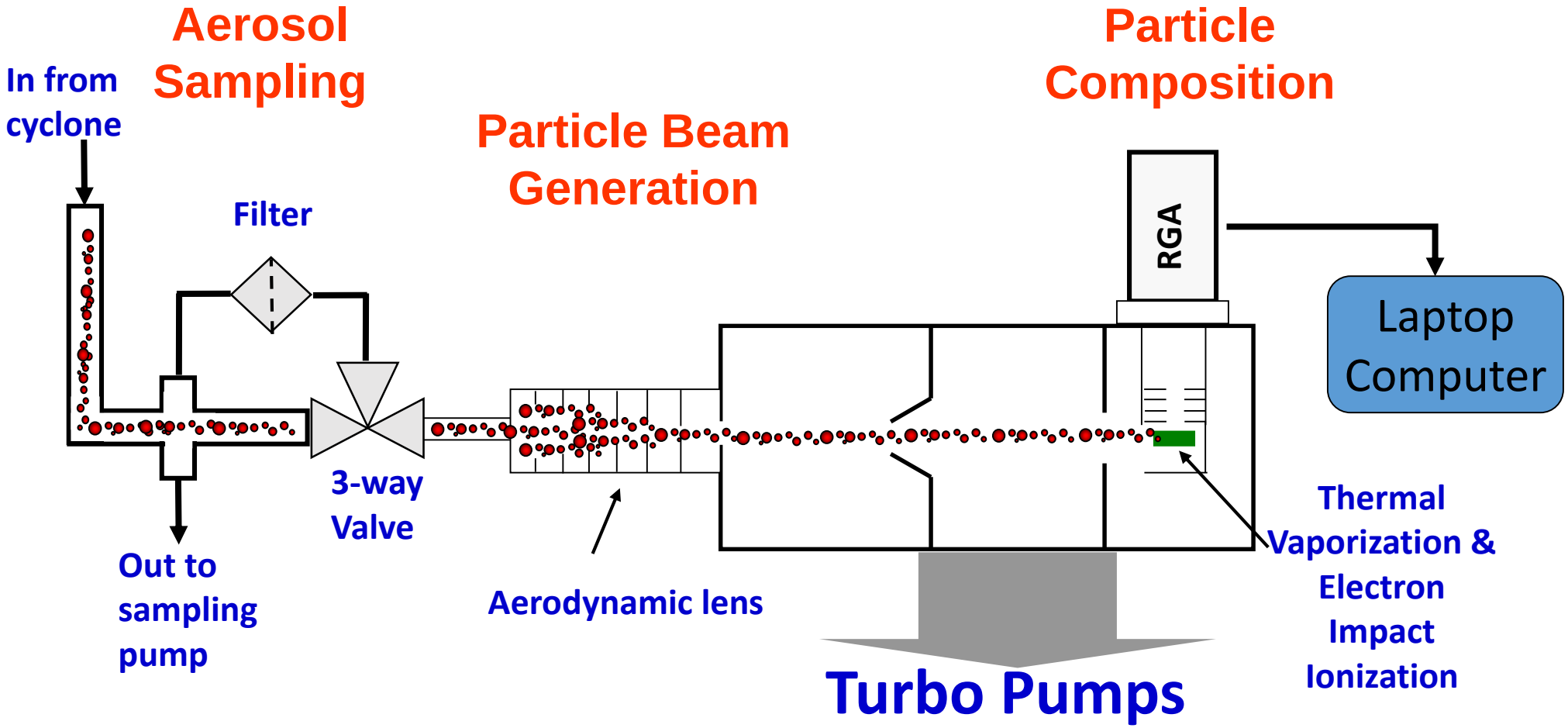
Aerodyne Research, Inc.

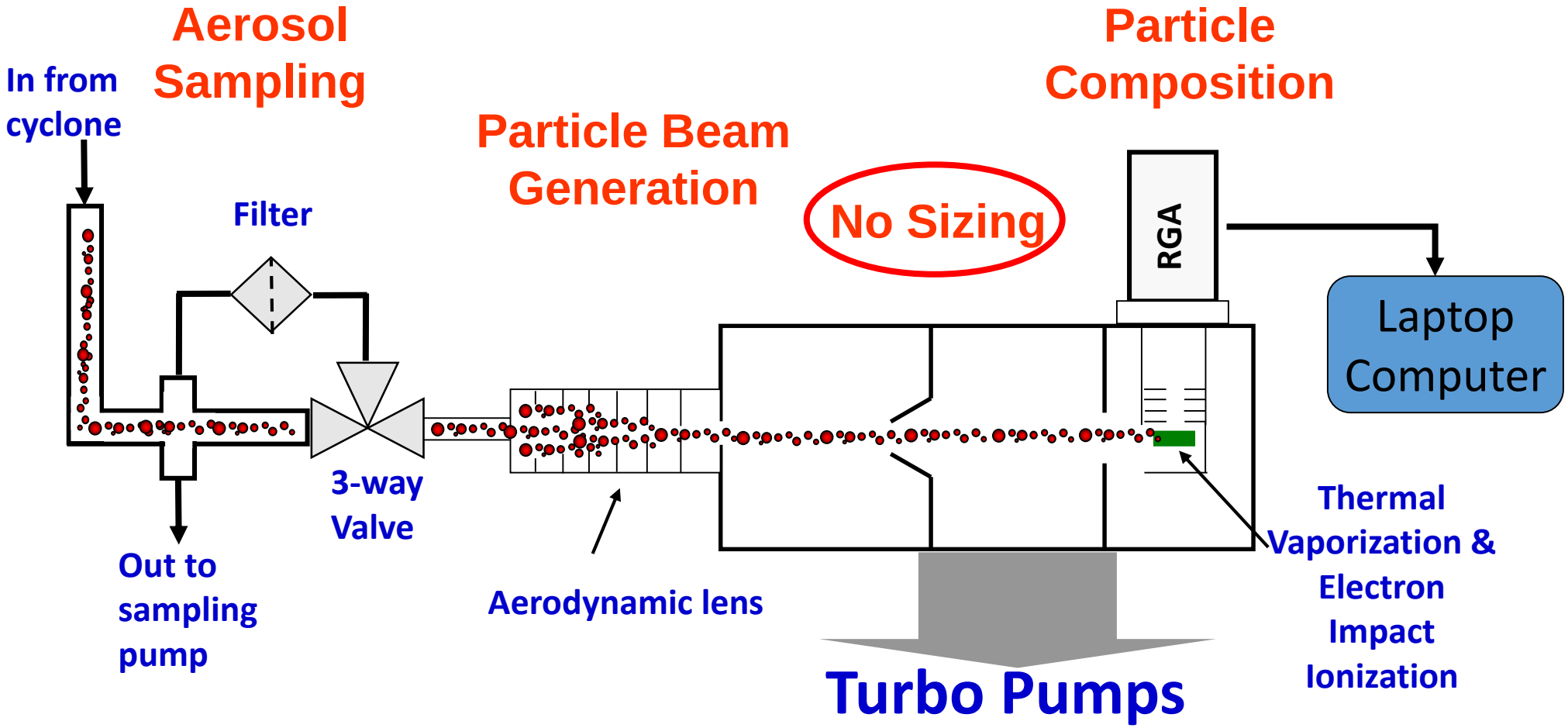
ACSM Update

Aerosol Chemical Speciation Monitor (ACSM)



Ng, et al., Aerosol Sci. Technol., 45:7, 770-784, 2011

Aerosol Chemical Speciation Monitor (ACSM)



