Hardware Update

John Jayne

5th AMS User's Meeting

10/11/04

Hardware

- TOF – AMS
- Light Scattering module
- Short chamber
- Beam Width Probe
- High pressure lens for larger size particles
- Rigid critical aperture holder
- Cryopump
- *New Vaporizer…*


AMS Power Supply
Electronics
Turbo Pumps
Diaphragm Pump
AMS Electronics
AMS Turbo Pump Controller
TPS


AMS Electronics
AMS Turbo Pump Controller
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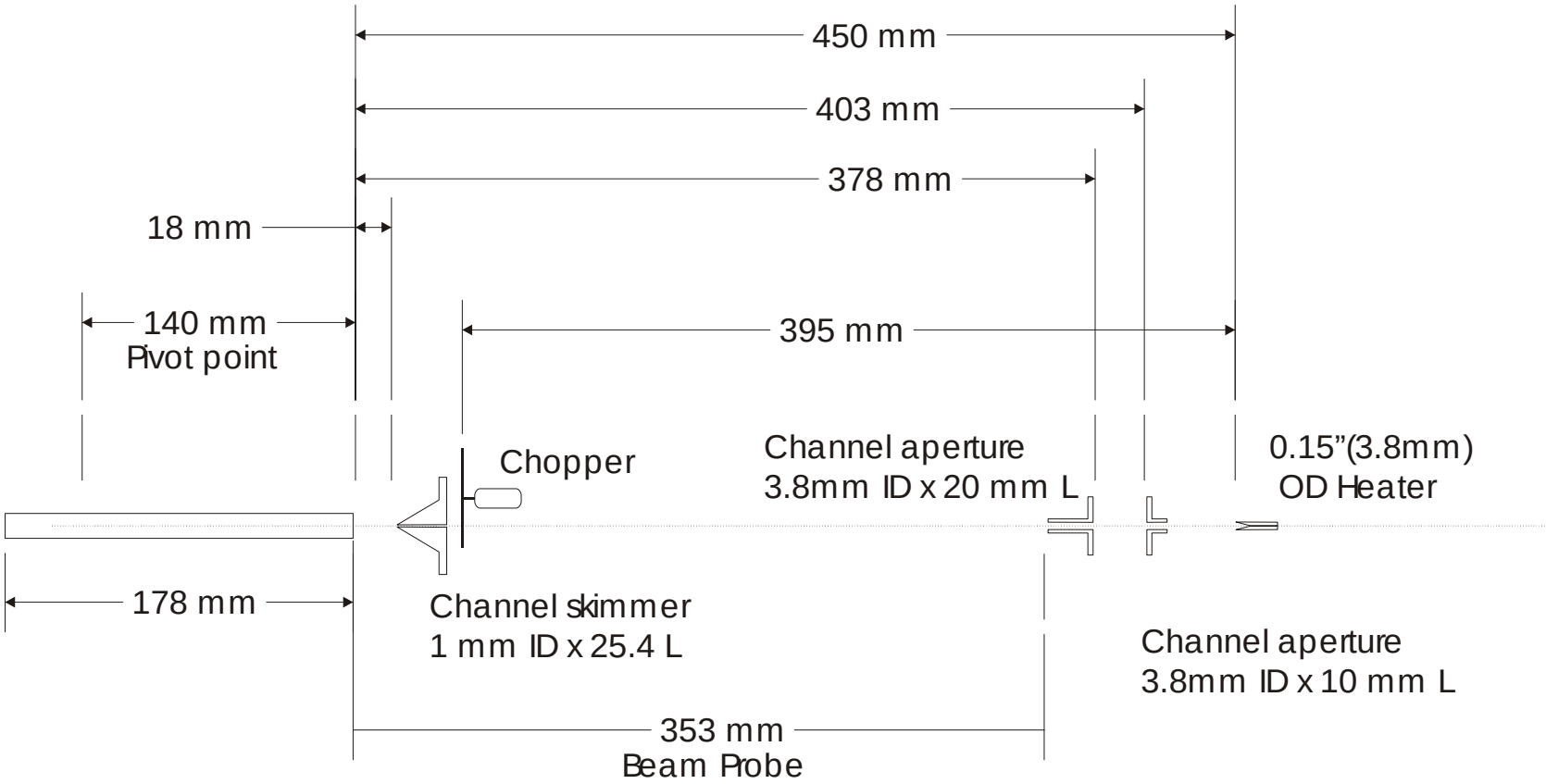
Distances and Apertures for 255-xxx AMS Chamber



