# SEMINAR SERIES

## PHOTONICS INITIATIVE

ADVANCED SCIENCE RESEARCH CENTER
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## *From Maxwell bilayers to superkagome lattices*

The fate of topological edge modes under increased geometric complexity

**Abstract** – Elastic metamaterials are structural materials that owe their unique wave manipulation capabilities to their complex internal architecture. Topological metamaterials are a special subclass of metamaterials whose behavior is controlled by the topology of their phonon bands. In this talk, I will discuss the mechanics of a class of metamaterials known as topological Maxwell lattices. While these systems have been the object of extensive theoretical investigation, their treatment has typically been limited to ideal configurations, confined to the static limit, and restricted to 2D configurations.

In this talk I will address the following questions, that are both philosophical and practical. What is the fate of topologically protected phenomena, such as topological edge modes and polarization, when we increase the level of geometric and kinematic complexity of the lattices, either by adding dimensions or by considering more intricate inter-cell connectivity? What is their robustness against the onset of the structural non-idealities that are commonly encountered in realistic lattices fabricated using any of the available additive or subtractive manufacturing methods? What new opportunities for mechanical functionality arise from incorporating these effects in their design?

Assisted by laser vibrometry experiments, I will show that it is possible to design bilayer structures in which coupling mechanisms transfer the in-plane topological polarization of the individual layers to the out-of-plane degrees of freedom, leaving a strong signature of topological polarization in the flexural response. Then I will introduce a framework for cell augmentation, by which one can generate kagome macrocells that can be assembled into “superkagome” lattices, and I will discuss non-trivial and unexpected connections between the polarization of these macrocells and their primitive counterparts.

**Bio** – Stefano Gonella is the James L. Record Professor in the Department of Civil, Environmental and Geo- Engineering at the University of Minnesota. He received Ph.D. and M.S. in Aerospace Engineering from Georgia Tech in 2007 and 2005, respectively, following a Laurea, also in Aerospace engineering, from Politecnico di Torino in 2003. Before joining the University of Minnesota, he was a post-doctoral associate at Northwestern University. His research interests revolve around the modeling, simulation and experimental characterization of dynamical phenomena in architected materials, phononic crystals, and acousto-elastic metamaterials. His latest efforts have been directed towards understanding the role of topological states of matter in the design of mechanical metamaterials. He was recipient of the NSF CAREER award in 2015. During the 2023-2024 academic year he is the William R. Kenan Visiting Professor for Distinguished Teaching at Princeton University.

## STEFANO GONELLA

University of Minnesota

**Date:**
Monday October 30, 2023

**Time:**
1:00pm – 2:00pm

**Location:**
ASRC Auditorium
85 Saint Nicholas Terrace
New York, NY 10031

**Host:**
Andrea Alù, Director,
Photonics Initiative, ASRC,
CUNY GC

This is an in-person seminar.
If you opt to join via zoom use meeting ID 835 3483 3037, Passcode 841237

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