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### Transport at spin-orbit and exchange-split interfaces: Giant universal asymmetry

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We report on theoretical investigations and k.p calculations of carrier tunneling in model systems and hetero structures composed of exchange-split III-V semiconductors, involving spin-orbit interaction. The media are possibly separated by thin tunnel barriers. In a 2x2 exchange-split band model, we prove that, when spin-orbit interactions included in the conduction band of two exchange-split semiconductors, the electrons can be differently transmitted with respect to an axis orthogonal to both the axis normal to the interface and the magnetization direction. The transmission asymmetry between +k// and -k// incidence is shown to reach 100% at some points of the Brillouin zone corresponding to a totally quenched transmission for given incidence angles. We establish the universal character of the transmission asymmetry, independent on the spin-orbit strength and material parameters. Particular asymmetry features are reproduced by more complete 14 x 14 bands calculations involving inter band coupling. On the other hand, calculations performed in the valence-band of model hetero structures and including tunnel barriers in both 6 x 6 (without inversion asymmetry) and 14 x 14 k.p band models more astonishingly highlight the same trends in the transmission asymmetry which is shown to be related to the difference of orbital chirality and to the related branching of the corresponding evanescent states responsible for tunneling current. In both cases (electrons and holes), the asymmetry appears to be robust and persists even when only a single electrode is magnetic. This paves the way to new functionalities with spin orbitronic devices.

#### Biography

H J Drouhin graduated from the École Polytechnique, France in 1979 and obtained his PhD degree with habilitation (Doctorat d'État) in 1984 from Paris-Sud University, Orsay, France. He has made major contributions to the field of semiconductor spin physics and spintronics. He is Associate Professor, Vice President of the Physics Department, and Researcher (Physics and Chemistry of Nano-objects group leader) at Irradiated Solids Lab., (CNRS & CEA/DSM/IRAMIS, École Polytechnique). He was the Dean of Studies for the École Polytechnique from 2000 to 2008 and Deputy Vice- President for Research from 2008 to 2014. He is the author of more than 80 scientific publications as well as being decorated with the Chevalier Legion of Honour (French Pres., 2002) and being made an Officer of the National Order of Merit (French Pres., 2009). He was elected as a Fellow of SPIE in 2007.

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