



Laser Ignition a New Concept to Use and Increase the Potentials of the Gas Engines

**Dr. Günther Herdin/CTO GE Jenbacher
2nd Annual Advanced Stationary Reciprocating
Engines Conference**




GE imagination at work



Future Ignition Systems

- Plasma Ignition
- High Frequency Ignition
- Auto Ignition
- **Laser Ignition**
- Pressure Wave Ignition
- Diesel Pilot Ignition
-

GEJ Laser Ignition Activities

	1999	2000	2001	2002	2003	2004	2005	2006
basic works and verification TU Wien, Institut for Photonics TU Graz, Institut for ICE	Jubiläums Fonds der österreichischen Nationalbank 							
basic engineering and engine tests TU Wien, Institut for Photonics TU Wien, Institut of Process Engineering TU Graz, Institut for Experimental Physics	FFF  August 2000 first engine test							
basic engineering and HCCI combustion TU Wien, Institut for Photonics TU Wien, Institut for Process Engineering TU Wien, Institut for ICE TU Graz, Institut for Experimental Physics TU Wien Francesconi Technology	A3 BMVIT 							

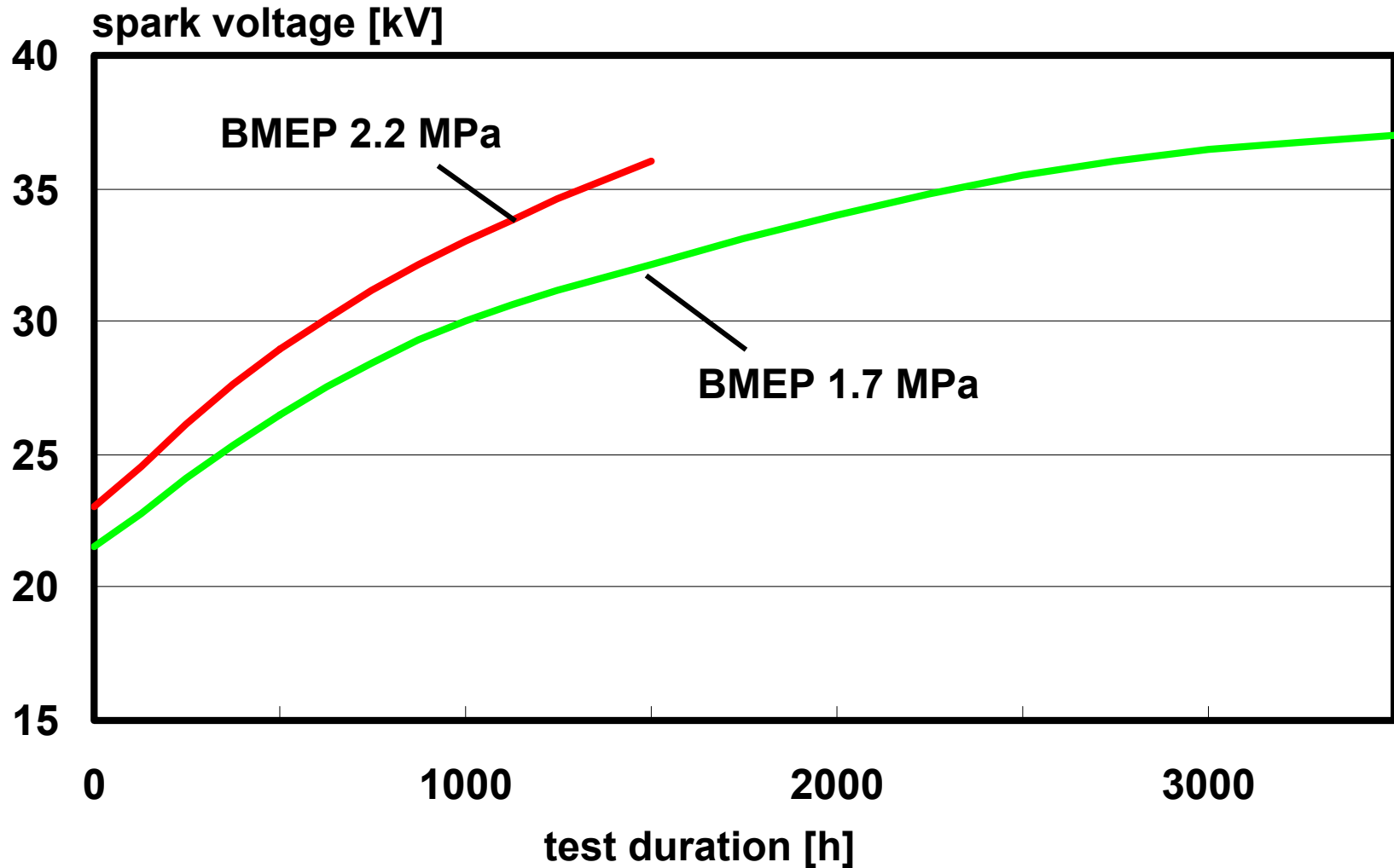
Why Laser Ignition?

conventional spark plug systems comes to the physical border line

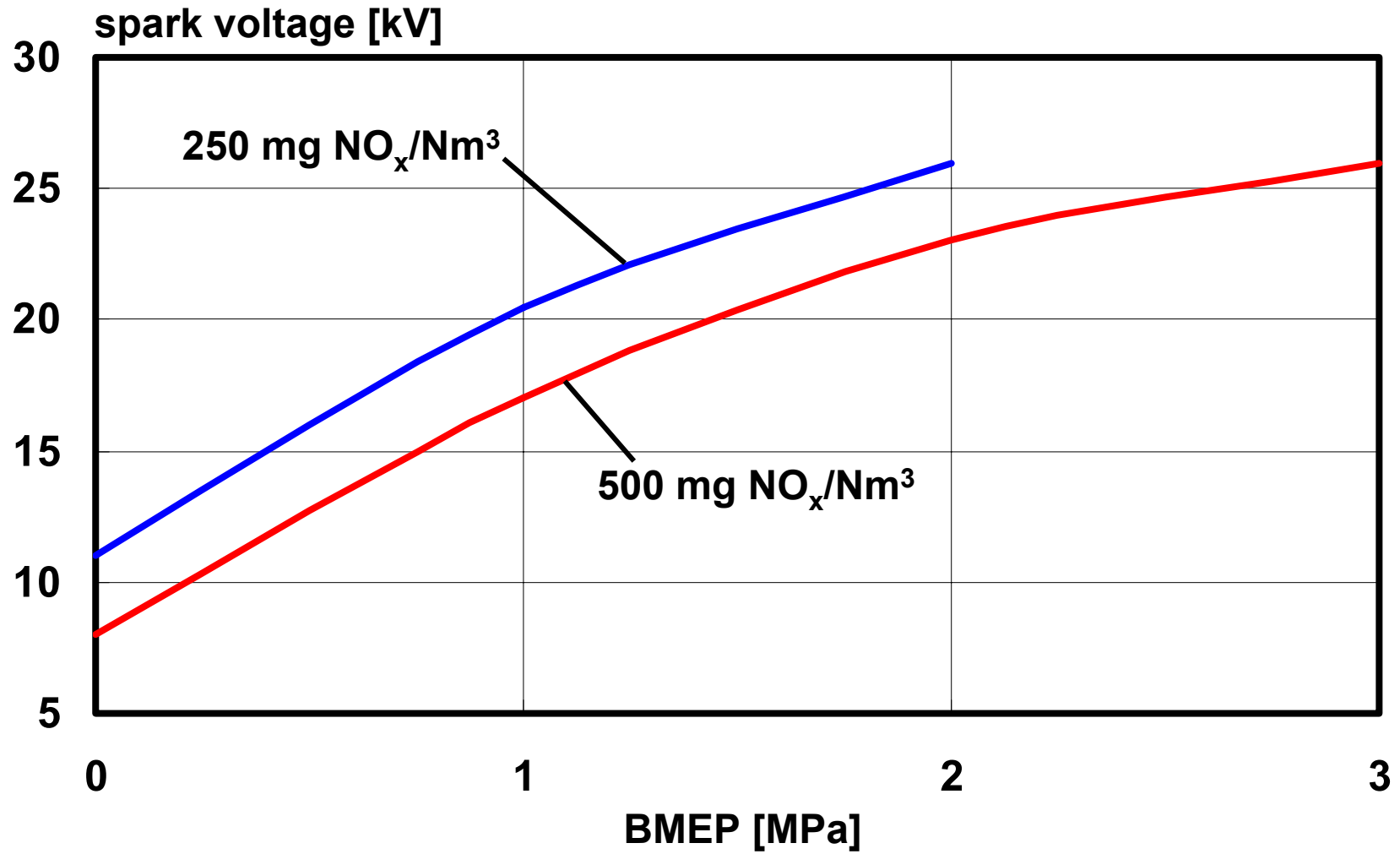
..... and the Laser ignition can help to have BMEP`s higher than 2.4 MPa for gas engines. With this we see efficiencies of 48 % possible and NOx emissions in the range of 30 ppm.

