

## Optical fields to control ultracold atomic/molecular collisions

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**Synopsis** Ways to suppress inelastic or reactive processes between ultracold particles using electromagnetic fields are investigated.

Research focusing on the formation of ultracold atomic and molecular quantum gases is a continuously expanding field due to its envisioned applications such as quantum-controlled chemistry or quantum simulation.

The aim of our theoretical work is to find ways to suppress inelastic or reactive processes between colliding particles in ultracold quantum gases. Using a laser field detuned to the blue of a relevant transition, we propose to couple the initial colliding particle state to a repulsive excited one, thus preventing the particles to come close to each other [1].

We intend to apply this “blueshielding” technique for ultracold quantum gases, close to quantum degeneracy. In this case, due to the extremely small collisional energies (10-100 nK) it is possible to address a single repulsive channel with the laser field, thus ensuring a full control of the suppression efficiency.

The selection of a well-defined molecular state requires the knowledge of the molecular structure down to the hyperfine scale in particular for the electronically excited molecular states. We have developed an asymptotic model [2] relying on an asymptotic description of the molecular hyperfine structure, extended to the short range.

We will present our results in case of the  $^{39}\text{K}^{133}\text{Cs}$  molecule for the first and second excited dissociation limits. We have also performed a full treatment of molecular rotation for these asymptotes. We will compare the possibilities of blue-shielding of  $^{39}\text{K}$  and  $^{133}\text{Cs}$  collision (heteronuclear molecular case) to the case of  $\text{Na} + \text{Na}$  collision (homonuclear molecular case) [3]. As a first step we consider rotational molecular states for shielding.

Prospects for the generalization to the shielding of molecule-molecule collisions will also be addressed.

## References

- [1] S. Bali, D. Hoffmann, T. Walker 1994 *Europhys. Lett.* **27** 273
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