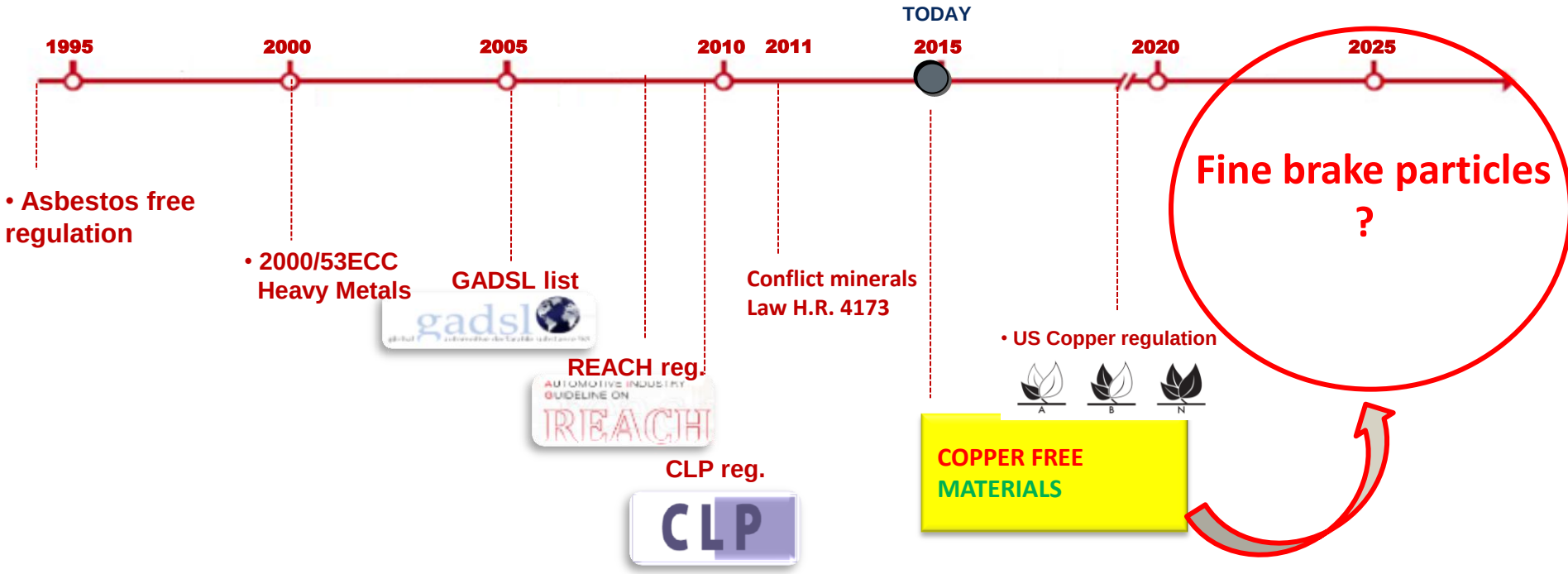
PMP Collaboration: System description

Environmental Policy: We should be prepared

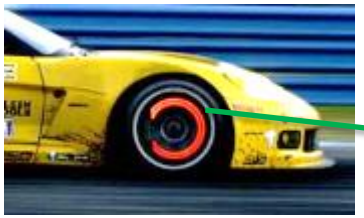
Fulfill all most restrictive worldwide regulations

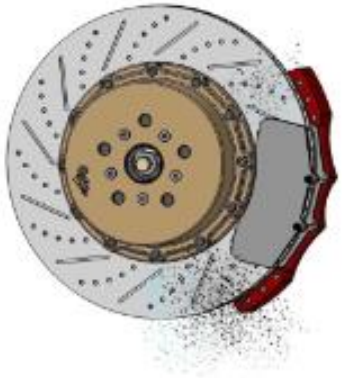
At frontline with all incoming legislations

Trying to anticipate future legislations



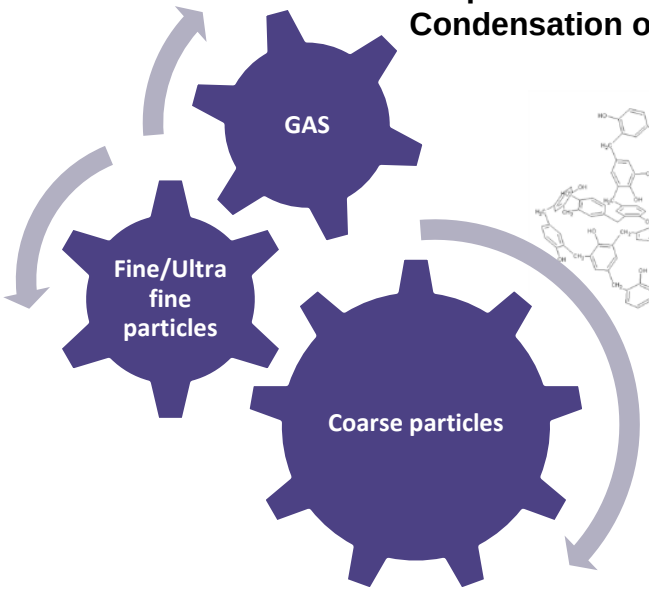
Wear & Emission from Brake systems



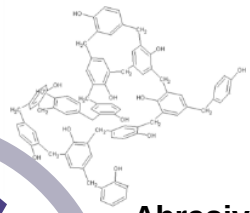


The wear process between the disc and the pad produce particles and gaseous emissions

