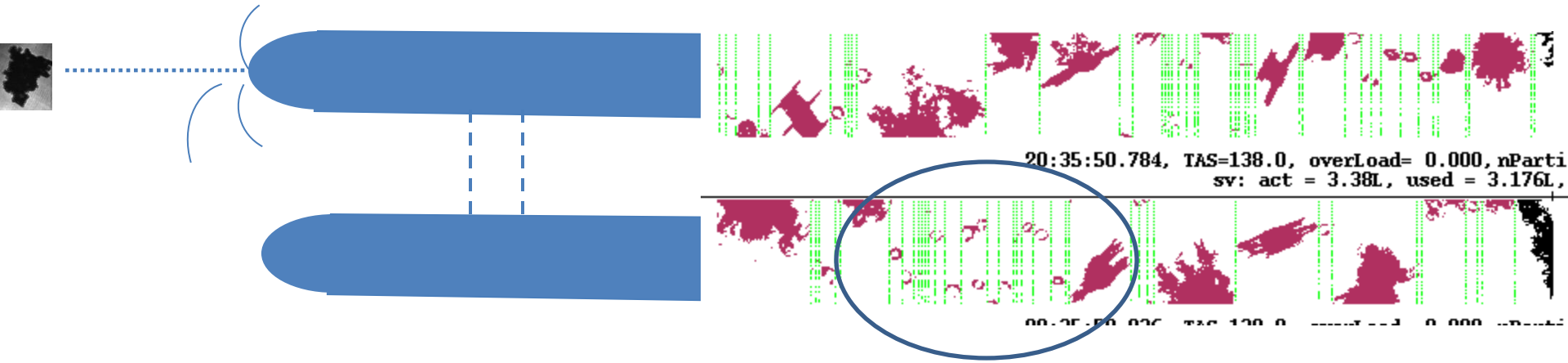
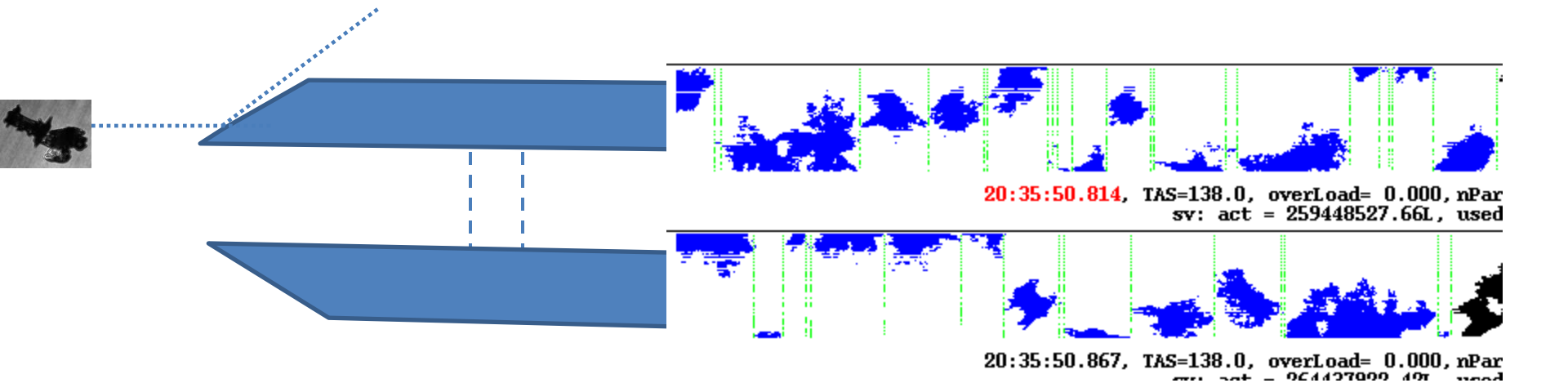
CSET Cloud/Aerosol instruments

- CN
- UHSAS
- 2DC
- 3VCPI
- CDP

Software:

- NCPLOT
- NCPP
- XPMS2D
- Aeros
- CPIDISPLAY
- SPEC Software (available)
- Mission coordinator
- Field Catalog


