### ATZ live

SYSTEMOPTIMIERUNG Gasaustausch und Gemischbildung

ANSAUG- UND ABGASSYSTEME Auslegung und Variabilitäten

AUFLADUNG Effizienz und Dynamik

/// KEYNOTE-VORTRÅGE

Dr. Joachim Schommers Daimler AG

Dr. Martin Scheidt Schaeffler Technologies AG & Co. KG



#### Ladungswechsel im Verbrennungsmotor

Aufladung - Ventiltrieb - Gemischbildung

6. MTZ-Fachtagung 22. und 23. Oktober 2013 | Stuttgart



#### SUPPORTING THE ENGINE CALIBRATION PROCESS BY FAST GAS EXCHANGE AND COMBUSTION ANALYSIS DIRECTLY AT THE TEST BED

Dr. Robert Fairbrother, development simulation GCA Dipl.-Ing. Rudolf Gande, development gasoline engines Georg Salentinig, development software <u>Dr. Thomas Leifert</u>, product management GCA Ing. Johann Krammer, product management BOOST

**AVL List GmbH** 



# Everybody belives the test result except the test engeneer.

# Nobody belives the analysis result except the analyst.



#### SUPPORTING THE ENGINE CALIBRATION PROCESS BY FAST GAS EXCHANGE AND COMBUSTION ANALYSIS DIRECTLY AT THE TEST BED

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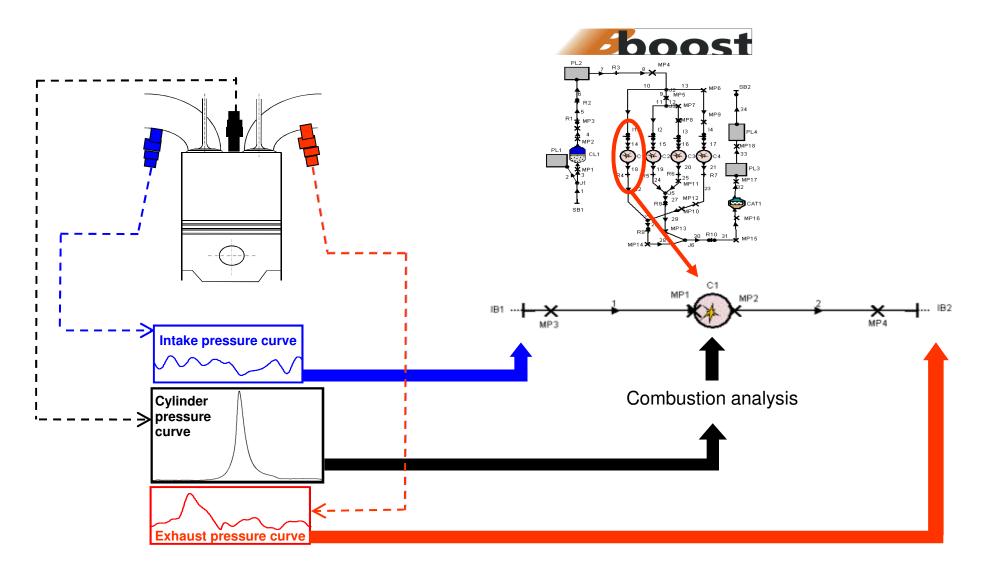
#### • GCA / GCA-online

