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

INTERNSHIP PROPOSAL

Laboratory:Laboratoire de Physique Théorique/Laboratoire Collisions Agrégats Réactivité
CNRS identification code: UMR 5152/UMR5589
Internship director'surname: **GEORGEOT Bertrand / GUERY-ODELIN David**
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Internship location: Toulouse, France

Thesis possibility after internship: YES
Funding: In progress If YES, which type of funding:

Applications of methods from neural networks to the simulation of complex physical systems

Learning methods from neural networks have undergone major developments in recent years, and are the basis of recent techniques of artificial intelligence that have found many applications in several fields.

The simulation of complex physical systems is one of the most difficult tasks to achieve by the current numerical methods. Very recent works have shown that it is possible to use neural network methods to perform such numerical simulations, based solely on time sampling of the past evolution of the system. This could have promising applications in e.g. meteorology.

The internship will focus on clarifying the usefulness of these methods through the study of several types of complex systems, and in particular will focus on systems classical or quantum chaotic dynamics. An important aspect will be to determine the parameters of the neural network and learning process according to the desired physical quantities and the precision that one wishes to obtain. This will give a clear idea of the validity and accuracy of these new methods. We will also study the simulation of statistical physics systems out of equilibrium.

The internship will be supervised by a team of researchers from the Laboratoire de Physique Théorique and the Laboratoire Collisions Agrégats Réactivités of IRSAMC, Toulouse. The project will require both numerical simulations and analytical calculations.

Reference: S Bompas, B. Georgeot, D. Guéry-Odelin "Accuracy of neural networks for the simulation of chaotic dynamics: precision of training data vs precision of the algorithm", Chaos 30, 113118 (2020) (preprint arXiv:2008.04222).

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