



Seminar

Can high-energy gauge field theories be simulated using ultra low-energy systems?

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Abstract

I will discuss the question of whether theories of high-energy physics can be simulated by low-energy, non-relativistic, many-body systems- such as ultracold atoms.

Such ultracold atomic systems, lack the kind of symmetries and dynamical properties of HEP models. In particular, they do not manifest either local gauge invariance, nor Lorentz invariance, which are crucial properties of the field theories that give rise to the "standard model" of elementary particles.

It turns out however, surprisingly, that there are ways to configure atomic system to manifest both local-gauge invariance, and Lorentz invariance. In particular, local gauge invariant can arise, either as an effective, low energy, symmetry, or as an "exact" symmetry, that follows from the conservation laws in atomic interactions.

Our current results suggest that the type of Abelian and non-Abelian models which give rise to the "standard model" can in fact be described by suitable configurations of ultracold atoms that are trapped in optical lattices.

Such systems could in principle be used to construct analog-simulators of Hep models.

They can mimic lattice gauge theories of Abelian (compact-QED) , and

non-Abelian $SU(2)$ Yang-Mills theories.

Hence, it is hoped that they might lead to new sort of (table-top) experiments, that can be used to study various QCD phenomena, as the confinement of dynamical quarks, phase transitions, and other effects, that cannot be handled with the currently known computational methods.

references:

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