Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Hot Surface Ignition and Flame Propagation of Hydrocarbon Air Mixtures PHILIPP BOETTCHER, BRIAN VENTURA, GUILLAUME BLANQUART, JOSEPH SHEPHERD, California Institute of Technology — To mitigate the risk of accidental explosions in industrial facilities and in the aviation industry, the mechanisms and parameters leading to ignition must be investigated. Of particular are isolated hot surfaces in contact with gaseous hydrocarbon fuels, and thus ignition of premixed n-hexane air and n-heptane air mixtures is examined using a high temperature glow plug. Measurements include schlieren visualization, particle streaks, pressure, and temperature measurements in the plume created by the hot surface. These measurements are performed for experiments in both air and combustion mixtures ranging in equivalence ratio from 0.5 (near the lower flammability limit) to 3.0. This allows for comparison of ignition temperature, flame speed, pressure rise, and temperature distribution with a computational flame model. For equivalence ratios above 0.7 the ignition temperature was observed to be insensitive to increasing fuel concentration and showed good agreement with the model. Three distinct combustion modes are observed that scale with the Richardson number: single flame, multiple flames, and puffing. These behaviors show the transition from flame propagation dominated to buoyancy dominated behavior, with puffing cycles of the order 10 Hz.

Philipp Boettcher
California Institute of Technology

Date submitted: 06 Aug 2010 Electronic form version 1.4