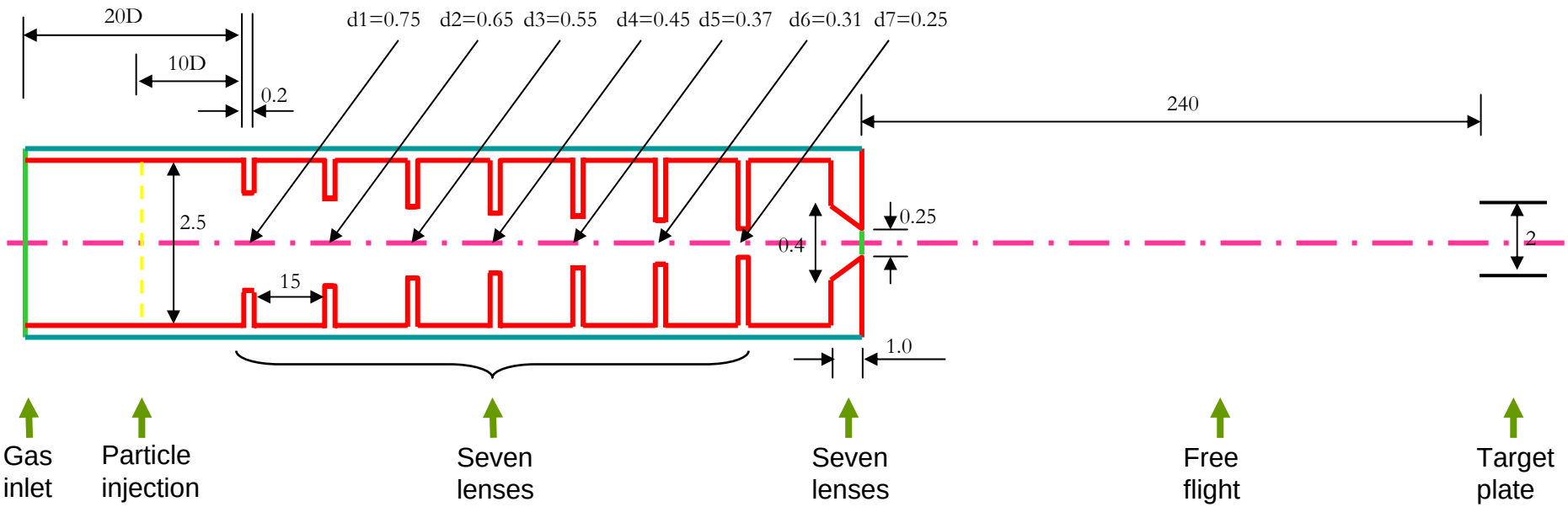
Aug. 2003

New chamber is 10 cm shorter, series 215-xxx

Lens For larger particle transmission

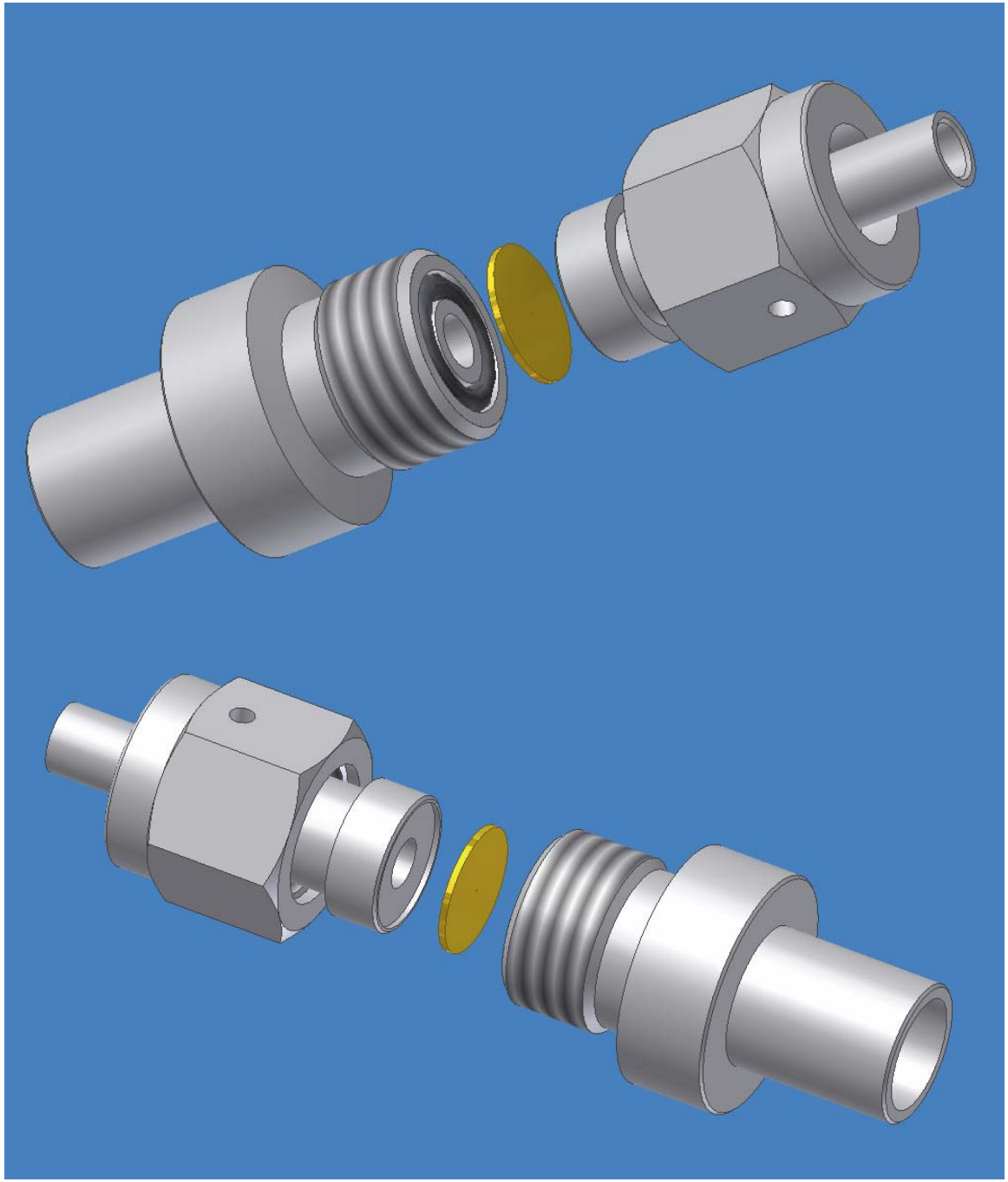
~0.3 – 3 um

Unit: mm



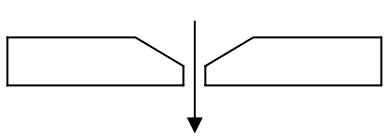
Schreiner at al. (1999)

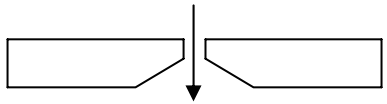
Zhang et al. (2002)