Ng, et al., Aerosol Sci. Technol., 45:7, 770-784, 2011

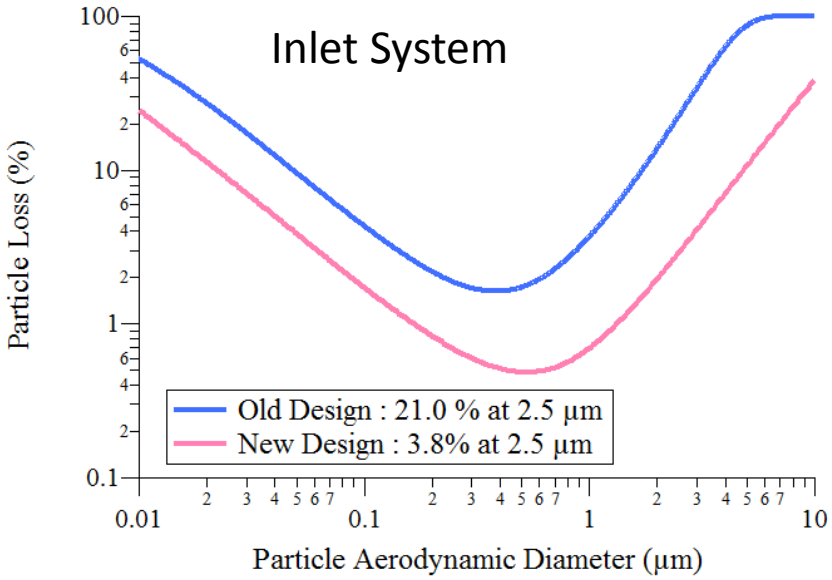
105 Instruments Around the World

TOF-ACSM
x17

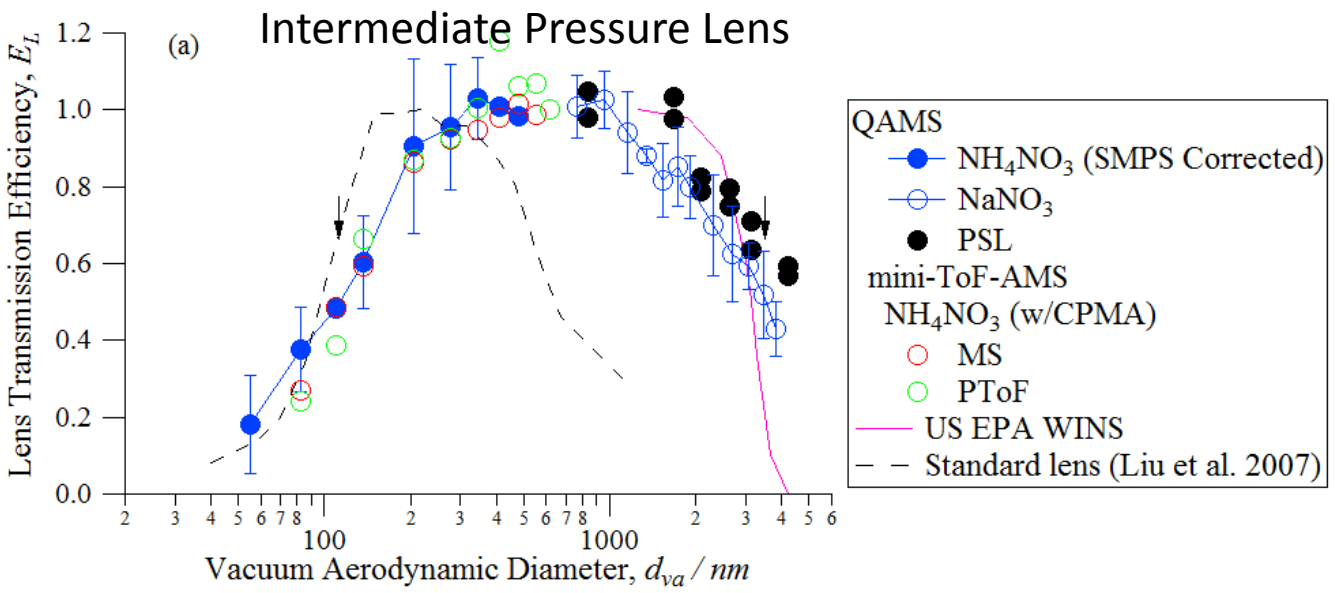
Q-ACSM
x88

PM2.5 Capable ACSM

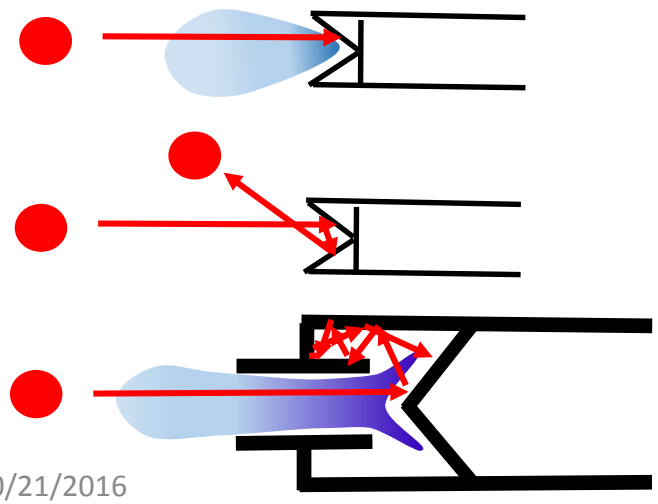
Xu et al., Atmos. Meas. Tech., in press

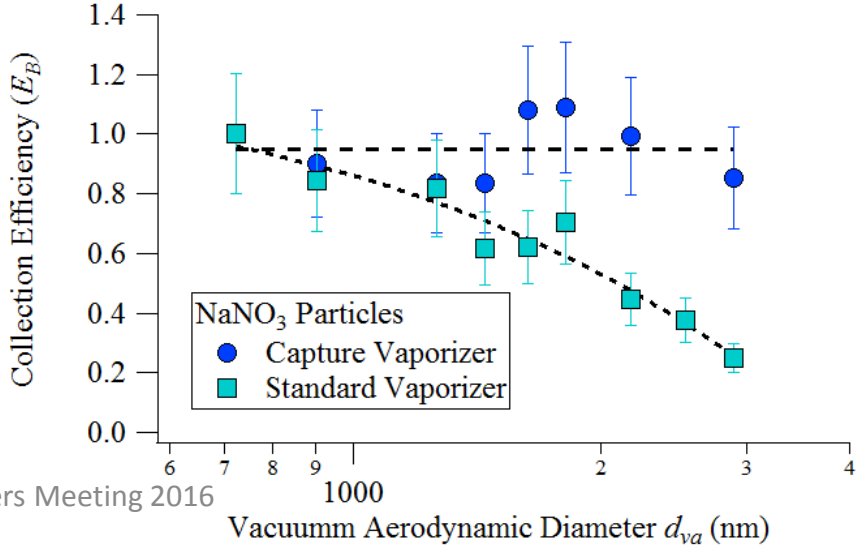


Von der Weiden et al., Atmos. Meas. Tech., 2, 479-494, 2009.

