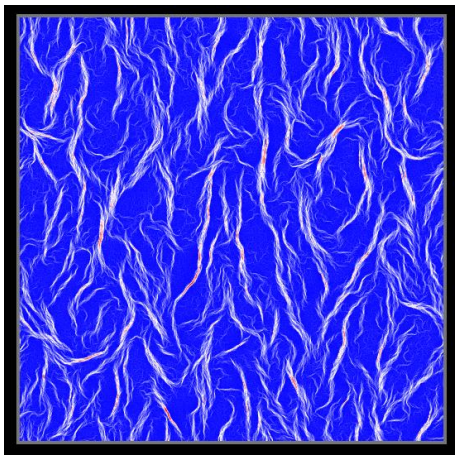
CEA Saclay –Service de Physique de l'Etat Condensé (SPEC) (page web)
Laboratoire *SPHYNX*

INTERSHIP/PHD POSITION

VERY LARGE SCALE SIMULATIONS OF VERY SIMPLE MODELS FOR COLLECTIVE MOTION

In spite of past efforts to characterize properly the collective phenomena displayed by even the simplest models for collective motion, the asymptotic nature (in the infinite-size, infinite-time limit) of many of them remains elusive.

Recent work on the Vicsek-model, and its siblings, has revealed the presence of mesoscale structures (bands, sheets, waves, etc.) involving typically at least thousands of particles. How these structures arrange themselves on larger scales in space and time is not known.



Vicsek-like model for active nematics. Here 32 million particles have been moving for 20 million timesteps, and the system is still in a transient not allowing to decide whether the asymptotic state is chaotic or not.

This unsatisfactory situation arises when progress on continuous theories for these systems suggest the existence of large-scale chaotic, turbulent regimes not observed yet on the simple particle-based models.

The project will mostly consist in performing very large-scale simulations of both the simple models (up to 100 million particles) and their continuous descriptions on GPU or Xeon-Phi computers. Most of the work will focus on the two-dimensional case, but higher dimensions could also be investigated. Extensions to less simple models relevant for bacterial colonies and/or motility assays will also be considered.

References:

- Peshkov, I. Aranson, E. Bertin, F. Ginelli, H. Chaté, 2012, "Nonlinear field equations for self-propelled rods", *Physical Review Letters* 109, 268701.
- Y. Sumino, K.H. Nagai, Y. Shitaka, D. Tanaka, K. Yoshikawa, H. Chaté, and K. Oiwa, 2012, "Large scale vortex lattice emerging from local aligning collisions be- tween moving microtubules", *Nature*, 483, 448.
- C.A. Weber, T. Hanke, J. Deseigne, S. L´eonard, O. Dauchot, E. Frey, H. Chaté, 2013, "Can vibrated polar disks really order?", *Physical Review Letters* 110, 208001.

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