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Effects of scalar alignment on flame structure in multi-modal combustion TEMISTOCLE GRENGA, MICHAEL MUELLER, Princeton University — In practical systems, combustion does not occur in the asymptotic limits of nonpremixed and premixed combustion. Furthermore, when coupled with autoignition at elevated temperatures and pressures, complex multi-modal processes occur. An example of the complex interactions between combustion modes is the stabilization of lifted nonpremixed jet flames, which can occur kinematically via a classical triple flame, kinetically via autoignition, or via a combination of the two. In these lifted coflow jet flames, the direction of premixed (triple) flame propagation and autoignition front propagation is perpendicular to the mixture fraction gradient. Conversely, in equivalent multi-modal counterflow flames, the premixed flame or autoignition front propagation would be aligned with the mixture fraction gradient. In this work, the effect of this alignment on the multi-modal flame structure is assessed by comparing detailed numerical simulations of laminar DME/air flames in both lifted coflow jet and counterflow configurations under otherwise equivalent conditions. The thermochemical structures of both configurations are compared to a recently proposed reduced-order manifold for multi-modal combustion.

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