PHYSICS COLLOQUIUM:
Holography and the Pandemic:
Using holographic video microscopy for rapid immunoassays

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Date:
9/4/2020

Time:
10:30 AM-11:50 AM

Link:
Please email snsgradstaff@ucmerced.edu for Zoom link and passcode

About The Speaker:

David Grier is a Professor of Physics at New York University and Director of NYU's Center for Soft Matter Research. He received his PhD in Physics from the University of Michigan and was a postdoc in Experimental Condensed Matter Physics at AT&T Bell Laboratories. He then joined the faculty of Physics at the University of Chicago, where he was a member of the James Franck Institute and the Institute for Biophysical Dynamics. Grier moved to NYU in 2004 as the founding member of the CSMR. His research program seeks out principles of self-organization in many-body systems with a particular emphasis on organization driven and revealed by wave-matter interactions. As part of this effort, his group has pioneered the use of computational holography for control and characterization of soft-matter systems, including the first experimental demonstration of real-life tractor beams. A serial entrepreneur, Grier is a member of the National Academy of Inventors and has been named a Te chnology Pioneer by the World Economic Forum. He is a Fellow of the American Physical Society, a Packard Fellow and has won the undergraduate teaching awards at both the University of Chicago and NYU.

Abstract:

The hologram of a microscopic object encodes information about that object's size, shape, composition and three-dimensional position. Often, that information is retrieved by computing a three-dimensional reconstruction of the complex medium and then analyzing the result. The three-dimensional reconstruction, however, contains no more information than the original two-dimensional hologram (and usually less). In special cases, the recorded hologram instead can be fit, pixel-by-pixel, to the exact Lorenz-Mie theory of light scattering. For a micrometer-scale colloidal sphere, this analysis yields the position to within a few nanometers over a range extending to hundreds of micrometers. More importantly, it yields the sphere's diameter to within a couple of nanometers. This is fine enough to monitor molecules and viruses binding to the surfaces of functionalized beads simply by watching the beads grow larger in real time. The same analysis yields the bead's refractive i ndex with part-per-thousand resolution, which elegantly solves the barcoding problem for multiplexed binding assays. This talk will explain how to use holographic microscopy for precision particle characterization. It then will showcase a few practical and scientific applications that illustrate the power of the technique before diving into the emergency application for COVID-19 testing.

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