Realization of an ytterbium condensate in the ground state and prospects of the metastable condensate

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Abstract:

Bose-Einstein condensation (BEC) has been observed in alkali atoms, hydrogen and metastable helium. Extending atomic species beyond these atoms is an important step for a future investigation. In particular, a BEC of two-electron atoms such as ytterbium (Yb) and alkaline-earth atoms is remarkable because of their propaties such as narrow intercombination transitions, simple structure of the spinless ground state, and metastable triplet states.

After we originally developed laser-cooling and -trapping of Yb atoms [1], we archived a BEC of Yb atoms by all-optical method [2]. Through evaporative cooling of high-density ^{174}Yb atoms by ramping down the trap depth in far-off resonant trap (FORT), we observed anisotropic expansion after release from the FORT, which is characteristic of BEC. The obtained scattering length is consistent with the result of our photoassociation experiment [3].

Finally, I will describe on our recent experimental result: optical excitation into the metastable state. Trapping atoms in the metastable $^3P_2$ states are important because various novel features of atoms in the $^3P_2$ state are theoretically predicted, such as existence of pure-long state molecules and anisotropic interaction between atoms [4]. Up to now, we successfully observed optical excitation of trapped atoms in the ground $^1S_0$ state to the $^3D_2$ state and subsequent spontaneous decay into the $^3P_2$ state.

References:

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[2] Y. Takasu *et al.*, Phys. Rev. Lett. **91**, 040404 (2003).

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[4] A. Derevianko *et al.*, Phys. Rev. Lett. **90**, 063002 (2003).

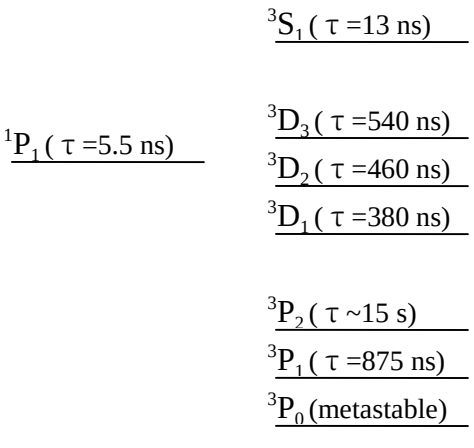

Figure: Related energy leves of Yb