Increase of Spark Voltage

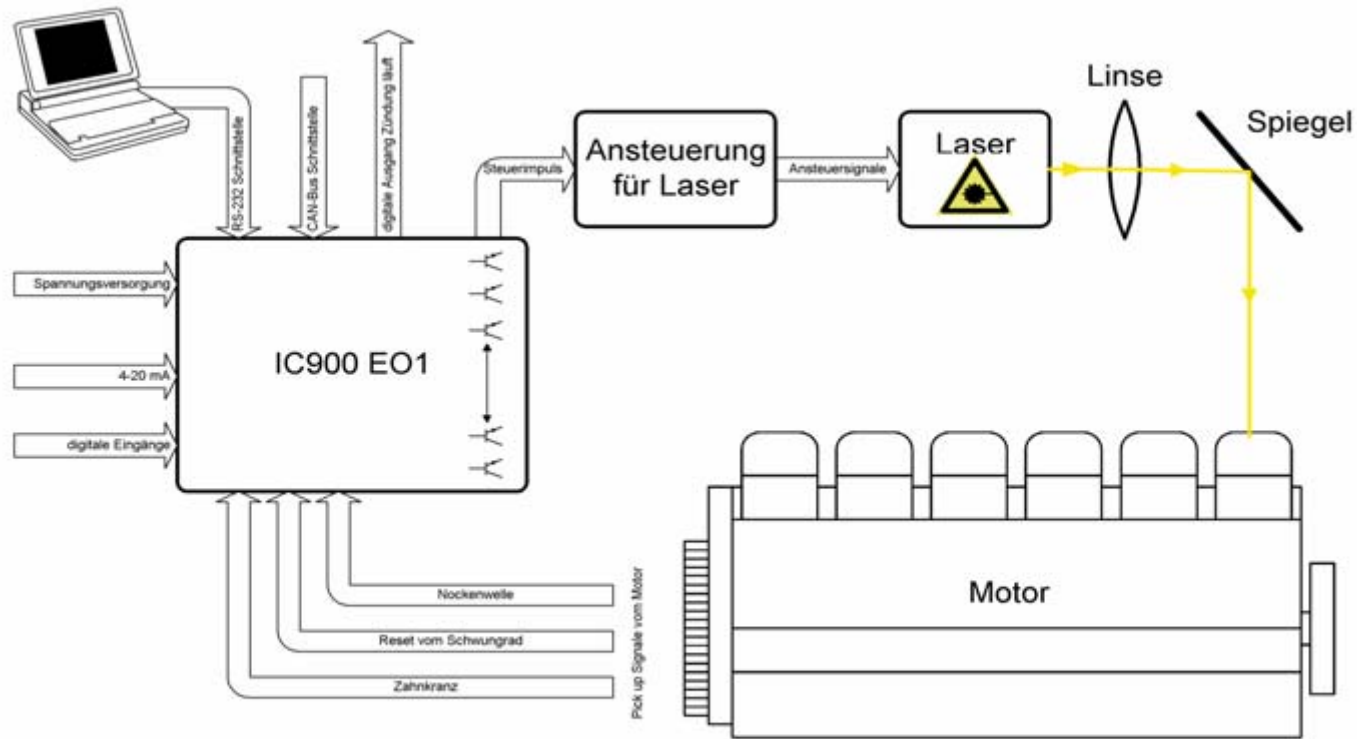
Comparison BMEP 2.2 / 1.7 MPa



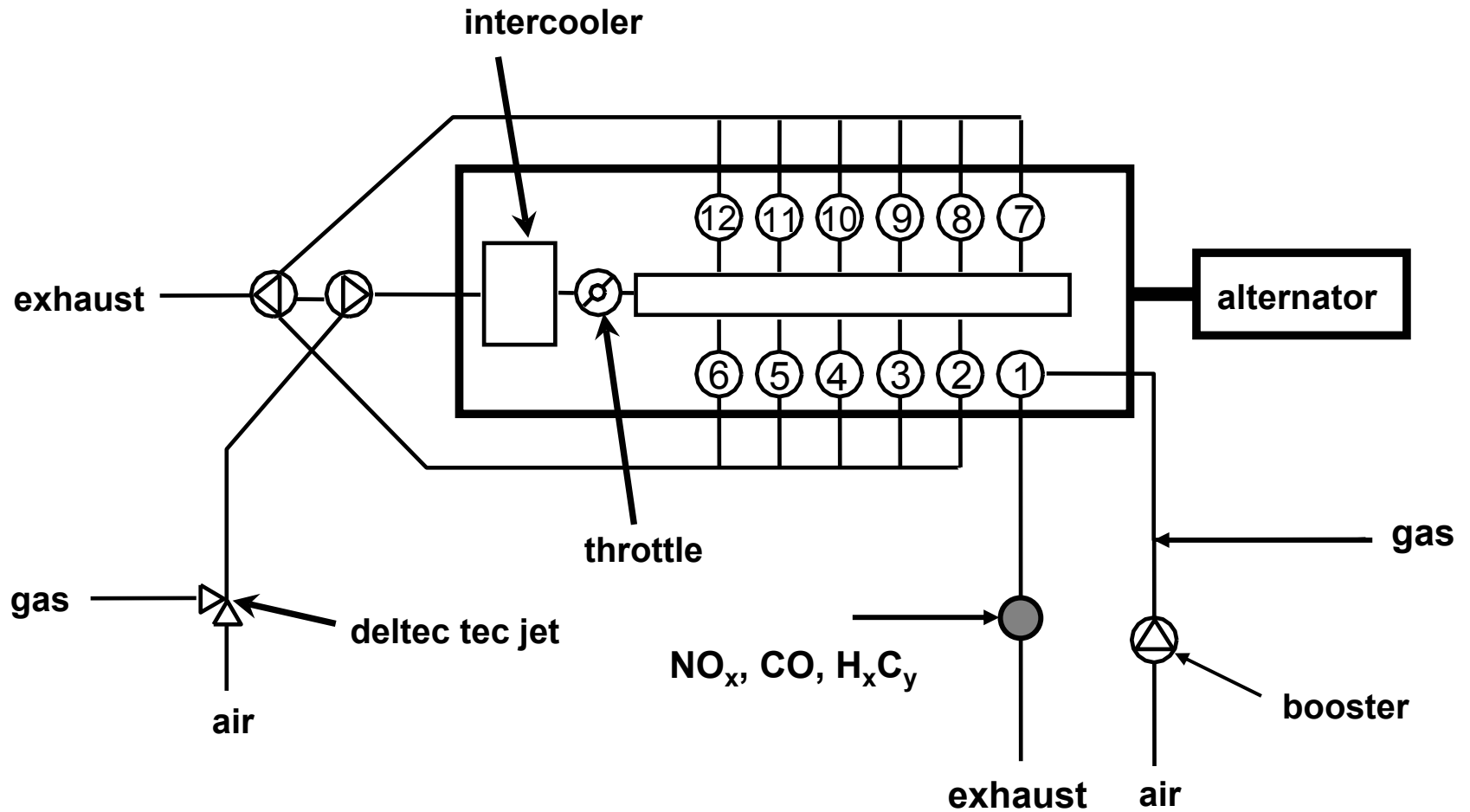
Spark Voltage vs BMEP



Control of the Nd-Yak Laser IC-900 E01



Scheme Research Engine



Laser – Ignition Engine Test