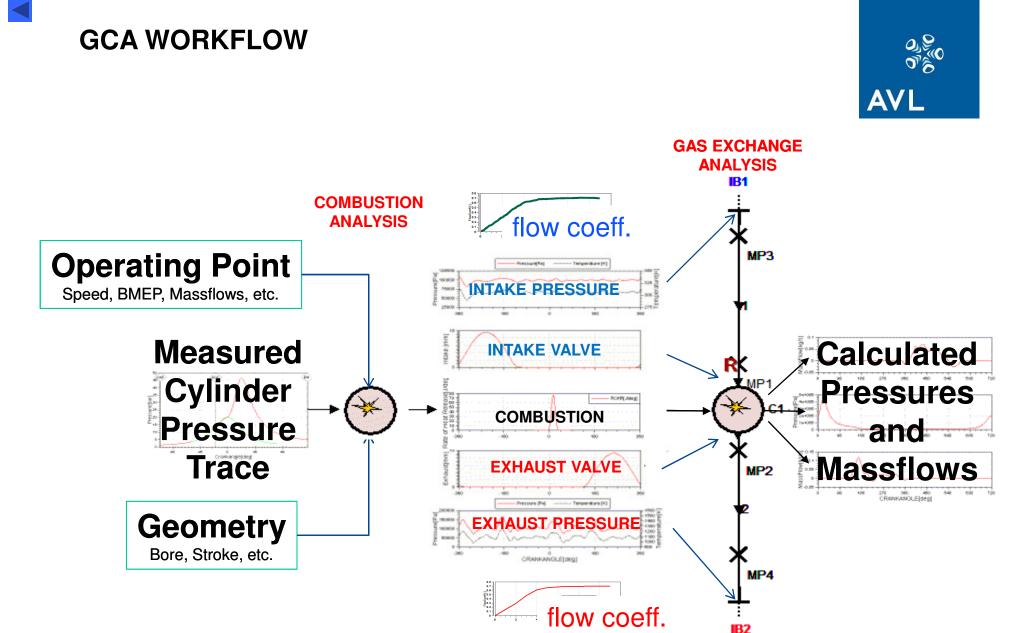
- low end torque: potential and risk
- test cell and measurement set-up
- low end torque: application
- GCA-online at the test cell



#### **AVL GCA: WORKING PRINCIPLE**

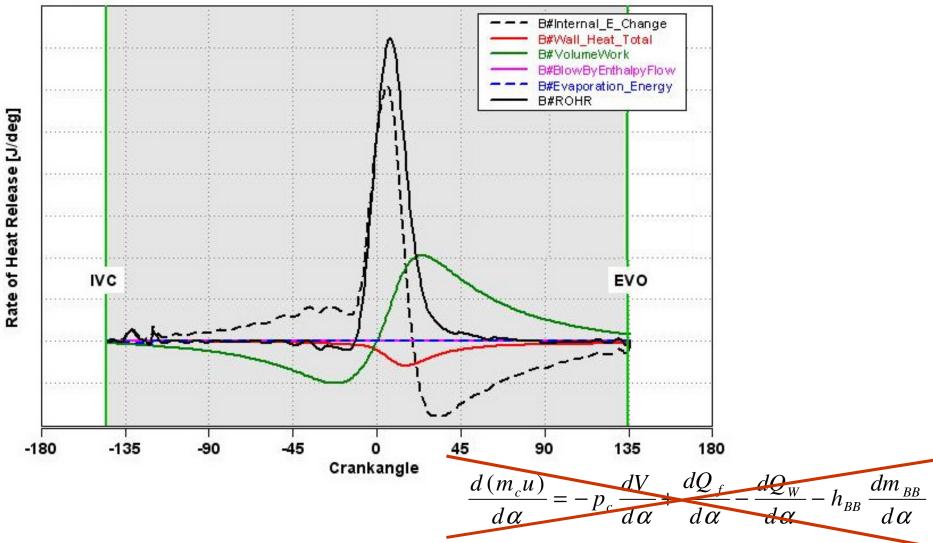










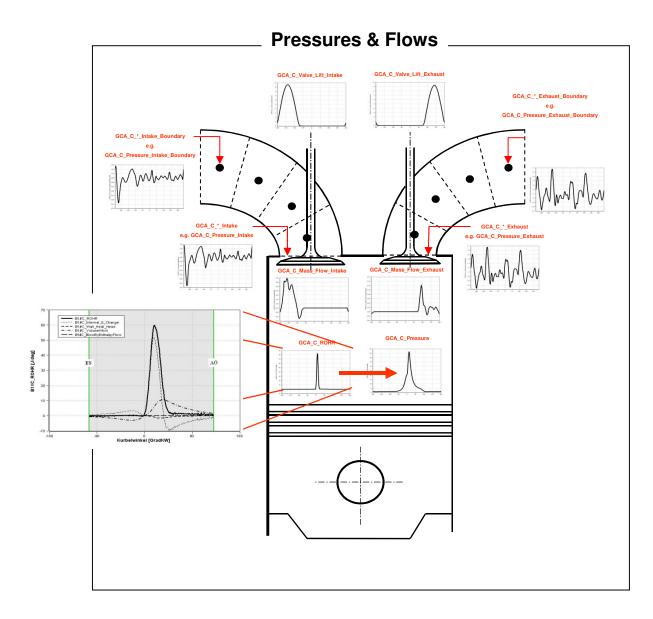


dQ<sub>f</sub>: heat release by combustion after fuel injection

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#### **GAS EXCHANGE ANALYSIS**





