Functional Analysis, Mathematical Physics, and Dynamical Systems

(FAMPDS)

Joint American-Ukrainian Virtual Colloquium Series

Spring 2021

Talk 7: *Generalized Nonlinear Schrödinger Equation: Self-Dynamics by Convolution*

Michael Maroun (Independent Researcher, Boston, MA)

Abstract

The Lamb shift is an unique signature of time-independent quantum vacuum fluctuations and self-interaction in Hydrogen. A novel generalized nonlinear equation of motion is constructed with a convolution kernel that can accommodate self-interaction in an essential nonlocal manner. The kernel can be constructed out of the time-independent Maxwell vacuum solutions. The solutions vary with dimension and thus so does the convolution kernel. The kernel can also be chosen to form a linear equation, the Korteweg–De Vries equation, or the Gross-Pitaevskii equation. Solutions are sought on the space $L^2(\mathbb{R})$, but are also considered on the space of distributions not necessarily only by trivial set containment. The Maxwell kernel for $d = 1$ is linear and thus approximate solutions can be constructed for the nonlinear equation of motion on compact subsets of $\mathbb{R}$. The equation itself exhibits superlinearity, which is a critical property of such nonlinear equations of motion. In particular, it will be proved that there is an unique rotationally invariant distributional solution in $d = 3$, and for $d = 1$ it will be proved that there is in fact an elliptic modular particular solution that admits a precise algebraic and geometric interpretation of the quantum vacuum.

Friday, April 23, 10:00-11:00 AM (PDT), 20:00-21:00 (EET)

Online via Zoom at

https://fresnostate.zoom.us/j/5233106532