Baylor University

COLLEGE OF ARTS & SCIENCES
Department of Mathematics

14TH BAYLOR LECTURE SERIES IN MATHEMATICS

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Public Lecture
“Simplification” in Partial Differential Equations
Monday, September 18, 2023
4:30 pm – 5:30 pm
Hankamer H101 – Kayser Auditorium

We will recall the origins of Fourier analysis and its connection to partial differential equations through the work of Fourier on heat conduction in the early 19’th century. This led to the representation of solutions of evolutionary equations by the Fourier method, as a superposition of plane waves, a remarkable “simplification” that transformed the study of linear partial differential equations and led to fundamental technical advances in the 19th century. With the advent of computers in the middle of the 20th century, through the remarkable computations of Fermi--Pasta--Ulam (mid50s) and Kruskal--Zabusky (mid 60s) it was observed numerically that nonlinear equations modeling wave propagation, asymptotically, also exhibit a “simplification”, this time as superposition of “traveling waves” and “radiation”. This has become known as the “soliton resolution conjecture”. The only proofs available have been for “integrable” equations, which can be reduced to a collection of linear equations. The proof of such results, in the non--integrable case, has been one of the grand challenges in the study of nonlinear differential equations. Recently, there have been important breakthroughs in obtaining mathematical proofs of these types of numerical observations, in the context of nonlinear wave equations, which I will discuss.

Colloquium Lecture:
Unique Continuation and Boundary Unique Continuation, Old and New
Tuesday, September 19, 2023
2:30 pm – 3:30 pm
Sid Richardson Building SDRICH 344

We will recall the notion of unique continuation of solutions of elliptic equations from the work of Hadamard and Carleman in the early 20th century, with further contributions by many of the top analysts on the 20th century. We will then discuss recent progress, in connection with problems in geometry, motivated by the study of nodal sets, singular sets and critical sets. We will then turn to corresponding problems up to the boundary and explain older and recent progress on the connection between boundary unique continuation and regularity of the boundary.