#### **GCA-ONLINE PC REQUIREMENTS**





CPU:	Intel Core-i or Intel Xeon with 4 or more cores at 3GHz
RAM:	4 GB
OS:	Windows 7 (32/64bit) or Windows XP
Interfaces:	GigaBit Ethernet, CD-ROM,
	PCI-E and RS232 or ExpressCard (on Notebooks)



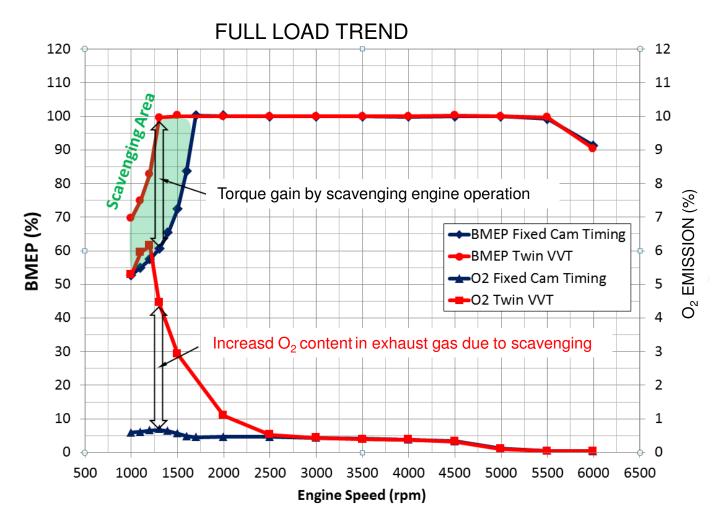
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#### **TURBOCHARGED GASOLINE ENGINES**

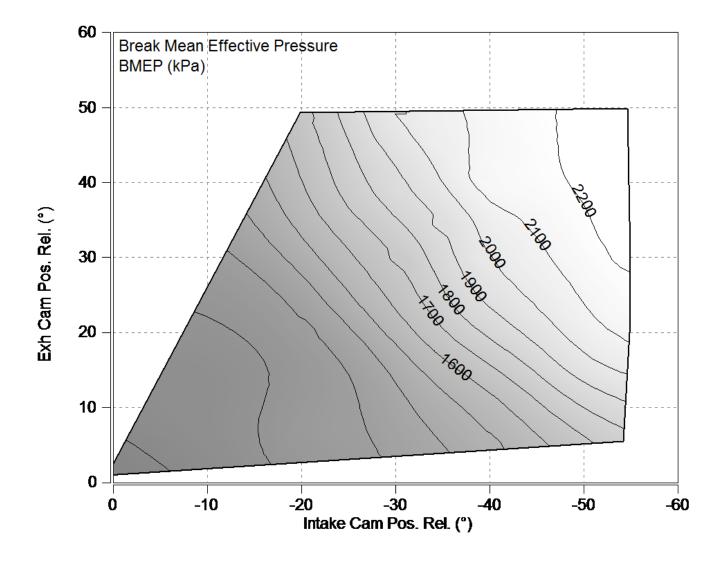




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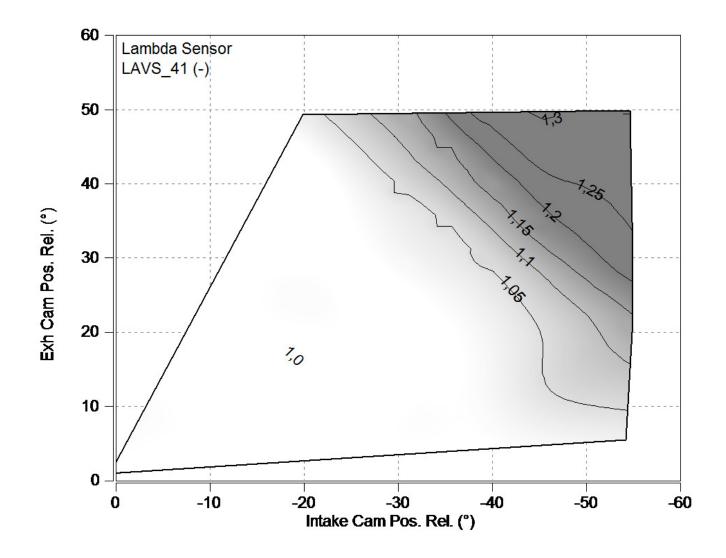






