis for understanding interactions of halo nuclei and RIBs. Using a novel experimental approach [1], reactions of the weakly–bound nuclei ^{9}Be and ^{6,7}Li with heavy targets consistently showed suppression of complete fusion by $\sim$30% [2, 3]. The low threshold energies for breakup of Li and Be are widely associated with their observed suppression of complete fusion [1–5], with breakup described as cluster decay from unbound states independent of the mechanism that populates it [6–12]. However, knowing the reaction processes leading to breakup is not sufficient to understand the interplay between breakup and suppression of fusion [3]. It is critical to also know the timescale of each process [13], whether the breakup occurs before or after the projectile reaches its point of closest approach to the target nucleus.

From our recent sub–barrier coincidence measurements for the reactions of ^{6,7}Li with ^{207,208}Pb and ^{209}Bi, breakup mechanisms and their timescale are identified. The probability for sub–barrier breakup processes fast enough ($\sim 10^{-22}$s) to affect fusion are extracted and used to predict above-barrier suppression of complete fusion using the classical trajectory model PLATYPUS [14]. The results of this study will be presented.

---

[1] M. Dasgupta *et al.*, Phys. Rev. Lett. **82**, 1395 (1999)
[2] M. Dasgupta *et al.*, Phys. Rev. C **66**, 041602(R) (2002).
[3] M. Dasgupta *et al.*, Phys. Rev. C **70**, 024606 (2004).
[4] C. Signorini *et al.*, Eur. Phys. J. A **5**, 7 (1999).
[5] Y.W. Wu *et al.*, Phys. Rev. C **68**, 044605 (2003).
[6] H. Freiesleben *et al.*, Phys. Rev. C **10**, 245 (1974).
[7] G.R. Kelly *et al.*, Phys. Rev. C **63**, 024601 (2000).
[8] R. Ost *et al.*, Z. Phys. **266**, 369 (1974).
[9] J.L. Québert *et al.*, Phys. Rev. Lett. **32**, 1136 (1974).
[10] D. Scholz *et al.*, Nuc. Phys. A **288**, 351 (1977).
[11] C. Signorini *et al.*, Phys. Rev. C **67**, 044607 (2003).
[12] A. Shrivastava *et al.*, Phys. Lett. **B 633**, 463 (2006).
[13] D.H. Luong *et al.*, Phys. Lett. **B 695**, 105 (2011).
[14] A. Diaz-Torres *et al.*, Phys. Rev. Lett. **98**, 152701 (2007).