Electrostatic Aerosol Measurement of High Efficiency Separation Systems
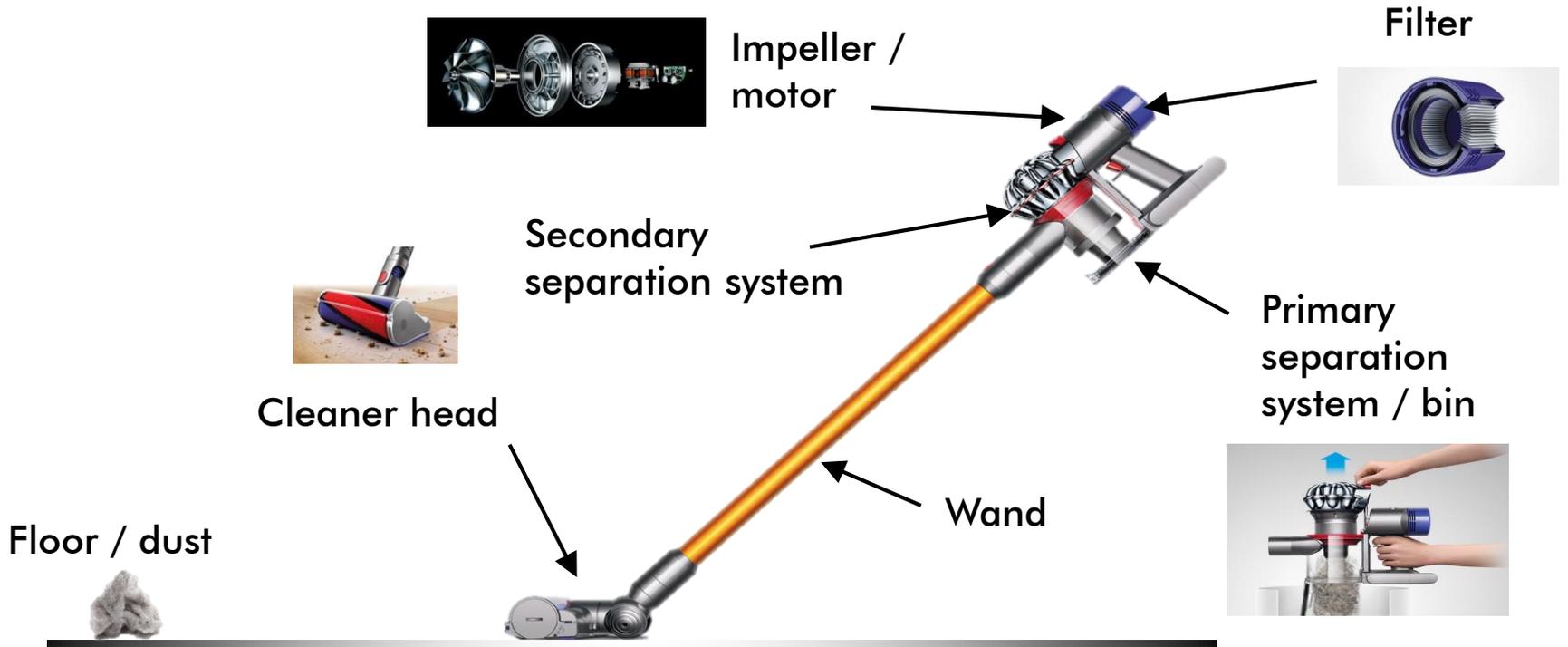
Tom Grimble
Dyson Technology Ltd.

Dyson Product Range
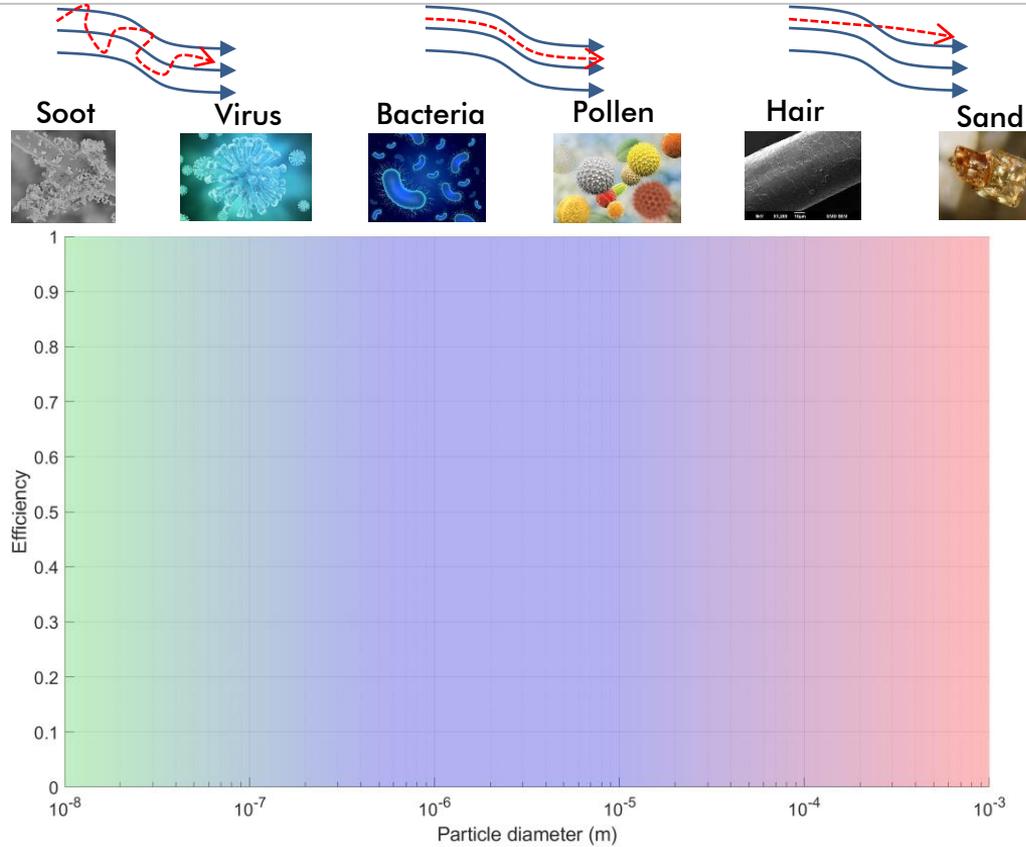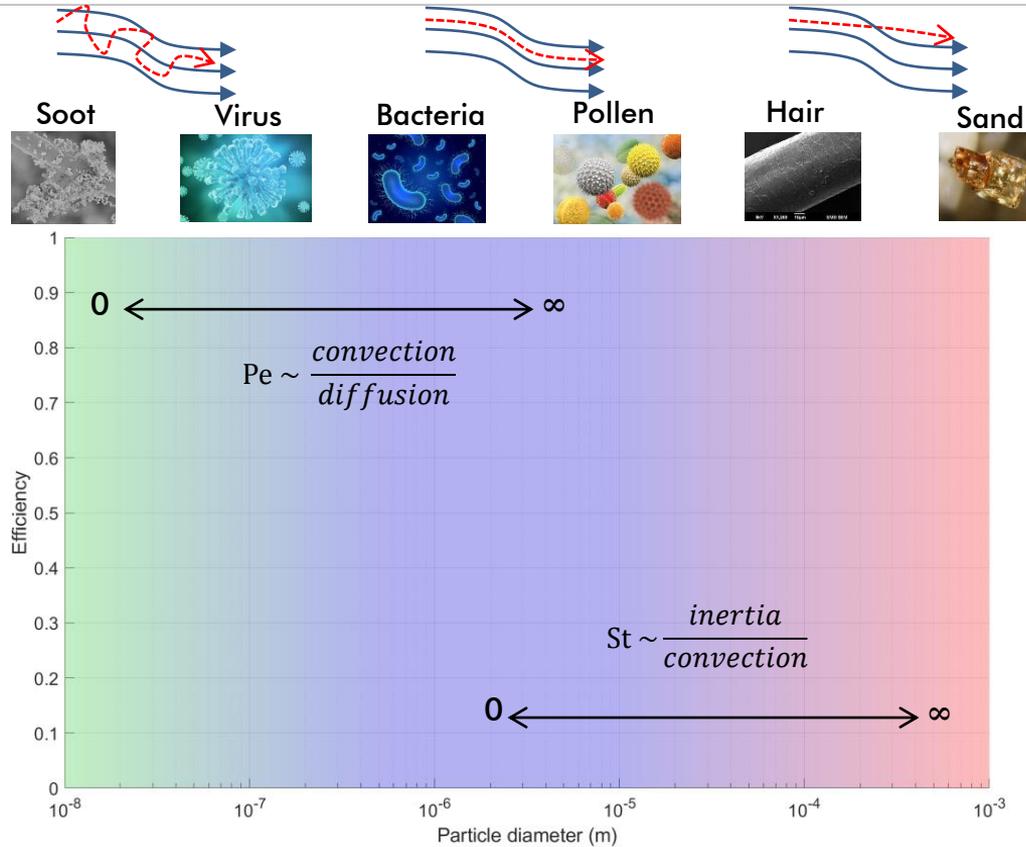
Dyson Floorcare Technology

