Contribution ID: **303** Type: **Invited Presentation**

How Does Breakup of Light Weakly-bound Projectiles Affect Fusion?

Wednesday, 31 May 2017 11:30 (25 minutes)

Fusion reactions provide the means to discover new elements, produce new exotic isotopes, investigate nuclear structure, and study many-body quantum dynamics. The fusion of light, weakly-bound projectiles (e.g., 6,7Li, 9Be) with heavy targets at above-barrier energies is found to be suppressed by 25-35% compared to both model expectations, and to fusion of strongly-bound projectiles [1]. This presents a major challenge to our understanding of fusion, particularly for measurements with nuclei far from stability.
Due to their low breakup thresholds, direct breakup of these nuclei into their intrinsic clusters (6Li⟶αd, 7Li⟶αt, 9Be⟶ααn) may prevent fusion – after breakup, capture of the complete charge of the projectile is be hindered. Although these direct breakup modes are present, many unbound states are also accessible via nucleon transfer [2]. For example, 7Li can disintegrate through proton pickup, forming unbound 8Be. This mode becomes dominant as the target mass decreases, with direct breakup negligible for A<60 [3].
To infer the influence of breakup on fusion we need to understand both the mechanisms causing breakup and their timescales. Narrow resonances such as the 8Be 0+ (τ≈10−16 s) survive much longer than the collision time (10−21 s), and will arrive at the fusion barrier intact. Thus they are not expected to contribute to fusion suppression. Only if breakup occurs on the timescale of the collision (e.g. via the short-lived 8Be 2+ state) can fusion be suppressed.
Here we discuss recent measurements of sub-barrier breakup and their interpretation in terms of a classical dynamical model [4]. In the absence of a quantum model for transfer triggered breakup, classical trajectory models were developed, guided by experimental insights, to understand breakup and incomplete fusion in near-barrier collisions. Comparison with experimental measurements have shown how the correlations of the breakup fragments are altered by their proximity to the target nucleus at breakup [5] providing a probe of breakup timescales. These results suggest that the detailed structure of the intermediate states populated is crucial in determining the influence of breakup on fusion.
References:
[1] L. F. Canto et al., Phys. Rep. 596, 1 (2015) (and refs. therin)
[2] D. H. Luong et al., PLB 695, 105 (2011)
[3] S. Kalkal et al., PRC 93, 044605 (2016)
[4] A. Diaz-Torres et al., PRL 98, 152701 (2007)
[5] E. C. Simpson et al., PRC 93, 024605 (2016)

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