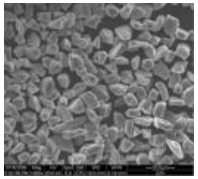
Emissions



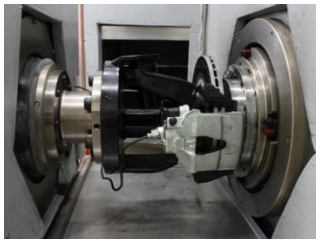
Evaporation and Condensation of organics



Abrasives, lubricant, fillers, disc wear…



Protocol Analysis



AKM, Mojacar….

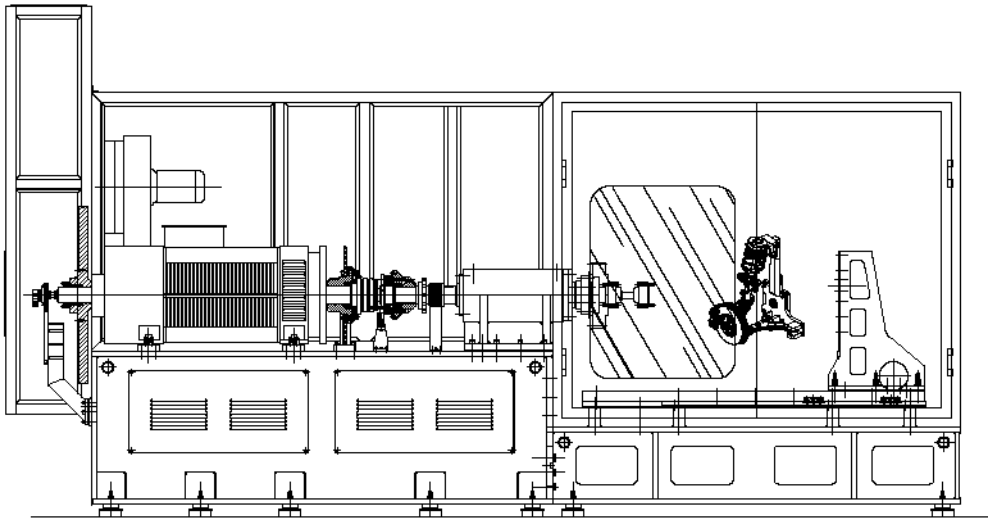
Mechanism

Understand the wear mechanism

Develop new pad generation with control wear & emissions

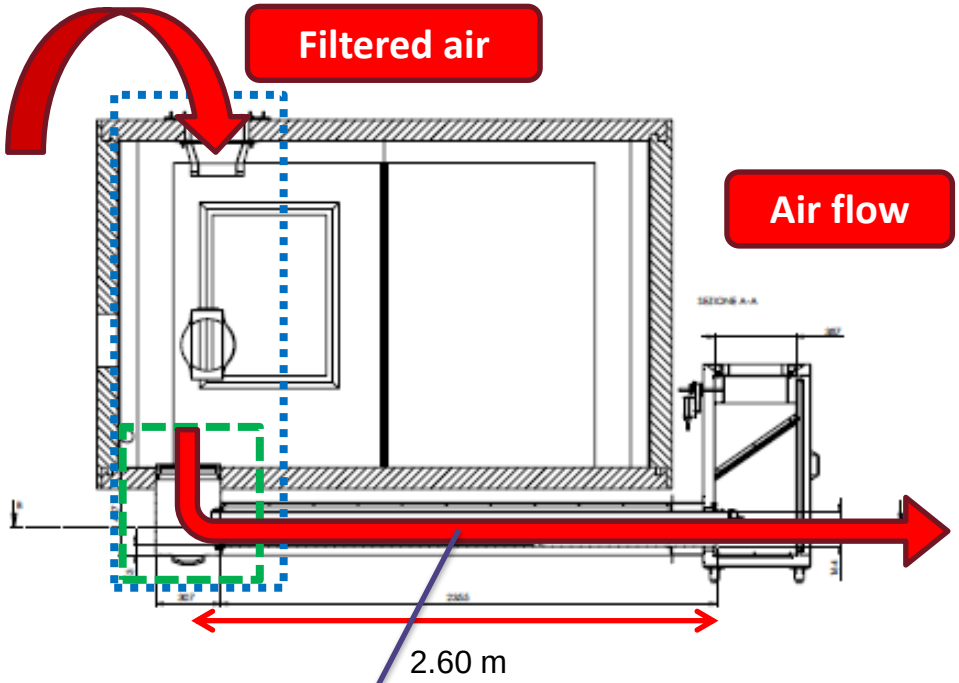
Mini Dyno Main characteristics

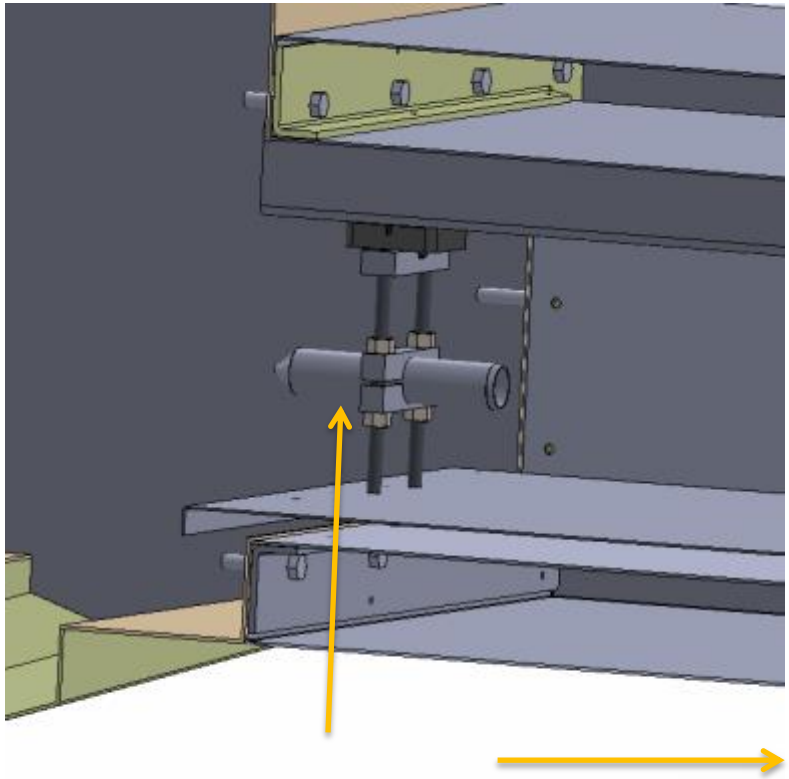
Configuration



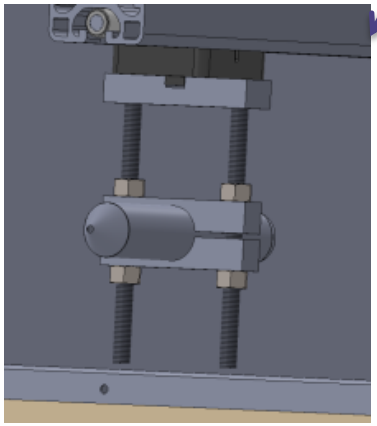
- DC motor 191 kW;
- Constant torque of 2000 Nm up to 991 rpm;
- Constant Power from 911 to 200 rpm;
- Drag torque 2000 Nm;
- Max pressure: 200 bar
- Max speed 2600 rpm;
- Mechanical inertia up to 50 kg/m^2;
- Brake aspiration/ventilation flow rate 1200 - 2000 m^3/h;
- 4 input analog channels for fixed temperature measurements;
- Friction level elaboration;
- Optional climatic control
    - Thermal field: from -20 to + 50 °C with 2°C accuracy;
    - Adiabatic field: RH from 10% to 80-90% with 5% accuracy;