Impeller / motor

Filter

Secondary separation system

Primary separation system / bin

Cleaner head

Floor / dust

Wand

Particle behaviour

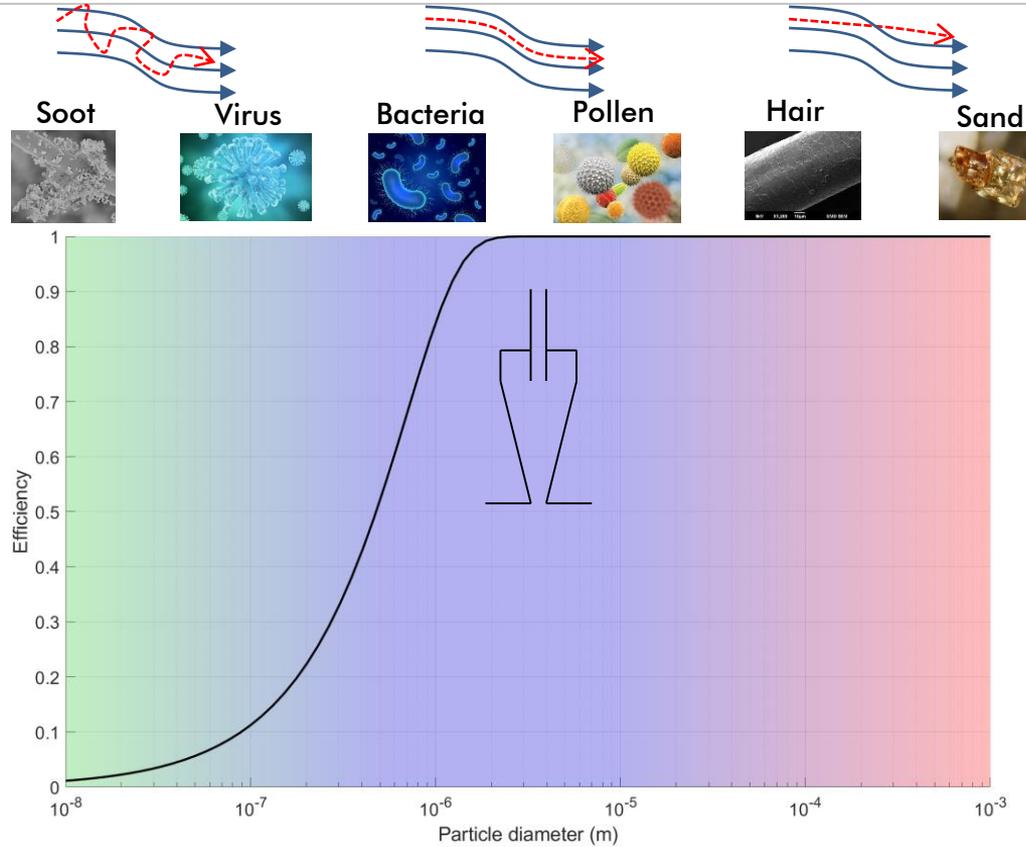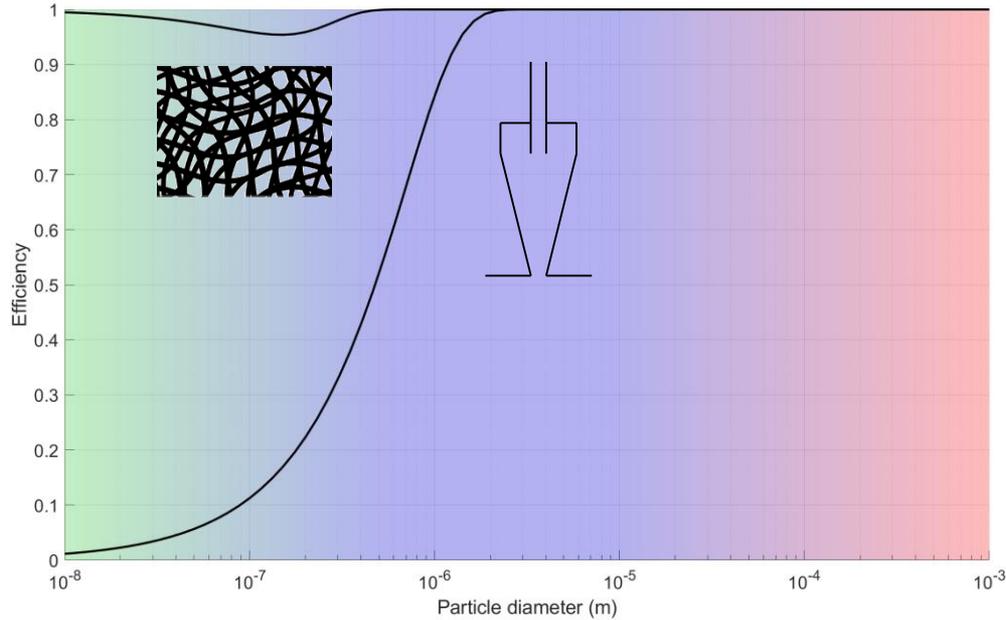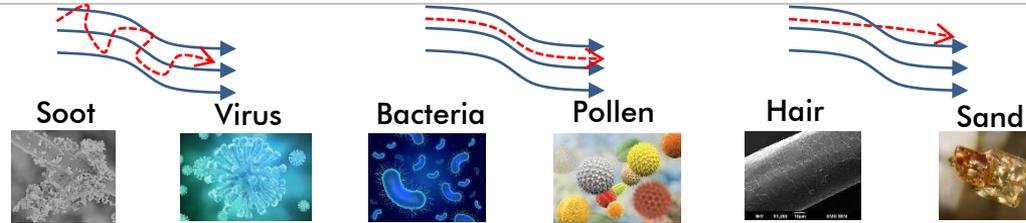Soot Virus Bacteria Pollen Hair Sand

Efficiency vs Particle diameter (m)