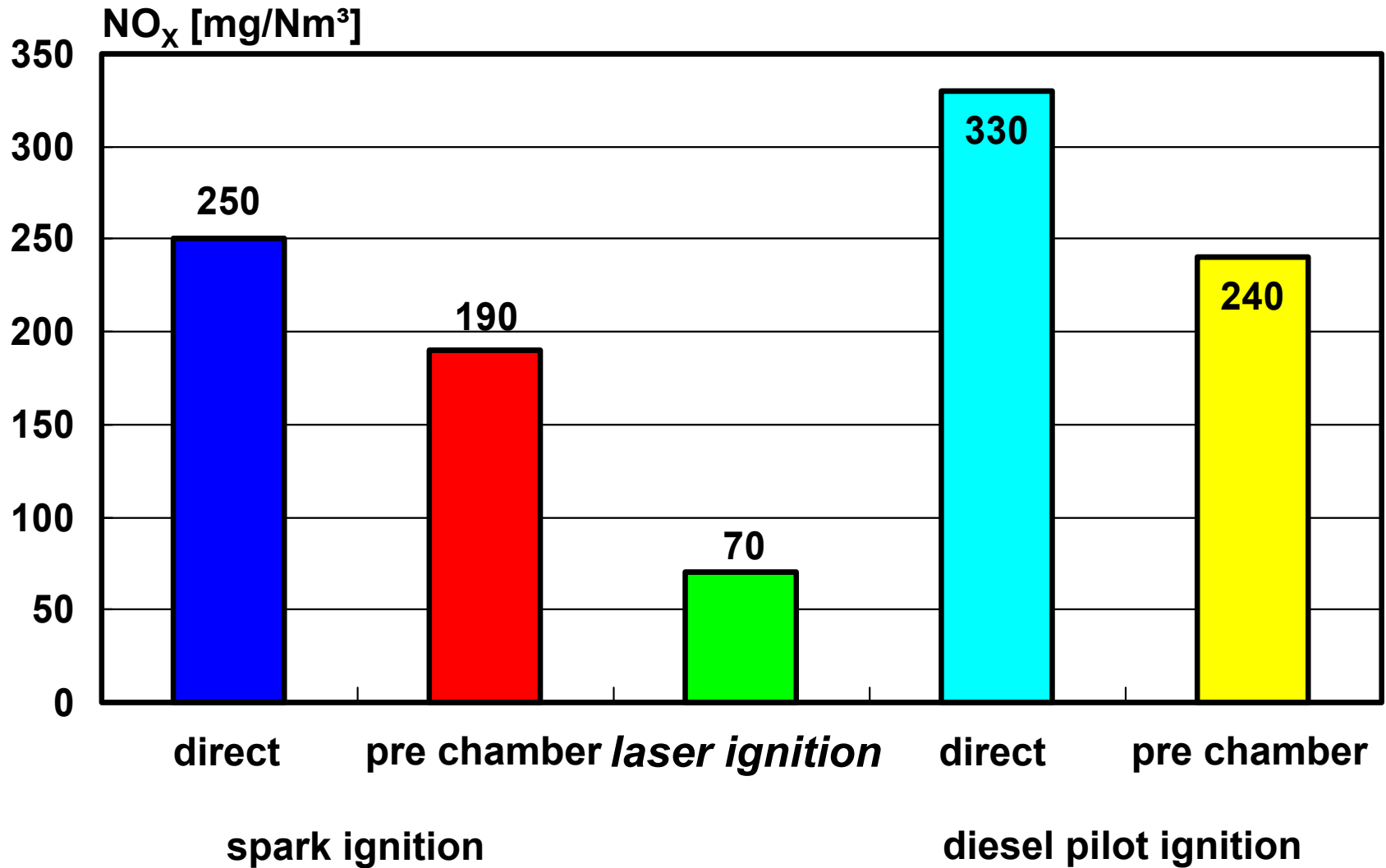


first engine test 08.2000

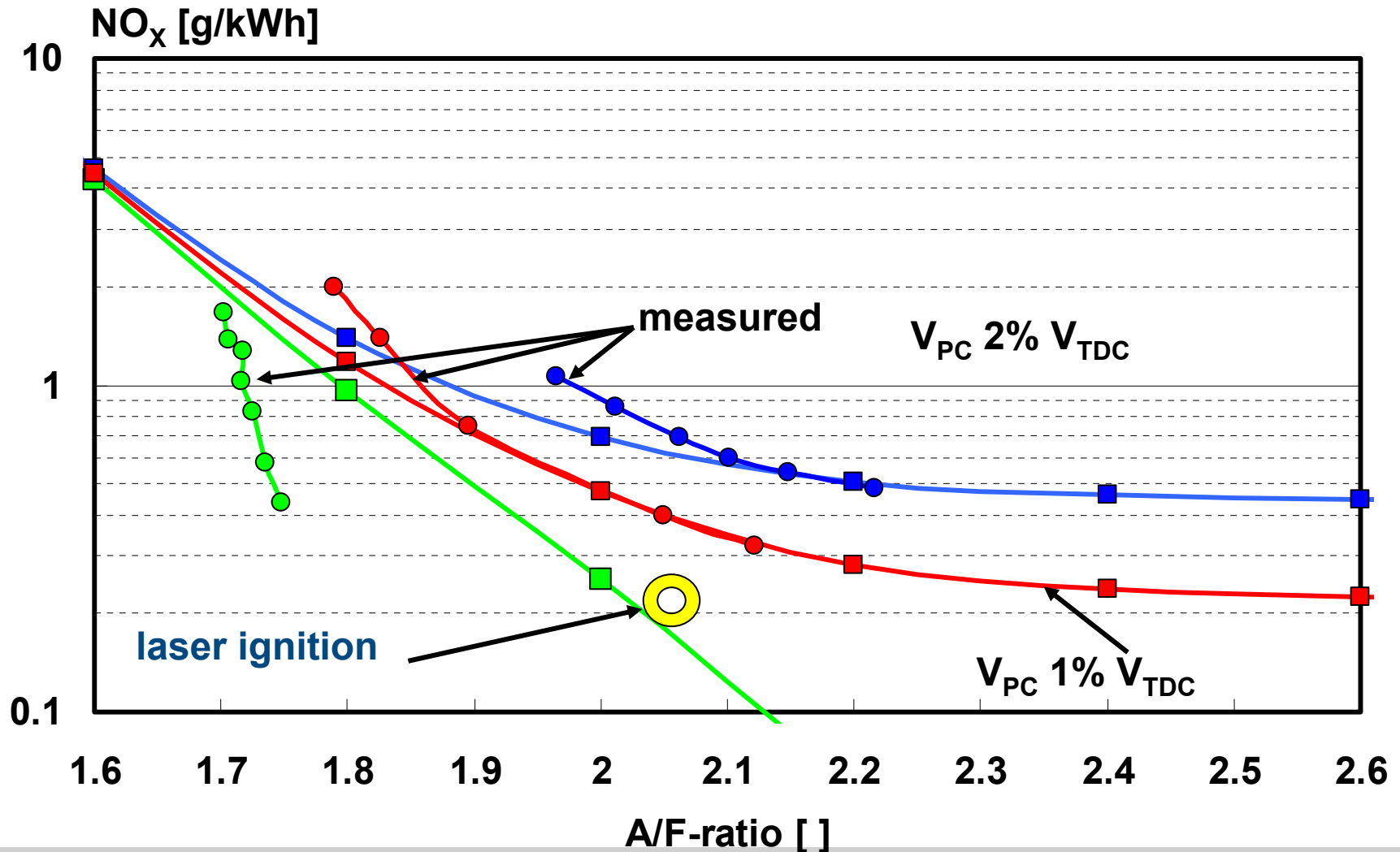
Laser - Ignition Engine Test



Potentials NO_x-Emissions

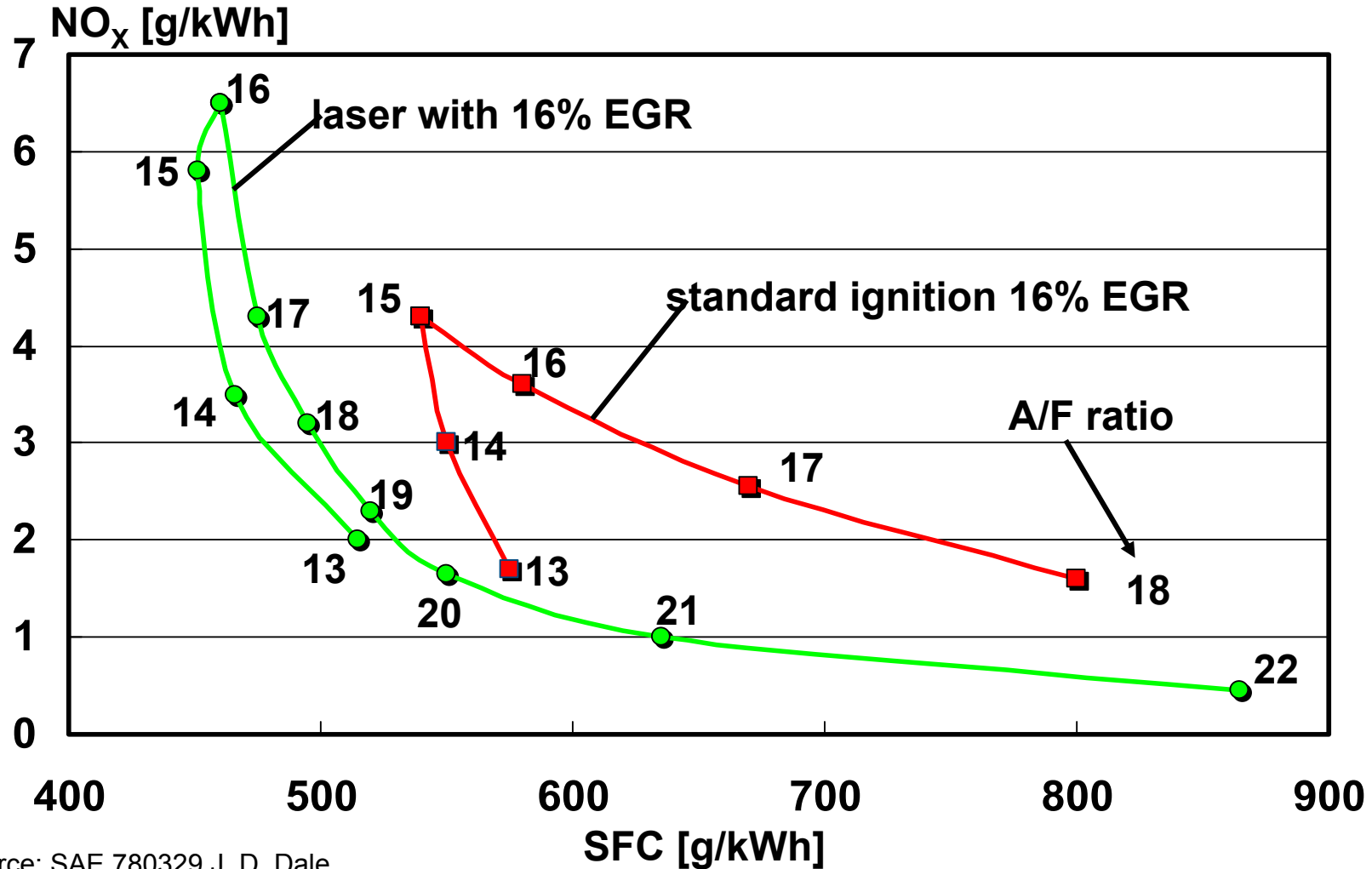


Comparison NO_x Emission Conventional Ignition / Laser Ignition



Effect of Ignition System