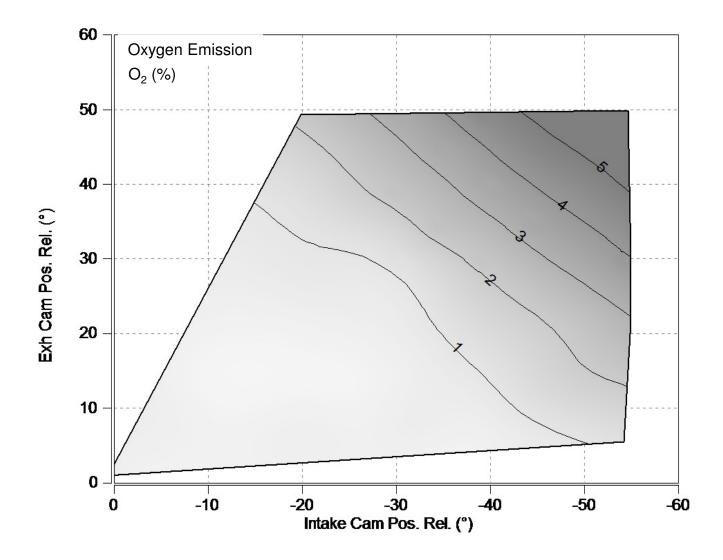






### **OXYGEN EMISSION**







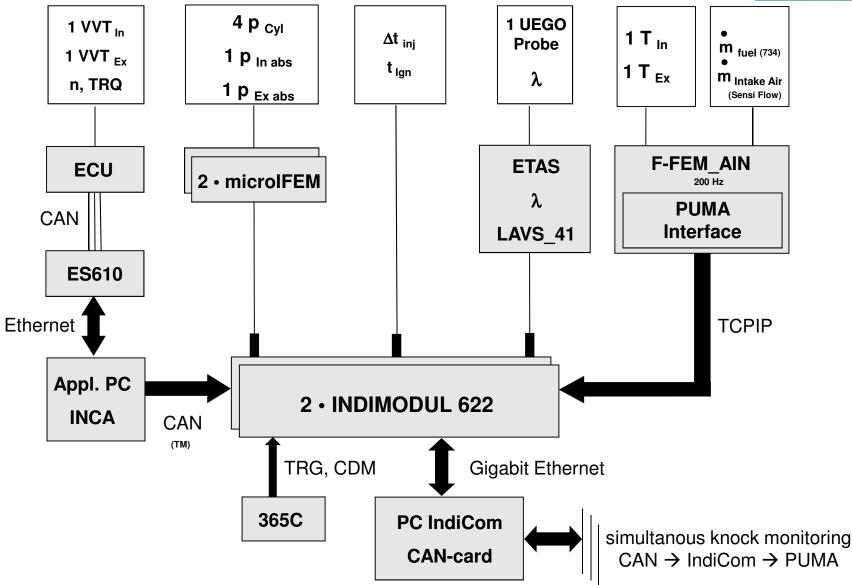
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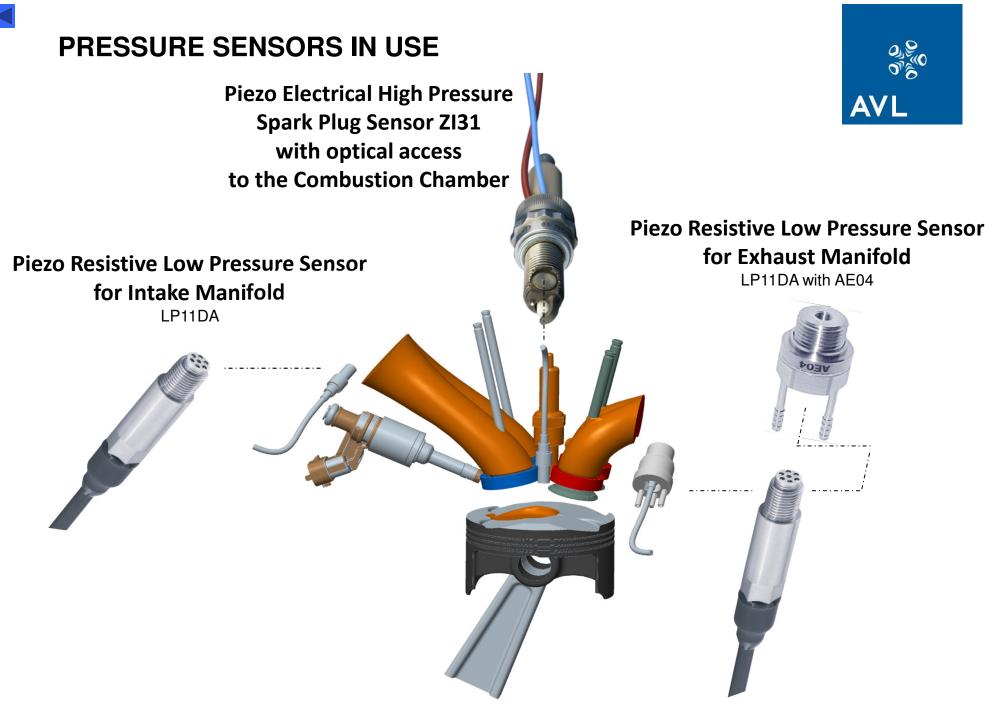
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## test cell setup and measurement parameters









