ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
ΤΜΗΜΑ ΦΥΣΙΚΗΣ

CRETE CENTER FOR QUANTUM COMPLEXITY AND NANOTECHNOLOGY

ΓΕΝΙΚΟ ΣΕΜΙΝΑΡΙΟ ΤΜΗΜΑΤΟΣ ΦΥΣΙΚΗΣ

PHYSICS COLLOQUIUM

Thursday, 17 October 2013

17:00 -18:00

3rd Floor Seminar Room

"Quartets of order parameters in domes preventing quantum criticality and quartet engineering in correlated nanostructures"

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Abstract

Despite some initial seminal contributions by McMillan, Psaltakis, Machida and others, quantum mean-field theories with multiple order parameters at the microscopic level have been essentially replaced by semi-phenomenological Ginzburg-Landau schemes because of the raising complexity. We will show that in any spinor microscopic multiorder parameter mean-field theory, there is a universal *quartet* correlation between order parameters that obey a simple rule that we reveal. These *quartets* represent the building blocks of Quantum Complexity. Overlapping "*closed*" ensembles of quartets form *patterns of condensates* and such examples are the triplet SO(5) model for superconductivity and SDW of S.-C. Zhang or an analogue singlet SO(5) model that we report. We have applied the rule to the SU(8) model for density waves and superconductivity of Solomon and Birman, identifying numerous quartets involving virtually all types of superconducting and particle-hole condensates. From numerical investigations over dozens of these quartets, we conclude that quartets can be found in two regimes: the *hierarchy* regime or the *equity* regime. In the *equity* regime, the quartet manifests fully, and we argue this regime corresponds to the *dome* states observed around expected quantum critical points in a number of correlated systems. With Bogoliubov-DeGennes calculations of extended Hubbard models on real space nanostructures we show that the equity regime can also be engineered either at the edges of samples or at interfaces and other nanostructures involving quantum ordered states. We provide an original explanation for the behavior of metallic states at the interfaces of insulators and we discuss some possible implications of quartet engineering on spintronics and topologic quantum computation.