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ФАКУЛТЕТЕН СЕМИНАР

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Ultra-Cold beams: atoms, molecules, ions and electrons

Laser techniques applied to precision spectroscopy, to control of atomic beams or to govern chemical reactions have improved considerably our knowledge on atomics and molecular physics. In a first part, as a new source for Focused Ion Beams and Electron Beams, we propose to ionize the high flux of an effusive atomic beam which is transversely cooled and compressed by lasers to increase its brightness. The very low transverse temperature (mK range) and the relative low density of the starting atomic sample ensure excellent initial conditions for obtaining bright and monochromatic charge sources. In contrast to the standard photoionization techniques used by similar sources, we use field ionization of Rydberg atoms which ameliorates several existing problems, including the required laser power, the effects of chromaticism created during the ionization process and the stochastic space charge effect. Possible application for new microscopes, lithography or implantation are forseen.

In a second part we shall present our attemps to generalize this procedure to a molecular beam. Following our pioneer work [Science **321**, 232 (2008)] we have considerably generalized the optical pumping method and we are now able to transfer levels of Cs_2 molecules on demand into a single ro-vibrational level (including v = J = 0) of the singlet ground electronic state [Phys. Rev. Lett. **109**, 183001 (2012)]. Finally, combined with Sisyphus cooling this method is probably able to produce a collimated beam or even a large sample of traped molecules at sub-mK temperature. Theoretical modeling and perspective ideas of this emerging technology will be given.