

Suppression of anisotropic interaction between ultracold polar molecules

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The obtaining of ultracold heteronuclear alkali-metal dimers opened exciting prospects for the study of ultracold quantum gases. To be able to control these molecules, a highly detailed understanding of their internal structure, the molecule-molecule long-range interactions and the molecule- external field interactions is required. Using the multipolar expansion, we characterize the long-range interactions between two ultracold heteronuclear bialkali (composed of Li, Na, K, Rb and Cs) molecules in their rovibronic ground level, both in free space and in a static electric field.

With no external field we show that for distances higher than 100-200 a.u. the interaction is dominated by the usual R^{-6} Van der Waals interaction, R being the intermolecular distance. The C_6 coefficient of the Van der Waals interaction is strongly dependent of the permanent dipole moment of the molecules and varies from 10^3 a.u. for LiNa up to 10^7 a.u. for NaCs, far higher than typical alkali atom-alkali atom long-range interaction. The molecules having no preferred orientation in free space, the R^{-3} dipole-dipole interaction averaged to zero. For low intermolecular distances a R^{-3} strongly attractive interaction appears which can be interpreted as a spontaneous mutual alignment of the two molecules.

We demonstrate that for an electric field intensity below a characteristic value the expected anisotropic dipole-dipole interactions are suppressed. For most bialkali molecules, the characteristic field is equal to 1–5 kV/cm, which can have important consequences on ultracold experiments.