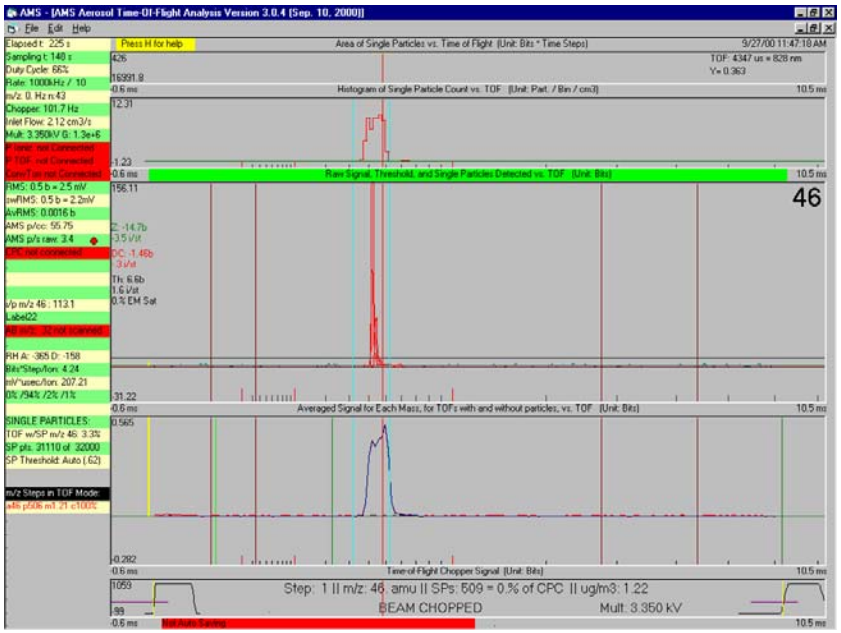


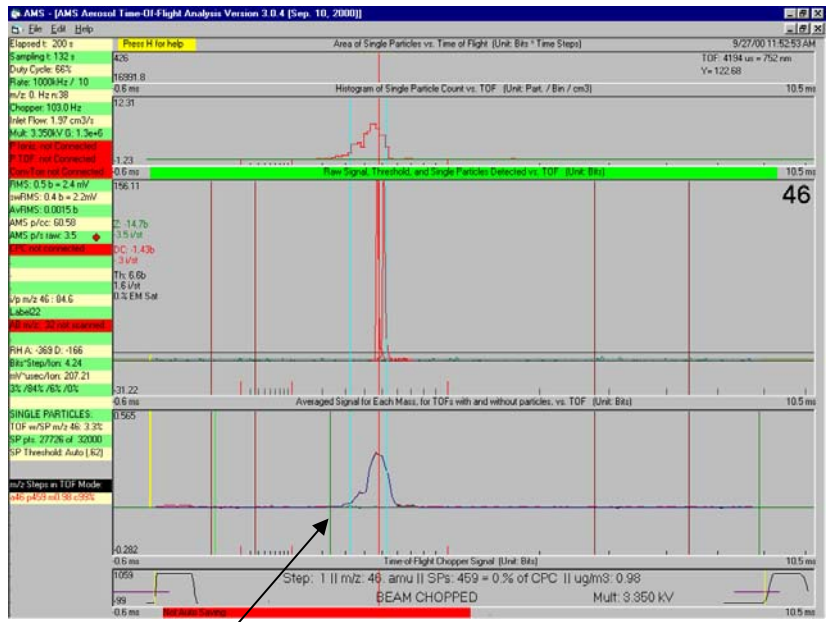
VCO Style
Critical Aperture
Holder

The orientation of the pinhole is important



