NIXE performance at the AIDA cloud chamber:

immersion & deposition freezing experiments

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VI-ACI Meeting,
10. May 2010

NIXE

New Ice eXpEriment - Cloud and Aerosol Particle Spectrometer

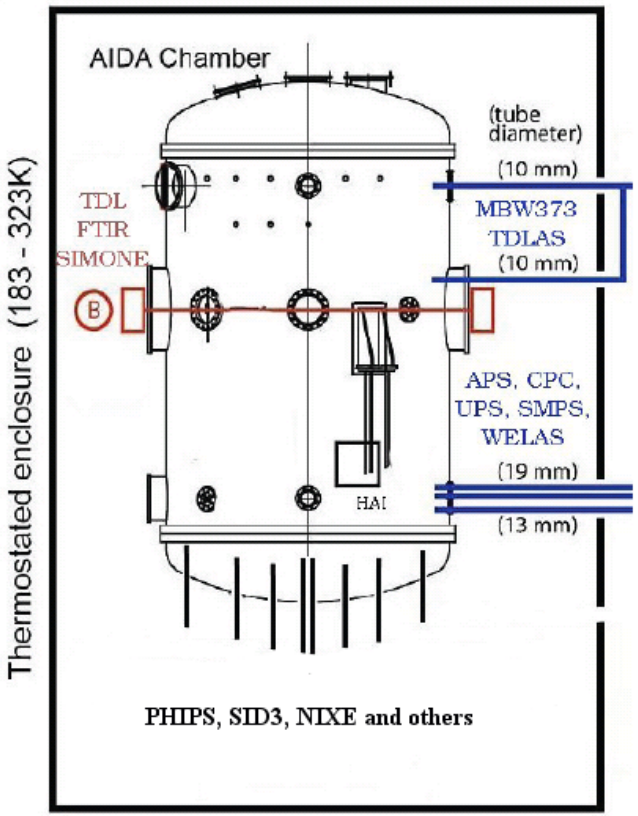
CAS-Pol + PbP:
Cloud Aerosol Spectrometer

- Light Scattering Technique
  Particle by Particle
- Forward: particle size
  Backward: refractive index, shape
  Depolarization: asphericity
- D_p 0.6 - 50μm

CIP-Greyscale:
Cloud Imaging Probe

- Optical Imaging Technique
  Particle by Particle
- Particle size & shape
  3 grey levels $\rightarrow$
  improved particle visibility
- D_p 15 - 900μm

NIXE@AIDA

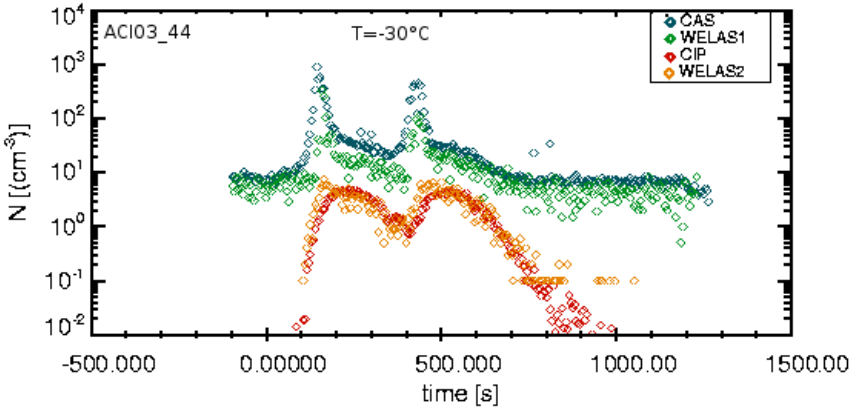


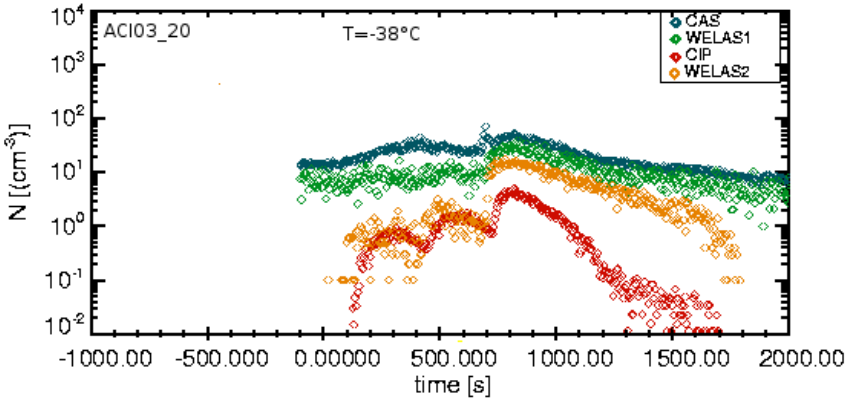
suitable for aircraft instruments,
first NIXE application

