

## Wide Range Aerosol Spectrometer

SMPS+C Condensation Nucleus Counter, Model #5.400 with Classifier  
 "Vienna"-Type DMA, Model #5.500 and Portable Aerosol Spectrometer, Model #1.108/1.109



### ■ Motivation

Gravimetric measurements have shown, that the entire part of the mass of fine dust below  $0.5 \mu\text{m}$  makes not even 1 percent. But, if the particles are counted, 80 % of all particles are in the size range below  $0.5 \mu\text{m}$ . It is not obvious if the particle number or the particle mass has a greater effect on the human health. Therefore it would be very desirable to have a device, which is able to measure particles over a wide size range.

### ■ Solution

GRIMM has developed a new measuring system, which consists of two particle counters and sizers: The GRIMM #5.400 SMPS+C and the GRIMM #1.108 or #1.109 Portable Aerosol Spectrometers.

The GRIMM SMPS+C consists out of the high resolution CPC

### ■ Measurement Principle

#### The Portable Aerosol Spectrometer:

It provides single particle count and size classification in real time. The sample air with various size particles is drawn constantly through the flat light beam, produced by a focused laser diode. Each scattered signal from a single particle is detected by 90 degree by a high-speed photo diode, so particle colour changes can be neglected. Each signal is then counted and classified in 15/31 different size channels by an integrated pulse height analyser. These counts can be shown each second, six seconds or

each minute on an attached computer.

#### DMA:

A clean volume of controlled air enters the air inlet, this assures a clean air flow around the high voltage rod. The sample air, passing an impactor and neutraliser enters the sample air inlet at the outer wall. When voltage is supplied to the rod the particles are separated according to their electrical mobility. Only particles with the appropriate charge and size travel to the inner rod and into the sample air outlet, entering the Condensation Particle Counter as mono-disperse aerosols.

#### CPC:

The aerosols enter via the sampling tube to the Saturator, where they cross a heated ( $35^\circ\text{C}$ ) N-butyl-alcohol saturation pipe. There the aerosols are exposed to the alcohol vapour. Particles and vapour then flow into the cooling condenser unit ( $10^\circ\text{C}$ ), where the supersaturated vapour condenses on all the particles as they pass through. This process increases the particle size. These droplets then cross a laser beam of light optic where each droplet scatters light onto a photodiode. These signals are continuously counted and are expressed in particles/ $\text{cm}^3$  each second on the LCD. These counts are then stored as data and also transmitted via the RS-232 to an external data acquisition device.

With this system of the combination of two particle counters it is possible to measure the particle size distribution over a very wide range. The coarse particles ( $> 0.5 \mu\text{m}$ ), which determine the total mass of aerosol particles, are counted as well as the smaller particles ( $< 0.5 \mu\text{m}$ ), which determine the total number of the aerosol particles. So this system is mobile and suitable for testing the aerosol quality under all conditions.

## Application

The WRAS is the perfect solution for many applications, where the whole size distribution of the aerosol particles is of interest. Not only for measurements in environmental networks and for climatic research activities, but also for air quality monitoring in production processes and workplace safety measurements.

## Specification

### Counter-CPC

- All-in-one real-time counter from 5 nanometers upwards
- Able to count up to  $10^7$  particles/ccm
- Data display in counts per ccm
- Data storage via a memory card
- Data updates every second on the LCD
- Direct computer access via RS-232 port
- 4 LED instrument condition with 3 colour status modes
- Integrated N-butyl-alcohol bottle with liquid level
- Indication and fill/drain port
- Integrated odour removal absorber air filter
- Port for 3 optional analogue climatic (or gas) sensors
- Portable, battery operated
- Integrated flow and temperature control system
- Integrated lead battery and charger for 5 h (#5.403 only)
- Various power supplies 110/220 VAC, 50 or 60 Hz
- Classifiers can be attached (S-DMA, M-DMA, L-DMA) and are automatically identified and controlled
- Powerful 32-bit WINDOWS data acquisition program

### Publication

- Wileke, K., and Baron, P.A., (1993), *Principles, Techniques, and Applications*, John Wiley & Sons, New York
- Reischl, G.P., (1991), *Measurement of Ambient Aerosols by the Differential Mobility Analyzer Method: Concepts and Realization Criteria for the Size Range between 2 and 500 nm*, *Aerosol Sci. Tech.* 14, 5-24



\* picture by Degussa

## Wide Range Aerosol Spectrometer

### Classifier-DMA

- Up to 255 different size channels (for size distribution analysis, e.g. M-DMA: 5 to 350 nm)
- Can make a complete "fast scan" from 5 to 350 nm in less than 110 seconds

### Aerosol Spectrometer

Size range:	0.25 to 32 $\mu\text{m}$ , 31 size channels (#1.109) or 0.3 to $> 20 \mu\text{m}$ , 15 size channels (#1.108)
Dust mass:	0,1 to $> 100000 \mu\text{g}/\text{m}^3$
Measurement:	0.1 min. or 1 min.
Continuous results:	0.1 min. or 1 min.
Sample-flow:	72 l/h, volume controlled
Clean rinsing air flow:	0.2 l/min.