NO_x-Emission and Fuel Economy

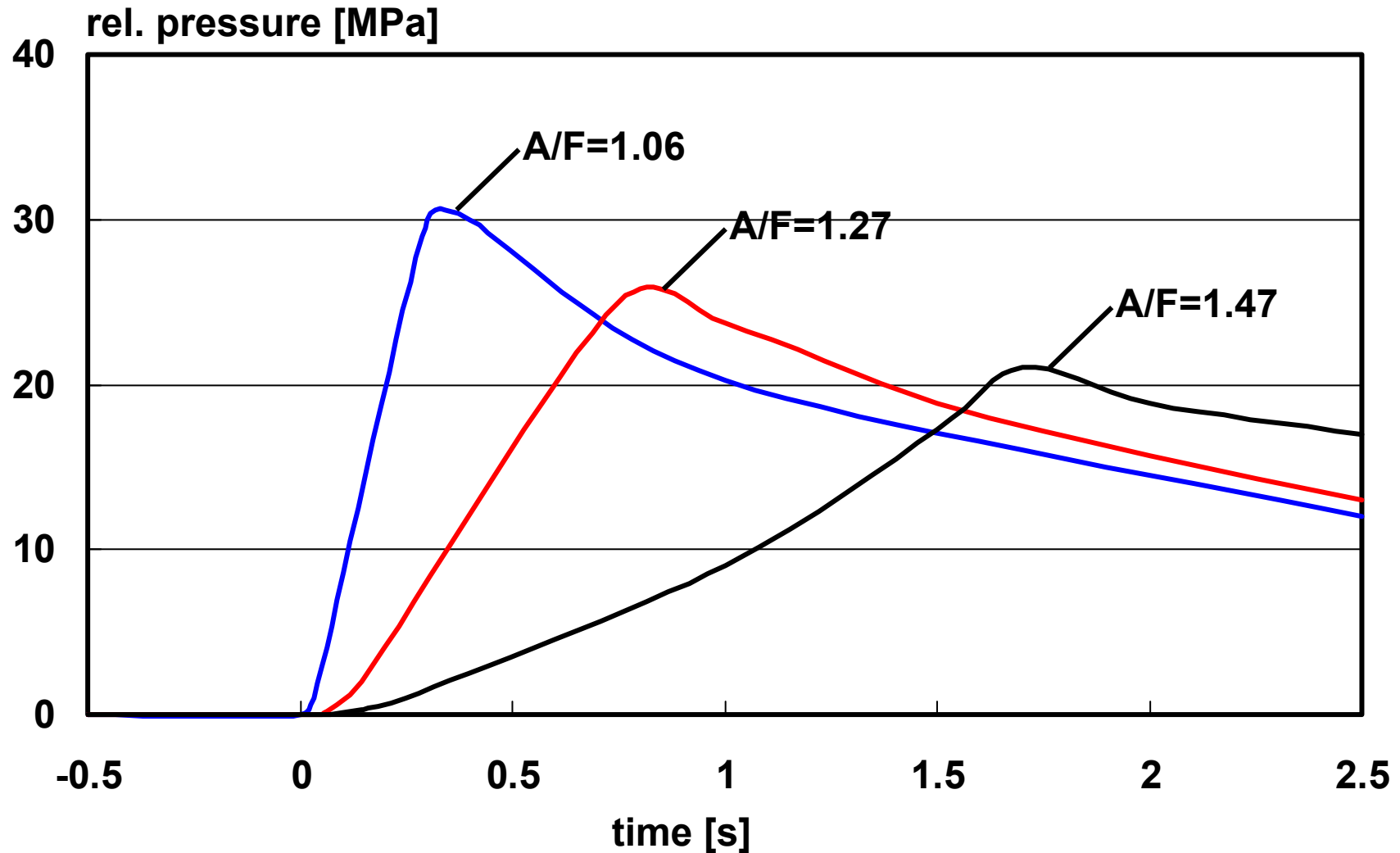


source: SAE 780329 J. D. Dale

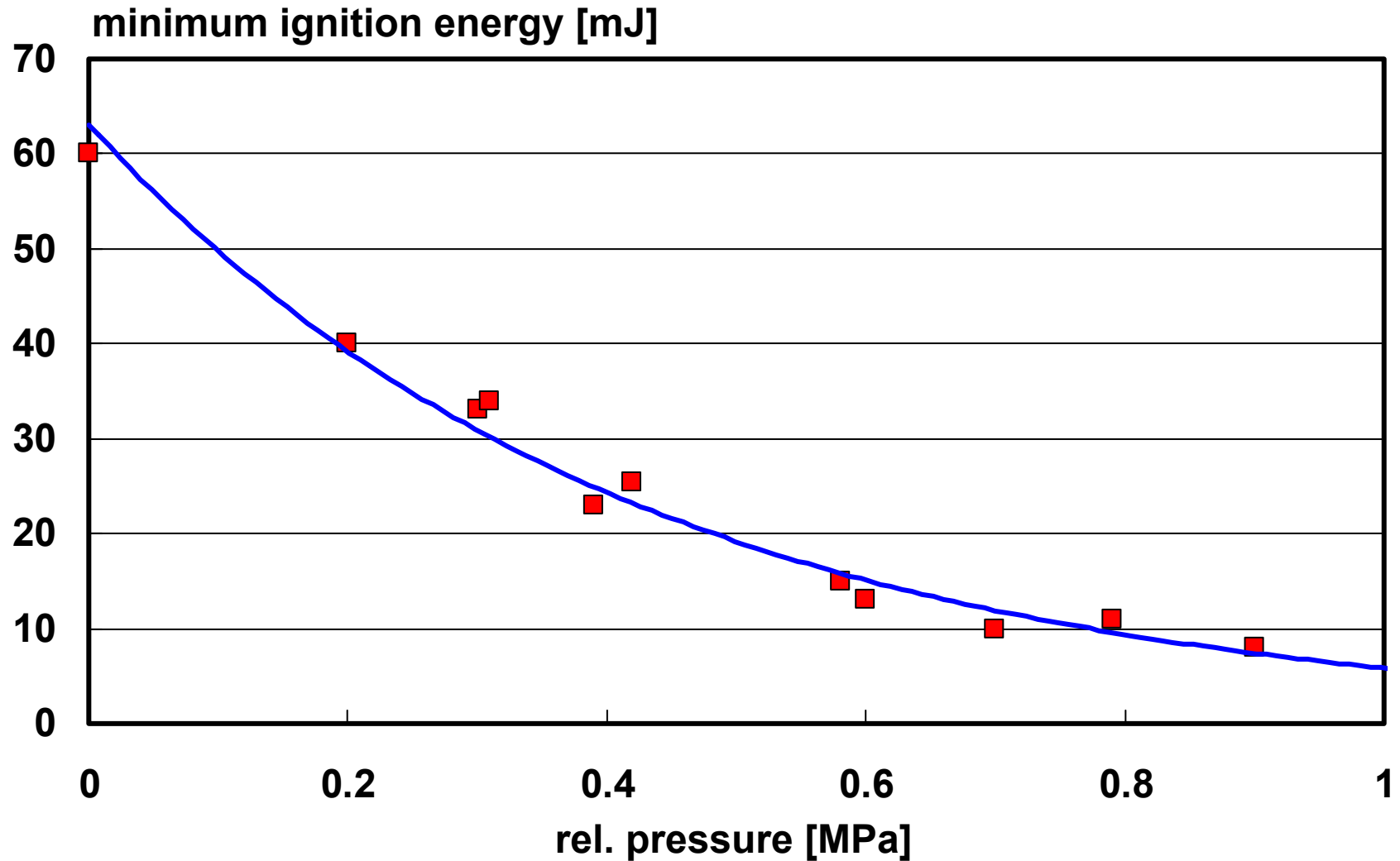


Pressure Course Nd-YAG-Laser

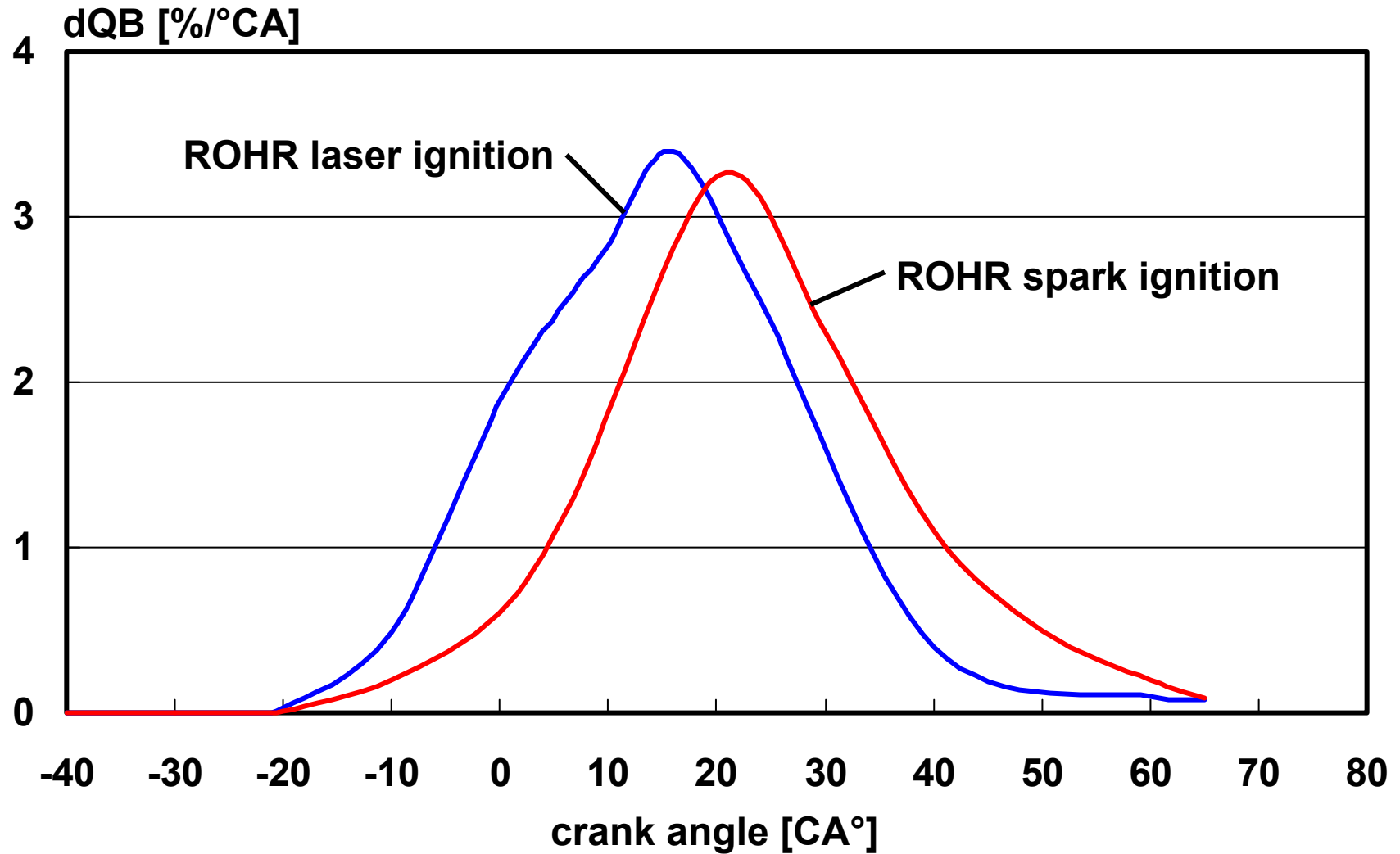
Minimum Ignition Energy, $p_{rel} = 0.4 \text{ MPa}$