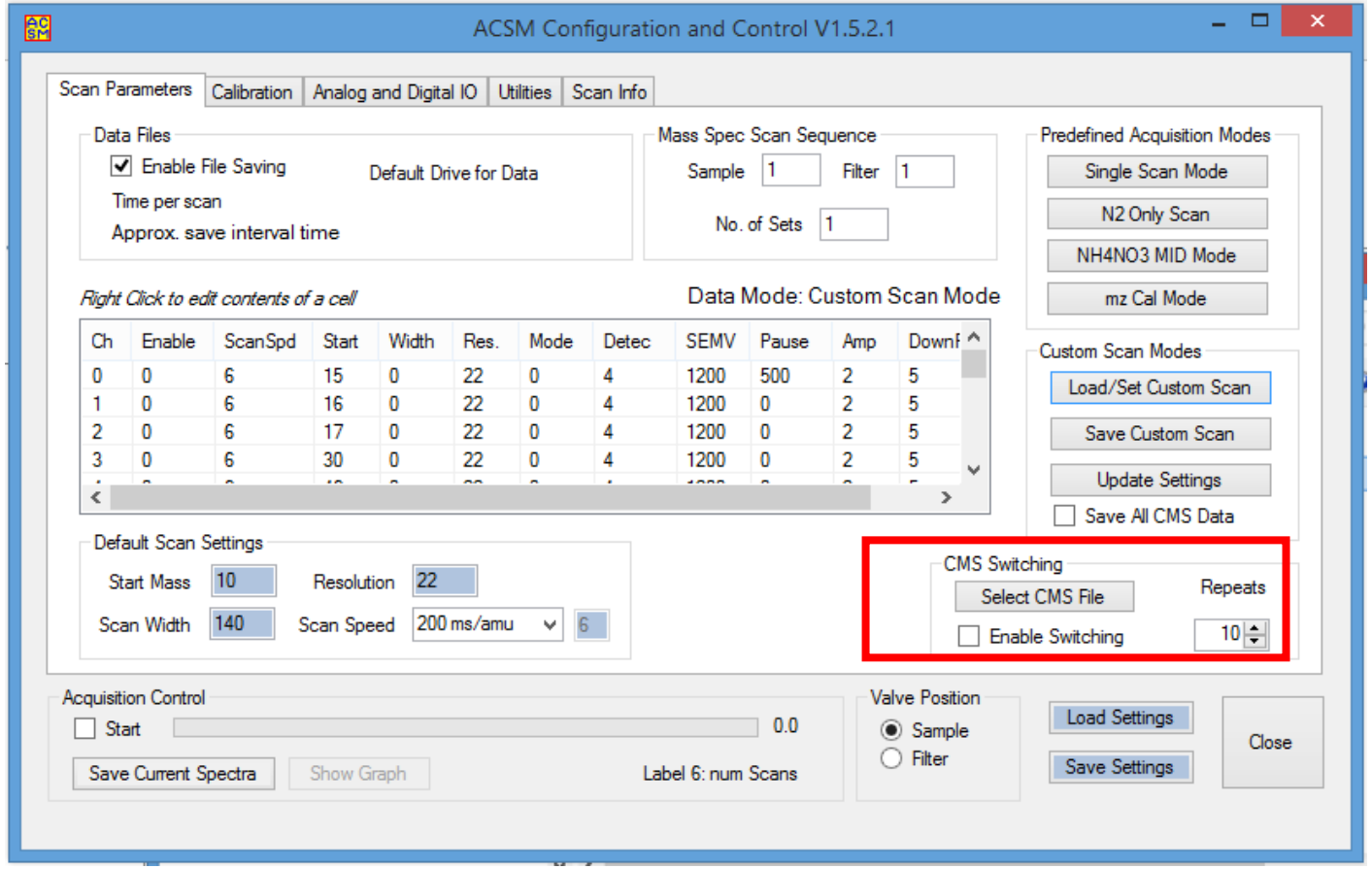


Capture Vaporizer





Custom Mass Spec (CMS) Switching Mode – to investigate time-resolved behavior of m/z 44 (and others)

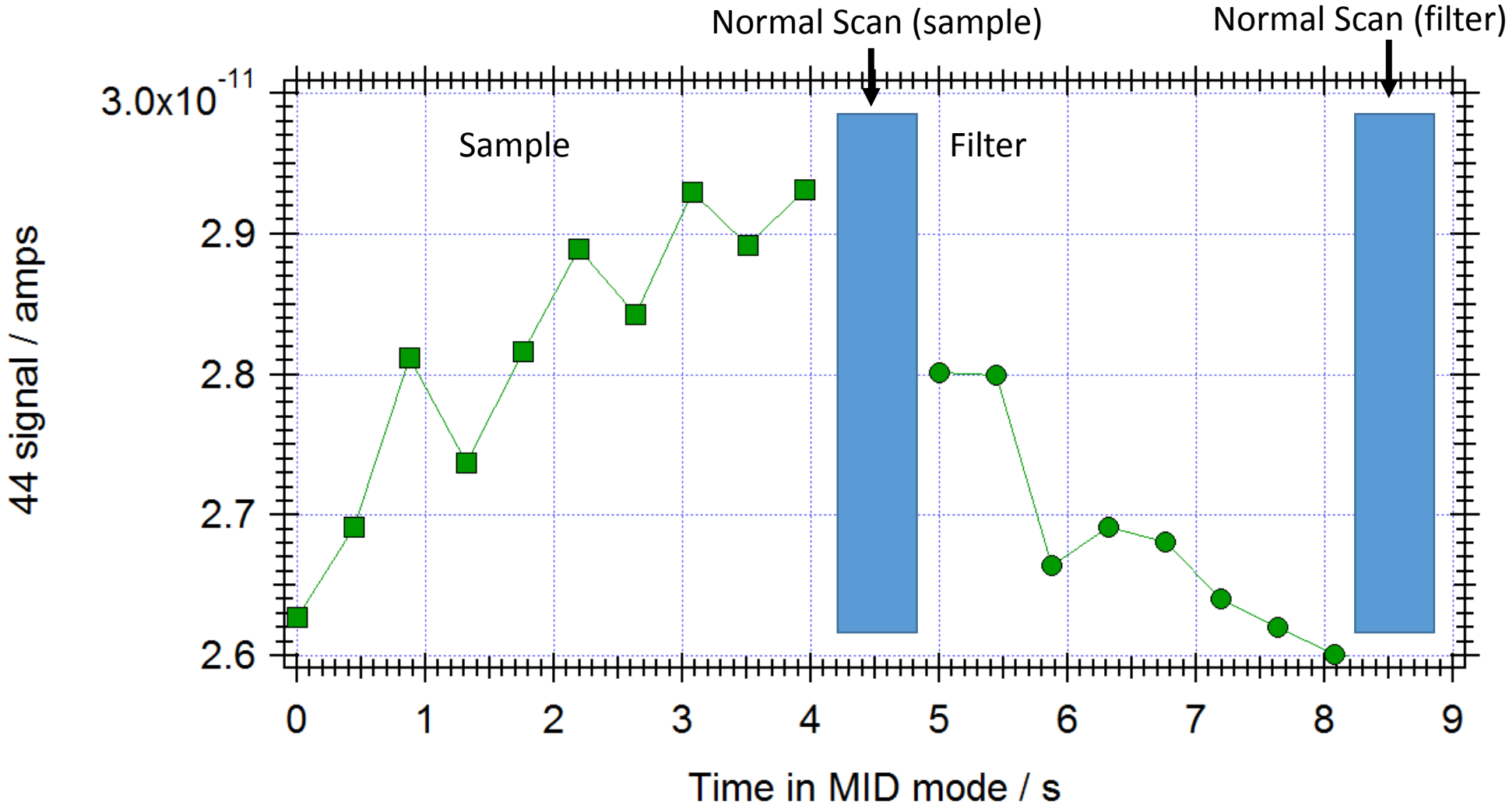


Can switch between an MID mode and standard 'single scan mode'

