

The PinAAcle Family of AAS

Features and Benefits

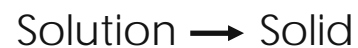
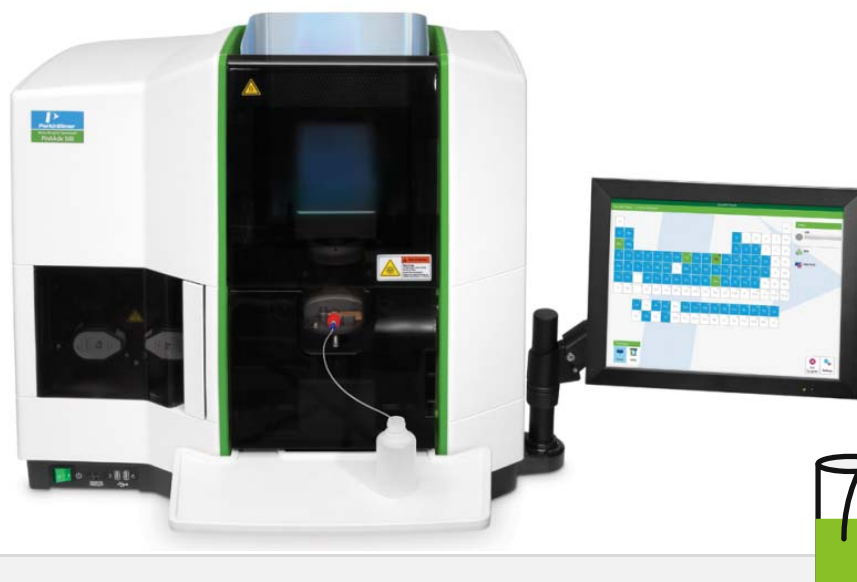
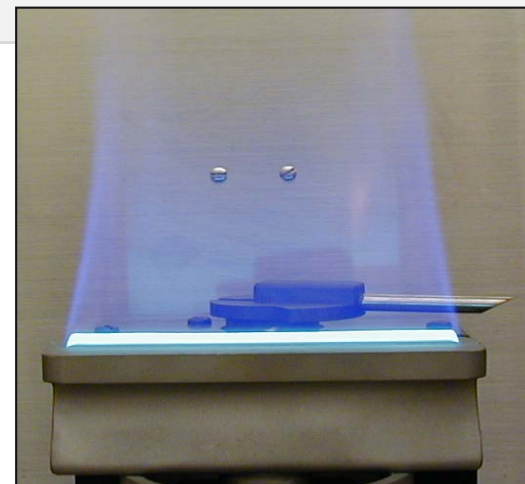
Riccardo Magarini

Budapest 2016, October 17th



Flame Atomic Absorption

- Fast
 - 3 – 5" per determination
- Low analytical costs
- Easy to use
- Single element technique

