DC3: The compartmentalised formose reaction

Supervisor: Prof. Andrew Griffiths, andrew.griffiths@espci.fr

Host institution: École Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI), Laboratoire de Biochimie, Paris, France

The Laboratory of Biochemistry (LBC) is a multidisciplinary laboratory spanning physics, chemistry, and biology. The unifying theme of their research is the use of microfluidic systems, and in particular droplet microfluidic systems, to answer questions in the field of biology and for the development of biotechnology applications. Three main areas of fundamental research can be distinguished: (1) the emergence of Darwinian chemical systems (origin of life), (2) Darwinian system dynamics and directed evolution, and (3) single-cell analysis and screening. There is great synergy between fundamental research and applied projects, and this has resulted in the creation of several start-ups.

Project description: Study the autocatalytic formose reaction and its coupling to the growth and division of compartments (aqueous droplets in an emulsion) via osmosis and diffusion. Several crucial properties (growth, division, variation, competition, rudimentary heredity, and selection) are required for living and evolving systems to arise from this simple physical-chemical process. The aim here is to test whether the compartmentalised formose reaction system is capable of rudimentary evolution by natural selection. Specifically, DC3 will: (1) Develop microfluidic systems that allow multiple cycles of droplet growth and size-dependent droplet division. (2) Use this microfluidic system to monitor growth-division cycles of multiple "generations" of droplets, starting from mixtures of droplets with different initial compositions. (3) Aided by theoretical modelling, explore how initial conditions (temperature, sugars, food sets, or modulators such as amino acids or borates) may cause heritable variation in droplet growth rates. (4) Explore experimentally how evolution might be rendered more efficient by improving heredity and evolvability.

Secondments: This project is carried out in strong collaboration with the following groups, and visits to their laboratories are expected during the project. A willingness to travel and spend time abroad is therefore essential:

- Host: ELVESYS (ELV) | Supervisor: Alexander McMillan | Timing: M13 | Length: 1 month | Purpose: Explore new technological developments in microfluidics systems.
- Host: Parmenides Foundation (PARM) | Length: 2 months | Purpose: Develop theoretical model to explore how initial conditions cause heritable variations in droplet growth.

Eligibility conditions:

- Relevant MSc degree or equivalent (e.g., chemistry, biochemistry, physics).

Required Skills:

- The candidate should have expertise in fluid physics/physicochemistry and ideally microfluidics/microfabrication. They should have a strong command of written and spoken English.

Monthly allowances:

- Living allowance: €3400*
- Mobility allowance: €600
- Family allowance, if applicable: €660

Estimated gross salary: ~43,000 €/year

* The living allowance is adjusted by a country correction coefficient, depending on the country where the host institution is located. The exact net salary is dependent on local tax and social and health insurance regulations and will be confirmed upon appointment.

Enquiries

For general information about the DarChemDN visit the project website or send an email to info@darchem-dn.eu.

How to apply

To complete your online application, visit the DarChemDN recruitment web page.

Required documents:

- Cover Letter
- Curriculum Vitae (including contact information of two referees)
- Copy of Transcripts
- Copy of Diplomas (if available at the time of application – otherwise please provide a confirmation with the expected graduation date)

Only shortlisted applicants will be contacted. Interviews are expected to be online in November/December 2023.

Application deadline: To receive full consideration, applications must be submitted before **31 October 2023**.