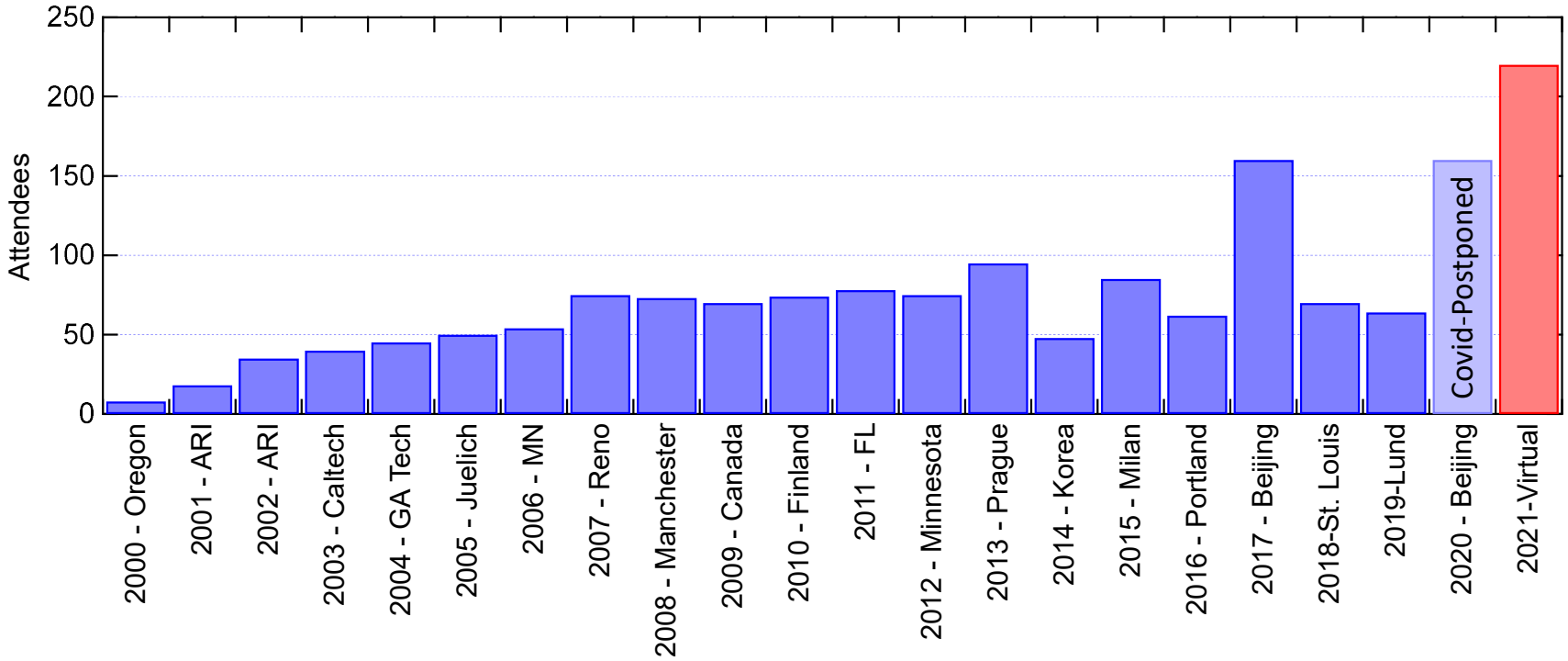
Overview of Aerodyne Instruments

21st (and first virtual) AMS Users Meeting

J. Jayne

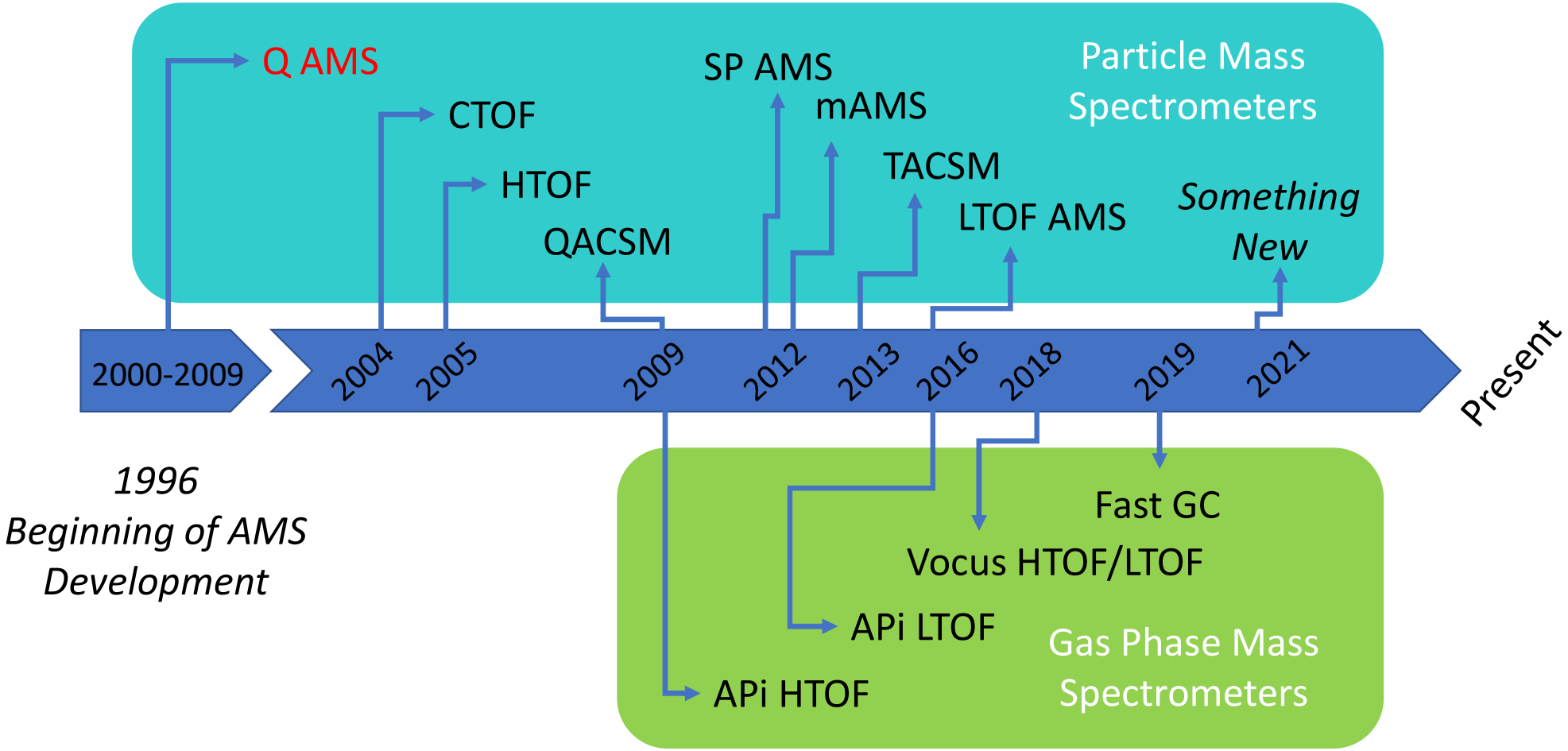
Jan 19, 2021

AMS Users Meeting Attendance



>280 Registered attendees for 2021 Virtual Meeting

MS Systems Production Time-Line



Aerodyne Mass Spectrometer Systems

2000-to date

Aerosol Instruments

~~QAMS~~
CTOF AMS
HTOF AMS
SP HTOF AMS
mini-AMS
LTOF AMS
QACSM
TOF ACSM
TOF ACSM X
Calibration System