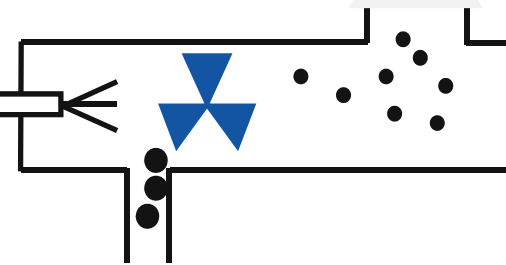


Ionization

Excitation

Atomization

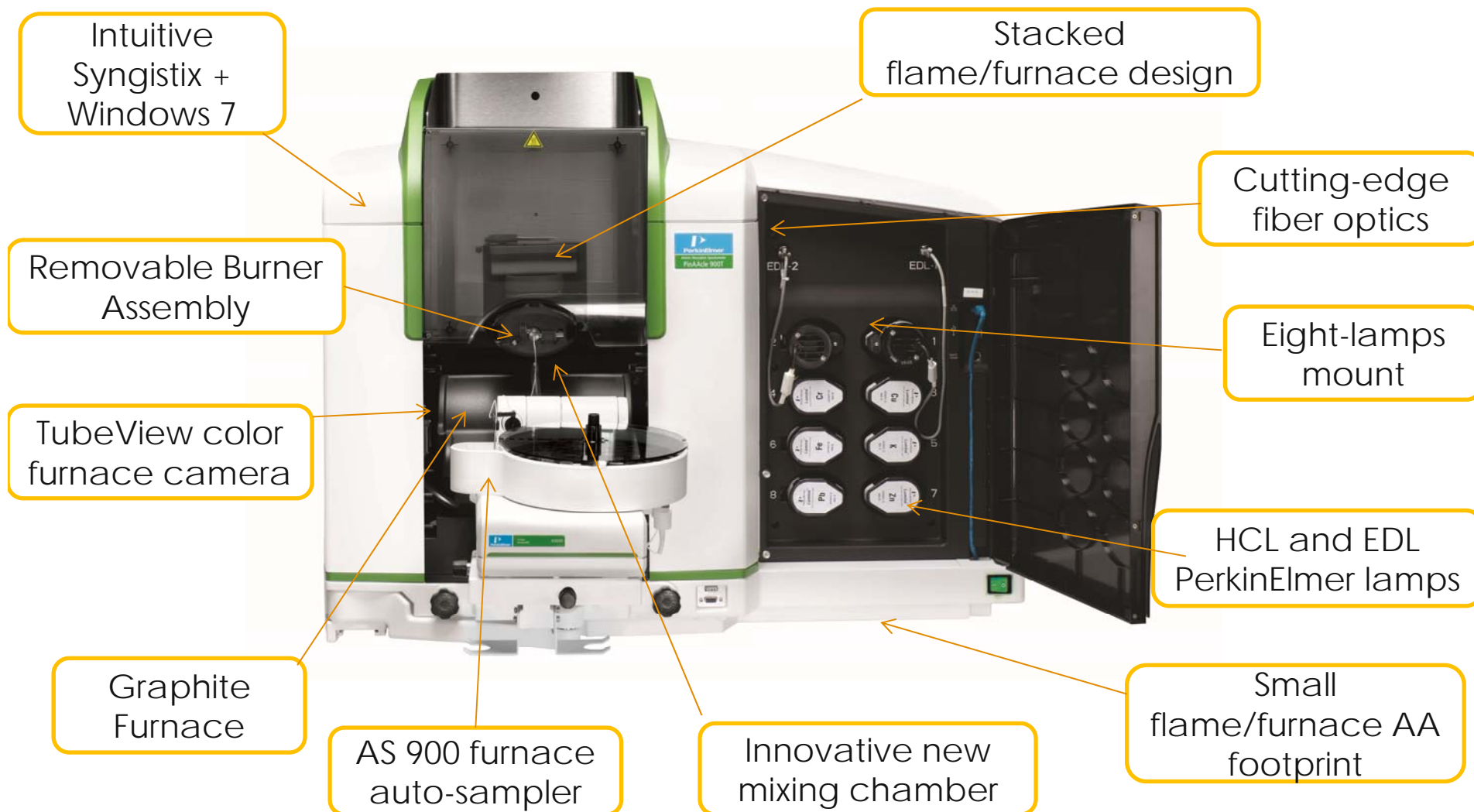
Vaporization



PerkinElmer PinAAcle platform

- Real Time Double Beam
- State of the art optics with fiber optics
- Customized solid state detector
- Automatic gas control
 - Oxidant and Fuel Only Mixed in Spray Chamber
- Optimized sample introduction system
 - Inert to acid, alkalis and organics
 - Solid titanium burner head
 - Adjustable nebulizers
- EDL lamps
- HGA with D₂ background correction
- THGA with Zeeman background correction
- FIAS and FI-FU (Fias-Furnace)
- Syngistix Software Platform

