Description of Funded Research Projects
1st Call for H.F.R.I. Research Projects
to support Post-Doctoral Researchers

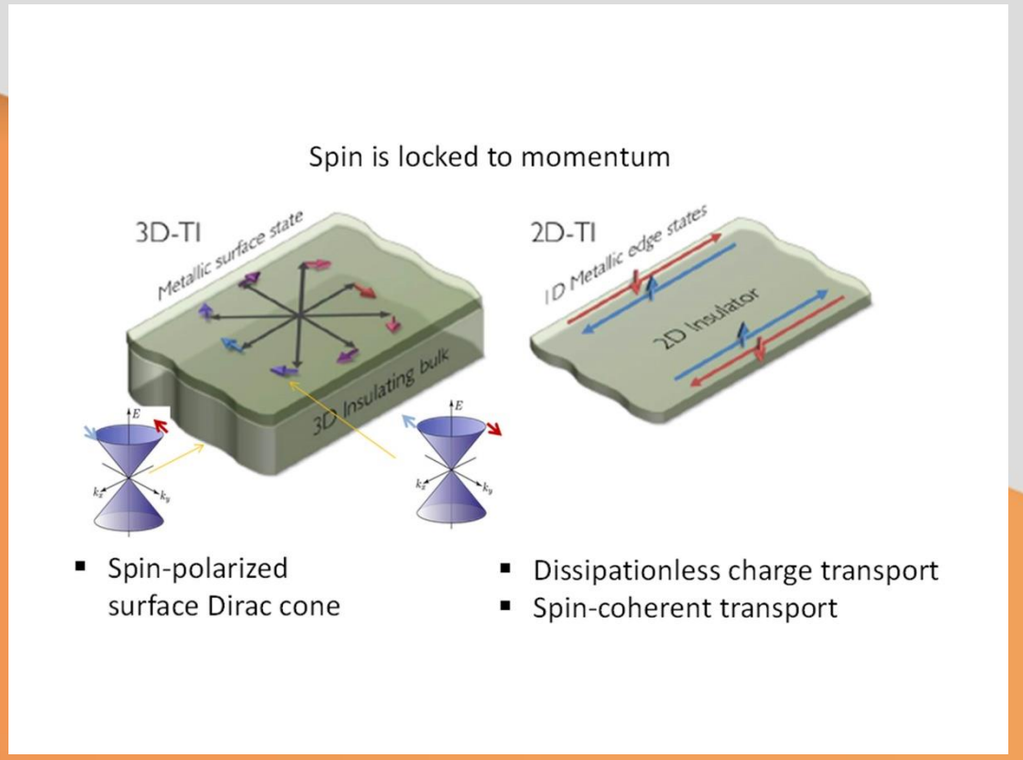
H.F.R.I.
Hellenic Foundation for
Research & Innovation

Research Project Title:

2D crystalline thin films with non-trivial topology

Principal Investigator:

Dimitra Tsoutsou



Popular Title:

Neonatal Phagocyte Enhancement in Sepsis

Scientific Field:

Physics

Host Institution:

NCSRD Demokritos

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The Nobel Prize in Physics 2016 was awarded to the theoretical discoveries of topological phase transitions and topological phases of matter, underlying the remarkable importance of such materials for both fundamental research as well as for practical applications. In addition, the advent of graphene has generated an enormous interest in a number of other 2D crystals (silicene, germanene, MX2), creating the prospect for exciting new versatile applications. In the '2D-TOP' Project we attempt the "fusion" between 2D materials and topological quantum matter worlds with the aim to unveil new electronic states with unique properties. Specifically, the Project focuses on the experimental realization and physical characterization of two different classes of 2D crystals with a non-trivial topological order, namely the topological insulators (TI) and the topological Weyl semimetals (WSM). It is predicted that stanene, is a TI that conducts electricity only in 1D edge channels with virtually no heat dissipation and with remarkable spin coherence over macroscale distances. In addition, the recent discovery of topological WSM opens opportunities to store and/or process information by taking benefits from the selected chirality of Weyl Fermion bands. The 2D topological materials investigated in this Project could ultimately establish topology as a paradigm shift for nanoelectronics and spintronics enabling a whole new line of technology for low power electronics. Taking into account that the continued scaling of CMOS becomes limited due to power dissipation, the topological materials could have a remarkable impact in the semiconductor market in the next years. To achieve the objectives, crystalline 2D films will be grown by MBE, according to theoretical guidelines. Various Surface Science techniques will be employed in order to investigate the crystallinity, the topology-related valence band features and the electrical response of the topological materials, such as Reflection High Energy RHEED, XRD, Raman spectroscopy, STM, XPS and ARPES.

Overall, the main breakthrough targeted in this project is to engineer new forms of matter which represent new electronic states, creating the prospect of new versatile applications. The discovery of topological quantum matter has already transformed condensed matter physics, showing that matter can behave in unpredictable ways. Specifically, one of the main hurdles in modern nanoelectronics is the enormous power density dissipated on the chips, which seriously inhibits further miniaturization and degrades performances. The 2D topological materials investigated in this Project could ultimately establish topology as a paradigm shift for nanoelectronics and spintronics enabling a whole new line of technology for low power electronics. Taking into account that the continued scaling of CMOS becomes limited due to power dissipation, the topological materials could have a remarkable impact in the semiconductor market in the next years.

To me, H.F.R.I. funding would mean...

This is a unique opportunity in order to be a able to extend my scientific research in the area of the 2D topological materials. Due to the lack of external EU funding, H.F.R.I. funding was the only route to continue my research activities in Greece. In addition, I expect to gain valuable experience in the implementation, management and coordination of funded research Projects.

The Principal Investigator,
Dimitra Tsoutsou

Funding

Amount: **200,000 €**

Duration: **36 months**

Foundation: **H.F.R.I.**

H.F.R.I.
Hellenic Foundation for Research & Innovation

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