NRC postdoc – Flame-wall interaction

In GTs, combustion occurs within a confined environment, such that flames unavoidably propagate in the vicinity of a (relatively) cold solid boundary or wall. This flame-wall interaction (FWI) adversely affects **combustion efficiency**, **pollutant emissions**, and **durability and lifetime of heated components** (e.g., combustor liners). These are expected to be exacerbated for ultra-lean hydrogen enriched flames as Fig. 3 suggests. We observed that when comparing lean 100% methane flames shown in (a) with much leaner 30% methane 70% hydrogen flames in (b), the near-wall reaction zone becomes highly fragmented with a high concentration of diffuse CH_2O, suggesting local flame quenching and extinctions, as well as strong heat fluxes through the wall.

To address this, a low-swirl burner will be outfitted with an in-house built, water cooled, temperature-controlled plate. Using simultaneous OHxCH_2O PLIF to directly measure the local heat release rate in the flame, and stereoscopic particle image velocimetry (stereo-PIV) to characterise the velocity flow field, we will aim to correlate variations in local flame structure and topology (wrinkling scales, flame thickness, flame surface density) and heat release rate, with spatial variations in temperature and heat flux along the wall.

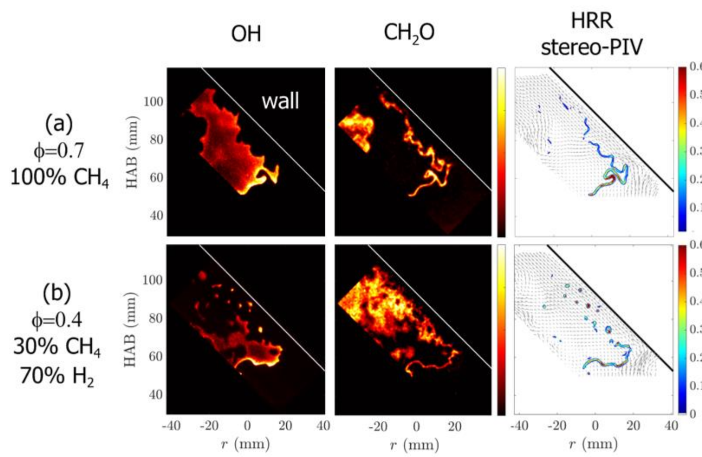

Figure 1. Individual OH and CH_2O PLIF images with resulting heat release rate (HRR) map in fully premixed (a) ϕ = 0.7 100%CH_4 and (b) ϕ = 0.4 30%CH_4 +70%H_2 low-swirl flames showing high downstream concentration of CH_2O and fragmented reaction zone.

These measurements will provide insight into the underlying physical mechanisms that govern FWI, where we will then investigate how the incident angle and cooling of the plate may influence the stabilization mechanisms of the low-swirl flame and define its shape.