Transnational Access Activity:	E2-2010-10-08-0047
PI:	Martin Gysel, PSI, Switzerland
Host Chamber:	AIDA, KIT, country code
Period:	2010.11.15 – 2010.12.03
Campaign name:	SOOT11
Coworkers:	Marie Laborde, PSI, Switzerland; Michael Flynn, Univ. Manchester, UK Jonathan Taylor, Univ. Manchester, UK Julie Cozic, LGGE, France Lucie Polo, LGGE, France.

Single Particle Soot Photometer (SP2) intercomparison campaign SOOT11

The AIDA chamber was selected for the SP2 intercomparison campaign due to KIT's expertise in producing and characterizing soot test aerosols including different types of combustion sources and the option to add coatings with secondary organic aerosol (SOA). Furthermore, the AIDA chamber makes it possible to provide soot test aerosols with a wide range of physical and chemical properties which are stable in time (except for slow coagulation). This would be very difficult to achieve with online combustion sources.
Typical experiments started with filling of the AIDA chamber followed by characterization of the fresh combustion aerosol with the SP2s and other instruments. Afterwards the aerosol in the AIDA chamber was exposed to aging processes such as coagulation, condensation of SOA and/or liquid cloud activation. The evolution and changes of the soot properties during and after the aging were followed by all available techniques. A detailed list of the experiments with SP2 measurements is provided in Table 1. The investigated aerosol samples include CAST (Combustion Aerosol STandard), diesel exhaust, reference black carbon materials, pure secondary organic aerosol and a volcanic ash sample.
The aim of the SP2 intercomparison campaign was to bring the European SP2 users together in order to:

- Exchange experimental expertise between experienced and new users.
- Harmonize instrument calibration.
- Compare data analysis procedures with a particular focus on secondary data products such as BC mass size distribution, optical size distribution of different particle types and determination of coating thickness.

The broader goal of this activity was to assure comparability of SP2 data from different research groups and to improve accuracy of reported primary data (e.g. BC mass concentration) and derived data products (e.g. mass absorption coefficient) obtained by combining SP2 data with absorption measurements (photo-acoustic soot spectrometer and Aethalometer) also available in this project.
All experiments were done as planned and all main goals could be achieved. The exchange between the different research groups was stimulating and fruitful. Furthermore, the results are very promising. As an example Figure 1 provides a comparison of the black carbon core mass size distributions as measured by all six involved SP2 instruments for a CAST soot aerosol. Differences between the individual instruments were smaller than ~20% for total mass and modal diameter.
There are no plans for another SP2 intercomparison-campaign in the immediate future as it is more important to analyse the huge amount of data acquired during all experiments and to publish the

major outcomes first. After that a follow-up campaign targeting on the remaining open questions for soot measurements will certainly be desirable.
First results from the SP2 intercomparison at AIDA during SOOT11 will be presented with several contributions to the 10th International Conference on Carbonaceous Particles in the Atmosphere (Vienna, June 2011) and to the forthcoming European Aerosol Conference (Manchester, September 2011). ThPhD students involved in this project will include some results in their PhD theses. Preparation of peer reviewed publications is currently in progress covering the following topics:

- Detailed comparison of all important SP2 data products for all involved SP2 instruments.
- Optical properties of the combustion aerosols as measured by the photo-acoustic soot spectrometer, cavity ring down spectrometer, aethalometer, particle soot absorption photometer and nephelometer instruments.
- Mass closure study including filter-based, SP2 and SMPS measurements in combination with model results.
- Optical properties of the volcanic ash sample.