20:35:50.784, TAS=138.0, overLoad= 0.000, nParti
sv: act = 3.38L, used = 3.176L,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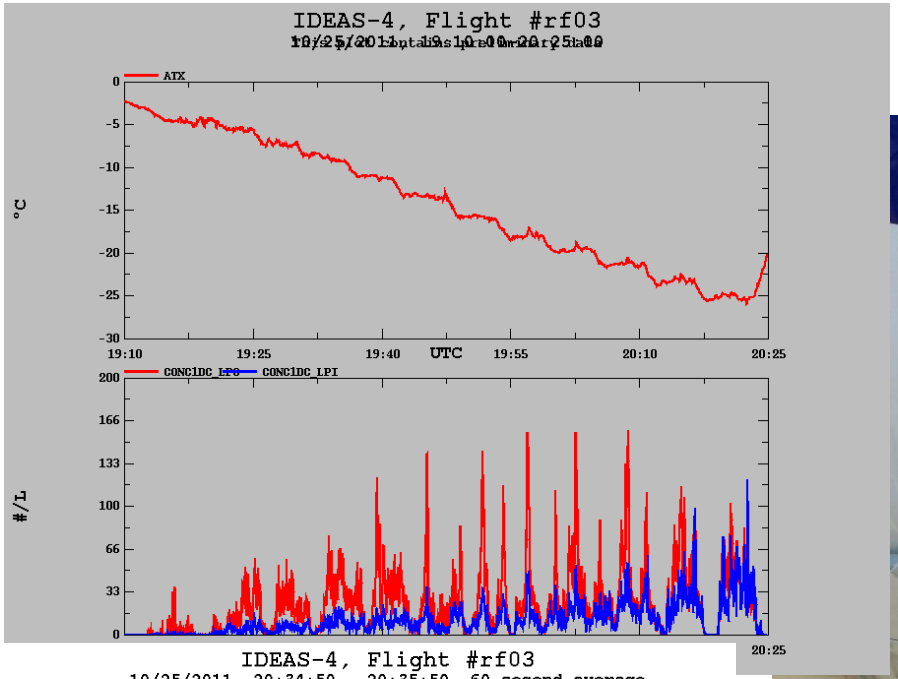
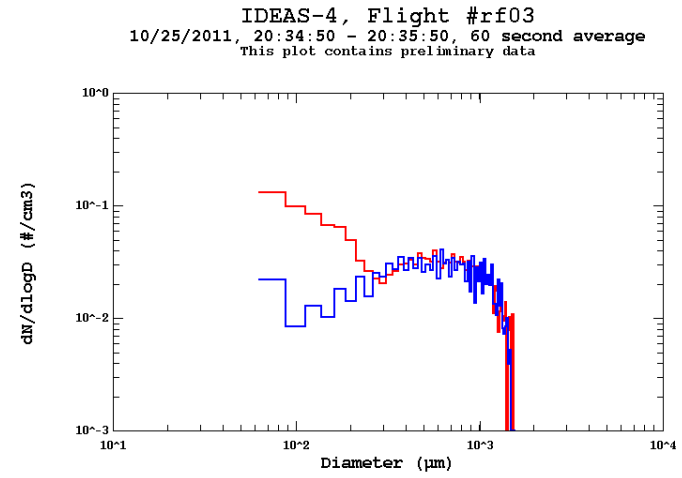
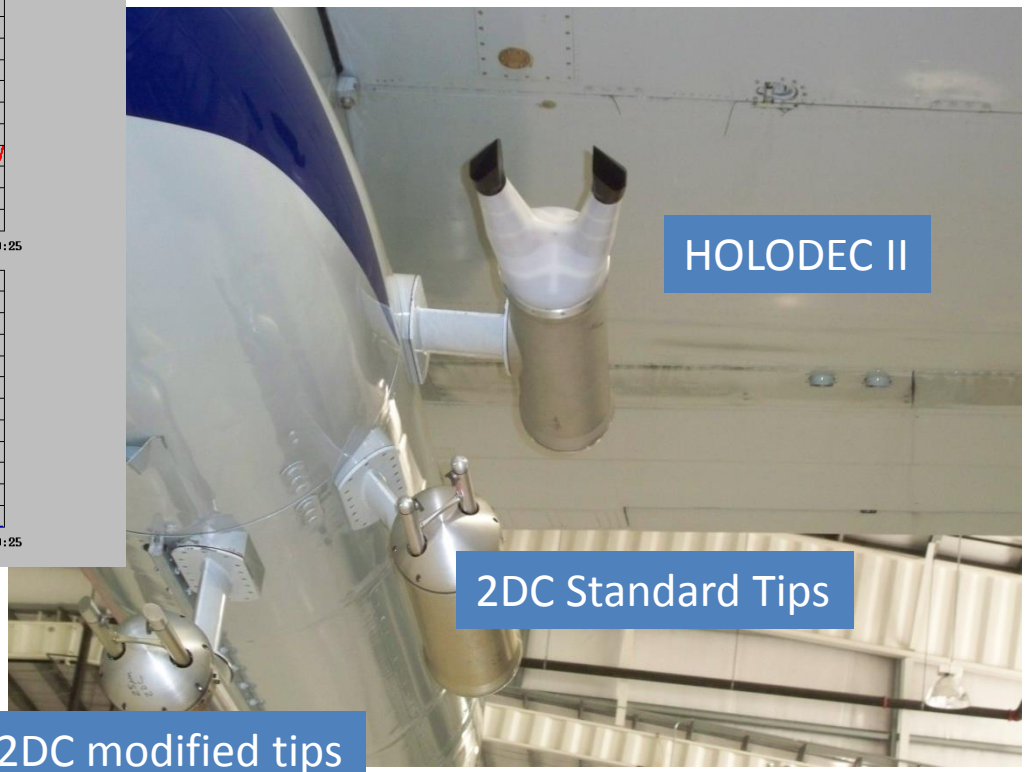
sv: act = 259448527.66L, used
20:35:50.867, TAS=138.0, overLoad= 0.000, nPar

