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Insights into flame-flow interaction during boundary layer flashback of swirl flames[1] RAKESH RANJAN, The University of Texas at Austin, DOMINIK EBI, Paul Scherrer Institut, Switzerland, NOEL CLEMENS, The University of Texas at Austin — Boundary layer flashback in swirl flames is a frequent problem in industrial gas turbine combustors. During this event, an erstwhile stable swirl flame propagates into the upstream region of the combustor, through the low momentum region in the boundary layer. Owing to the involvement of various physical factors such as turbulence, flame-wall interactions and flame-flow interactions, the current scientific understanding of this phenomenon is limited. The transient and three-dimensional nature of the swirl flow, makes it even more challenging to comprehend the underlying physics of the swirl flame flashback. In this work, a model swirl combustor with an axial swirler and a centerbody was used to carry out the flashback experiments. We employed high-speed chemiluminescence imaging and simultaneous stereoscopic PIV to understand the flow-flame interactions during flashback. A novel approach to reconstruct the three-dimensional flame surface using time-resolved slice information is utilized to gain insight into the flame-flow interaction. It is realized that the blockage effect imposed by the flame deflects the approaching streamlines in axial as well as azimuthal directions. A detailed interpretation of streamline deflection during boundary layer flashback shall be presented.

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