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A Structure Function Analysis of Intermittency and Universality in Turbulent Premixed Flames SAMUEL H. R. WHITMAN, COLIN A.Z. TOWERY, University of Colorado Boulder, ALEXEI Y. POLUDNENKO, Texas A&M University, PETER E. HAMLINGTON, University of Colorado Boulder —
In recent years, turbulence-flame interactions have been explored using both spectral and physical space approaches, but to date there remains limited understanding of how turbulence spectra and scales of motion vary throughout the flame structure (i.e., through premixed flamelets). We shed light on this question using a recently developed structure function analysis to analyze a range of premixed reacting flows. High-resolution direct numerical simulations (DNS) allow for a flame-normal structure function to be calculated locally, capturing the effect of heat release on the turbulent scales of motion and energy spectrum. We use this analysis to examine whether a universal relation for such structure functions can be derived through non-dimensionalization that is fully consistent throughout the flame, or whether different flame regions (e.g., the preheat and reaction zones) obey different laws. The same techniques are applied to a set of turbulent premixed flames with varying chemical kinetic mechanisms to further investigate universality across fuel types. The resulting implications for intermittency and universality in premixed reacting flows are discussed.

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