ParisTech ESPCI PARIS PSL

RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: Physics *Physics*
Subfield: (Applied Physics, Chemistry, Mathematics, Mech. Eng.…)
Soft Matter
Title: Characterization of the flow of concentrated suspensions under vibrations.
ParisTech School: ESPCI Paris PSL
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Lab location: ESPCI Paris PSL 10 rue Vauquelin 75005 Paris
(Lab/Advisor website):https://www.cbi.espci.fr/accueil-22/
Short description of possible research topics for a PhD:
Cements, sewage sludge, chocolate are dispersions, carbon suspensions are dispersions of non-Brownian particles. In industry, it is important to be able to prepare such highly concentrated dispersions in order to reduce the water impact of the processes while keeping systems with low viscosity.
In this thesis we will study the flows of highly concentrated suspensions of non Newtonian particles under vibration. Vibrating a suspension makes it possible to reduce the viscosity and to prepare dispersions with ultra high solid fraction. In this pHD, we will take advantages of the technics developed in our laboratory to characterize the features of the flow as a function of the amplitude of the external mechanical vibrations and of its frequency. We will use home made sensors to measure and characterize the shear stress map in a Couette cell[4]. These measurements will be complemented by solid fraction measurements under shear using Xray tomography [1], the friction coefficient and the forces profile between particles will be analyzed using a tuning fork[2,3,5] .
Required background of the student: (What should be the main field of study of the applicant before applying?)
The student should have a solid training in physics, fluid mechanics and be an experimentalist.***A list of 5 (max.) representative publications of the group:***

1:Ovarlez, G., Le, A.V.N., Smit, W.J., Fall, A., Mari, R., Chatté, G. and Colin, A., 2020. Density waves in shear-thickening suspensions. *Science Advances*, *6*(16), p.eaay5589.

2;Comtet, J., Chatté, G., Niguès, A., Bocquet, L., Siria, A. and Colin, A., 2017. Pairwise frictional profile between particles determines discontinuous shear thickening transition in non-colloidal suspensions. *Nature communications*, *8*(1), pp.1-7.

3.Chatté, Guillaume, Jean Comtet, Antoine Niguès, Lydéric Bocquet, Alessandro Siria, Guylaine Ducouret, François Lequeux, Nicolas Lenoir, Guillaume Ovarlez, and Annie Colin. "Shear thinning in non-Brownian suspensions." *Soft matter* 14, no. 6 (2018): 879-893.

4. Anais Gauthier, Mickael Pruvost, Olivier Gamache, Annie Colin, A new pressure sensor array for local normal stress measurement in complex fluids arXiv:2010.04474

5. Madraki, Y., A. Oakley, A. Nguyen Le, A. Colin, G. Ovarlez, and S. Hormozi. "Shear thickening in dense non-Brownian suspensions: Viscous to inertial transition." *Journal of Rheology* 64, no. 2 (2020): 227-238.