# Shielding ultracold collisions with microwave and static electric fields: similarities and differences

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Collisions between ultracold molecules often produce fast trap loss. To avoid this, shielding methods have been developed, using carefully engineered microwave or static electric fields. These methods produce long-range repulsive interactions that prevent colliding pairs approaching closer than a few hundred bohr and suppress most loss processes. This talk will explore similarities and differences between microwave and static-field shielding.

Both microwave and static-field shielding may be understood in terms of effective potentials. For scattering properties, it is most useful to consider effective isotropic potentials that govern the scattering for individual partial waves $L$, particularly s-wave scattering ($L = 0$). These effective potentials are qualitatively similar for microwave and static-field shielding [1, 2], with a repulsive wall at a few hundred bohr and a weak attractive well (asymptotically $\sim R^{-4}$) at even longer range. The balance between attraction and repulsion allows control of the scattering length and the creation of 2-molecule bound states.

Microwave shielding is almost universal, in the sense that all polar molecules have very similar scattering properties when lengths, energies and Rabi frequencies are expressed in suitable reduced units [2]. This universality extends to elastic cross sections, loss rates, scattering lengths and bound states. Static-field shielding, by contrast, depends crucially on the reduced rotational constant [3] and different molecules have quite different scattering properties and can support different numbers of bound states [4].

For condensed-matter simulations, the anisotropy of the interaction is crucial, and it is useful to consider effective potentials that include the anisotropy explicitly. If time allows, I will describe anisotropic effective potentials for static-field shielding [5] and contrast them with those for microwave shielding [6] and from earlier work on static-field shielding [7]. The differences will produce qualitatively different behaviour for condensed-matter systems shielded with microwave or static electric fields.

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