Physikalisches Institut
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Albert-Ludwigs-Universität Freiburg

SONDERKOLLOQUIUM

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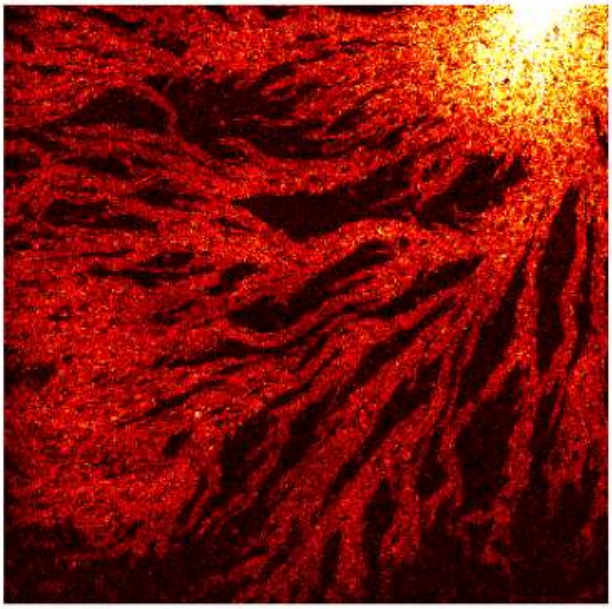
IM SEMINARRAUM, GUSTAV-MIE-HAUS



Physical principles in sensing and signaling

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Biological cells, although alive, exist in a physical world and follow its laws. Keeping this in mind allows us to address a number of challenging questions at the interface between physics and biology: What are the physical limits of sensing and can cells reach them? How do cells process information and how does information translate into cell behavior and strategy? How do cells communicate over macroscopic distances to form multicellular organisms? Answering these questions would help extend the historic successes of physics from nonliving to living matter, contributing to make the life sciences more quantitative and predictive. Using a combination of statistical-physics modeling and data from biological collaborators, my group gained a number of surprising new insights over the last 10 years. For instance, using active energy-consuming sensing strategies, cells can approach the physical limit as set by the random arrival of molecules at the cell surface by diffusion. Maximizing information flow optimizes cell behavior, e.g. in order to search for nutrients. Although cells are only a few micrometer in size, they manage to communicate over almost one millimeter in development by exploiting a critical-like state known from phase transitions in physical systems. In addition to satisfying our curiosity of how things work, such findings will also have significant biomedical applications.