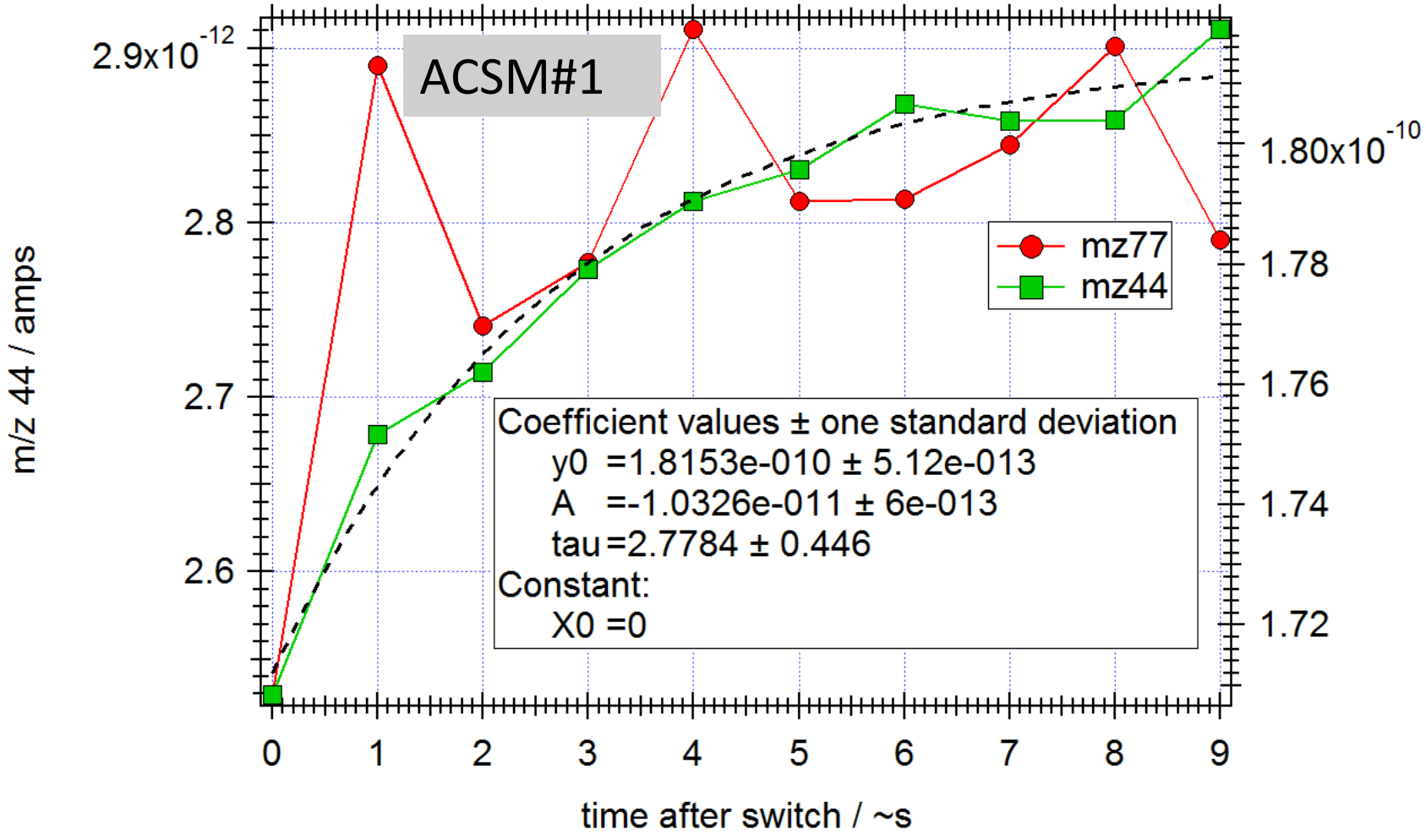
# of Repeats is iterations of MID mode before moving to 'single scan mode'

Generates new type of data file for the custom scan mode data which has is the average of all 'Sets'

What data looks like



PAM Generated Naphthalene SOA Data from ACTRIS Intercomparison II



Instrument	tau
ACSM#1	2.77
ACSM#2	0.60
ACSM#3	2.34
ACSM#4	3.00

TOF-ACSM Detectors

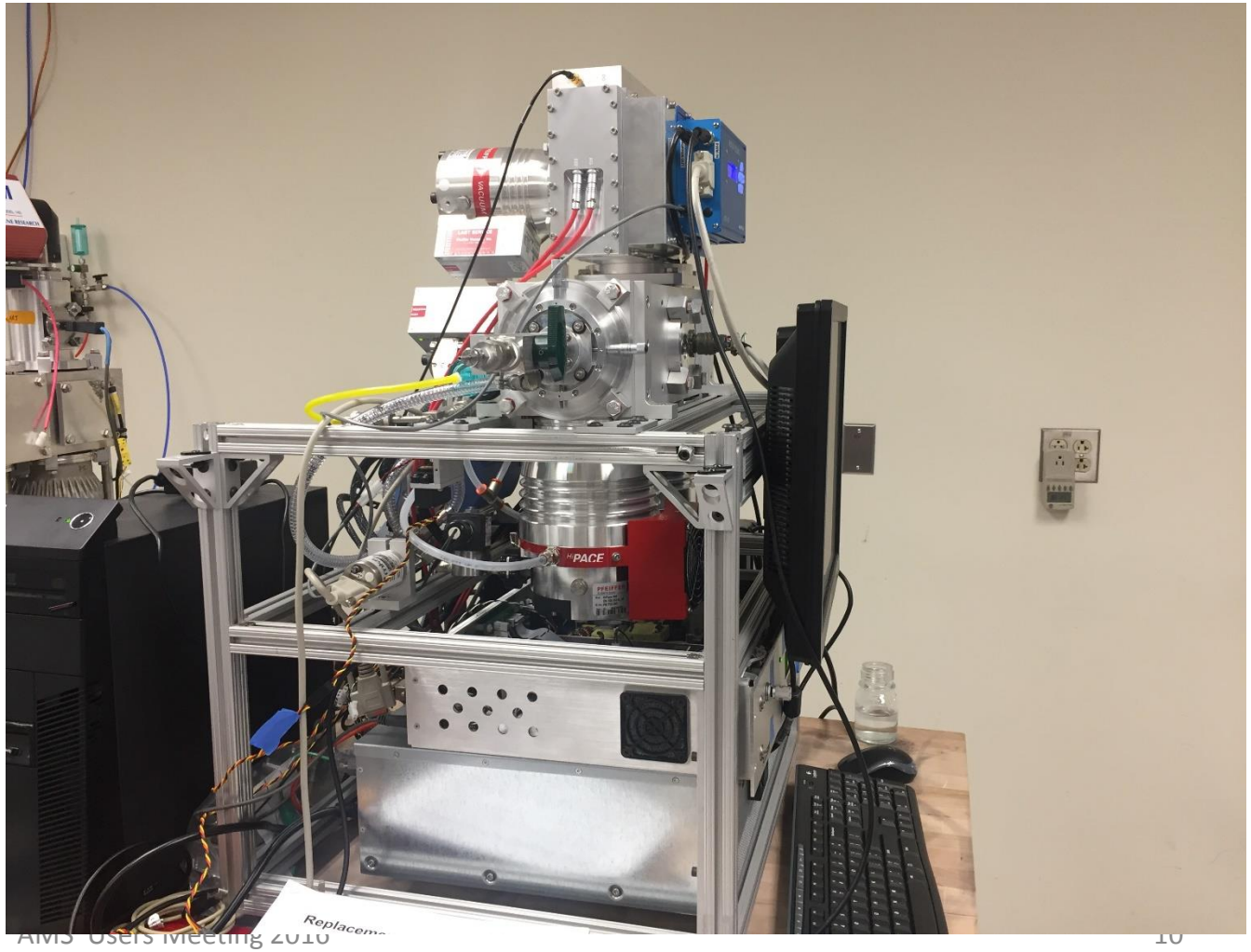
- Implementing a new type of detector
- Benefits
  - Longer Life (factor of 8)
- Drawbacks
  - Somewhat lower resolution (~30%)
  - Maybe lower sensitivity (still testing)
  - Backwards compatibility requires swapping whole extractor flange

