CCT Colloquium Series

Nanophotonics: From Imaging With Super Resolution to Mimicking Celestial Phenomenon in the Lab

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Abstract:
In this talk, I will present some of the current advances in our understanding of the fundamental processes of wave-matter interactions at the nanoscale. Specifically, I will focus on two distinct subfields as a part of the rapidly developing discipline of nanophotonics. First, I will introduce a new type of complex media, inhomogeneous in nature but with hidden symmetries, which has attracted much attention in recent years. I will show that illumination of the nano-structured metal films, with an electromagnetic field, results in energy localization at the nanoscale and large enhancement of the local photon densities. The enhancement of the local fields corresponds to excitation of localized collective electronic modes - surface plasmons. At critical metal concentrations (percolation threshold), the metal films are self-similar or fractal in nature. Thus, for a wide range of incident wavelengths, resonating clusters exist in the composite. This broad optical response results in anomalous EM properties of the composites, which makes them ideal for applications in bio-sensing and nonlinear optics. In the second part of my talk, I will extend my presentation into the area of novel artificial metamaterials. Specifically, I will review the current state of art for exciting strong magnetic response in the optical range. I will show that arrangement of artificial magnetic elements in 1D or 2D structures could be used to develop sub-wavelength transmission lines, and may lead to novel optically active materials. In conjunction with an electric response, resonant magnetic nanostructures could serve as an effective media with negative index of refraction, providing imaging with unsurpassed optical resolution. Finally, a new direction for the field of metamaterials is proposed that is to mimic with photons celestial phenomenon such as orbital motion, light trapping and formation of chaos. Specifically, realistic metamaterial designs will be presented to provide laboratory environments for studies of light dynamics in close proximity to massive gravitational objects. Revisit of the Bertrand theorem for the stability and closeness of orbital motion for photons will be presented with important ramifications for development of novel highly stable photonic traps and cavity lasers.

Speaker's Bio:
Dr. Genov received the equivalent of a European Master of Science degree in Theoretical Physics from Sofia University, Bulgaria, and an MS degree in Physics and a minor in Computer Science from New Mexico State University. He also holds a Doctoral degree in Electrical & Computer Engineering, and a MSAA degree in Aeronautics & Aerospace Engineering, both from Purdue University. In 2005, Dr. Genov joined the NSF Nanoscale Science and Engineering Center, at the University of California at Berkeley as a research associate. Since 2008 he is an assistant professor of Physics and Electrical Engineering and LONI Institute Fellow at Louisiana Tech University. Dr. Genovâ��s research has resulted in the publication of two book chapters and more than 50 papers in leading peer-reviewed journals including Nature, Nature Photonics and Physical Review Letters.

Refreshments will be served.
This lecture has a reception.

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