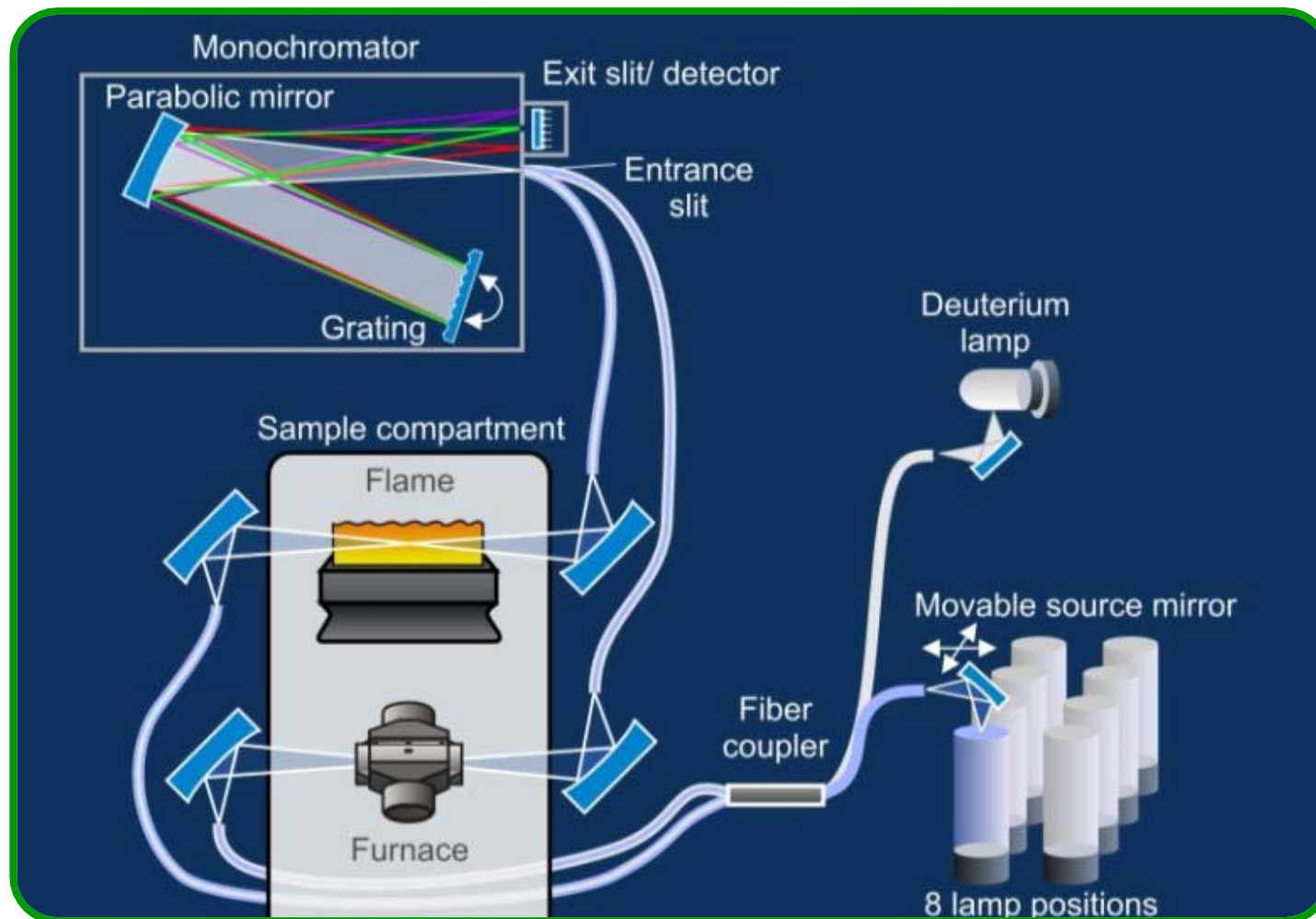
PinAAcle 900 platform (models F; H; T)



The PinAAcle™ 500 Flame AA Spectrometer



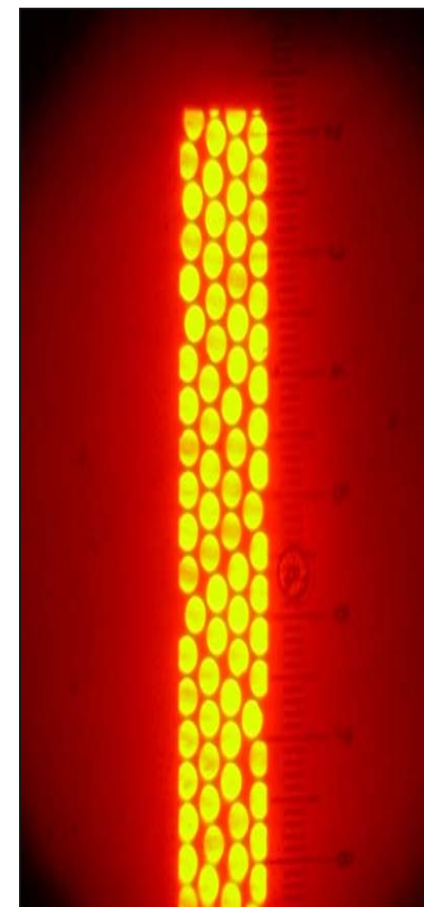
Optical System with Fiber Optics



PinAAcle: Unique innovAActive fiber optics design!

