

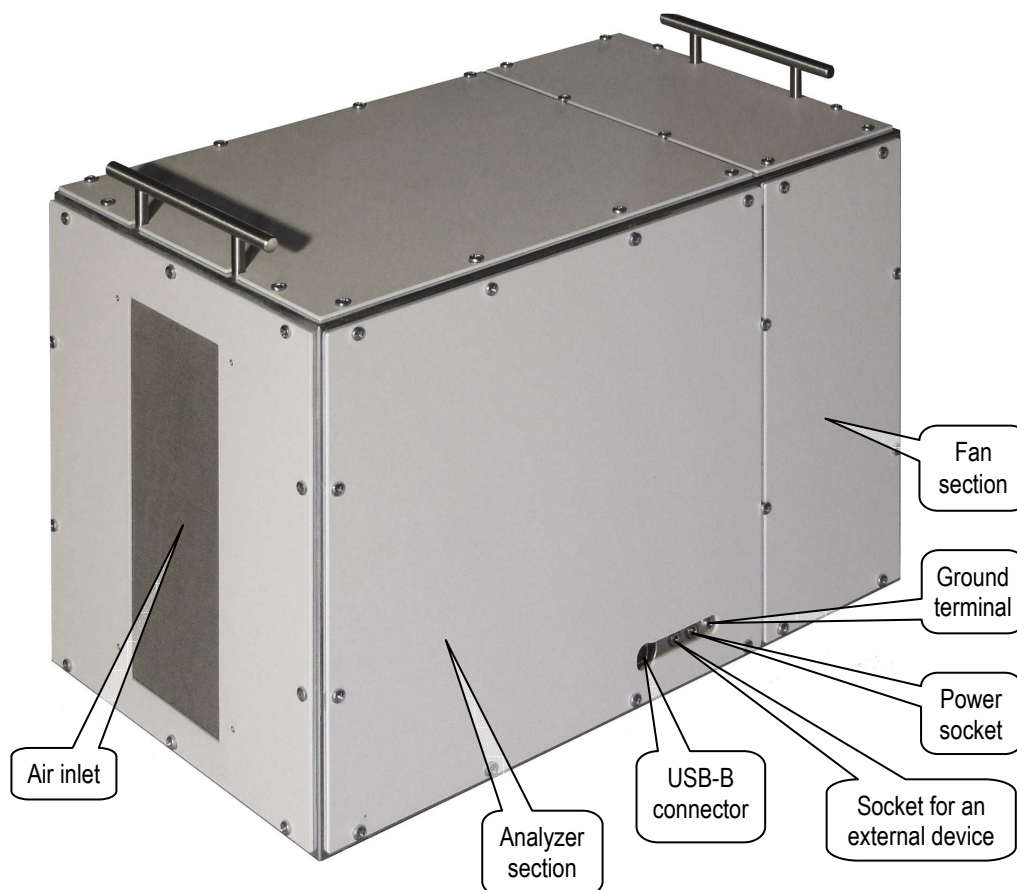
INTRODUCTION to SIGMA

for readers who are familiar with BSMA

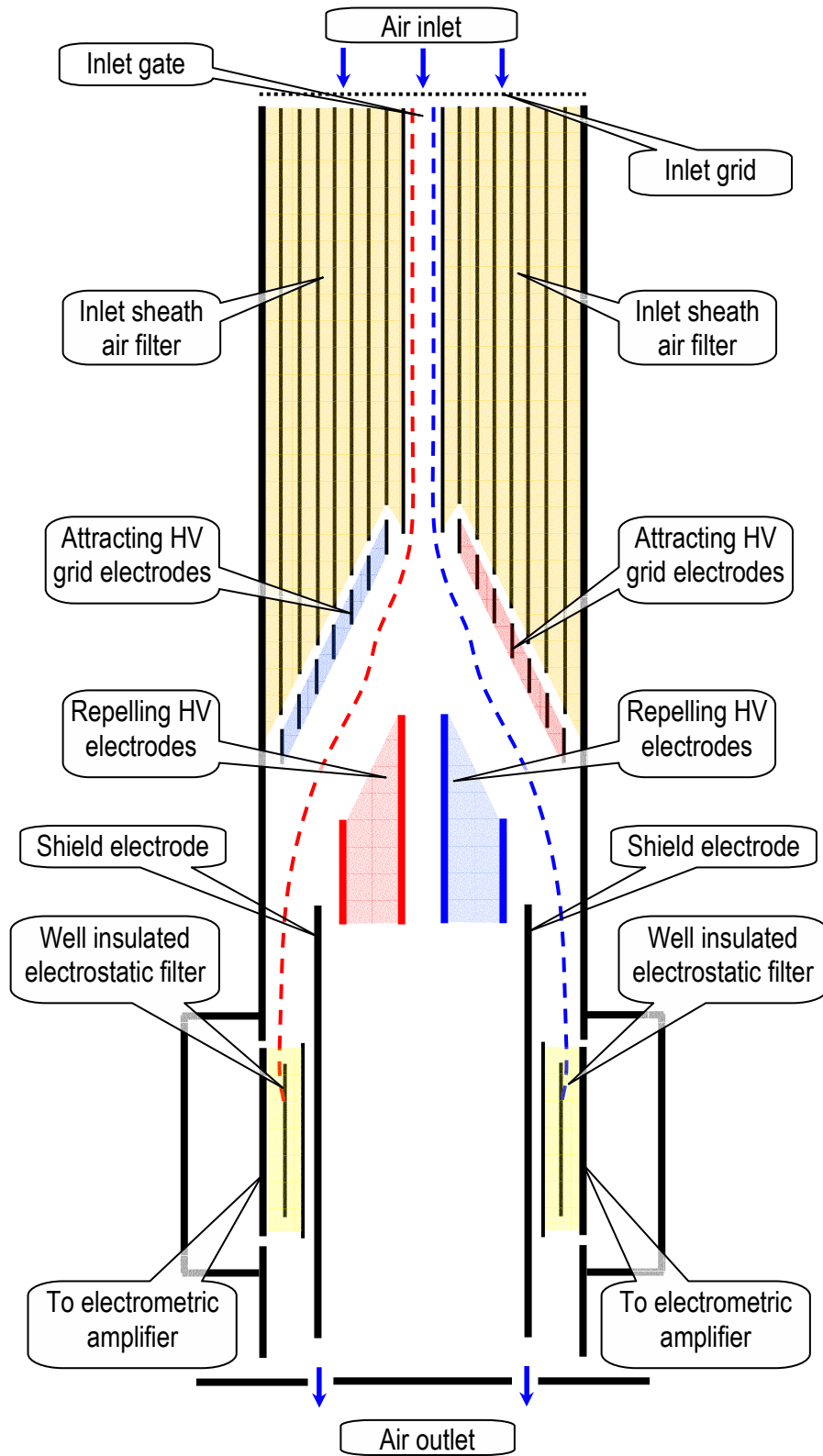
(for additional information see <http://ael.physic.ut.ee/tammet/sigma>)

The Symmetric Inclined Grid Mobility Analyzer SIGMA is a successor of scanning mobility analyzers IGMA (Inclined Grid Mobility Analyzer) and BSMA (Balanced Scanning Mobility Analyzer). It is developed for atmospheric nanometer aerosol research in the size range of 0.4–7.5 nm and the mobility range of 0.032–3.2 cm²V⁻¹s⁻¹ and optimized for the measuring of low concentration nanometer particles. Some distinctive properties of the instrument are:

- The positive and negative air ions are sampled from the same inlet air flow and measured exactly simultaneously.
- The sheath air is sucked into the instrument directly from the atmosphere together with the analyzed air and ions pass during the analysis only the unaffected atmospheric air.
- Passage time of ions during measurement is about 0.1 s and heating of air less than 0.3 K.
- High flow rate of about 36 dm³/s suppresses the disturbing effect of external electric field and assures representative sampling of the ions from the atmosphere.
- Low inlet loss of ions enables reliable estimating and numerical compensation of ion fraction concentrations.
- Temperature and pressure sensitive calibration coefficients are operatively adjusted during the measurement according to the readings of built-in meteorological sensors.
- The sensitivity of the instrument to low concentration of intermediate ions and the time resolution are essentially improved when compared with BSMA.

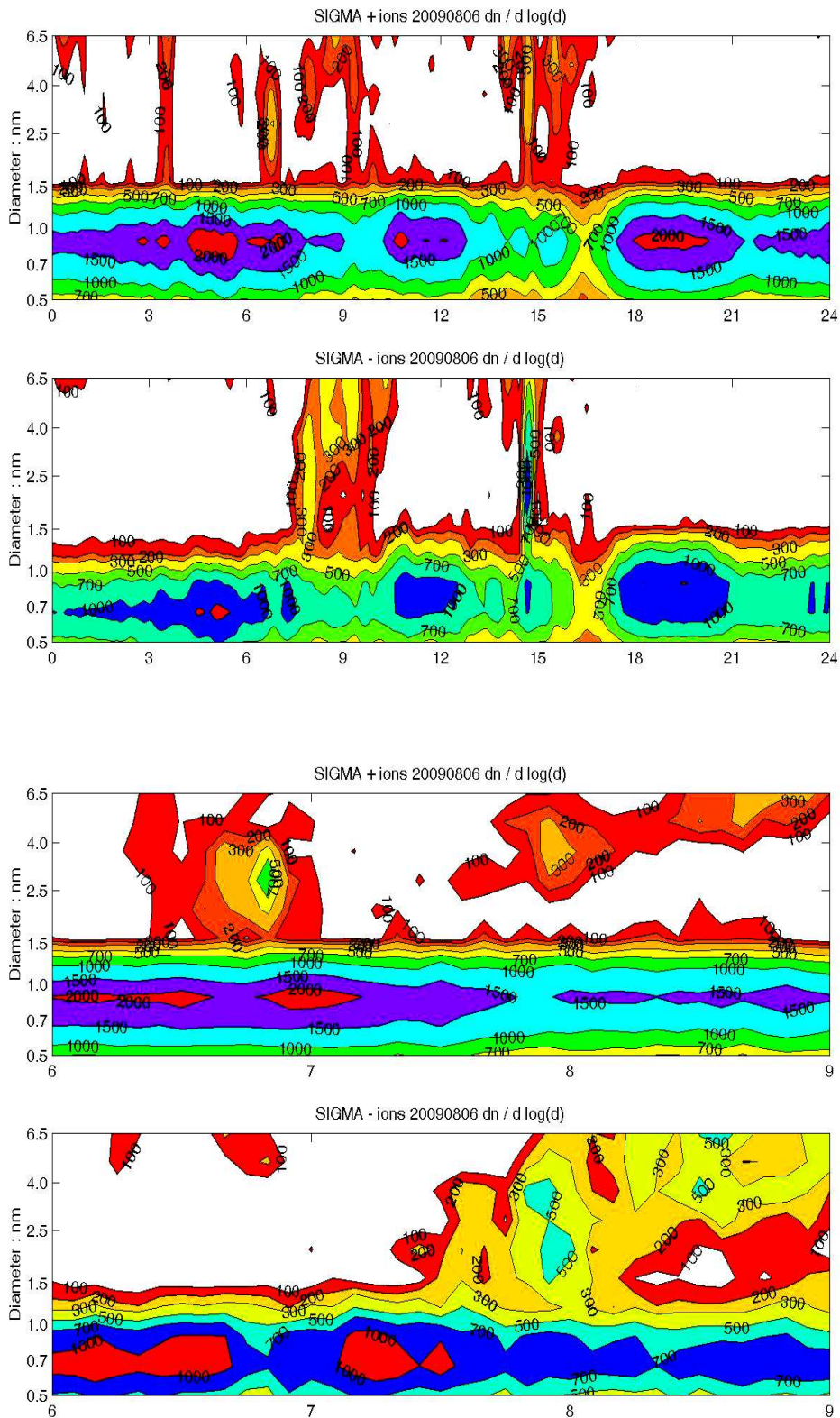


