

3D04: DIESEL FUEL JET LIFT-OFF STABILIZATION IN THE PRESENCE OF LASER-INDUCED PLASMA IGNITION.

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**Comment by R.J.H. Klein-Douwel, Radboud University Nijmegen, The Netherlands**  
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You show pictures of OH\* chemiluminescence, but you also indicate in some pictures that soot is present. How do you discriminate between signals of OH\* and soot? You indicate that a narrowband filter, centered at 310 nm, is used. But as shown in the chemiluminescence spectra in our paper [1], thermal radiation from soot incandescence may cause a background signal, even when using a narrowband filter. Or do you have other methods to ascertain that there is no soot background signal when looking for OH\* chemiluminescence?

Reference:

[1] R.J.H. Klein-Douwel, A.J. Donkerbroek, A.P. van Vliet, M.D. Boot, L.M.T. Somers, R.S.G. Baert, N.J. Dam, J.J. ter Meulen, Paper 2D12, *Proc. Combust. Inst.* 32 (2008) in press.

**Reply by Lyle Pickett**  
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It is true that soot incandescence can cause significant thermal radiation in a reacting diesel spray, even at ultraviolet (UV) wavelengths (310 nm). However, past studies in our facility have shown that the UV light emitted very near the lift-off length is dominated by OH chemiluminescence, rather than UV soot incandescence [1]. Soot incandescence at UV wavelengths can become significant downstream of the lift-off length, if soot forms, but there is a finite distance between the lift-off length and the region of soot formation [2]. Furthermore, at 310 nm, the ratio of downstream soot incandescence to upstream OH chemiluminescence is relatively small, allowing collection of both without camera saturation [1]. Therefore, band-pass filtering at 310 nm, interpretation of the lift-off length is straightforward, even in sooting fuel jets [1].

If the fuel jet happens to be weakly sooting, visible-wavelength filters can be utilized (e.g. a 500-nm short-wavelength-cutoff filter) to collect chemiluminescence as the interference from soot luminosity is small, and the light emission at visible and UV wavelengths is spatially coincident in the region near the lift-off length [1]. This was the setup for our results shown in Fig. 2. However, we checked that our visible-wavelength lift-off imaging was coincident with that determined through OH chemiluminescence by simultaneously imaging with a second UV camera and filters. For the “natural” lift-off length condition of Fig. 2, we found that the upstream air entrainment was sufficient to produce an entirely soot-free fuel jet. Indications of a soot-free fuel jet include no laser-

induced incandescence, no laser extinction, and weak, nearly-constant luminosity after ignition (see photodiode signals in Fig. 5) [3]. Although laser ignition shortens the lift-off length, and causes soot to form (see Fig. 2 and Fig. 5), our high-speed imaging configuration was already setup to collect chemiluminescence based on the natural lift-off length. With this setup, the downstream soot luminosity is so strong that it saturates the image (see “SOOT” in Fig. 2) and increases the photodiode signal (see Fig 5), but the upstream chemiluminescence remains detectable to identify the transient lift-off length.

#### References:

- [1] B. Higgins, D. Siebers, SAE Transactions 110 (3):739–753, 2001, SAE Paper 2001-01-0918.
- [2] L.M. Pickett, D.L. Siebers, *Int. J. Engine Res.* 6 (2006) 103–130.
- [3] L.M. Pickett, D.L. Siebers, *Proc. Combust. Inst.* 29 (1) (2002) 655–662.