Ultracod Collision between Spin-Orbit-Coupled Dipoles

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Synopsis We study ultracold scattering theory of two dipole with synthetic spin-orbit couplings.

Many exotic quantum phenomena can be understood from the competition between the kinetic and interaction energy. Recently, one innovative way of changing the kinetic energy, i.e. changing the dispersion relationship, has been realised via the synthetic spin-orbit interaction. This non-trivial dispersion relationship strongly modifies the scattering properties between two atoms, giving rise to special thresh-old behaviour. However, most of these studies have been focused on short-range interaction, while the scattering properties can also be strongly modified by long-range interactions such as dipole-dipole interaction.

Here, we present a theoretical study on the quantum scattering between two aligned dipoles that subject to synthetic spin-orbit couplings at ultracold temperature. Both the spin-orbit coupling and the anisotropic dipole-dipole interaction mix different partial waves, and the problem, in general, can be formulated as a multi-channel scattering calculation. We develop a modified R-matrix propagation method and numerically investigate behaviours of scattering observables such as threshold laws of scattering length.

This study will help us better understand the few-body scattering nature, which paves the way for building the microscopic model of the corresponding many-body system, such as the recent achieved spin-orbit-coupled dipolar Bose-Einstein Condensates [1].

References

[1] Y. Deng *et al.* 2012 *Phys. Rev. Lett.* **108** 125301

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