Shattering from probe tips







Analysis will be Cooperative project with R. Jackson and G. McFarquhar U. Illinois

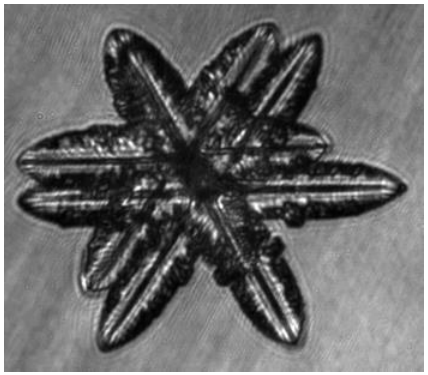
3V-CPI

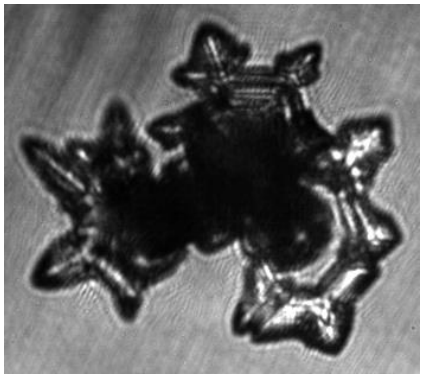
128 element 10 micron photo diode array X 2 (Stereo).

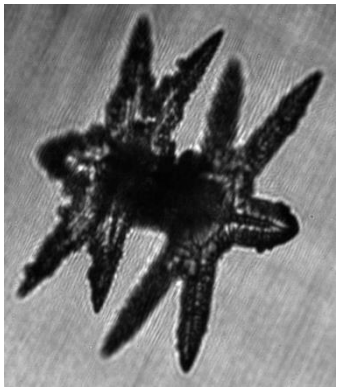
Serves as trigger for camera in CPI
CPI images with 2.3 micron resolution

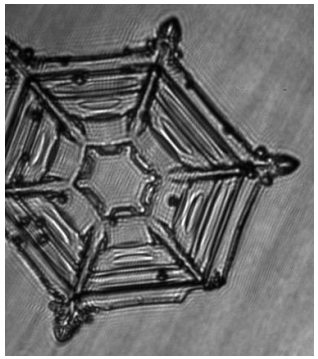
Variance in triggering sensitivity a problem.

