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Steady Marangoni flow traveling with chemical fronts LAURENCE RONGY, ANNE DE WIT, Center for Nonlinear Phenomena and Complex Systems, Université Libre de Bruxelles, CP 231, 1050 Brussels, Belgium — Chemical fronts propagating in a solution with a free surface generate spatiotemporal distributions of heat and mass that can initiate surface tension-driven and buoyancy-driven convections leading to complex experimental dynamics. It is useful to discriminate the influence of the various effects by analyzing model systems where only one type of convective flow is active. The goal of our work is to theoretically investigate the coupling between autocatalytic reactions, diffusion and Marangoni-driven flows to understand the resulting chemo- hydrodynamic patterns. We use the incompressible Navier-Stokes equations coupled to a conservation equation for the autocatalytic product concentration in the absence of gravity and for isothermal conditions. The boundary condition at the free surface introduces a solutal Marangoni number, M, representing the coupling intensity between hydrodynamics and reaction-diffusion processes. We show that such systems reach an asymptotic dynamics characterized by a steady fluid vortex traveling at a constant speed with the front. Increased propagation speed, front deformation and possible transient oscillating dynamics occur when M increases.

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