Particle behaviour

Particle behaviour

Particle behaviour
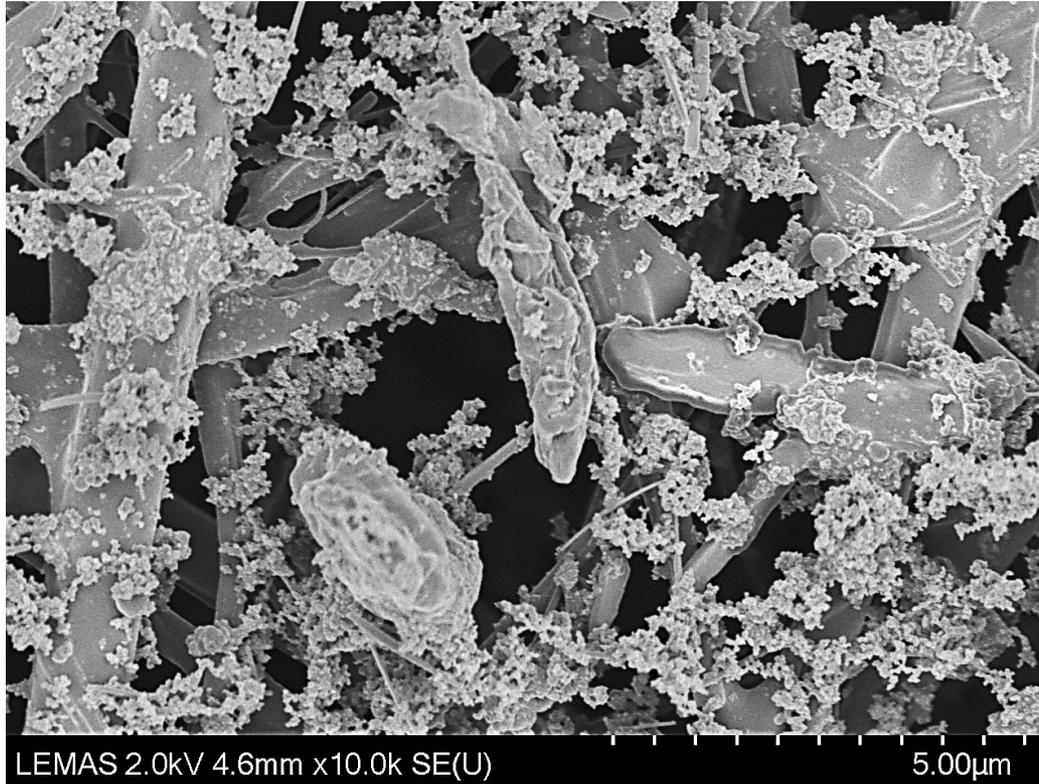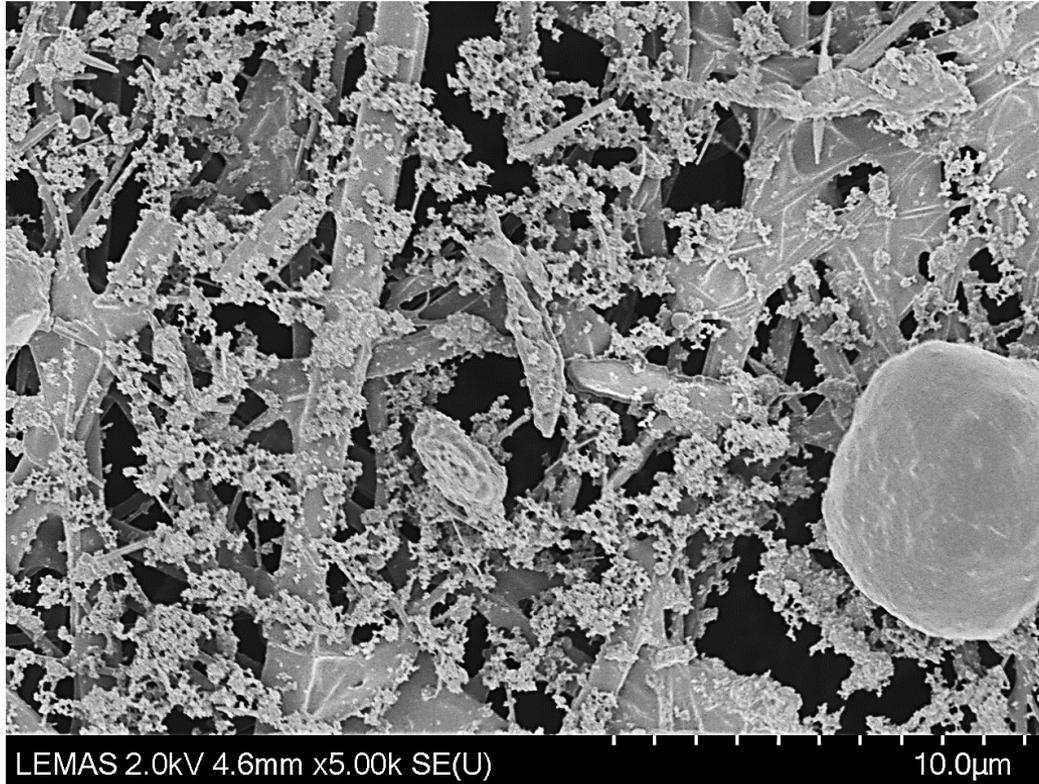
Soot   Virus   Bacteria   Pollen   Hair   Sand

Efficiency

Particle diameter (m)

10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3}

Household Aerosols

LEMAS 2.0kV 4.6mm x50.1k SE(U)   1.00μm

Household Aerosols

LEMAS 2.0kV 4.6mm x25.0k SE(U)   2.00μm

Household Aerosols

LEMAS 2.0kV 4.6mm x10.0k SE(U)   5.00μm

Household Aerosols

LEMAS 2.0kV 4.6mm x5.00k SE(U)   10.0μm

Household Aerosols

LEMAS 2.0kV 4.6mm x1.00k SE(U)   50.0µm
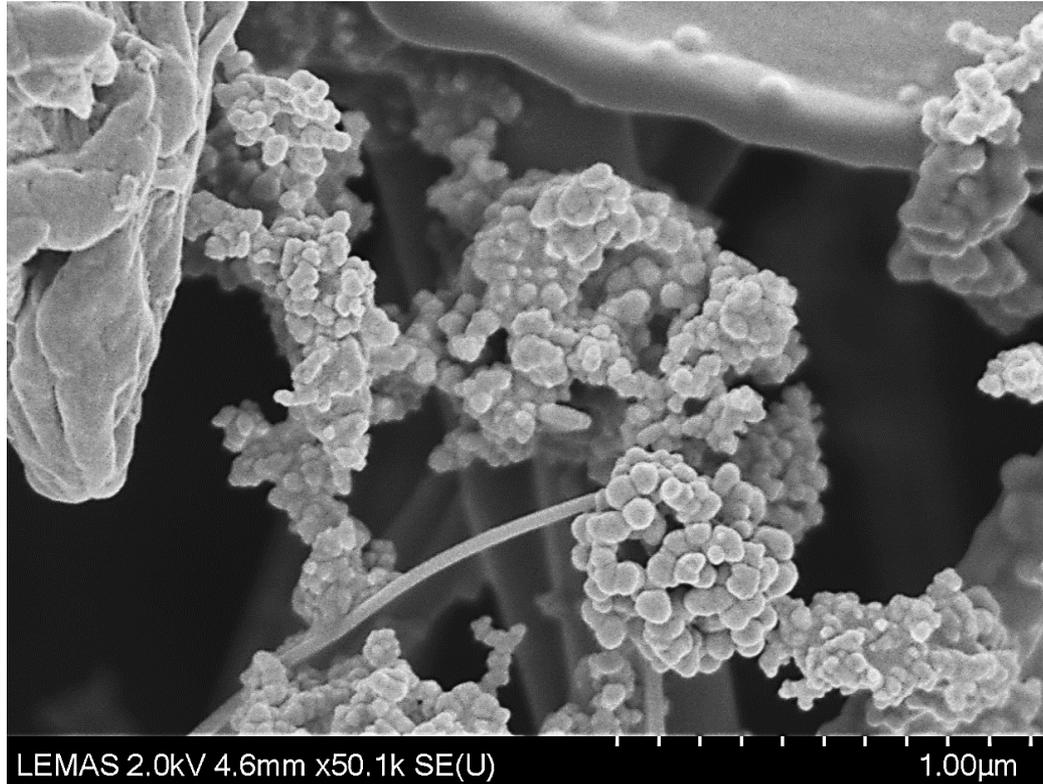
Simulated Test Dusts
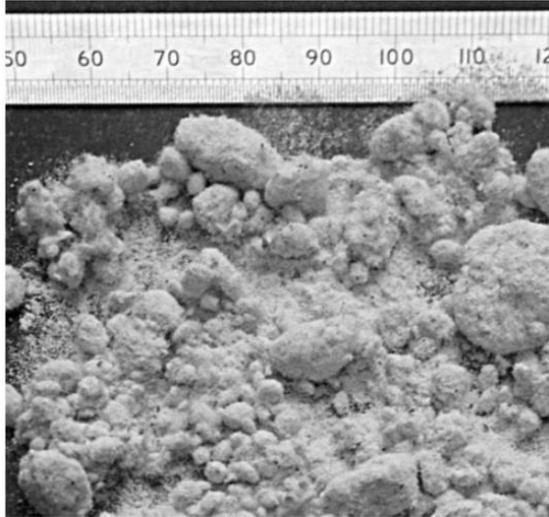
IEC

