au programme des séminaires ICARE…

Investigation of pressure effects on the small scale wrinkling of turbulent premixed Bunsen flames

par

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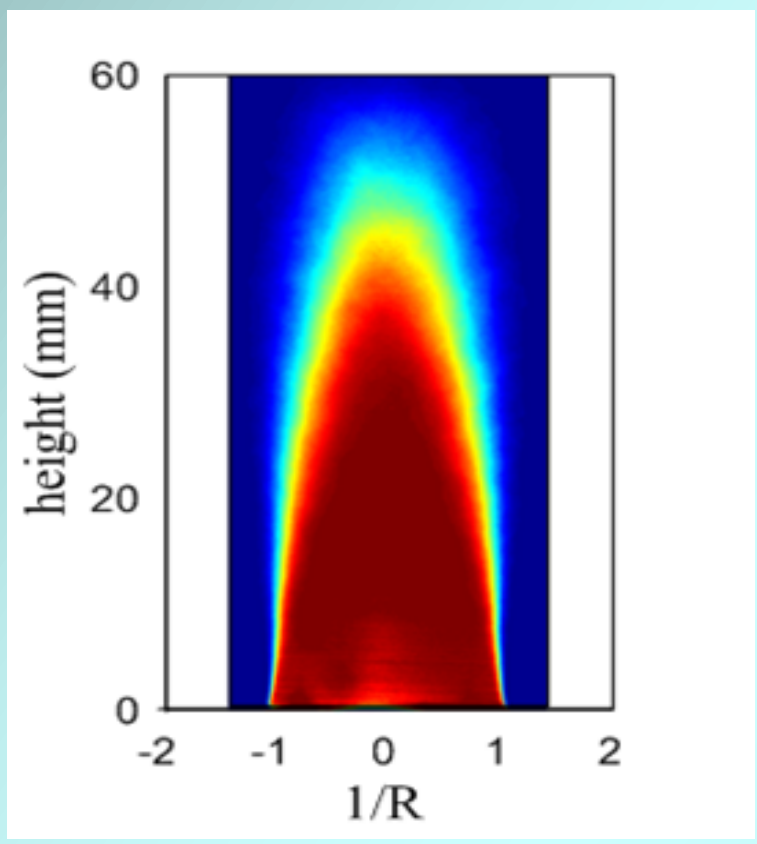

High pressure turbulent premixed flames have been significantly studied in the past decade. The eloquent flame images obtained under high pressure conditions attest the large changes in flame front wrinkling enhanced by the pressure increase. Among the explanation attempts, pressure was assumed to promote Darrieus–Landau (DL) instabilities. More recently the role of the laminar flame thickness was also identified as a key parameter for the flame/turbulence interactions. The objective of the current study is to contribute to this debate by isolating the effects of the suspected parameters.

To do so, turbulent methane/air flames are investigated in a high pressure combustion test facility. A multi-grid turbulence promoter system has been developed and implemented to obtain a more intense, isotropic and homogeneous turbulence at the burner exit. The pressure range is 0.1–0.4 MPa, and the mixture composition is varied between ER = 0.7 and ER = 1.0. Instantaneous flame images have been collected using Mie scattering tomography and exploited to analyze flame–turbulence interactions under controlled conditions. Flame and turbulence parameters have been independently varied under DL instability free conditions to isolate the effect of the laminar flame thickness and that of the small scale turbulence eddies. The stretching of the turbulence energy spectrum towards smaller turbulent length scales is identified as the main reason for the enhanced flame front wrinkling under high pressure flame conditions, together with the reduction of the laminar flame thickness. The Taylor micro-scale appears to be the regulating turbulence scale for flame–turbulence interactions.

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