

FLAG ERA – iSpinText

Introduction

FLAG ERA Kick-off meeting
April 13, 2016, Budapest
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iSpinText: Induced Spin Textures in van der Waals
Heterostructures

Main area: Advanced nanofabrication and spintronics

Keywords: spintronics; spin-orbit; magnetism; topological; hetero-structures; 2D materials; BiTeI; topological insulator; dichalcogenids

Duration (months): 36

Total project funding: € 703 252



Initial problem:

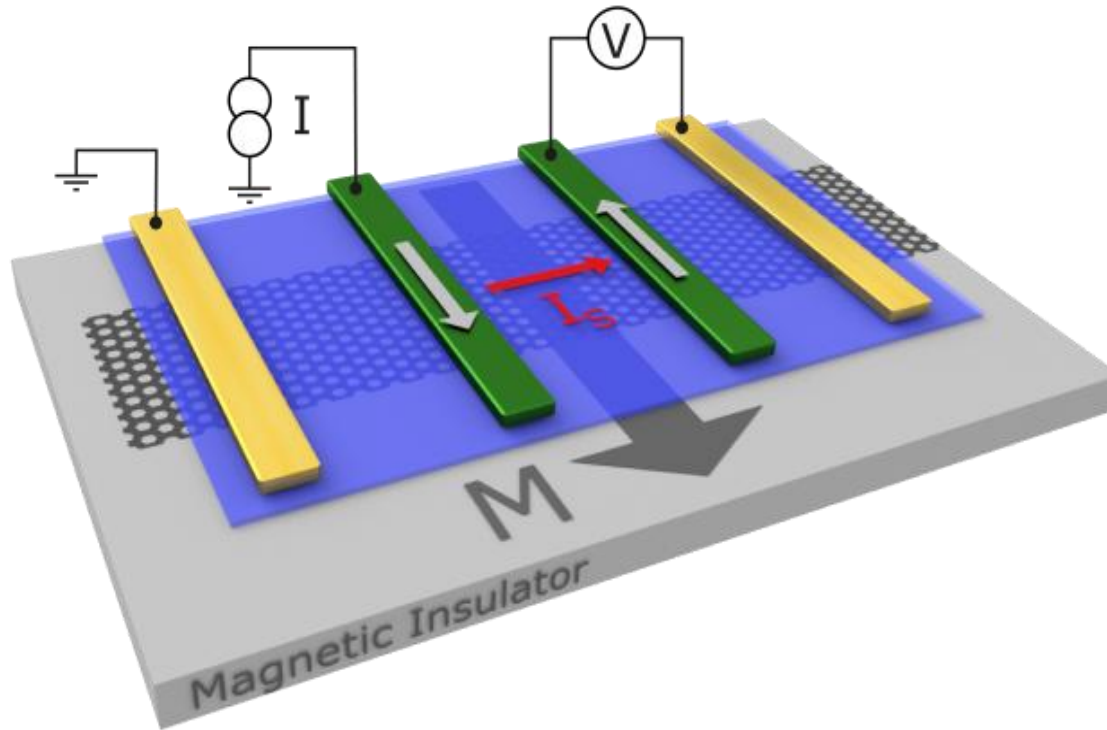
- Graphene is the perfect candidate for spintronics
- But the read-out and the manipulation of spin information is not available

iSpinText: Induced Spin Textures in van der Waals Heterostructures

In this project we will investigate novel routes to add electric and magnetic control over the spin by introducing different spin textures in graphene. Spin textures are induced by developing various 2D proximity heterostructures.