- **Mineral Dust**
- **Cellulose**
- **Cotton Lint**

DMT Group

BES 17kV   WD12mm SS38   10Pa x2,500   10µm
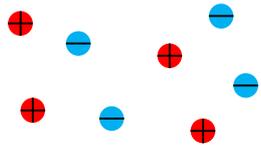Sample   0   Jun 13, 2013
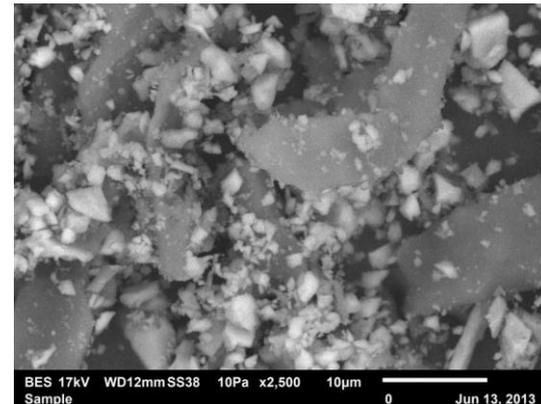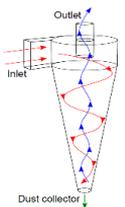
Objectives of Aerosol Measurement
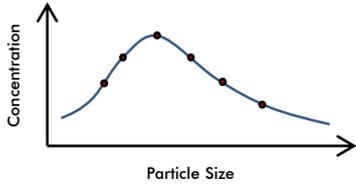
Reference particle size distributions for all test materials

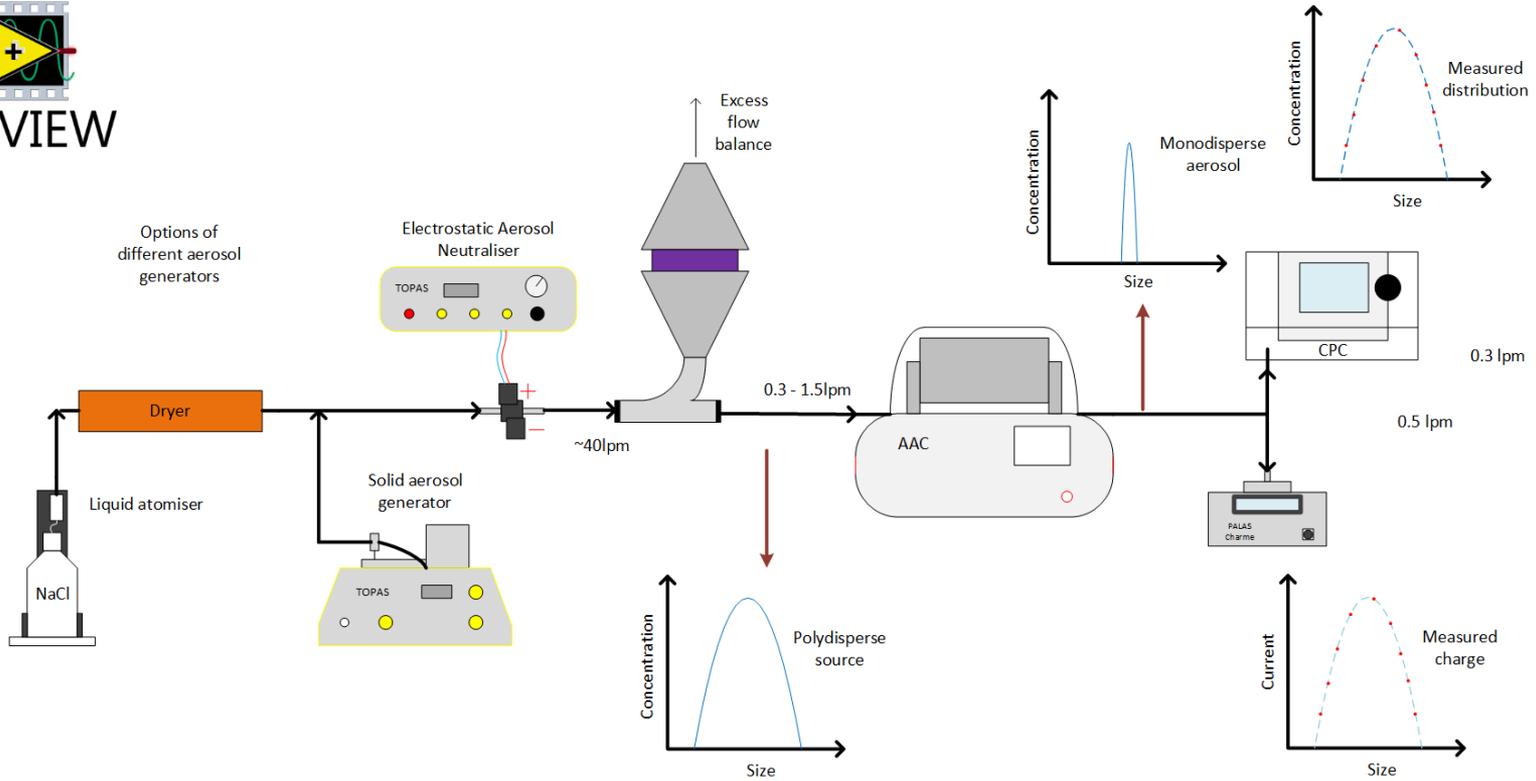Understanding of particle properties beyond size e.g. charge

Measure separation performance and influence of separation on charge
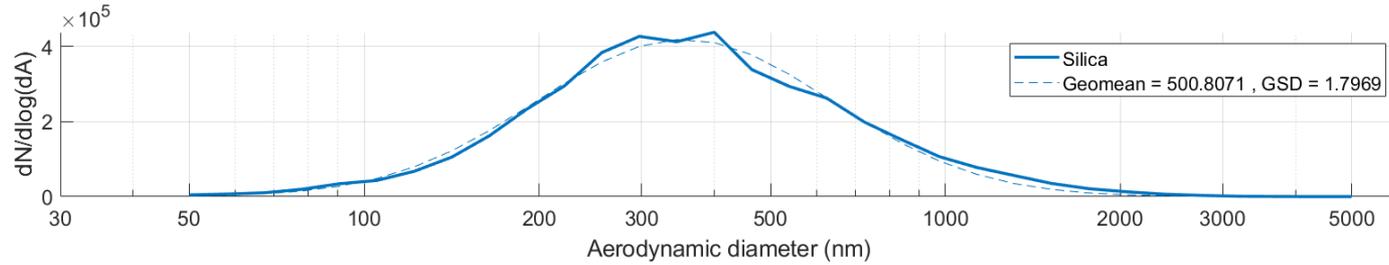