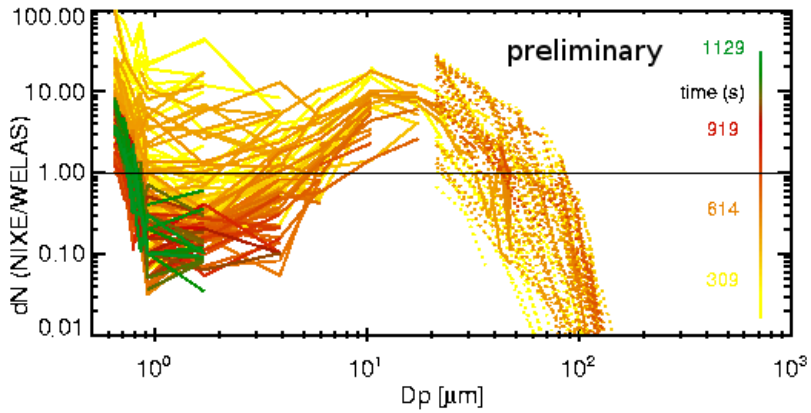
HALO02 & ACI03

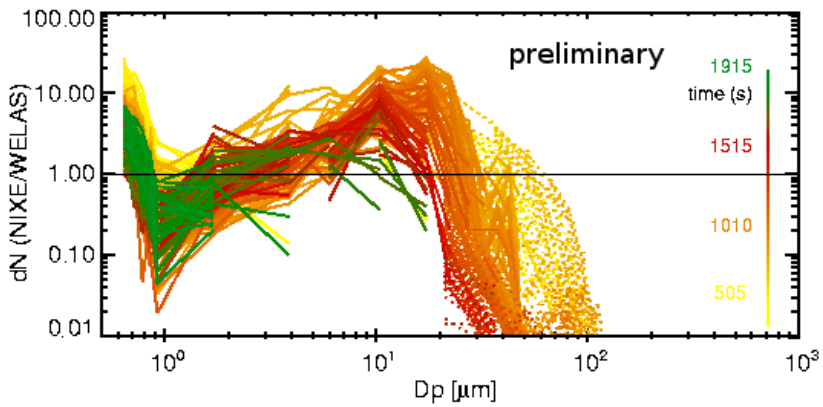
- 29 + 43 experiments
- varying aerosol type:
  mineral dust (AD2, SD2)
  soot (GfG, CAST)
  coated aerosols
- water to ice transition experiments
- mixed-phase cloud conditions
- ice nucleation experiments
- instrument comparison