#### SUPPORTING THE ENGINE CALIBRATION PROCESS BY FAST GAS EXCHANGE AND COMBUSTION ANALYSIS DIRECTLY AT THE TEST BED

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#### STATE OF THE ART ENGINE

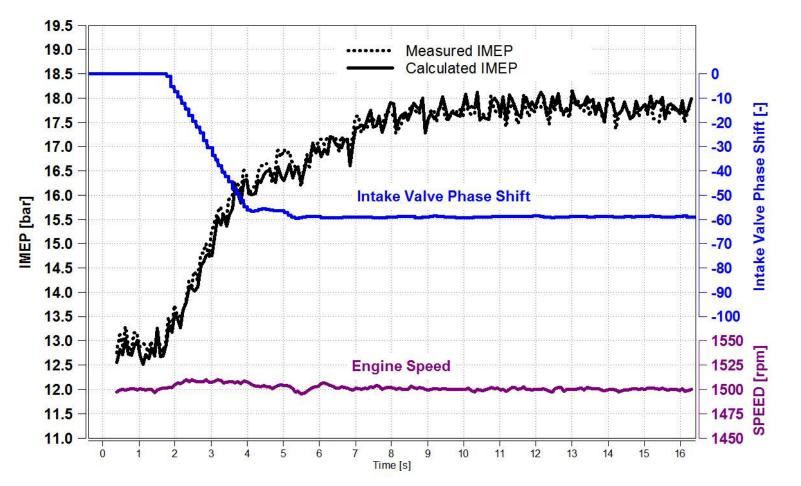


4 cylinder GDI gasoline engine of a series passenger car:

Engine type:	4 cylinder gasoline, in line
Configuration:	GDI, VVT, 16 valves, 1 stage Turbo Charger
Power:	P <sub>e</sub> = 180 kW
Torque:	Trq = 380 Nm
Displacement:	$V_{total} = 2.0 I$
Compression ratio:	$\varepsilon = 9.7$

