

PHYSICAL MATHEMATICS SEMINAR

Mechanics, Geometry and Topology of Diseases

FABIAN SPILL

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ABSTRACT:

Experimental biologists traditionally study biological functions as well as diseases mostly through their abnormal molecular or cellular features. For example, they investigate genetic abnormalities in cancer, hormonal imbalances in diabetes, or an aberrant immune system in vascular diseases. However, many diseases also have a mechanical component which is critical to their deadliness. Notably, cancer kills typically through metastasis, where the cancer cells acquire the capability to remodel their adhesions and migrate. Such mechanical alterations also change geometrical features, such as the cell shape, or topological features, such as the organisation of vascular networks, or cellular neighbourhoods within a tissue.

While some of these mechanical, geometrical or topological features in biology are long known, the traditional perspective is to consider them as emergent from molecular features. However, mechanical, geometrical and topological features can also affect the molecular state of a cell. Therefore, the most complete view of many biological systems is to consider them as a complex mechano-chemical system, and disease such as cancer are then interpreted as perturbations to this system that cannot be solely explained by considering one feature in isolation (such as a single gene that 'causes' cancer). I will discuss several examples of systems where this mechanical/geometrical/topological coupling to molecular features plays a crucial role: cells that change their shape, blood vessel cells that open gaps to let cancer cells pass during metastasis, and mitochondria that change their organisation in diabetes.

TUESDAY, OCTOBER 25, 2022

2:30 PM – 3:30 PM

Building 2, Room 449

<http://math.mit.edu/seminars/pms/>