Ultracold dipolar atoms in two dimensions: from Wigner crystal to pair superfluidity and ferromagnetism

S. Giorgini
INO-CNR BEC Center, and Dipartimento di Fisica, Università di Trento, I-38123 Povo, Trento, Italy

Two-dimensional systems of ultracold atoms or molecules with strong dipolar interactions are expected to realize many interesting and exotic quantum phases. I will discuss some recent theoretical results obtained using quantum Monte Carlo methods on both dipolar fermions and bosons in single and bylayer geometries where dipoles are oriented perpendicular to the plane of motion by an external field. These include the spontaneous formation of a triangular lattice and the transition to a crystal phase at high density, a novel type of BCS-BEC crossover for Fermi superfluidity in bilayers as well as the transition to a new phase with pair superfluidity of bosons featuring peculiar drag properties between the two layers. In the case of two-component fermions on a single 2D layer with spin-symmetric dipolar repulsion, I will also discuss some preliminary results on a possible ferromagnetic transition driven by exchange interactions occurring at high density.