NIXE-WELAS COMPARISON



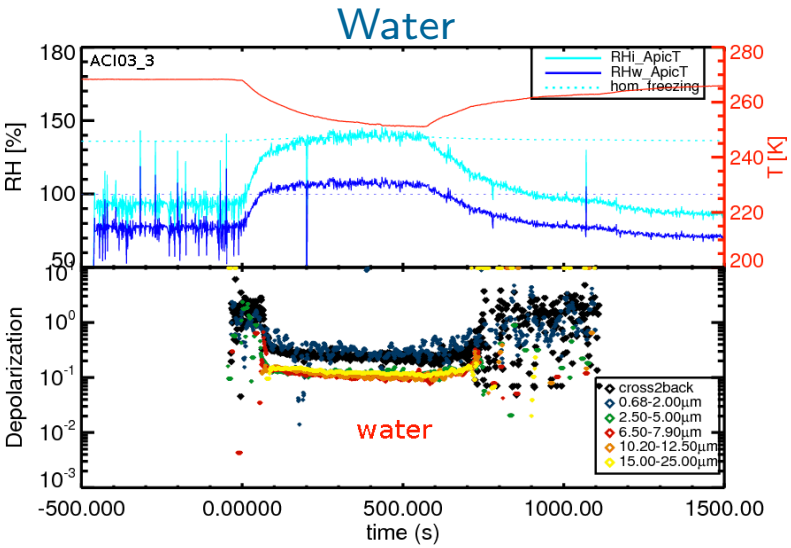


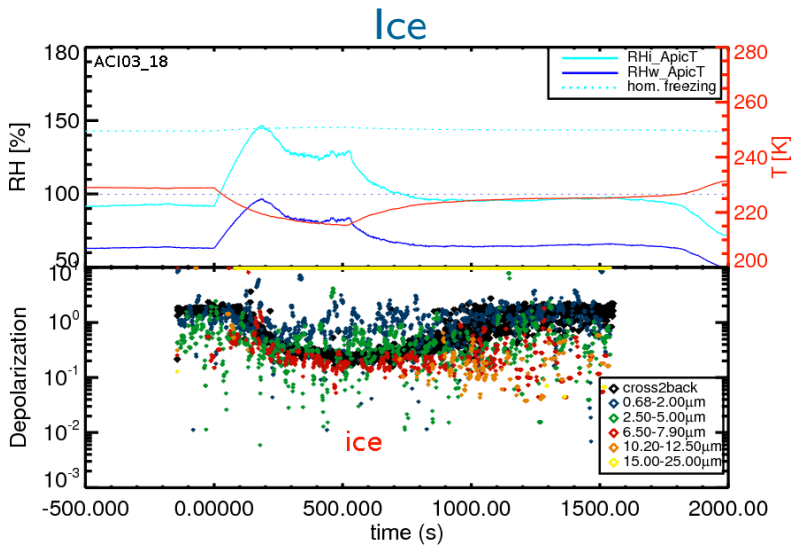




- often agreement for measured N
- systematic disagreement in size distribution
- comparison with other instruments needed

NIXE DEPOLARIZATION SIGNAL



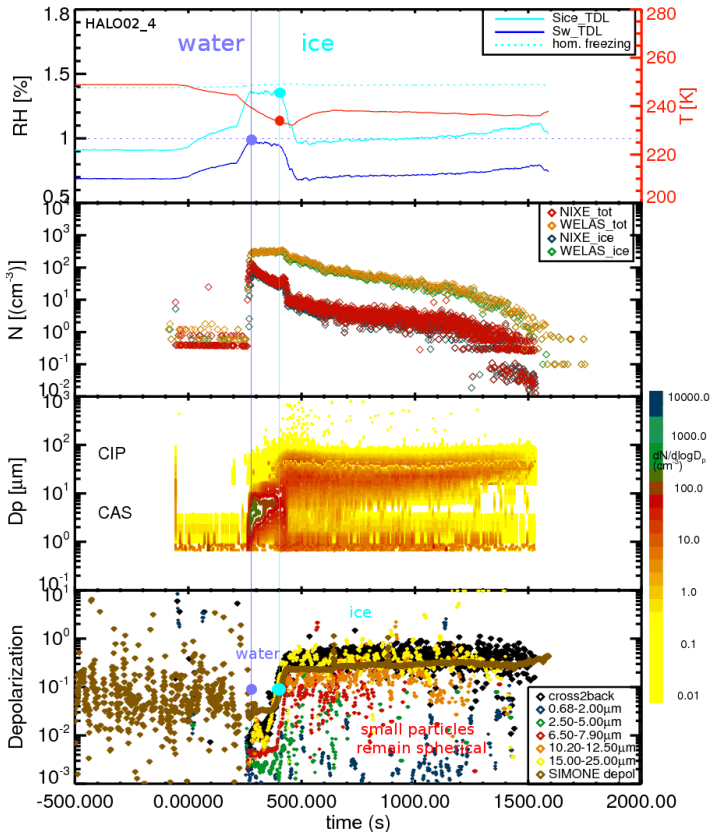


- aerosol & ice signal broader and larger than water signal
- aerosol, droplet & ice depolarization differ

IMMERSION FREEZING:

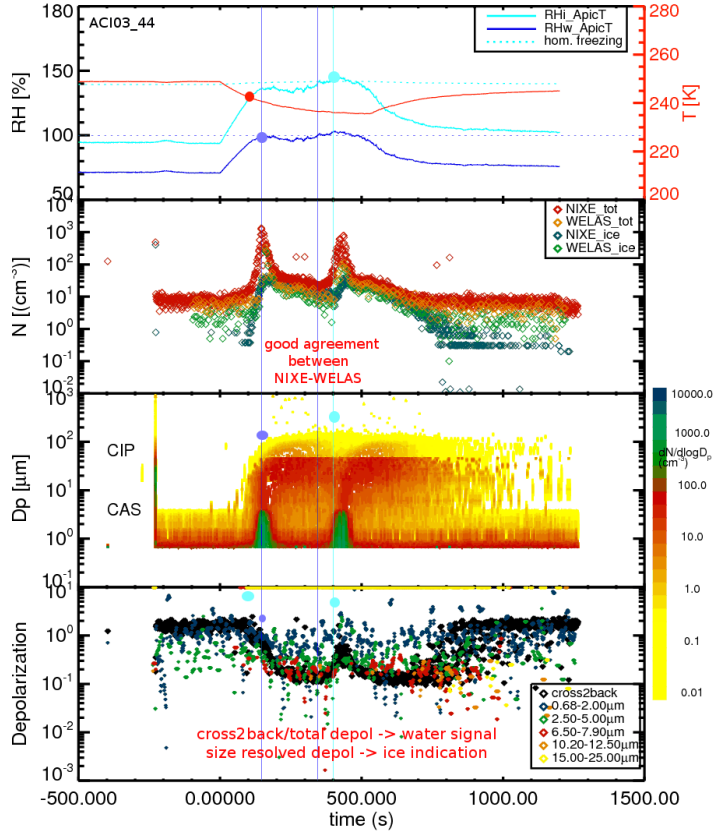
WATER TO ICE TRANSITION EXPERIMENTS

GfG soot



→ homogeneous freezing of soot at $-38^\circ C$

mineral dust AD2

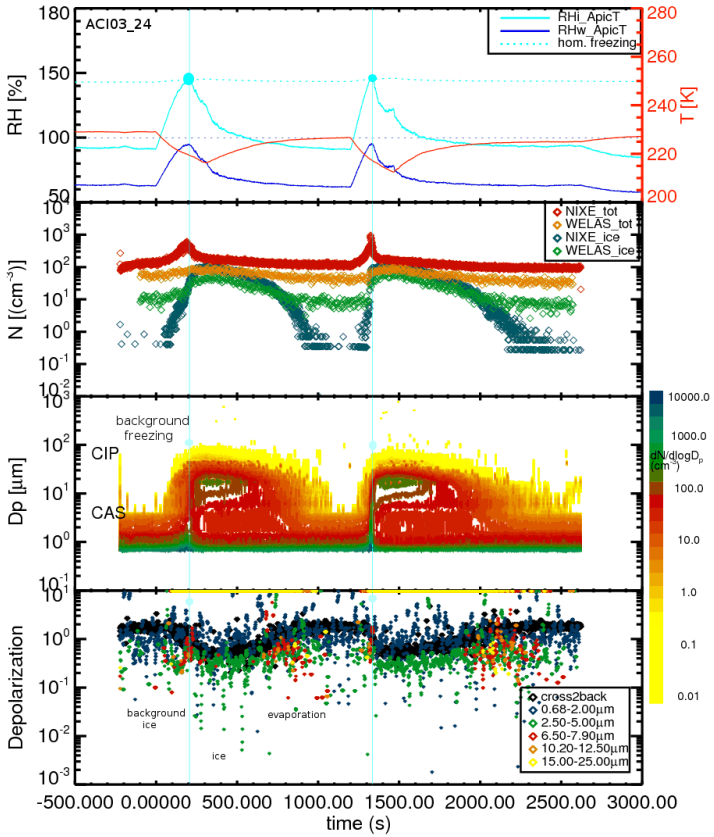


→ heterogeneous freezing of AD2 at $T > -38^\circ C$

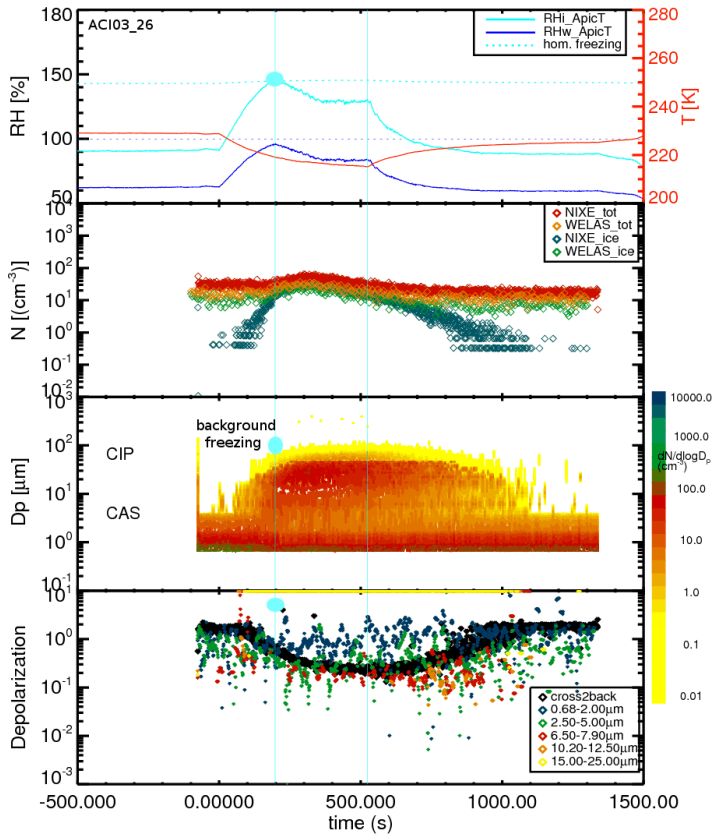
