Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Theory of vaporization and combustion of fuel sprays in strained laminar mixing layers JAVIER URZAY, Center for Turbulence Research, Stanford University, ANTONIO SANCHEZ, Departamento de Ingeneria Termica y de Fluidos, Universidad Carlos III de Madrid, HEINZ PITSCH, Institut fur Technische Verbrennung, RWTH Aachen University, AMABLE LINAN, ETSI Aeronauticos, Universidad Politecnica de Madrid — The vaporization and combustion of a monodisperse fuel spray in a laminar counterflow mixing layer is investigated under conditions such that the droplet Stokes number is smaller than 1/4, so that the droplets do not cross the stagnation plane, but instead tend to accumulate there because of their inertial slip motion. Vaporization is confined to the thin strained mixing layer separating the spray from the hot stream, which can be described with an Eulerian description for the liquid phase. The numerical integration of the resulting boundary-value problem provides the structure of the reactive mixing layer, including the standoff distance from the stagnation plane where droplets disappear and the flame location. Limiting asymptotic solutions for extreme values of the controlling parameters are also determined, and a generalized vaporization law for droplets in the presence of thermal gradients is derived. The results provide increased understanding of laminar spray flamelets.

Javier Urzay
Center for Turbulence Research, Stanford University

Date submitted: 15 Aug 2011 Electronic form version 1.4