中央大學物理學系

Department of Physics, National Central University

Colloquium

Artificial spacetime, topological instanton, and emerging electrodynamics in pseudo-Hermitian quantum mechanics

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Abstract: Geometric (Berry) phase plays a fundamental role in quantum mechanics, exemplified by the 2-level system where it appears as the magnetic flux from a fictitious monopole at a degenerate point. When the Hamiltonian is time-dependent, the Berry phase also evolves, generating an electric field via the Faraday effect. Here, we study an overlooked scenario: 2-level *pseudo-Hermitian* systems with real spectra. Our model supports a Berry curvature akin to a (2+1)D electromagnetic field which cannot be reduced to a static magnetic field as in the Hermitian cases, even when the system is time independence. This feature arises from an emergent spacetime metric in the parameter space, where one adiabatic parameter acts as 'time' while the others as 'space'. Interestingly, the Berry curvature is linked to spacetime singularities—*instantons*—carrying quantized topological charges. Such point-like instantons parallel the role of magnetic monopoles in Hermitian systems, bridging open-system Berry phase physics with field-theoretic concepts.