

Master internship position (M2)

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

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Salary: ~ 600 €/months

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

Experimental and numerical investigation of electromagnetic helicity in coupled dielectric scatterers

Scientific context

The broader project in which this internship proposal is embedded aims to determine whether collective electromagnetic interactions can preserve or control wave helicity in complex scattering media. Helicity characterizes the handedness of an electromagnetic wave and is closely related to the balance between its electric and magnetic responses. Testing helicity preservation experimentally requires more than measuring total scattering: it calls for a suitable protocol to reconstruct the relevant field components and distinguish helicity-preserving from helicity-converting contributions.

Objectives and research programme

The internship will combine microwave experiments and numerical modeling to develop such a protocol and apply it to dielectric spheres.

Design and implementation of a helicity measurement protocol. Using the microwave experimental platform in Nice, the student will investigate how to excite and detect electromagnetic fields with controlled polarization and how to reconstruct the field components, including their relative phases, needed to determine helicity-resolved responses. The feasibility and accuracy of the protocol will be assessed on simple reference configurations.

Experimental study of dielectric spheres. A set of available dielectric spheres will be characterized in the microwave frequency range. Measurements on an isolated sphere and on configurations involving two or a few spheres will provide preliminary tests of the protocol and explore how inter-particle coupling modifies the electromagnetic response.

Numerical modelling and comparison with experiment. A coupled-dipole model incorporating electric and magnetic responses and their interactions through electromagnetic Green tensors will be developed or adapted. Numerical predictions will be compared with measurements to assess the model's validity and guide the interpretation of helicity-resolved observables.

The primary outcome will be an experimentally validated methodology for measuring helicity conversion in scattering systems. The study of collective effects will provide an initial application and a basis for subsequent investigations of larger and more complex structures.

Work plan and international collaboration

The five-month internship will combine hands-on microwave measurements, scientific programming and physical analysis. A one-month research stay with the Brazilian partner is envisaged, providing focused training in theoretical and numerical methods and supporting the interpretation of the experimental results.

Expected outcomes and training

The student will gain experience in microwave experimentation, field measurements, electromagnetic multiple-scattering theory and numerical modelling. Expected outcomes include a documented helicity measurement protocol, preliminary experimental results for isolated and coupled spheres, and a comparison with theoretical predictions.

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 have the opportunity to collaborate with Brazilian researchers: Felipe Pinheiro, from Federal University of Rio de Janeiro, and William Oliveira and Tobias Micklitz, from Brazilian Center for Research in Physics (Rio de Janeiro).

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