Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Validation of an LES Model for Soot Evolution against DNS Data in Turbulent Jet Flames MICHAEL MUELLER, Princeton University — An integrated modeling approach for soot evolution in turbulent reacting flows is validated against three-dimensional Direct Numerical Simulation (DNS) data in a set of n-heptane nonpremixed temporal jet flames. As in the DNS study, the evolution of the soot population is described statistically with the Hybrid Method of Moments (HMOM). The oxidation of the fuel and formation of soot precursors are described with the Radiation Flamelet/Progress Variable (RFPV) model that includes an additional transport equation for Polycyclic Aromatic Hydrocarbons (PAH) to account for the slow chemistry governing these species. In addition, the small-scale interactions between soot, chemistry, and turbulence are described with a presumed subfilter PDF approach that accounts for the very large spatial intermittency characterizing soot in turbulent reacting flows. The DNS dataset includes flames at three different Damköhler numbers to study the influence of global mixing rates on the evolution of PAH and soot. In this work, the ability of the model to capture these trends quantitatively as Damköhler number varies is investigated. In order to reliably assess the LES approach, the LES is initialized from the filtered DNS data after an initial transitional period in an effort to minimize the hydrodynamic differences between the DNS and the LES.

Michael Mueller
Princeton University

Date submitted: 09 Aug 2012 Electronic form version 1.4