New for 2021

2009-to date

Gas Phase Instruments

APi – TOF
EI-TOF
VOCUS PTR
GC (EI TOF, CIMS, VOCUS)

Available with H or L ToF MS detectors

Sources

IMR (I^-, SF_6^-, H_3O^+, Acetate,…)
Nitrate (NO_3^-)
FIGAERO
VIA

} Aerosol Sources

Aerodyne Mass Spectrometry Development and Support Team

Engineers	**AMS/ACSM Scientists**	**CIMS/Vocus/GC Scientists**
Bill Brooks	Phil Croteau	Manjula Canagaratna
Wade Robinson	Leah Williams	Jordan Krechmer
Dan Thompson	Manjula Canagaratna	Francesca Majluf
Salvador Cartagena	Ed Fortner	Anita Avery
Stephen Prescott	Ben Nault	Andy Lambe
Adin Field	Anita Avery	Megan Claflin
Jason Curry	Donna Sueper	Brian Lerner
	Harald Stark	Donna Sueper
	Andy Lambe	Harald Stark
	Penglin Ye *(in China)*	Penglin Ye

Doug Worsnop
John Jayne
Cameron Martin

Support email address: CACC-Support@aerodyne.com
New Aerodyne Knowledge Base
CACC Group Personnel: www.aerodyne.com/centers/aerosol-cloud-chemistry/

Aerodyne CACC

CACC-Support@aerodyne.com

Full bios at www.aerodyne.com/centers/aerosol-cloud-chemistry


Doug


John


Jordan


Dan


Manjula


Wade


Stephen


Leah


Phil


Harald


Donna


Bill


Ed


Sal


Cameron


Andy

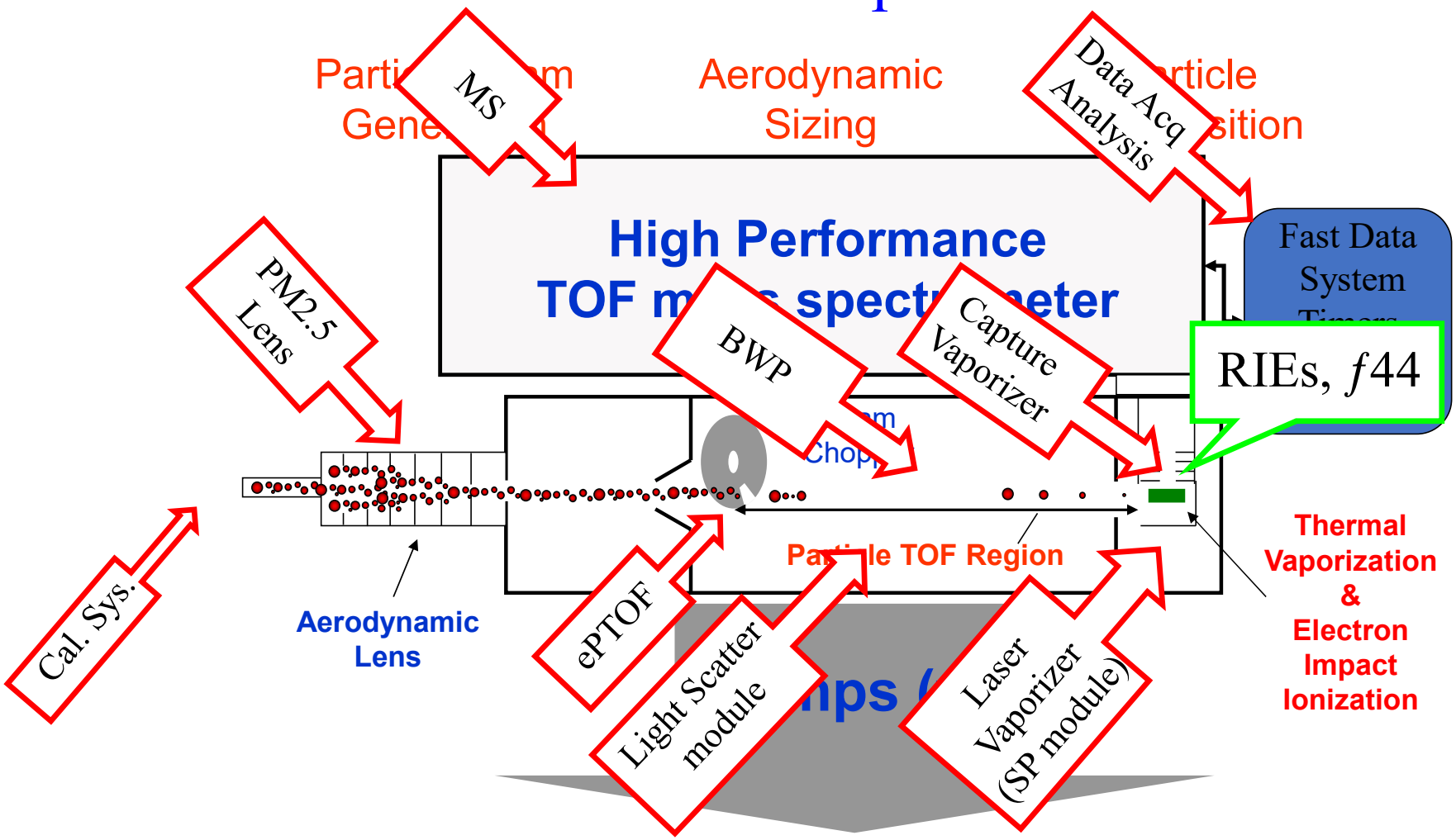

Megan


Brian


Francesca


Anita

Aerosol Mass Spectrometer



AMS Components and Other Aerodyne Instruments

Components

SP – Soot Particle module
LS – Light Scattering module
PAM – *OFR*
TAG Aerosol Collector
Thermal Denuder
Aerosol Dryer
Sample Line Flow Controller
Pressure Controlled Inlet
EyeOn control system
Beam Width Probe
Auto Valve System
PM2.5 Lens and Capture Vaporizer

