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Time evolution of cell size distributions in dense cell cultures
EVGENIY KHAIN, Oakland University — Living cells in a dense system are all in contact with each other. The common assumption is that such cells stop dividing due to a lack of space. Recent experimental observations have shown, however, that cells continue dividing for a while, but other cells in the system must shrink, to allow the newborn cells to grow to a normal size. Due to these "pressure" effects, the average cell size dramatically decreases with time, and the dispersion in cell sizes decreases, too. The collective cell behavior becomes even more complex when the system is expanding: cells near the edges are larger and migrate faster, while cells deep inside the colony are smaller and move slower. This exciting experimental data still needs to be described theoretically, incorporating the distribution of cell sizes in the system. We propose a mathematical model for time evolution of cell size distribution both in a closed and open system. The model incorporates cell proliferation, cell growth after division, cell shrinking due to "pressure" from other cells, and possible cell detachment from the interface of a growing colony. This research sheds light on physical and biological mechanisms of cell response to a dense environment and on the role of mechanical stresses in determining the distribution of cell sizes in the system.

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