Compare lab controlled scenarios to real world measurements to test validity
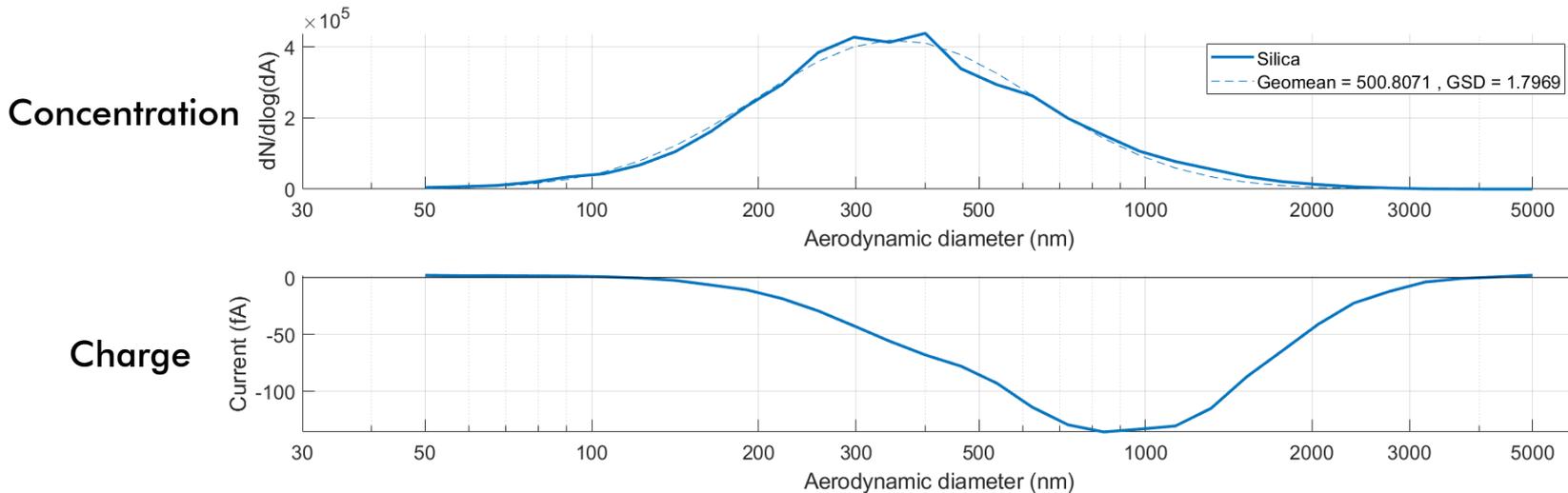
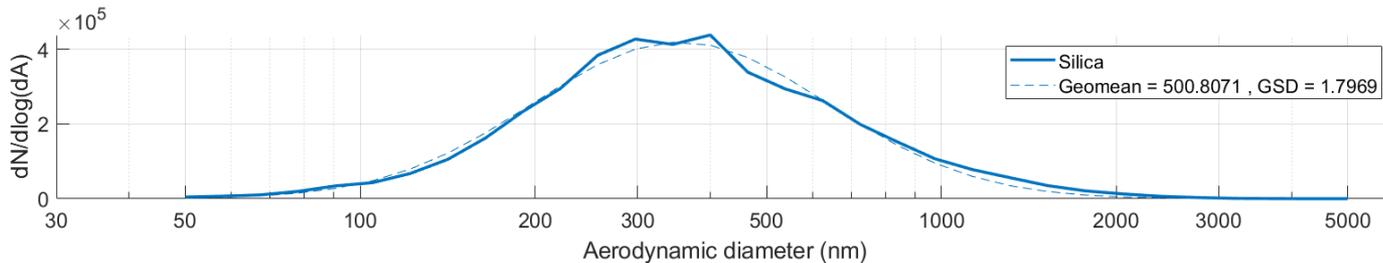# Size and charge distribution

Silica dust (ISO12103 A2)

dyson
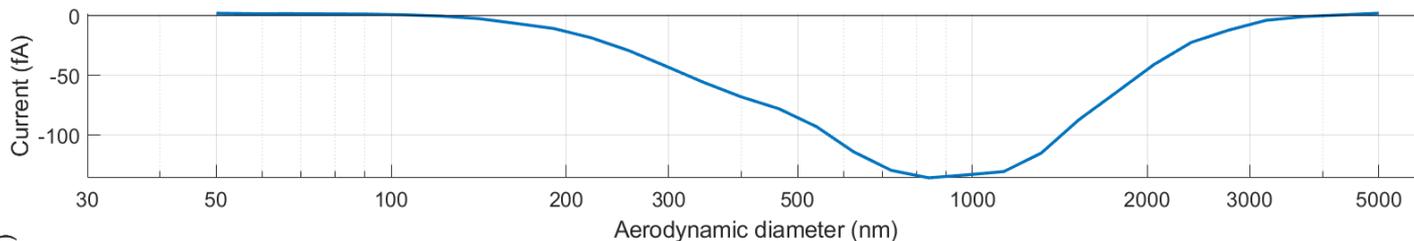
Concentration

Silica dust (ISO12103 A2)

Concentration

Charge

Silica dust (ISO12103 A2)
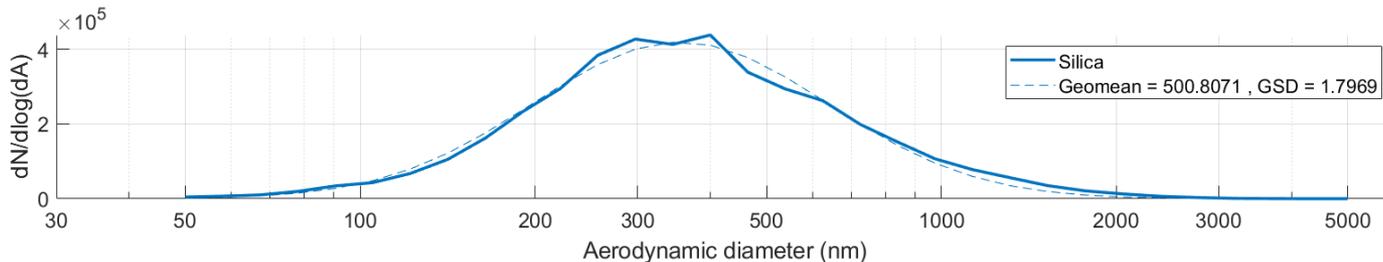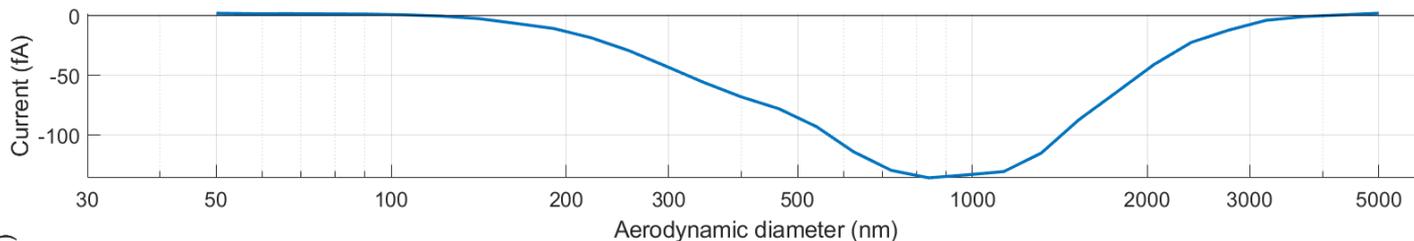
Silica dust (ISO12103 A2)

