Temperature Behaviour of Fano-Feshbach Resonances in Ultra-Cold Thulium at Low Magnetic Fields

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Fano-Feshbach resonances serve as a powerful instrument to control inter atomic interactions. In order to be able to control interactions between atoms in our experiments with ultra cold thulium we have measured spectra of Fano-Feshbach resonances [1].

In order to measure such resonances in ultra cold thulium atom loss spectra were measured in optical dipole trap for several temperatures from 2 to 12 μK in $0 - 26$ G magnetic field range. We found that the density of resonances rises with temperature from 2 to 3 resonances per Gauss due to appearance of new resonances. Appearance of new resonances in rare-earth atoms was understood theoretically and demonstrated experimentally previously [2]. The higher temperature resonances were associated with higher order collisional partial waves.

The change in positions for both types of resonances was investigated for various temperatures. The effect of negative shift in positions of some resonances was observed and is understood as Stark shift, appearing due to the light power change in the optical dipole trap accompanying change of the temperature of the atomic cloud. Besides the novel effect of transformation in statistics of resonances with temperature was found. Namely at low temperatures the distribution of resonance spacings is close to random, typical for non-interacting resonances while at higher temperatures this distributions becoming chaotic.

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