

Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: LPENS

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Internship location: LPENS

Thesis possibility after internship: YES

Funding: NO

If YES, which type of funding:

Large N Quantum Systems

Since antiquity, quantum field theories and statistical models in the large N limit (with many degrees of freedom per volume) play an important role in understanding strongly correlated matter, and their holographic correspondence to gravity. More recently, the Sachdev-Ye-Kitaev (SYK) model and its many variants and generalizations have enabled much progress on these topics, but also on the dynamics of quantum information ("many-body quantum chaos" or "scrambling").

In this *stage*, after gaining some familiarity with some basics of large N field theory, we will focus on a more specific project of your choice. Here are some examples:

- Theory of "soft modes". Their emergence from conformal/reparametrization symmetry. Their dynamical implications, e.g., fast scrambling.
- Characterizing "[Dirac fast scramblers](#)" from the perspective of Conformal Field Theory in 1+1 and 2+1 dimensions.
- Applications to condensed matter theory: large N solvable models for non-conventional phase transitions, superconductivity, transport in strongly correlated states.
- Applications to dynamics of quantum information, e.g., wormhole teleportation, information recovery with time-reversal.
- Open quantum dynamics/hybrid quantum circuit in the large N limit.
- Verifying proposals of realizing SYK physics by quantum Monte Carlo.

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