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High spatial resolution PIV and CH-PLIF measurements of a Shear Layer Stabilized Flame CHRISTOPHER FOLEY, IANKO CHTEREV, JERRY SEITZMAN, TIM LIEUWEN, Georgia Institute of Technology — In practical combustors, flames stabilize in thin shear layers with very high strain rates, which alter the flame burning rate - either enhancing or diminishing reaction rates, and even leading to extinction. Therefore, the bulk velocity that provides stable operation in these combustors is limited, presumably due to the associated maximum stretch rate that the flame is able to withstand. The focus of this work is to develop a deeper understanding of the interaction between flow and flame for a shear layer stabilized, premixed flame. This study consists of planar, high resolution, simultaneous PIV and CH-PLIF measurements, in a 8 x 6 mm plane with 0.11 mm and 0.16 mm PIV vector and CH-PLIF image resolution, respectively, of the flame stabilization region in a swirling jet. The hydrodynamic strain induced stretch rate along the high CH concentration layer of the flame front is calculated from these measurements. In addition, this study elucidates the unsteady behavior of the flame in the thin shear layer. The measured flame stretch is highly spatially and temporally dependent, and dominated by contributions from normal and shear strain terms of axial velocity. Although normal strain is much greater than shear, the near horizontal flame orientation results in neither strain term dominating flame stretch. Furthermore, the flame angle changes the sign of the shear strain contributions as observed experimentally, an important implication for reduced order modeling approaches.

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