Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

An MRI study of Laminar Entrainment in an Autocatalytic Chemical Plume M.C. ROGERS, Dept. of Physics, University of Toronto, A.J. SEDERMAN, M.D. MANTLE, MRRC, University of Cambridge, S.W. MORRIS, Dept. of Physics, University of Toronto, S.B. DALZIEL, DAMTP, University of Cambridge, L.F. GLADDEN, MRRC, University of Cambridge — Plumes are formed when a continuous source of buoyancy is supplied at a localized source. Buoyancy can be created by either a heat flux, a compositional difference, or a combination of both. Here we study laminar plumes due to an autocatalytic chemical reaction - the iodate-arsenous acid (IAA) reaction. In the absence of buoyancy effects, the nonlinear kinetics of the IAA reaction produces a sharp propagating front, rather like a weak flame front. However, the reaction produces buoyancy both by exothermicity, and by the compositional difference between the reactant and product, causing a plume to form. Velocity measurements were made on horizontal cross sections of IAA chemical plumes using an MRI technique known as the Gradient Echo Rapid Velocity and Acceleration Imaging Sequence (GERVAIS). Ordinary laminar plumes made by the injection of compositionally buoyant fluid exhibit Gaussian velocity distributions across the plume conduit. In contrast, we show that entrainment of fresh reactant into the conduit of an IAA chemical plume creates a buoyancy flux at the interface between reactant and product solution. This gives IAA chemical plumes unique, non-Gaussian velocity profiles.

Stephen Morris
Dept of Physics, University of Toronto

Date submitted: 05 Aug 2006 Electronic form version 1.4