



School of Physics,
Mathematics and Computing

Mathematics & Statistics Colloquium

Surprising links between Quantum Mechanics and Fluid Dynamics

Thursday March 13, 2025
15:00 - 16:00

Blakers Lecture Theatre
(MATH: [G18], 223.G18)

Followed by:
Refreshments in
Monadelphous Integrated Learning
Centre (MILC)
16:00 - 17:00

Abstract

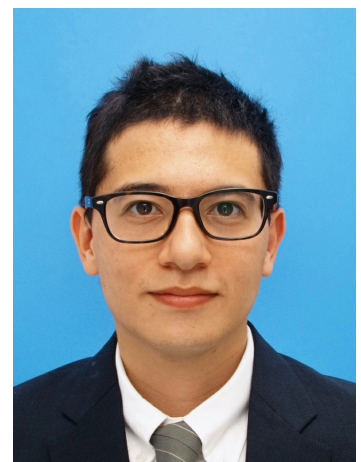
In this talk, we explore intriguing connections between quantum mechanics and fluid dynamics through the Madelung transform, which links the Schrödinger equation to

the Euler and Navier-Stokes equations. Using this correspondence, we show that a charged relativistic fluid with intrinsic spin satisfies the Schrödinger equation in its Madelung form. The inclusion of spin introduces a quantum correction to the classical fluid energy, which, when coupled with Maxwell's equations, naturally leads to a fluid-mechanical derivation of the Schrödinger equation. Building on this framework, we examine the implications of using fluid mechanics as a model for the wave function, particularly in the context of coupling quantum effects with gravity. This perspective offers fresh insights into the intersection of quantum mechanics, fluid dynamics, and gravitational physics.

About the presenter

Naoki Sato is a theoretical physicist specializing in plasma and mathematical physics. He earned a Ph.D.

in Advanced Energy from The University of Tokyo and has since conducted research at the Research Institute for Mathematical Sciences at Kyoto University and the Department of Complexity Science and Engineering at The University of Tokyo. He is currently an Associate Professor at the National Institute for Fusion Science.



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