Functional Analysis and Mathematical Physics Interdepartmental Research Group (FAMP) Colloquium Series Fall 2021

Talk 2: *Singular Perturbations of Schrödinger Operators in Generalized Distributional Quantum Theory*

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Abstract

Recently, the author has developed a generalized version of quantum theory, which gives meaning to singular Schrodinger potentials as generalized functions. There is particular interest in corrections to the Coulomb potential that are natural from the perspective of the electrostatic multipole expansion. Specifically, there is the Lamb shift which currently cannot be calculated using Schrodinger perturbation theory, though this does not preclude effective potentials such as the Uehling potential. However, the Uehling potential accounts for only about 3% of the Lamb shift. Mathematically, the multipole correction terms are singular in that they give very poorly behaved operators of multiplication. In this presentation, an exposition demonstrating the issue of nonuniqueness of self-adjoint extensions and the connection to a distributional interpretation is elucidated. Generalized spectral functions and a $C-$spectrum is proposed, and connected to the usual theory of self-adjoint extensions via quadratic forms. The issue that arises is the need for a lower bound, one that does not exist a priori. This then leads naturally to a rigorous definition of a quantum field, one where not only does the probability of finding the system in a particular state change from point to point in spacetime, but probabilistically speaking, the spectrum (and hence ground state, i.e. mass gap whenever $E_0 \neq 0$) also changes from point to point in spacetime.

Friday, October 15, 10:00 - 11:00 AM (PDT)
Online via Zoom at
https://fresnostate.zoom.us/j/5233106532