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

Dr. Günther Herdin/CTO GEJenbacher

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**
- **….**

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GEJ Laser Ignition Activities

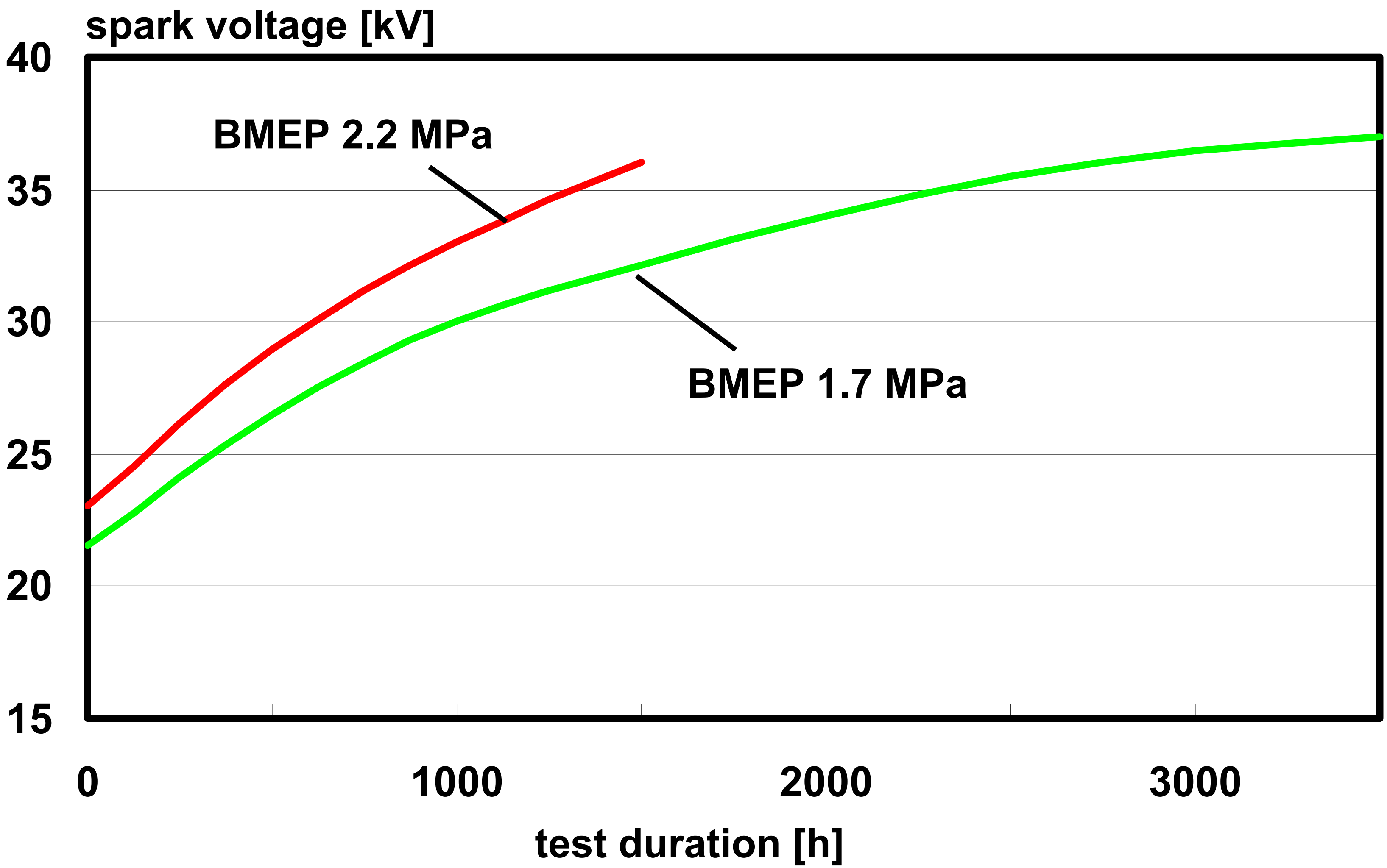
	1999	2000	2001	2002	2003	2004	2005	2006
basic works and verification **TU Wien, Institut for Photonics** **TU Graz, Institut for ICE**	**Jubiläums Fonds der österreichischen Nationalbank**							
basic engineering and engine tests **TU Wien, Institut for Photonics** **TU Wien, Institut of Process Engineering**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

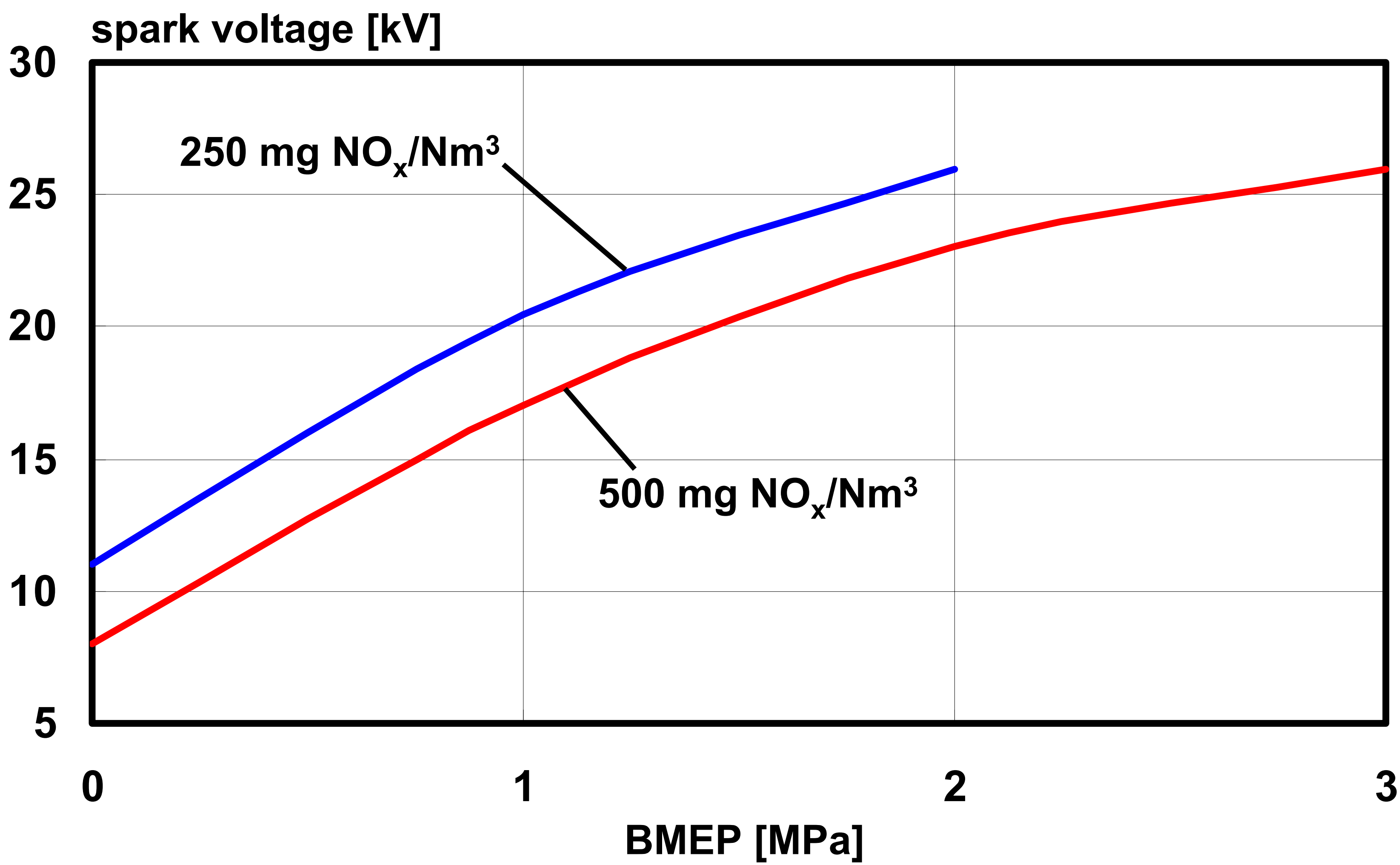
conventional spark plug systems comes to the physical border line

……. 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



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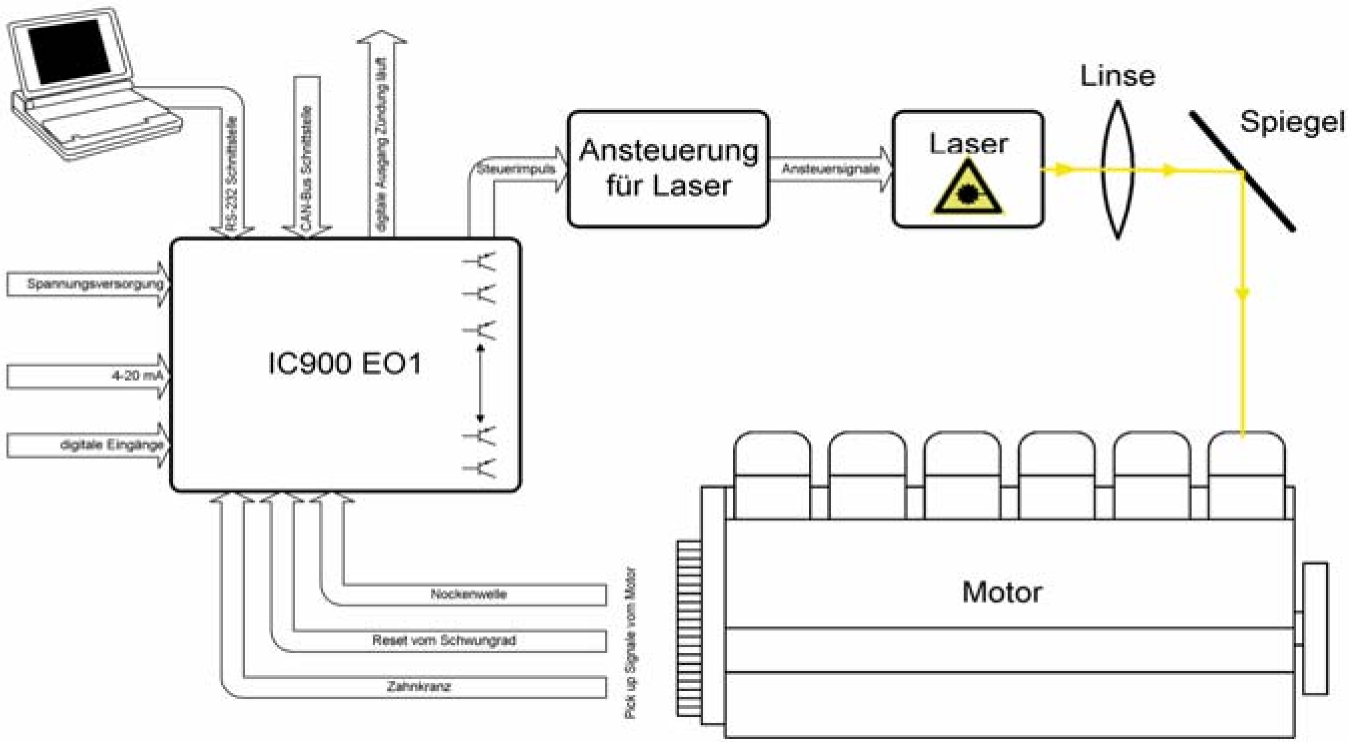
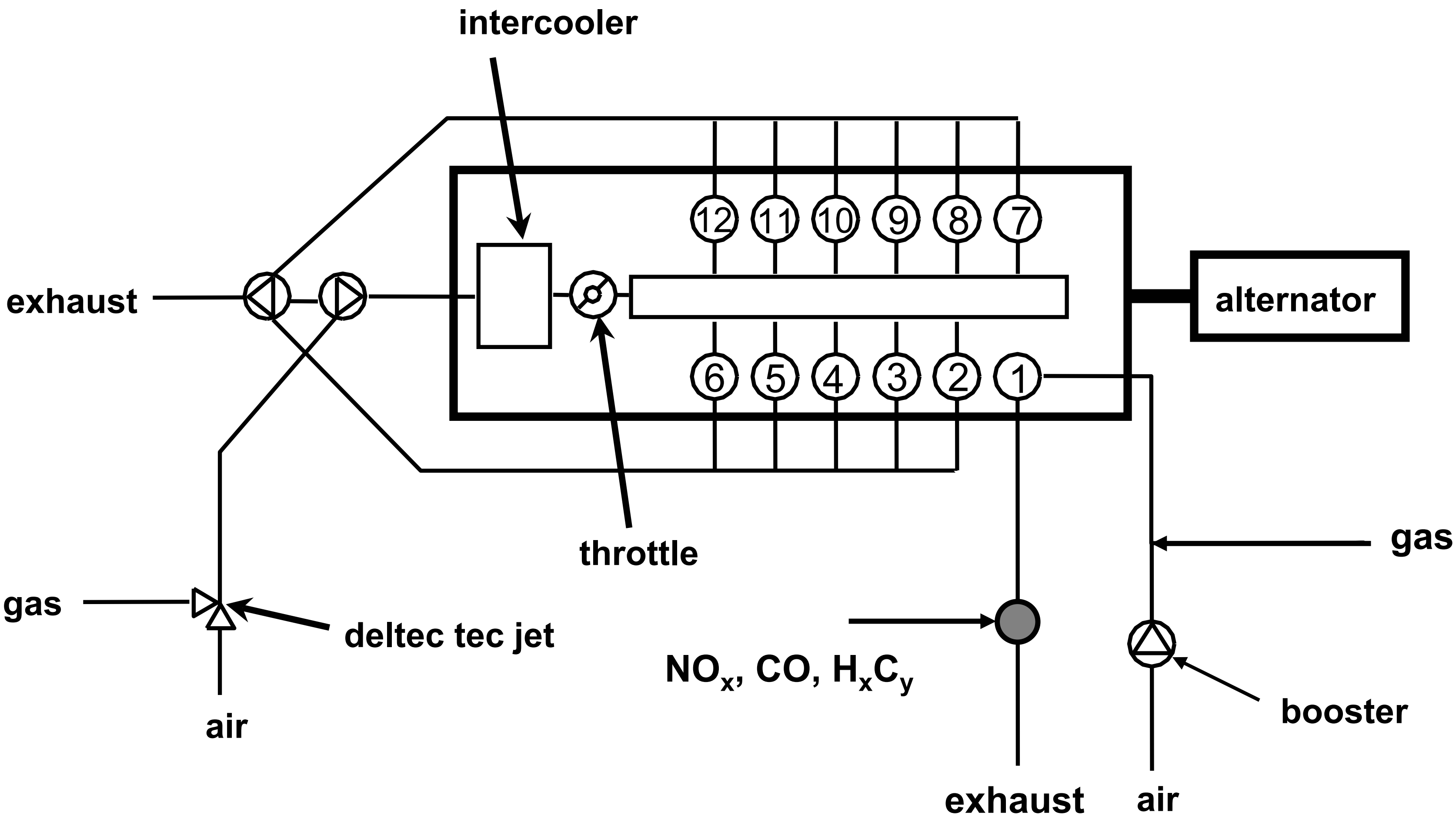
Control of the Nd-Yak Laser
IC-900 E01