FastTOF

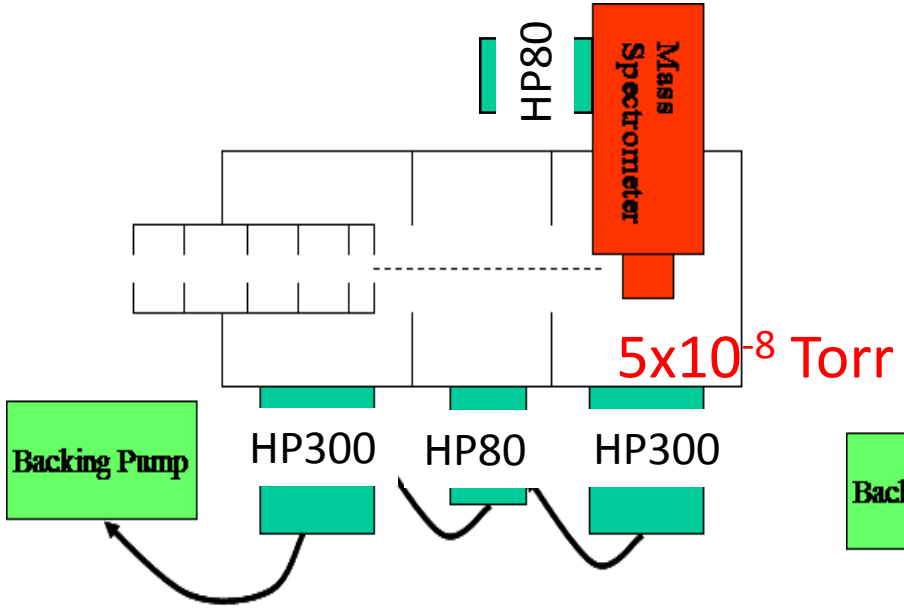
MagneTOF

Q-to-TOF-ACSM Upgrade Possibility

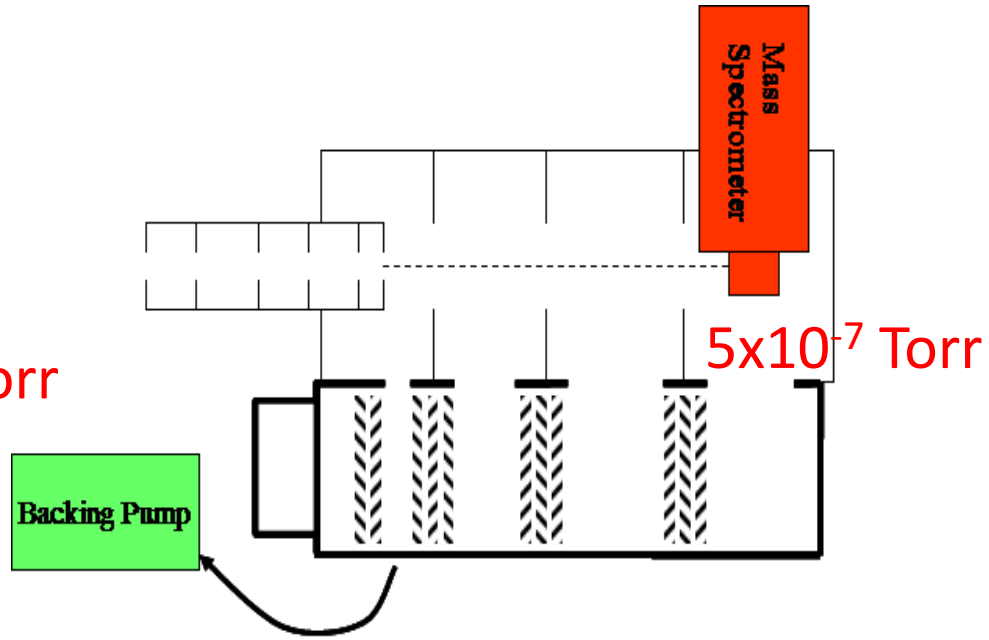
- Can this be done?
  - Yes
  - System exists
  - Runs AMS DAQ
  - Uses Frankensteined AMS/ACSM electronics
  - Same footprint/crate
- Should this be done?
  - No
  - It's too expensive.



Splitflow/SingleTurbos Comparison
Both equipped with eTOF-MS



Discrete/Single turbos



Split flow turbo

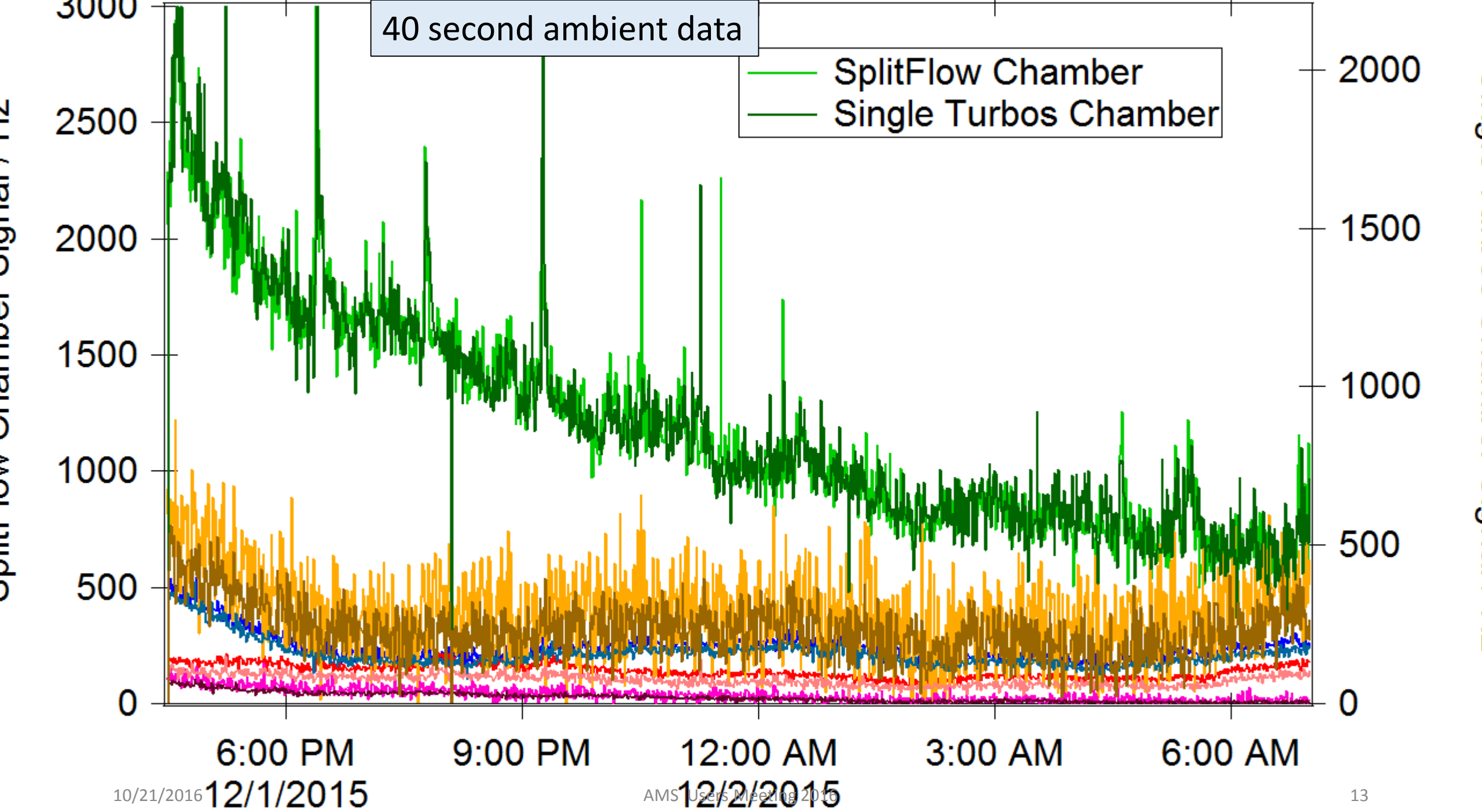
Nominal Pumping speeds (L/s)

