



Propuesta de Trabajo Fin de Máster

Año académico 2022-2023

MÁSTER EN MÉTODOS COMPUTACIONALES EN CIENCIAS

**Proyecto Nº 04**

**Título:** Thermodynamic cycles with magnetotactic bacteria

**Departamento/ Laboratorio:** Física y Matemática Aplicada

**Director:** Dr. Reinaldo García García

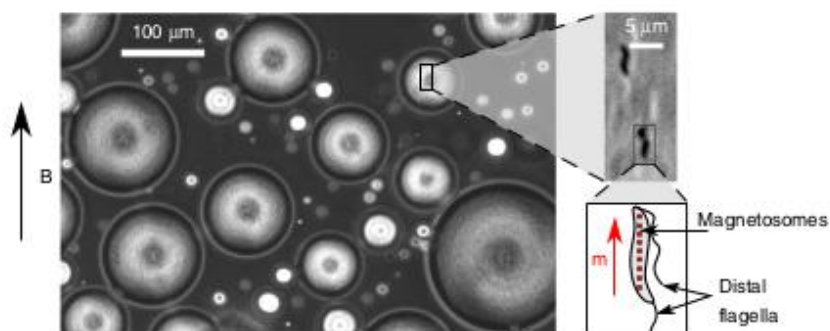
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**Resumen:**

Stochastic thermodynamics is a remarkably active field given its relevance for physics, chemistry, and biology. Stochastic thermodynamics focuses on the study of the fluctuations of thermodynamic observables upon arbitrary driving protocols. It also addresses the interplay between thermodynamics and information. Recently, the field has steadily shifted toward the elucidation of the thermodynamic properties of active and living systems in the search for fundamental principles allowing us to better understand life. In this project we propose a numerical study of the stochastic thermodynamics of active matter with a focus on a realistic model of magnetotactic bacteria. These organisms can be manipulated using shear flows and an imposed magnetic field, so that one can turn such bacteria in microscopic motors from where to extract, for instance, work. As part of the present proposal, one needs to properly define thermodynamic observables and efficiencies, to simulate stochastic bacterial trajectories upon variation of the shear rate and the magnetic field, to perform thermodynamic cycles numerically and to analyze them statistically. The project is conceived as part of a collaboration with the team of Prof. Dr. Eric Clément, from the PMMH laboratory at ESPCI, Paris Sciences et Lettres Research University, France, where experiments with real magnetotactic bacteria are performed. This represents an excellent opportunity for the student not only to model relevant living systems numerically, but also to analyze real experimental data, establishing a link between advanced theoretical models and state-of-the-art experiments with active and living systems.



Water-in-oil emulsion of magnetotactic bacteria in presence of a magnetic field

**OPTATIVAS RECOMENDADAS**

1. Programación avanzada