①

②
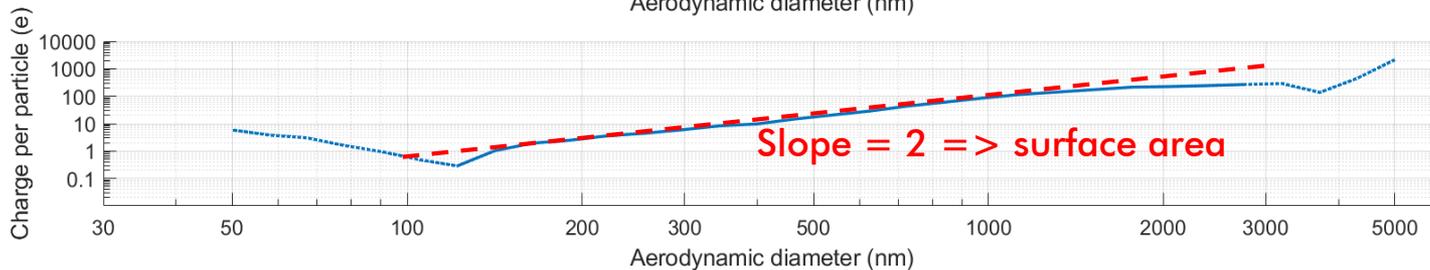
② ÷ ①

Slope = 2 => surface area

Neutralisation
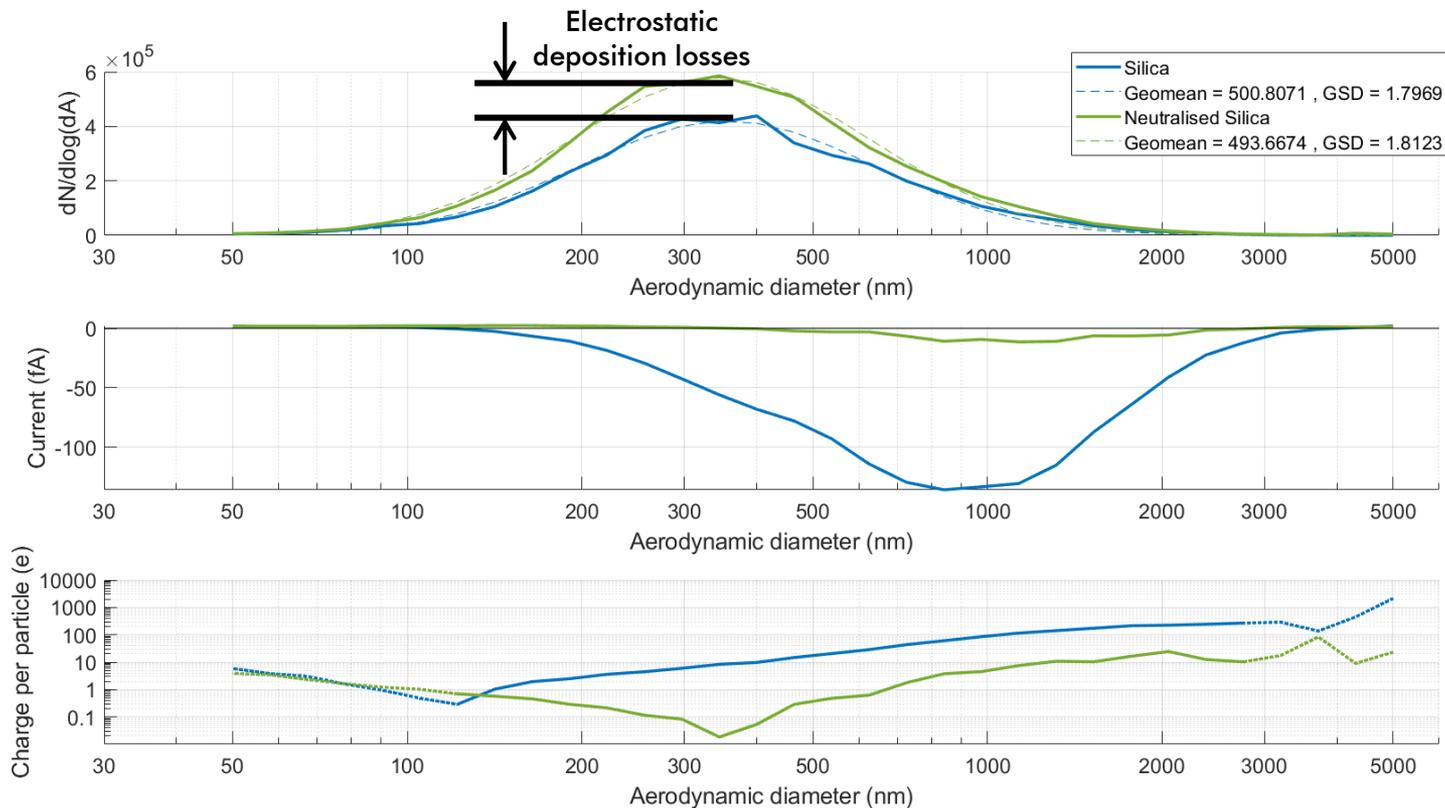
Silica vs Dolomite

Fine Dust in Cyclones

2μm

Scaled Velocity
- 1.0
- 0.9
- 0.8