3V-CPI









…makes beautiful photos of ice particles. Up to 450 per second!

Tube from 3VCPI probably shatters very fragile ice

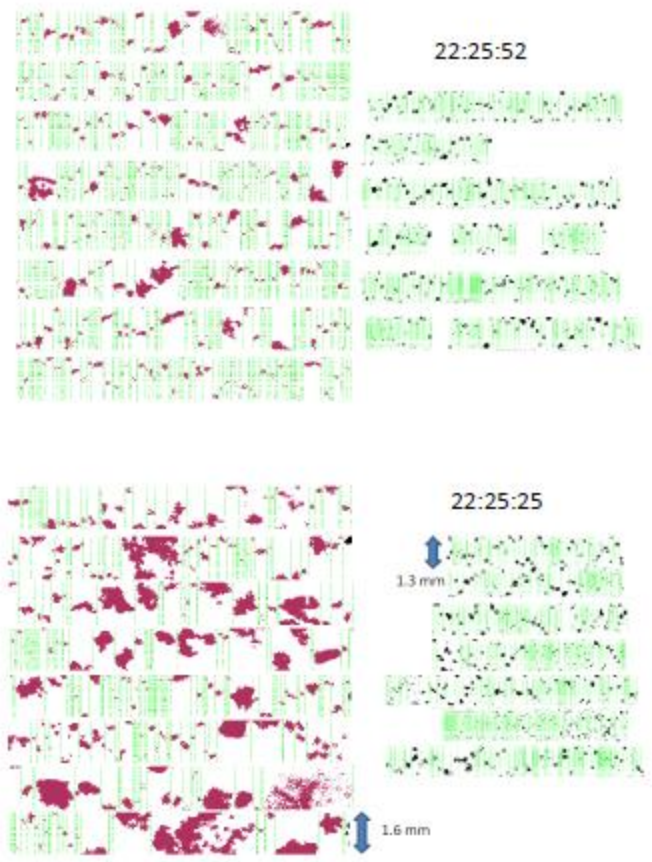
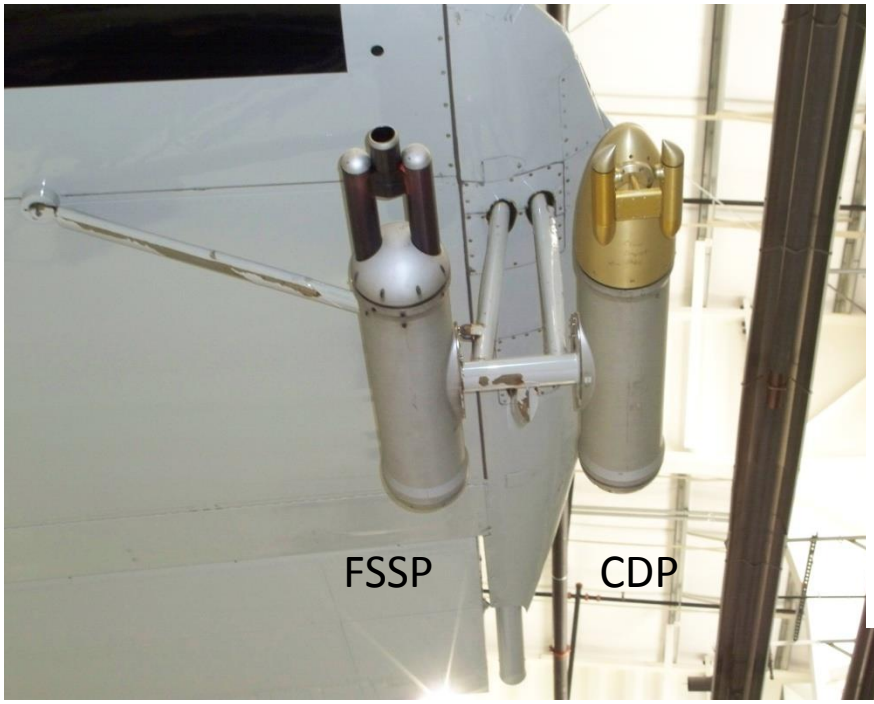
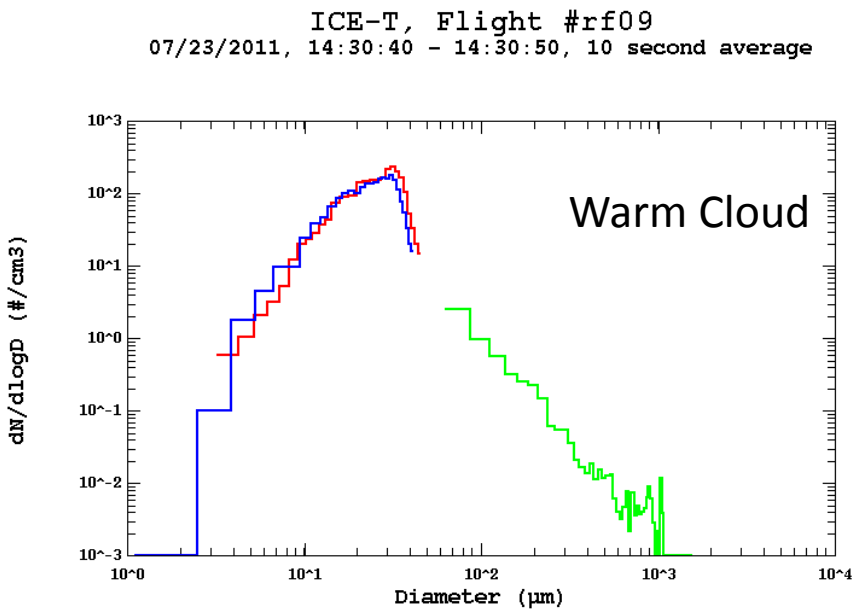