Min. Ignition Energy Nd-YAG-Laser

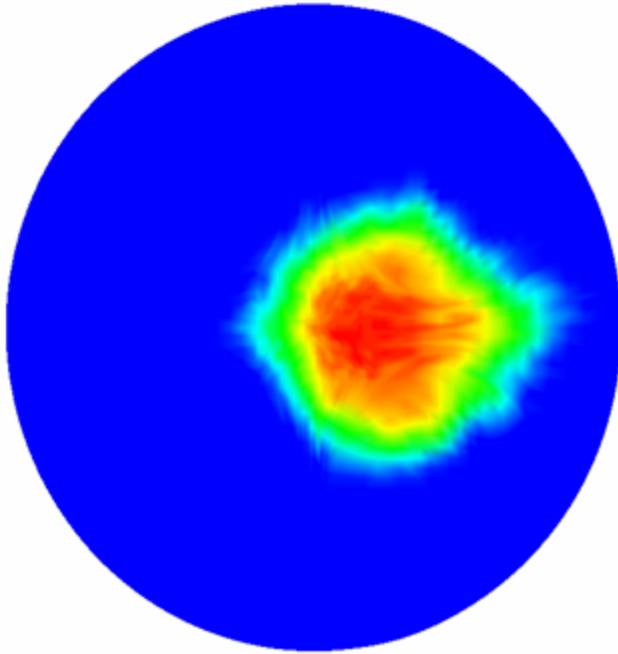


Laser Ignition Heat Release Position

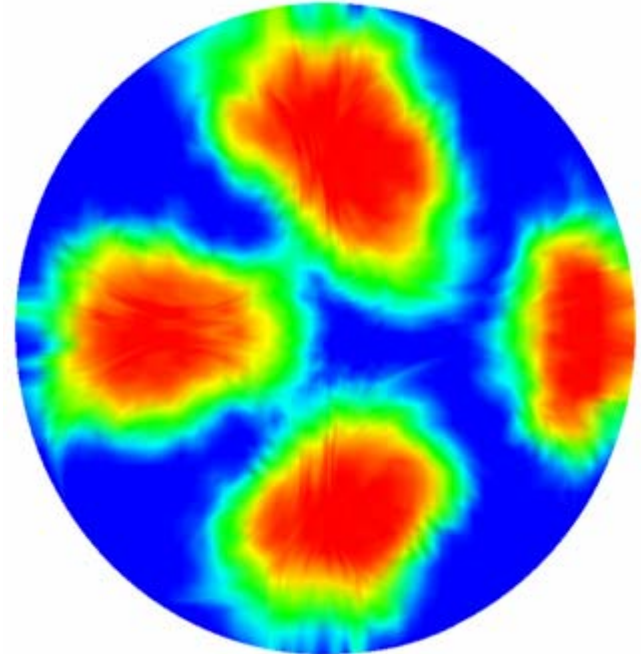


Laser Ignition Single Point / Multi Point

flame front 29° after ignition

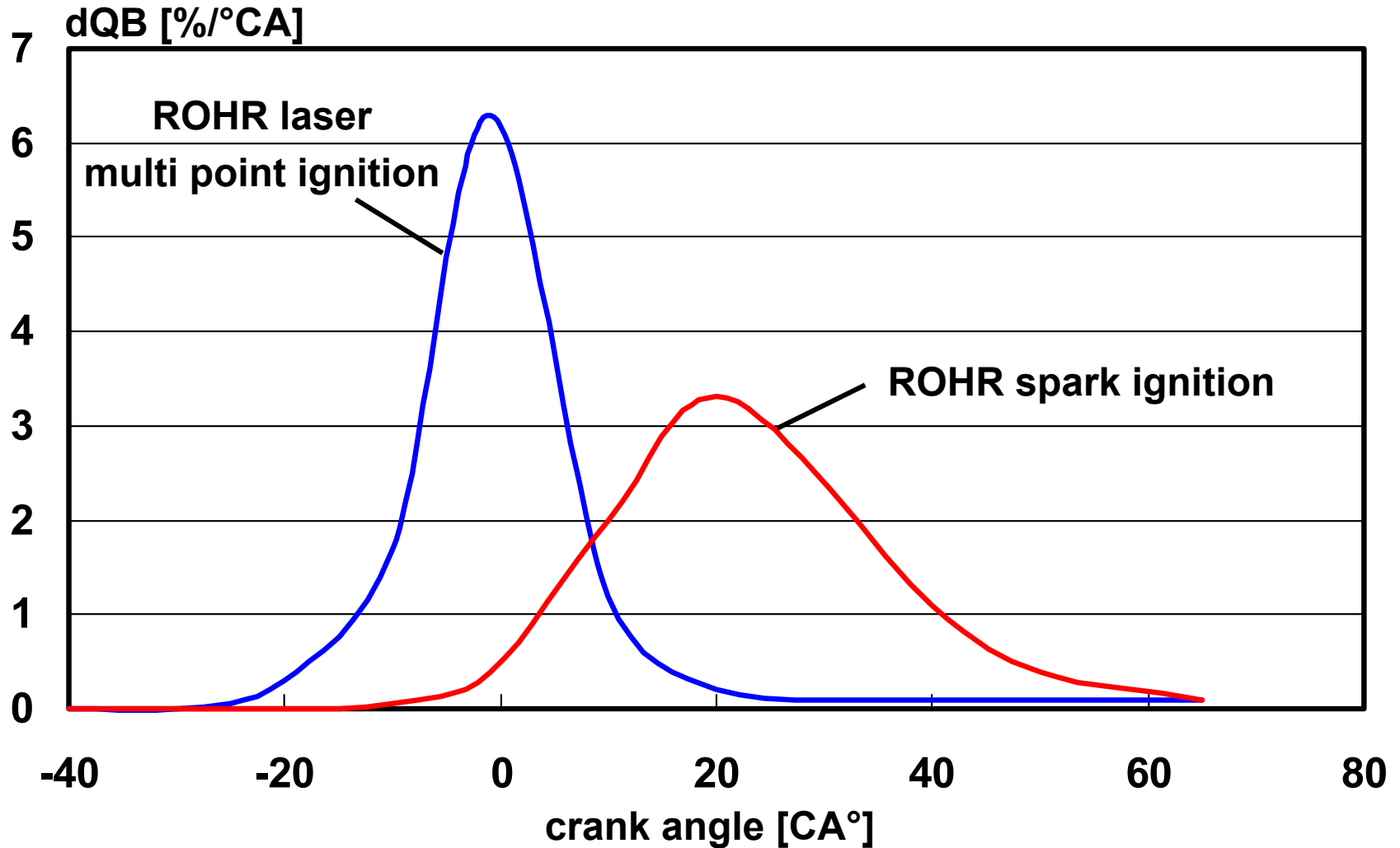


single point ignition

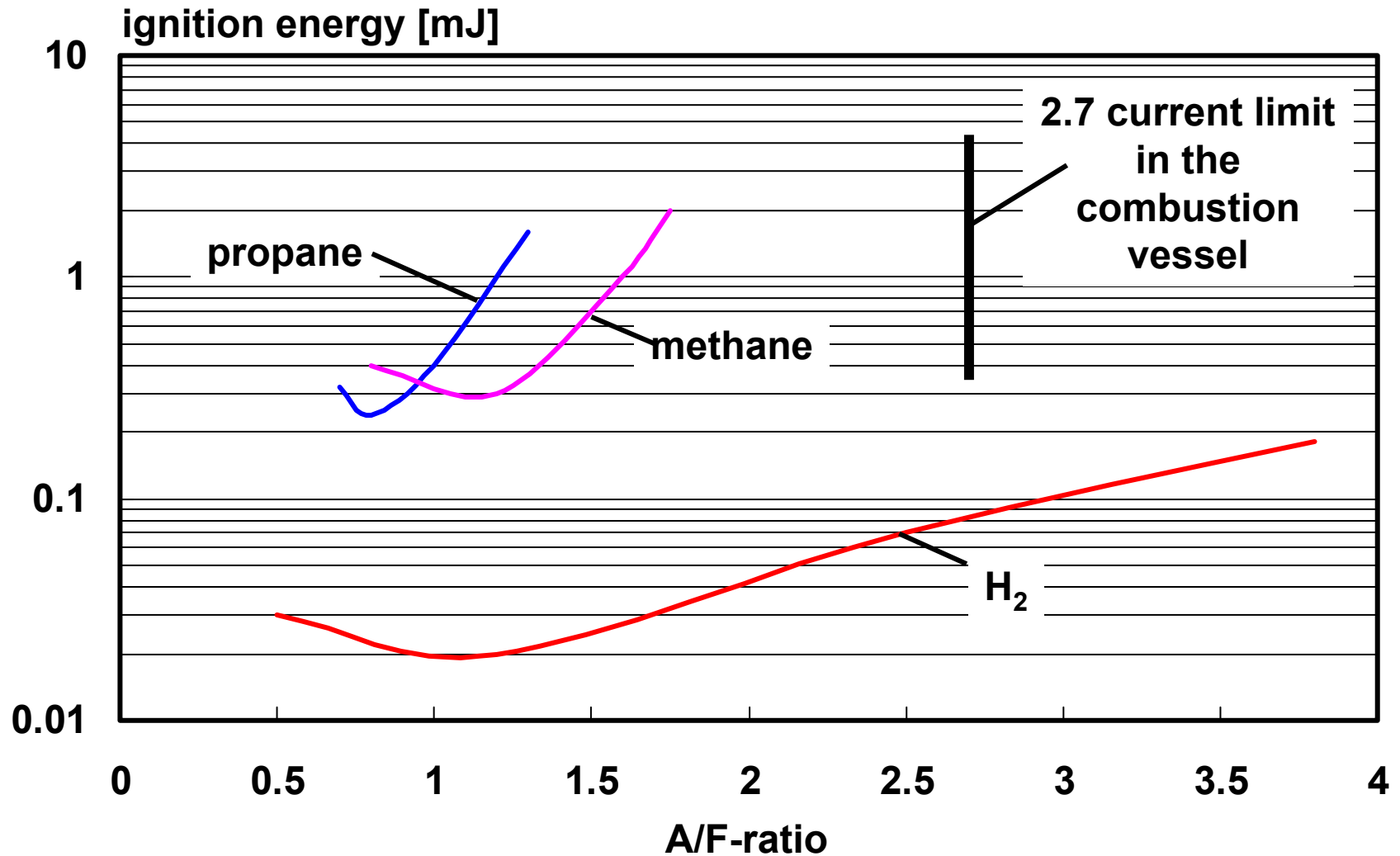


multi point ignition (4 points)

Laser Ignition Heat Release - Single Point / Multi Point



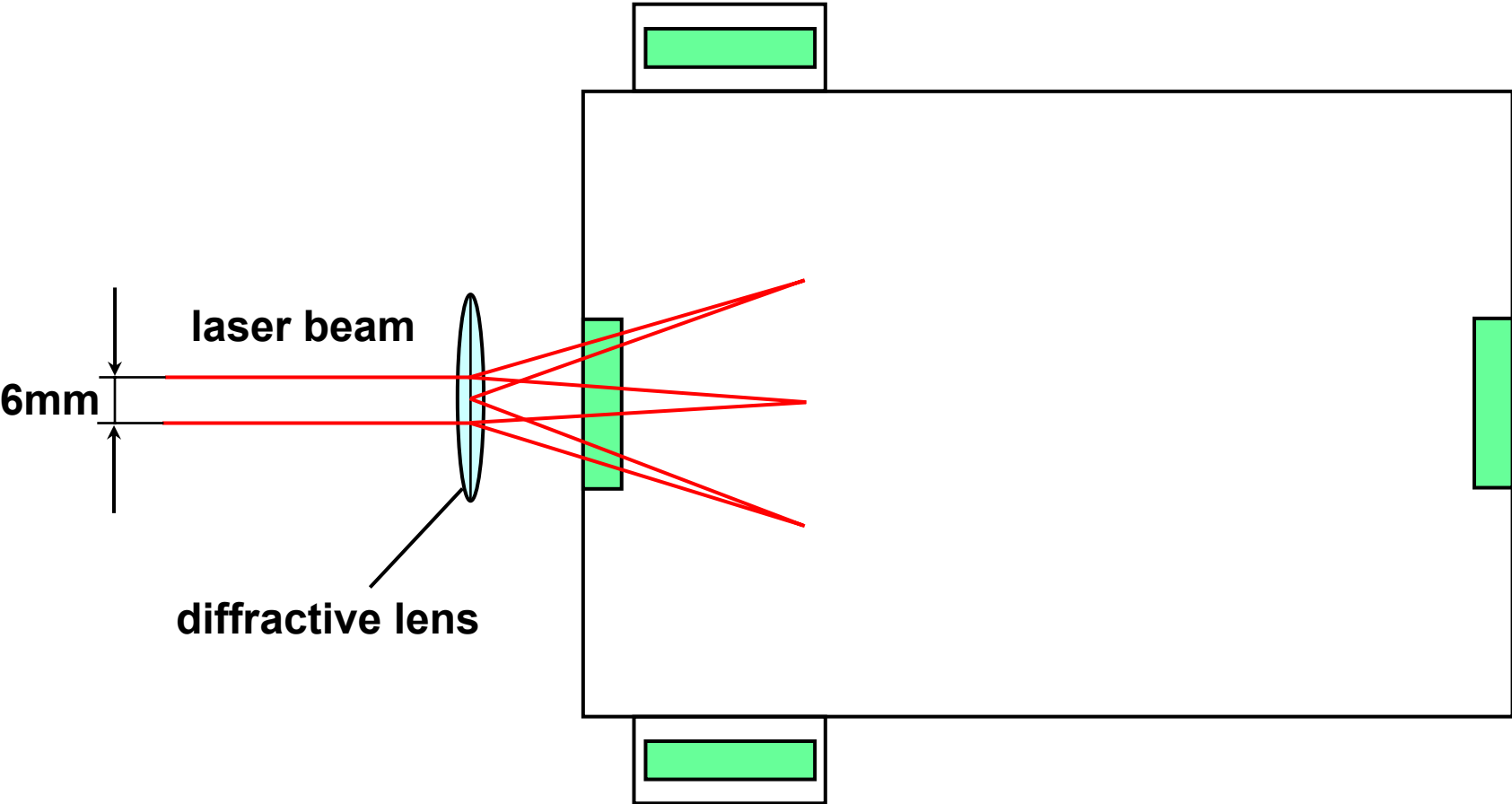
Minimum Ignition Energy - U. Maas/B. Lewis



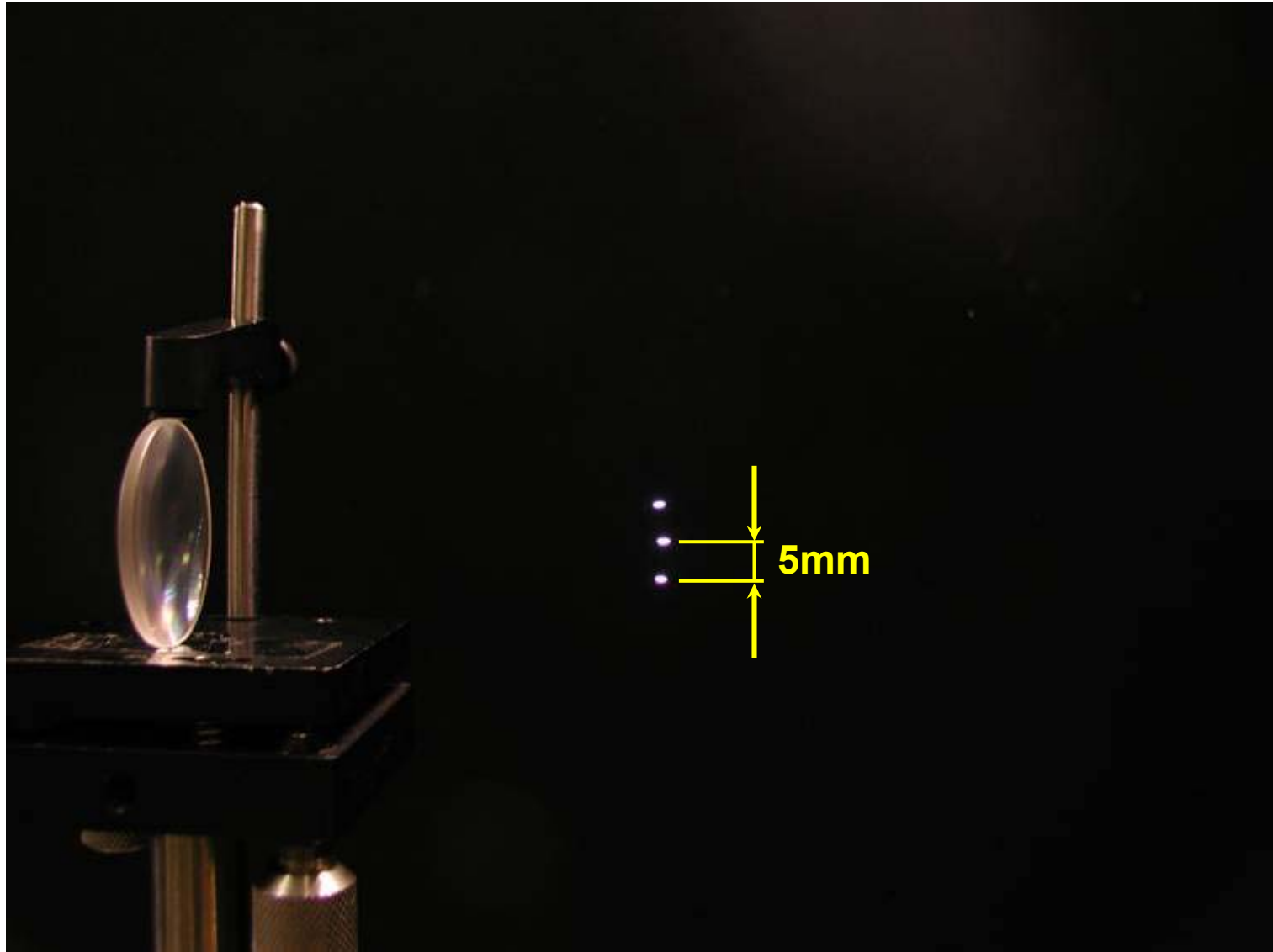
View of the Plasma after the Planar-Konvex Lens



