

## Master 2: International Centre for Fundamental Physics

### INTERNSHIP PROPOSAL

**Laboratory name :** Matériaux et Phénomènes Quantiques – MPQ UMR7162

**Location :** Université Paris Cité – 10 Rue A. Domon et L. Duquet – Bât. Condorcet – 75013 PARIS

**Internship director :** Prof. Cristiano Ciuti (THEORIE group)

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<https://mpq.u-paris.fr/en/annuaire/ciuti-cristiano-en/>

<https://scholar.google.it/citations?user=rzc1ND0AAAAJ&hl=en>

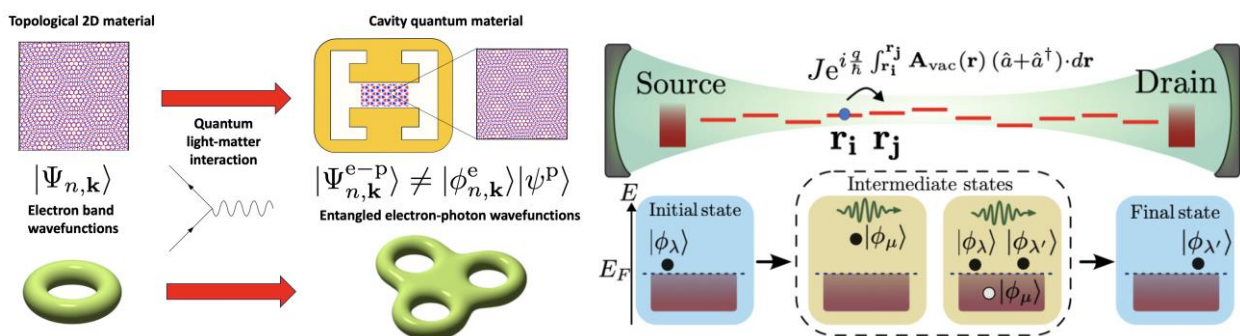
#### Exploring topological quantum conductors made of cavity quantum materials

Recently, we demonstrated the profound impact that the interaction between cavity quantum electromagnetic fields and topological quantum materials, such as quantum Hall systems and 2D moiré materials, can have on their quantum transport and topological properties [1-3]. In this theoretical internship, the Master's student will learn, develop and employ cutting-edge theoretical techniques of quantum many-body physics and cavity Quantum Electrodynamics (QED) in order to investigate the quantum transport of novel emerging topological cavity quantum materials.

[1] F. Appugliese, J. Enkner, G. L. Paravicini-Bagliani, M. Beck, C. Reichl, W. Wegscheider, G. Scalari, C. Ciuti, J. Faist, *Breakdown of topological protection by cavity vacuum fields in the integer quantum Hall effect*, [Science](#) **375**, 1030-1034 (2022)

[2] G. Arwas, C. Ciuti, *Quantum electron transport controlled by cavity vacuum fields*, [Physical Review B](#) **107**, 045425 (2022)

[3] D.P. Nguyen, G. Arwas, Z. Lin, W. Yao, C. Ciuti, *Electron-photon Chern number in cavity-embedded 2D moiré materials*, [Physical Review Letters in press \(aXiv:2303.08804\)](#)



**Condensed Matter Physics :** YES

**Quantum Physics :** YES

**Macroscopic Physics and complexity :** YES

**Theoretical Physics :** YES