Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Metachronal waves in epithelium cilia to transport bronchial mucus in airways JULIEN FAVIER, Univ Aix-Marseille, M2P2 lab, CHATEAU SYLVAIN, Univ Sherbrooke, Qubec and Univ Aix-Marseille, M2P2 lab, UMBERTO D'ORTONA, Univ Aix-Marseille, M2P2 lab, SBASTIEN PONCET, Univ Sherbrooke, Qubec — Metachronal waves of beating cilia are an efficient mechanism to transport mucus in human airways. The numerical results we will present will shed new light on the understanding of chronic respiratory diseases, such as Asthma of COPD. A coupled lattice Boltzmann - Immersed Boundary is used to simulate the multiphase environment in which the cilia are immersed : a periciliary layer and the mucus layer. A purely hydrodynamical feedback of the fluids is taken into account, and a coupling parameter is introduced, allowing the tuning of both the direction of the wave propagation, and the strength of the fluid feedback. The cilia, initially set in a random state, quickly synchronize with their immediate neighbors giving birth to metachronal waves. A comparative study of both antipleptic and sympleptic waves is performed by imposing the metachrony. Antiplectic waves are found to be the most efficient to transport and mix fluids compared to other random or synchronised cilia motions. The numerical results will be discussed and compared to experimental and clinical results obtained by collaborators, to progress on the understanding of the inner mechanisms of chronic respiratory diseases.

Julien Favier
Univ Aix-Marseille, M2P2 lab

Date submitted: 10 Jul 2017 Electronic form version 1.4