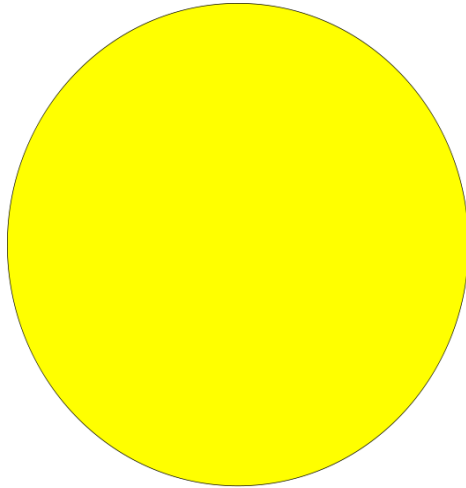
- 1) High Light transmission due to fiber optics and unique possibility of fiber beam shaping
- 2) Does not get “dirty” over time like mirrors which leads to less cleaning and maintenance of mirrors.
- 3) Fiber optics makes it possible to design a small footprint instrument, with high performance true double beam optics.

Best light transmission with
minimum maintenance and
compAAct footprint



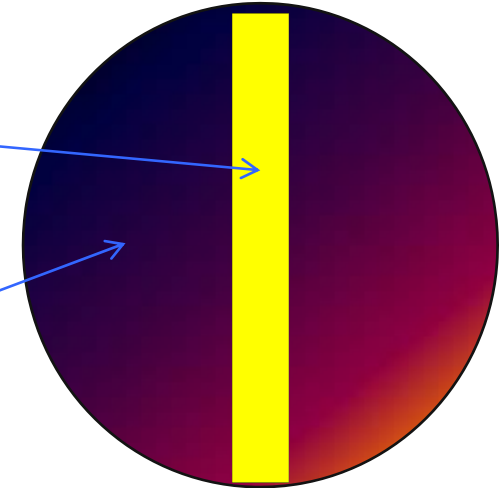
PinAAcle: Unique innovAAtive fiber optics design!

Light from
lamp

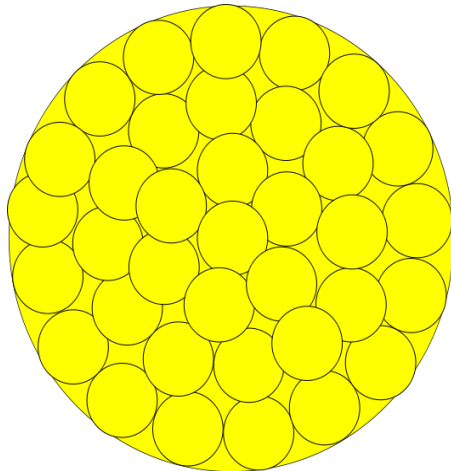


Conventional “slit”
shapes the beam.

Lost light intensity



Light from
lamp captured
by *fiber optics*

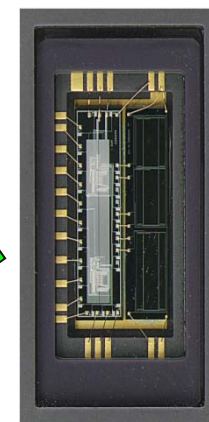


Fiber optics reshaped
from circular to “slit”
shape, transmitting ALL
light.

