

Center for Applied Mathematical Sciences Distinguished Lecturer, Spring 2023



Gigliola Staffilani

Abby Rockefeller Mauze Professor
Department of Mathematics
Massachusetts Institute of Technology

On the wave turbulence theory for a stochastic KdV type equation

Abstract: This talk is a summary of a recent work completed with Binh Tran. Starting from the stochastic Zakharov-Kuznetsov (ZK) equation, a multidimensional KdV type equation on a hypercubic lattice, we provide a rigorous derivation of the 3-wave kinetic equation. We show that the two point correlation function can be asymptotically expressed as the solution of the 3-wave kinetic equation at the kinetic limit under very general assumptions: the initial condition is out of equilibrium, the dimension is $d > 1$, the smallness of the nonlinearity is allowed to be independent of the size of the lattice, the weak noise is chosen not to compete with the weak nonlinearity and not to inject energy into the equation. Unlike the cubic nonlinear Schrödinger equation, for which such a general result is commonly expected without the noise, the kinetic description of the deterministic lattice ZK equation is unlikely to happen. One of the key reasons is that the dispersion relation of the lattice ZK equation leads to a singular manifold, on which not only 3-wave interactions but also all m -wave interactions are allowed to happen. To the best of our knowledge, this work provides the first rigorous derivation of nonlinear 3-wave kinetic equations. Also, this is the first derivation for wave kinetic equations in the lattice setting and out-of-equilibrium.

Tuesday, January 17, 2023

Kaprielian Hall

**Reception: 3:00 p.m.
KAP 410**

**Lecture: 3:30 p.m.
KAP 414**

**Wine & Cheese: 4:30 p.m.
KAP 410**

CAMS Director:
Susan Friedlander
susanfri@usc.edu



Gigliola Staffilani's research concerns dispersive partial differential equations.

After postdoctoral studies at the Institute for Advanced Study, Stanford University, and Princeton University, Staffilani took a tenure-track faculty position at Stanford in 1999, and earned tenure there in 2001. While at Stanford, she met her husband, Tomasz Mrowka, a mathematics professor at MIT, and after a year and a half found a faculty position closer to him at Brown University. She moved to MIT in 2002, where, in 2006 she became the second female full professor of mathematics.

She has received many honors and awards in recognition of her research. Staffilani was a Sloan Fellow from 2000 to 2002. In 2009-2010 she was a member of the Radcliffe Institute for Advanced Study. In 2012 she became one of the inaugural fellows of the American Mathematical Society. In 2014 she was inducted into the American Academy of Arts and Sciences. In 2021, she was elected to the National Academy of Sciences.