Investigating ultrafast magnetization dynamics of 2D transition metal phosphorus trichalcogenides

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With most recent transistors reaching down 5 nm in thickness, new questions are raised on how to achieve viable THz magnetic control on heterostructures thick of a few atoms only. In this framework, the optical control of spin dynamics on the femtosecond time scale could represent a significant improvement of the speed of data processing technologies [1]. The proposed experimental thesis work aims at addressing some of these questions by following two axis. Firstly, the project will be dedicated to the understanding of spin and charges dynamics of Van der Walls magnets such as transition metal phosphorus trichalcogenides (XPS_3 with X=Fe, Co, ...). An example of such dynamics measurements in a layered FePS2 sample at low temperature in the visible range is shown on figure 1.

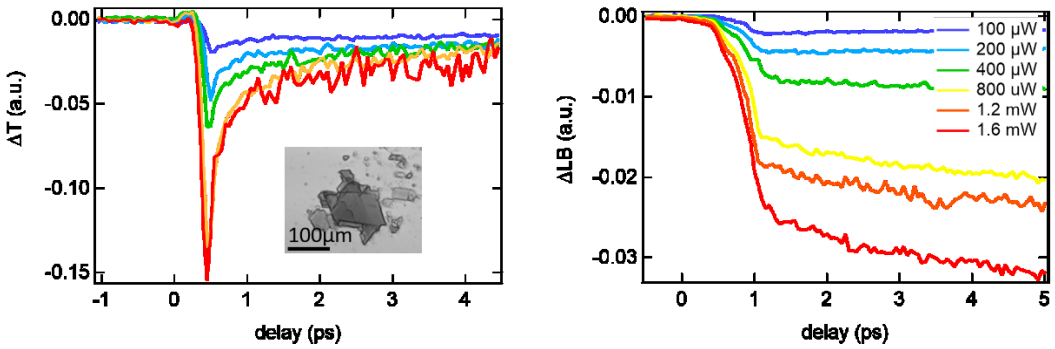

FIG 1: Pump probe measurements (resp at 400 nm and 800 nm) in $FePS_3$ at 30 K vs pump fluence. Left: transient transmission. Inset: 200 layers thick $FePS_3$ flake. Right: transient linear birefringence corresponding to spin dynamics (LB).

The role of sample substrate will be then investigated. The emphasis will be made on understanding the interplay of the electrons, spins and phonons ultrafast dynamics inside and between each constituent, depending on nanostructure geometry and composition (isolant, metallic or magnetic substrate). The successful candidate will take part to the life of the team and will acquire high- level skills in ultrafast spectroscopy and magnetism in a friendly and supportive work environment. They will have access to the forefront ultrafast magneto-optical techniques that have been developed in our team over last years from the visible to XUV ranges [3-4]. We are looking for a highly motivated candidate with a good background in condensed matter physics and light-matter interaction processes, and with a strong interest in experimental physics.

[1] Beaurepaire E. et al. *Phys. Rev. Lett.* **76**, 4250-4253 (1996).
[3] Mertens, F et al., Adv. Mater. ***35***, 2208355 (2023).
[4] Matthiesen, M. et al., Phys. Rev. Lett. ***130***, 076702 (2023).
[3] Barthelemy M. et al. *Optica* **4**, 60-63 (2017).
[4] Maghraoui A. et al. Phys. Rev. B **107**, 134424 (2023).