Air extraction channel





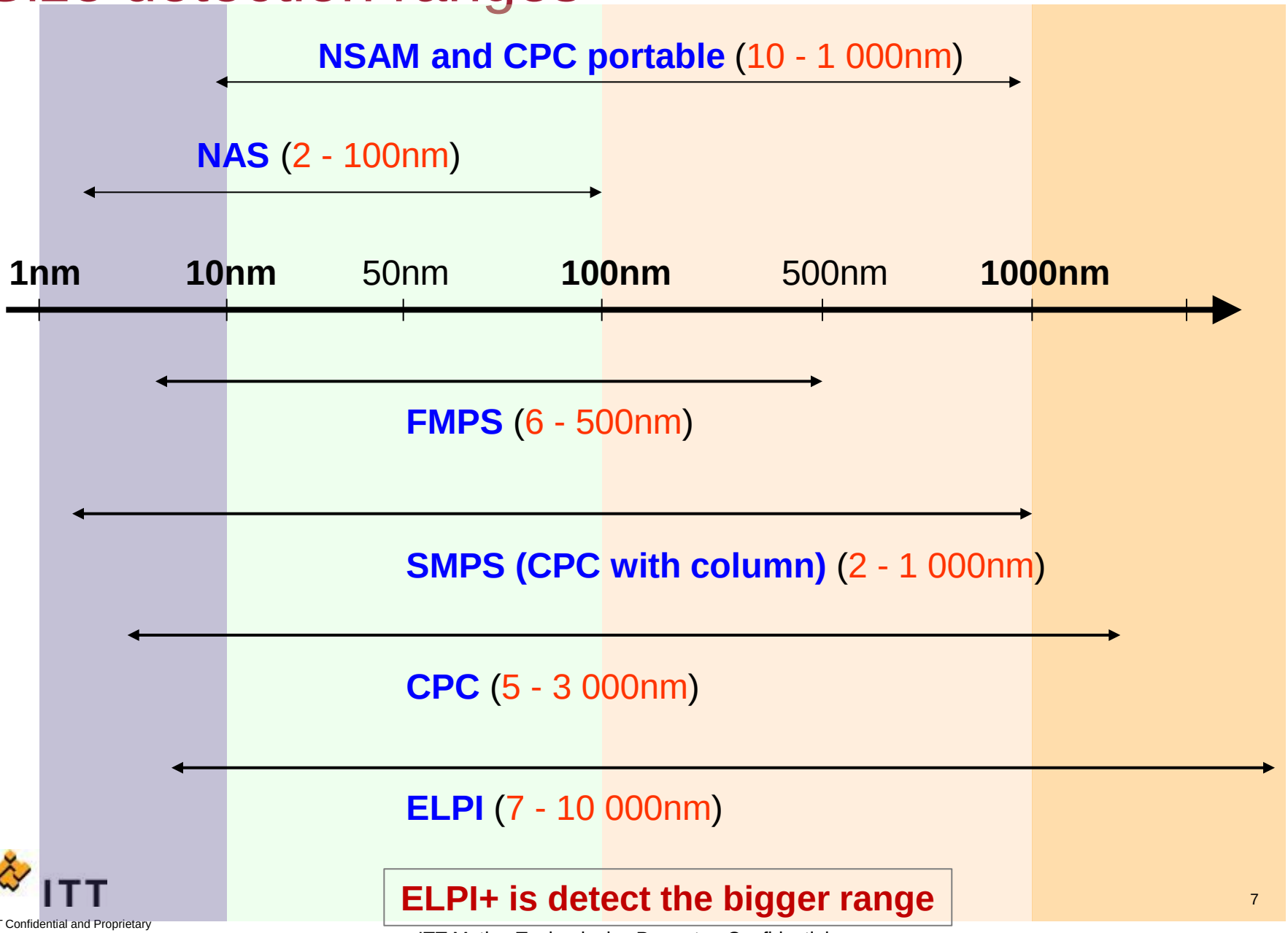
Nozzle to collect air to analyse



Dyno Characteristics

item	Description	ITT
1	airflow orientation	Vertical
2	maximum air speed / km/h	40
3	maximum air speed / m/s	11
4	maximum airflow / m^3/hr	2000
5	air speed/flow measurement	air inlet duct and upstream from brake
6	environmental control	no, only fresh air
7	airflow direction	up to down
8	main inlet duct	
a	shape	circular
b	height / mm	n.a.
c	width / mm	n.a.
d	**hydraulic diameter equivalent**	250
e	diameter for round duct / mm	250
9	duct entry to brake enclosure	
a	shape	circular
b	height / mm	n.a.
c	width / mm	n.a.
d	diameter / mm	250
10	brake enclosure	
a	shape	rectangular, closed box
b	width / mm	970
c	depth / mm	2530
d	height / mm	1555
11	main outet duct	
a	shape	round
b	height / mm	n.a.
c	width / mm	n.a.
d	**hydraulic diameter equivalent**	200
e	diameter for round duct / mm	200
12	main outet duct entry	
a	shape	rectangular
b	height / mm	165
c	width / mm	335
d	**hydraulic diameter equivalent**	**253**
e	diameter for round duct / mm	n.a.