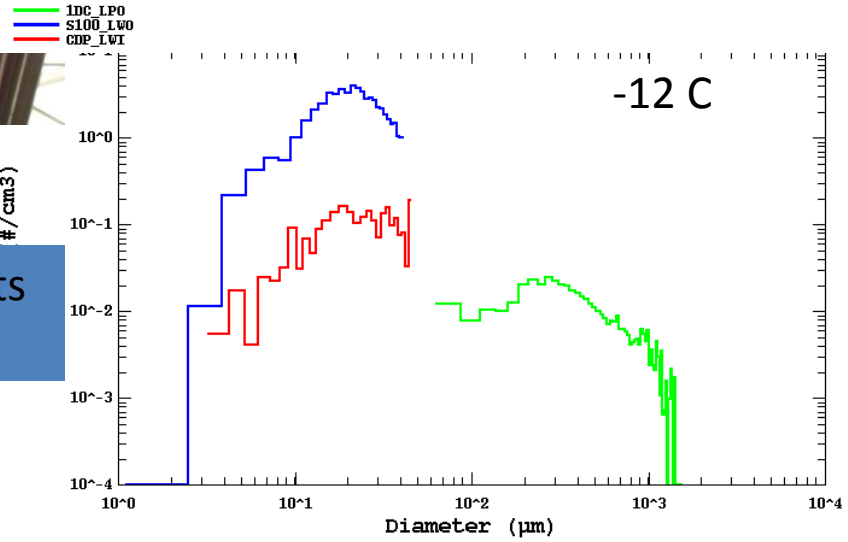
Fig. 8. 2DC (red) and 2DS (black) images taken near 22:25:52 (top) in the upper anvil and at 22:45:25 (bottom) in the lower anvil regions. Corresponding CPI images are shown in Fig. 7 for 22:25:52.

From Stith et al., 2014 ACP

Single Particle Light Scattering







- Shattering of ice creates many artifacts from shroud (FSSP)

Imaging probes

- Time response of diode arrays historic problem
- Sample volume poorly known for particles <~100 microns
- Size corrections needed for out of focus particles
- Shattering…
  - Correct by modifying probe tips
  - Correct by analysis of particle inter-arrival times (e.g. Field et al, 2006 and others)

Single Particle Light Scattering

- Sample volume must be small to avoid multiple droplets in view—inhibits sampling for ice formation
- Poorly known response to natural ice particles in most cases (size, counts)
- Faster probes (FFSSP, CDP, SID II) can sample each particle, allowing inter-arrival times to be used for some corrections for shattering.
- Sample volume determination not robust

