UNIVERSITY OF CALIFORNIA
MERCED | School of Natural Sciences

Applied Mathematics
Ph.D. Dissertation Defense
Candidate: Jessica Taylor

Date:

Thursday
April 18, 2019

Time:

11:30am – 12:30pm

Location:

SSB 130

Abstract:

This dissertation is composed of work on two types of Schrodinger equations: the nonlinear Schrodinger equation with dipolar interactions (dipolar NLS) and the parity-time (PT) symmetric linear Schrodinger equation.

In the dipolar NLS work, we use a gradient-decent method to compute 3D ground states of the equation. We discover that highly-prolate traps, whose long axis is parallel to the dipoles, can give rise to "candlestick" ground states. Direct numerical simulations of the dipolar NLS equation reveal that the nucleus of the candlestick mode undergoes collapse, while obtaining a highly flat, pancake shape. The rate of this anisotropic collapse scales differently from what occurs in isotropic collapse. Stability analysis reveals a surprising cusp point in the mass vs. chemical potential curve, which may serve as a signature for these dynamics.

In addition, PT linear Schrodinger equations with complex PT-symmetric periodic potentials are studied analytically and computationally. The possible symmetries of the band-dispersion functions and associated Floquet-Bloch states are identified. Using singular perturbation analysis, we show that band-dispersion functions become complex-valued following the closure of a spectral gap at a degenerate point. Furthermore, we analyze the effect of highly-localized perturbations using asymptotic techniques. These analytical results are elucidated by detailed computations. These results shed new light on the irreversible nature of the phase transition that takes place as the band-dispersion functions become complex.

Bio:

Jessica R. Taylor is a fourth-year Ph.D candidate in the Ilan group of the Applied Mathematics Program at University of California, Merced. She has received both her B.Sc (2015) and M.Sc (2017) at UC Merced.

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