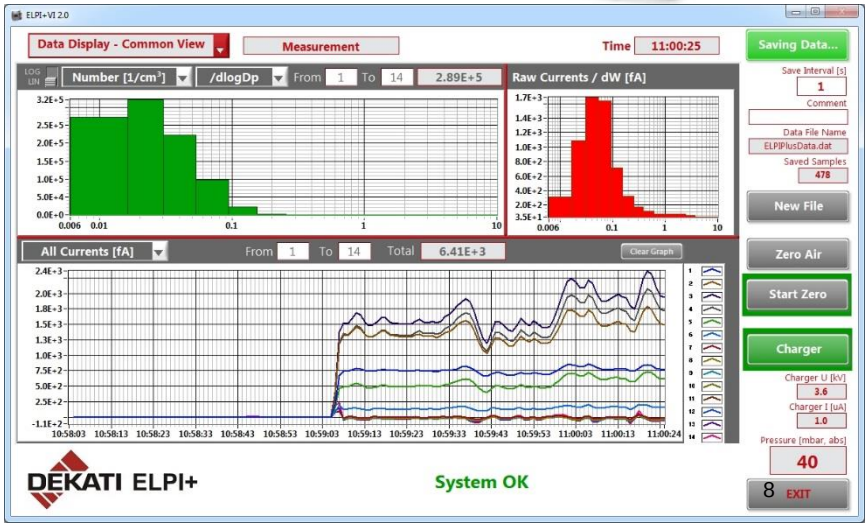
Size detection ranges



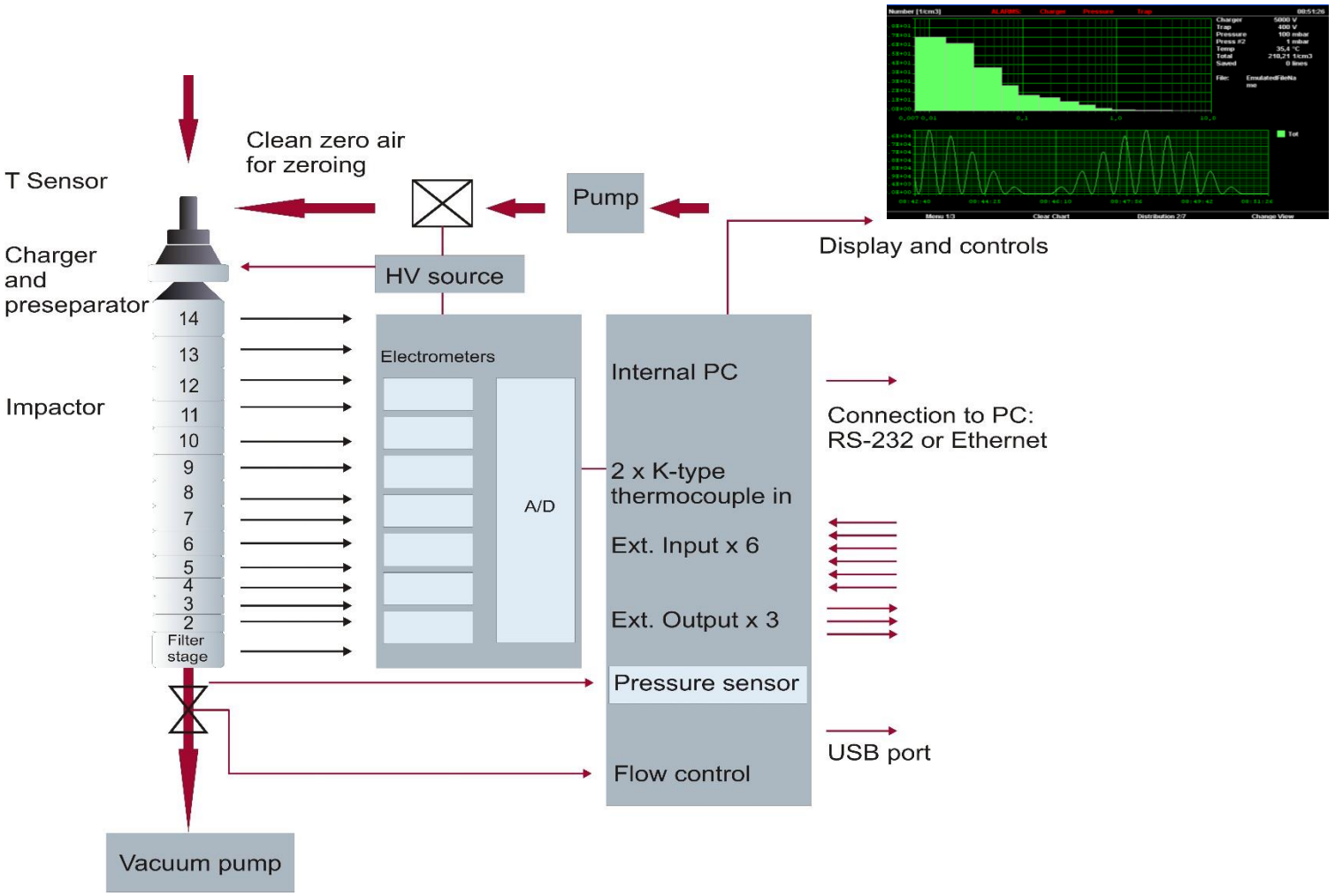
ELPI+ is detect the bigger range

ELPI®+: Electrical Low Pressure Impactor

- Number size distribution and concentration
  - Real-time, 10 Hz
- 6 nm - 10 µm
  - 14 size fractions
  - 100 or 500 with High Resolution ELPI®+
- Particles are collected
  - Possibility for chemical analysis on the collected samples
- Wide dynamic range
  - From outdoor air to power plant stack concentrations

