CRETE CENTER FOR QUANTUM COMPLEXITY AND NANOTECHNOLOGY

UNIVERSITY OF CRETE DEPARTMENT OF PHYSICS

CAPACITIES

ΓΕΝΙΚΟ ΣΕΜΙΝΑΡΙΟ ΤΜΗΜΑΤΟΣ ΦΥΣΙΚΗΣ

PHYSICS COLLOQUIUM

Thursday, 5 October 2017

17:00 -18:00

3rd Floor Seminar Room

" Non trivial topological properties of 2D materials "

Dr. Athanasios Dimoulas

Institute of Nanoscience and Nanotehnology, NCSR "Demokritos", Greece

Abstract

Topological insulators (TI) and semimetals have emerged in recent years as a new state of matter where strong spin-orbit interaction, combined with crystal symmetries result in materials with robust, exotic surface states such as spin-polarized Dirac cones in 3D TIs or surface Fermi arcs in Dirac (DSM) and Weyl semimetals (WSM). Despite quantum field theory predictions for the existence of massless Weyl fermions, these elementary particles have never been observed so far. Their "incarnation" as low energy excitations in topological semimetals opens exciting new opportunities for "table top" high energy physics. One of the biggest challenges now is how to obtain control of these exciting properties in thin films for practical applications.

In this presentation the main achievements in the area of topological materials will be reviewed. Then, the MBE growth of atomically thin 2D layered metal chalcogenide materials will be presented discussing the epitaxial quality of the thin films probed by in-situ STM, high resolution STEM and synchrotron XRD. In-situ ARPES will be used to image the electronic band structure of the grown TI (Bi_2Se_3, Bi_2Te_3) and 2D semimetal materials with the main aim to discover new topological semimetal phases among 2D metal dichalcogenides. The first ever grown epitaxial $HfTe_2$ and $ZrTe_2$ 2D semimetals will be presented showing a linear dispersion in the form of a gapless Dirac cone at the center of the Brillouin zone with the Dirac point located exactly at the Fermi level. This is evidence for epitaxial DSM, the first of its kind, made of monolayer-thick 2D material, showing prospects for easy integration in device structures.