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Effect of the boundary layer thickness on the hydrodynamic instabilities of coaxial atomization under harmonic flow rate and swirl ratio fluctuations CORENTIN JORAJURIA, NATHANAEL MACHICOANE, RODRIGO OSUNA, ALBERTO ALISEDA, University of Washington — Break-up of a liquid jet by a high speed coaxial gas jet is a frequently-used configuration to generate a high quality spray. Despite its extended use in engineering and natural processes, the instabilities that control the liquid droplet size and their spatio-temporal distribution in the spray are not completely understood. We present an experimental measurements of the near field in a canonical coaxial gas-liquid atomizer. The liquid Reynolds number is constant at 10^3, while the gas jet Reynolds number is varied from 10^4-10^6. The liquid injection rate and the swirl ratio are harmonically modulated to understand the effect of unsteadiness on the interfacial instability that triggers primary break-up. The gas velocity is measured using a combination of hot-wire anemometry and 3D PIV, resolving the gas boundary layer and the three-dimensionality of the flow, particularly in the cases with swirl. The development of the hydrodynamic instabilities on the liquid-gas interface is quantified using high speed visualizations at the exit of the nozzle and related to the frequency and growth rates predicted by stability analysis of this boundary layer flow. The resulting droplet size distribution is measured at the end of the break-up process via Particle Phase Doppler Anemometry and compared to stability analysis predictions statistics.

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