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Conditional budgets of second-order statistics in nonpremixed and premixed turbulent combustion JONATHAN F. MACART, TEMISTOCLE GRENGA, MICHAEL E. MUELLER, Princeton Univ — Combustion heat release modifies or introduces a number of new terms to the balance equations for second-order turbulence statistics (turbulent kinetic energy, scalar variance, etc.) compared to incompressible flow. A major modification is a significant increase in viscosity and dissipation in the high-temperature combustion products, but new terms also appear due to density variation and gas expansion (dilatation). Previous scaling analyses have hypothesized that dilatation effects are important in turbulent premixed combustion but are unimportant in turbulent nonpremixed combustion. To explore this hypothesis, a series of DNS calculations have been performed in the low Mach number limit for spatially evolving turbulent planar jet flames of hydrogen and air in both premixed and nonpremixed configurations. Unlike other studies exploring the effects of heat release on turbulence, the turbulence is not forced, and detailed chemical kinetics are used to describe hydrogen-air combustion. Budgets for second-order statistics are computed conditioned on progress variable in the premixed flame and on mixture fraction in the nonpremixed flame in order to locate regions with respect to the flame structure where dilatation effects are strongest.

Jonathan MacArt
Princeton Univ

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