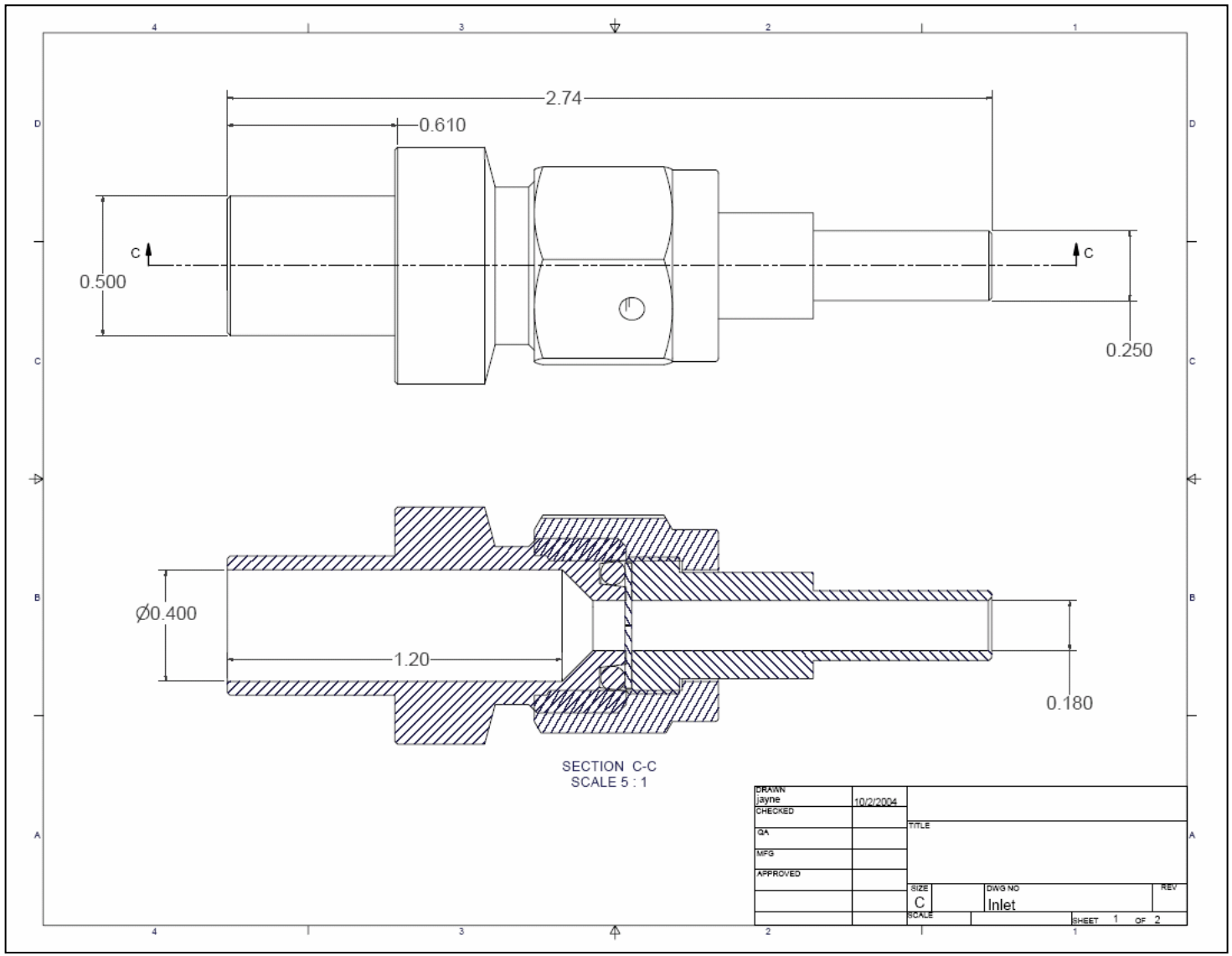




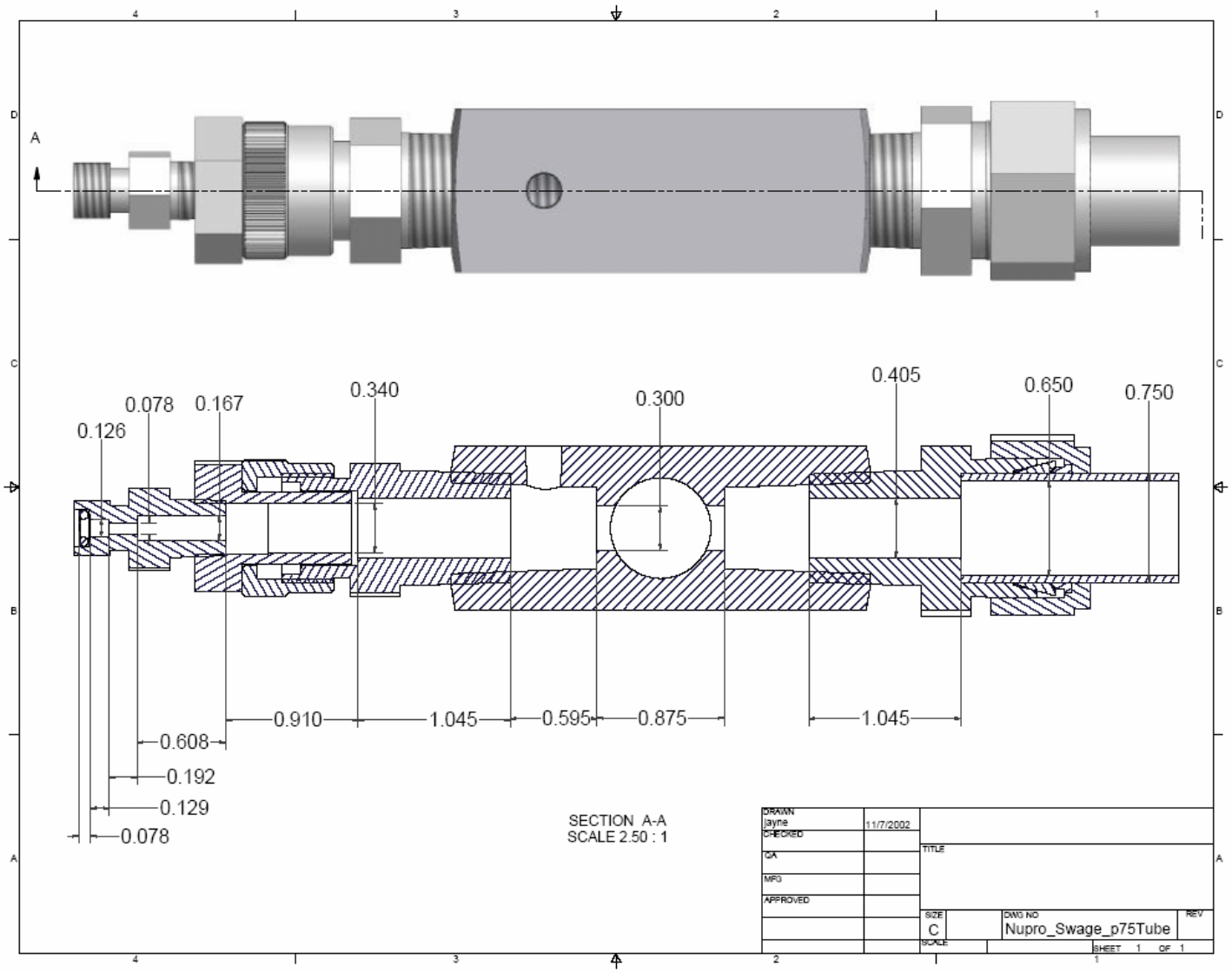


“Pimple” effect

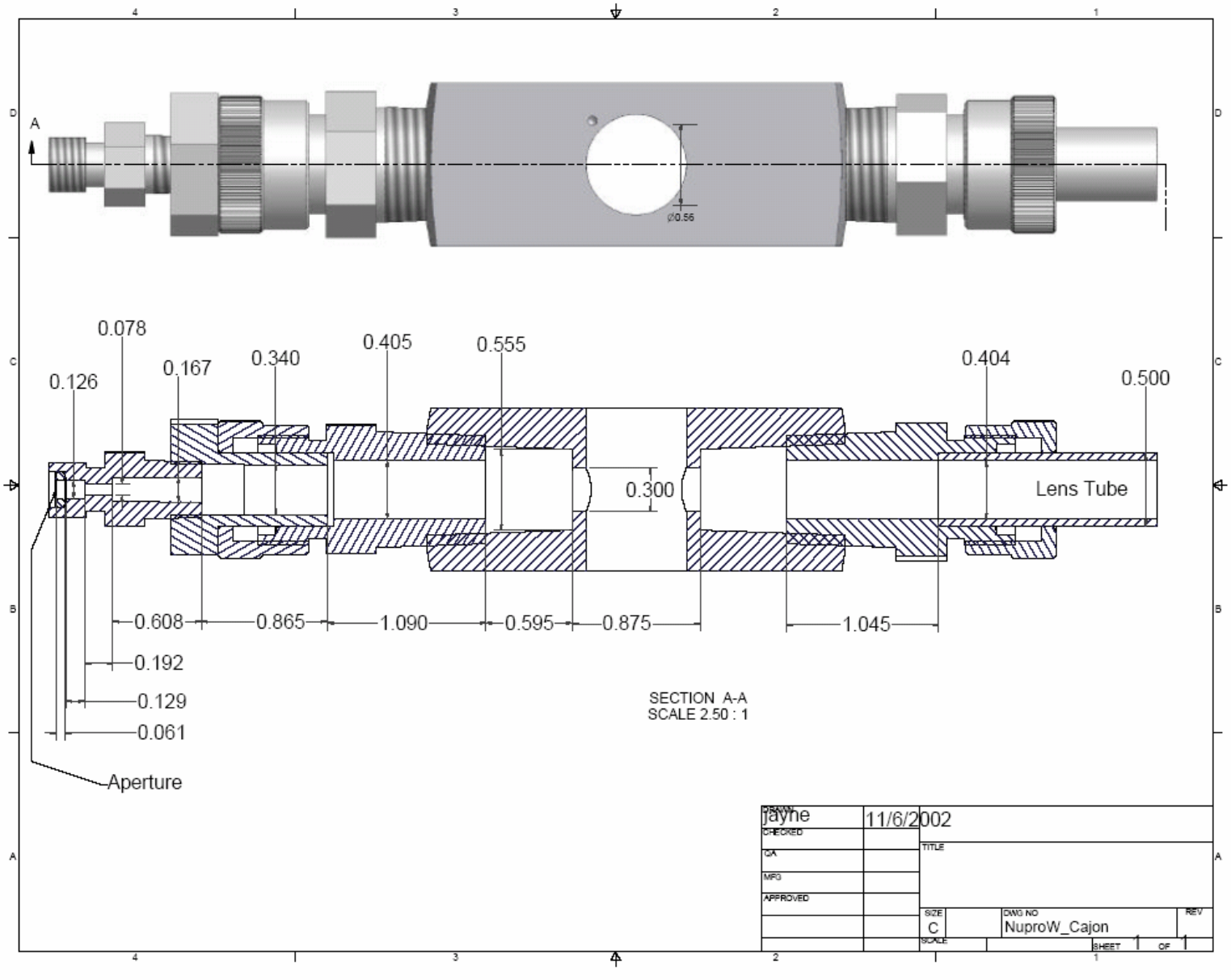
Possible Design for Improved Critical Aperture Holder



