Frequency comb cooling of atoms below the Doppler limit DAMIR AUMILER, NEVEN ŠANTIĆ, DANIJEL BUHIN, DOMAGOJ KOVACIĆ, IVOR KRESIĆ, TICIJANA BAN, Institute of Physics — One of the main obstacles that prevents the extension of laser cooling techniques to a variety of atomic species is associated with technical difficulties in creating continuous wave (cw) laser light in the vacuum ultraviolet spectral range. This issue can be addressed using mode-locked femtosecond lasers with high pulse repetition rates which produce optical frequency combs (FCs). FCs provide high peak powers needed for efficient frequency conversion via nonlinear crystals or high harmonic generation, while simultaneously preserving long coherence times needed for efficient laser cooling. Hence, laser cooling schemes with FCs have been proposed, and FC cooling of atoms and ions has recently been demonstrated. We will present results of Doppler cooling of rubidium atoms using a FC. This cooling scheme is analogous to cw laser cooling as only a single comb line is involved in the cooling process. We complement the experimental results by theoretically modeling the resonant excitation of atoms by two counter-propagating beams of a FC, i.e. 1D FC cooling. We will demonstrate that the analogy with cw laser cooling goes beyond the Doppler limit, and that sub-Doppler temperatures can be achieved with FC cooling using standard orthogonal linear and orthogonal circular polarizations.

Damir Aumiler
Institute of Physics

Date submitted: 01 Feb 2019

Electronic form version 1.4