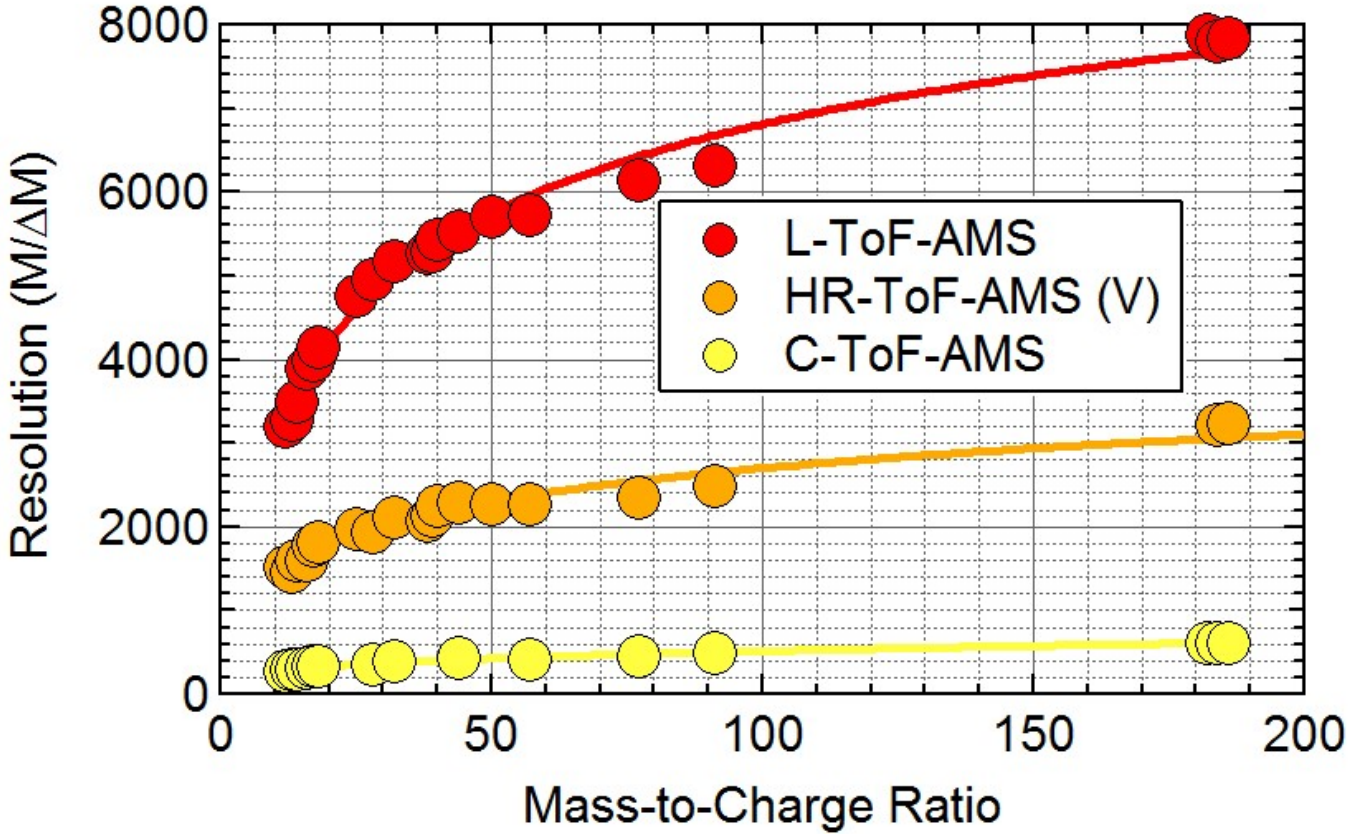
Instruments

TILDAS (high precision IR measurement for trace gases and isotopes)
CAPS (NO2, PMex, SSA)
TWST-EN (Measures cloud optical depth and cloud droplet size and phase)

HTOF and LTOF AMS Systems

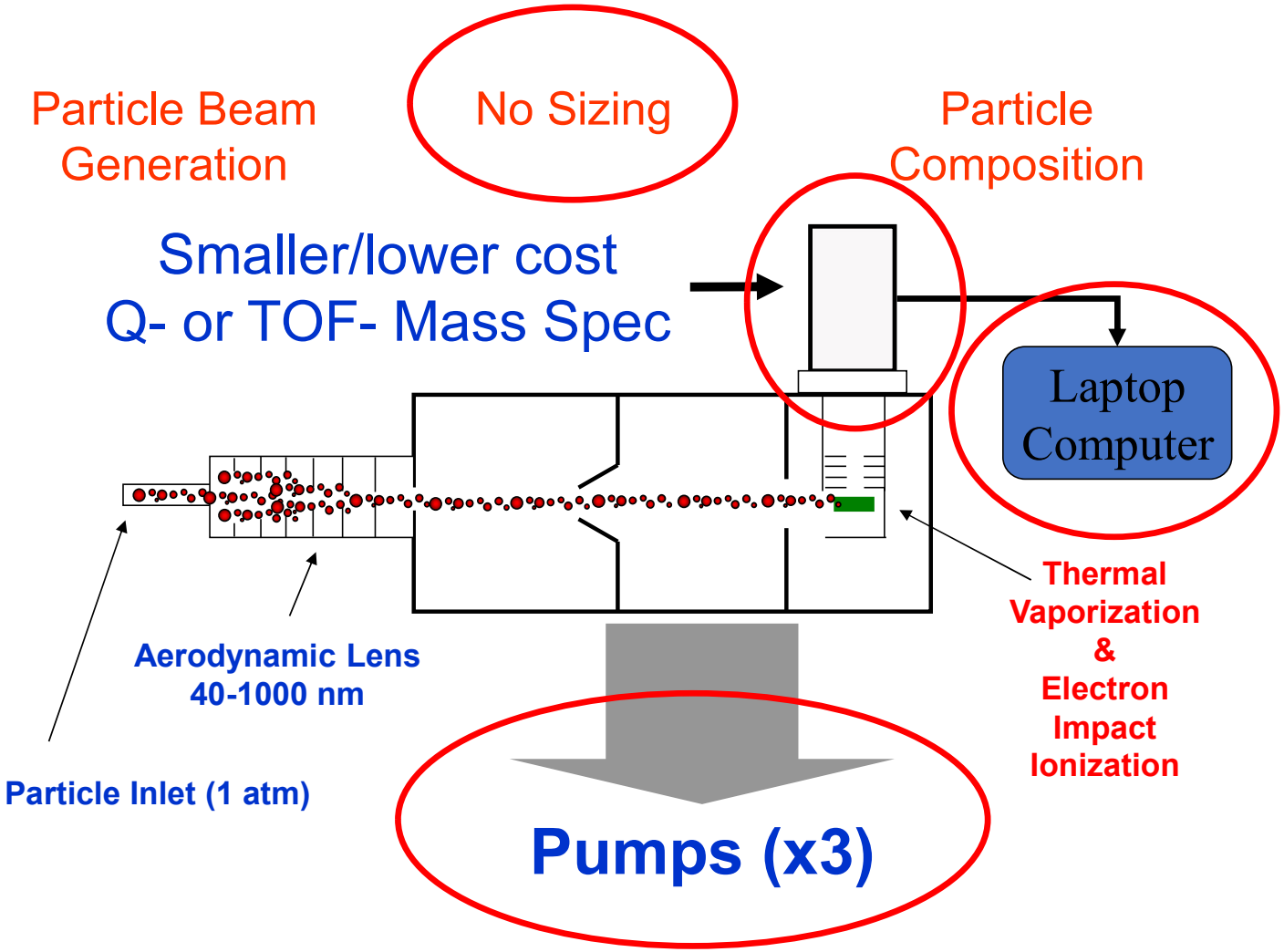
LTOF AMS ~2x the resolution of HTOF (Vmode) with the same sensitivity.
Also, 2x the length of the HTOF