Current HTP w/Critical Aperture and Valve Body

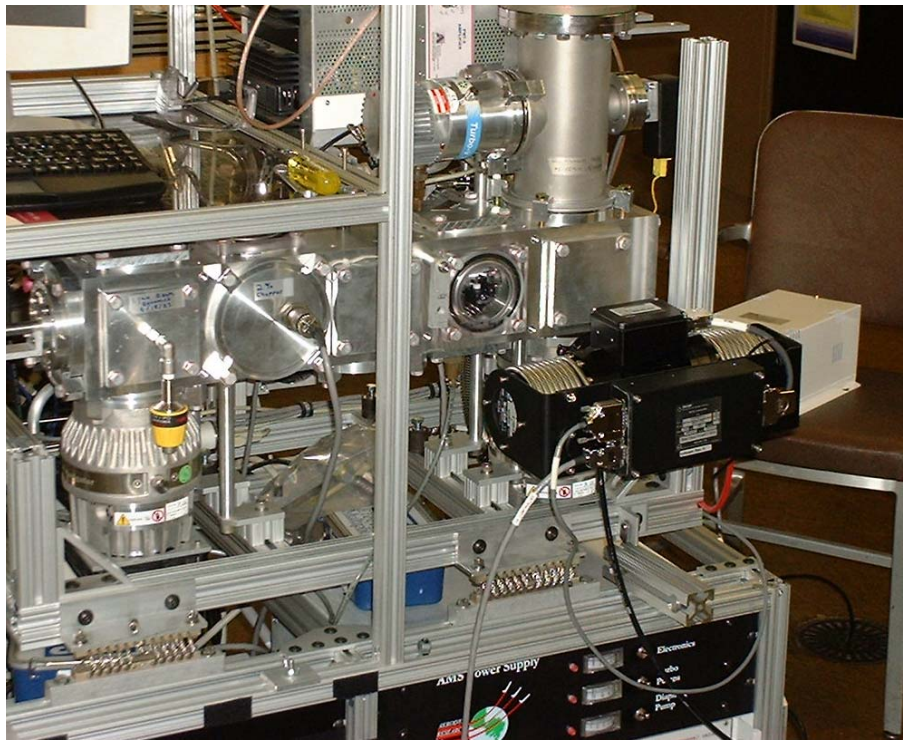


Current Standard Lens w/Critical Aperture and Valve Body



Ricor MicroStar™ Cryopump

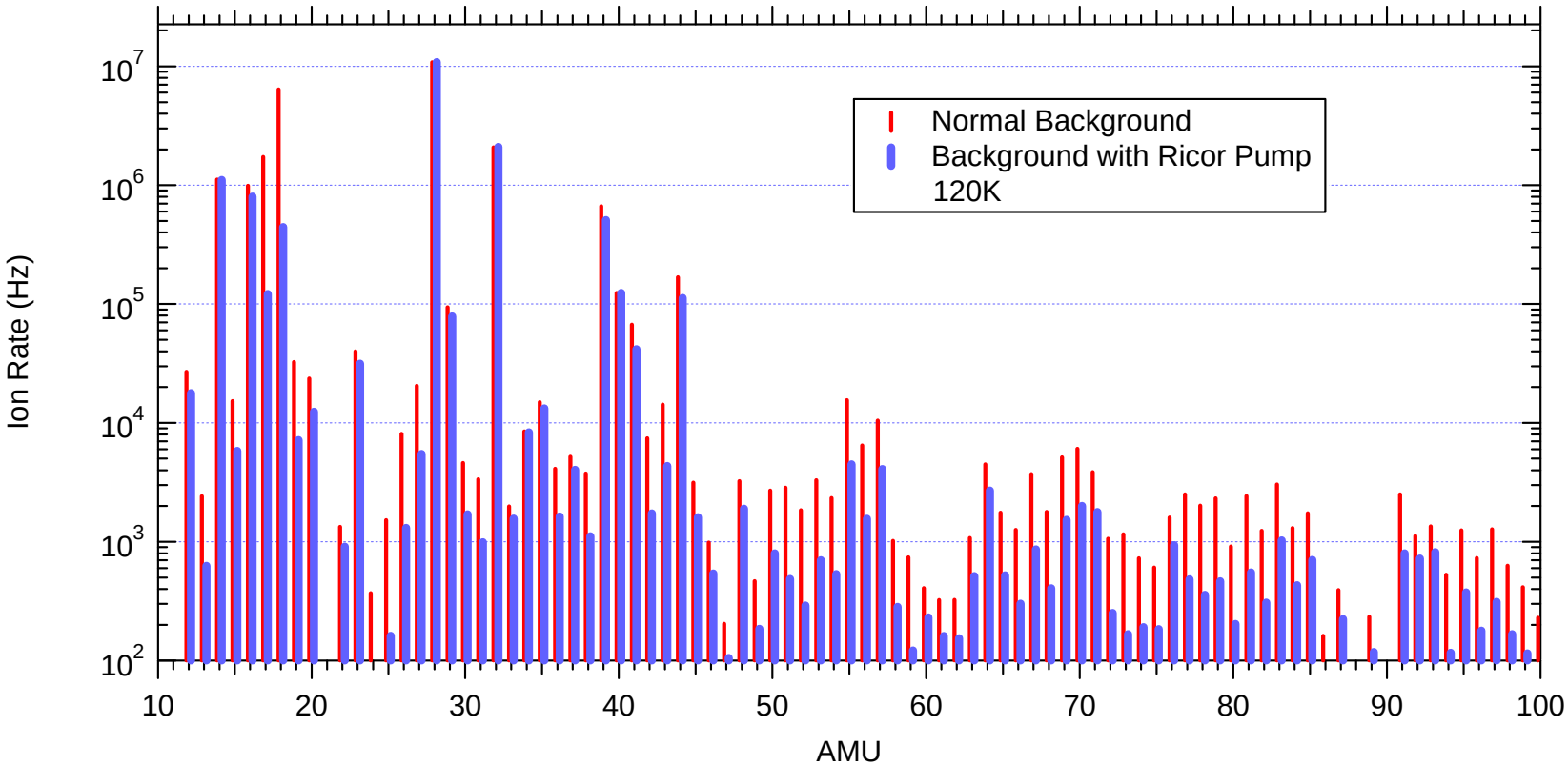
fast pump out / background reduction in ARI Aerosol Mass Spectrometer ionizer chamber



- •1000 Ls^{-1} pumping speed for water
- 17 kg (38 lbs)
- 400 Watts start-up at 50 VDC (~200W normal load)

