Laser cooling of atoms using a frequency comb

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Laser cooling has revolutionized the field of atomic and molecular physics. Its applications range from atomic interferometry, optical frequency standards, high precision spectroscopy, to ultracold chemistry and simulations of complex many-body interactions.

Despite the fact that laser cooling is a mature research field, it is still limited to atoms with simple level structure and transitions in the visible spectrum range. One of the major obstacles is the unavailability of continuous-wave (cw) laser sources in the UV spectrum. Possible solution of this problem presents itself in the form of a frequency comb (FC), with its high peak power needed for efficient frequency conversion via nonlinear effects.

Furthermore, the FC has been proposed as a laser source for cooling atoms with complex level structures and for simultaneous cooling of multiple atomic species.

We report on the laser cooling of ^{87}Rb atoms with a frequency comb centered at 780 nm and repetition rate of 80.5 MHz. Rb atoms are precooled in a standard 6-beam MOT geometry, reaching a cloud temperature of approximately 170 μK then the frequency comb interacts with the cold atomic cloud in 1D geometry in the lin $\perp$ lin polarization configuration. We investigate the dependence of the final atomic temperature on the FC detuning from the ^{87}Rb cooling transition, interaction time and FC intensity.

Keywords: FREQUENCY COMB, MOT, ^{87}RB TEMPERATURE, DETUNING.