Resolution of C-TOF, H-TOF and L-TOF



Andy Lambe

Aerosol Chemical Speciation Monitor - ACSM

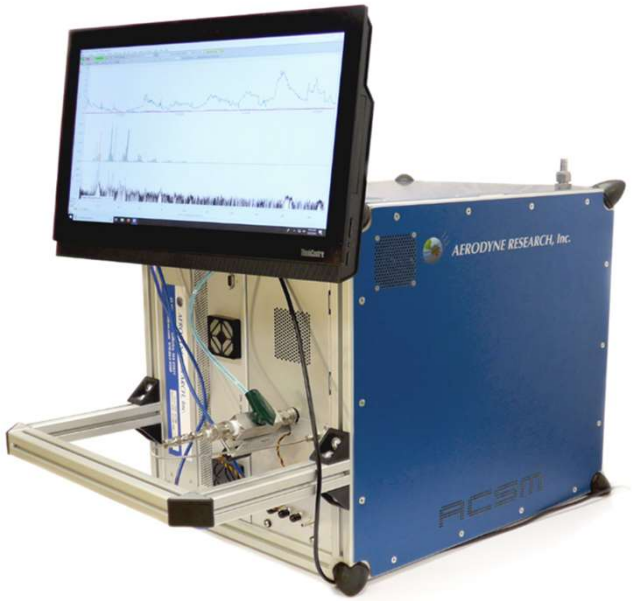


QACSM and ToF ACSM Systems

QACSM

For routine monitoring

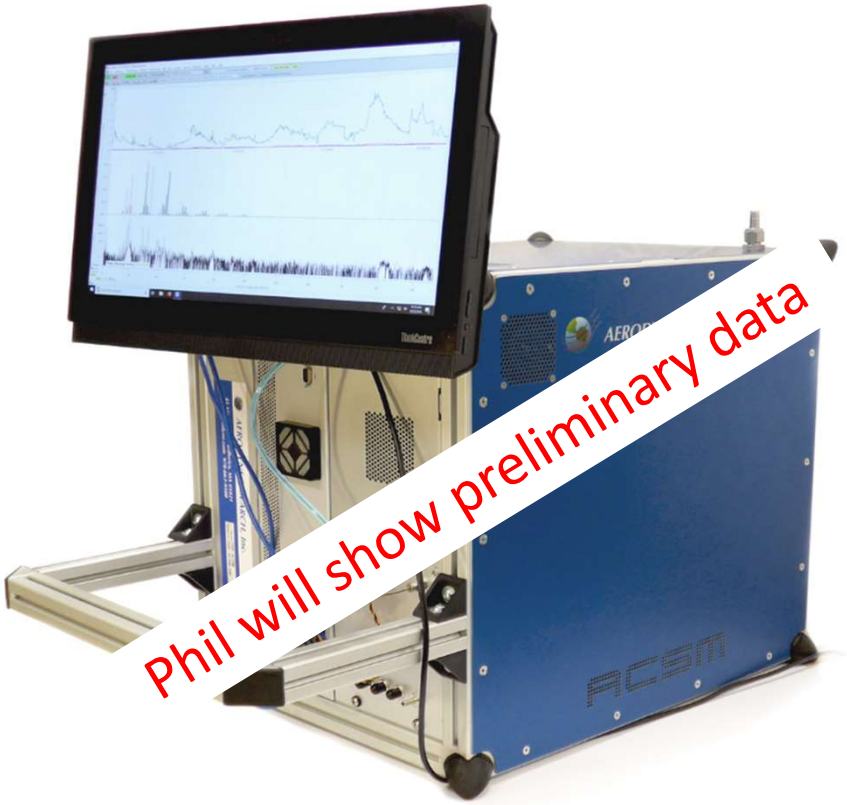
eTOF ACSM



Higher performance compared to Q ACSM
2-3x improved sensitivity with faster data rate (~1 min).

ToF ACSM X
New this Year

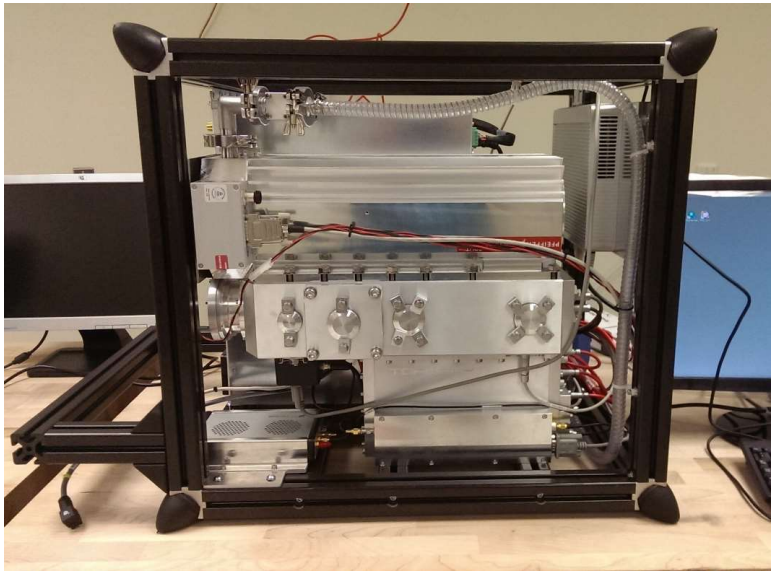
- *'X' for eXtra resolution*
- ~2000 M/ΔM
- *Provides O:C and H:C ratios*
- *Improved NH4 measurements*
- *Performance evaluation in progress*



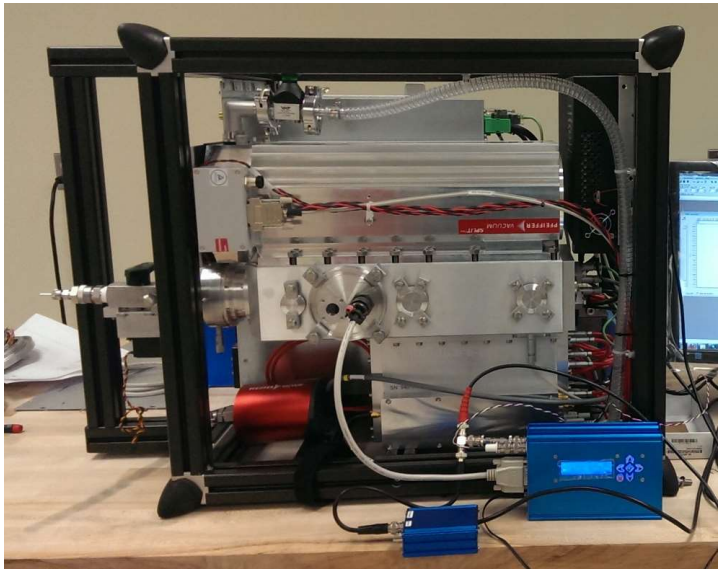
(Almost) Same size as TOF ACSM but uses a higher resolution TOF MS