A simplified diagram of SIGMA (M1:2)



Dotted lines are two air ion trajectories. Positive ions are deflected to the left and negative to the right. Sheath air filter voltage is 520 V. Voltages of the attracting and repelling deflection electrodes are relaxing from 3000 to 25 V during every 19 second scan. Electrostatic filter collectors are supplied from 240 V internal batteries.

Example of a measurements at Tammemäe



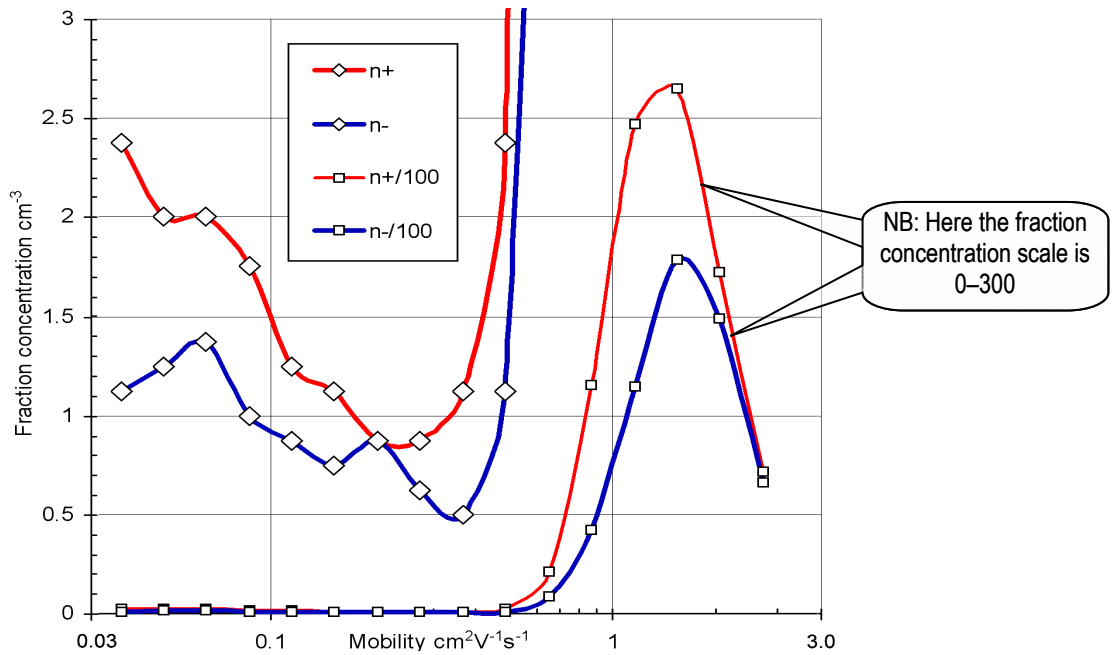
Burst of positive particles between 06:30 and 07:00 is of unknown origin.

Burst beginning about 07:30 is a typical nucleation event.

Burst about 15:00 is a typical rain event.

Demonstration of sensitivity

Mobility distribution presented by fraction concentrations measured at Tammemäe 20090920 from 16:00 until 24:00, a period without nucleation events.



Demonstration of 20 second time resolution

Wide size fraction concentrations of ions during a water jet experiment in the laboratory. Blue lines show **negative** and red lines **positive** ions.