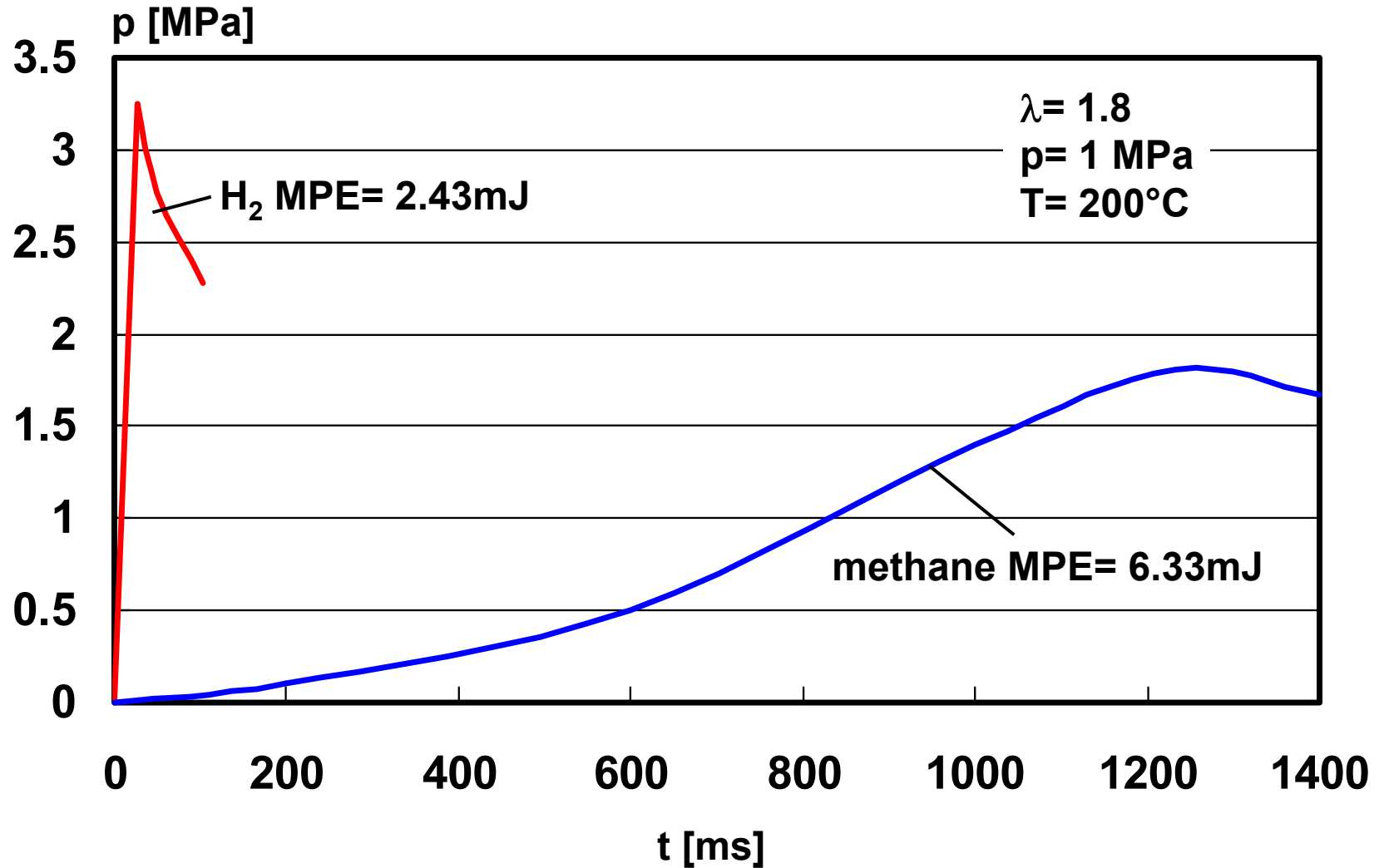
Close 3-Point Ignition Diffractive Lens



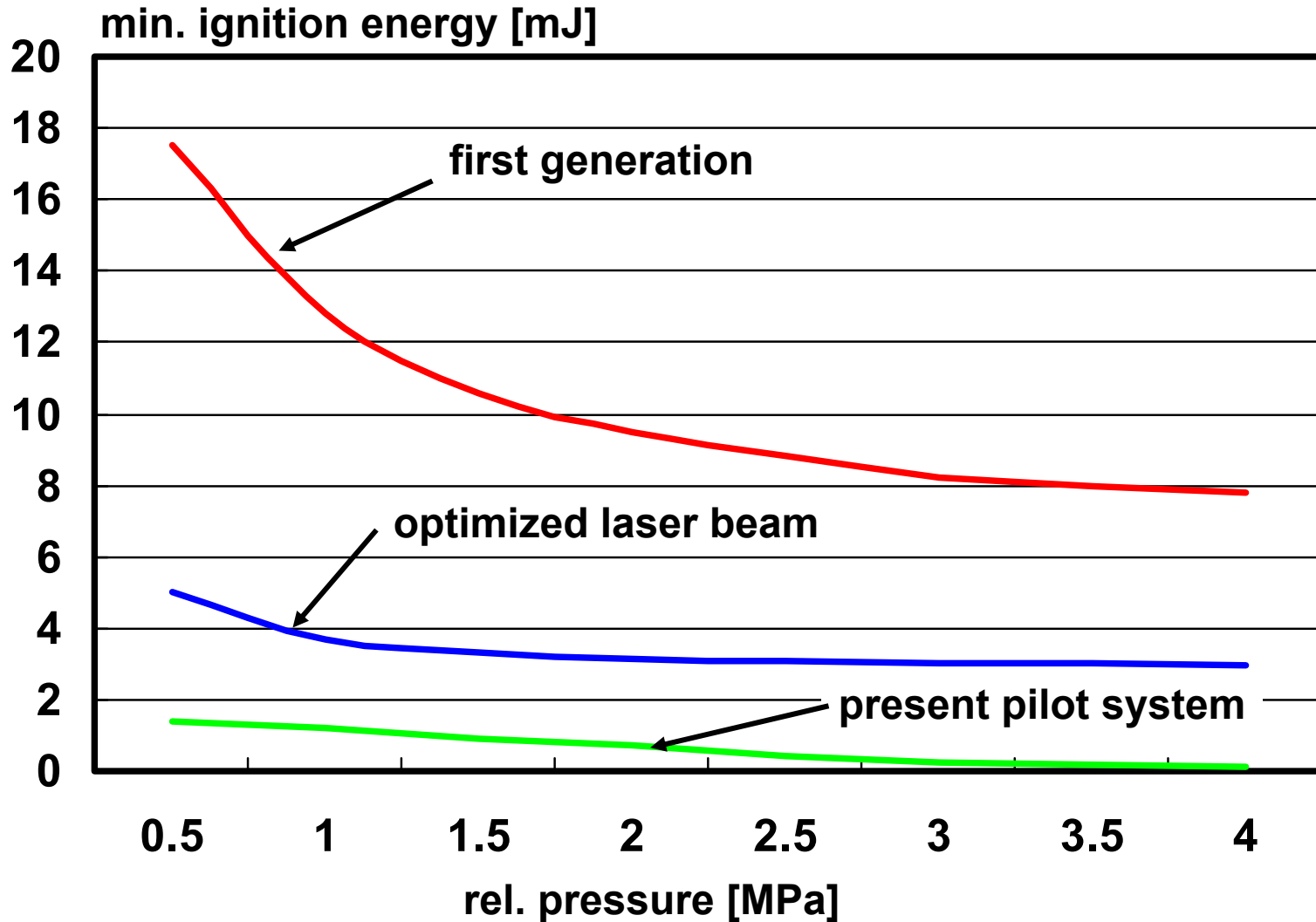
Diffractionive Lensto Gen. 3 Ignition Plasmas



