Friday October 3, 2014
Seminar 10:00 AM
BRK, ROOM 2001

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"Electrodynamic description of a spaser: shape, size, modes, minimal threshold and saturation"

A spaser is a nano-optical light generator utilizing plasmonic modes of metallic nano-particles (NP). Its similarities with the conventional laser are discussed within an electrodynamic framework. Methods to decrease the threshold for optical pumping by varying the NP shape, size, and spasing modes are considered. Universal dependences, figures of merit, and the role of saturation are illustrated with analytical and numerical examples.

In the electrostatic limit (small particles), the threshold gain depends only on the dielectric constants of the metal and the gain material. A variation of nanoparticle shape, composition, or spasing mode may only shift the plasmonic resonance to a wavelength where the dielectric constants define a minimal threshold, but it cannot improve this material-imposed optimum. This general argument is illustrated by detailed numerical studies of the lasing thresholds for two experimentally relevant geometries: silver spheroids and spherical shells embedded into a gain material. For both cases, we include retardation for finite-sized particles. This allows us to quantify how an increasing particle size increases the spasing threshold.

The operation of a continuous spaser above threshold can be described within a purely electrodynamic framework with an intensity-dependent dielectric function. This allows one to obtain local fields and cross-sections in both self-oscillating and driven regimes.

Brief Bio: Dr. Nikita Arnold graduated from the Moscow Institute of Physics and Technology (MIPT) in 1987 and got his PhD in Radiophysics from MIPT/General Physics Institute (GPI, Russian academy of science, Moscow) in 1991. Since then he held various positions at GPI, Columbia University, Oak Ridge National Laboratory, and Johannes Kepler University in Linz, Austria. He has co-authored more than 70 articles on laser material processing, dielectric elastomer actuators and, recently, nano-optics.

Hosted by Alexander Kildishev, Associate Research Professor of Electrical and Computer Engineering