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Time-Resolved, Two-Dimensional Imaging of Scalar Mixing in Turbulent Gas-Phase Jets MICHAEL PAPAGEORGE, JEFFREY SUTTON, Ohio State University — The objective of this work is to examine the dynamics of scalar mixing in turbulent, gas-phase jets using kHz-rate laser diagnostics. The research is underpinned by a new High Energy Pulse Burst Laser System (HEPBLS), which is capable of delivering more than 150 high-energy ($> 500mJ$) pulses with repetition rates exceeding 10 kHz. The unique system allows for the extension of traditionally low repetition-rate planar laser techniques such as Rayleigh scattering and Planar Laser-Induced Fluorescence (PLIF) to high-speed imaging applications. In this study, two turbulent jets with Reynolds number equal to $10,000$ and $15,000$ (based on jet diameter) are used to study time-dependent scalar mixing and dissipation processes. Temporally-resolved, two-dimensional images of the mixture fraction and scalar dissipation rate fields are obtained at axial positions of $\frac{x}{D} = 10$ to $\frac{x}{D} = 40$, revealing the highly transient mixing topology within turbulent jets. Averaged results are validated against similar imaging techniques at low repetition rates and known turbulent scaling laws. In addition to "real time" visualization, the scalar mixing dynamics are characterized with temporal and spatial statistics.

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