Dipolar quantum gases from a few-body perspective

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Dipolar interactions between trapped atoms or molecules (see for example Lahaye et al. [1] for a review) provide an interesting new scenario where the two-body interaction becomes spatially anisotropic, being repulsive if the dipoles are aligned, but (partly) attractive when the dipoles can orientate head-to-tail. We discuss how in low-dimensional few-body systems with dipolar interactions, Wigner-localized states of different symmetry may emerge as a function of increasing coupling strength [2][3]. When set rotating, the vortex lattice in the bosonic case depends on the dipolar tilt angle. In much analogy to the vortices in quantum dots at strong magnetic fields, also in fermionic systems with dipolar interactions the vortices are revealed by the symmetry breaking through the anisotropic interaction. Progress with atom chips (see for example the review by Fortágh and Zimmermann [4]) opens exciting new perspectives for integrated systems [5]. In this context, we furthermore discuss a microscopic analogue of source-drain transport with ultracold bosonic atoms in a triple-well potential [6] and address how effects similar to Coulomb blockade in quantum dots and wires may occur with cold atoms.

The talk reviews recent work done in collaboration with with G. Bruun, J. Cremon, G. Eriksson, L.H. Kristinsdóttir, G. Kavoulakis, F. Malet and A. Wacker.

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