

Gauge Fields and Quantum Matter. The Stuff Dreams are Made Of

By Gerard Valentí-Rojas

Gauge fields are found in the modern description of gravity and the most fundamental interactions known in our Universe, but they also appear when describing why a cat always lands on its feet. Gauge fields are both physical entities and useful resources that help us sharpen our understanding of the world.

In this talk, we explore the ability of certain gauge fields to deeply alter the properties of quantum matter and even its mere identity. These dramatic effects become palpable when said fields back-act on matter. Things get even more exotic when robust structures known as topological solitons are present in the systems under study.

This is a journey across dimensions, curved spacetimes, and unconventional phases of matter. We introduce a composite particle duality, engineer synthetic flux attachment, elaborate on chiral axion electrodynamics, and delve deep into statistical transmutation. Out of this study, we are able to predict new topological phases of matter, find anomalous features in the dynamics of fields, gain a universal understanding on how bosons can become fermionic, and speculate on how things gravitate.