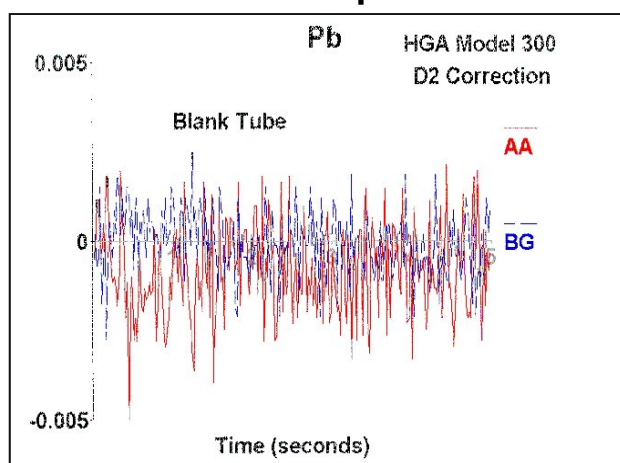


Customized Solid-State Detector

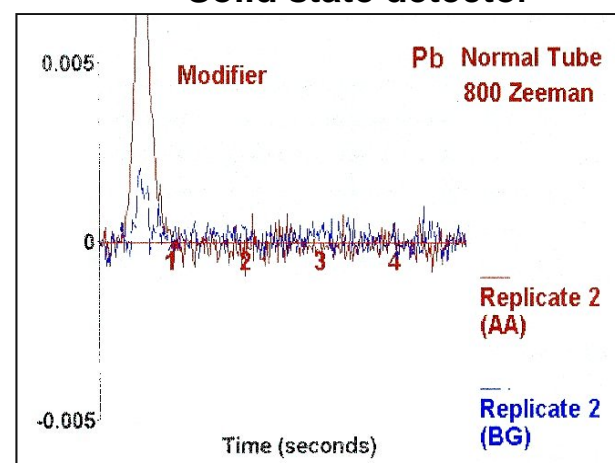
- Integrated low noise CMOS charge amplifier array
 - Exceptional signal-to-noise and Quantum Efficiency
 - Improves signal throughput, lower background and therefore better DLs
- Performances
 - Traditional PMT's performance decrease as the detector ages. This does not happen with solid state