ToF ACSM and mini-AMS Systems

TOF ACSM



cTOF mini-AMS



Differences between ACSM and mAMS are the MS, chopper and the DAQ system

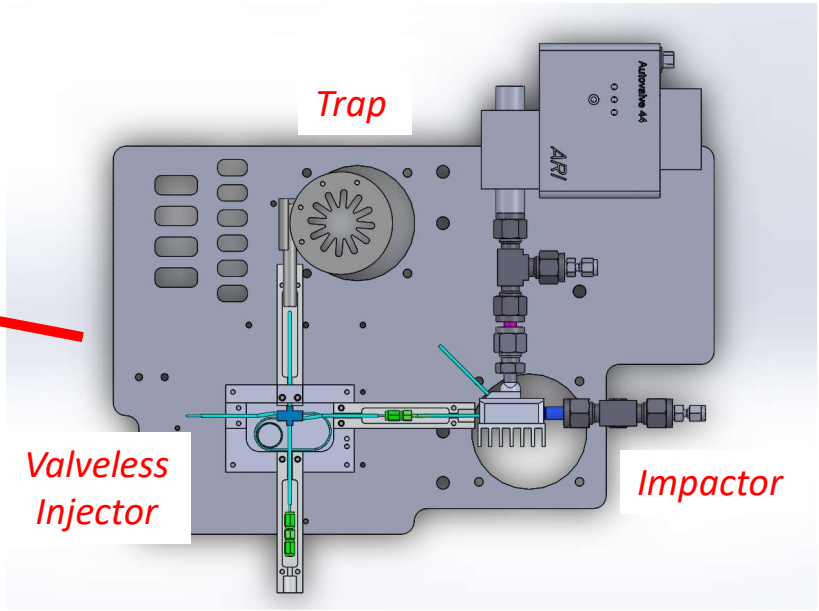
All AMS and ACSM Systems Share Some Common Features

- Particle aerodynamic lens
- A differentially pumped high vacuum system, *efficient gas-particle separation*
- Particle vaporizer
- Electron impact ionization source
- Mass spectrometer ⟹ performance/Cost

TAG System
for Organic Aerosol Molecular Speciation

TAG collector show with Agilent GC MS detector, also compatible with EI TOF MS and CIMS detectors

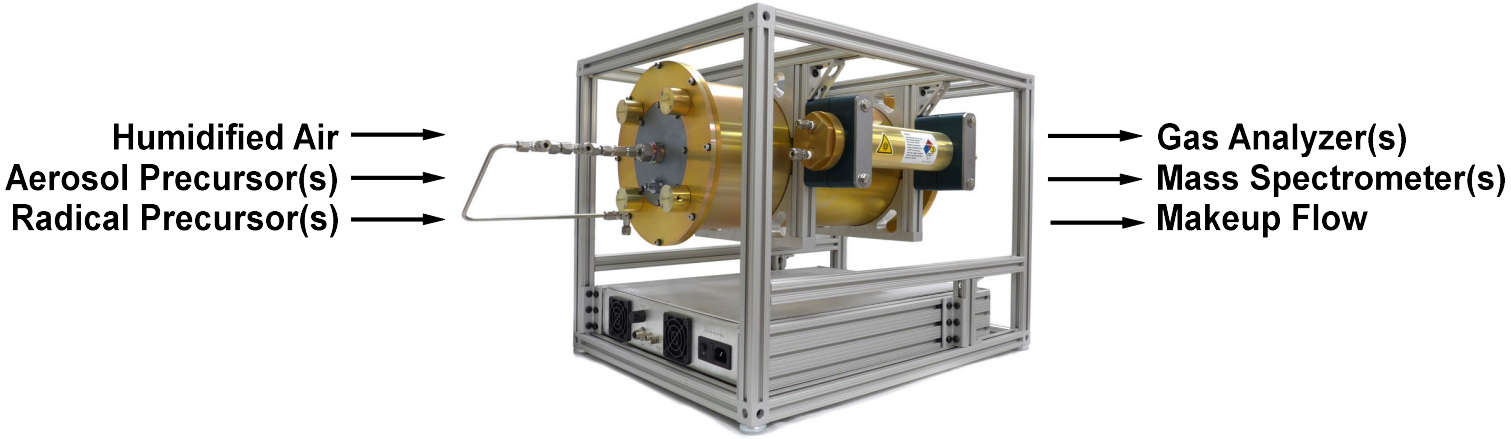
Impactor Collection and Thermal Desorption cell (iCTD) and valveless injector Module



Wen Xu, Aerodyne
Nathan Kreisberg, Aerosol Dynamics
Allen Goldstein, UC Berkeley

PAM – Potential Aerosol Mass Oxidation Flow Reactor

Front end to AMS/ACSM (and CIMS/Vocus) for lab and ambient experiments

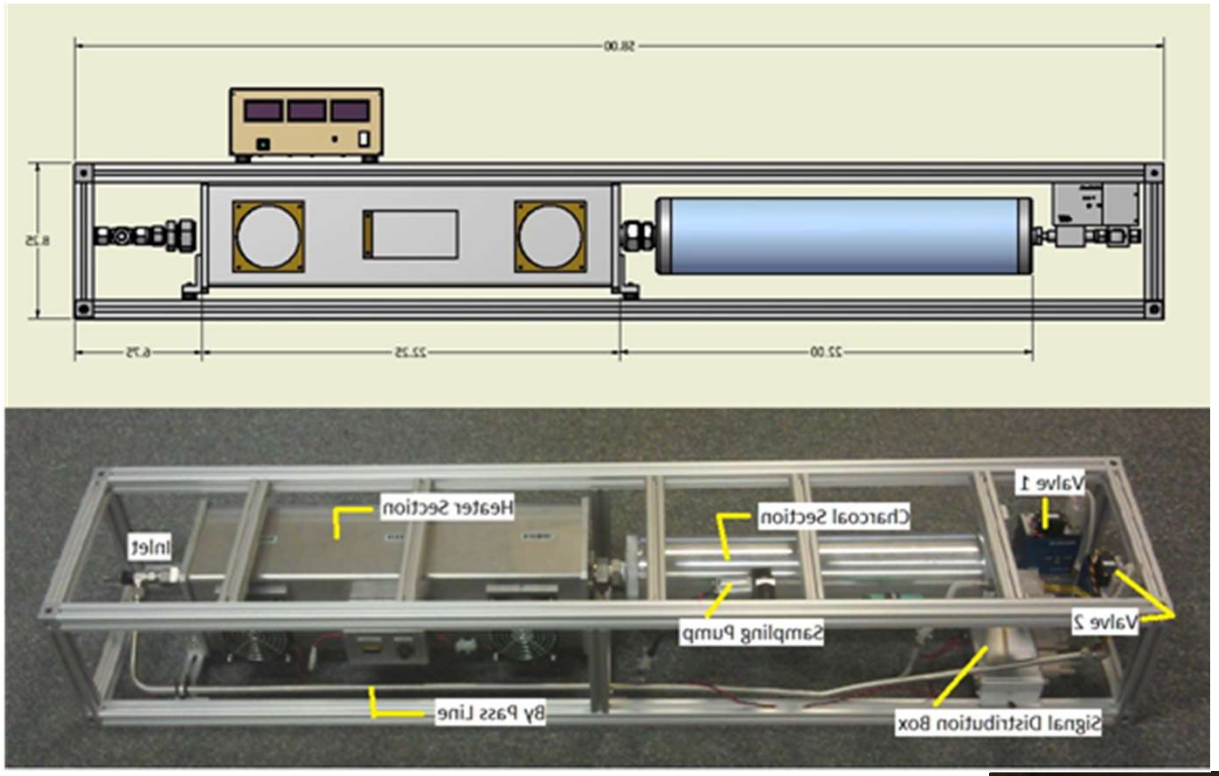


Radical Precursors + hv →→ Radicals
Radicals + Aerosol Precursors →→ Oxidation Products