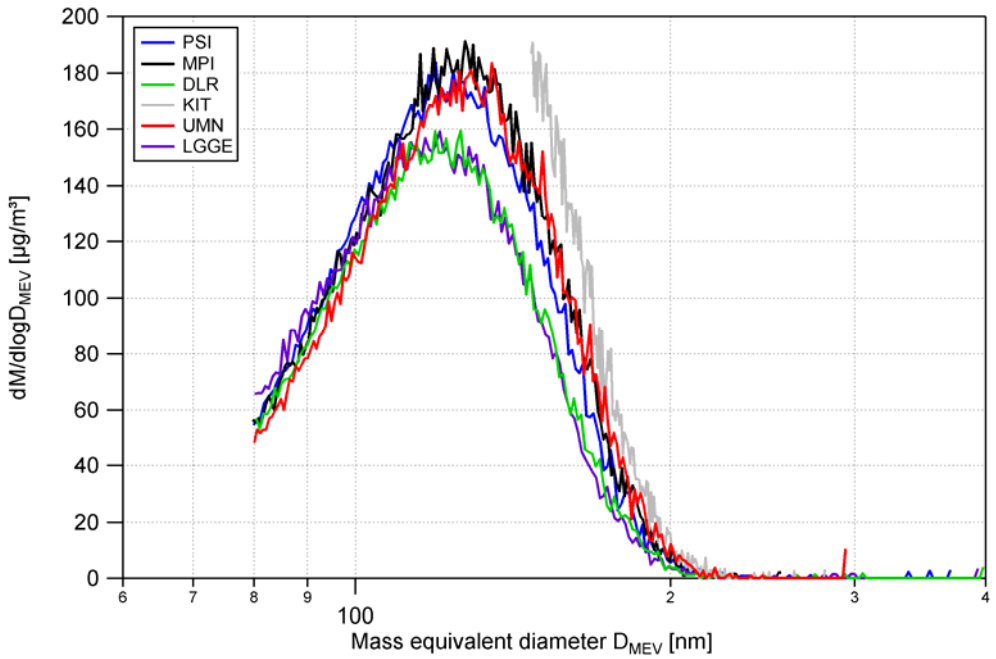

Figure 1: Comparison of BC core mass size distributions as measured by all 6 SP2 instruments.

Table 1: List of experiments conducted with SP2 instruments.

Date	AIDA / SP2 instruments
Mon, 15	• Set up of aerosol generators, DMA and dilution. • Set up of SP2 instruments (adjustment of the particle beam and the split detector with PSL particles).
Tue, 16	• Fullerene soot calibration of SP2 instruments.
Wed, 17	• CAST soot C/O rato 0.29. • PSL calibration of SP2 instruments.
Thu, 18	• CAST soot C/O 0.29 + stepwise coating with SOA
Fri, 19	• CAST soot C/O 0.4 + stepwise coating with SOA.
Mon, 22	• Cloud processing of CAST aerosol: repeated liquid cloud activitions.
Tue, 23	• Long term coagulation experiment with CAST soot (C/O=0.29). • Aquadag calibration of SP2 instruments.
Wed, 24	• Continue long term coagulation experiment + coating of the remaining particles with SOA.
Thu, 25	• Homogeneous nucleation of SOA and subsequent coagulation with CAST soot (C/O=0.29).
Fri, 26	• Volcanic ash and subsequent coagulation with CAST soot (C/O=0.4)
Mon, 29	• Diesel engine soot (2000 rpm, 82 Nm). SP2 measurements before and after cloud activation.
Tue, 30	• AIDA: Diesel engine soot (2000 rpm, 195 Nm). SP2 measurements before and after cloud activation. • Online diesel exhaust measurements at different operating conditions. • PSL calibration of SP2 instruments.
Wed, 1	• AIDA: Diesel engine soot (2000 rpm, 195 Nm) • Online diesel exhaust measurements at different operating conditions. • Fullerene soot calibration of SP2 instruments.
Thu, 2	• AIDA: Diesel engine soot (2000 rpm, 82 Nm) + coating step with SOA. • NAUA: Diesel engine soot (2000 rpm, 82 Nm) + coating step with SOA. • Online diesel exhaust measurements at different operating conditions. • PSL calibration of SP2 instruments.
Fri, 3	• AIDA (-59°C): Diesel engine soot (2000 rpm, 82 Nm). • Online diesel exhaust measurements at different operating conditions.