Cold molecular collisions

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This presentation aims at giving a flavor of what happens when molecular collisions (reactive or inelastic) occur at low energy / temperature, in the near cold regime (1-50 K) [1]. This domain is relevant to many objects of astrophysical interest, such as cold dense molecular clouds. In this domain, resonances (Feshbach or shape/orbiting) are predicted by theory for many systems.

The focus will be on experimental observations of reactive and inelastic collisions at low energies [2-5]. Supersonic molecular beam sources are now commonly used. However, observing the quantum nature of molecular collisions, especially at the very low energies, is conditioned by the resolution of all physical observables concerned. In particular, several possibilities to decrease the collision energies were developed [1,4,6-8] based on $E_{\mathrm{tr}} = \frac{1}{2}\mu v_{\mathrm{R}}^2 = \frac{1}{2}\mu\{v_{\mathrm{A}}^2 + v_{\mathrm{B}}^2 - 2v_{\mathrm{A}}\, v_{\mathrm{B}}\, \cos\gamma\}$ where μ the reduced mass and v_A and v_B are the velocities of the beams crossing at angle γ. The results presented will mainly focused on the first observations of resonances between neutral species [2-5]. Some implications for astrophysical interest will complete the presentation.

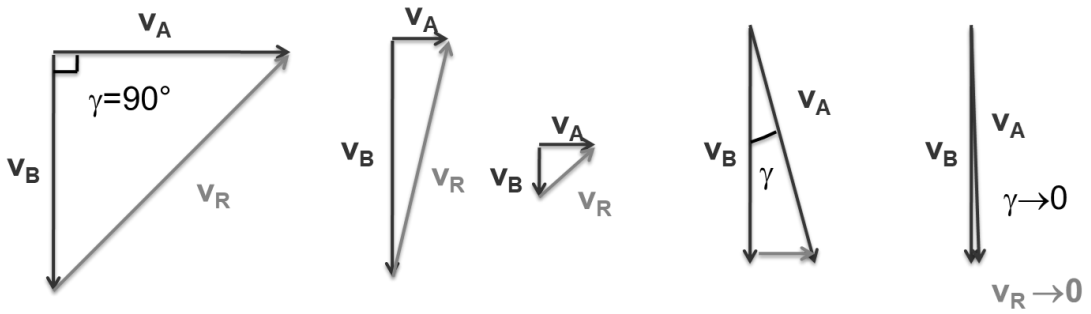

Figure 1: Beam configurations. (a) two beams at 90° with matched velocities; (b) with only one beam decelerated or (c) with the two beams decelerated with matched velocities [6]; (d) with matched velocities at γ = 20° [5]; (e) merged beams with matched velocities [4,7] or co-expansion [8].

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