- Technique developed by Bill Brune (Kang et al., ACP, 2007)
- **Includes**: OFR, O_3 chamber, humidifier, autovalve, UV and RH/T sensors
- **Options**: MFCs, UV lamps (l = 313 – 369 nm), syringe pump for VOC injection
- Automated operation via PAM controls software

Andy Lambe

Thermal Denuder System

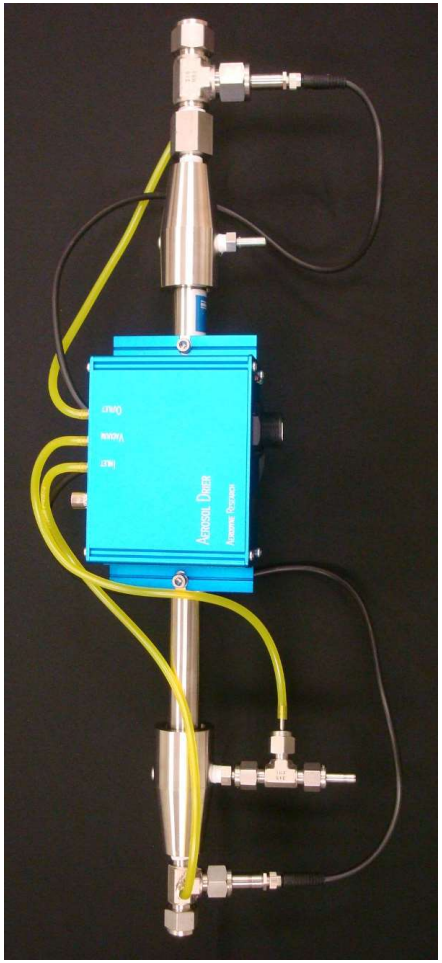


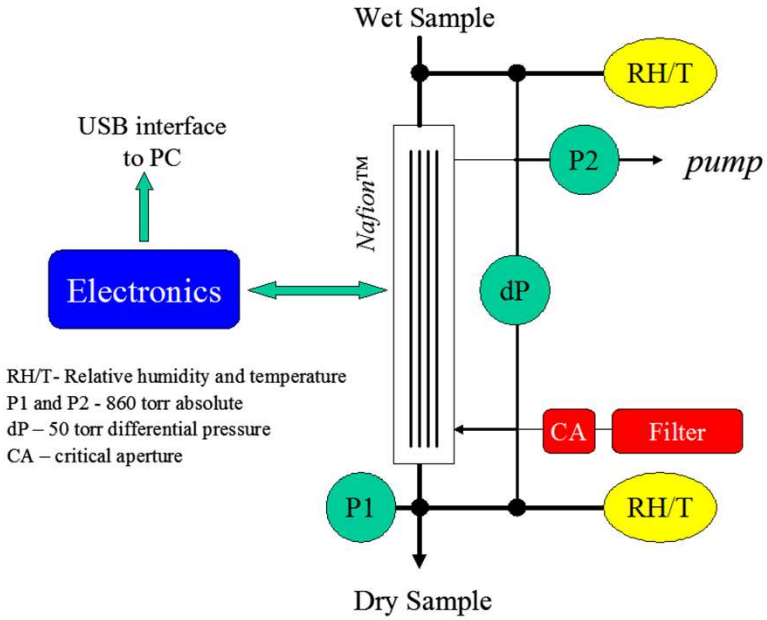
For aerosol volatility studies

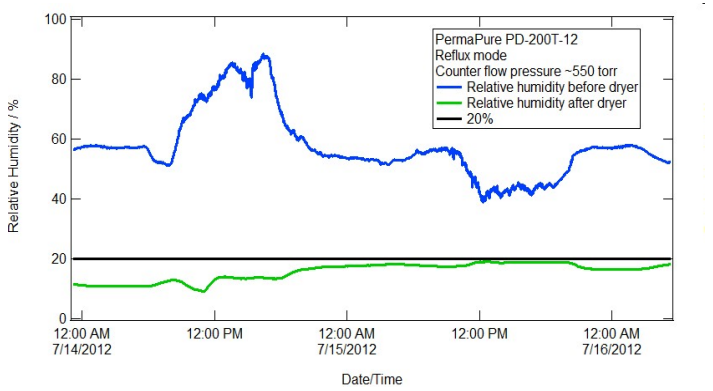
Recent control SW updates

Aerosol Sample Dryer System

Nafion based dryer

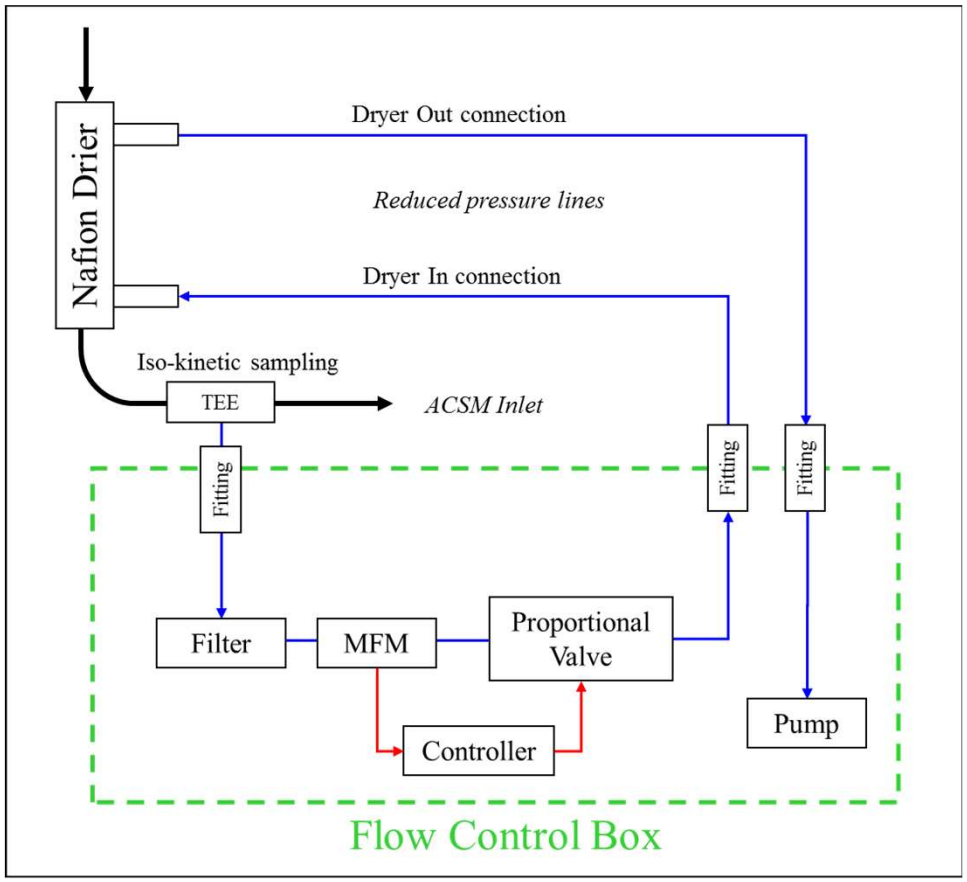




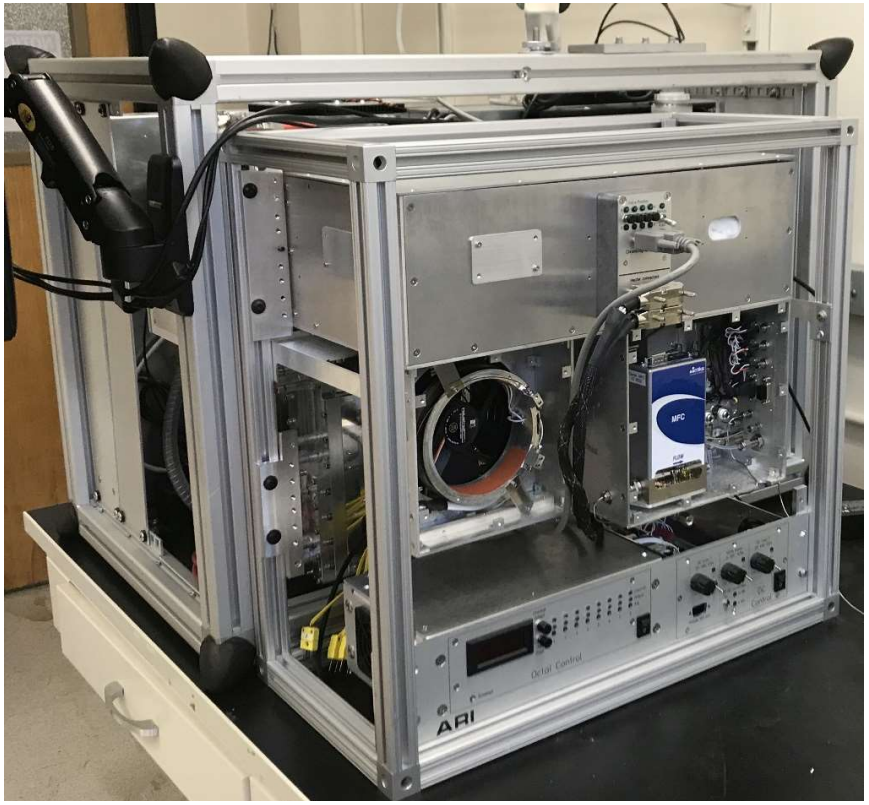


Sample Line Flow Controller System

