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Optics, optoelectronics and nanomechanics using atomically thin materials

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Recent progresses in the fundamental knowledge of low-dimensional systems and nanomaterials have opened up enormous possibilities for diverse applications. In this context, the development of a broad range of atomically thin, layered materials have become an exciting new direction of research for a large community of physicists, chemists, materials scientists, electrical and mechanical engineers alike. The meteoric rise of graphene as a 2D functional material for a range of applications has paved the way for the "discovery" of a wide variety of other 2D, atomically thin, and layered materials with a broad range of electronic and optical properties. In this talk, the author will present some of our recent results in photonics, optoelectronics and nanomechanics using some of these atomically thin materials, focusing on the theme of structural and functional tunability of these materials. Specifically, author will discuss how graphene can be used to design tunable photo detectors and ultrafast actuators with extremely high performances. Further, the author will talk about how quantum size-effects can be used to widely tune the optical properties of bismuth selenide, and present an array of exciting new results from atomically thin molybdenum disulfide. Finally, author will introduce the idea of 2D alloys - materials with tunable compositions in a purely 2D lattice. These materials and systems are just a small representative of the new field of 2D materials that can potentially revolutionize materials science in the next decade.

Biography

Swastik Kar is an Assistant Professor at Northeastern University at Boston, USA. He obtained his PhD in Physics from the Indian Institute of Science, Bangalore, India, in 2004. His interests lie in the fields of synthesis, characterization, physics and applications of graphene and other 2D and carbon-based nanomaterials. He has published over 50 papers including in journals such as *Nature Materials, Nature Nanotechnology, Nature Photonics, Nature Communications, Nano Letters, ACS Nano* and *Physical Review Letters*. He has h-indexes of 20 (ISI Web of Science) and 22 (Google Scholar), and is the recipient of a 2014 NSF CAREER award.

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Atomic nucleus as a mesoscopic system

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Complex atomic nuclei, similarly to complex atoms, molecules, and nanostructures of condensed matter, are typical mesoscopic objects. They are self-bound quantum many-body systems of strongly interacting constituents with clearly pronounced statistical regularities, where at the same time individual quantum states can be studied, experimentally and theoretically. The nuclei reveal the unique combination of single-particle (shells), collective (deformation, vibration, rotation, and superfluidity) and chaotic phenomena. In this talk I will discuss manifestations of quantum chaos in nuclei as a theoretical, experimental and computational tool. In particular, the violations of fundamental symmetries of nature (spatial inversion and time reversal) can be significantly enhanced in nuclei due to the special interplay of chaotic and structural effects. A related topic is thermalization in a closed quantum system without a heat bath where the driving force is provided by interparticle interactions. Finally I will touch the physics of open and marginally stable many-body systems, the main direction of the current development at the frontiers of modern nuclear physics.

Biography

Vladimir Zelevinsky has completed his PhD from the Moscow State University in Russia and then worked for many years at the Budker Institute of Nuclear Physics in Novosibirsk. He spent three years as Visiting Professor at the Niels Bohr Institute in Copenhagen. From 1992 he is Professor at the Michigan State University. He has published more than 200 papers in reputed journals and serving as Deputy Editor of the *EPL Journal* and Associate Editor of Nuclear Physics A Journal.

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