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Novel quantum magnets: Dipolar quantum gases[1]

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Experimental creation of chromium condensate with large magnetic dipole moment and ultracold polar molecules with large electric dipole moment has generated significant interest in dipolar quantum gases. The long-range and anisotropic nature of the dipolar interaction potential greatly enriches the properties of the system, many of which are not present in their non-dipolar counterparts. In this talk, I will present our recent studies on dipolar BEC as well as dipolar fermions, with the emphasis on the latter which is relatively less studied. From a semi-classical calculation based upon the phase space representation of the Fermi gas, I will show how the dipolar interaction deforms the Fermi surface and manifests itself in collective excitations and time-of-flight expansion dynamics of the cloud. Finally, I will describe a self-consistent Hartree-Fock-Bogoliubov theory that also takes dipolar induced fermionic superfluid pairing into account.

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