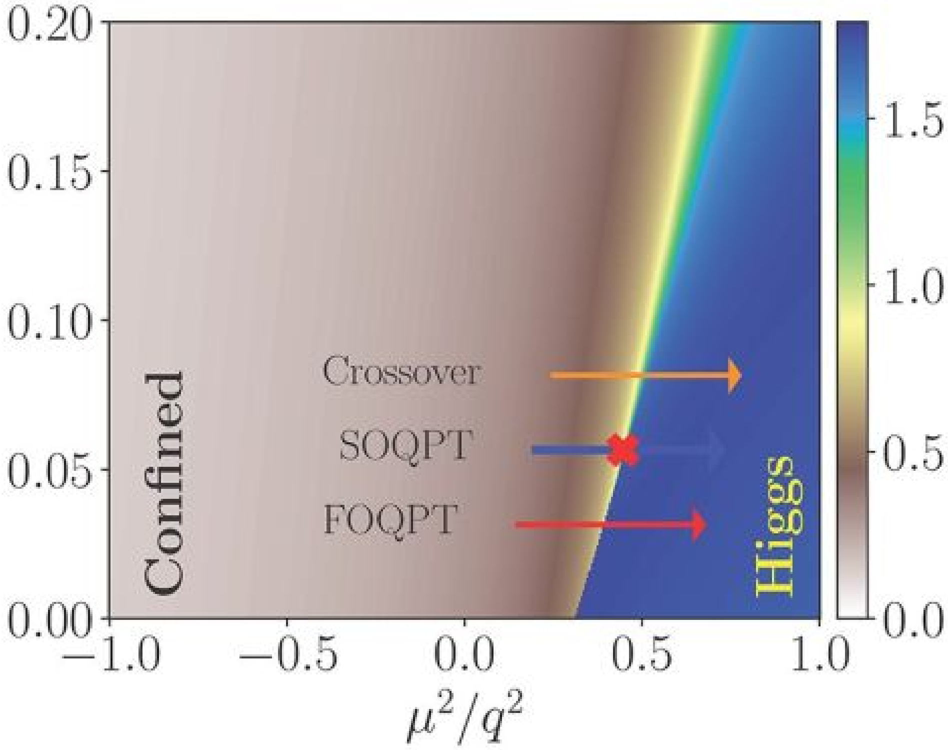

Abelian-Higgs mechanism in 1+1 dimension

A team of researchers from Jagiellonian University of Cracow, the Institute of Fundamental Physics IFF-CSIC and ICFO uncovers hidden gems lurking behind the Abelian-Higgs model in one spatial dimension and time.

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While universal fault tolerant quantum computing with error correction remains elusive, the future belongs to special purpose quantum computers, i.e. quantum simulators. Although there are no rigorous proofs, the physics community strongly believes that quantum simulators have already led to quantum advantage, especially, in studies of quantum dynamics and quantum disordered systems. So far, most of the applications of quantum simulators have concerned models of condensed matter physics. However, this paradigm is beginning to change, and more and more, there are impressive applications to quantum chemistry and optimization problems. In physics, the current focus is on quantum simulation of fundamental models of high energy physics: Lattice Gauge Theories and Quantum Field Theories.

The Higgs mechanism is an essential ingredient of the Standard Model of particle physics that explains the ?mass generation' of gauge bosons. While its seemingly simple one-dimensional lattice version may serve as an interesting novel quantum simulator, until now, it remained unexplored.

In a recent study published in **Physical Review Letters**, Titas Chanda with Jakub Zakrzewski from Jagiellonian University in Cracow, Luca Tagliacozzo from the Institute of Fundamental Physics IFF-CSIC and ICREA professor Maciej Lewenstein from ICFO have taken up the challenge to fill this gap. Unlike the system in continuum, two distinct regions in the lattice version are identified, namely the confined and Higgs regions. These two regions are separated by a line of first order phase transitions that ends in a second order critical point. Above this critical point the regions are smoothly connected by a crossover. The presence of a second order critical point allows one to construct an unorthodox continuum limit of the theory that is described by a conformal field theory (CFT).

This work is strongly motivated by the current prospects of quantum simulations of quantum gauge theories, and opens a path towards observing the Higgs mechanism in experiments with cold atomic setups.