Scheme Research Engine



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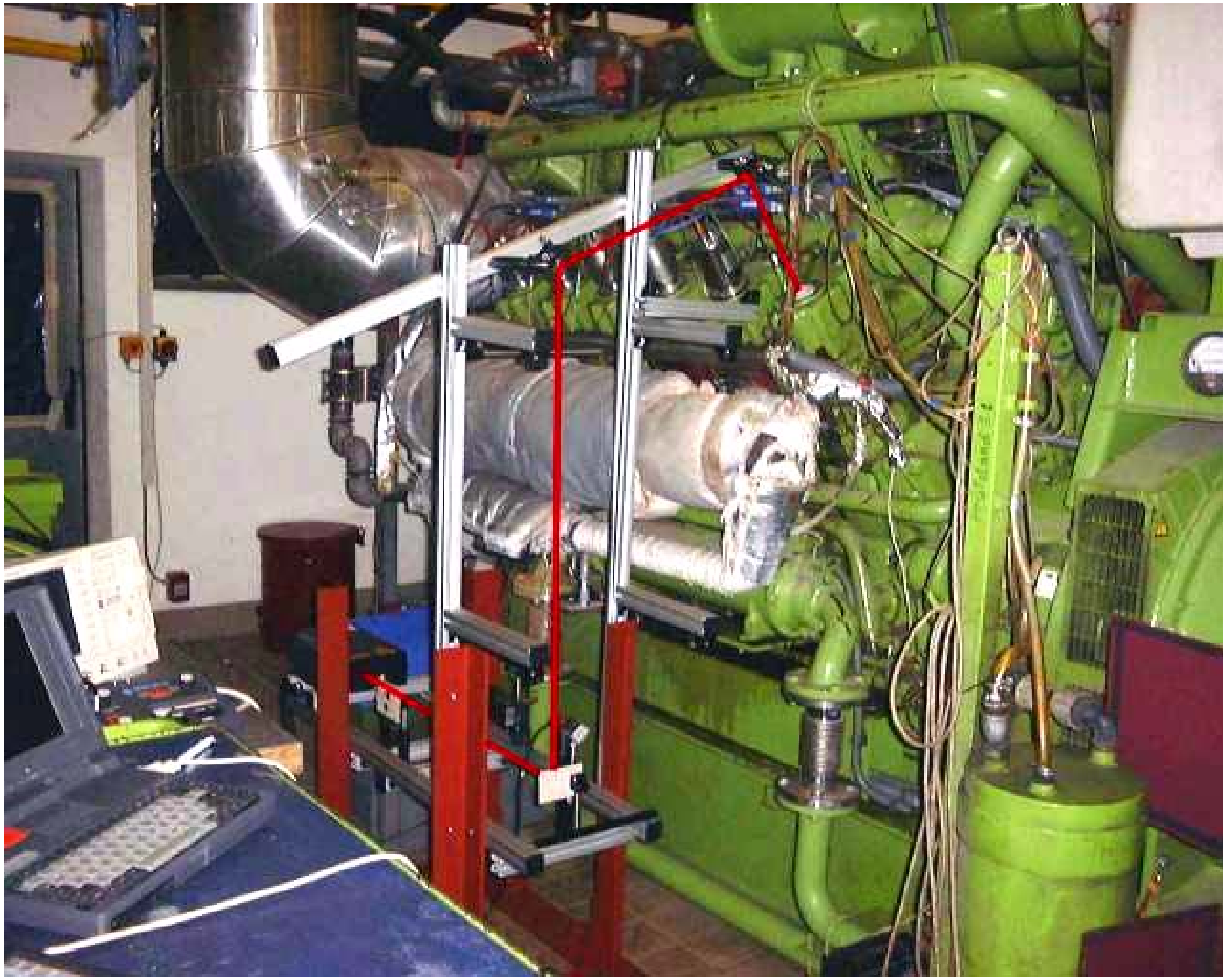
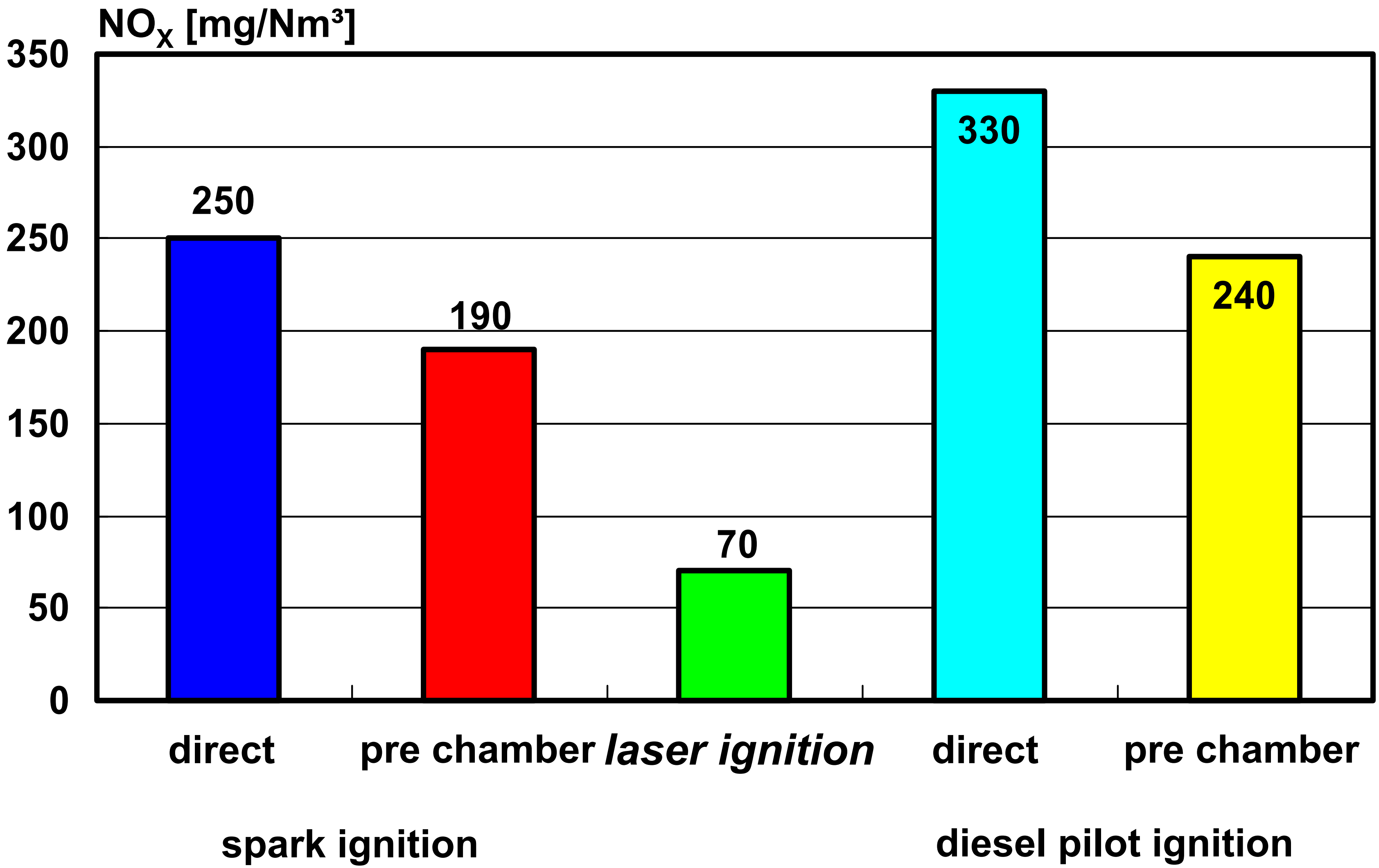
Laser – Ignition Engine Test



first engine test 08.2000

Laser - Ignition Engine Test

Potentials NO_X-Emissions



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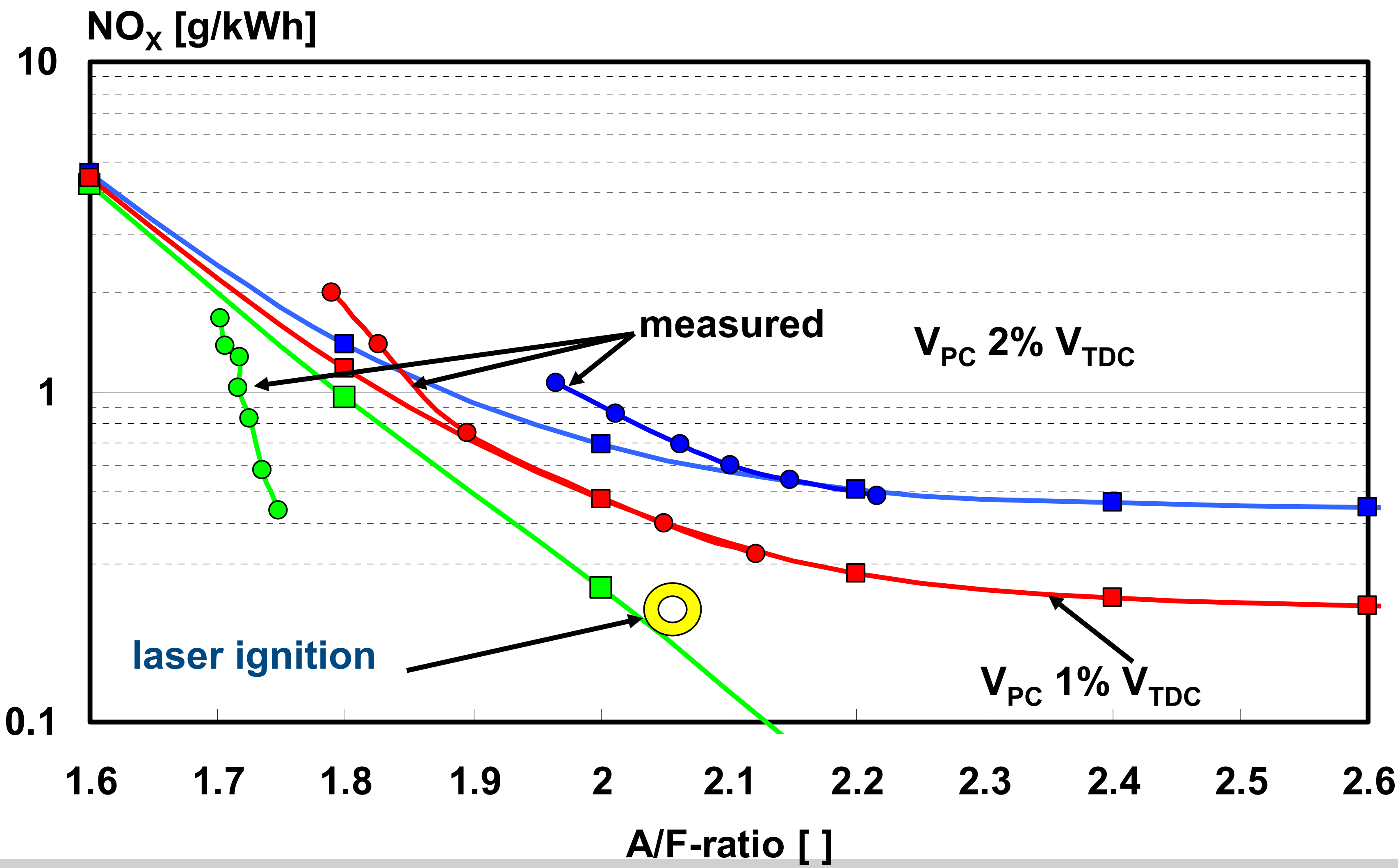
Comparison NO_X Emission Conventional Ignition / Laser Ignition



