

INTERNSHIP PROPOSAL

Laboratory name : **LPENS**
CNRS identification code : **UMR 8023**
Internship supervisor : **Xiaowen Chen**
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Internship location : **LPENS, 24 rue Lhomond, Paris 5^{ème}**
Thesis possibility after internship : **NO**
Funding : **NO**

Understanding spatial-temporal synchronization of applause

Synchronized applause is a well-observed example of collective behavior in human, yet its spatial-temporal propagation is not fully understood. This internship will analyze data collected in audience response in theatre, with a strong focus on audio data. Combining data analysis and modeling coupled oscillators, it will investigate how individuals interact with the group that give rise to synchronization of applause in real audience. From the data analysis perspective, the internship student will investigate different measure of synchronization and extend traditional methods from dyads to groups, and to include time delays. Furthermore, it will also address the technical challenge of blind source separation: that while spatially extended microphones collect data across many sound sources, the overlapping of them makes it difficult to interpret. Finally, the internship student will also derive theoretical models of how anticipation and prediction change the global dynamics, such as simulating coupled oscillators (Kuramoto models), and also to understand how hearing discrete claps rather than detecting the continuous phase change the behavior of the model.

This internship is supervised by Xiaowen Chen (LPENS) and co-supervised by Julie Grèzes (DEC, ENS). The data will be analyzed is collected by the Grèzes team [1].

Experience of coding, solid background in statistical physics or non-linear dynamics, and motivation to work closely with data are expected.

Reference:

- [1] O. Simonot-Bérenger, V Chung, J Pelletier, J Grèzes, Collective effervescence mediates the effect of individual emotion on spectators' enjoyment of theatrical performances (2025).
- [2] Z Nédá, E Ravasz, T Vicsek, Y Brechet, A Barabási, Physics of the rhythmic applause (2000).
- [3] Q Michard and J-P Bouchaud, Theory of collective opinion shifts: from smooth trends to abrupt swins (2005).

Condensed Matter Physics: NO
Quantum Physics: NO

Soft Matter and Biological Physics: YES
Theoretical Physics: YES