Abstracts of the Talks (Tuesday May 21, 2024)

9:00 – 10:00 **Narek Hovsepyan**, Rutgers University

Title: "On the lack of external response of nonlinear media in the second-harmonic generation process."

Abstract: Second Harmonic Generation (SHG) is a process in which the input wave (e.g. laser beam) interacts with a nonlinear medium and generates a new wave, called the second harmonic, at double the frequency of the original input wave. We investigate whether there are situations in which the generated second harmonic wave does not scatter and is localized inside the medium, i.e., the nonlinear interaction of the medium with the probing wave is invisible to an outside observer. This leads to the analysis of a semilinear elliptic system formulated inside the medium with non-standard boundary conditions. More generally, we set up a mathematical framework needed to investigate a multitude of questions related to the nonlinear scattering problem associated with SHG (or other similar multi-frequency optical phenomena). This is based on a joint work with Fioralba Cakoni, Matti Lassas and Michael Vogelius.

10:30 – 11:30 **Bill Rundell**, Texas A& M University

Title: "Scattering beyond Helmholtz: the plus and minus factors of nonlinearities."

Abstract: We will look at the Westervelt equation which is a mainstay of nonlinear acoustics and the inverse problem of recovering two critical space-dependent coefficients: the wave speed c(x) and the imaging parameter traditionally written as B/A. Difficulties arise in the analysis of this equation due to the presence of a nonlinearity coupled to the leading order term. On the positive side this allows for a splitting of the terms containing the unknowns and, under certain conditions, permits their uncoupling.

11:30 – 12:30 **Liliana Borcea**, Columbia University

Title: "Enhanced wave transmission in random media with mirror symmetry."

Abstract: I will present an analysis of a striking phenomenon observed experimentally: The enhancement of wave transmission due to coherent interference effects in random media with mirror symmetry about a wave barrier. The mathematical model is the acoustic wave equation and we consider two setups where the wave propagation is along a preferred direction: randomly layered media and randomly perturbed waveguides. We use the asymptotic stochastic theory of wave propagation in random media to characterize the statistical moments of the random transmission and reflection coefficients which are scalar valued in layered media and matrix valued in waveguides. With these moments we can quantify explicitly the enhancement of the mean transmitted intensity induced by symmetry. Joint work with Josselin Garnier from Ecole Polytechnique, France.

2:00 – 3:00 **Henrik Garde**, Aarhus University

Title: "Reconstruction of cracks in Calderón's inverse conductivity problem using energy comparisons."

Abstract: Consider Calderón's inverse conductivity problem, on determining a conductivity coefficient from a local Neumann-to-Dirichlet (ND) mapping, corresponding to applying currents and measuring voltages on some (small) subset of the domain boundary. If a "background conductivity" is known and perturbed on some part of the domain, the support of the unknown perturbation is called an inclusion. A lot of progress has been made for exact reconstruction of inclusions based on energy comparisons, which compares the measured ND map with ND maps from "extreme" test-inclusions. In particular, the unknown perturbation can be irregular, it can simultaneously have positive and negative parts, and may even be unbounded and degenerate. This talk is on a recent collaboration with Michael Vogelius. We proved that the same reconstruction method (without modification) for inclusions of positive volume, also gives exact reconstruction of general collections of cracks in the form of unions of Lipschitz hypersurfaces, consisting of both perfectly conducting and perfectly insulating cracks.