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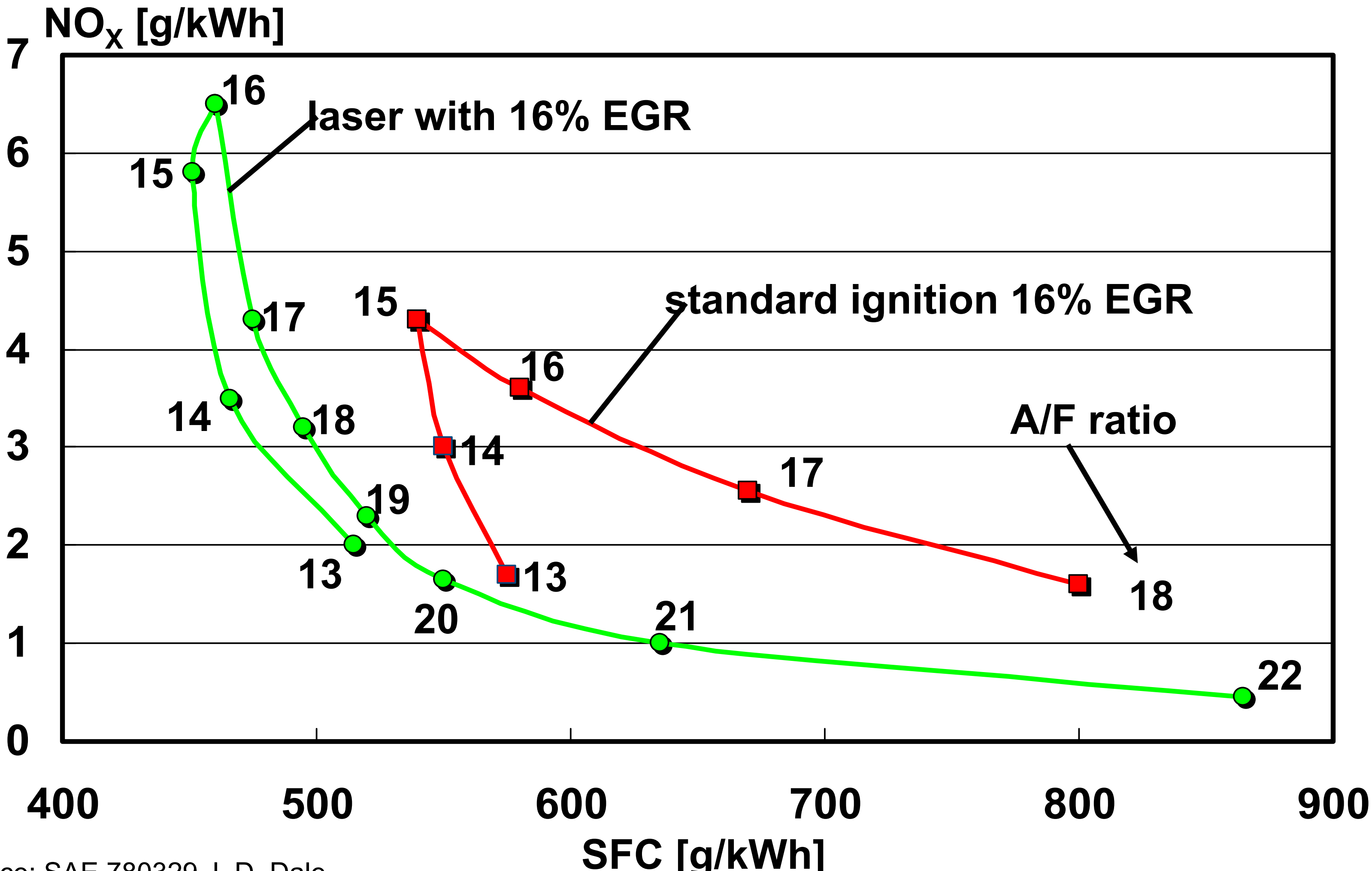
Effect of Ignition System
NO_X-Emission and Fuel Economy



source: SAE 780329 J. D. Dale

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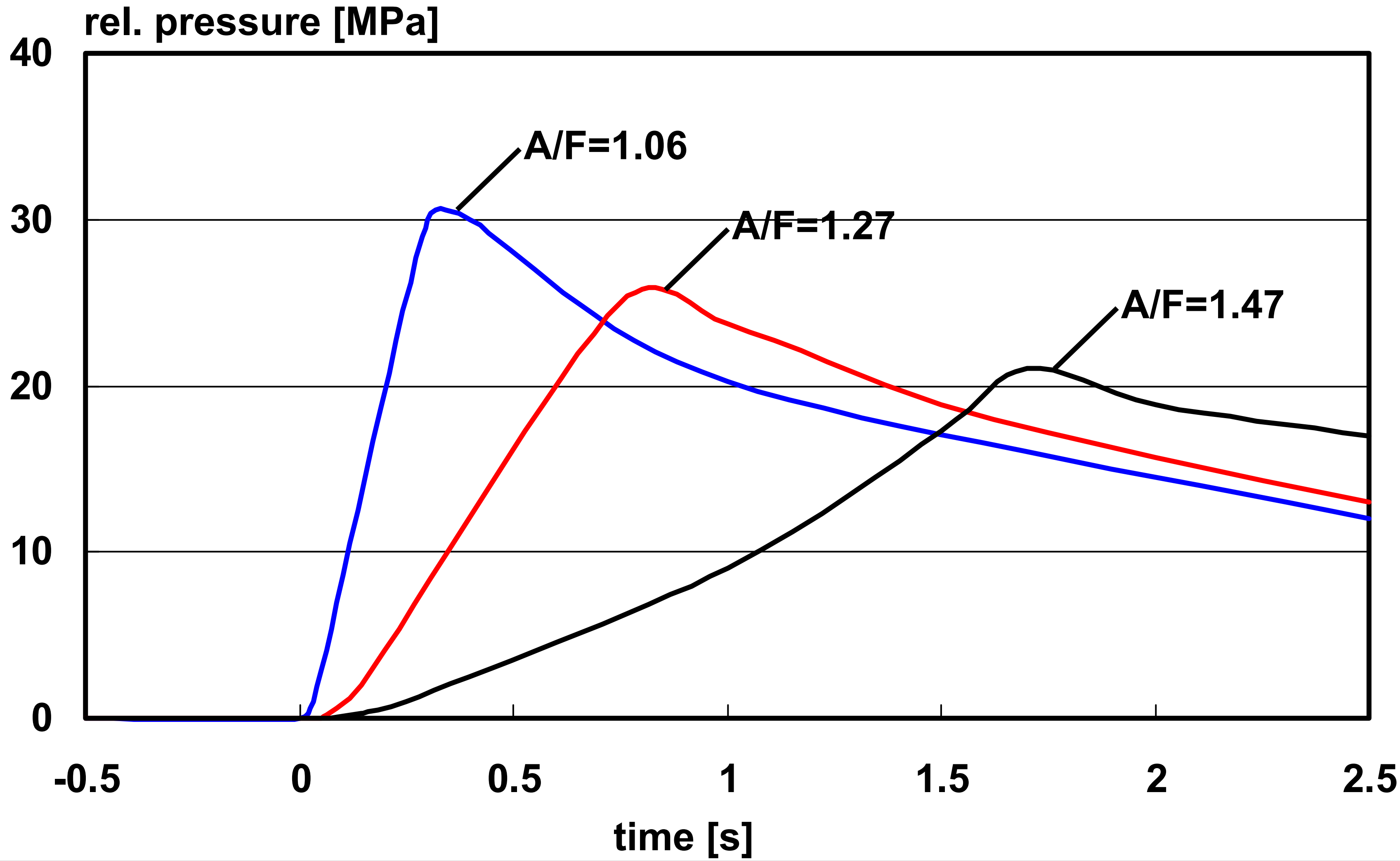
Pressure Course Nd-YAG-Laser Minimum Ignition Energy, p_{rel} = 0.4 MPa



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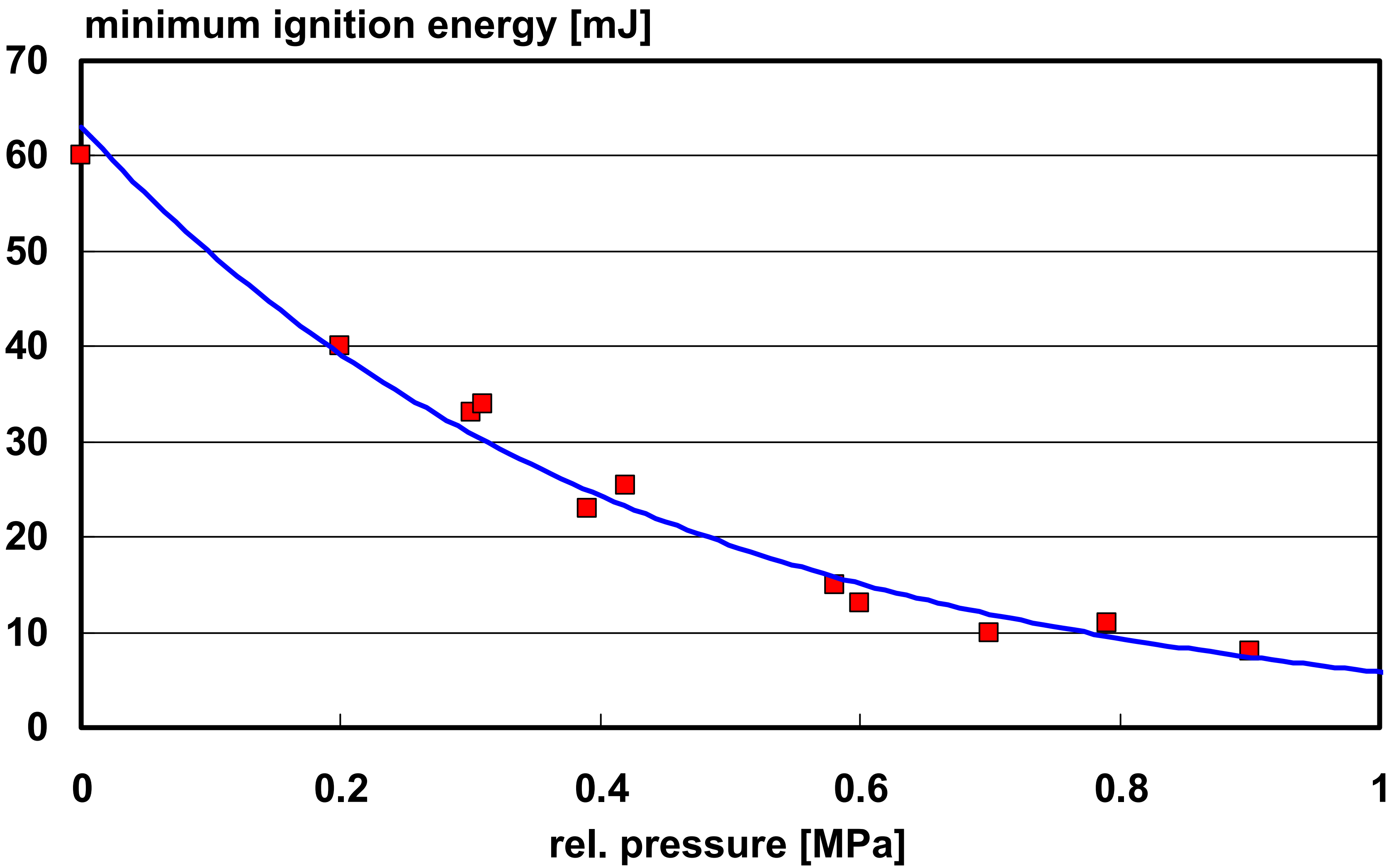
Min. Ignition Energy Nd-YAG-Laser