300 80 300 80 40 170 135 160

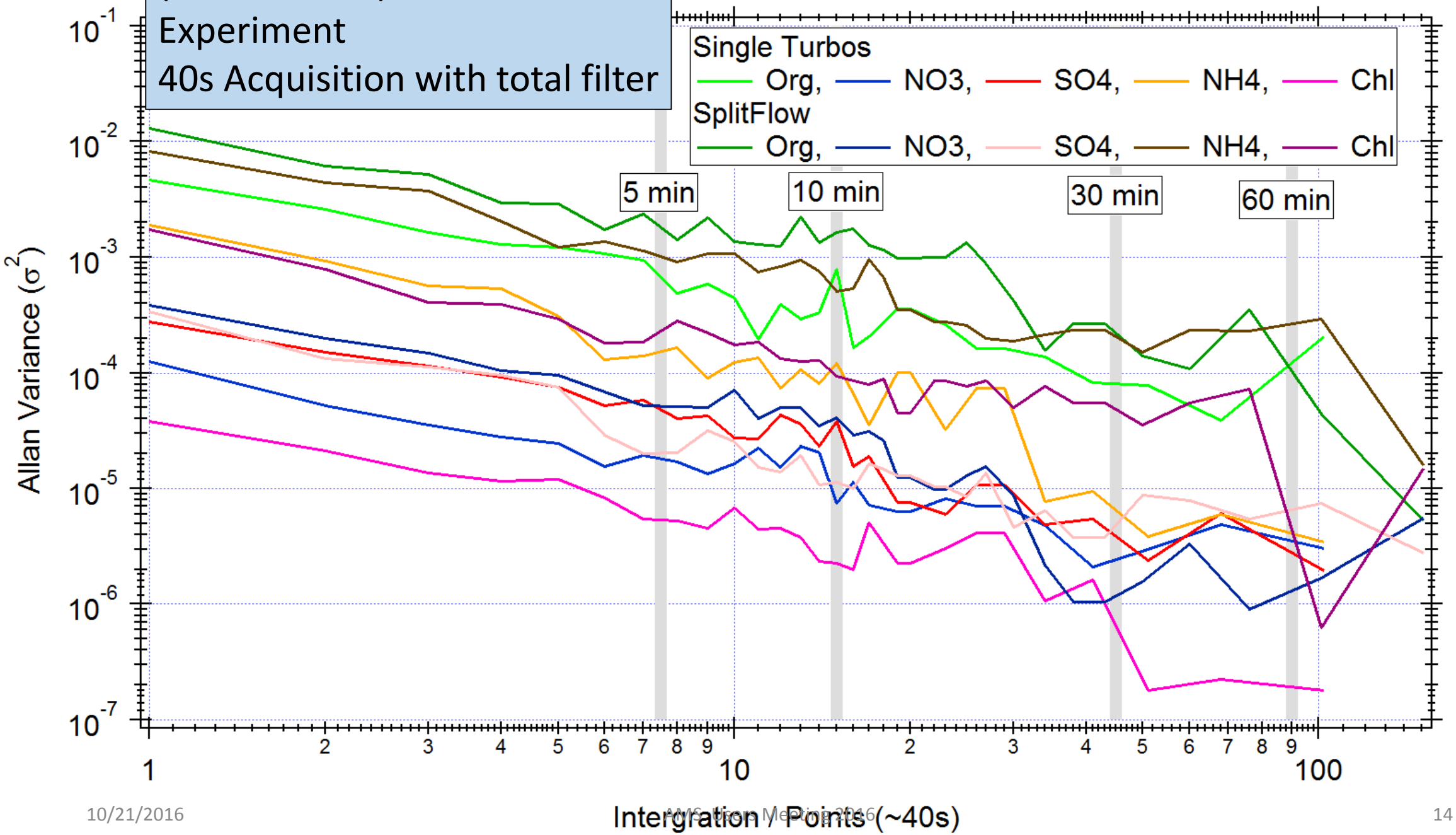
Comparison between operating parameters for Single Turbos (ST) and SplitFlow (SF) ToF-ACSM Systems

