PhD and Postdoc Positions

Theory of mechano-genetic interactions in stem cell aggregates

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Embryonic stem cells can self-organize into 3D aggregates called embryonic organoids, which reproduce early mammalian embryogenesis. Initially, these aggregates are spherically symmetric, but they later break rotational symmetry with polarized expression patterns of key proteins, in a way that parallels the formation of the primary (head-to-tail) axis in mammals. We want to identify the mechanisms leading to this polarization.

Preliminary data indicates that different processes contribute to the aggregate polarization, which include cell differentiation, but also the motion of individual cells, large-scale tissue flows, and cell division. Moreover, recent work has observed intriguing features, such a scaling of the polarized expression patterns with the aggregate size.

To better understand the interplay between cell differentiation and mechanics, the researcher will work in close collaboration with experimentalists to **develop effective, data-based computational models**. To obtain part of the experimental data, the researcher will **develop new approaches to harness RNA sequencing data**. The **developed models will be numerically solved and compared to experimental data**, including RNA sequencing data, imaging data, and mechanical measurements. This will allow us to quantitatively dissect the interactions between genetic mechanisms of cell fate specification and mechanically driven cellular motion and tissue deformation.

The project will be carried out between two institutes, the EMBL (European Molecular Biology Laboratory) in Barcelona and the Turing Center for Living Systems in Marseille. It will be embedded in a long-term, ERC-funded collaboration between the teams of Vikas Trivedi, Verena Ruprecht (both Barcelona), Matthias Merkel, and Pierre-François Lenne (both Marseille). The precise scope of the project will depend on the career stage of the researcher (PhD or Postdoc).

Expected profile of the applicant: Bio-physicist or soft-matter physicist, computer scientist, or applied mathematician with a strong interest in morphogenesis

Start date: January 2024 (other start dates can be discussed)

To apply: We invite applicants to submit to matthias.merkel@univ-amu.fr and vikas.trivedi@embl.es:

- a CV,
- a letter covering prior research experience and professional interests (1 page), and
- contact information of 2-3 references.

Informal inquiries are welcome.