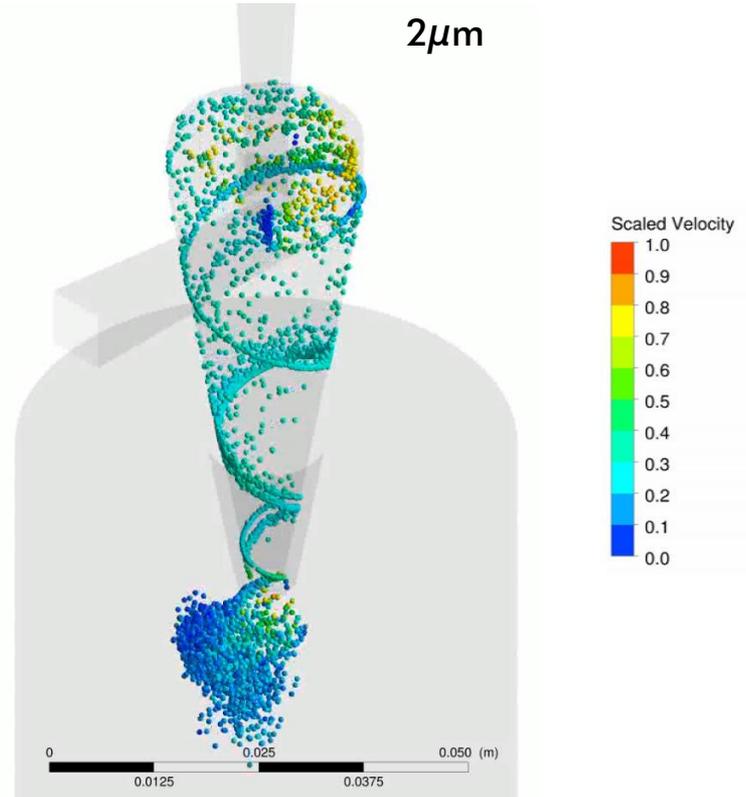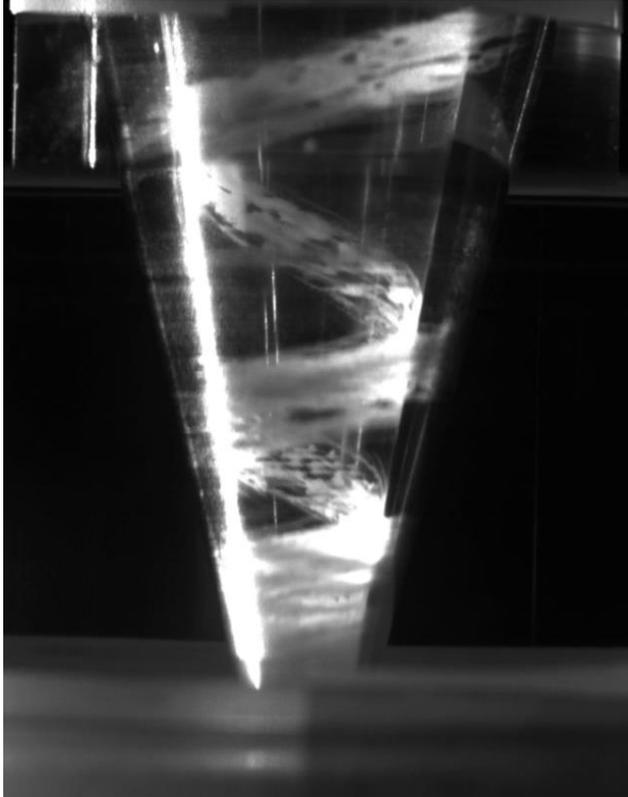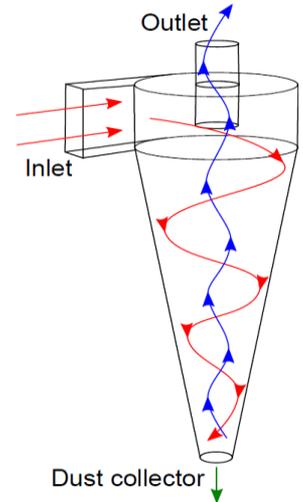- 0.7
- 0.6
- 0.5
- 0.4
- 0.3
- 0.2
- 0.1
- 0.0
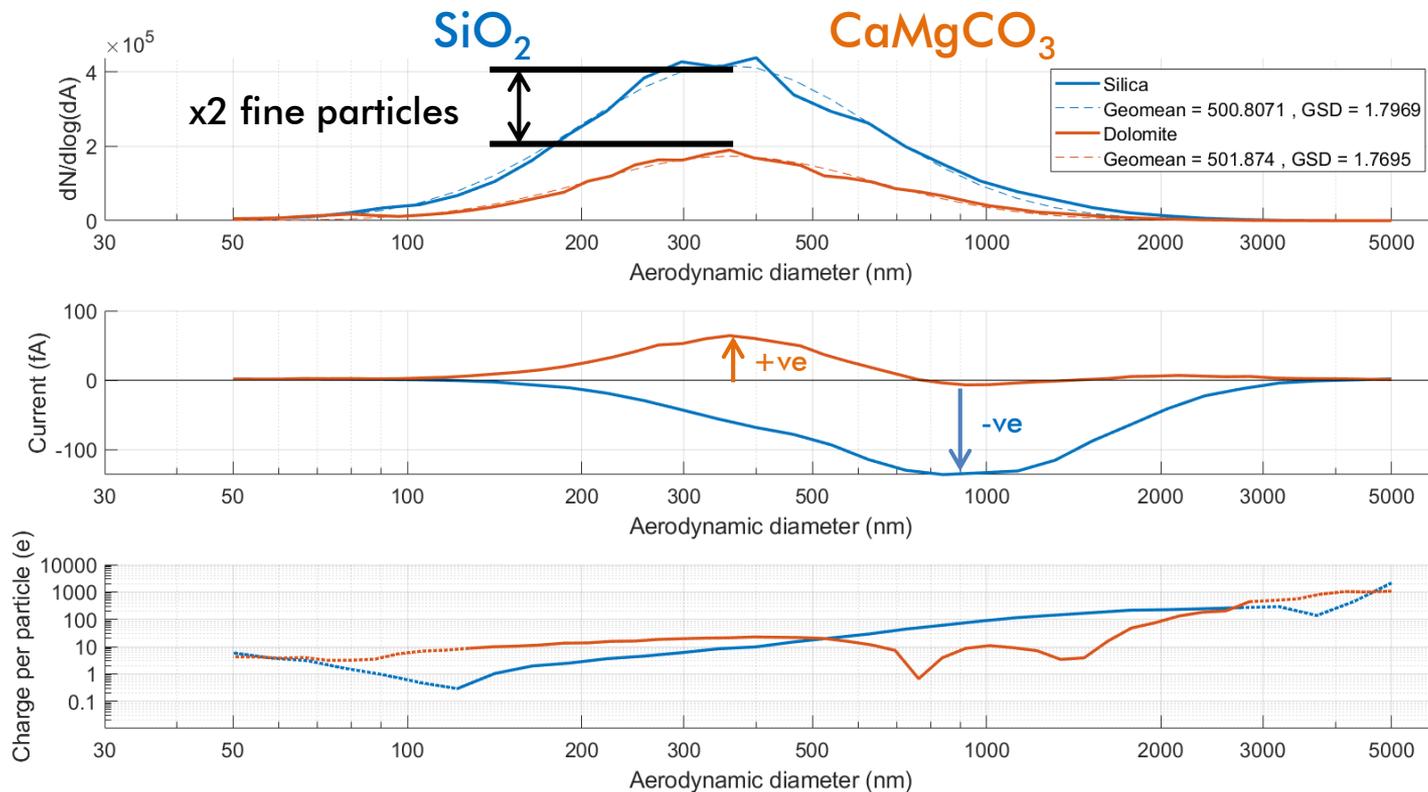
Separation System Influence on Charge