DEPOSITION FREEZING:

FREEZING OF COATED PARTICLES

CAST soot+sulphuric acid coating



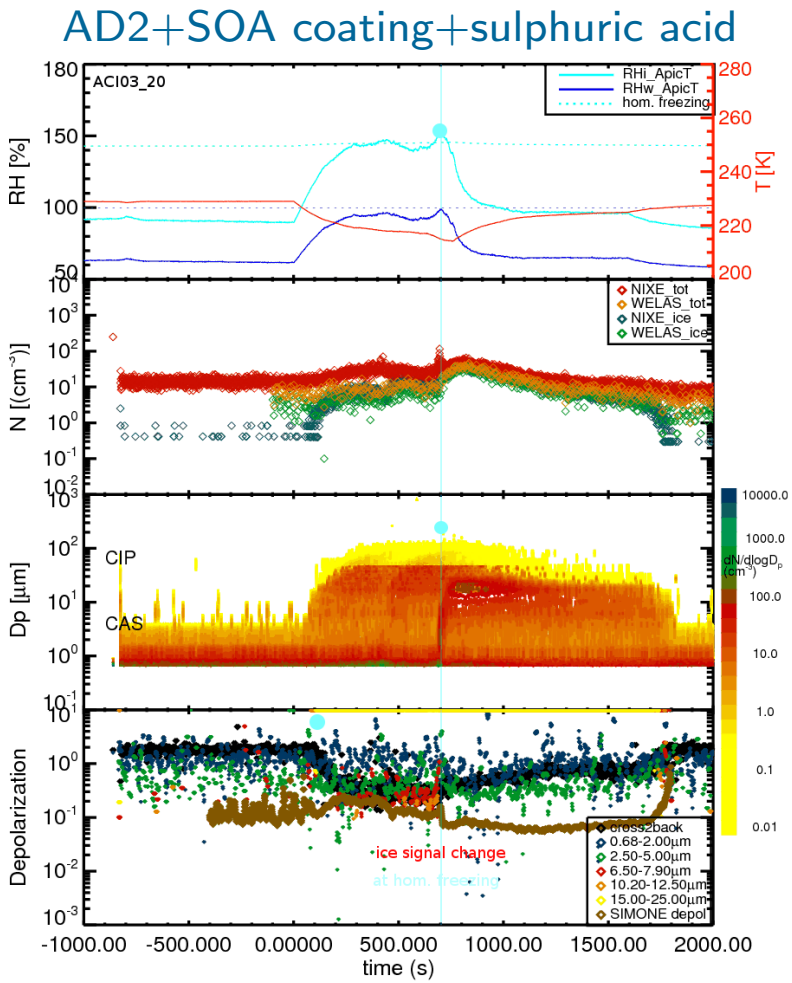
SD2+SOA coating



- background freezing
- main ice nucleation at Koop line
- different coatings can suppress heterogeneous freezing

DEPOSITION FREEZING:

IN COMPETITION



- heterogeneous freezing does not reduce RHi efficiently
- higher pump rate
- homogeneous freezing of a large number of sulphuric acid
- fast reduction of RHi

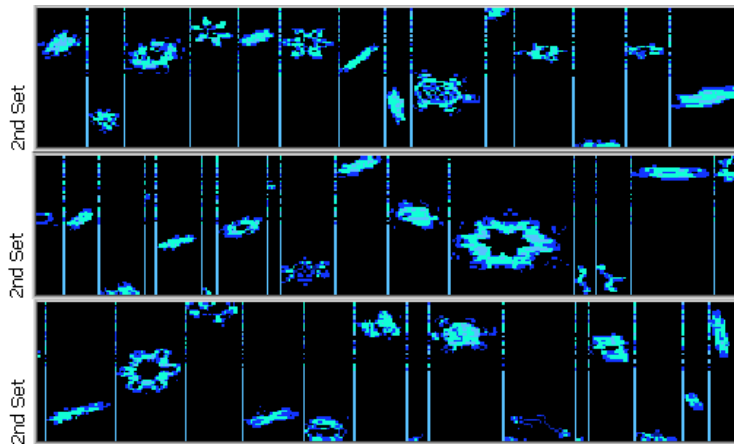
Imaging

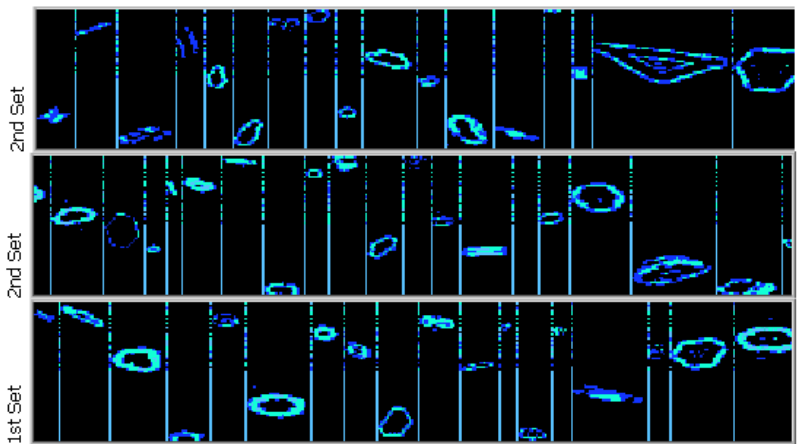
CIP Particle Shapes, T=$-10°C$, Seed Ice