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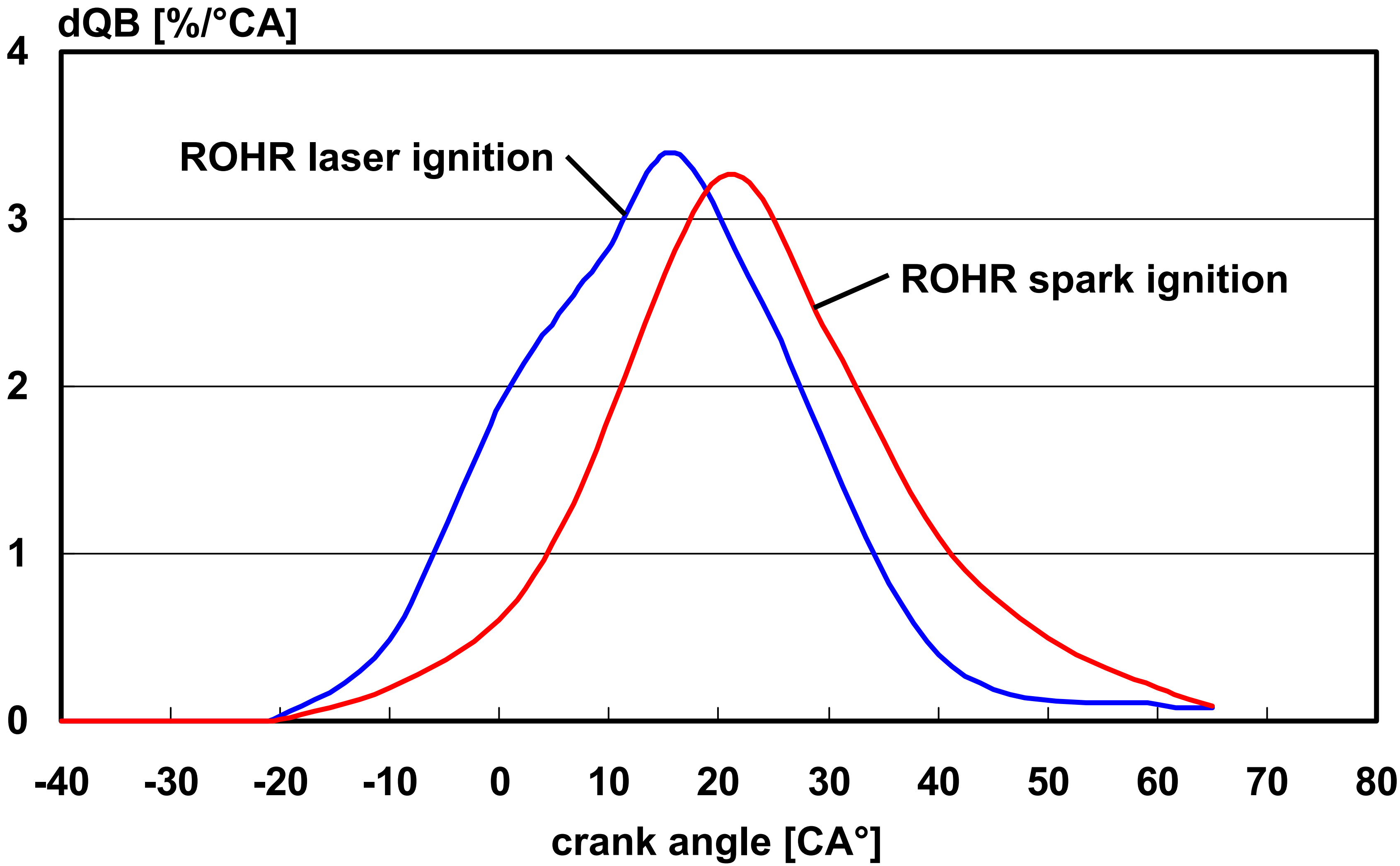
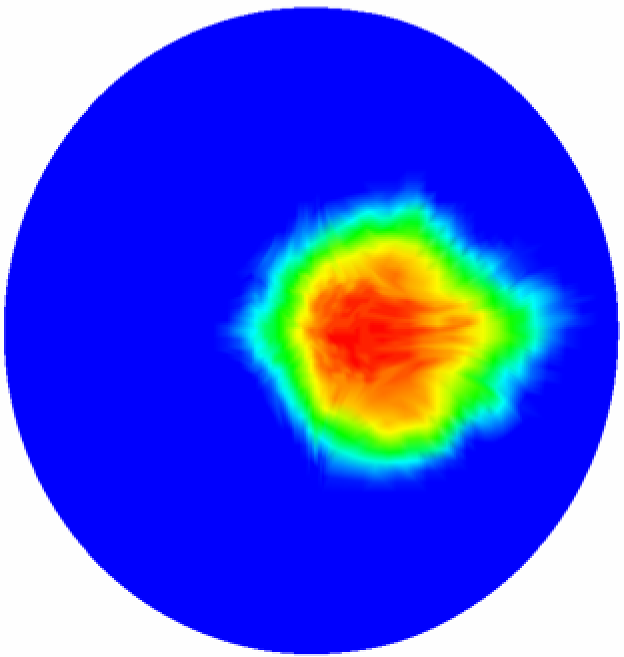
Laser Ignition
Heat Release Position

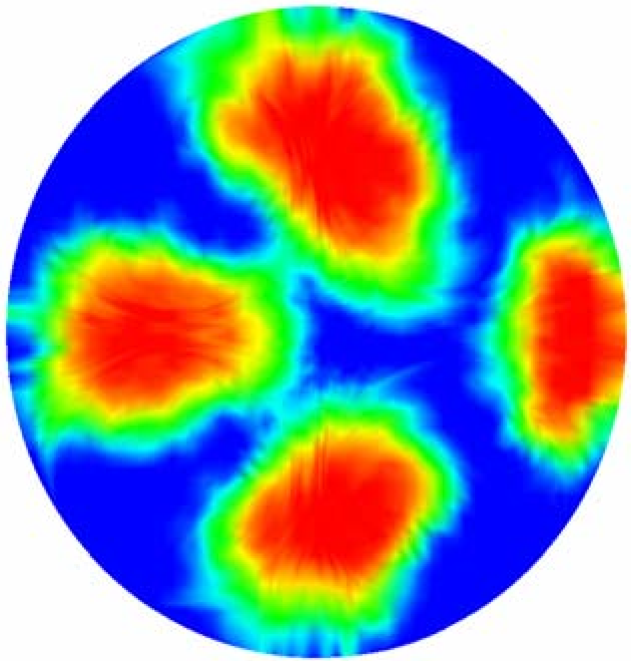


Laser Ignition Single Point / Multi Point

flame front 29° after ignition

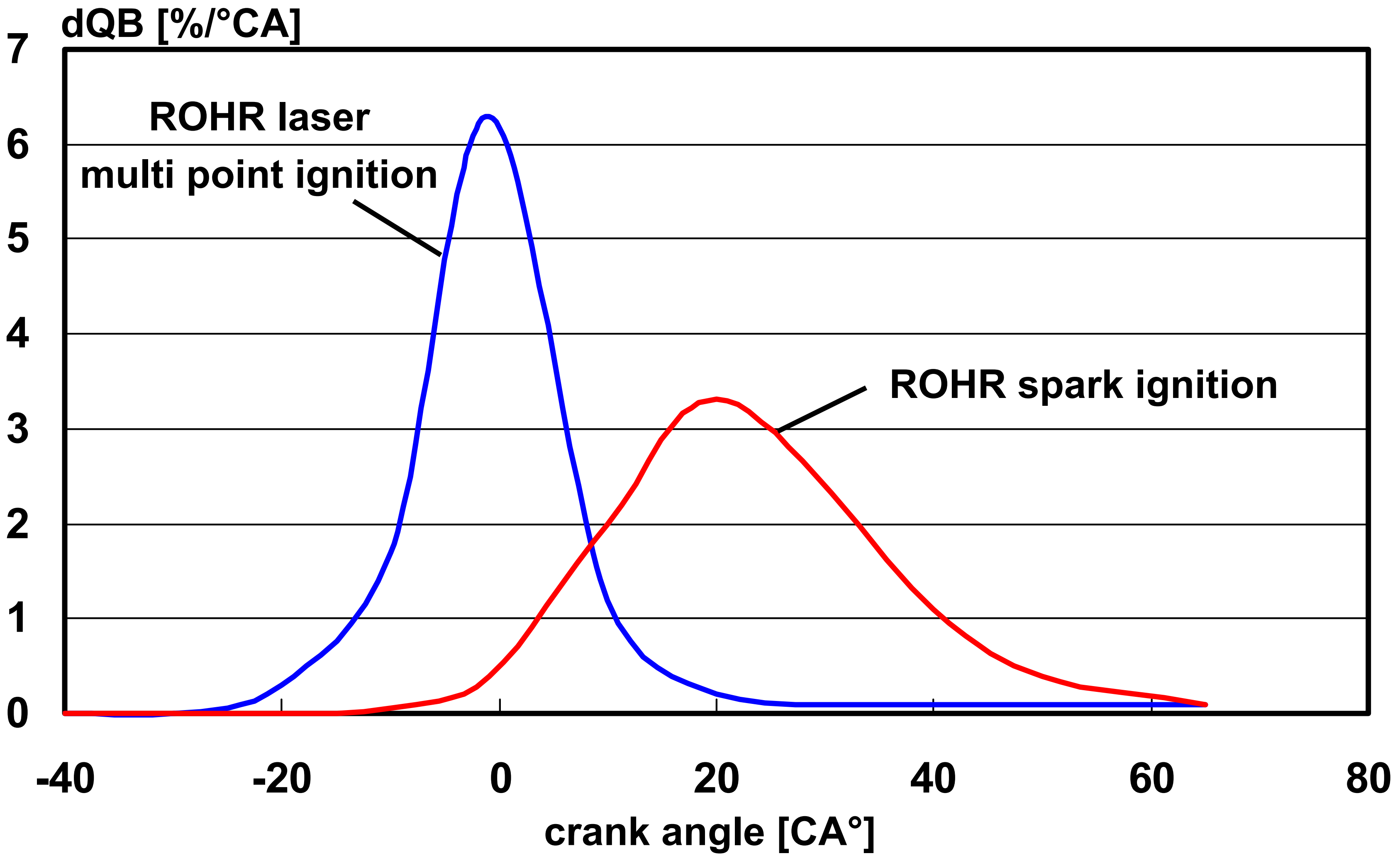


single point ignition



multi point ignition (4 points)

Laser Ignition
Heat Release - Single Point / Multi Point



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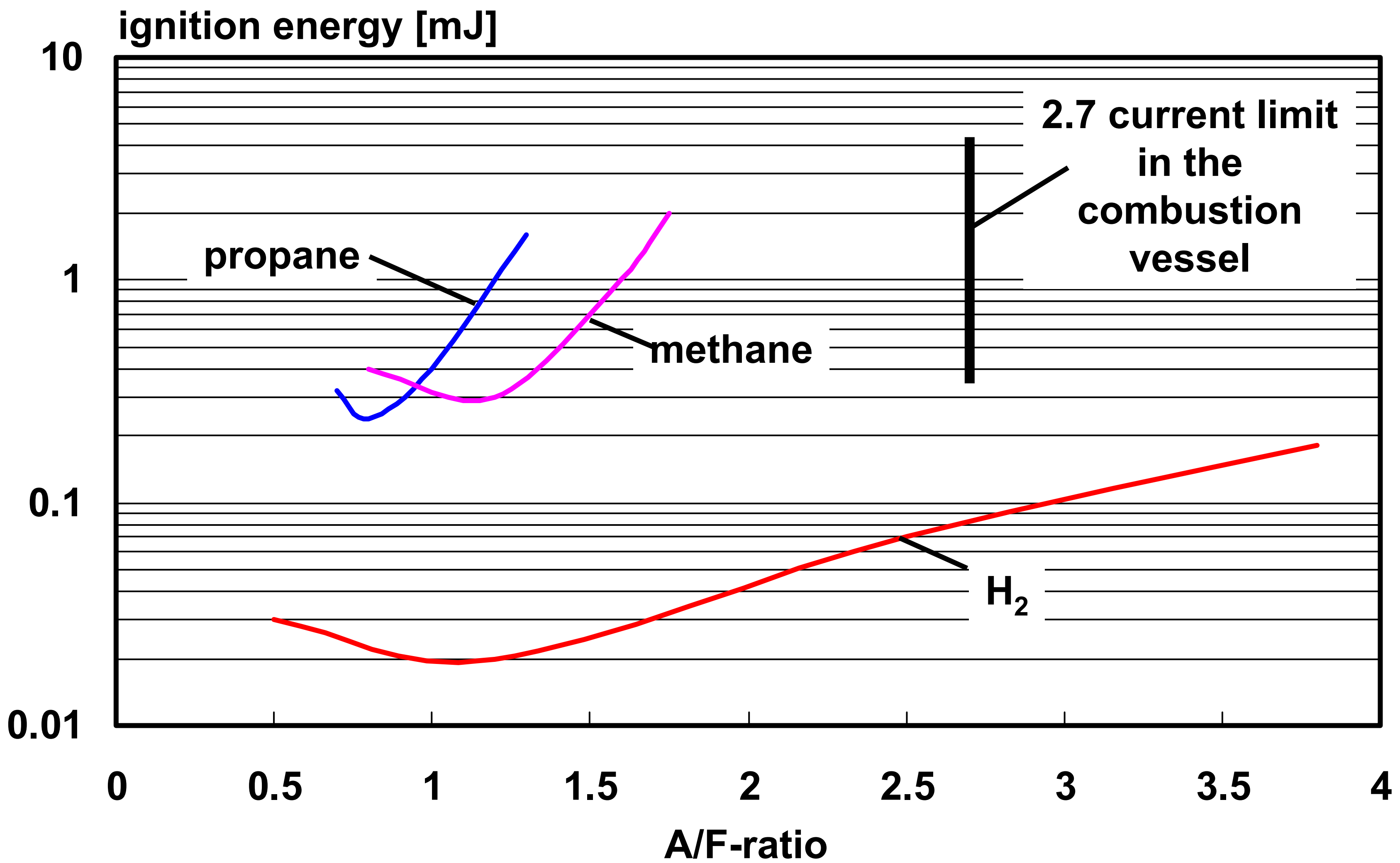
Minimum Ignition Energy - U. Maas/B. Lewis



