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INSTITUTO DE CIENCIAS MATEMÁTICAS

UNIVERSIDAD COMPLUTENSE
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Colloquium

Undecidability of the Spectral Gap Problem

SPEAKER: David Pérez García (UCM-ICMAT).

DATE & PLACE: November 6, 2014. 13:00 - 14:00 Aula Naranja ICMAT. Calle Nicolás Cabrera 13-15. Campus Cantoblanco, UAM. Madrid.

SIMULTANEOUS BROADCAST: Aula Miguel de Guzman, Facultad de Ciencias Matemáticas, UCM, Ciudad Universitaria.

ABSTRACT:

When talking about different phases in physics, the first thing that comes to mind is the division in solid, liquid and gas. At zero (or close to zero) temperature, where quantum mechanics is the physical law that governs the system, there are also different phases.The exotic and unexpected properties of some of these quantum phases, like superconductivity, superfluidity, fractional statistics, topological dependency, etc. have attracted the attention of physicists for many years.
Mathematically, the definition of quantum phase is given by the existence of a gap in the spectrum of the Hamiltonian that encodes the interactions of the system. This is why some of the most famous open problems in quantum many body physics, like Haldane's conjecture, ask about the existence/absence of spectral gap in concrete models.
In this talk, aimed at non-specialists, I will first introduce the spectral gap problem, motivate its interest and give a brief historical overview. Then, I will sketch the proof of our recent result: the existence of spectral gap is an undecidable problem. This explains clearly why there is no known general criterion to decide the existence of spectral gap. Our result implies that there cannot be any.

(joint work with T. S. Cubitt and M.M. Wolf).