Dendrites

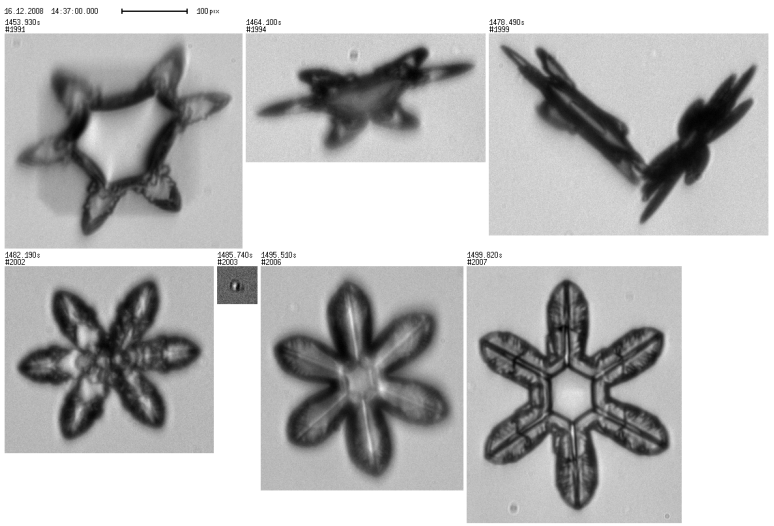
Plates

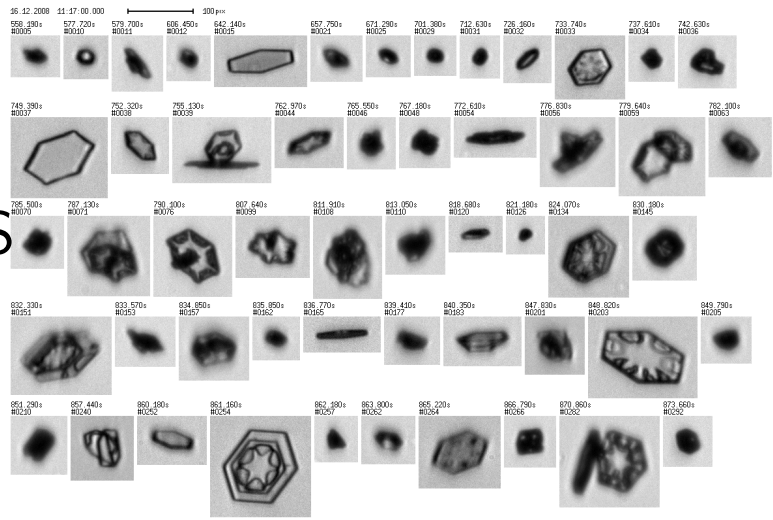
CIP





PHIPS





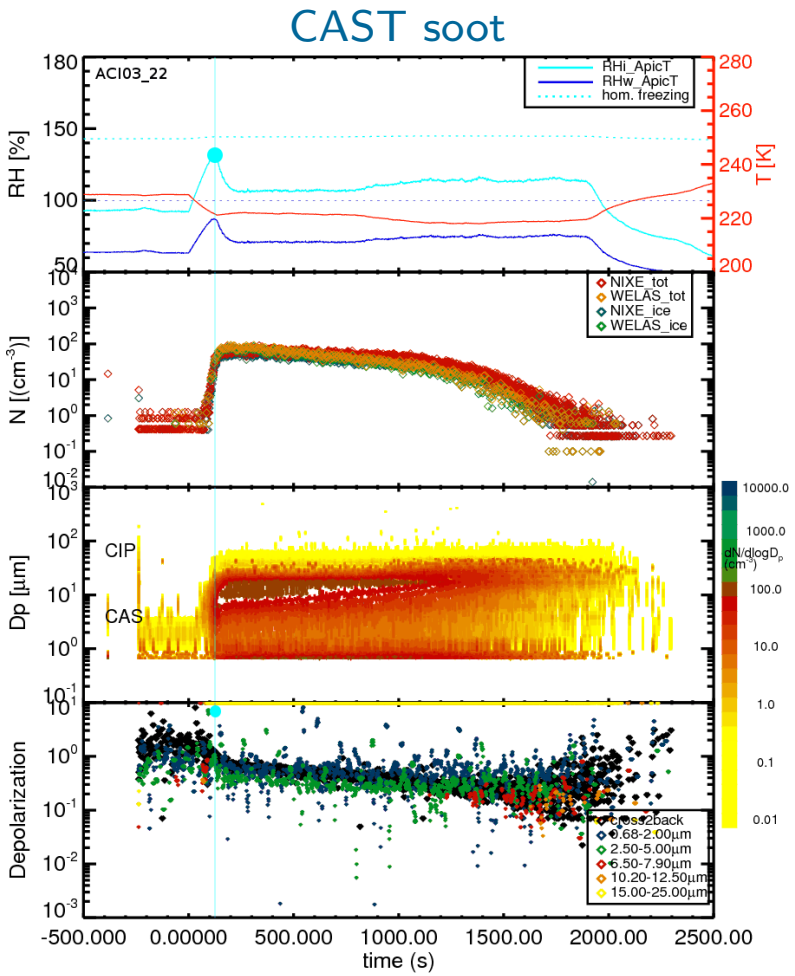
SUMMARY

- NIXE total N similar to WELAS total N
- systematic differences between size distributions
  → yet to be solved
- Water & ice separation with NIXE possible
- Ice particles in water background detectable
- Immersion freezing: dust more active than soot
- Deposition freezing: coatings can suppress freezing

- separation of different ice shapes
- determination of NIXE ice fraction

DEPOSITION FREEZING:

