Old Dominion University
Department of Physics

Virtual Colloquium

Tuesday, March 23, 2021
3:00 pm

"Harnessing atomic defects in flatland for quantum information science and technologies"

Dr. Pankaj K. Jha
Thomas J. Watson Laboratory of Applied Physics and Materials Science
California Institute of Technology

Abstract: Single-photon emitters (SPEs) are elementary building blocks for scalable quantum technologies, including quantum communications, quantum computing, and quantum sensing. Recent discoveries of quantum light emission from two-dimensional van der Waals (vdW) layered materials have introduced promising candidates for SPEs. In contrast to bulk materials, vdW materials offer easier integration into photonic devices and lack of surface dangling bonds as well as the reduced symmetry of these materials results in minimal coupling between the defects and the solid lattice.

In this talk, I will discuss SPEs in hexagonal boron nitride (*h*BN) that has received particular attention owing to its enticing properties, such as high photostability and brightness at room temperature, minimal loss due to refractive index mismatch with free space, and small coupling to phonon modes which results in high Debye-Waller factor. First part of my talk will be devoted to answering two fundamental questions about *h*BN color centers: (1) Where are these color centers located in a multilayered flake and (2) What is the orientation of their dipole moment? Further, I will shine light on different spectral broadening mechanisms of these color centers which is critical for realizing indistinguishable photons. In the second part of my talk, I will discuss our ongoing work on using *h*BN color centers for photon addition quantum technology, applied to the imaging of geosynchronous objects. Finally, I will conclude by presenting my vision for this quantum hardware platform, outlining its usages for on-chip light sources, quantum sensors, and hybrid quantum interfaces, to name a few.

BIO: Dr. Pankaj K. Jha is a Postdoctoral Research Associate with Prof. Harry Atwater at the California Institute of Technology. His research is focused on building quantum hardware with atom-like defects in crystals to nanomaterials, metamaterials and their hybrid combinations. Prior to Caltech, he was a postdoctoral scholar with Prof. Xiang Zhang at UC Berkeley. At Berkeley, his research on interfacing quantum optics with materials science was highlighted by Berkeley National Lab, Kavli Foundation, Moore Foundation, Nature Photonics, and others. For this work, he was selected as one of the finalists for the Tingye Li Innovation Prize 2016 for early career professionals. Dr. Jha received his Ph.D. in Physics under the supervision of Prof. Marlan Scully at Texas A&M University. His doctoral work was recognized with several awards, including Robert A. Welch Foundation Fellowship and Herman F. Heep and Minnie Belle Heep Foundation Fellowship.

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