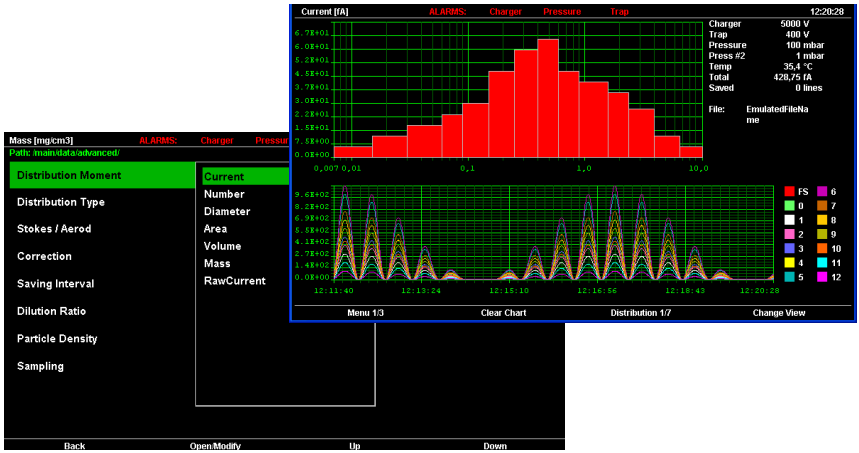


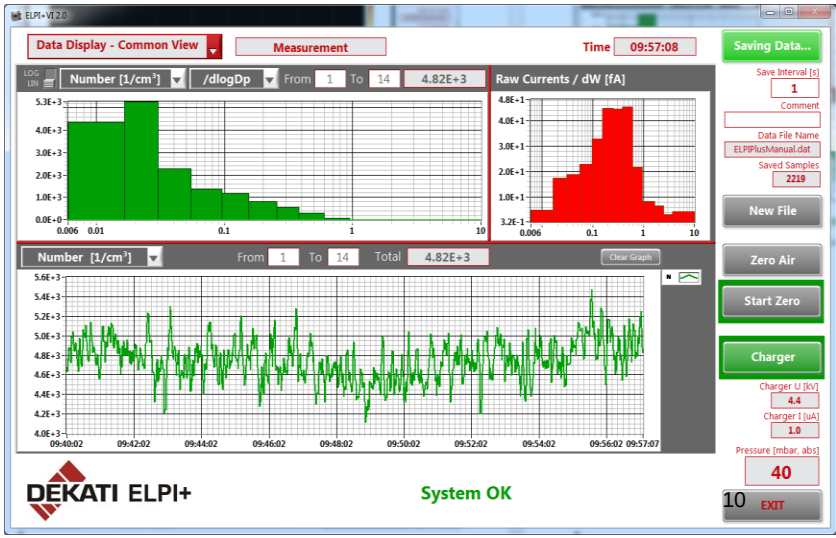
ELPI®+ Operating Principle



ELPI®+ Operation

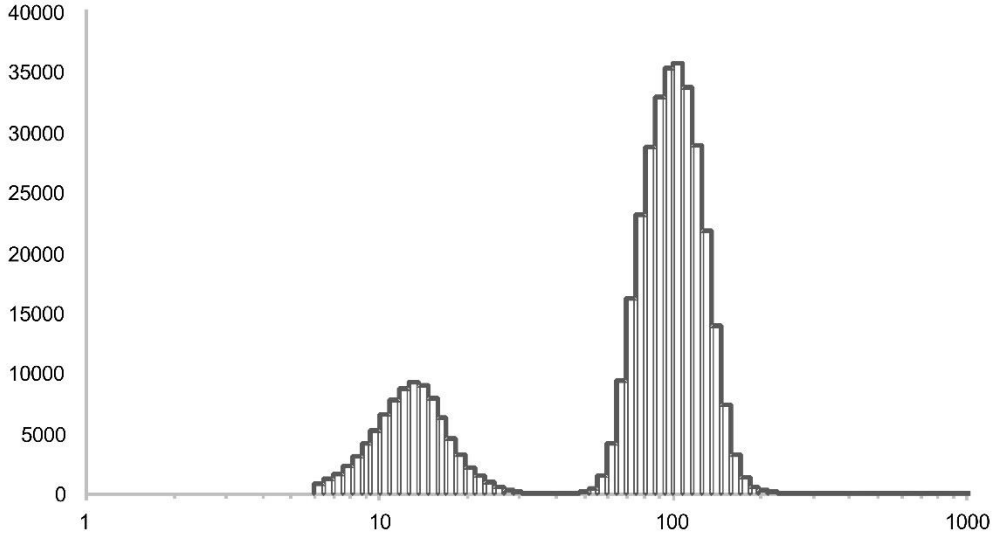
- Standalone operation
  - ELPI®+ unit display
    - See online data
    - Control the unit
    - Measure
    - Save the data
- Operation via laptop
  - ELPI®+VI software
    - Controls ELPI®+
    - Saves the data
    - Automatic Q/N and Q/M measurement

