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Laser cooling of solids: Towards absolutely cold quantum nanoobject

The physics of mesoscopic systems, i.e. the systems with characteristic size of 1–100 nm, is a new area of science occupying an intermediate position between the quantum (microscopic) and classical (macroscopic) physics. The appearance of mesoscopic physics follows the latest advances in the techniques of trapping, manipulating, and laser cooling of different nanoobjects. Using the optical tweezers, RF trap, magneto-gravitational potentials, or acoustic fields for spatial localization of a nanoobject, we can implement the optomechanical system that is extremely well isolated from the environment. A fundamental question of a particular interest addresses the way to transfer the classical nanoobject into a quantum state and vice versa. As of today, widely used methods for nanoobject cooling can achieve translational temperatures of a few hundred microkelvin, which is several orders greater than the quantum temperature limit of the transition to a quantum state. If such quantum nanoobject can additionally be internaly cooled, we can obtain an absolutely cold quantum nanoobject with unique physical properties. In this talk, I will describe some of the recent advances and future opportunities in both internal and translational cooling of doped nanocrystals and quantum dots localized in optical or RF traps.

Biography

Andrei Ivanov is a Head of the Department of Optical Physics and Modern Natural Science at the ITMO University. He received his degree as a Candidate of Physical and Mathematical Sciences in 2007. His main fields of interest are nano-photonics, nonlinear optics, and laser cooling of solids. His current research activities focus on multi photon transitions in the bulk and on the surface of the semiconductors of different dimensions; pre-breakdown generation of free carriers in the insulators and semiconductors caused by the ultra-short pulse laser radiation; photon avalanche effect in the semiconductors and heterostructures, and dynamical Stark effect. His research at the ITMO University has been supported by the Russian Foundation for Basic Research and the Ministry of Education and Science of the Russian Federation. He is the Member of the D S Rozhdestvensky Optical Society and the Optical Society of America (OSA).

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