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Time-resolved analysis of thermo-acoustic instability triggering in a low-swirl burner using simultaneous high-speed laser diagnostics.

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The growth of a thermo-acoustic instability is studied in a low-swirl methane-air burner as the equivalence ratio is increased. Using simultaneous high-speed acetone (for fresh gases) and OH (for burnt gases) laser induced fluorescence, it is possible to study the flame and flow motions. Dynamic Mode Decomposition allows to extract the behavior of the flame at the frequency of the thermo- acoustic instability and to confirm that the origin of the instability lies in the periodic detachment of ring vortices, as expected from the literature. To study the growth of the instability , Hilbert transform is used to obtain the temporal evolution of the phase of the fluorescence signal at different points in the burner. It shows that the inner and outer parts of the flame fluctuate more and more in phase as the equivalence ratio is increased. By creating bursts of flame, this is the mechanism for the increase of the amplitude of the instability.

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