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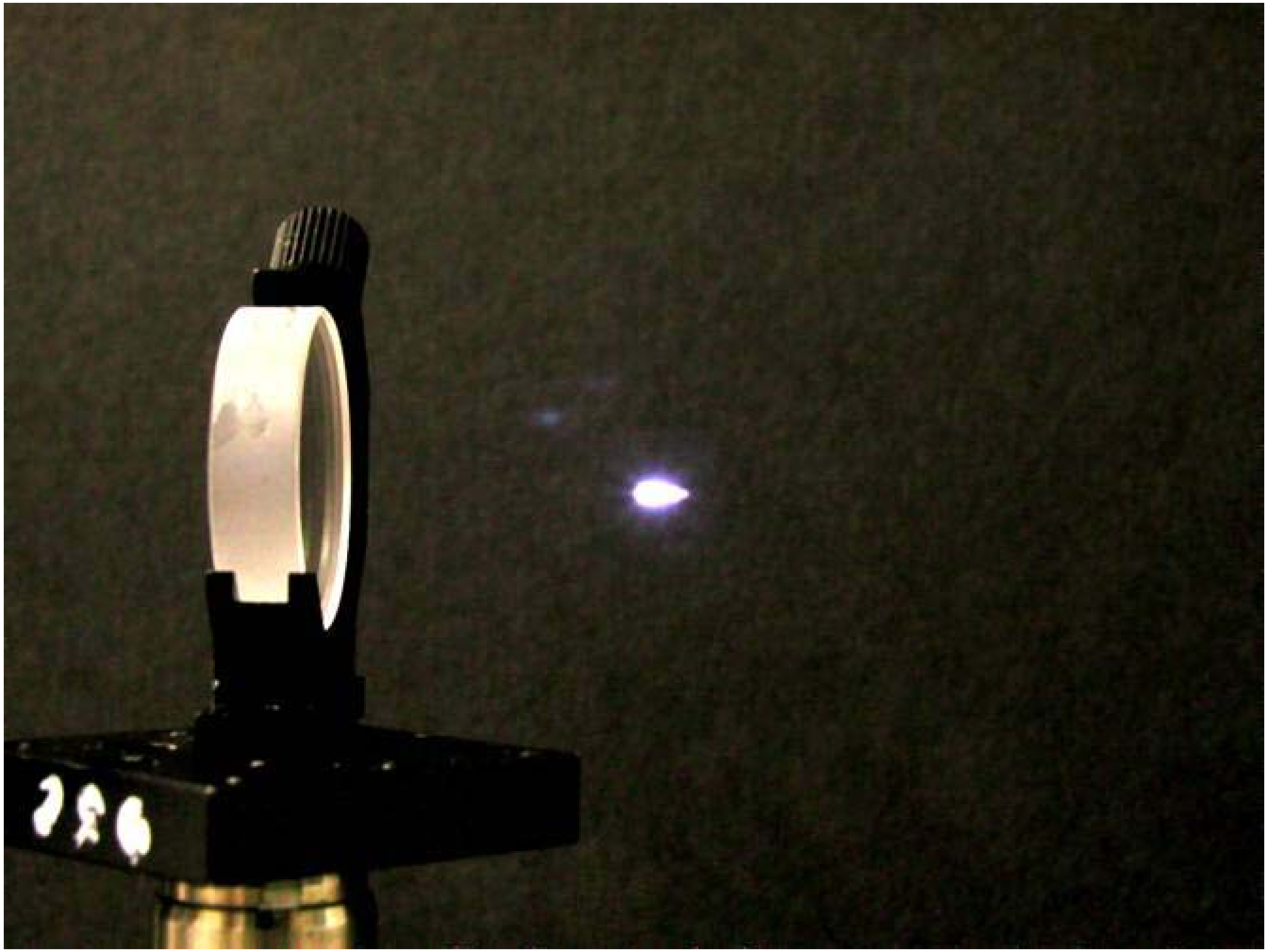
View of the Plasma after the Planar-Konvex Lens



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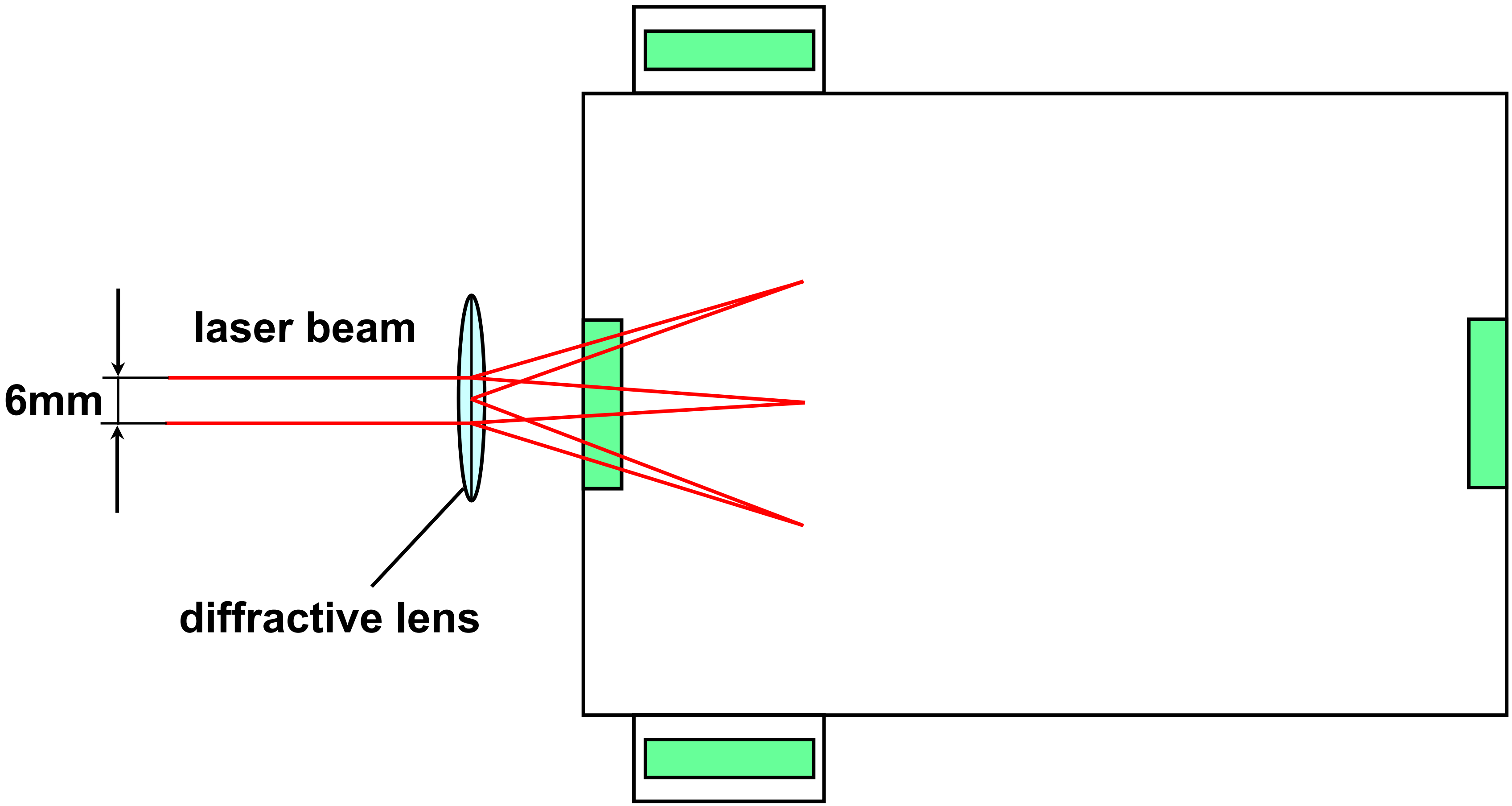
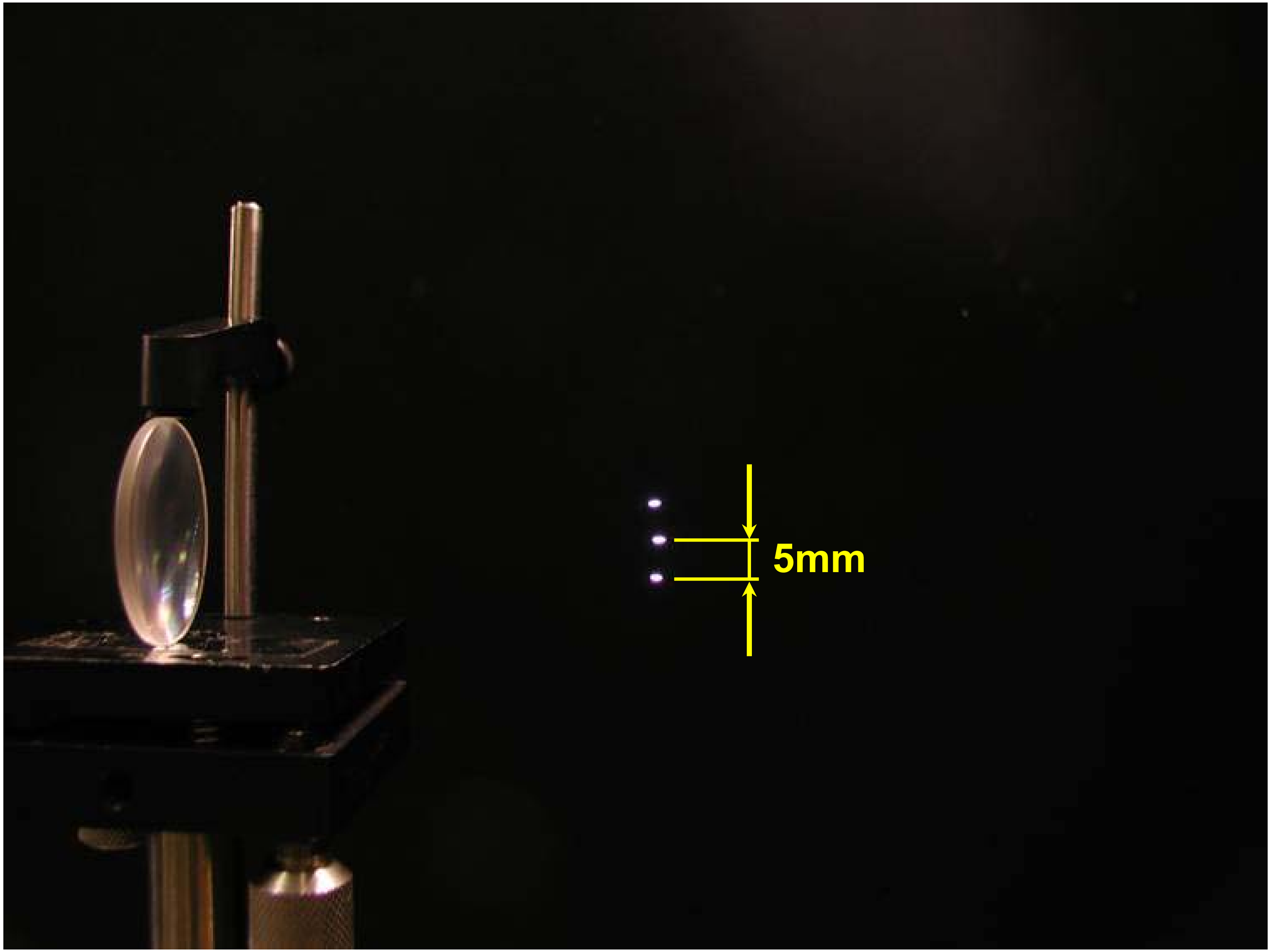
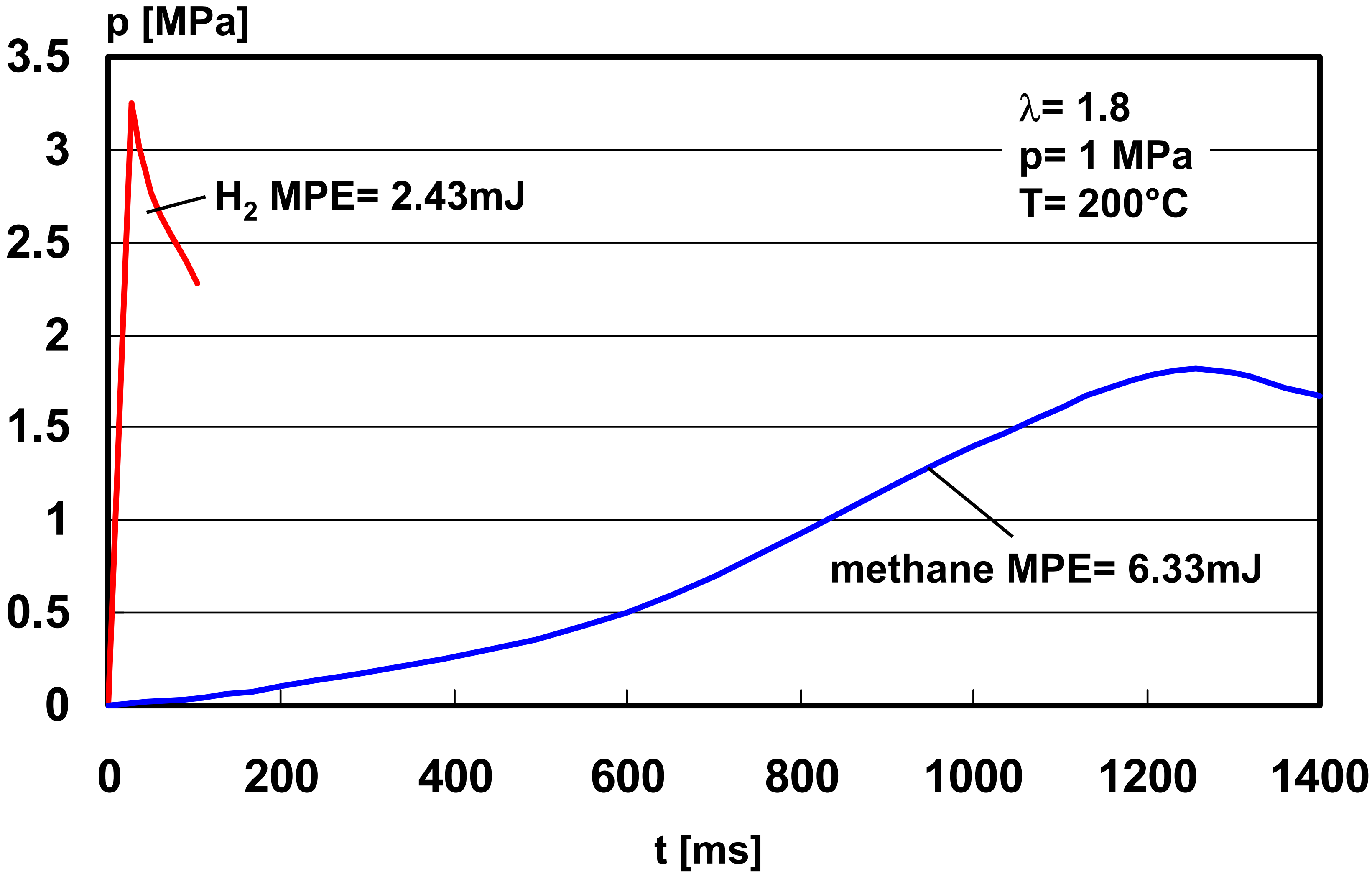
Close 3-Point Ignition
Diffractive Lens