- Light weight, low power (24V)
- Up to 8 LPM
- Designed for compatibility with Dryer system



ARI Fast GC system



ARI GC system shown connected to EI TOF MS

Adaptable to:

- EI-TOF MS
- Vocus PTR-TOF MS
- CI-ToF-MS
- Other detectors

Supports two columns

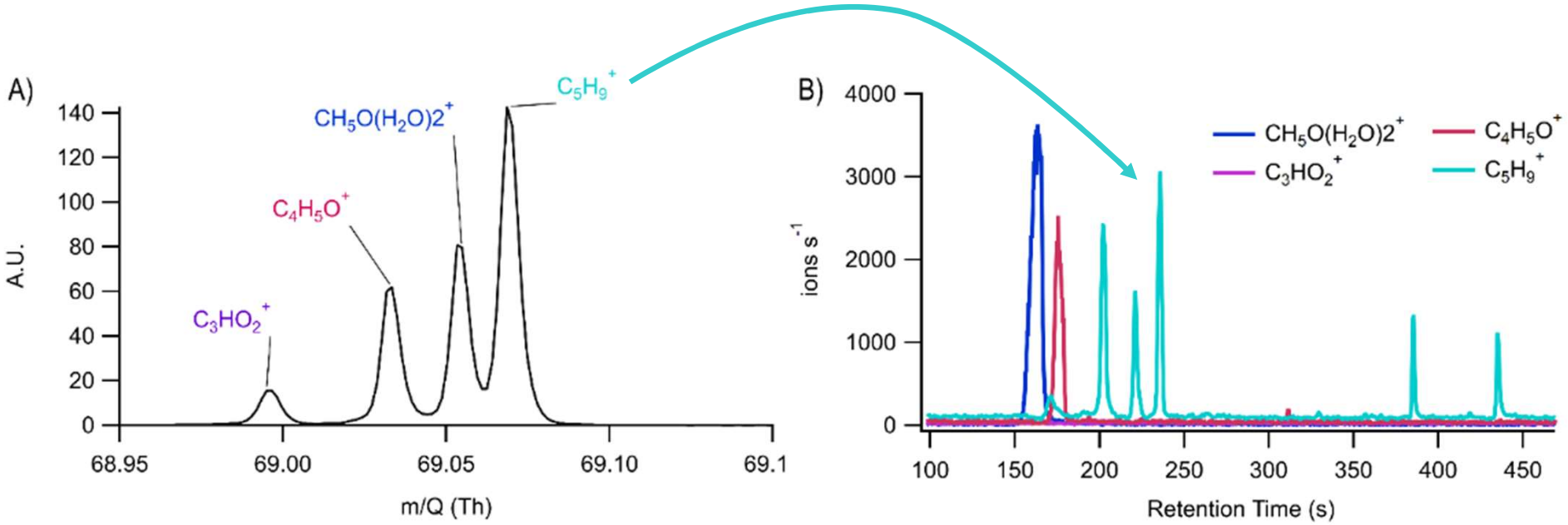
Max. heating rate: 130 C/min
Max cooling rate: 190 C/min
Max column temp: 260 C

Size: 55H x 55W x 30D (cm)
Weight: 24 kg (52 lbs)
Power: ~250W

Brian Lerner, Megan Claflin, Dan Thompson, Stephen Prescott

Claflin et al., Atmos. Meas. Tech., 14, 133–152 (2021)

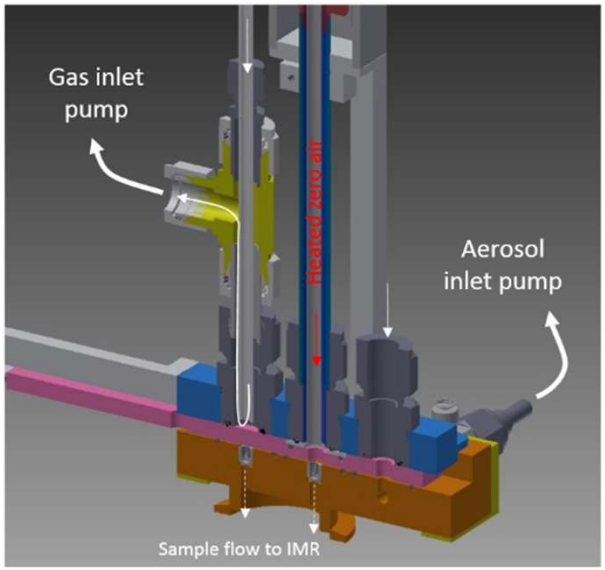
Sample GC-Vocus data.



