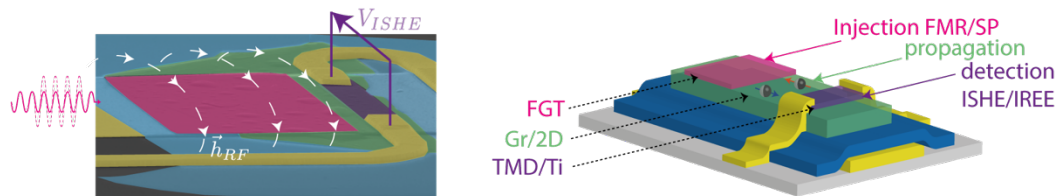


# Towards a van der Waals only Spintronics

Spin-based electronics has already transformed data technology, enabling innovations such as hard-drive read heads and MRAM devices. Today, it is driving transformative breakthroughs in in-memory processing as well as neuromorphic and stochastic computing. Its search for novel phenomena at material interfaces has driven attention toward 2D materials with their exceptional tunability. Moreover, the full range of conventional electronic phases (insulating, metallic, semiconducting) to more exotic ones (superconductivity, magnetic, topologically protected) is now spanned. Yet, the integration of these materials into devices that retain their unique intrinsic properties remains an experimental challenge [1],[2].

Within the TELEM group, a new experimental platform tailored for spintronics has recently been established, demonstrating its sensitivity and versatility by probing the magnetization dynamics of single Cobalt patch (of  $6 \times 10 \text{ } \mu\text{m}^2$  surface down to thicknesses below 10 nm) grown on different 2D materials (such as hBN, Graphene and the TMD  $\text{WSe}_2$ ) [3]. Moreover, preliminary results show the injection of pure spin currents via spin pumping from Cobalt, and their subsequent propagation in Graphene detected through the inverse spin Hall effect in adjacent Palladium electrodes.



The proposed internship and PhD thesis will build upon this foundational work by integrating diverse 2D materials into our advanced spintronic platform. One core direction includes exploring transition metal dichalcogenides and topological insulator as alternatives to heavy metals for spin-to-charge conversion in the final spin current detection. The thesis will also investigate the not yet explored magnetization dynamics of the recently discovered 2D magnets of the  $\text{Fe}_n\text{GeTe}_2$  family (where  $n$  ranges from 4 to 5), which consistently reports Curie temperatures exceeding room temperature [4].<sup>12</sup>

The selected candidate will assume full responsibility for the project, from design and fabrication in the MPQ cleanroom to comprehensive device characterization. We seek an ambitious physics student, motivated to master a spectrum of experimental techniques spanning nanofabrication, cleanroom protocols, ultra-low-noise from DC to microwave measurements, python interfacing and data analysis.

[1] J Sierra *et al.*, Nature Nanotechnology, **16**, 8, 856-868 (2021)

[2] JG Park *et al.*, <https://arxiv.org/abs/2505.02355>.

[3] K Sobnath *et al.*, ACS Appl. Electron. Mater., **7**, 19, 8821-8827 (2025)

[4] H Wang *et al.*, Nature Communications, **14**, 2483 (2023)