Diffractive Lensto Gen. 3 Ignition Plasmas



Comparison Hydrogen vs. Methane



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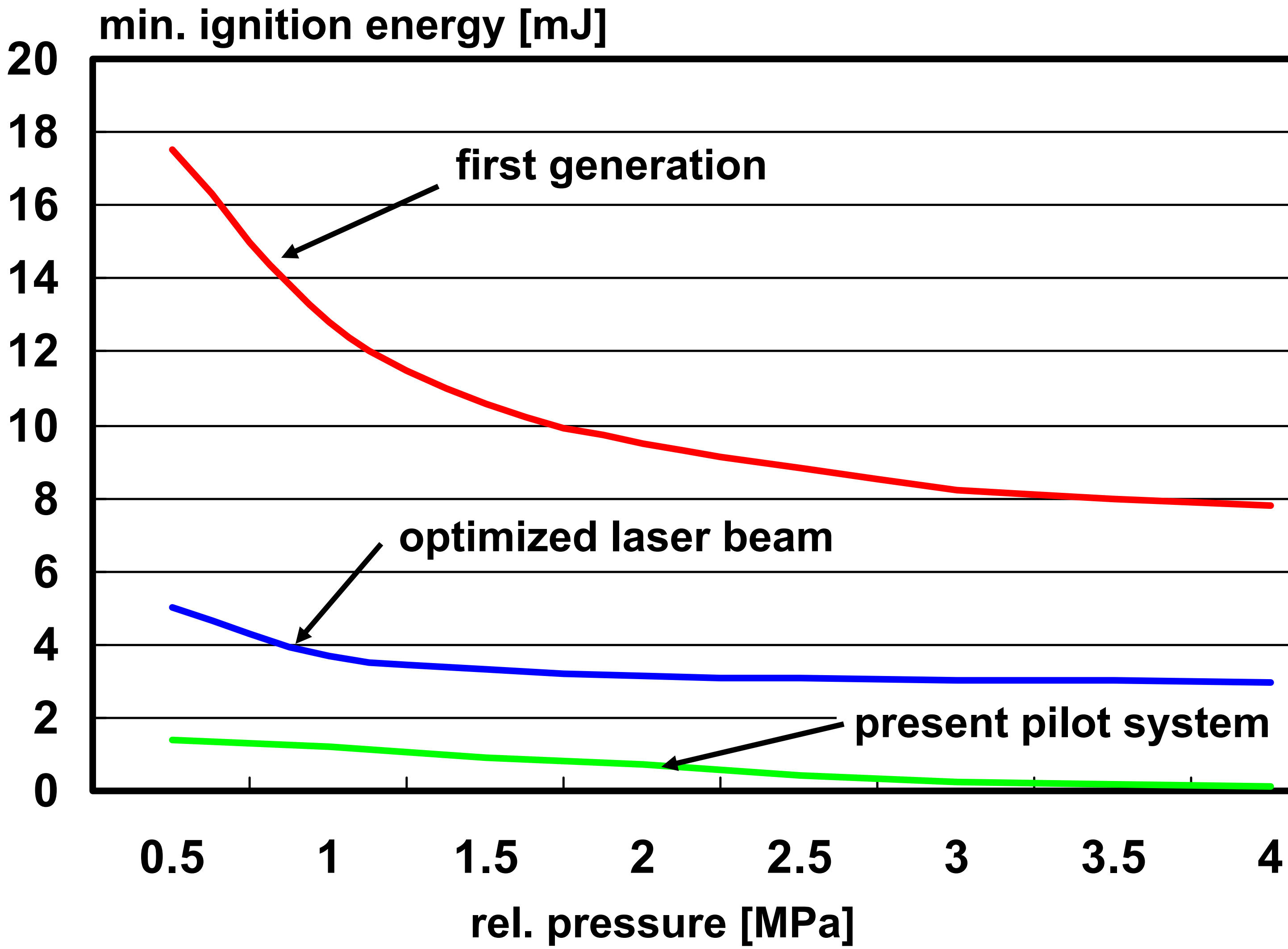
Laser Optimization Combustion Vessel



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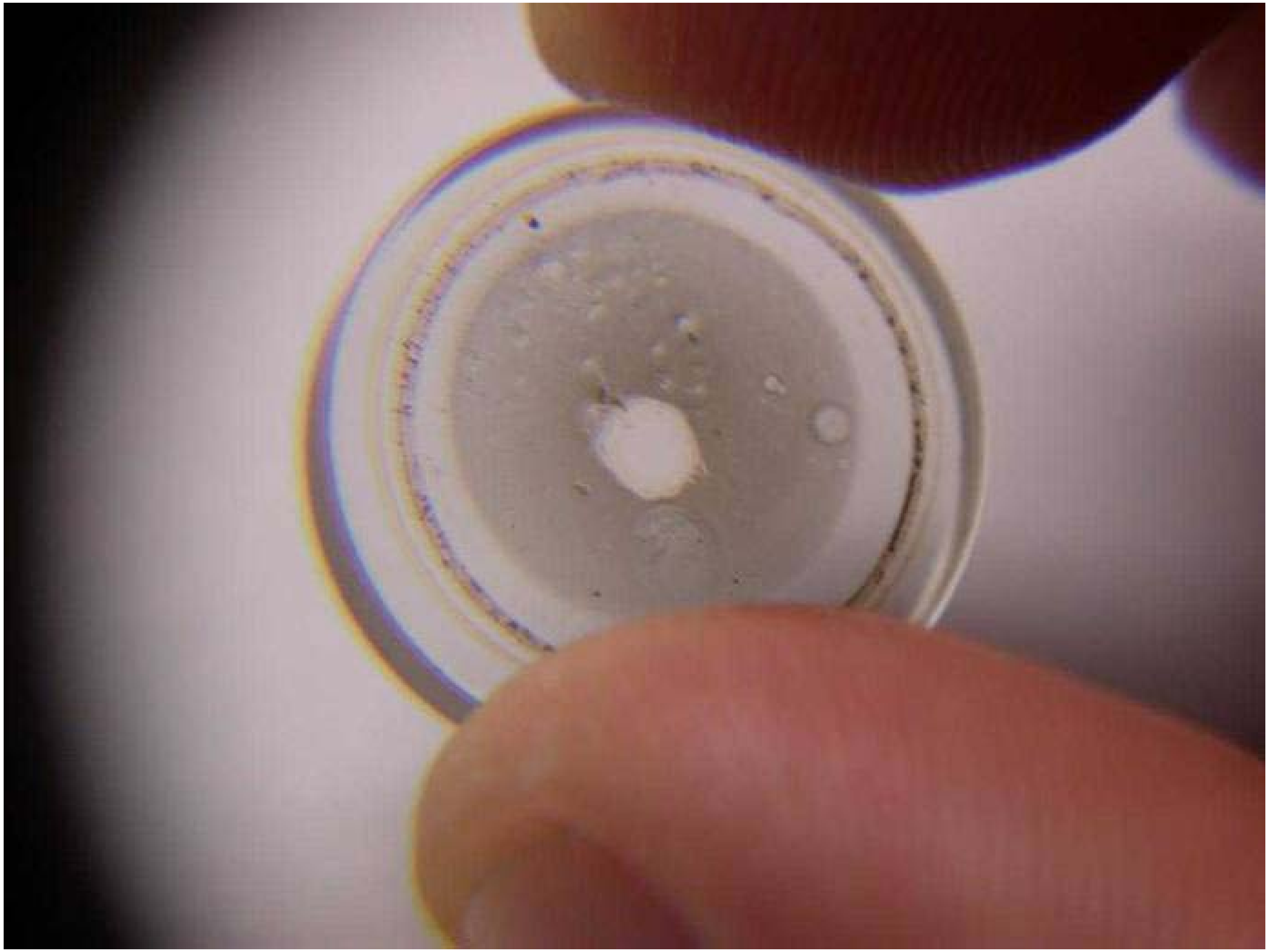
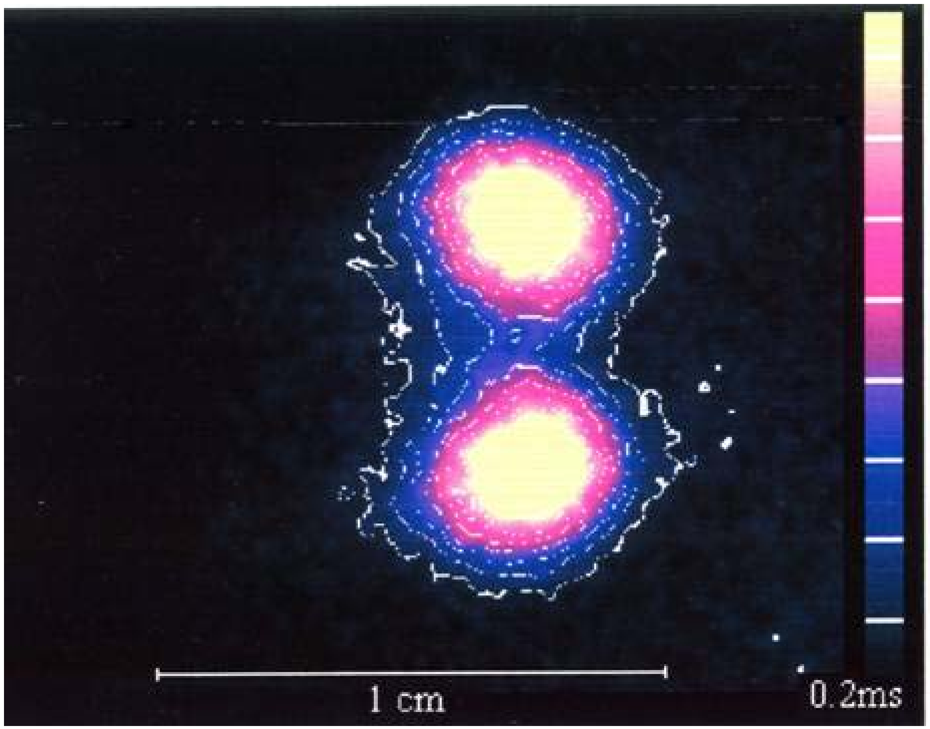
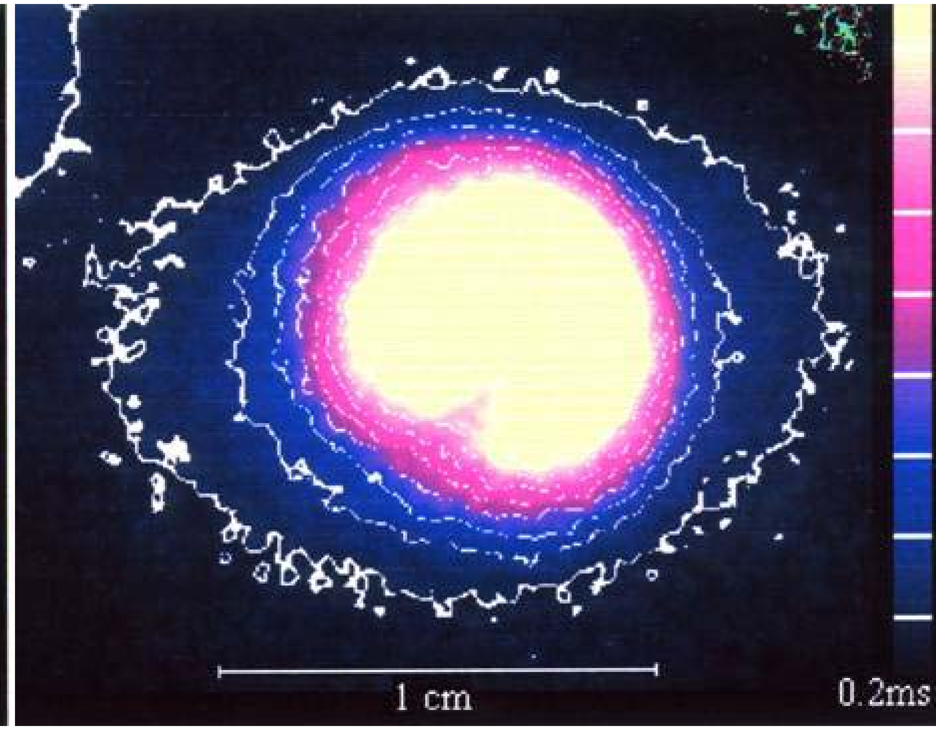
Self Cleaning Effect of the Window