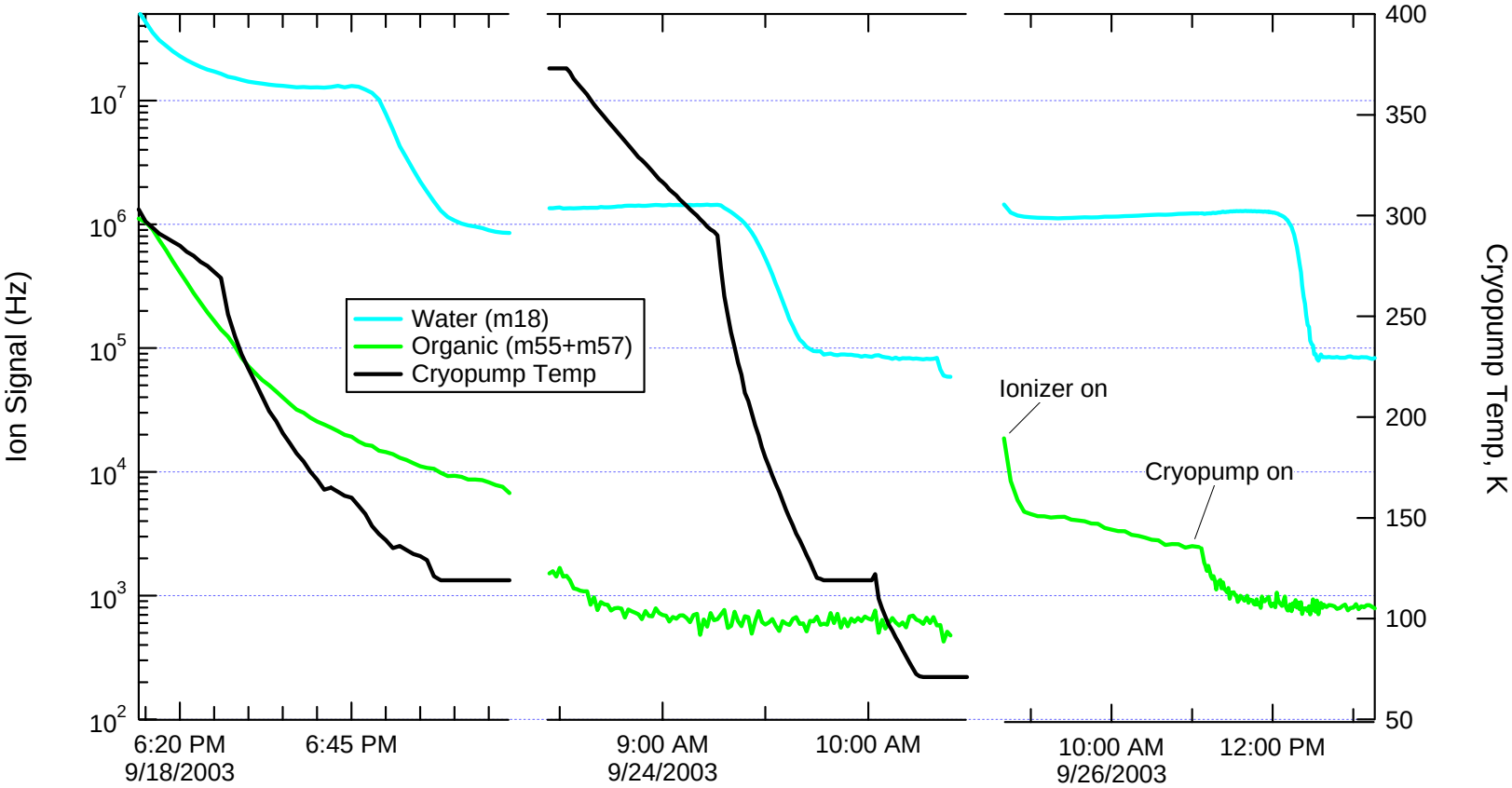
- Cryoshiled surrounds ionizer
- Mounted between P5 (V301) and chamber

Comparison of Mass Spec with and without Cryopump



Water vapor drops ~15x; organics drop between 2 and 10x

Ricor Microstar Cryopump performance in AMS



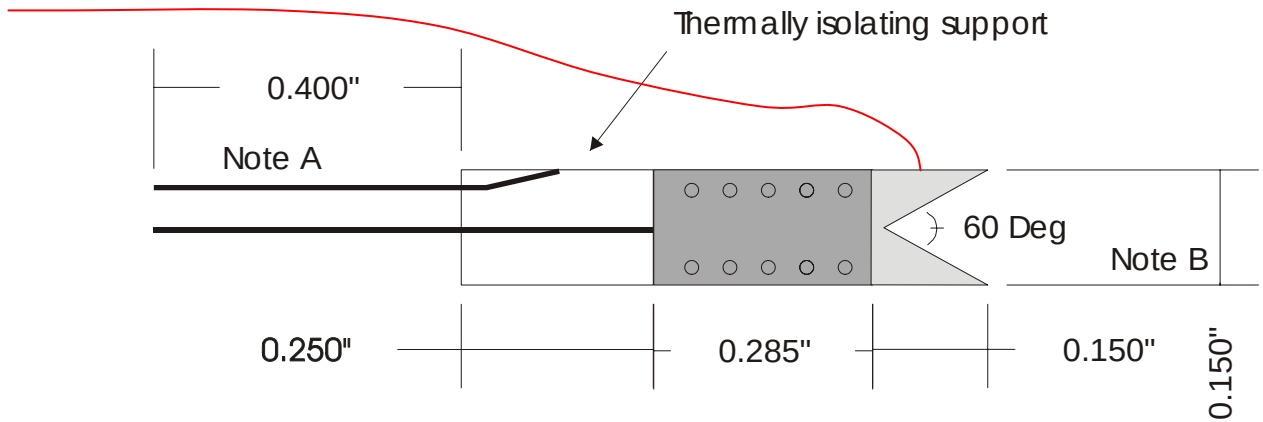
Test 1 - Pump from vent condition
Cryopump on from start

Test 2 - Cryopump on after 4 days of 'normal' pumping

Test 4 - Ionizer off overnight, turbos on
Cryopump on later

Current Vaporizer Design

Thermocouple



Notes:

A- Two heater leads. One lead attached to ID of thermally isolating support

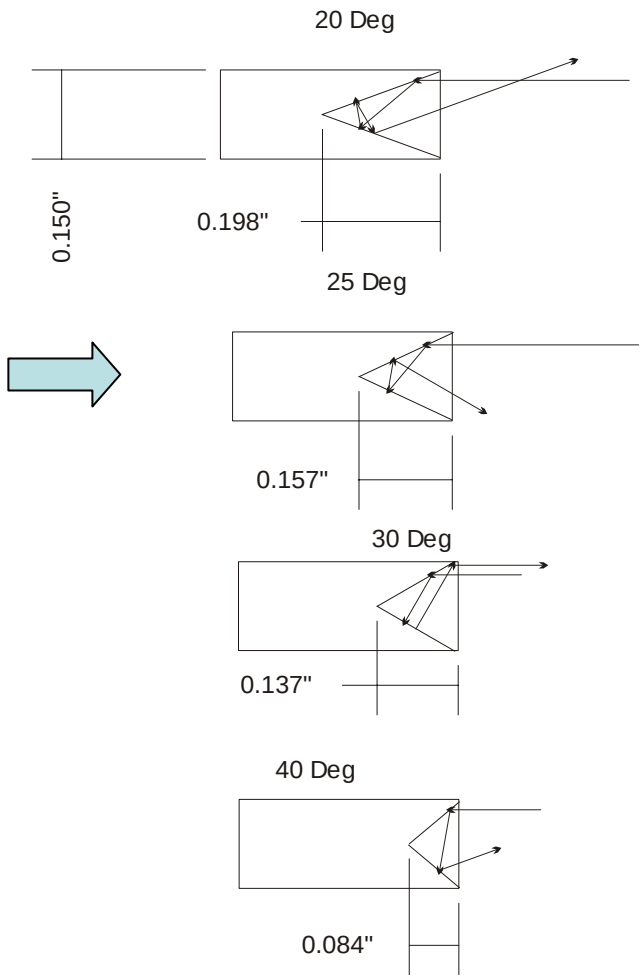
B- make one heater using 80% dense molybdenum
and one heater using 50% dense molybdenum
(radius of curvature on cone angles < ~ .015)