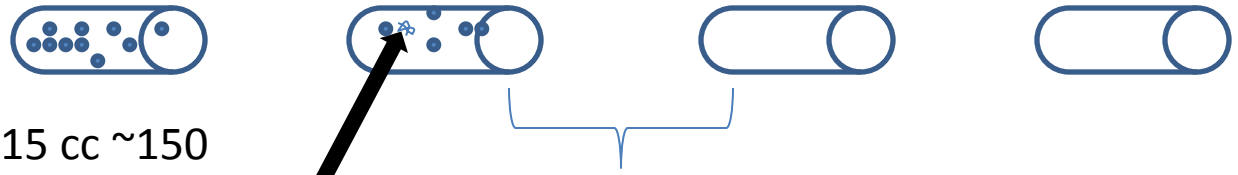
HOLOGRAPHY: HOLODEC II

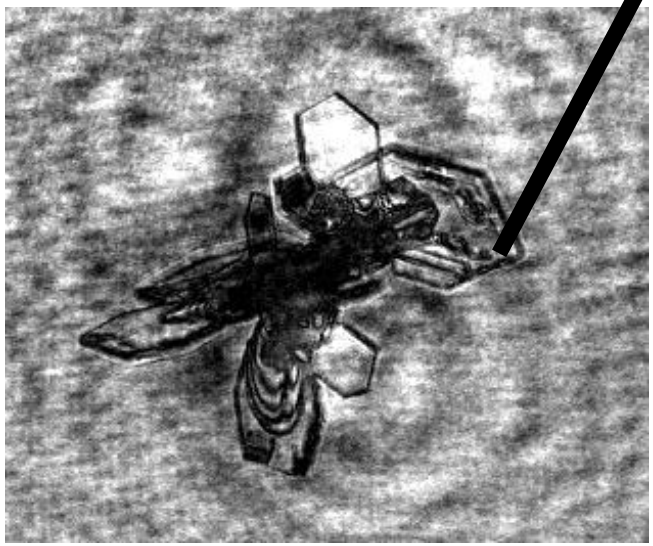
A joint development between NCAR and Michigan Tech. University

