In current diesel engines, legislated emission levels are generally met through aftertreatment. Combustion technologies with intrinsically lower smoke and NOx emissions can minimize the aftertreatment system required, and thus reduce the related costs. These combustion concepts mostly rely on enhanced mixing and reducing (local) temperatures and can therefore be classified as Low Temperature Combustion (LTC) concepts.

**High speed laser diagnostics**

Improvements in combustion technology are sustained by a detailed understanding of underlying physical and chemical processes, in the case of LTC in particular:

- Transient combustion phenomena (ignition, extinction, …)
- Effects of gradients of temperature
- Effects of gradients in mixture strength

For a closer understanding of these phenomena laser diagnostics at rates much faster ($\geq 1$ kHz) than typical time-scales of turbulent flame are necessary.

**Experimental setup**

For investigation of the phenomena mentioned, a dedicated test rig has been developed, which consists of a one-cylinder optically accessible heavy-duty engine, based on a DAF MX engine, driven by an electrical motor. This optical access is obtained using a mirror and sapphire liner and piston parts (Figure 1).

**High speed combustion imaging**

Crossing the Combustion modes in Diesel Engines (XCiDE):

Detailed laser-diagnostic studies in an optical engine


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**Laser setup**

To access flame dynamics at these short time-scales, spatial distributions of diatomic molecules like OH and CH can be monitored.

**Dye laser**: For their excitation, a Sirah Credo high-speed (HS) dye laser is used (Figure 2). R6G and Styryl 8 dyes can be used for excitation of OH and CH, respectively.

**Pump laser**: This laser will be pumped by our HS PIV laser. This EdgeWave IS8II-DE double cavity Nd:Yag laser has a pulse energy of 7 mJ at 5 kHz net repetition rate. This enables 1.2 °CA resolution at 1000 rpm engine speed.

**Camera system**

The rather low pulse energies at high repetition rates make imaging of OH and CH molecules a challenge. For this, the current Vision Research Phantom V7.1 camera will be equipped with a high speed image intensifier. The camera can use 800x600 pixels resolution at 4800 frames per second. The image intensifier is lens coupled to the camera and allows gating times down to 5 ns.

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