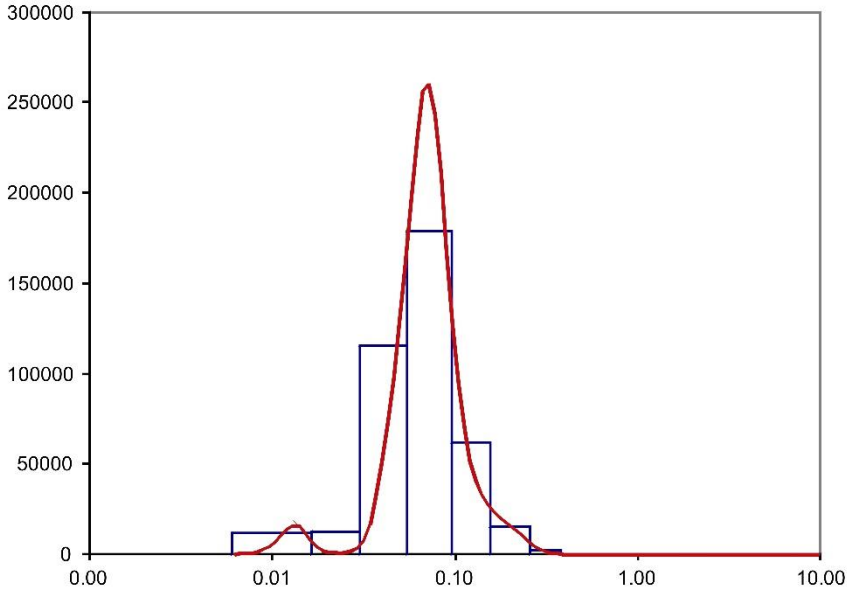




HR-ELPI®+ Calculation

- Inside HR-ELPI®+VI
- Data file format similar to ELPI®+
  - Either 100 or 500 size
- Data processing in HRELPI®+xls





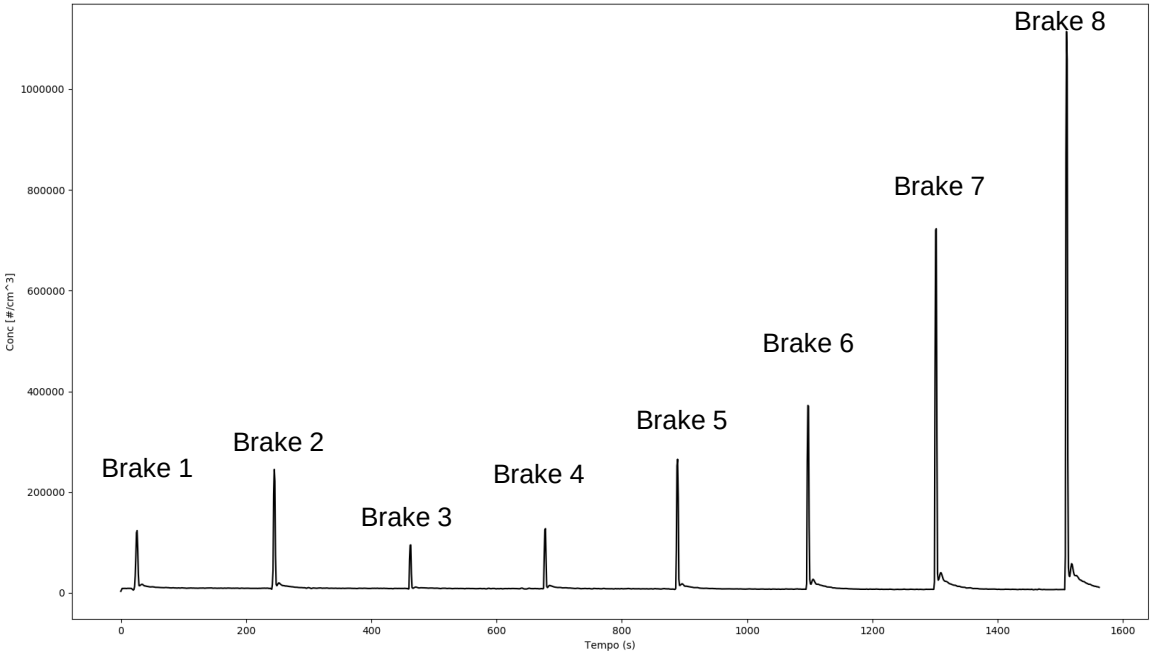
Data analysis with DEKATI done in ITT minidyno