Nov. 17, 2000
John Jayne

Scale 1" = .25"

Aerodyne Research, Inc.
45 manning Road
Billerica, MA 01821
(978)663-9500 (x233)
jayne@aerodyne.com

Cone Shaped Oven Heater Design to maximize particle collisions and minimize cone length



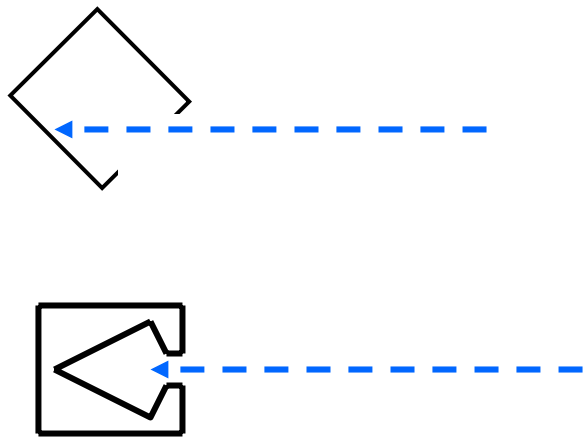
Oven Angle N relative to beam axis

Specular reflections
1) 180 - N incoming on beam axis
2) N 1st reflection
3) 180 - 5N 2nd reflection
4) 5N 3rd reflection
5) 180 - 9N 4th reflection
6) 9N 5th reflection

Oven Angle	No. of Collisions	Minimum length
20	4	.198
25	3	.157
30	3	.137
40	2	.084

Particle trapping type vaporizer

Svane et al, 2004
Pettersson Sweden



- *Will effect temporal profile of vapor plume and resolution of particle size measurement.*
- *Will be physically larger, or will reduce collection angle.*
- *Temperature gradients…*

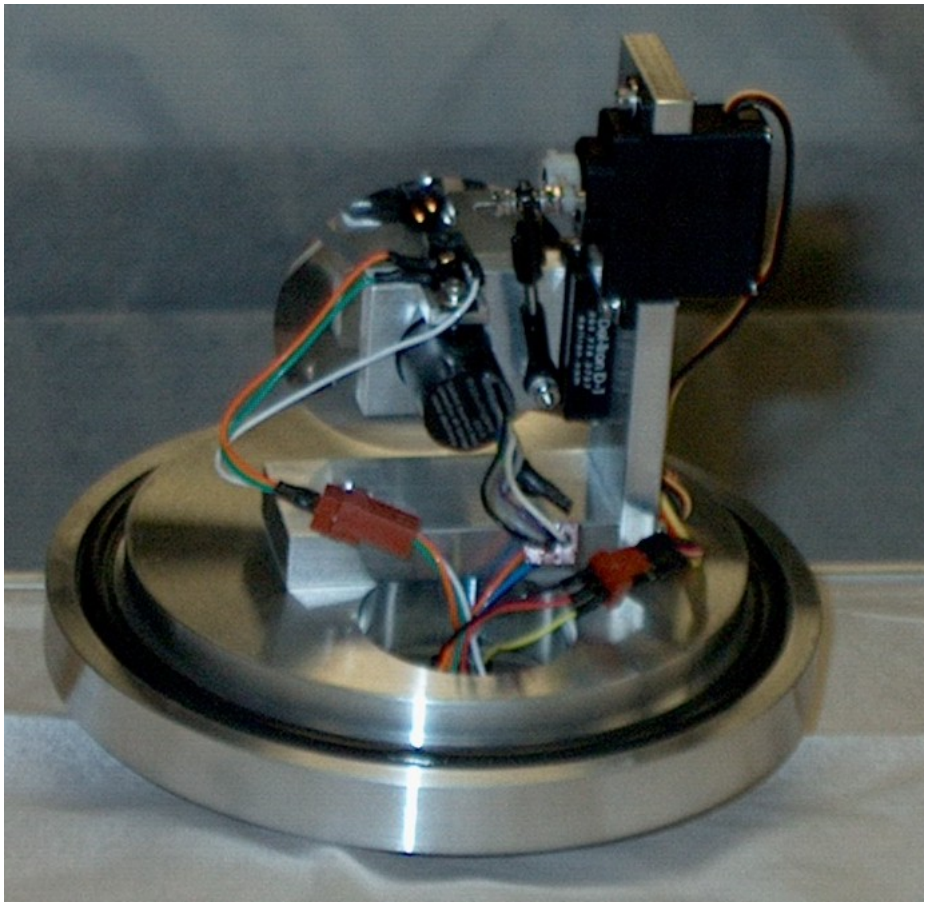
Digital interface for control electronics??

-eliminate toggle switches

-enable data logging of pumps stats and vaporizer, etc.

-enable computer control of pumps, vaporizer, chopper, etc.

