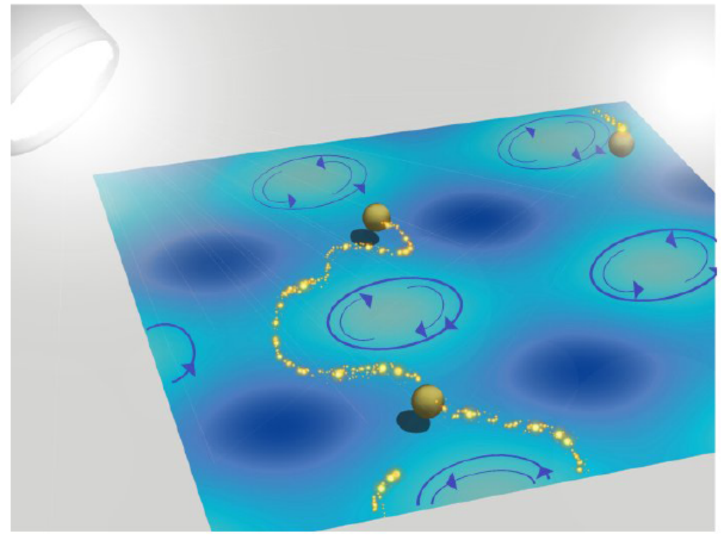
The Institute of OPTICS

Research Seminar

UNIVERSITY OF ROCHESTER

Resonant Optical Forces on Metallic and Dielectric Nanoparticles



Prof Juan José Sáenz

Depto. Física de la Materia Condensada,
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PhD UAM Madrid, 1987
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We will describe the interaction of fields with non-uniform spatial distribution with metallic and dielectric nanoparticles. We will also discuss the peculiar particle dynamics in the non-conservative force field of an optical vortex lattice.

Special Time and Place
2:30 pm, Friday, Apr 1, 2011
Wilmot 116
Refreshments served

HAJIM
SCHOOL OF ENGINEERING & APPLIED SCIENCES

Resonant Optical Forces on Metallic and Dielectric Nanoparticles

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Abstract: Light forces on small (Rayleigh) particles are usually described as the sum of two terms: the dipolar or gradient force and the scattering or radiation pressure force. The scattering force is traditionally considered proportional to the Poynting vector, which gives the direction and magnitude of the momentum flow. However, as we will show, when the light field has a non-uniform spatial distribution of spin angular momentum, an additional scattering force arises as a reaction of the particle against the rotation of the spin. This non-conservative force term is proportional to the curl of the spin angular momentum of the light field. The unusual properties of the optical forces acting on particles with both electric and magnetic response will also be analyzed. We will focus on nanometer-sized spheres of conventional semiconductor materials, like Silicon (Si) or Germanium (Ge), which have extraordinary electric and magnetic optical properties in the infrared-telecom range of the electromagnetic spectrum.

We will also discuss the peculiar particle dynamics in the non-conservative force field of an optical vortex lattice . Radiation pressure in the vortex field (arising in the intersection region of two crossed optical standing waves) plays an active role spinning the particles out of the whirls sites leading to a giant acceleration of free diffusion. Interestingly, we show that a simple combination of null-average conservative and non-conservative steady forces can rectify the flow of damped particles. We propose a “deterministic ratchet” stemming from purely stationary forces [6] that represents a novel concept in dynamics with considerable potential for fundamental and practical implications.

Biography: Juan José Sáenz is Professor at the Condensed Matter Department of the Universidad Autónoma de Madrid (UAM). Since 1993 he runs the Moving Light and Electrons (MoLE) group at UAM. He joined the UAM as Assistant Professor in 1982 where he worked on the stability and equilibrium properties of small clusters and crystals in Prof. N. García’s group. He was also involved in the first works on magnetic force microscopy (MFM) in collaboration with Prof. Güntherodt’s group in Basel. In 1987 he obtained his PhD from UAM. During his post-doc, he worked on electron field emission from nanotips in Dr. H. Rohrer’s group at IBM-Zürich.

From 1989 to 2006 he was Associate Professor at UAM. In 2003 he was Invited Professor in the EM2C-(CNRS) Lab. at École Centrale Paris. Since 2007 he is Full Professor at UAM. His research interests include theoretical modelling of scanning probe microscopies (SPM), quantum electron transport through nanocontacts, light scattering and wave transport through complex media. He is co-organizer of the “Trends in Nanotechnology” (TNT) conference series.