Concentration for14 size fractions in function of different brake

Time

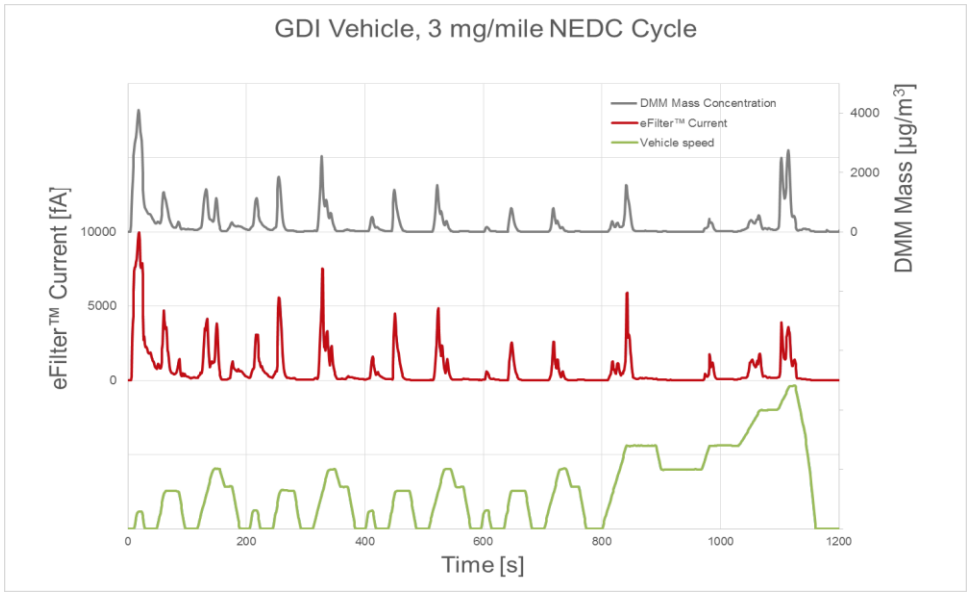
ch1	ch2	ch3	ch4	ch5	ch6	ch7	ch8	ch9	ch10	ch11	ch12	ch13	ch14
3.09E+03	2.36E+03	2.97E+03	4.37E+03	2.88E+03	9.38E+02	1.76E+02	9.14E+01	4.68E+01	2.67E+01	1.24E+01	7.77E+00	5.66E+00	4.70E+00
5.83E+03	4.66E+03	5.79E+03	8.61E+03	5.60E+03	1.70E+03	2.44E+02	1.14E+02	5.42E+01	2.99E+01	1.37E+01	8.38E+00	5.84E+00	4.63E+00
8.54E+03	6.74E+03	8.38E+03	1.24E+04	7.98E+03	2.29E+03	2.21E+02	7.92E+01	2.59E+01	1.28E+01	5.29E+00	3.20E+00	1.58E+00	1.03E+00
8.82E+03	6.94E+03	8.65E+03	1.29E+04	8.26E+03	2.32E+03	1.94E+02	6.34E+01	1.81E+01	8.78E+00	3.73E+00	2.42E+00	1.01E+00	6.64E-01
8.71E+03	6.93E+03	8.66E+03	1.28E+04	8.26E+03	2.31E+03	1.93E+02	6.32E+01	1.71E+01	8.38E+00	3.79E+00	2.42E+00	9.15E-01	5.72E-01
8.72E+03	6.90E+03	8.63E+03	1.28E+04	8.22E+03	2.30E+03	1.87E+02	6.03E+01	1.61E+01	8.56E+00	3.85E+00	2.43E+00	1.07E+00	6.61E-01
8.75E+03	6.87E+03	8.60E+03	1.28E+04	8.18E+03	2.28E+03	1.84E+02	5.89E+01	1.59E+01	8.33E+00	3.88E+00	2.52E+00	1.11E+00	6.08E-01
8.91E+03	6.88E+03	8.58E+03	1.28E+04	8.17E+03	2.27E+03	1.84E+02	5.95E+01	1.75E+01	1.03E+01	5.36E+00	3.62E+00	1.55E+00	7.81E-01
...	...	...	....	...	...	...	...	....	...	...	...	...	....

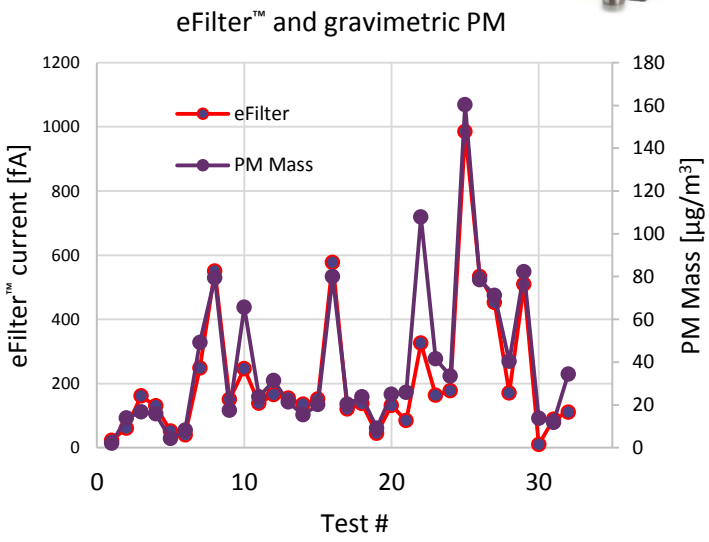
Ch1 counts for 8 brakes



eFilter™ :Total mass + real-time

- Standard gravimetric filter measurement
- Real-time signal throughout the filter sampling
- Real-time PM accumulation during different stages of the measurement





Contribution of PSA in PMP TF2

- PSA consists of PCD (Peugeot/Citroën/DS) and OV (Opel/Vauxhall)

- PCD
  - Thesis to allocate knowledge about measurement equipment and method
  - Doing tests and measurements with pin-on-disc bench
  - Working together with University Technology Compiegne UTC, INERIS and CETIM
  - Support of exhaust emissions experts

- OV
  - Leads the working relationship with ITT
  - Analyze brake pad emission in OV laboratory

- PSA contact for PMP is Olaf Bausch