Active drops and interfaces

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Active matter provides a framework for studying and exploring systems driven out of equilibrium by the constant consumption of energy. Drawing inspiration from flocking and swarming behaviour in settings as disparate as birds, fish, sheep, bacteria and molecular motor assays, active matter offers theoretical insights into generic traits of collective motility and many related biophysical phenomena [1].

A common approach that has been developed to describe behaviour at the mesoscopic level, is to model the systems on liquid crystals, both polar and apolar, with additional terms added to the stress tensor to account for the non-equilibrium activity. These approaches reveal a variety of novel phenomena including giant fluctuations and spontaneous flow transitions [1], all for bulk active systems. The behaviour and properties of finite regions of active matter, or of the interfaces between active and passive components, is less developed, although there are recent studies of droplets [2] and free surfaces [3]. This project will develop the former of these – active droplets – with a view to understand steady state propulsion speeds and the interplay between interfacial boundary conditions, defects in the orientational order and motility. The project will be primarily theoretical, supported by appropriate numerics, and offers the potential to continue in the general area of soft active matter for a PhD.

References

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