Polarized cold cloud of thulium atom

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Quantum simulations is very fast developing field in recent year which has a lot of promises in various applications ranging from frequency standards and metrology to quantum simulation of electro-magnetic properties of solid state materials, turbulence or even formation of stars in earlier universe. Among many potential platforms for quantum simulations cold atoms certainly one of the most promising ones. In particular lanthanides have a special place in the field due to their unique properties, such as large orbital momentum and large magnetic momentum in the ground state. Large orbital momentum in ground state leads to easily tunable interactions between cold atoms via low-field Feshbach resonances, while large magnetic moment leads to relatively strong dipole-dipole interactions. In particular, thulium atom has orbital angular momentum of 3 and magnetic moment of 4 Bohr magnetons in the ground state. Besides, it has relatively simple level structure, this way combining strength of more developed Er and Dy with advantage of more clean system.

Practical implementation of quantum simulation requires nevertheless deep cooling of atoms to temperature of quantum degeneracy. Cooling of the thulium atom to the Bose-Einstein condensation (BEC) has not been achieved yet. Traditionally the last step of cooling to BEC temperatures is done via evaporative cooling either in a magnetic or in an optical dipole trap. Reaching BEC temperatures requires polarization of atomic cloud in the trap to increase phase density of the atomic ensemble. Several methods of polarization of an atomic cloud in dipole trap were suggested previously. Among them are polarization by optical pumping, microwave-assisted polarization and polarization of atomic ensemble in highly detuned magneto-optical trap (MOT) prior to loading into the dipole trap. The last method has advantage of absence of heating on polarization step as well simplicity (no extra laser or microwave source is required).

In this contribution, we report on loading of polarized ensemble of thulium atoms into optical dipole trap and provide measurement of reached degree of polarization.