Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Molecular mixing in highly turbulent premixed flames[1] XINYU ZHAO, PATRICK MEAGHER, University of Connecticut — Honoring Ted OBrien: The molecular mixing rules and rates in premixed flames subject to intense turbulence are investigated in this study. Direct numerical simulation (DNS) of a spherical product kernel is conducted in a homogeneous isotropic turbulence box. The triply periodic computational domain outside the product kernel is comprised of fresh mixtures. The transient flame kernel undergoes flame propagation, local extinction, and eventually global extinction. During the transition, the compositional space evolves from a low-dimensional manifold to increasingly higher dimensions. The DNS data are subsequently explicitly filtered to study the subgrid-scale behavior of the scalars. The Euclidean minimum spanning trees are constructed to understand the change of localness during the extinction process. Conditional statistics of major and minor species are collected, according to the mixing rules of various mixing models. A scalar gradient based mixing frequency model is constructed and assessed for its suitability to represent the mixing rates of critical species during all phases of the flame kernel evolution.

[1]The work was supported by the Air Force Office of Scientific Research under the grant number FA9550-18-1-0173 (Dr. Chiping Li).

Xinyu Zhao
University of Connecticut

Date submitted: 30 Jul 2019 Electronic form version 1.4