Photomultiplier

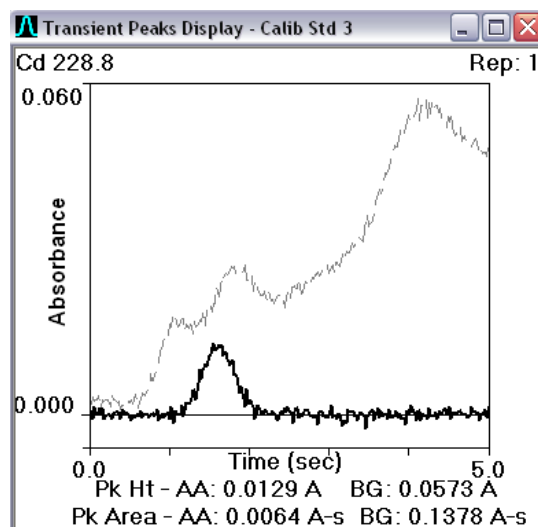


Solid state detector

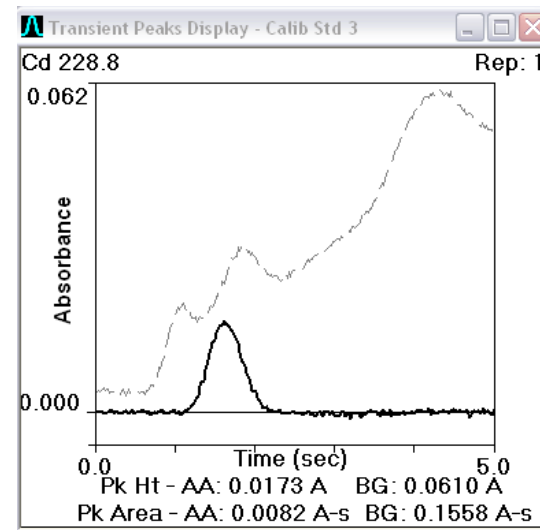


Electrodeless Discharge Lamps

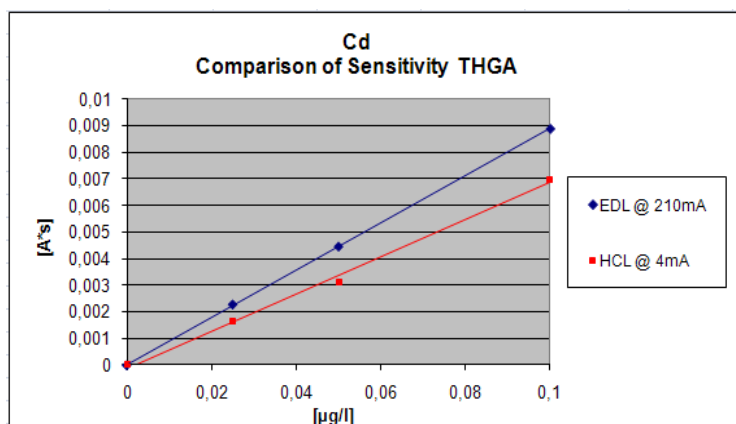
- Longer lifetime than HCL
- Lower cost of ownership
- Better S/N ratio for better DL
- One universal starter (lamp driver) for all EDL elements
- Intelligent pre-warm up for best time efficiency



