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Towards two-dimensional quantum gases of strongly dipolar molecules[1] ADEN LAM, NICCOLO BIGAGLI, CLAIRE WARNER, SEBASTIAN WILL, Columbia University — In recent years, ultracold atoms have been very successful in investigating strongly interacting quantum many-body systems. The experimental toolkit of atomic physics provides precise control of the interactions via external fields. Exploiting this control, ultracold atoms can be bound into deeply bound molecules that possess useful internal degrees of freedom. In particular, heteronuclear molecules in the rovibrational ground state with tunable dipolar interactions make the study of quantum systems with strong long-range interactions accessible and constitute an attractive system for quantum simulation. At Columbia, we are working towards a two-dimensional (2D) system of ultracold dipolar molecules to study novel phases in 2D quantum systems with long-range interactions. In a regime where repulsive dipolar interactions dominate, the emergence of a self-organised crystal phase is predicted. Upon reducing the interaction strength, a quantum phase transition into a dipolar superfluid is expected, as well as the possible appearance of a supersolid. In the setup under construction, we will use homogeneous electric fields - created by in-vacuum electrodes - to control the dipolar interactions. In addition, we will be able to observe the 2D quantum phases via high resolution imaging.

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