MPIDS Colloquium

MAX-PLANCK-GESELLSCHAFT

Confining and releasing cell monolayers

Pascal Silberzan, PhD

Biology Inspired Physics at Mesoscales
Institut Curie – Centre de Recherche
Paris, France

Cell monolayers routinely exhibit collective behaviors controlled by cell activity and cell-cell interactions. In this context, confinement and boundary conditions play an important role in the organization and dynamics of these cell assemblies. Interestingly, many in vivo processes, including morphogenesis or tumor maturation, involve small populations of cells within a spatially restricted region.

We report experiments in which epithelial monolayers confined in circular disks exhibit low-frequency periodic radial displacement modes. When the boundary is removed, cells collectively migrate on the free surface. The essential characteristics of the collective dynamics in these two situations are well-accounted for by a unique theoretical model in which cells are described as persistent random walkers which adapt their motion to that of their neighbors.

In contrast, elongated fibroblasts that do not develop significant cell-cell adhesions self-organize until reaching a perfect nematic order upon confinement in sufficiently narrow linear stripes. When the cells are confined within a disk, the number and charge of the topological defects characteristic of nematics can be controlled, emphasizing the balance of activity and friction in this system.

More active cells such as myoblasts confined in stripes also organize in a nematic phase but their director makes a finite angle with the stripe direction. Simultaneously, the cells develop a spontaneous shear flow. Moreover, we evidence a critical width below which cells orient parallel to the stripe and do not flow. These observations are explained by an active gel theoretical model. The shear flow is reminiscent of in vivo observations where cancer cells escaping collectively from a tumor can locally migrate in antiparallel directions within the same strand.

Wednesday, April 10th, 2019 at 2:15 pm

MPIDS, Prandtl lecture hall, Am Faßberg 17, Göttingen

Max Planck Institute for Dynamics and Self-Organization
Living Matter Physics
Dr. Yoav Pollack
Email: yoav.pollack@ds.mpg.de, Phone: +49-(0)551/5176-117
Am Faßberg 17, 37077 Göttingen, Germany