UNIVERSITÉ CÔTE D'AZUR — INPHYNI INSTITUT DE PHYSIQUE DE NICE — cnrs

Master internship position (M2)

Internship location: Institut de Physique de Nice (INPHYNI)
17 rue Julien Lauprêtre, 06200 Nice, FRANCE

Contacts: Geoffroy Aubry — `geoffroy.aubry@univ-cotedazur.fr`
Ulrich Kuhl — `ulrich.kuhl@univ-cotedazur.fr`
Fabrice Mortessagne — `fabrice.mortessagne@univ-cotedazur.fr`
`https://inphyni.univ-cotedazur.eu/sites/wacs`

Salary: $\sim$ 600 €/months

PhD thesis possibility after internship: **YES** (Funding under review)

Transverse spreading of 2D localized microwaves in the presence of absorption

Context Various mechanisms underlie metal-insulator transitions in condensed matter. One of these mechanisms is Anderson localization, which is caused by quantum interference induced by disorder. As a consequence, the Drude diffusion of an electron through the sample has to be corrected, and when the interferences become large enough, conduction may cease, leading to an insulating phase. Because the origin of this phenomenon lies in interference, it has been suggested 40 years ago by Anderson himself that it should be easily observed using “classical” waves as light or sound[1]. A signature of localization lies in the transmission transverse profile: in the diffusion regime, a Gaussian beam spreads in time whereas in the localization regime it saturates. This transverse profile beam spreading should be independent of transmission[2].

Objectives The intern will perform an experimental test of the independence of the claim that the transverse profile spreading in the presence of Anderson localization does not depend on absorption.

Work program Review the fundamental concepts of Anderson localization of light and how the beam spreading is a signature of it. Use multiple antennas in a 2D microwave cavity and wavefront shaping techniques to create an incident Gaussian beam on the disordered sample made out of high index dielectric cylinders. With other antennas, measure the field in transmission and reconstruct the transmission profile. Until now we designed the setup and performed some preliminary measurements. We now need to measure the first transmission profiles and then gradually add absorption in the cavity. These measurements will be carried out in Nice with theoretical backup from a group at University of Fribourg (Switzerland). If time allows, test another smoking gun of Anderson localization: the quantum boomerang[3].

Supervision and environment Hosted at INPHYNI (Université Côte d'Azur, Nice), the intern will work within the Waves in Complex Systems group (WaCS), and will benefit from a collaboration with the Soft Matter and Photonics group based in Fribourg through a recently funded International Research Project (2027-2030, funded by CNRS) between the two groups. INPHYNI is a very active institution in the research on Anderson localization with three groups contributing to the topic (Theoretical physics, Cold Atoms and WaCS). The internship will combine training in wave physics, computational physics, and statistical physics, offering the student a solid introduction to modern wave transport studies.

Profile We are looking for candidates who are highly motivated to conduct research and have a keen interest in fundamental physics, particularly wave physics.

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[1] P. W. Anderson. *Philos. Mag. B* **52**, 505 (1985).

[2] N. Cherroret, S. E. Skipetrov, and B. A. van Tiggelen. *Phys. Rev. E* **82**, 056603 (2010).

[3] T. Prat, D. Delande, and N. Cherroret. *Phys. Rev. A* **99**, 023629 (2019).