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The Soliton Nature of the Super-Klein Tunneling Effect, Confinement, and Zero-Energy States in 2D Dirac Systems

Monday 1 December 2025 15:30 (1 hour)

This talk presents a unified view of soliton-induced transparency and supersymmetric confinement in two-dimensional Dirac systems. I first show how the super-Klein tunneling (SKT) effect arises from a correspondence between the Davey–Stewartson II (DS II) integrable system and quasi-exactly solvable Dirac Hamiltonians generated by DS II breather solutions. I then review supersymmetric methods for designing electrostatic potentials that display perfect transmission, localized states, and zero-energy modes. Exactly solvable Lorentzian wells that mimic quantum-dot confinement and radial ring potentials illustrate how supersymmetry organizes degeneracies and exotic current-carrying zero modes. Overall, the framework links integrability, supersymmetry, and perfect transmission in 2D Dirac materials.

Presenter: CORREA, Francisco