Discussion of hardware failures



Wire fatigue problem on chopper assembly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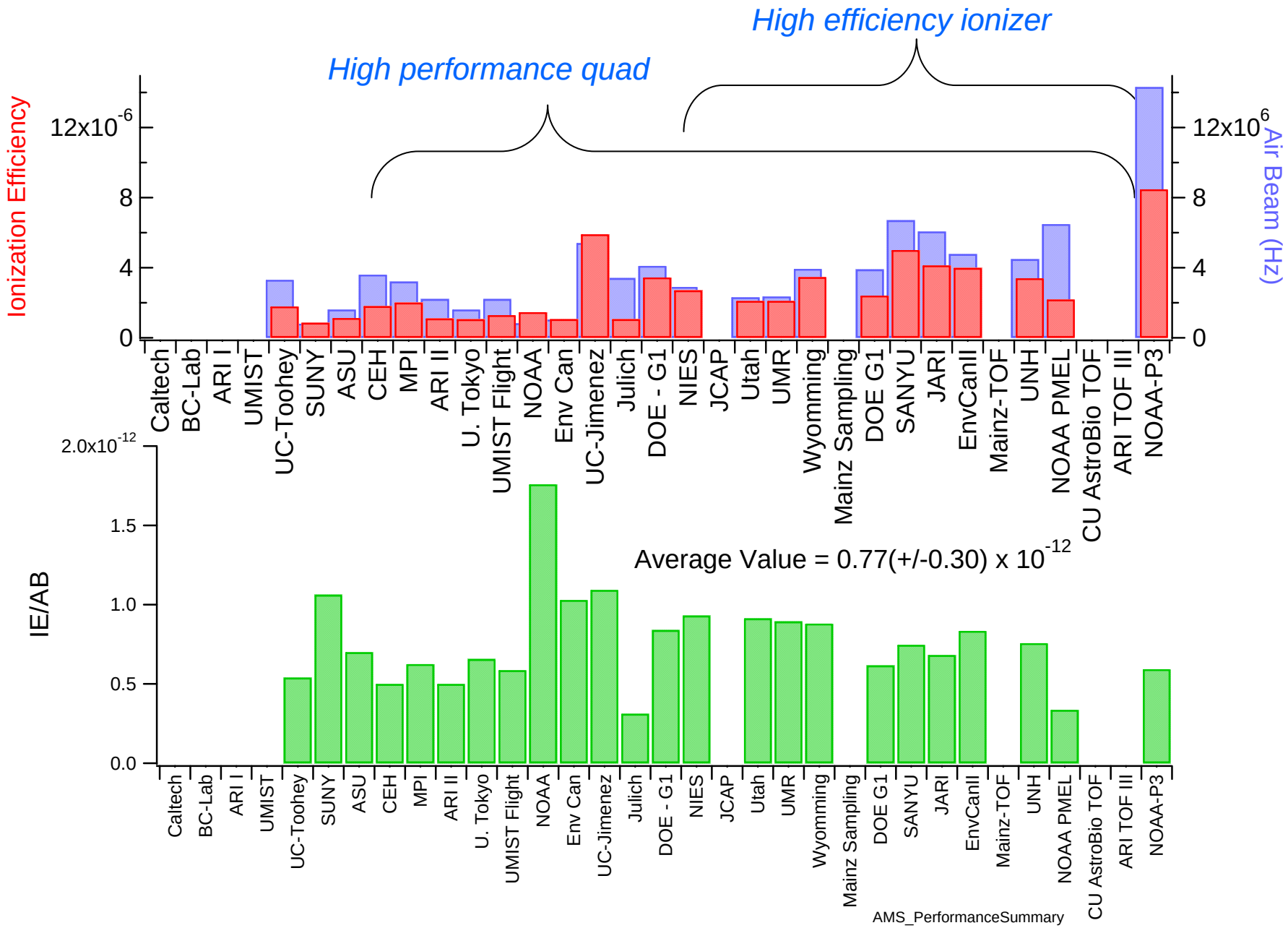
Air Beam and Ionization Efficiency

- Ionization efficiency, IE (ions/molecule)
  - Sample a particle of known size (no. of molecules) and measure the number of ions produced. *Typically a few ions generated from 10^6 molecules.*
- Air Beam, AB (Hz, ions / second)
  - The signal at N2 (or O2), use signal strength as a measure of instrument sensitivity. *Typically a few million ions per second.*

Variability in Ionization Efficiency and Air Beam

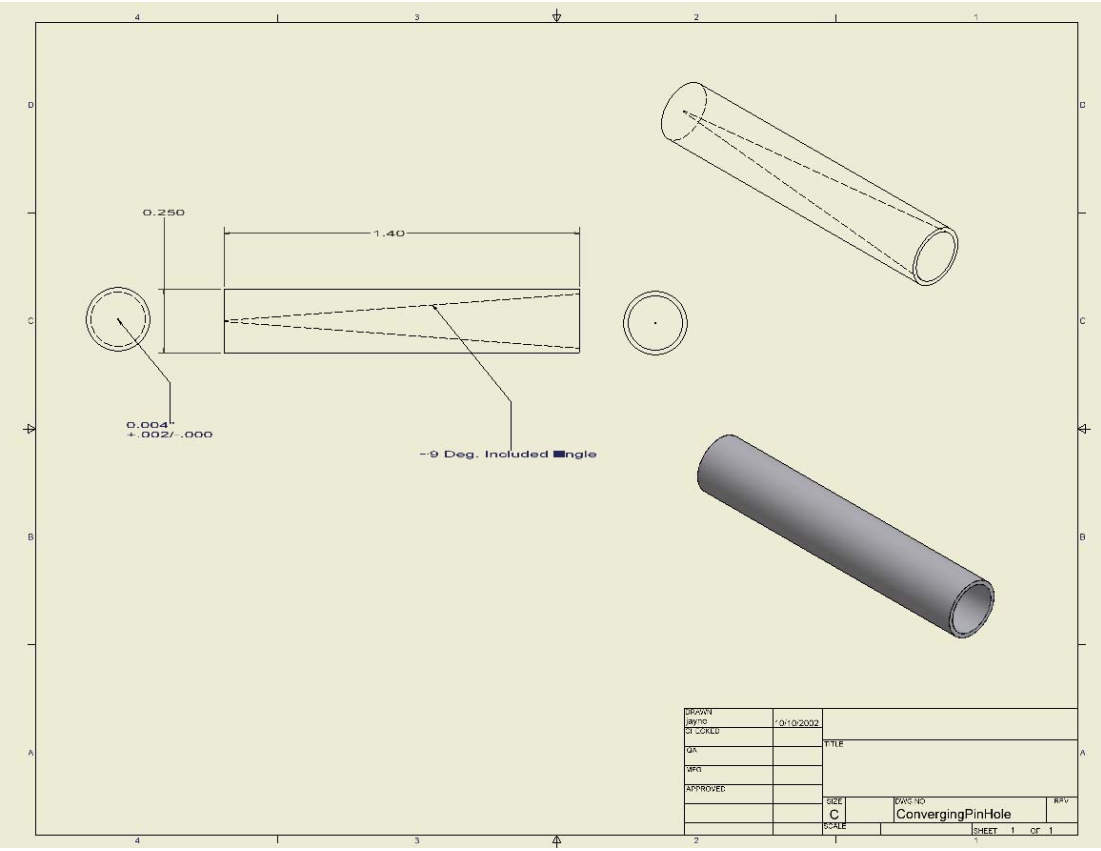
- Position of filament with respect to slit in ion reference region. *IE/AB constant*
- *Multiplier collection efficiency. IE/AB constant*
- Pressure in TOF chamber (small internal leaks can have a measurable effect on AB intensity). *IE/AB larger*
- *Positioning of vaporizer inside ionizer volume IE/AB smaller*
- Machining imperfections in skimmer channel. AB could be off-axis. *IE/AB larger*

Summary of AMS Performance at Time of Delivery



$CH_3O^+ = 31$

Converging nozzle to improve collection of micron size particles



A fabrication challenge…

- Two nozzles have been made (not quite to spec).
- Measurement results not as expected, no improvement in large particle transmission

Adjustable Inlet with Micrometer heads