Call for PhD position

"Transport and mixing of (re-)active particles: a bottom-up approach"

FUNDING – PhD candidate will be funded (~1700 euros/month) by iMust Labex (ActiMix project); **Starting PhD deadline Nov 1st 2014**.

LOCATION - The PhD will will be involved in a joint research program between iLM at Université Lyon1, Fluid mechanics laboratory at Centrale Lyon and Physics Laboratory at ENS de Lyon. In practice, main setups will be organized between ENS-Lyon for large-scale aspects, and iLM for microfluidic and laminar flow aspects.

KEYWORDS - Experiments, transport and mixing, colloids, molecular diffusion, hydrodynamics.

CONTEXT - Transport and mixing of particles is a key phenomenon involved in situations as diverse as steering a cup of coffee, homogenizing industrial chemical reactors, dispersion in environmental and oceanic processes, down to the growing field of Lab-on-a-chip microsystems. Yet the complex interplay between global flow deformation and local transport (classically by diffusion) remains only partially understood.

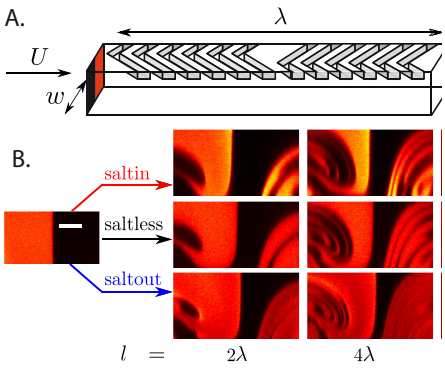

Figure 1 - A. Sketch of the chaotic micromixer. B. Confocal imaging fluorescent cross-sections at different channel location showing colloids concentration fields : saltin (20mM salt with colloids) ; saltless no-salt reference case ; saltout (20mM salt in black diluting solution).

In a recent work, we demonstrated the possibility to fundamentally modify particles mixing by modifying their local dynamics (going beyond simple diffusion) by weakly inhomogeneous chemical background. This new result which demonstrates that global mixing can be tuned by molecular-scale mechanisms open a brand new perspective at the frontier between soft matter and large-scale hydrodynamics. The present PhD proposes to explore the consequences and possibilities brought by this novel approach.

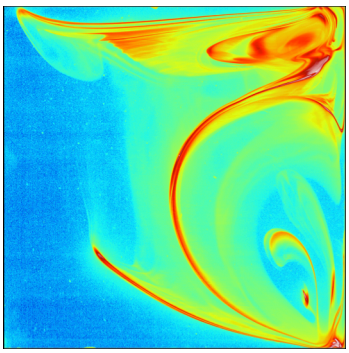

Figure 2 – Laser induced fluorescence concentration field obtained in a Hele-Shaw cell.

PROJECT- As a starting action, the PhD candidate will build on the existing setups to extend the characterization and understanding of the role of chemical heterogeneities (salt gradients!) in colloids transport. He/She will make a special point in bridging effects from microfluidic scales up to meter scales, benefiting from the complementary expertises and methodologies mastered by the advisors.

Based on this first step, richer and original configuration will be explored by introducing reactive aspects, with all or part of the particles becoming sources of chemical production (dissolution for instance), or even being capable of self-propulsion! The coupled dynamics between flow-field, chemical field and particles distribution is expected to display singular and interesting properties, with possible connections with microorganisms' distribution in ocean or bioreactors. When exploring this new aspects, we will first try to focus on the specific length scale and experimental configuration that will prove most appropriate.

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