Master 2: ***International Centre for Fundamental Physics***

INTERNSHIP PROPOSAL

(One page maximum)

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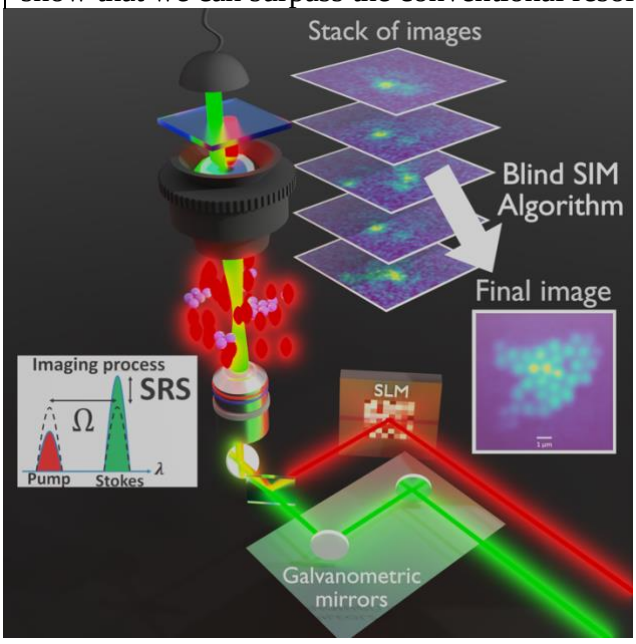
Thesis possibility after internship: YES/NO
Funding: YES/NO If YES, which type of funding:

Label-free super-resolution nonlinear microscopy

Raman-based microscopies exploit the intrinsic vibrational spectrum of molecules, achieving video-rate imaging speeds without the need of labelling fluorophores. While there has been a tremendous improvement in speed for Raman microscopy, the spatial resolution has barely enhanced and, as a matter of fact, reaching resolution at the 100 nm-scale still remains a very challenging topic [1].

This project aims at exploiting speckle-based methods to achieve super-resolution in coherent Raman microscopy. We have recently developed a novel sampling methodology (figure below) to adapt single-pixel [2] microscopy to well-established computational imaging algorithms (blind SIM) using a stack of speckly images [3]. Current image reconstructions show that we can surpass the conventional resolution achieved in Stimulated Raman Scattering microscopy [4].



As a next step, we envisage to further increase the resolution capabilities by increasing the nonlinearity of the Raman process. In particular, we will set up an add-on technique, coherent anti-Stokes Raman scattering microscopy, on our current experiment. The development of the project will be experimental and will also require some numerical calculation. Therefore, experience with optical experiments and programming languages are pluses. Depending on the outcome of the project, it could potentially follow up as a PhD project, that will be based on the recent activities of the group on computational microscopy [5]. Informal queries are welcome.

[1] Gong et al. Nat. Photonics 14, 115 (2019).
[2] Edgar et al. Nat. Photonics 13, 13 (2019).
[3] Mudry et al. Nat. Photonics 6, 312 (2012).
[4] Guilbert et al., in preparation.
[5] Soldevila et al., Optica 6, 341 (2019). Sturm et al., ACS Photonics 6, 1409 (2019)

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES/NO Soft Matter and Biological Physics: YES/NO

Quantum Physics: YES/NO	Theoretical Physics: YES/NO