

## DC2: Combining theory and experiments on evolving autocatalytic systems

---

**Supervisors:** The candidate will be supervised by one of the following scientists: (i) Prof. Eörs Szathmáry, [szathmery.eors@gmail.com](mailto:szathmery.eors@gmail.com); or (ii) Prof. Gonen Ashkenasy, [gonenash@bgu.ac.il](mailto:gonenash@bgu.ac.il); or (iii) Prof. Dora Tang, [dora.tang@uni-saarland.de](mailto:dora.tang@uni-saarland.de); or (iv) Prof. Sijbren Otto, [s.otto@rug.nl](mailto:s.otto@rug.nl).

**Host institution:** The candidate will be based in one of the following host institutions: (i) Parmenides Foundation (PARM), Center for the Conceptual Foundations of Science, Pöcking, Germany; or (ii) Ben Gurion University of the Negev (BGU), Laboratory for Systems Chemistry; Beer-Sheva, Israel; or (iii) Universität des Saarlandes, Center of Human and Molecular Biology, Saarbrücken, Germany; or (iv) University of Groningen. Stratingh Institute for Chemistry – Centre for Systems Chemistry, Groningen, the Netherlands.

**The Parmenides Foundation:** The Center for the Conceptual Foundations of Science at the Parmenides Foundation (<https://www.parmenides-foundation.org/>) is an international group interested in the evolution of systems at various levels from chemistry to language. Although the core activity is theoretical, collaboration with experimental groups is important and encouraged. We have an eminent past in the theory of evolution, minimal life-like chemical (super)systems, replicator theory, and multilevel selection, including replicators in protocells.

**Ben Gurion University:** Ben-Gurion University of the Negev is one of Israel's largest research universities, with approximately 20,000 students enrolled in five Faculties, including a strong Natural Sciences faculty. It has what is perhaps the strongest chemistry department in Israel. The University offers studies toward PhD degrees in all relevant fields. Gonen Ashkenasy's research group studies systems chemistry for many years. Their research focuses on variable replication processes driven by peptides and related molecules.

**Universität des Saarlandes:** The Tang Lab is an interdisciplinary lab, focused on unravelling the chemical and physical principles of living systems. They do this using bottom-up synthetic biology and biophysical approaches for the construction and characterization of synthetic cellular systems. The lab applies the system to questions in origin of life and modern biology including "how does compartmentalisation tune biochemistry in time and space?" and "what are the minimal number of components to generate a living system".

**University of Groningen:** The University of Groningen, established in 1614, has brought forward exceptional academics, like the first female student and the first Dutch astronaut. It ranks 'Top 100' in the ARWU Shanghai Ranking and the The World University Rankings. It has an excellent Chemistry Department (for example, Nobel Prize for Prof. Feringa in 2016). The research group of Sijbren Otto is world leading in Systems Chemistry, with a special emphasis on self-replicating systems, and pioneering in the area of the de-novo synthesis of life.

**Project description:** Develop the connection between theory and experimental work on the subject of evolving autocatalytic systems. The candidate will work on autocatalytic systems that can vary from newly identified autocatalytic networks to systems of self-replicating molecules, as developed in the research groups of Ashkenasy, Griffith and Otto. The focus of the research ranges from the identification of new autocatalytic sub-systems in computer-generated reaction networks to the development of models of existing autocatalytic and self-replicating systems. Research questions include assessing the evolvability of these systems as such, and when contained within compartments (water-in-oil droplets or coacervates) and developing strategies for improving 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: École Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI) | Length: 2 months | Purpose: Characterisation of reproducing compartmentalised systems.

Host: Paradigmatic Innovations GmbH (PARA) | Length: 3 months | Purpose: Explore the option space for and representation of the results to be achieved by the most modern knowledge-representation methods.

### Eligibility conditions:

MSc in chemistry or computational/systems biology. Candidates with a background in computational/theoretical chemistry or chemoinformatics and/or experimental chemistry are especially encouraged to apply. The candidate will enrol in the doctoral programme of the



Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them. (Grant Agreement No. 101119956)

respective host institution, except where this is the Parmenides Foundation, in which case the candidate will enrol in the [Doctoral Program of the Faculty of Chemistry and Pharmacy of LMU Munich](#). Corresponding admission requirements apply.

**Required Skills:**

Demonstrated experimental skills in chemistry and/or at least one relevant programming language and user-level understanding of linear algebra and differential equations. Creativity, intellectual risk-taking and interest in understanding of novel ideas. English as the working language.

**Monthly allowances:**

Living allowance: €3400\*

Mobility allowance: €600

Family allowance, if applicable: €660

**Estimated gross salary:** ~40,000 €/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](mailto:info@darchem-dn.eu). For specific questions about the science of the programme, contact the prospective supervisor by email (see above).

**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 the first round, potentially followed by an on-site visit in case of a second round.

**Application deadline:** Position remains open until filled. Applications are evaluated immediately upon receipt.