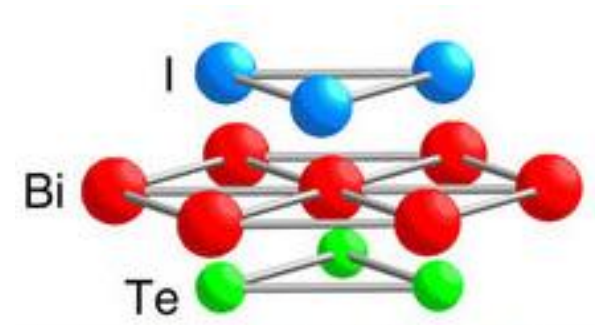
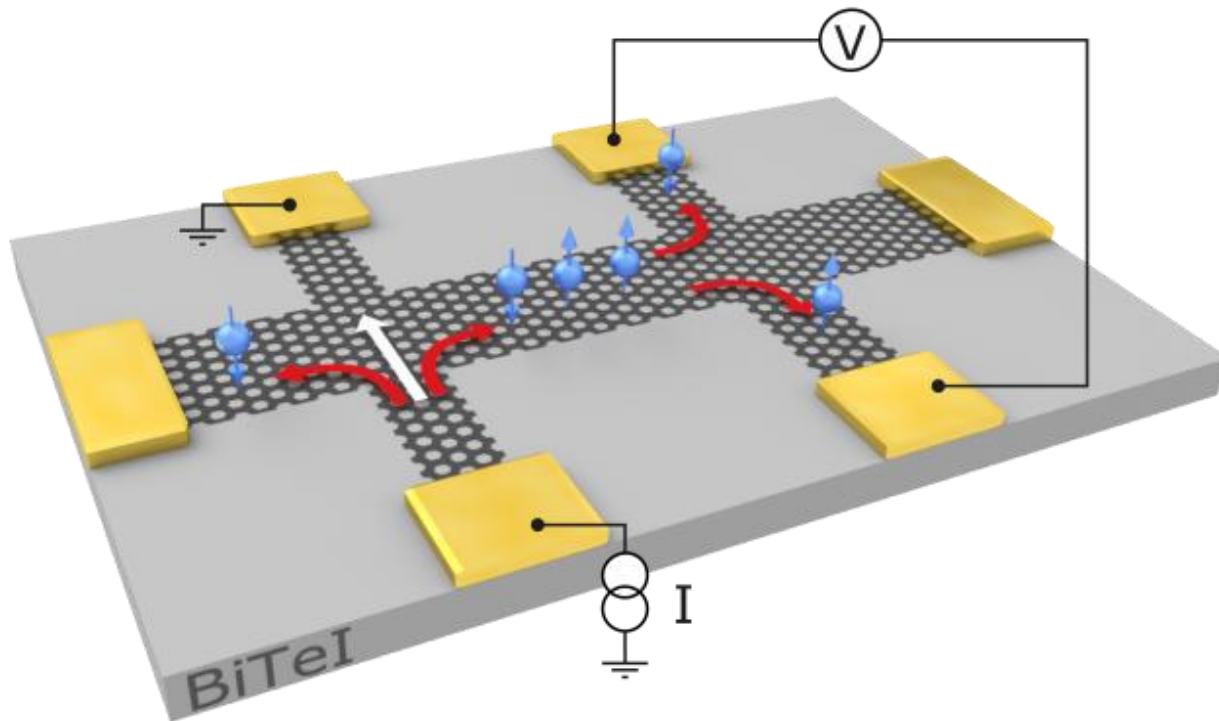


