INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

2A & 2B, Raja S.C. Mullick Road, Jadavpur, Kolkata-700032, India

Seminar Notice

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School of Physical Sciences

Title:	**Metasurface Empowered Flat-Optics for Microwave Applications**
Speaker:	**Abul K. Azad, MPA-CINT, MS K771, Los Alamos National Laboratories, USA**
Date:	**December 16, 2019 (Monday)**
Time:	**14:00 Hours**
Venue:	**C.V.Raman Hall, 2nd Floor, Main Building, IACS**
Abstract:	Metamaterials, artificial composites of subwavelength resonators, have enabled a number of unprecedented electromagnetic phenomena including negative index of refraction, super resolution imaging, electromagnetic cloaking, which are not possible to realize in natural materials. The electromagnetic (EM) properties of the natural material are mainly determined by their chemical elements and corresponding chemical bonds. In contrast, the EM properties of the metamaterial are defined by the resonant interactions of constituent resonators with the incident light. This allows tailored scattering properties (amplitude/phase) of the metamaterials to any desired value by controlling the size, shape, and relative arrangement of these subwavelength inclusions. The complex fabrication methods or three-dimensional metamaterials can be very challenging. A single layer metamaterial, often called metasurface, is the simplest form of metamaterials, which is easy to fabricate using traditional photo/chemical etching, lithography, and imprinting fabrication methods. However, a single layer metasurface suffers from low efficiency, which was further improved by employing few-layered metasurface. The few-layered metasurfaces have shown enhanced electromagnetic properties for realizing ultrathin optical components such as perfect absorber, polarization converter, chirality manipulator, phase/amplitude modulator, and flat-optical component, which are scalable from microwave to visible wavelengths. Recently, we have demonstrated a metasurface-based high-efficiency microwave flat lens. The tri-layer lens demonstrates focusing/collimating of broadband microwave radiations from 7.0 to 10.0 GHz, with a total gain of 29 dBi at the central wavelength 9.0 GHz while fed by a rectangular horn antenna. The measured focal length agrees reasonably well with design, achieving a 3dB directionality < 4.5° and confirming high-quality beam collimation along the propagation direction [1]. Also, we designed and demonstrated metasurface-based ultra-lightweight off-axis flat reflectarrays for microwave beam collimation and focusing, similar to a parabolic dish-antenna. Our ultrathin reflectarray exhibits a measured gain of 27.5 dBi at the central operating frequency of 11.8 GHz and a 3 dB directionality < ± 1.60 with an off-axis angle of 30° [2]. Finally, we have demonstrated a dynamic metasurface for active microwave beam steering without any movable components. The demonstrated device will enable low-cost, lightweight, and high-gain deployable transceivers for small-satellite platforms. **References:** 1. A. K Azad, A. Efimov, S. Ghosh, J. Singleton, A. J. Taylor, and Hou-Tong Chen, Applied Physics Letters 110, 224101 (2017) 2. S. Silva et. al., Scientific Reports, 2019 (Submitted)

All are cordially invited to attend the seminar