# MESURE PAR DISTRIBUTION DE LA TAILLE DES NANOPARTICULES AVEC LE PARTECTOR 2

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## PARTICLE SIZE DISTRIBUTION MEASUREMENT WITH THE PARTECTOR 2

## RESUME

Le moniteur de nanoparticules Partector 2 de naneos utilise un chargeur corona unipolaire remontant les informations suivantes: la surface de dépôt dans les poumons, le diamètre moyen des particules, le nombre de particules, la surface et les concentrations en masse. Bien que cette méthode soit déjà utilisée sur le terrain depuis plusieurs années, il a été décidé d'étudier s'il était possible de créer une mesure améliorée de la distribution des tailles sans utiliser un écart-type géométrique spécifique comme hypothèse. La nouvelle méthode consiste à utiliser des variatons de tensions de précipitation. Cet article a pour but de présenter les résultats de ce nouveau mode d'opération en comparant les distributions de taille rapportées par un Scanning Mobility Particle Sizer et celles d'un Partector 2.

## ABSTRACT

The naneos Partector 2 nanoparticle monitor uses a unipolar corona charger and reports lung-deposited surface area, average particle diameter, particle number, surface and mass concentrations. Although already on the field since several years, it has been decided to investigate whether it is possible to create a proper size distribution measurement without using a specific geometric standard deviation as assumption. The new method consists in using multiple different precipitation voltage. This article aims to present the results of this new mode of operation by comparing size distributions information reported by a Scanning Mobility Particle Sizer and those of a Partector 2.

**MOTS-CLÉS**: instumentation, nanoparticules, taille, distribution / **KEYWORDS:** instrumentation, nanoparticle, size, distribution

## INTRODUCTION

The naneos Partector 2 handheld nanoparticle monitor was introduced a few years ago and uses electrical particle detection to report lung-deposited surface area, average particle diameter, particle number, surface and mass concentrations. Internally, the Partector 2 uses a unipolar corona charger followed by two electrical detection stages; the two stages are separated by an electrostatic precipitator (cf. **Error! Reference source not found.**). The precipitator preferentially removes smaller particles with higher mobility, and thus the ratio of the two electrometer signals contains information on the average particle diameter.

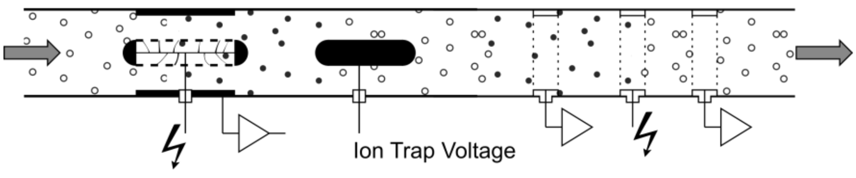

Figure 1. Scheme of the Partector 2

In the Partector 2's normal mode of operation, the precipitation voltage is kept constant, and the ratio of the two measured electrometer signals is used to compute an average particle diameter under the assumption that the particle size distribution is lognormal with a geometric standard deviation $\sigma$ of 1.9. This usually works well – however, if $\sigma$ is far from 1.9, the diameter calculation is systematically wrong.
We have therefore investigated whether it is possible to create a proper size distribution measurement without using assumptions by using multiple different precipitation voltages.

## METHODS

The firmware of the Partector 2 was adapted to step periodically through either 3 or 4 different precipitation voltages. As a result of one such voltage scan, we now have either 4 or 5 electrometer signals characteristic of the aerosol – the signal of the first electrometer, plus 3 or 4 signals of the second electrometer corresponding to the different precipitation voltages used. The total scan time is determined by the integration time per precipitation voltage, the necessary settling time between voltage steps, and the number of different precipitation voltages used. For typical values, it takes 24 seconds to complete one full scan. We use a data inversion algorithm to produce a particle size distribution with 8 size classes of diameters 10...300nm. From this size distribution, the usual characteristic values such as total particle number, geometric standard deviation, average particle diameter etc. can be determined.

To test the performance of this new mode of operation, we compared the results obtained by it with size distributions as reported by a scanning mobility particle sizer (SMPS, TSI 3082/3775), and those of a standard Partector 2. In the laboratory, we produced aerosols of increasing sizes with a tube furnace to test the data inversion algorithm over the entire size range of 10-300nm; further long-term measurements in an ambient monitoring station are ongoing.

## RESULTS

The figure (cf. Figure 2) shows a typical result from a laboratory experiment, where a box of 1m3 volume is filled sequentially with furnace-generated aerosol of increasing size.

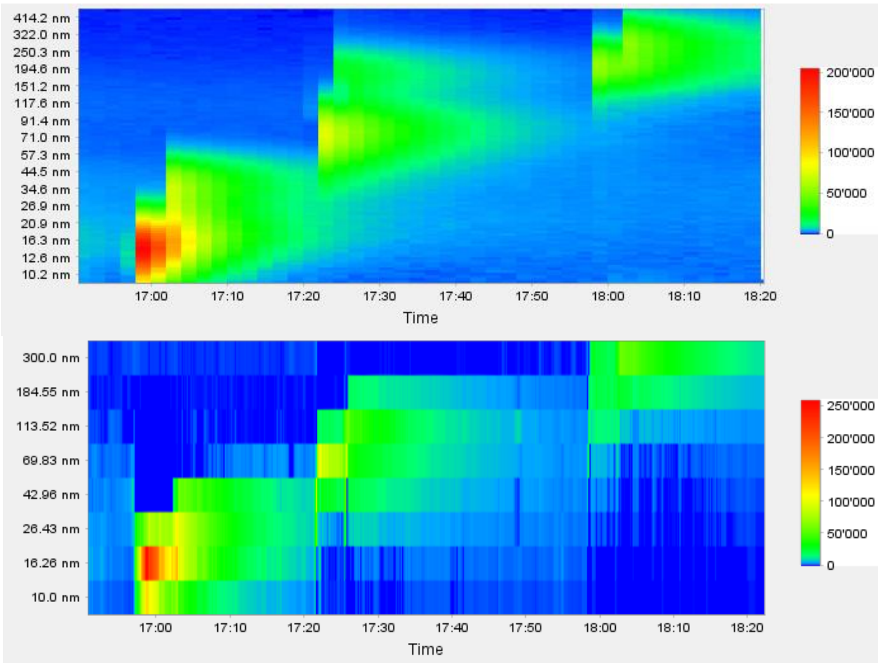


Figure 2. Size distributions in the laboratory experiment as function of time, for SMPS (top) and Partector 2 (bottom)

## DISCUSSION/CONCLUSION

First results using the Partector 2 to measure particle size distributions are encouraging. In particular, it appears that the artefacts that appear for aerosols far away of the standard Partector 2 assumption of $\sigma = 1.9$ (e.g. monodisperse aerosols) are no longer present. However, like many sizing devices, the new mode of operation has the disadvantage of a lower time resolution due to the scan time.

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