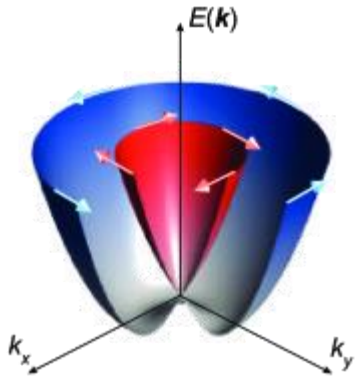
Ferroelectric control of the spin-orbit coupling

Context

Whereas conventional spintronics uses the exchange interaction in a ferromagnetic material to manipulate spin currents, spin-orbit coupling can now be used to generate or detect spin currents, possibly in absence of any ferromagnetic element. We have shown that new spin-orbit coupling quantum materials are exciting candidates for the spin-charge conversion, with in particular the possibility of a control of the spin-orbit properties by ferroelectricity[1].



As recently demonstrated by Intel[2], and by our group[3] in a Nature article, this could lead to the development of ultralow-power post-CMOS logic devices. This is in particular important as the question of the energy consumption of the Information and Communication Technologies is becoming an important environmental and geopolitic issue. We are currently building a start-up through a valorization project based on these discoveries.

Band structure of a Rashba system, with two Fermi contours having opposite spin helicities

Work program & Skills acquired during internship

The M2 internship and following PhD project aims at exploring the possibilities offered by these features. The student will realize the device nanofabrication in order to study the spin-charge interconversion electrically. He will explore the potential offered by the electric-field control of the spin-orbit conversion to create new devices. The student will develop skills in nanofabrication, and in magnetotransport (at room and low temperature) in thin films and in nanodevices. Transport simulations will be performed if necessary, in order to analyse the data.

He/she will benefit from the existence of a large collective momentum in our teams towards the development and integration of these devices, with ongoing ANR and EU projects, and more importantly with a valorization project aiming at creating a start-up based on this technology.

Requested qualities: Taste for experimental condensed-matter physics and collaborative work. Imagination, inventiveness, interest towards innovative microelectronics applications, and towards intellectual property creation. Possible will to pursue a career in a start-up environment.

http://www.spintec.fr/
17 avenue des martyrs
38054 GRENOBLE cedex 9
Contacts jean-philippe.attane@cea.fr
laurent.vila@cea.fr

Requested background: Master 2
Duration: 6 months
Start period: Feb/ March 2023
Possibility of PhD thesis : YES
Proposal number : do not fill in

[1] Attané, Vila et al., Nature Communications 4 (2013): 2944. ; Nature Materials 15.12 (2016): 1261. ; Nature Materials, 18(11), (2018) 1187 ; Nature Reviews Materials (2022), 7(4), 258 ; Nature Electronics (2021), 4(10), 740.
[2] Manipatruni et al., Nature 565.7737 (2019): 35.
[3] Noël, Attané, Vila et al., Nature 580.7804 (2020): 483