Conventional

1 particle in beam at a time

Holodec II





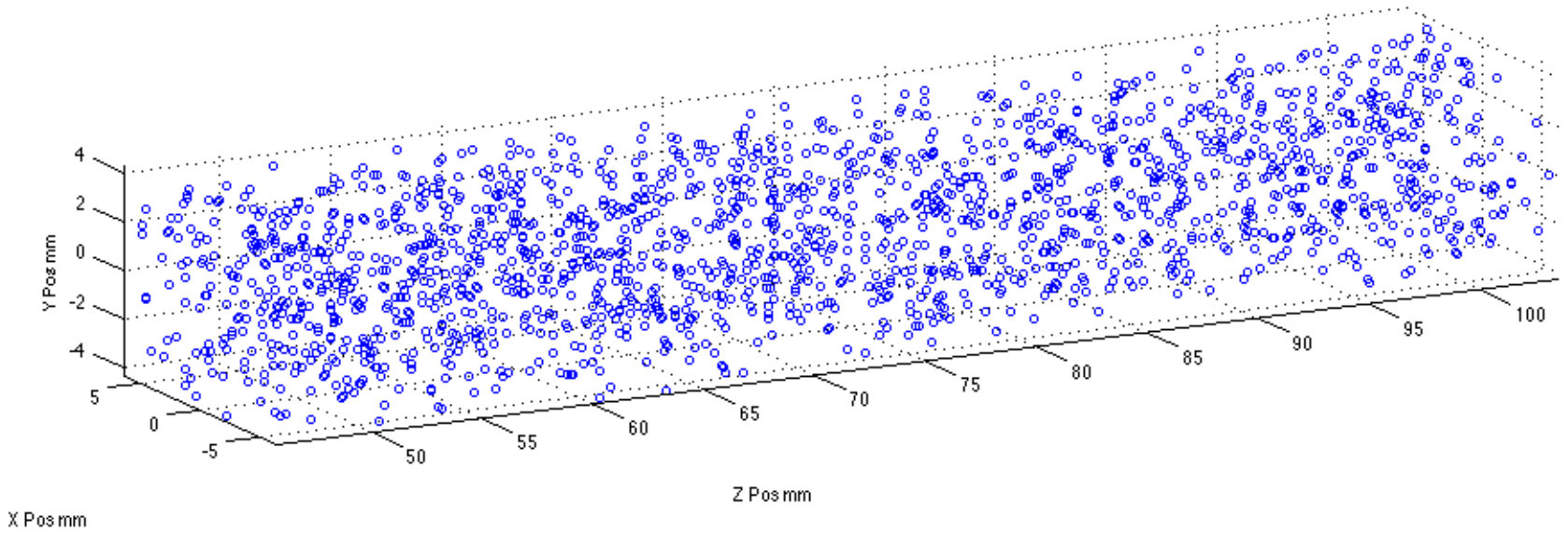
Particle Reconstruction By Jacob Fugal

Advantages:
- Reconstruction of particles in volume
  - Spacing of particles wrt neighbors
  - 3D view of particles
- Well defined sample volume. ~2 to 5 times greater than light scattering probes (~100 x locally)
- Resolution ~ 5 microns
- Low shattering/easy identified

Disadvantages:
- Computationally Intensive
- Gaps between samples

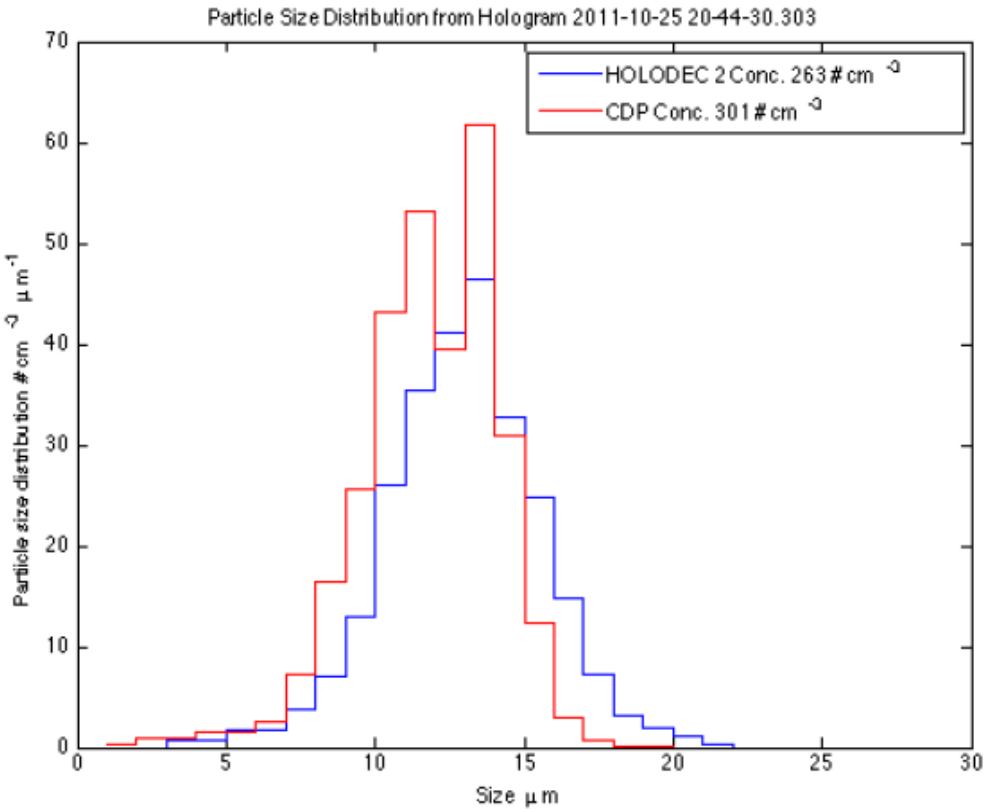
Spuler and Fugal, 2011, Applied Optics

Preliminary “Breakthrough” in droplet analysis by Fugal and MTU team—November 2011, IDEAS Flights with C130



30 minutes computation time, single GPU processor 48 GB memory

Preliminary comparison between HOLODEC and CDP droplet spectra



Fugal and MTU team results, November 2011