Sat 13:45
AMS Upgrades

- ePTOF - Efficient Particle Time-of-Flight
- ADQ1600, Custom data acquisition card
- PM2.5 Lens
- Capture vaporizer
- Auto tuning software for mass spectrometer
Efficient Particle Time-of-Flight ePTOF

Application of a higher throughput chopper wheel

Performance enhancements in size resolved measurements with the AMS

ARI/Tofwerk
(J. Jayne, J. Kimmel, R. Knokumuss, M. Cubison, M. Gonin)

CU/Boulder
P. Campuzano Jost, D. Day & Weiwei Hu, Harald,
Donna, Jose
Size measurement in the AMS

Single slit chopper limits throughput to 2%
Typical AMS pTOF Size Distribution

![Graph showing typical AMS pTOF Size Distribution](030707_sm.ps)
Multi-slit wheel for 50% aerosol throughput

Deconvolution procedure to obtain size information

- 3-phase brushless DC motor
- velocity regulated by closed loop control

Richard Knochenmuss - Tofwerk
300 nm NH$_4$NO$_3$ Raw Data

Recorded with multi-slit wheel

One chopper rotational period, 381 TOF extractions
300 nm NH4NO3 Data De-Multiplexed

![Graph showing ion counts over time with two curves, one blue and one black. The blue curve has sharpness=0, denoise=0, while the black curve has sharpness=4, denoise=4. The x-axis represents time in segment dimension, and the y-axis represents ions/s. The graph also includes a path location: D:\aCIMS\Chopper_Sequence\PAM_Dataexperiment2.pxp.]
Compares Single-slit (1%) to Multi-slit (50%)

m43 ion

a-Pinene + OH, ~10 µg/m³, 2 min data

Richard N. Zare,* Facundo M. Fernández, and Joel R. Kimmel

Joel R. Kimmel received his BS in Chemistry from Colorado State University in Fort Collins, Colorado in 1999. He is currently a Ph.D. candidate in the Department of Chemistry at Stanford University, where he works with Prof. Zare on the development of Hadamard transform time-of-flight mass spectrometry.

2003
Current ePTOF Controller

Chopper assembly
NW100 flange

Control Electronics
AMS DAQ ePTToF Ready

Deconvolved
(33 grams 291 nm AN and Airbeam)

Raw
(30 grams 300 nm ammonium nitrate + airbeam)
New PToF/ePToF Simple Graph Aid

- Denoise
- Sharpening
- Confidence Limit

Graph showing PToF bins in time (μs) with labeled regions and markers.
Ambient Data

Sharpness=0, Denoise = 0

Sharpness=4, Denoise = 4

Sharpness=10, Denoise = 10
ePTOF System Status

• More detailed measurements are ongoing CU and ARI. Ambient ePTOF data set from SOAS.

• Careful application of and denoising and sharpening. A proprietary *denoising* and *sharpening* deconvolution algorithm from Tofwerk.

• Chopper hardware is compatible with mAMS and AMS vacuum systems.

• Works with AP240 data card but only at 50% efficiency.

• Use with ADQ1600 data card is under development, 100% data duty cycle.
New Data Acquisition Card
SP Devices ADQ1600

- Fast with extended ADC range, 14 bit, 1.6 GS/sec
- Will replace AP240 (8 bit, 1 GS/sec)
- Custom firmware (Tofwerk-SPD collaboration)
- PCIe and USB versions (for all Tofwerk TOFs)
New Data Acquisition Card
SP Devices ADQ1600

• AMS DAQ V5, strategic break point for AMS sw.

• ePTOF mode under development.

• Single particle mode under development (support for LS module?)

• Joel will provide update on new AMS DAQ V5
PM2.5 Particle Lens

• We have working devices!
• Continued challenge is that each unit requires intensive characterization.
• We are improving at this.

• New results to be presented by Leah Williams
“Spot” measurements to quickly characterize focusing performance
Capture Vaporizer
and
Particle Bounce
Particle Bounce

Ideal scenario. Vaporization on 1\textsuperscript{st} collision

Lost ion production
Collection Efficiency

Standard Vaporizer 600C

\( \text{CE} = 22\% \)

\( \text{NH}_4\text{NO}_3 \)

\( (\text{NH}_4)_2\text{SO}_4 \)

“calibration”
TRACEPRO simulation of particle bounce with a “capture” geometry

Wire frame view
Single trajectory
10-100% incident energy flux display range
White diffuse surface
Capture Vaporizer pTOF Traces SO4 and NO3
Sulfate is broadened as expected

300 nm 620C
Particles entering Capture Vaporizer
more m30 and broader than m46
SO4 is broadened as expected

m64
m48
Sig_p30_R15430
Sig_p46_R15430

More experiments needed...
Org mass spectrum shows a bigger fraction of Org is going into m/z 44
Capture Vaporizer

- Mostly applicable to ACSM since pTOF is distorted (as expected).
- The device works, all the mass is recovered.
- Need to carefully evaluate fragmentation patterns.
- Data set from SOAS to be presented
  - Side-by-side comparison of HTOF w/CV and HTOF w/standard vaporizer
Automatic TOF tuning by Thuner

One button simultaneous tuning of multiple TOF (and User) voltages.

- TOFWERK software package (.net, dll)
- Commercial algorithms (Umetrics MODDE)
- Compatible with any Tofwerk TOF

Tofwerk: Manuel Hutterli, Fredrik Östlund, Christian Tanner
Thuner - Simultaneous optimization of signal intensity and resolution

Quad 2 (BSQ) and Primary Beam Voltages

Sensitivity
Resolution

CIMS Clinic Boulder March 2013