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Rayleigh-Taylor unstable, premixed flames: the transition to turbulence ELIZABETH HICKS, ROBERT ROSNER, University of Chicago — A premixed flame moving against a sufficiently strong gravitational field becomes deformed and creates vorticity. If gravity is strong enough, this vorticity is shed and deposited behind the flame front. We present two-dimensional direct numerical simulations of this vortex shedding process and its effect on the flame front for various values of the gravitational force. The flame and its shed vortices go through the following stages as gravity is increased: no vorticity and a flat flame front; long vortices attached to a cusped flame front; instability of the attached vortices and vortex shedding (Hopf bifurcation); disruption of the flame front by the shed vortices, causing the flame to pulsate; loss of left/right symmetry (period doubling); dominance of Rayleigh-Taylor instability over burning (torus bifurcation); and, finally, complex interactions between the flame front and the vortices. We measure the subsequent wrinkling of the flame front by computing its fractal dimension and also measure mixing behind the flame front by computing the finite-time Lyapunov exponents.

Elizabeth Hicks
University of Chicago

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