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Session M11: Biological Active Matter III

8:00 AM–11:00 AM, Wednesday, March 8, 2023

Room: Room 203

Sponsoring Unit: DBIO

Abstract: M11.00009 : Competition of convection and diffusion in the self-mixing of microtubule-kinesin active fluid with non-uniform activity: Simulation*

10:00 AM–10:12 AM

← Abstract →

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Active fluids with spatiotemporally varying activity have potential applications to micromixing; however previously existing active fluids models are not prepared to account for spatiotemporally-varying active stresses. Our experimental work used UV-activated caged ATP to activate controlled regions of microtubule-kinesin active fluid inducing a propagating active-passive interface. Here, we recapitulate our experimental results with two models. The first model redistributes an initial ATP distribution by Fick's law and translates the ATP distribution into a velocity profile by Michaelis-Menton kinetics. This model reproduces our experimental measurements for the low-Péclet number limit within 10% error without fitting parameters. However, as the model is diffusion based, it fails to capture the convective based superdiffusive-like behaviour at high Péclet numbers. Our second model introduces a spatiotemporally varying ATP field to an existing nematohydrodynamic active fluid model and then couples the active stresses to local ATP concentrations. This model is successful in qualitatively capturing the superdiffusive-like progression of the active-inactive interface for high Peclet number (convective transport) experimental cases. Our results show that new model frameworks are necessary for capturing the behaviour of active fluid with spatiotemporally varying activity.

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