Comparison Hydrogen vs. Methane



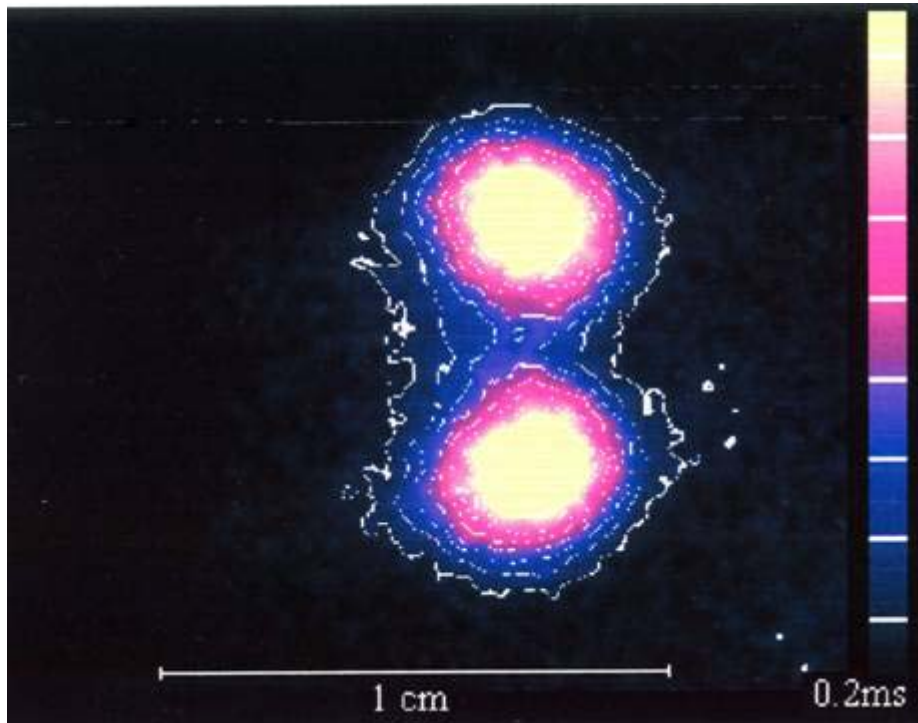
Laser Optimization Combustion Vessel



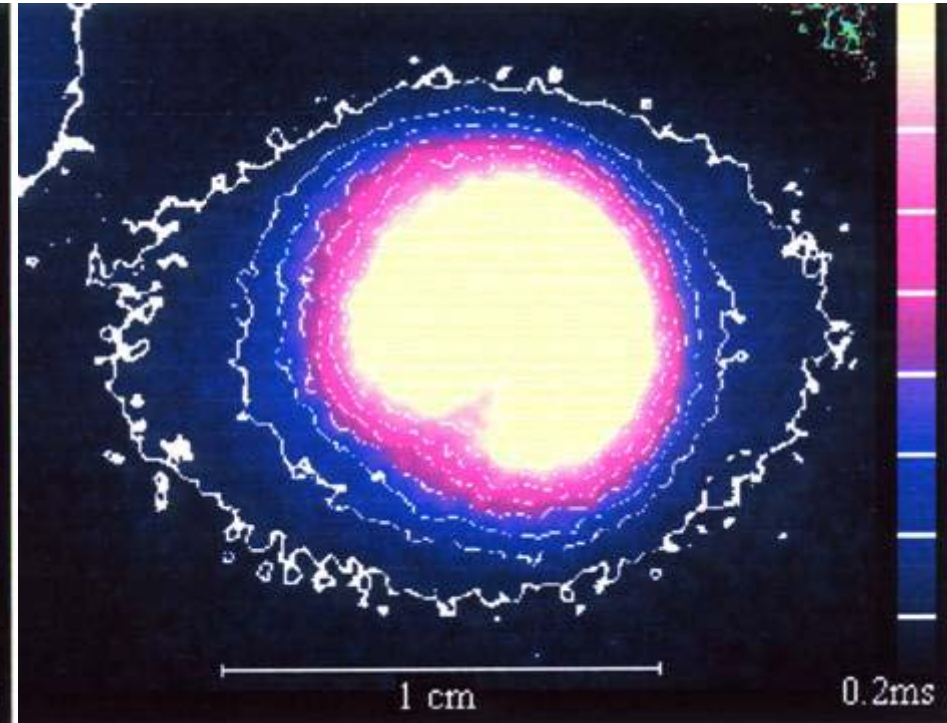
Self Cleaning Effect of the Window



Laser Ignition – LIF/OH Analysis



side view

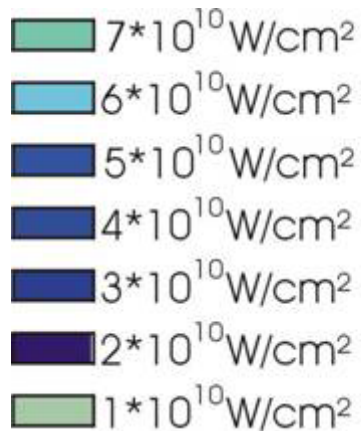


axial view

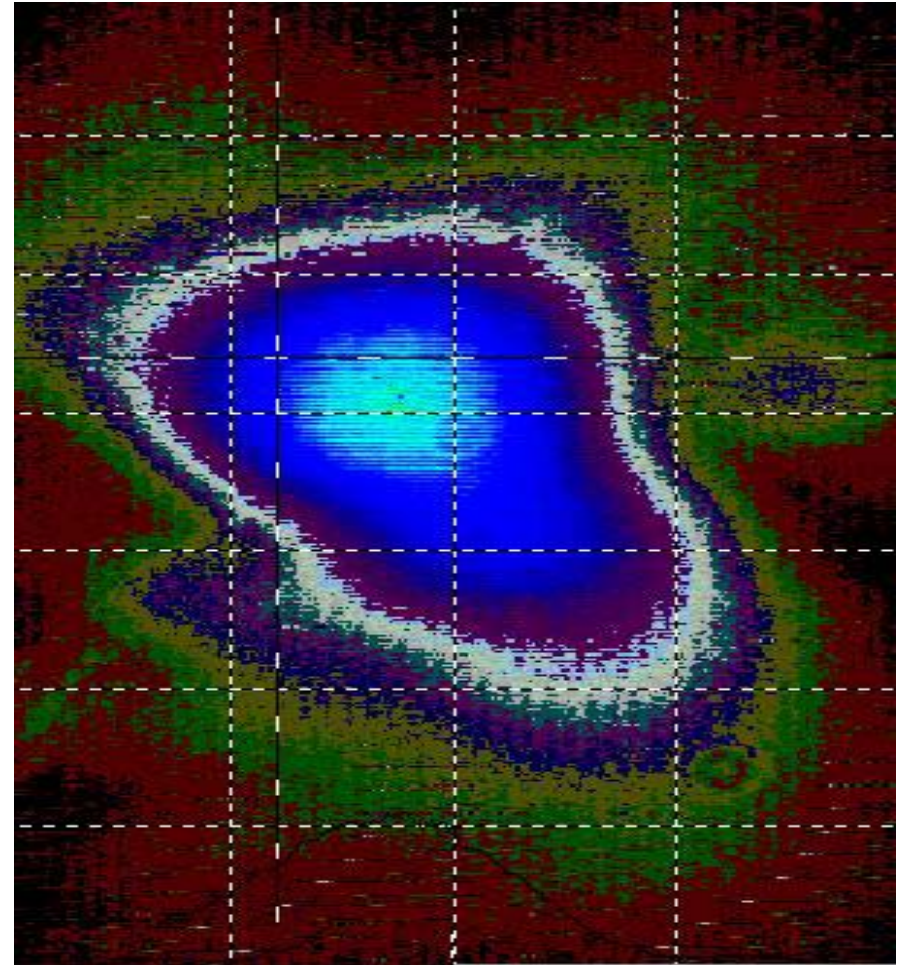
Prof. Neger TU-Graz

Example of Intensity

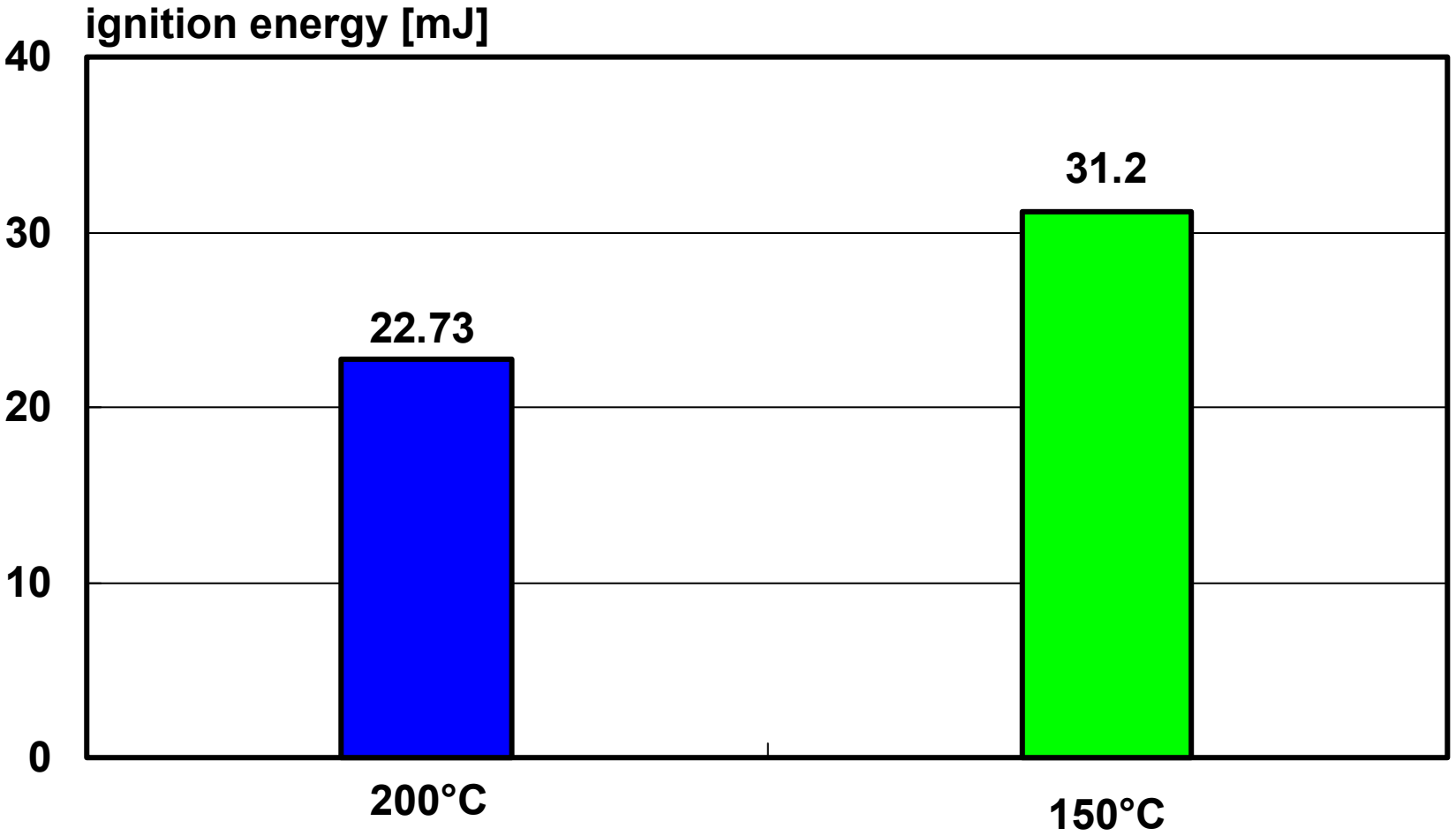
Energy 10 mJ/Pulse 10 ns



Rasterung:
39,6 μm horizontal
37,2 μm vertikal

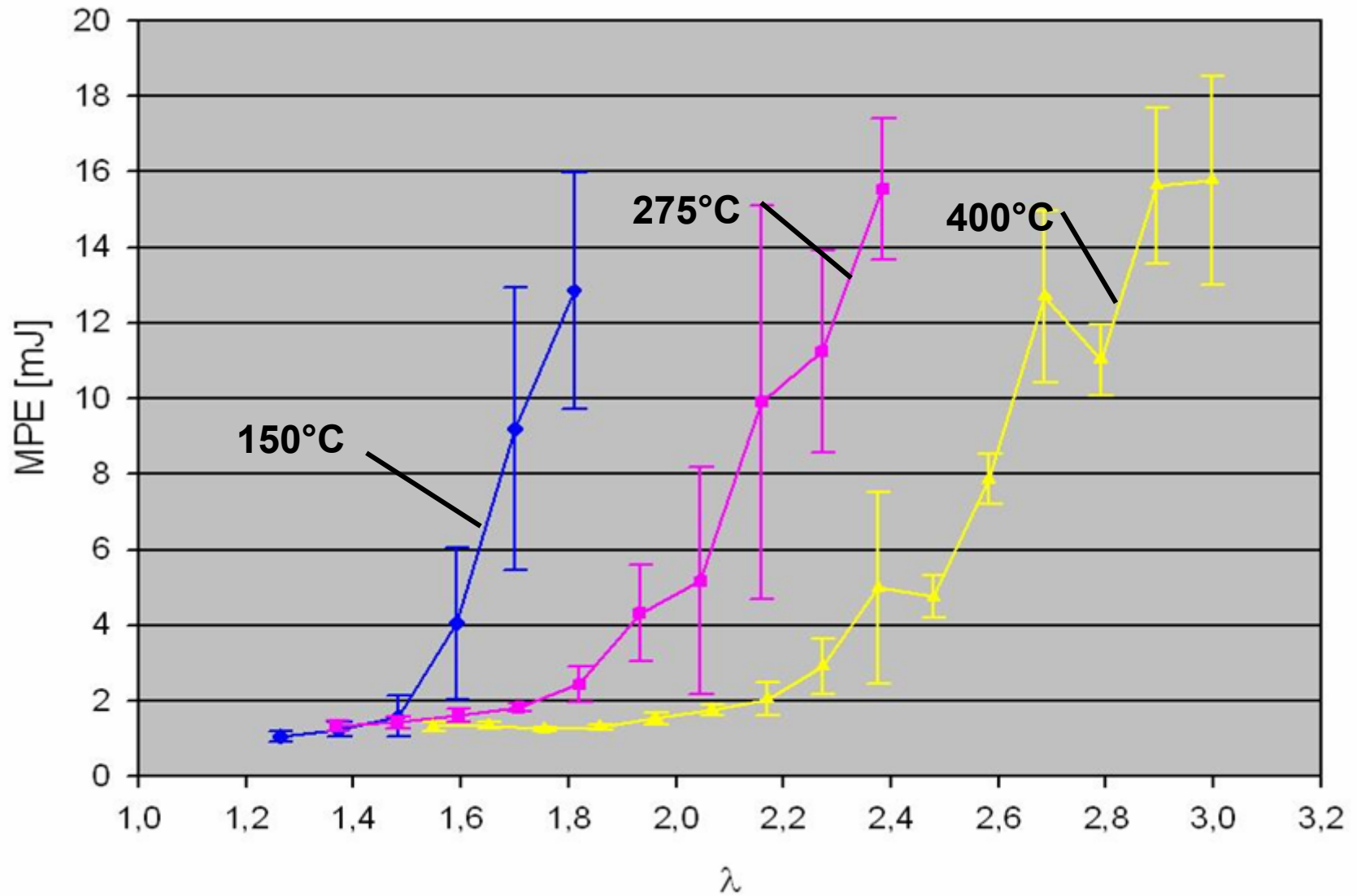


Combustion Vessel Influence Temperature



(A/F-ratio=const, p=3MPa, pulse duration = 5ns)

