

Master 2: International Centre for Fundamental Physics

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire de Physique des Solides (LPS)
CNRS identification code: UMR-8502
Internship director's surname: Kalugin
e-mail: pavel.kalouguine@universite-paris-saclay.fr Phone number: 01-69-15-69-39
Web page: <https://www2.lps.u-psud.fr/>
Internship location: : LPS, Orsay

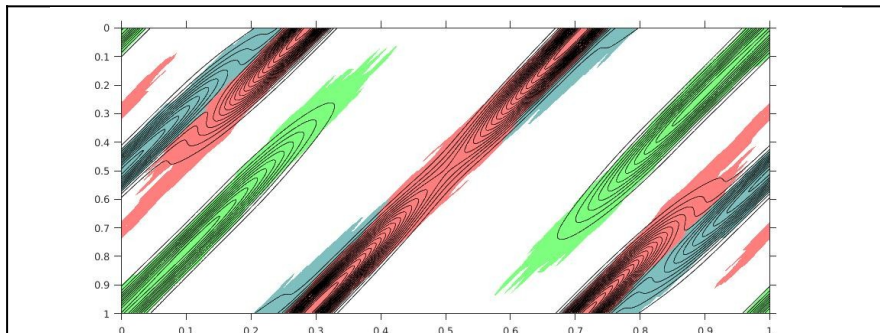
Thesis possibility after internship: NO

Funding: NO

If YES, which type of funding:

Exploration of matching rules in real quasicrystals

One of the most intriguing features of quasicrystals is the formation of an aperiodic long range order. A common way to describe the propagation of such an order involves the notion of the *matching rules*, a mathematical proxy for the complex interaction of atoms. Although many examples of matching rules have been developed for toy structure models, so far no realistic matching rule model has been proposed for a real material.



Watershed segmentation of atomic surfaces of CdYb quasicrystal

In this project you will participate in the development of the toolchain for the exploration of matching rules in real quasicrystals, following the research program proposed in [1]. The toolchain includes the tools for

1. Phasing of the raw X ray diffraction data
2. Segmentation and inventorying of the atomic surfaces (see Figure)
3. Automatic generation of the matching rules model
4. Assessment of the strength of the generated matching rules

Working on the project will involve development of the computer code in the new Julia programming language (<https://julialang.org/>)

The ideal candidate should have a strong background in numerical algorithms and mathematics (algebraic topology and commutative algebra).

[1] Pavel Kalugin and André Katz. Robust minimal matching rules for quasicrystals. *Acta Crystallographica Section A: Foundations and Advances*, 75(5):669–693, 2019.

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

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

Quantum Physics: NO

Theoretical Physics:

YES