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Blue whirl structure revealed[1] JOSEPH CHUNG, XIAO ZHANG, CAROLYN KAPLAN, University of Maryland, ELAINE ORAN, Texas A&M University — The blue whirl is a newly discovered whirling flame which shows only blue emission and burns liquid hydrocarbon fuels. It begins as a large, sooty fire whirl which decays to the self-sustaining, soot-free blue flame. Details of its structure were unknown in part due to difficulties in experimental diagnostics. This work presents numerical simulations of the blue whirl, which reveal its flow structure and burning modes for the first time. The numerical model solves the unsteady, compressible, Navier-Stokes equations. The effects of combustion are modeled using a calibrated chemical-diffusive model. The domain is a cubical enclosure with sides which are 30 cm long. Circulation is imposed by forcing air through the corners and a constant flux of fuel is specified at the center of the bottom floor within a specified diameter. The upper boundary is an outflow condition and all other boundaries are non-slip. The results reveal a triple flame structure within the blue whirl and the influence of vortex breakdown on its burning and flow structure.

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