Laser Ignition – LIF/OH Analysis



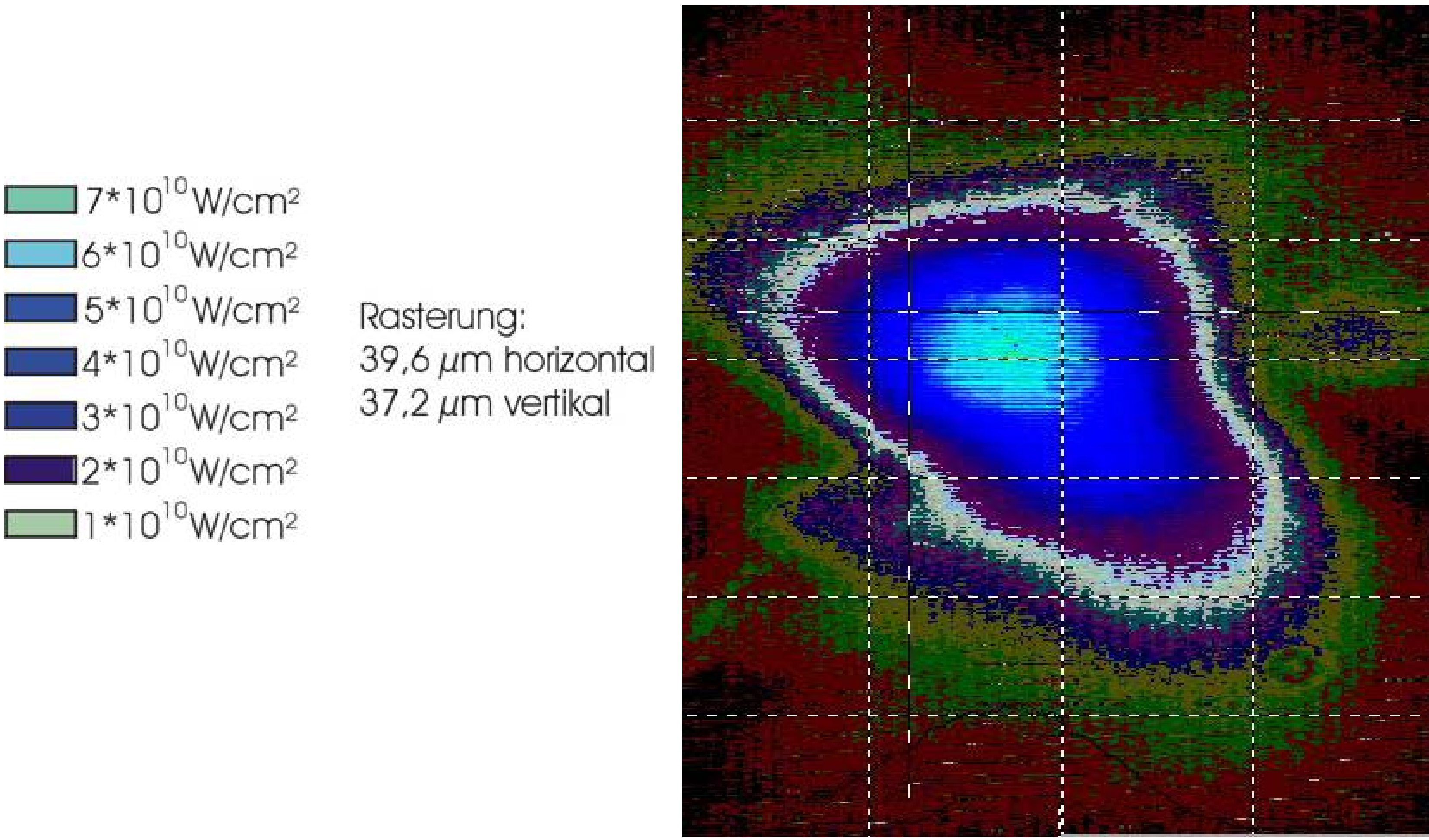
side view



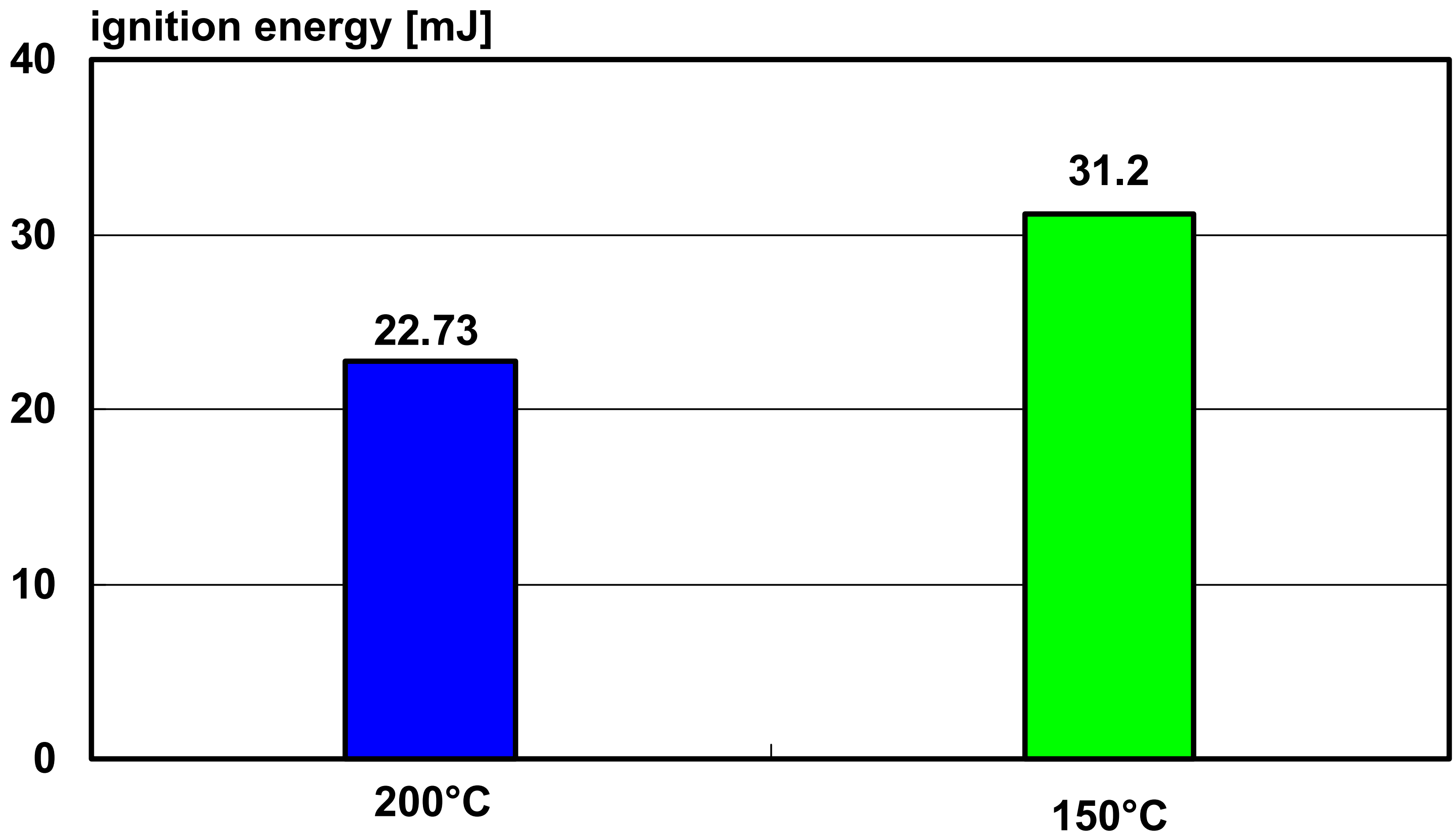
axial view

Prof. Neger TU-Graz

Example of Intensity
Energy 10 mJ/Pulse 10 ns

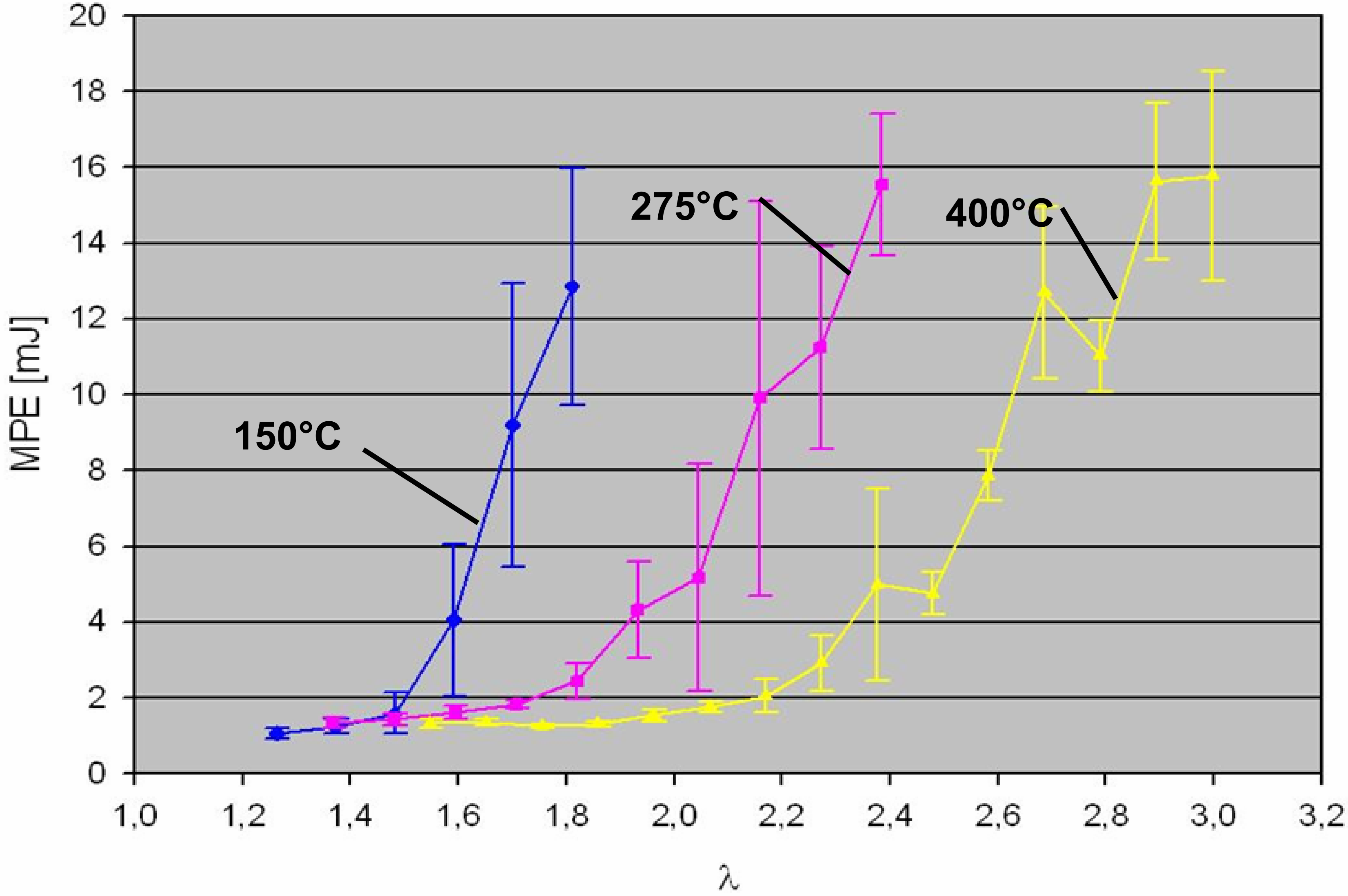


Combustion Vessel Influence Temperature



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

MPE vs A/F-Ratio λ at 30 bar



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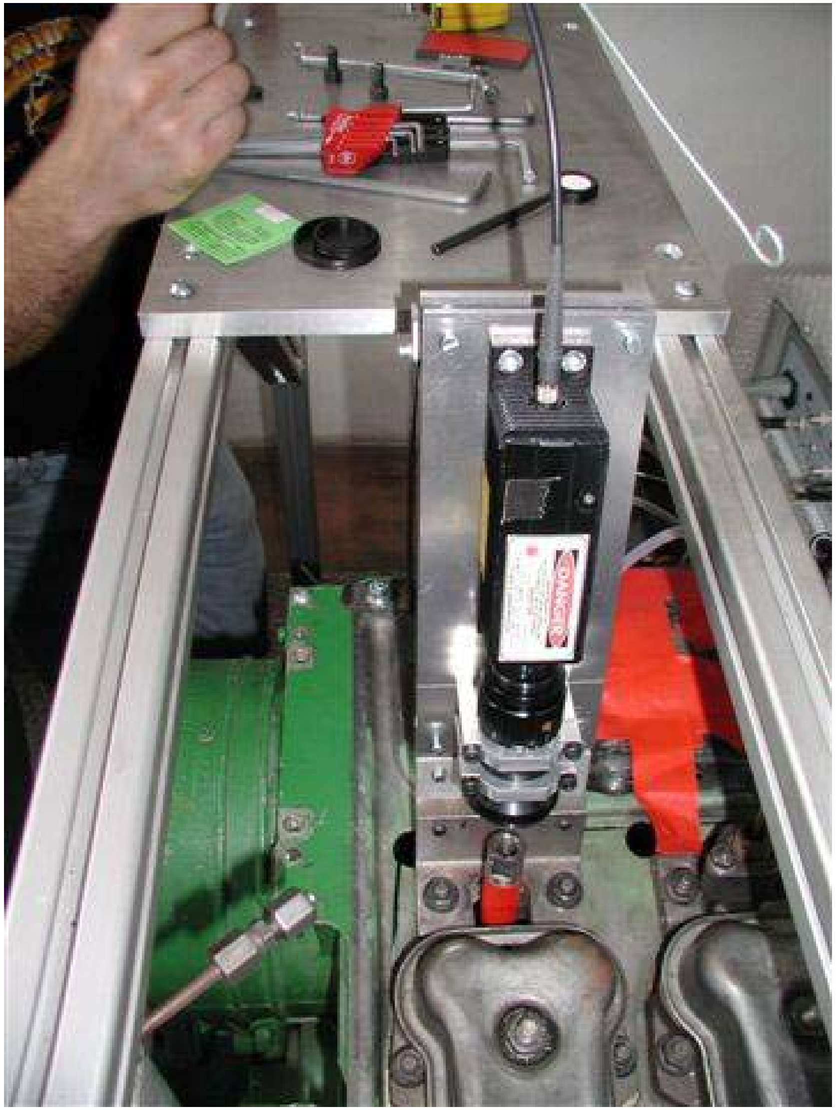
Prototype of the Special Designed Laser

