POSTDOCTORAL POSITION (2 YEARS)

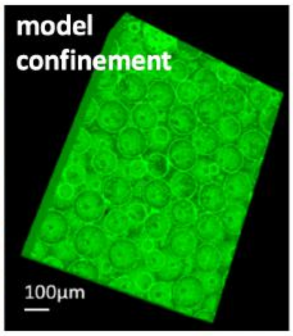
How to see particle dynamics in an opaque matrix?
Exploring DDM approach, from light to X-rays

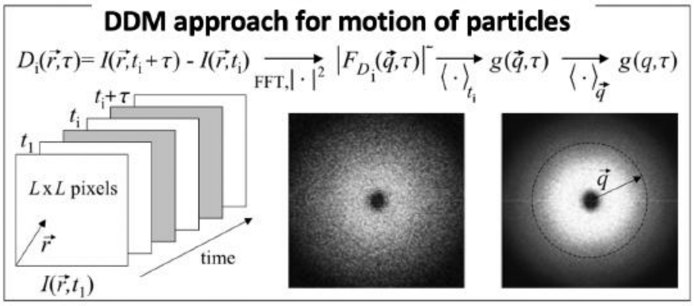
PHENIX

SORBONNE UNIVERSITÉ cnrs

Understanding and predicting the transfer of pollutants in soil, such as metal particles all the way to the now infamous microplastics, is a pressing environmental question. Transcribed to a scientific question, we deal with the movement of nm-µm particles, of various densities, inside an opaque porous matrix filled with water. In the bulk, depending on the particle size and mass, a combination of diffusion (stochastic motion) and sedimentation (directional motion) takes place and this balance is neatly represented by the so-called gravitational Péclet number [1]. Under confinement (and interactions with the matrix) the situation is naturally much more complex.

Currently the leading field for tracking particle dynamics in model solid porous media is based on optical microscopy techniques, which however require optically transparent samples. In this postdoctoral position we wish to explore alternative experimental methods for which optical transparency is not a pre-requisite: differential dynamic microscopy (DDM), and X-ray based methods, both in the real space (X-ray radiography) and reciprocal space (X-ray photon correlation spectroscopy). A common ground of all these techniques is to characterise particle motion at the level of the intermediate scattering function (ISF). While the DDM approach for treating a sequence of optical images is now well established for transparent or partially opaque samples [2], in PHENIX we have recently extended the same approach to a sequence of X-ray radiographs [3] and thus opened the way for studying completely opaque samples, such as soil.





There is a great interest, both in the experimental and simulation research communities, in understanding the different forms of the ISF and how diffusive (stochastic) motion and directional motion (such as sedimentation or active-particle propulsion) influence this quantity and thus how we can model and interpret it [4]. Within this postdoctoral project, we shall explore these different situations from model confinement all the way to model soils.
This postdoc is part of a 4-year project (ANR TRANSOIL 2025-29, "Transport of environmentally relevant particles in non-transparent soil-like porous structures"), which will enable interaction with parallel theory and simulation activities, as well as with specialists in soil mineralogy and models of soil (IC2MP, Poitiers). This experimental post-doctoral project entails unifying the data analysis of time-resolved data from light and X-ray imaging techniques (the DDM approach), which is currently of interest for several research areas of PHENIX and thus opens numerous possibilities of collaboration.

[1] [Piazza14] Piazza, R. *Rep. Prog. Phys.* **2014**, *77* (5), 056602. [Berut19] A. Berut, O. Pouliquen, Y. Forterre, *Phys. Rev. Lett.* **2019**, *123*, 2448005.

[2] [Cerbino08] Cerbino R., Trappe V., Phys. Rev. Lett, **2008**, 100, 188102. [Cerbino17] R. Cerbino and P. Cicuta, J. Phys. Them. B **2017**, 147, 110901.

[3] Levitz P.; Michot L.; Malikova, N.; Scheel, M. and Weitkamp, T. *submitted.*

[4] [Kurzthaler16] Kurzthaler, C.; Leitmann, S.; Franosch, T. *Sci Rep* **2016**, *6* (1), 36702.

Keywords: confinement, porous media, microparticles, differential dynamic microscopy, light and X-ray scattering

Period: 2-year grant starting in autumn 2025. **Salary:** Gross salary, from cca 2990€/month.

Candidate Profile: experimental physicist or physical chemist with a good experience of either differential dynamic microscopy (DDM) or X-ray/neutron/light scattering techniques, good programming skills and a particular interest in advanced data analysis.

Contact: Please send a CV and a motivation letter to Natalie MALIKOVA, **natalie.malikova@sorbonne-universite.fr, PHENIX laboratory, Tel: +33 144274031.**

PHENIX is a laboratory at the Sorbonne University is at the interface between Chemistry, Physics and Materials Science with a long-standing expertise of colloidal systems, electrolytes and fluids under confinement. Its strength lies in a combination of experimental and modelling activities (numerical simulations). Several international projects and networks are in place in PHENIX, providing a rich and multinational environment.