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Spontaneous motion and deformation of a droplet driven by chemical reaction NATSUHIKO YOSHINAGA, Tohoku Univ — Spontaneous motion has been attracting lots of attention in last decades in nonlinear and nonequilibrium physics partially for its potential application to biological problems such as cell motility. Recently several model experiments showing spontaneous motion have been proposed in order to elucidate underlying mechanism of the motion. The systems in these works consist of relatively simple ingredients, for instance oil droplets in water, but nevertheless the results show rich motion and deformation of the droplet. Importantly, the system breaks symmetry and chooses one direction of motion. In this work, we theoretically derive a set of nonlinear equations exhibiting a transition between stationary and motile states starting from advection-reaction-diffusion equation driven away from an equilibrium state due to chemical reactions. A particular focus is on how hydrodynamic flow destabilizes an isotropic distribution of a concentration of chemicals. We also discuss a shape of the droplet. Due to self-propulsive motion and flow around the droplet, a spherical shape becomes unstable and it elongates perpendicular to the direction of motion. This fact would imply that the self-propulsion driven by chemical reaction is characterized as a pusher in terms of a flow field.

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