Northeastern University

SEMINAR
Quantum Materials and Sensing Institute (QMSI)

"Optically driven quantum liquids in one dimension"

Prof. Matteo Mitrano

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Friday, March 27, 2026, 11:00am – 12:00pm
Venue: Elliott Hall – Room 130C
147 South Bedford St, Burlington, MA

The seminar is both in person and online

Abstract:

A key frontier of modern condensed matter is to harness light–matter interaction to coherently engineer quantum states in materials. Under optical driving, quantum materials exhibit emergent many-body phenomena, from ultrafast switching to dynamical quantum states without equilibrium analogs. Progress hinges on using light to both uncover new nonequilibrium states and devise strategies to stabilize them far beyond the duration of the drive.

One-dimensional Mott insulators are particularly compelling platforms for these goals. Electron fractionalization produces highly entangled ground states that are exceptionally responsive to optical perturbations, and theory predicts exotic ordering phenomena upon photoexcitation. In this talk, I will show how ultrafast X-ray spectroscopy provides a direct, microscopic view of these dynamics by resolving charge and spin responses of optically driven phases. I will discuss our observation of a photoinduced Tomonaga–Luttinger liquid state in the one-dimensional cuprate chain Sr_2CuO_3. I will then show how nonequilibrium states can be stabilized for nanosecond timescales by leveraging symmetry constraints in the parent ladder compound $Sr_{14}Cu_{24}O_4$.

Bio: Matteo Mitrano is an experimental condensed matter physicist. He received his PhD in 2015 for his work at the Max-Planck Institute for the Structure and Dynamics of Matter in Hamburg (Germany) and then continued his research at the University of Illinois at Urbana-Champaign (USA) as a Feodor Lynen postdoctoral fellow funded by the Alexander von Humboldt Foundation. Since 2020, he has been Assistant Professor of Physics at Harvard University (USA). His research investigates fundamental problems in quantum materials and their nonequilibrium properties, pursuing quantum control of strongly correlated electronic phases through advanced ultrafast optical and scattering probes in his laboratory and at large-scale facilities. His work has been recognized with the LCLS Young Investigator Award (2019), the PRISM Prize of the Italian National Research Council (2021), the U.S. Department of Energy Early Career Award (2022), the IUPAP Early Career Award for Structural Dynamics (2024), a Mercator Fellowship of the German Physical Society (2025), and a Alfred P. Sloan Research Fellowship in Physics (2026)