PHOTOASSOCIATION SPECTROSCOPY OF YTTERBIUM ATOMS WITH DIPOLE-ALLOWED AND INTERCOMBINATION TRANSITIONS

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We present our recent experimental results of photoassociation spectroscopy (PAS) of Yb atoms. The intercombination ($^1S_0$-$^3P_1$) transition has been used for PAS of four isotopes. Because of the narrow linewidth of the intercombination transition, rovibrational levels very close to the dissociation limit can be resolved. Taking advantage of this feature, we have observed a novel purely long-range state of ^{171}Yb due to the interplay of the hyperfine interaction and the resonant dipole interaction. A comparison of the transition intensity from the d-wave scattering state between ^{174}Yb and ^{176}Yb suggests the existence of a d-wave shape resonance for ^{174}Yb[1] . An experiment of optical Feshbach resonance is also underway.

PAS of the dipole-allowed ($^1S_0$-$^1P_1$) transition has been carried out to determine the scattering property of ^{174}Yb. The s-wave scattering wave function has been reconstructed from the photoassociation efficiency to various vibrational states, and we have deduced that the C_6 potential coefficient of the ground state is 1960 ± 400 a.u. and the s-wave scattering length is 5.54 ± 0.19 nm. This value of the scattering length is consistent with the property of ^{174}Yb BEC. Two-color PAS of ^{174}Yb has been successfully performed, and the result agrees with the result of the dipole-allowed one-color PAS.

Some topics other than PAS will also be presented briefly, such as trapping of metastable state atoms and achievement of quantum degenerate gases of some isotopes.

[1]S. Tojo *et al*., *Phys. Rev. Lett*. **96**, 153201 (2006).