Vocus mass spectrum at m/Q 69. The high-resolution MS shows four separate peaks

Chromatographic retention time separates the isomeric compounds.

Aerosol Inlets for Gas Phase Mass Spectrometer Systems



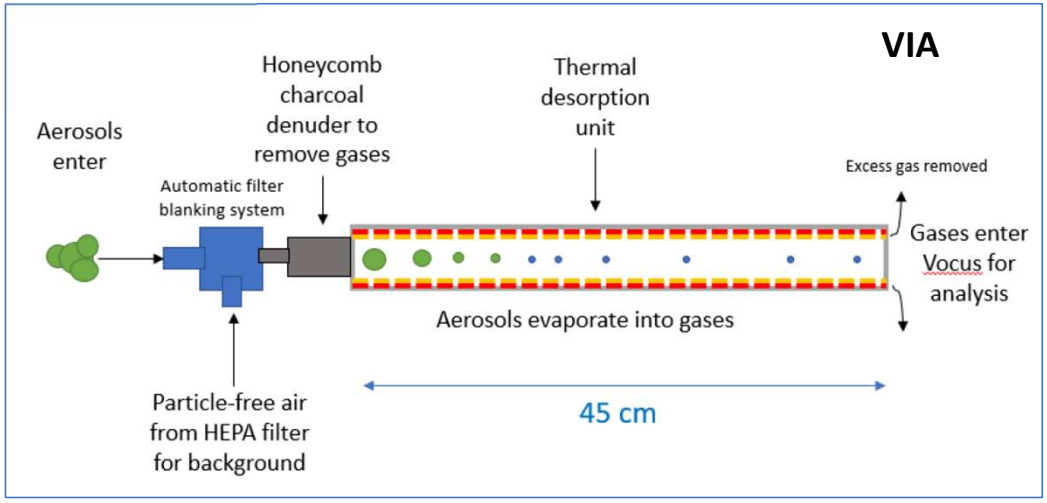
FIGAERO - Filter Inlet for Gases and Aerosol
Filter based particle collection with programmable thermal desorption up to ~250C

Used with CIMS Instruments

EyeOn Control System

VIA - Vocus Inlet for Aerosol
Online thermal desorption of organic aerosols
Programmable temperature from 150 - 250C

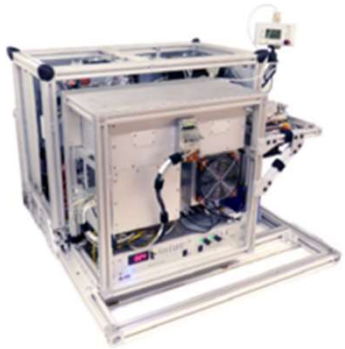
Used with Vocus Instruments



Aerodyne Suite of Mass Spec based Instruments for on-line Gas and Aerosol Chemical Characterization

Vocus PTR-TOF

GC-EI-TOF



TOF-CIMS

SV-TAG

AMS and ACSM

GC-Vocus

TOF-CIMS

TOF-ACSM

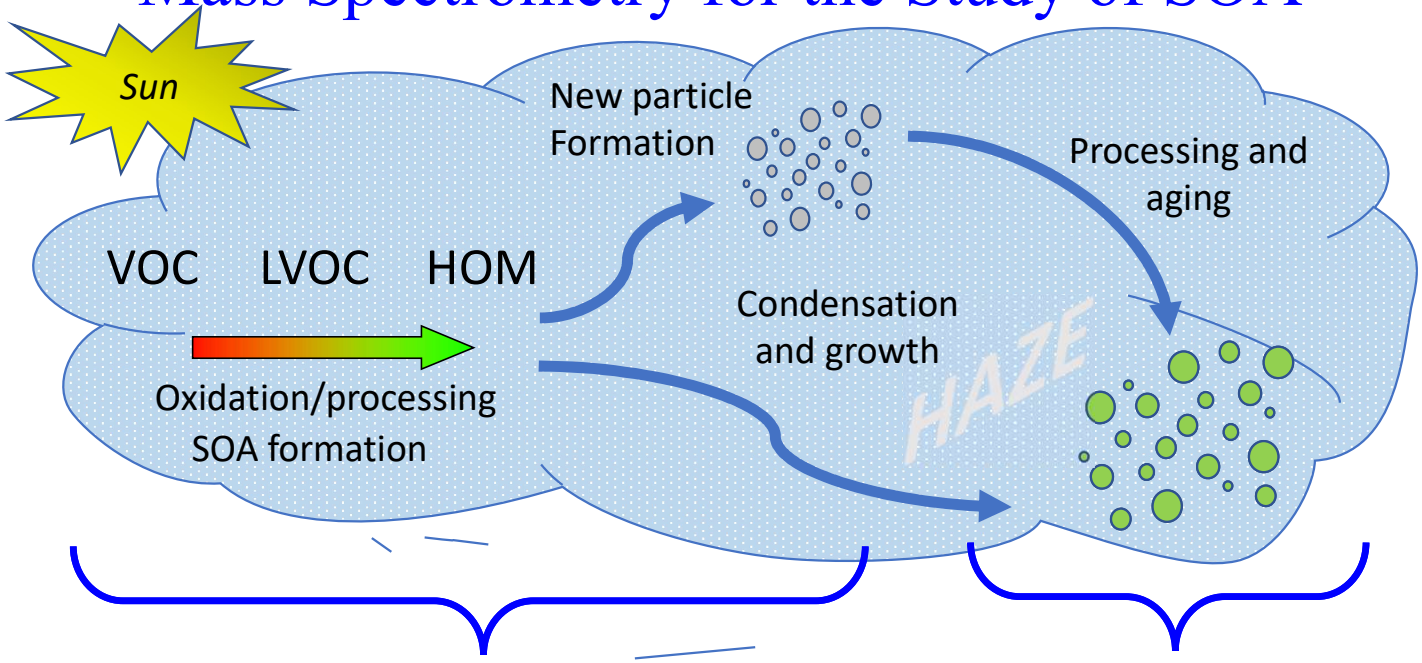
GC-EI-TOF

SV-TAG

Decreasing Volatility

Phil Croteau

CACC Research Group Focus
Mass Spectrometry for the Study of SOA



GC → PTR → CIMS (I^-, NO_3^-) → APi AMS/ACSM

Decreasing Volatility

Aerosol Composition
Chemical and physical properties

Compare observations from lab and field measurements to better understand gas to particle transformations

END