

THE UNIVERSITY OF HONG KONG

DEPARTMENT OF PHYSICS

RESEARCH SEMINAR

From electrons to gauge theories: emergence in correlated quantum matter

Mr. João Inácio

University of Würzburg

Abstract:

Emergent phenomena in strongly correlated systems arise when microscopic degrees of freedom reorganise into qualitatively new excitations at low energies. A central example is the Hubbard model, in which collective electronic low-energy excitations behave like bosons, giving rise to the Heisenberg model, and, at lower energy scales, the bosons give rise to fractionalised excitations and emergent gauge fields. Accessing this hierarchy remains challenging due to strong correlations, motivating the use of exact quantum Monte Carlo simulations.

In this talk, I explore different facets of emergence, from the exactly solvable Kitaev model, with its Majorana fermions and Z_2 gauge field, to more generic spin systems described by parton constructions with fractional excitations and emergent gauge fields. I will present recent numerical results on the interplay between magnetism, lattice vibrations, and topological excitations. In the end, I will discuss extensions to cavity-coupled systems, where light-matter interactions give rise to emergent polaritonic excitations in the Hubbard model.

Wednesday, April 1, 2026, 4:00pm

Room 522, 5/F, Chong Yuet Ming Physics Building, The University of Hong Kong

Department of Physics, Chong Yuet Ming Physics Building, The University of Hong Kong

Phone: 39172360 Fax: 25599152. Anyone interested is welcome to attend.