SOOT

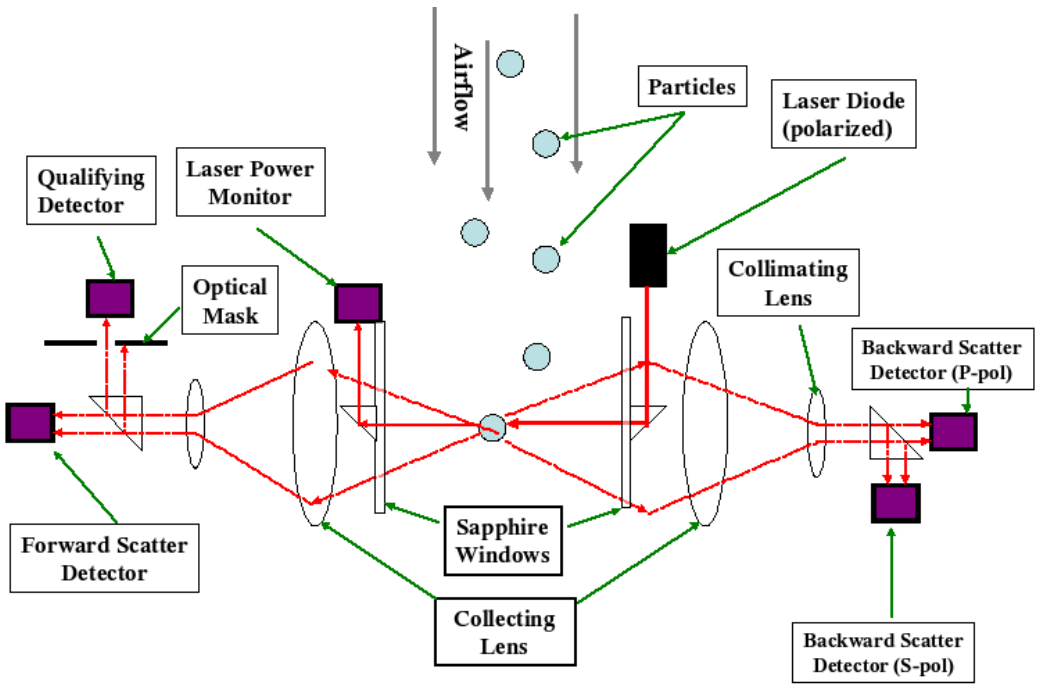


pure IN

→ heterogeneous freezing

below Koop line

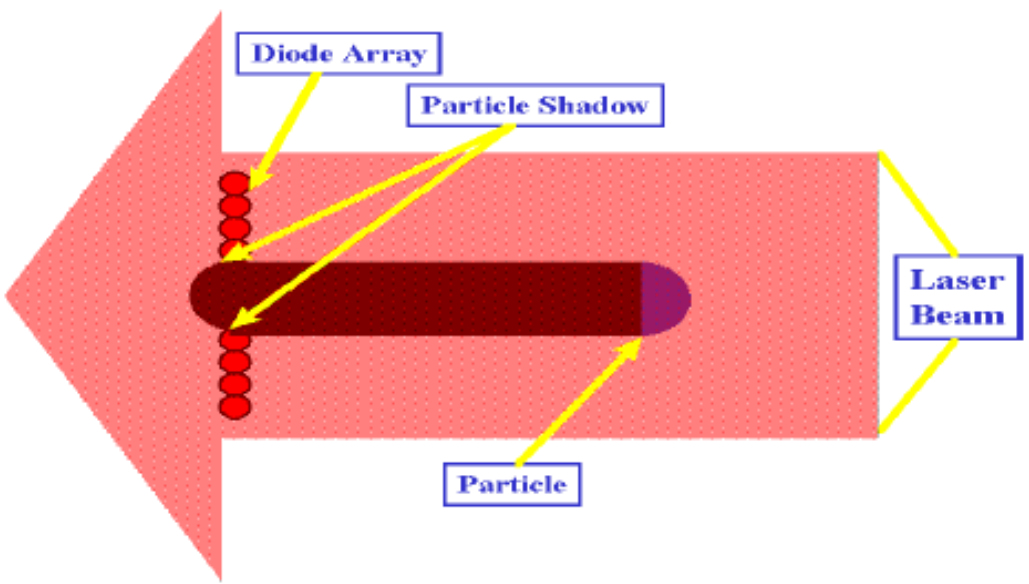
CAS-POL DESIGN



Forward/Backscatter Sensor Optical Path Diagram

- Light Scattering
- PbP
- Forward: particle size
  Backward: refractive index, shape
  Depolarisation: aspericity
- size range: 0.6 - 50μm
- calibration

CIP DESIGN



- Optical Imaging Technique Particle by Particle (PbP)
- Particle size & shape
  3 grey levels → improved particle visibility
- 15 μ resolution
- size range: 15 - 900μm
- calibration