UKE Paper of the Month January 2024

Emergent seesaw oscillations during cellular directional decision-making

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ABSTRACT:

Motile cells inside living tissues often encounter junctions, where their path branches into several alternative directions of migration. We present a theoretical model of cellular polarization for a cell migrating along a one-dimensional line, arriving at a symmetric Y junction and extending protrusions along the different paths that originate at the junction. The model predicts the spontaneous emergence of deterministic oscillations of growth and cellular polarization between competing protrusions during the directional decision-making process. The oscillations are modified by cellular noise but remain a dominant feature that affects the time it takes the cell to migrate across the junction. These predictions are confirmed experimentally for two different cell types (non-cancerous endothelial and cancerous glioma cells) migrating on a patterned network of thin adhesive lanes with junctions.

STATEMENT:

This is the first time a paper from UKE is published in Nature Physics, which was funded by a grant obtained by the first time at the UKE, showing the opening of a new field of study in our institution. This interdisciplinary work was done in the context of an international collaboration lead by a new team established on 2020 (Prof. Sáez), which main goal is to contribute to the internationalization of the UKE. Consequently, this work is a collaboration with an oncology group (Gauthier NC) in IFOM (Milan, Italy), and a theoretical team (Gov NS) at Weizmann Institute of Science (Rehovot, Israel).

BACKGROUND:

The work was mostly conducted by Nabil Al-Dam, and Johan M. Kux under the supervision of Prof. Pablo J. Sáez (since 2020), at the Institute of Biochemistry and Molecular Cell Biology (IBMZ). The focus of this team is to understand how cells move and communicate in health and disease. This work was supported by local Hamburg funding: Forschungszentrum Medizintechnik Hamburg (Grant No. 04fmthh2021), the German Research Foundation (Grant No. 335447717-SFB 1328, Project A20), and an international grant: Human Frontier Science Program (Grant No. RGP0032/2022), which has been granted to an UKE researcher for the first time.