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The geometry of mode-locked fronts in periodically driven advection-reaction-diffusion systems[1] KEVIN MITCHELL, JOHN MAHONEY, University of California, Merced, TOM SOLOMON, Bucknell University
— We consider reaction-diffusion dynamics within a periodically driven fluid forming a linear chain of alternating vortices. Prior theoretical and experimental work on this system has demonstrated rich structure in the dynamics of the reaction front; for certain parameter values, the front will be mode locked to the external driving. Using dynamical systems theory, we relate the mode-locking behavior to the existence of relative periodic orbits (RPOs), and we show that the mode-locked front itself follows the profile of a "burning invariant manifold" (BIM)—a generalization of traditional invariant manifolds for passive transport, which incorporates the dynamics of front propagation. Together, the RPOs and BIMs provide clear criteria for the emergence and destruction of mode locking as well as an explanation of the front geometry.

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