Nonlinear wave equations and integrable systems

Lectures: MWF 10:00-10:50 AM in Math 250

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Tentative outline
- Nonlinear PDEs as infinite-dimensional Hamiltonian systems, symplectic structure
- Traveling wave solutions and similarity solutions of nonlinear PDEs
- Symmetries, Noether’s theorem, conservation laws and linearized modes
- Lax pairs and the Ablowitz-Kaup-Newell-Segur method
- Inverse scattering transform for the Dirac operator on the infinite line
- Infinite number of conservation laws, commuting hierarchies and complete integrability
- Soliton dynamics and interactions
- Korteweg-deVries equation with periodic boundary conditions
- Boundary value problems and Bäcklund transformations
- Maxwell-Bloch equations and self-induced transparency
- Deift-Zhou method for oscillatory Riemann-Hilbert problems and long-time asymptotics
- Applications: water waves and nonlinear optics

Textbooks
Most of the material can be found in these books:
- M.J. Ablowitz & H. Segur: “Solitons and the inverse scattering transform”
- G.B. Whitham: “Linear and nonlinear waves”

Course work
Grades will be based on monthly homework and a final project.
There will not be a final exam.

Prerequisites
Ordinary and partial differential equations, real and complex analysis.