LOAD STEP

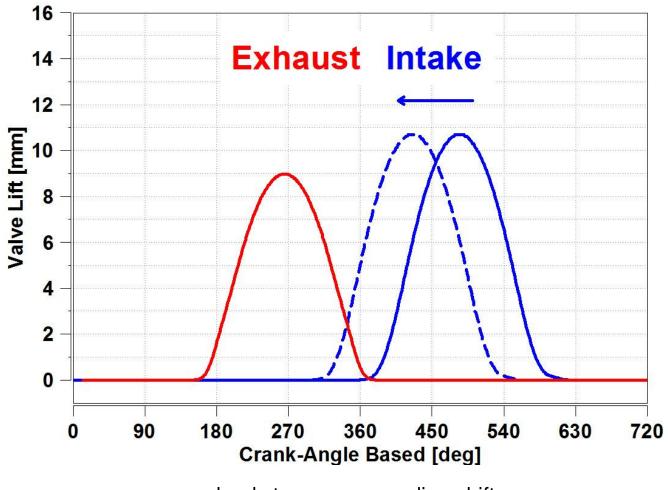




Low end torque: LOAD STEP within 25 cycles by cam phase shift



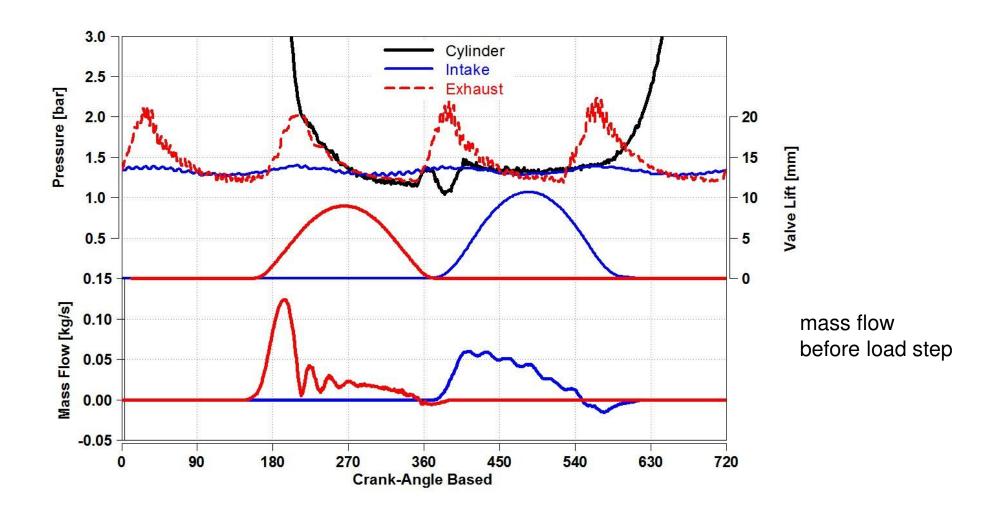




load step: corresponding shift

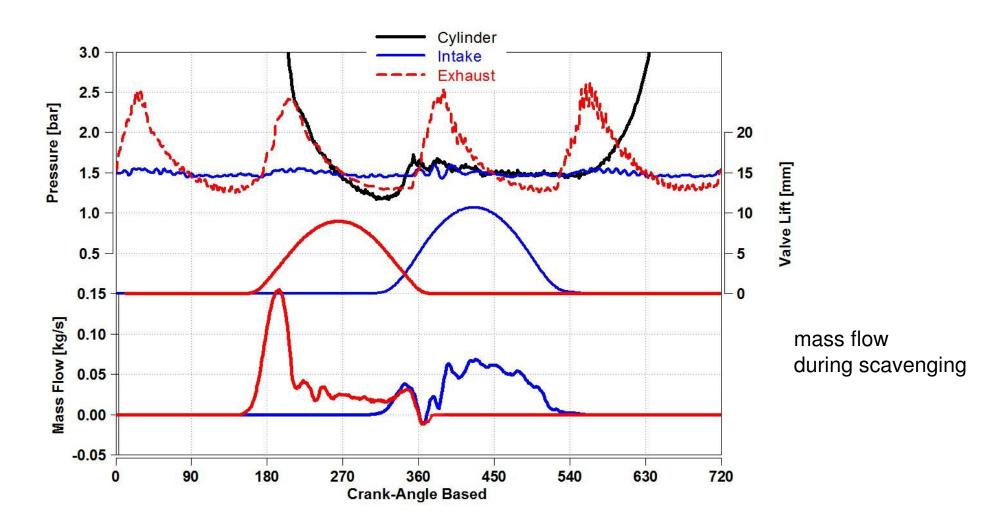
**SCAVENGING MODE** 





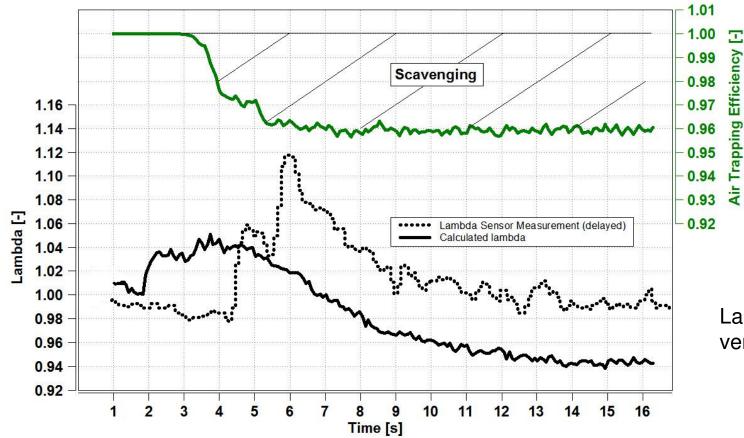
**SCAVENGING MODE** 





#### LAMBDA IN SCAVENGING MODE





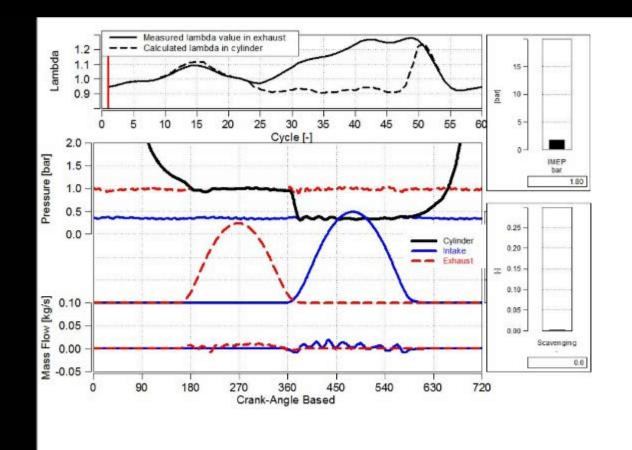
Lambda measured in exhaust versus calculated for cylinder



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- A complete gas exchange and combustion analysis tool was introduced which can be used online at the test bed or on the vehicle
