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Numerical description of blue whirls over liquid-fuel pools[1] ANTONIO L SANCHEZ, University of California San Diego, JAIME CARPIO, Universidad Politecnica de Madrid, WILFRIED COENEN, University of California San Diego, ELAINE ORAN, Texas AM University, FORMAN A WILLIAMS, University of California San Diego — Previous experiments of liquid-pool fires with ambient swirl have shown that, when the outer circulation is increased beyond a critical value, the existing fire whirl transitions to a new, fundamentally different configuration involving a lifted partially premixed front lying below a recirculating-flow bubble. The steady axisymmetric structure of this so-called blue whirl is investigated here by numerical methods. The problem is formulated with account taken of the boundary velocity induced by the thermal plume developing vertically above the axis, with a one-step Arrhenius description adopted for the heat release and a simple, optically thin approximation for H_2O and CO_2 radiation, the latter being fundamental for fuel vaporization. Integrations for increasing values of the swirl level are seen to describe all of the flow features observed in experiments, including the detachment and subsequent lifting of the flame edge, the emergence of vortex breakdown, and the establishment of a partially premixed front with a stoichiometric ring.

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