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Tuning ultracold collisions of excited rotational dipolar molecules[1]

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Ultracold molecular dipolar gases often suffer from losses due to chemical reactions (or eventual sticky collisions for non-reactive molecules). Loss suppression for both bosonic and fermionic dipolar species can be obtained in a one-dimensional optical lattice but this requires usually strong confinements to get into a pure two-dimensional collision regime. An alternative way can be found without confinement using rotationally excited molecules. In this talk I will explore the ultracold collisions of rotationally excited dipolar molecules in free space. I will focus on electric dipolar molecules of KRb [1] and electric and magnetic dipolar molecules of RbSr. I will show that we can sharply tune the elastic, inelastic and reactive rate coefficients of lossy molecular collisions when a second rotationally excited colliding channel crosses the threshold of the initial colliding channel, with the help of an applied electric field. We can increase or decrease the loss processes whether the second channel is above or below the initial channel. This could lead to favorable conditions for evaporative cooling. Additionally, we include the electric quadrupole and octopole moment to the dipole moment in the expression of the long-range multipole-multipole interaction. For processes mediated by the incident channel like elastic and loss collisions, the inclusion of quadrupole and octopole moments are not important at ultralow energies. They are important for processes mediated by state-to-state transitions like inelastic collisions.

[1] G. Wang, G. Quéméner, submitted to New J. Phys. (arXiv e-prints 1411.7539).

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