**MASTER PHYSIQUE ET APPLICATIONS**

***Master 2 Dispositifs Quantiques***

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# Internship offer

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## Gate tunable molecular junctions with 2D semiconductors

**Scientific project:**

2D materials such as graphene, hexagonal Boron nitride (hBN) and transition metal dichalcogenides ($MoS_2$, $WSe_2$) have unique electronic and optical properties but they also offer flexibility, high-speed operation and standard CMOS fabrication processes compatibility. These features make them appealing to play the role of contact layer in molecular electronic devices [1,2]. We propose to use such 2D semiconductors to overcome the issue of gating in vertically stacked molecular junctions. The typical structure will be Au/hBN/$WSe_2$/molecules/Au with a lateral metal contact on the $WSe_2$ layer to form the junction in such a way that electronic transport will be governed by three interfaces: metal/ $WSe_2$, $WSe_2$/molecules and molecules/Au. Tuning both the carrier density in the 2D semiconductor and the band alignment at interfaces can be achieved by means of the bottom Au layer. The realisation of the junctions will take advantage of recent results obtained by the group on in plane molecular junctions [3] and on metallic contacts on few-layers 2D materials [4,5,6].

[1] C. Jin and G. C. Solomon, J. Phys. Chem C. 122, 14233 (2018).
[2] J. Shin et al., Nature Comm. 11, 1412 (2020).
[3] K. Della Francesca et al., AIP Advances 10, 025023 (2020).
[4] J. Rastikian et al., Mater. Res. Express 6, 126307 (2019).
[5] J. Rastikian et al., Phys. Rev. Materials 5, 014004 (2021).
[6] S. Timpa et al., submitted.

**Methods and techniques:** clean room nanofabrication, electrical transport measurements at low temperature

**Possibility to go on with a PhD ? YES**
**Envisaged fellowship ? EDPIF**