SEASEN Session 1 (Biomath & Healthcare) Speaker 2

Theoretical investigation of spherical microswimmers in linear flows and external fields

Jihade Chaiboub[1],

[1] LAMFA, CNRS UMR 7352, Université de Picardie Jules Verne, Amiens, France

Several prokaryotic cells swim in an autonomous manner. Some of them are able to respond to external fields such as mechanical, magnetic, chemical and so on. The orientation of such cells is often a unit vector $\boldsymbol{p}$ which is described in an external field (say, gravity magnetic field) by a nonlinear equation. When these cells are placed in an external flow field, they reveals several more or complex trajectories. The purpose of the present work is to present exact analytical solutions for the orientation field $\boldsymbol{p}(t)$, and determine the particle trajectory in external linear fields such as shear flow, hyperbolic flow, etc. . The method for solving the equation of $\boldsymbol{p}(t)$ is inspired from a Bretherton-like approach, initially developed for a different vectorial equation. Our study highlights the unified nature for solving this kind of problems. We will see that the particle under flow exhibits both run and tumble regimes, and a variety of cell trajectories are extracted such as parabolic, helical and so on. This study offers a framework for generalizing the results to other types of flows.

This is joint work with M. Guedda, M. Benlahsen and C. Missbah.