UNIVERSITY OF CRETE
DEPARTMENT OF PHYSICS

CRETE CENTER FOR
QUANTUM COMPLEXITY
AND NANOTECHNOLOGY

ΓΕΝΙΚΟ ΣΕΜΙΝΑΡΙΟ ΤΜΗΜΑΤΟΣ ΦΥΣΙΚΗΣ

PHYSICS COLLOQUIUM

Thursday, 8 October 2015

17:00 -18:00

3rd Floor Seminar Room

"Proximity-induced topological superconductivity "

Prof. Alexander Golubov

MESA+ Institute of Nanotechnology, University of Twente, The Netherlands
Moscow Institute of Physics and Technology, Russia

Abstract

Overview of hybrid structures involving superconducting junctions on surfaces of topological insulators is given and results of recent experimental and theoretical studies are presented. To guide experimental work on the search for Majorana zero-energy modes, we calculate the superconducting pairing symmetry of a three-dimensional topological insulator in combination with an s-wave superconductor. In analogy to the case of nanowires with strong spin-orbit coupling we show how the pairing symmetry changes across different topological regimes. We demonstrate that a dominant p-wave pairing relation is not sufficient to realize a Majorana zero-energy mode useful for quantum computation. The relation between odd-frequency pairing and Majorana zero energy modes is derived by using Green functions techniques in three-dimensional topological insulators in the so-called Majorana regime. We discuss thereafter how the pairing relations in the different regimes can be observed in the shape of the tunneling conductance of an s-wave proximized three-dimensional topological insulator. We discuss the necessity to incorporate a ferromagnetic insulator to localize the zero-energy bound state to the interface as a Majorana mode. We also present the results of conductance spectroscopy measurements of a proximity induced superconducting topological insulator. We study the proximity effect between the fully-gapped region of a topological insulator in direct contact with an s-wave superconducting electrode (STI) and the surrounding topological insulator flake (TI) in Au/Bi1.5Sb0.5Te1.7Se1.3/Nb devices. The conductance spectra of the devices show the presence of a large induced gap in the STI as well as the induction of superconducting correlations in the normal part of the TI on the order of the Thouless energy. The shape of the conductance modulation around zero-energy varies between devices and can be explained by existing theory of s-wave-induced superconductivity in SNN' (S is a superconductor, N a superconducting proximized material and N' is a normal metal) devices.