- Using magnetic insulators & exchange interaction



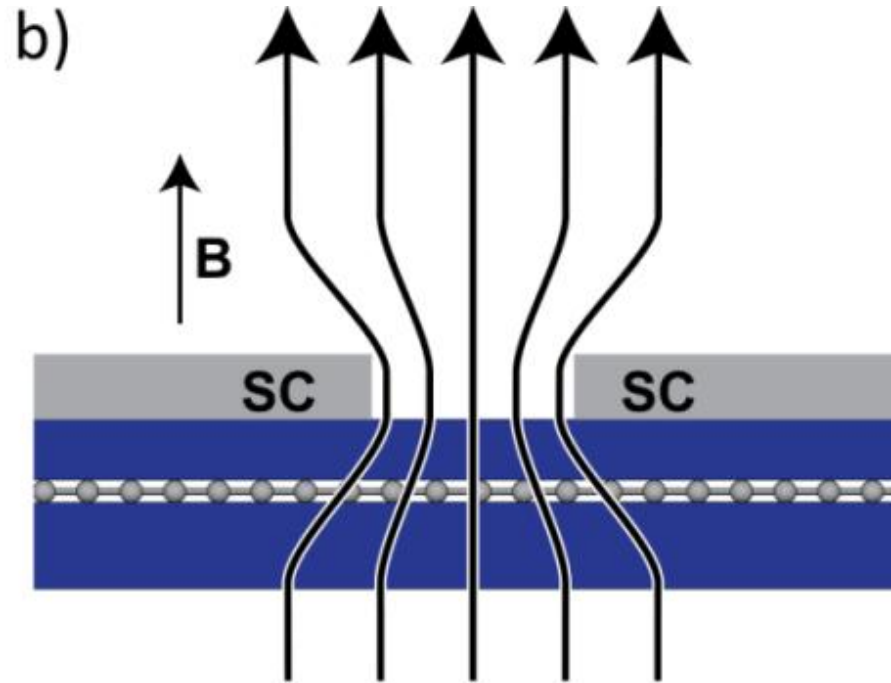
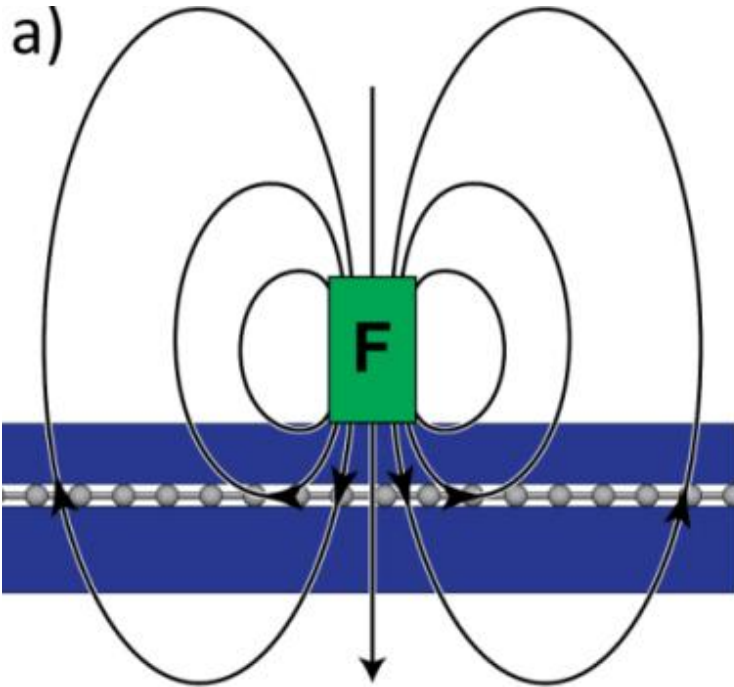
Gr spin-valve fabricated on a Magnetic Insulator (MI) for magnetic gating experiment with h-BN tunnel barriers (blue). The non-local signal can be tuned by changing the direction of the MI magnetization with respect to the magnetization of ferromagnetic electrodes (green).

- Using other 2D materials with spin-orbit interaction (SOI)












Graphene Hall-bar on a BiTeI substrate. The SO effect can be measured through spin-Hall and inverse spin-Hall effect in a non-local geometry.







- Using metallic superstructures



Generation of spin texture with metallic structures a) Placing ferromagnetic (F) islands close to Gr with an hBN isolation layer (blue) in-between the stray field of the F island induces skyrmion like magnetic field in the in the conducting Gr layer. b) When Gr-hBN heterostructure with superconducting layer (SC) on top is placed in external magnetic field the superconductor expels the B field lines, thus regions with zero magnetic field and finite magnetic field are generated in the 2D conducting layer of Gr with smooth variation between.

Country	Institution/ Department	Name of the Principal Investigator (PI)	Main role in the project
 Hungary	 Department of Physics, Budapest University of Technology	 Szabolcs Csonka	Coordinator Fabrication & characterization of 2D materials, proximity structures, DFT support
 Sweden	 CHALMERS Microtechnology and Nanoscience, Chalmers University of Technology	 Saroj P. Dash	Fabrication and optimization of graphene heterostructures, high SOI heterostructures
 Germany	 University of Konstanz Department of Physics, University of Konstanz	 Guido Burkard	Theoretical support for graphene + SOI, spin textures induced by metallic superstructures



Country	Institution/ Department	Name of the Principal Investigator (PI)	Main role in the project
 Switzerland	 UNI BASEL Department of Physics, University of Basel	 Christian Schönenberger	CVD graphene growth, development of encapsulated graphene samples, proximity structures
 Netherlands	 university of groningen zernike institute for advanced materials Zernike Institute for Advanced Materials	 Jianting Ye	Growth of layered materials, novel quantum states (SC, FM, etc) using liquid ion gating