- The tool can be used to overcome the limitations of slow feedback of available sensors (eg: A/F, m) as well as providing important additional information
- Development engineers at the test bed have immediate and direct access to accurate gas exchange and combustion analysis data that cannot be measured



## Everybody belives the test result even the test engeneer.

# Everybody belives the analysis result not only the analyst.



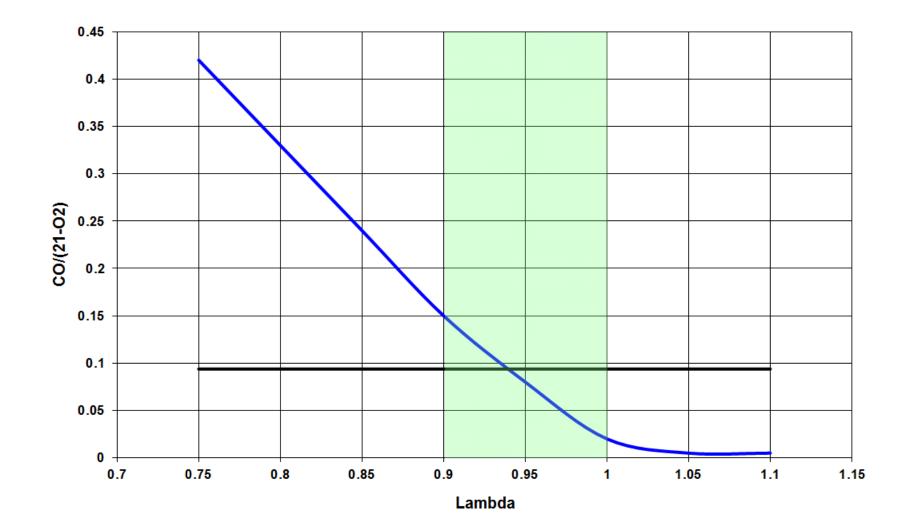
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#### **CALIBRATING EXHAUST EMISSION**





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### LAMBDA SENSOR LOCATION



