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Abstract for an Invited Paper
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Quantum Phases of Dipolar Molecules[1]

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I will discuss possible quantum phases of dipolar molecules focusing primarily on dipolar bosons in optical lattices and continuum systems in the two-dimensional regime. For the optical lattice case, I will discuss a few low temperature phases that emerge out of the dipolar superfluid. These phases include checkerboard supersolids, striped supersolids and collapsed [1]. The emergence of a striped supersolid is particularly interesting because the anisotropy of the dipolar interaction can be controlled externally. In the case of dipolar bosons in continuum systems, I will discuss the finite temperature phase diagram of purely repulsive interactions and show that for large dipolar repulsions a dipolar Wigner crystal appears at low temperatures and melts at intermediate temperatures into a dipolar hexatic fluid, before becoming a normal dipolar fluid at higher temperatures [2,3]. In addition, an intermediate dipolar supersolid phase is possible at low temperatures, which can also melt into a dipolar hexatic superfluid, before becoming a normal dipolar fluid at high temperatures [2,3]. Furthermore, I will discuss a generalization of Feynman's nodal theorem for interacting bosons and apply it to the ground state wavefunction of dipolar bosons to highlight the theorem's relevance to the quantum phases described [3]. Lastly, I will emphasize that the experimental characterization of theses phases may be possible via Bragg scattering and other experimental techniques.

[1] I. Danshita and C. A. R. Sa de Melo, Phys. Rev. Lett. 103, 225301 (2009).
[2] K. Mitra, C. J. Williams, and C. A. R. Sa de Melo, Arxiv 0903.4655v1.
[3] D. M. Kurkcuoglu and C. A. R. Sa de Melo, in preparation (2011).

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