Test Arrangement TU Vienna



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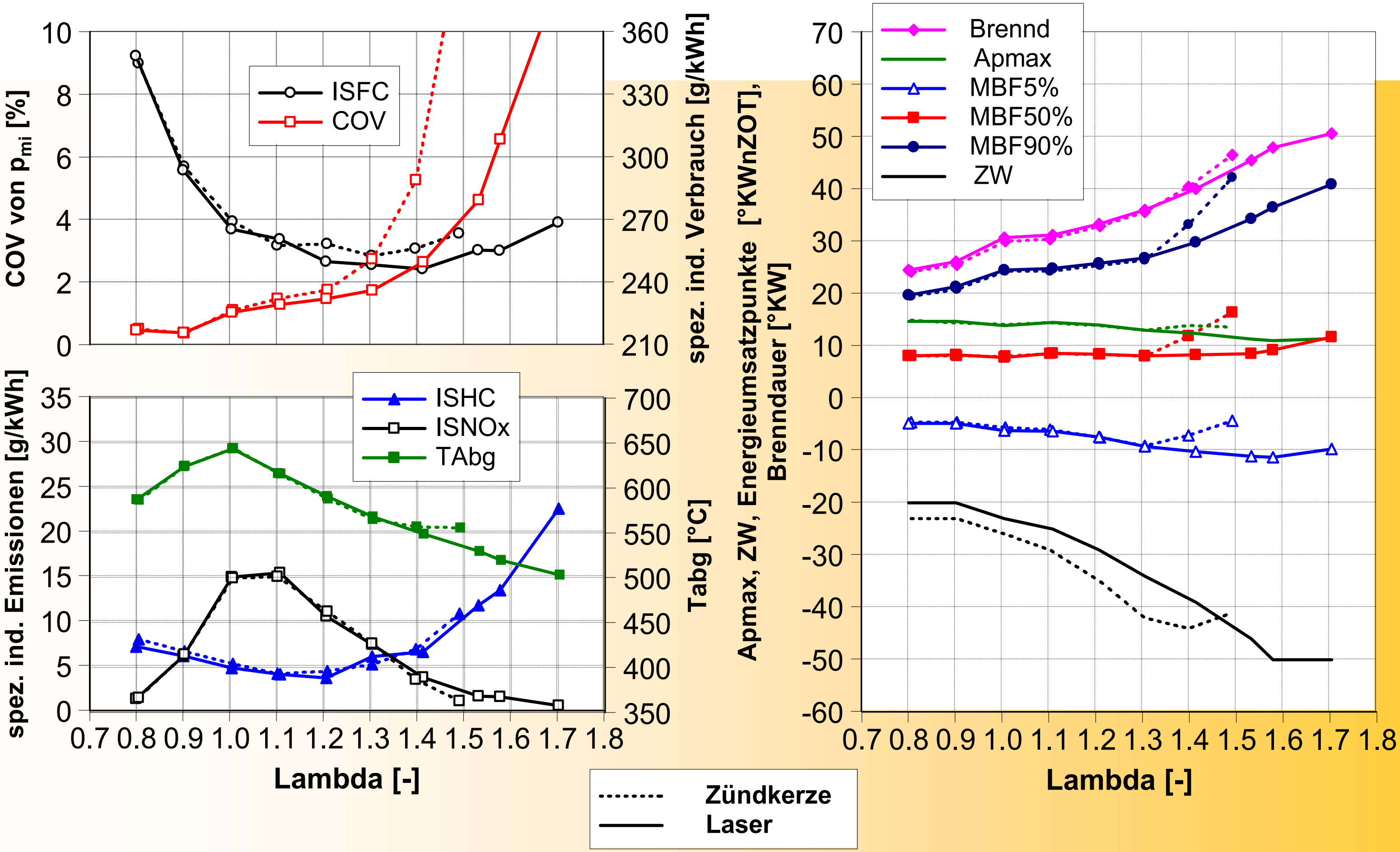
Results of the First Spec. Designed Laser



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

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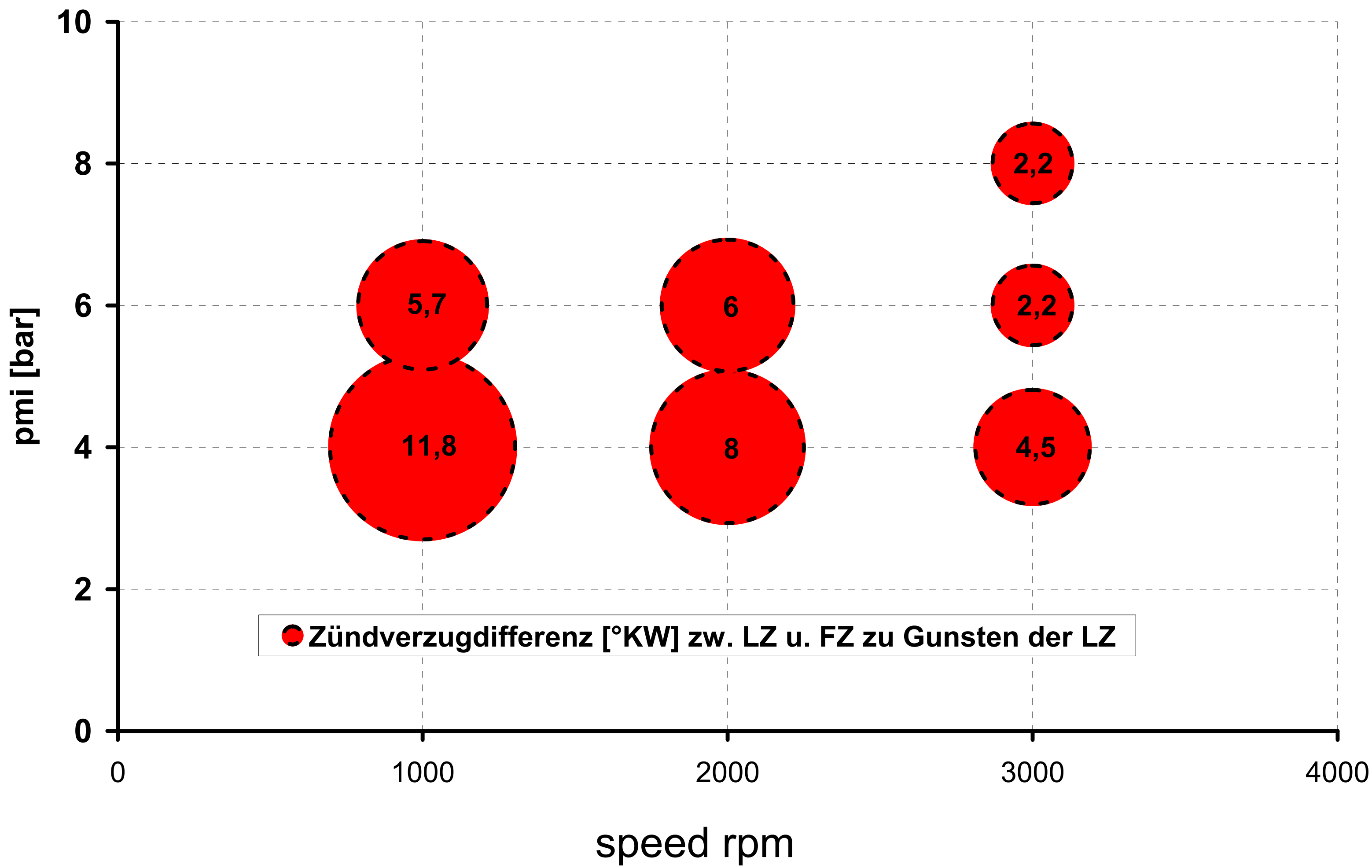
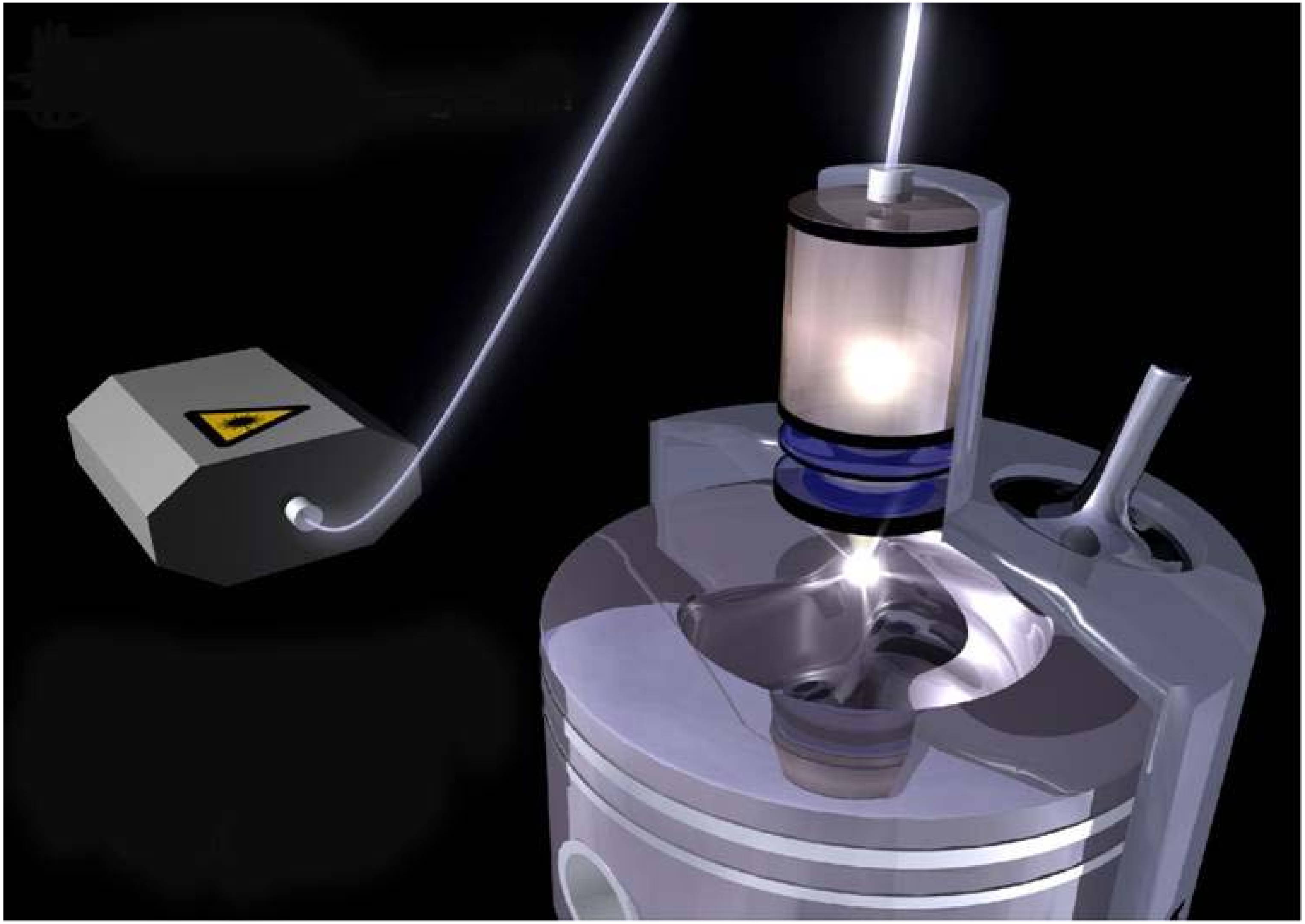
Reduction of the Ignition Delay w. L.I.



engine: Hatz 0.4 l/cyl.

Basic Concept Laser Ignition



City lights made from GE Jenbacher Gas Engines

Thank you for attention