Charge balance

$d_A = 500nm$
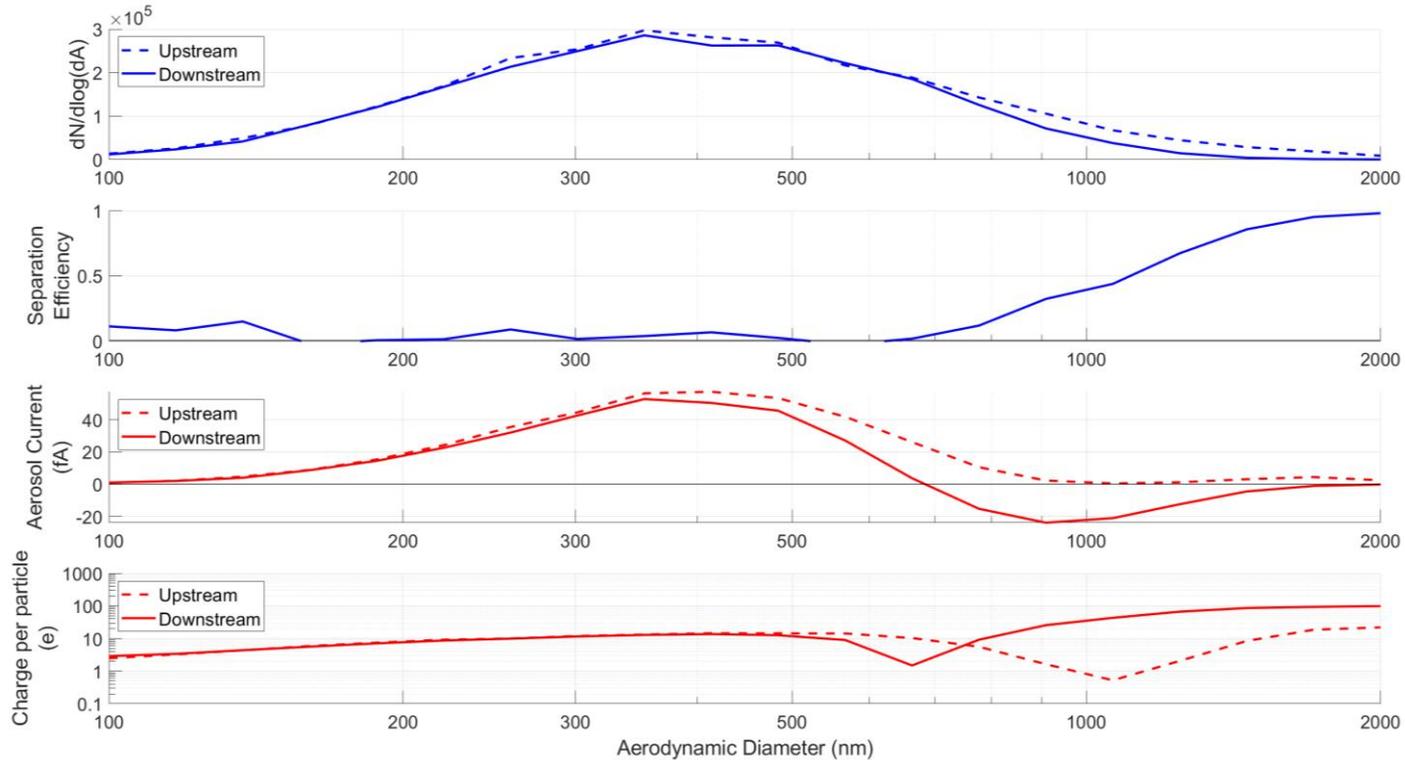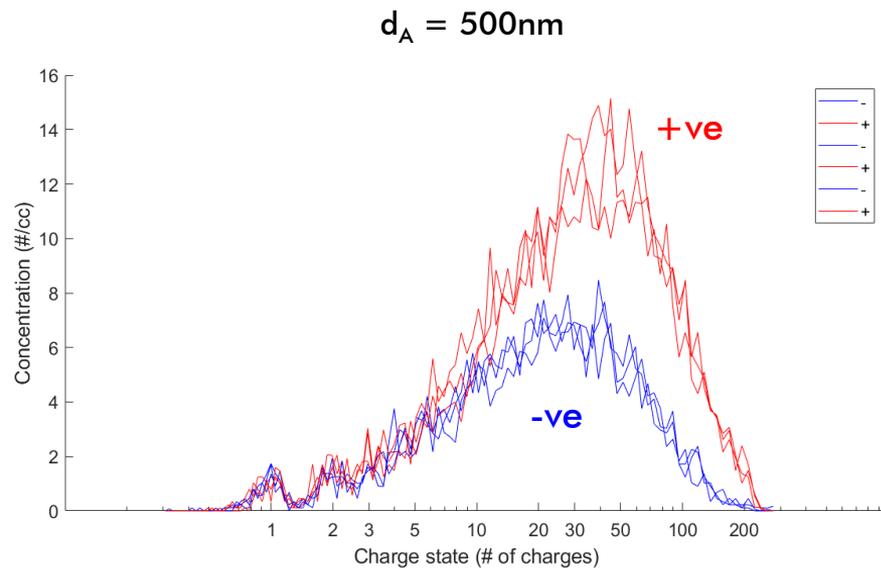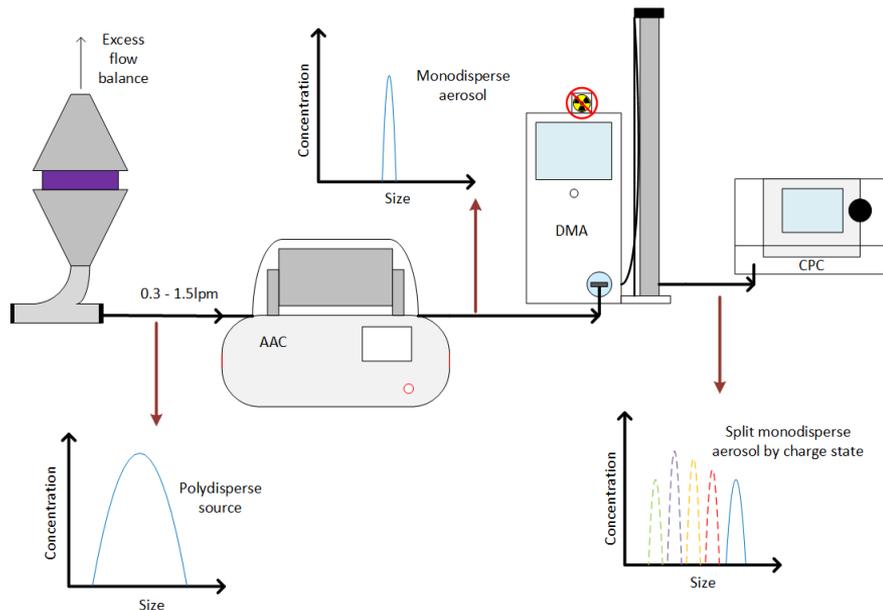
Instrumented Vacuum Cleaner

Backup filter

Flowrate measurement

Pressure measurement

Charme

Aerosol sampling section

Diluter

Separation System

APS

Motor control
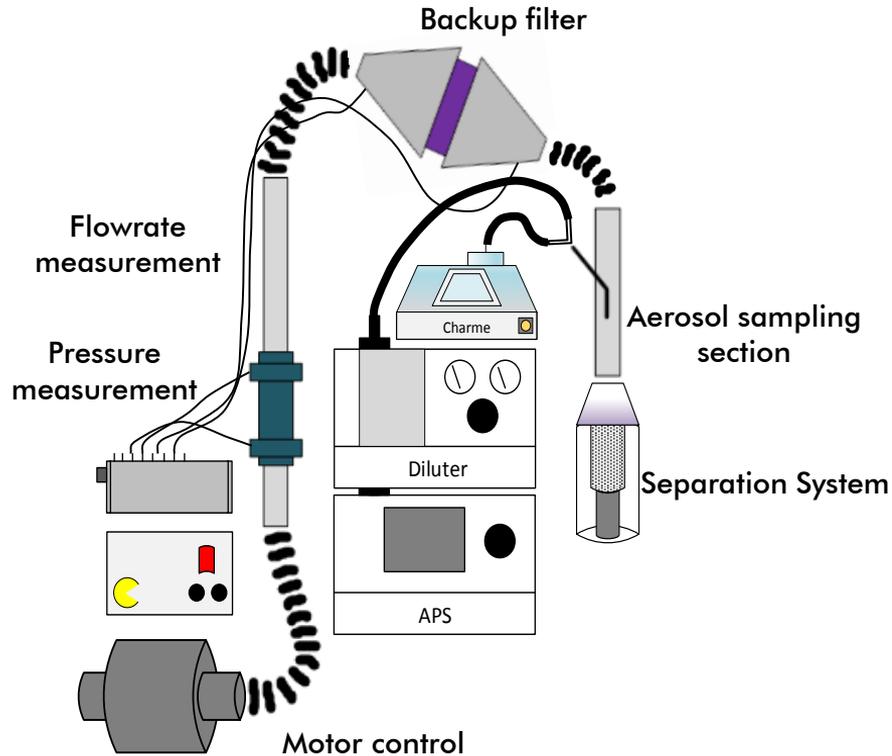
Live measurement:
- Aerodynamic performance
- Particle size distribution
- Net particle charge

Summary

- Understand both similarities and differences between test materials

- Particle properties beyond size distribution matter for system performance

- Value in developing test systems that measure more than just size

- Detailed lab testing helps correlate and query the real world