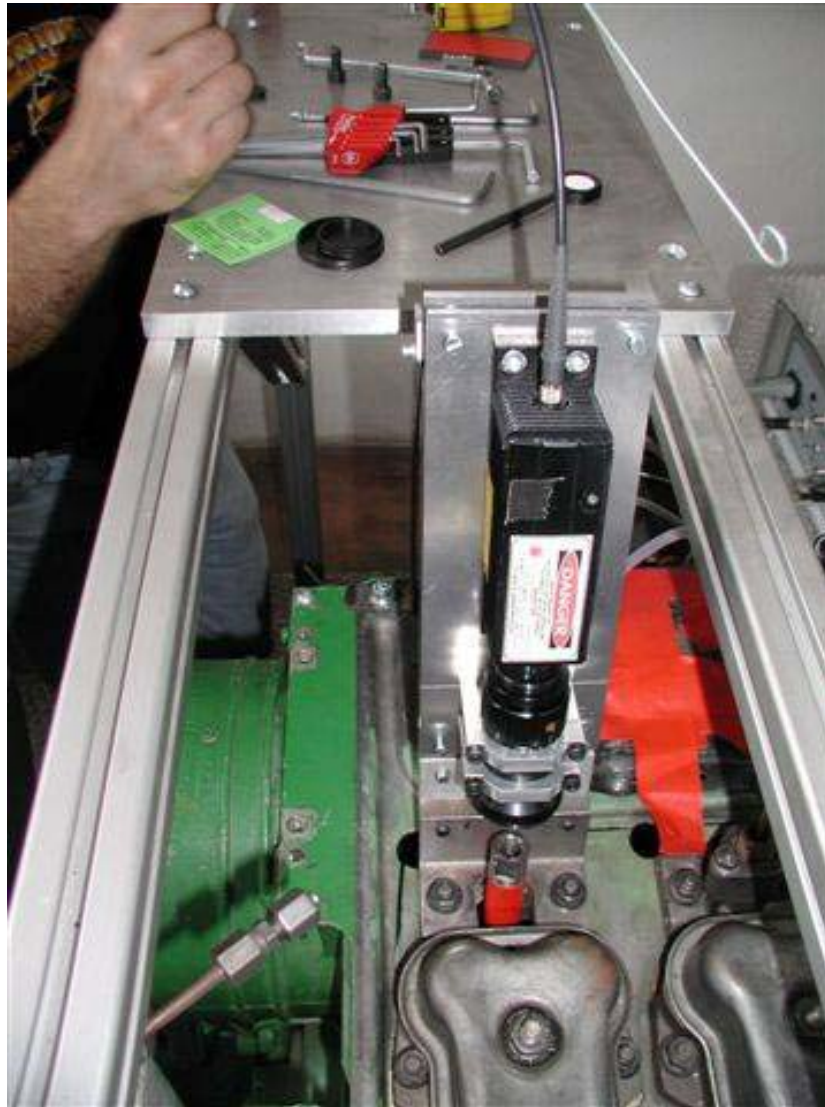
MPE vs A/F-Ratio λ at 30 bar



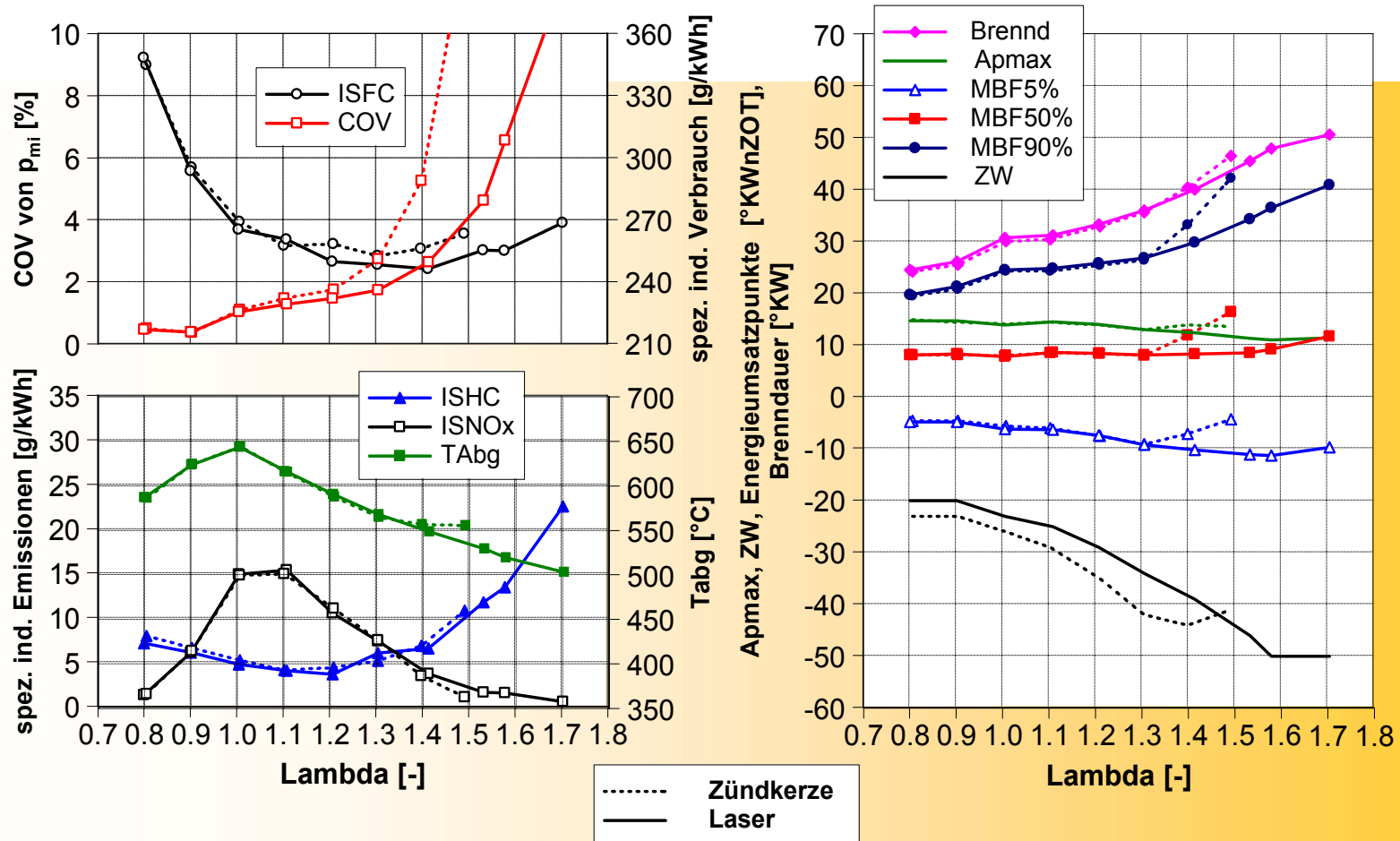
Prototype of the Special Designed Laser



Test Arrangement TU Vienna



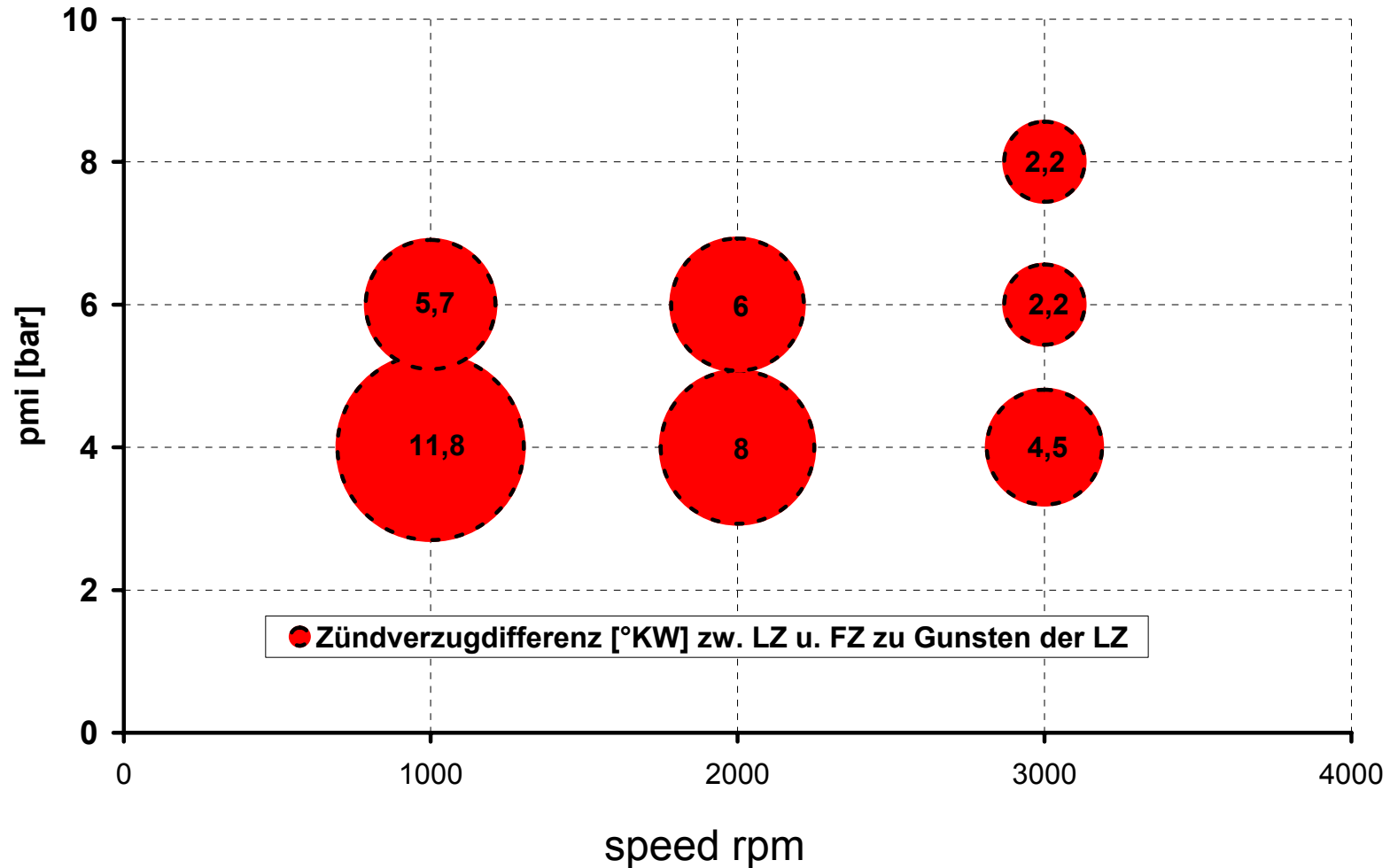
Results of the First Spec. Designed Laser



$n = 2000$ [min⁻¹]; $p_{mi} = 4$ [bar]; homogen; w/o AGR



Reduction of the Ignition Delay w. L.I.



engine: Hatz 0.4 l/cyl.

Basic Concept Laser Ignition



City lights

made from GE Jenbacher Gas Engines

Thank you for attention