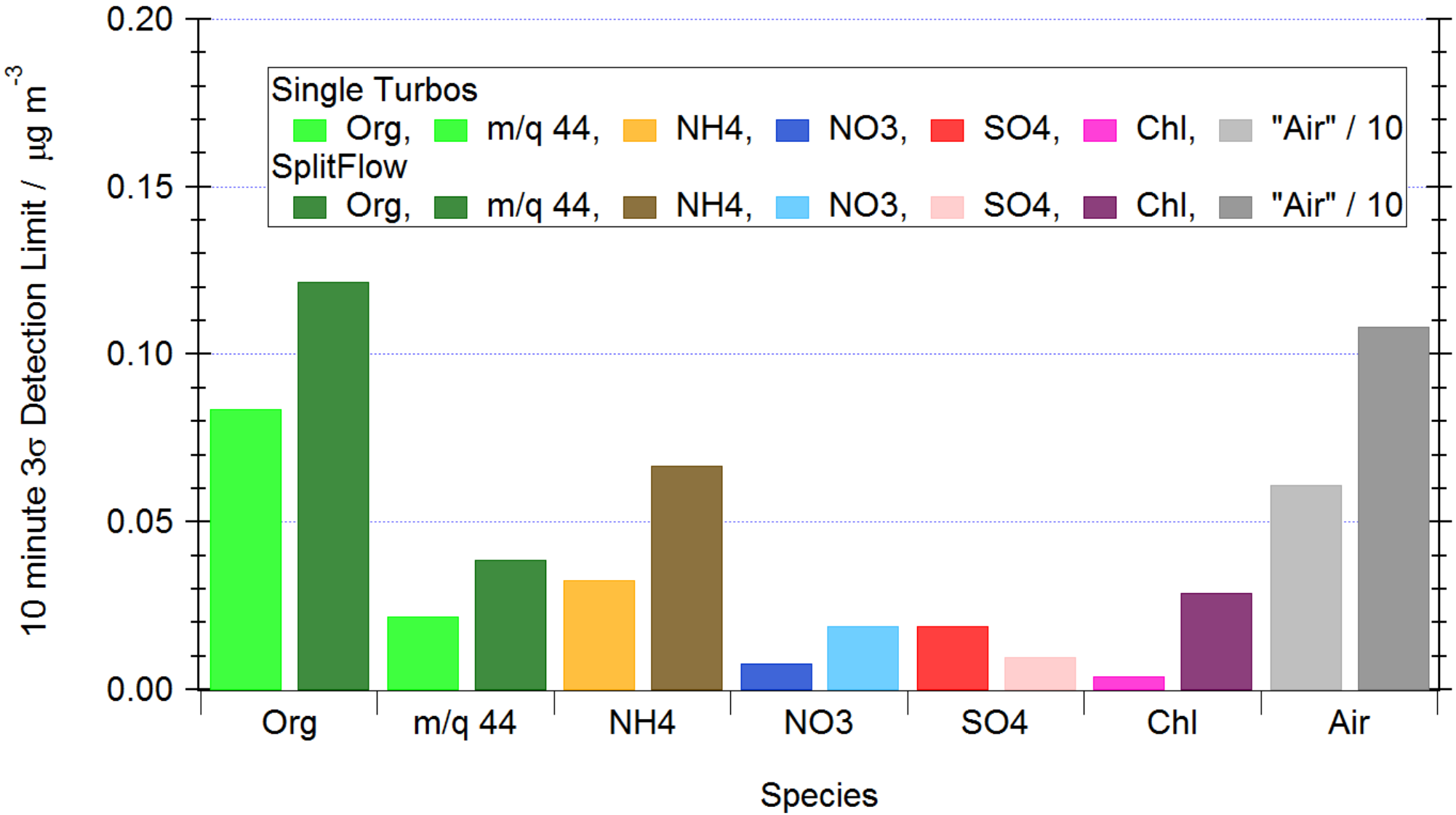
	ST System	SF System
Single Ion Strength / mv*ns	**1.98**	**1.98**
Resolution at m/z 28 (from DAQ)	306	317
AB Open / Hz	4.38×10^5	6.58×10^5
AB Closed / Hz	6.65×10^4	2.48×10^4
AB Diff / Hz	3.72×10^5	6.33×10^5
IE / ions/pg	184	201
IE / AB Open	**4.2×10^{-4}**	**3.1×10^{-4}**

Adjusted detector gain to match single ion between systems prior to the following experiments to try to get as close to an 'absolute' comparison as possible


40 second ambient data
SplitFlow Chamber
Single Turbos Chamber
3000
2500
2000
1500
1000
500
0
2000
1500
1000
500
0
6:00 PM
12/1/2015
9:00 PM
12:00 AM
12/2/2015
3:00 AM
6:00 AM

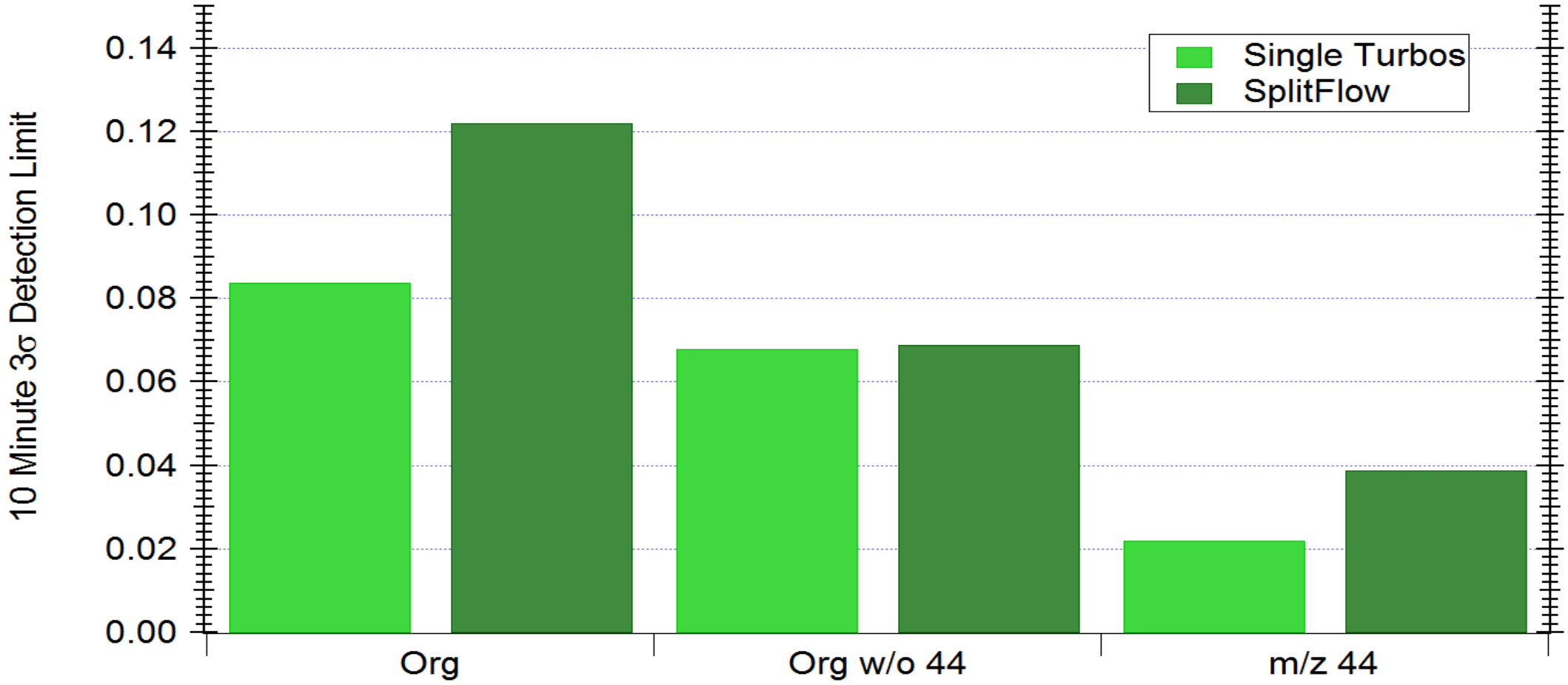
(Filter – Filter) Allan Variance Experiment
40s Acquisition with total filter



