SEMINARIO
Departamentos de Física Teórica I y II
Universidad Complutense de Madrid

CONFERENCIANTE: Charles Tahan

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TITULO: How superconductors and semiconductors could be better together

LUGAR: FACULTAD DE CIENCIAS FÍSICAS UCM
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ABSTRACT:

Spins in silicon and superconducting Josephson junction circuits and are two of the most promising qubit technologies for quantum information applications. In this talk I will discuss some of our work on both "traditional" solid-state qubits, especially quantum dots in silicon, and recent efforts to explore combining the best properties of both in unusual ways, especially via superconducting-semiconductors. We have proposed constructing superconducting devices such as wires, Josephson junctions, and qubits inside and out-of a single crystal, such as silicon or germanium [1,2]. The epitaxial and semiconductor nature of these devices, along with the extreme flexibility in device design of superconducting circuits down to the single-atom scale, may enable lower-noise and/or fundamentally novel physics. We consider applications for such super-silicon devices, showing that the state-of-the-art transmon qubit and the sought-after phase-slip qubit can both be realized in theory. The latter qubit leverages the natural high kinetic inductance of these materials. Building on this, we explore how kinetic inductance based particle detectors (e.g., photon or phonon) could

be realized with potential application in astronomy
or nanomechanics. First-generation super-semi devices in silicon, germanium, or diamond, which would not require atomistic fabrication approaches, could be realized in the near-term. Finally I will comment on different but related systems for super-semi-
based traditional qubits for quantum information processing and on how other ideas from spin-based quantum computing might benefit superconducting QC.

[1] Nature Communications 5, 3860 (2014)
[2] http://arxiv.org/abs/1407.0372