Master 2: *International Centre for Fundamental Physics*
INTERNSHIP PROPOSAL

Laboratory name: Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie
CNRS identification code: IMPMC – UPMC Sorbonne University
Internship director'surname: A. Marco SAITTA – PR1
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Web page: www.impmc.upmc.fr/~saitta
Internship codirector'surname: Fabio Pietrucci – MCF IMPMC (UPMC)
Internship codirector'surname: Rodolphe Vuilleumier – PR1 PASTEUR (ENS/UPMC)
Internship location: IMPMC – UPMC – Campus Jussieu
Thesis possibility after internship: YES
Funding: Likely (Labex/Idex/ANR), or ED's If YES, which type of funding:

Topology and social networks methods for phase transformations of matter

The study and understanding of transformations in statistical systems, from condensed matter phase transitions to chemical reactions and protein folding, is one of the most fundamental and difficult problems in physics. To this end, we are developing a novel conceptual framework to describe the general phase space of such transformations and extract their kinetic features, using topology-based ideas stemming from theory of graphs algorithms (Google) and social networks, whose first toy-model applications are very promising. We now need a student with strong theoretical physics/mathematical skills and motivation to fully develop this project.

Techniques in use: Advanced statistical mechanics and thermodynamics
Applicant skills: Strong theoretical skills in statistical mechanics and thermodynamics
Key words: Topology, phase space, free-energy, statistical ensembles.
The team (scan the codes, see what we look like "in action"):
A. Marco Saitta, Full UPMC Professor of Physics, team leader

Video from my General Seminar at the Physics Department of ENS, February 2015

Fabio Pietrucci, Assistant UPMC Professor of Physics at IMPMC, expert of Advanced Thermodynamics methods

Video snippet from my course at the Paris International School on Advanced Computational Materials Science, August 2015

Rodolphe Vuilleumier, Full UPMC Professor of Chemistry at PASTEUR (ENS), normalien of the 1992 class (master in Theoretical Physics, agrégé de physique), expert in atomic modeling of liquids

Video snippet from my course at the Paris International School on Advanced Computational Materials Science, August 2015

Recent Publications: since the start of this collaboration (end of 2014), 4 PNAS papers (among others) have been published by the team members, and a 5th one is under review.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:
Condensed Matter Physics: YES Macroscopic Physics and complexity: YES
Quantum Physics: NO Theoretical Physics: YES