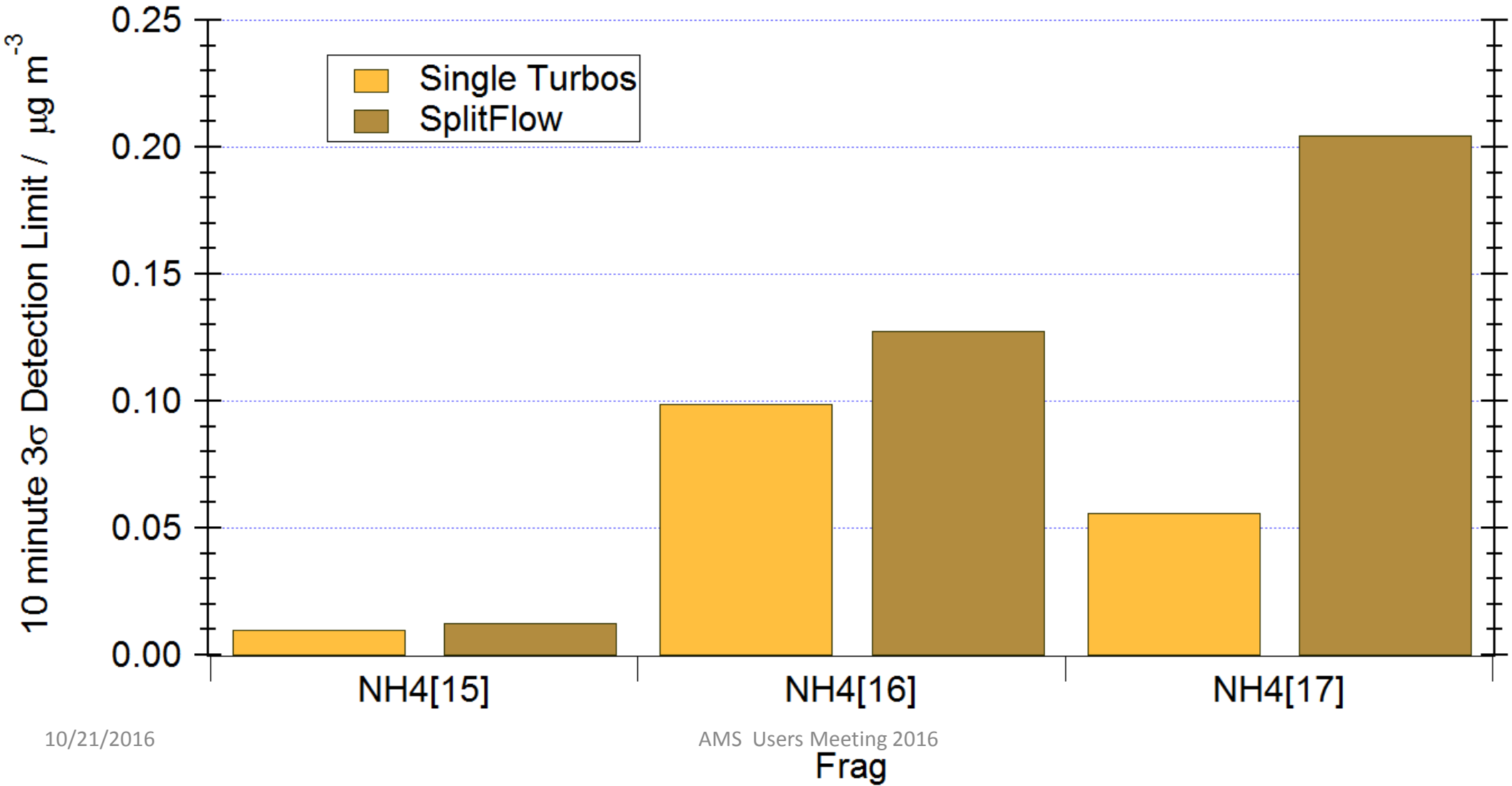


	Org		m/q 44		NH4		NO3		SO4		Chl		"Air"	
	ST	SF	ST	SF	ST	SF	ST	SF	ST	SF	ST	SF	ST	SF
10 min. 3σ DL	0.084	0.122	0.022	0.039	0.033	0.067	0.008	0.019	0.019	0.010	0.004	0.029	0.61	1.09

Org Breakdown



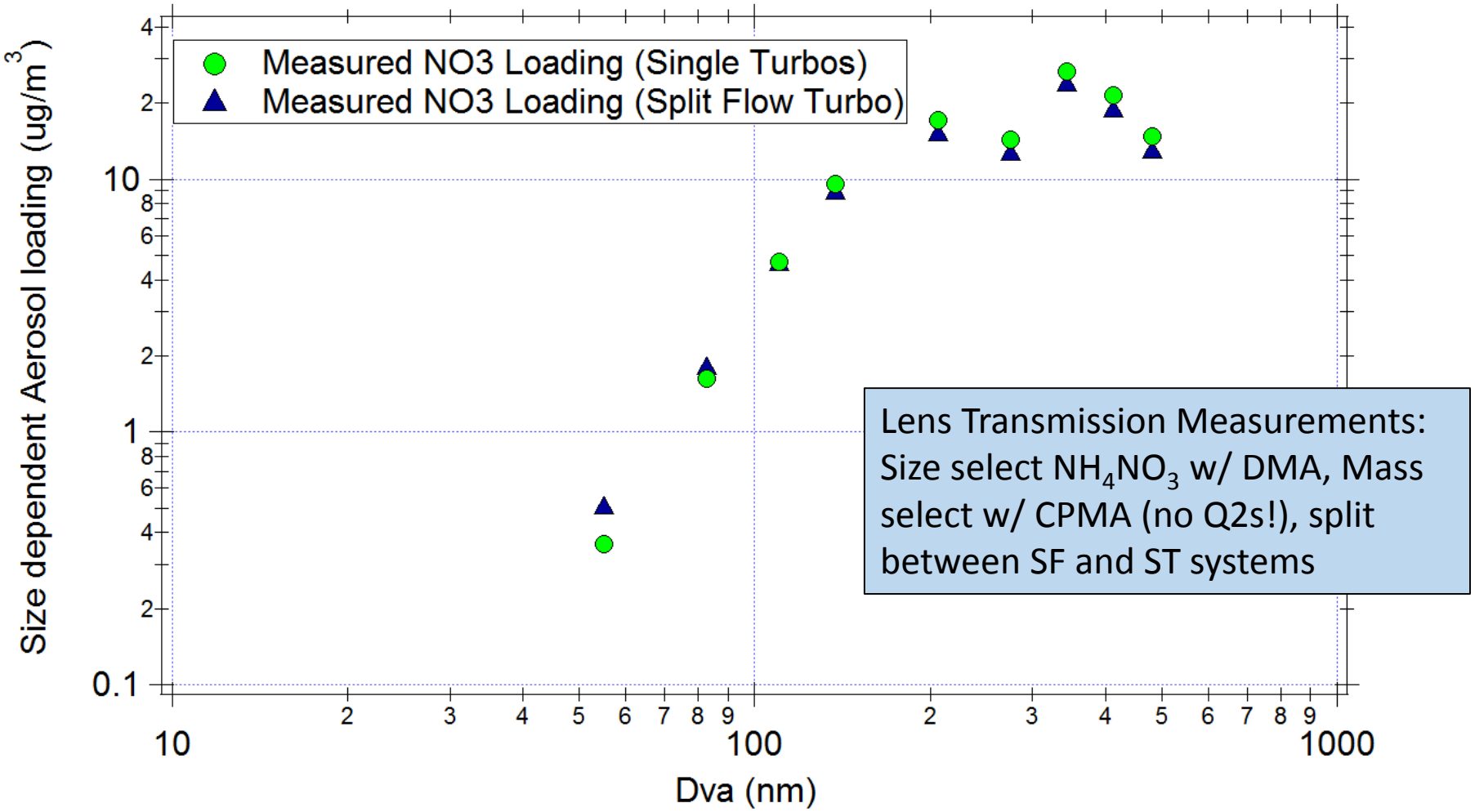
NH_4 Breakdown



Signal-to-Noise Comparison Summary

- Overall comparison is quite similar
- For Organics and NH4, Single Turbos configuration has slightly enhanced detection limits compared to SplitFlow
  - This is likely due to lower ultimate pressure in detection region (lower water and CO2 background signals)

Lens Transmission



Lens Transmission Measurements: Size select NH_4NO_3 w/ DMA, Mass select w/ CPMA (no Q2s!), split between SF and ST systems

Lens transmission is pretty much identical