Cd 0.1 µg/L



Cd 0.1 µg/L

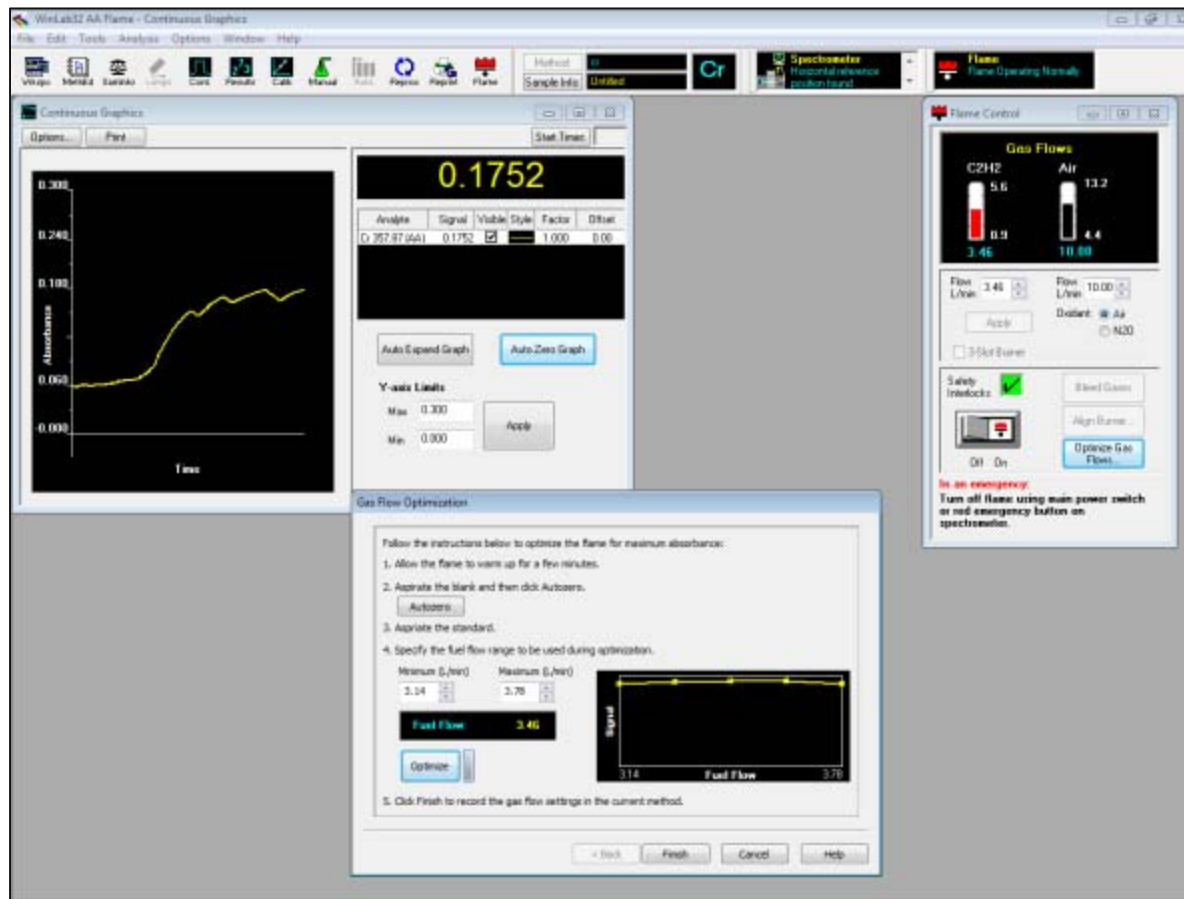


HCL



EDL

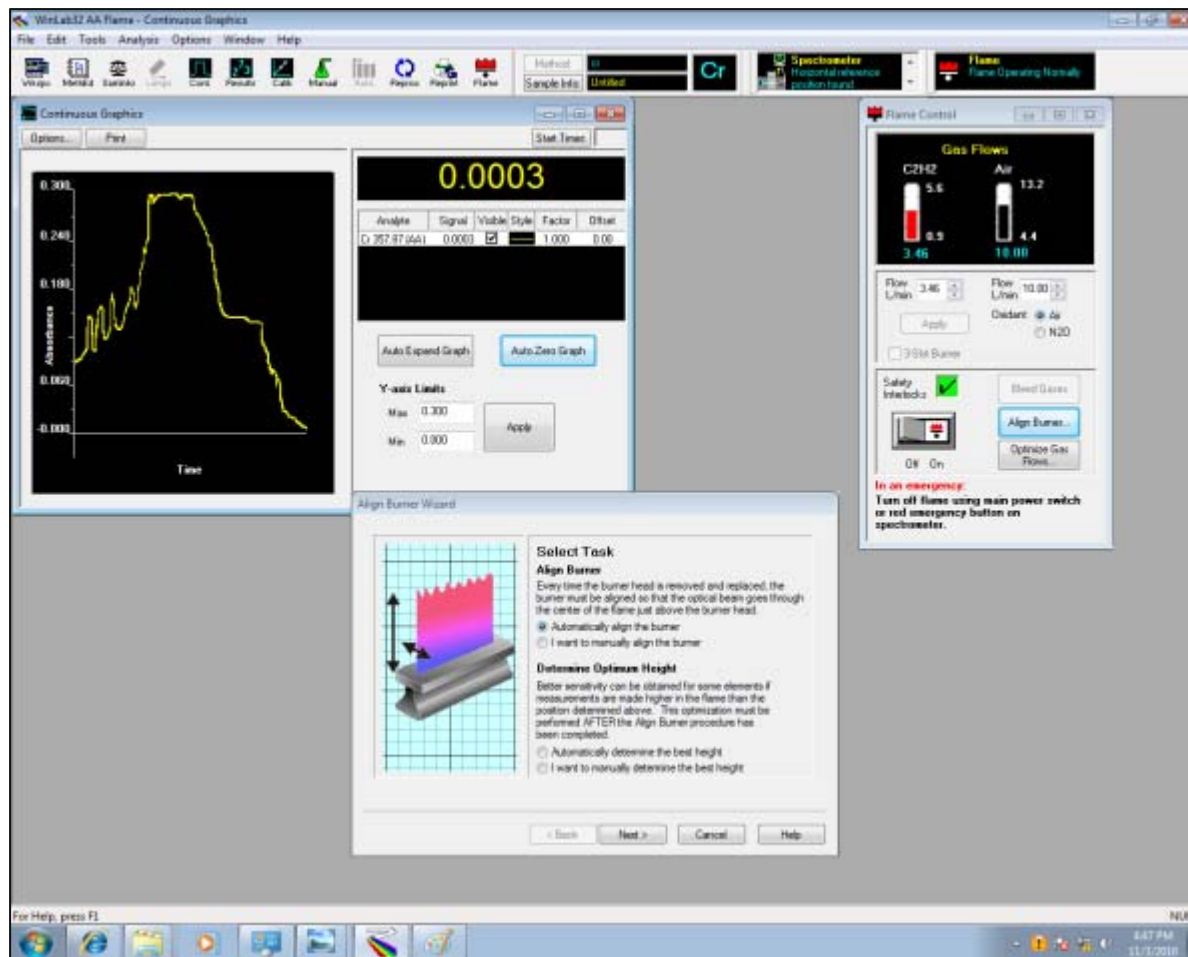
Flame Gas Flow Optimization



User Benefits:

- Element specific
- Optimized results
- Ease of use
- Reproducible

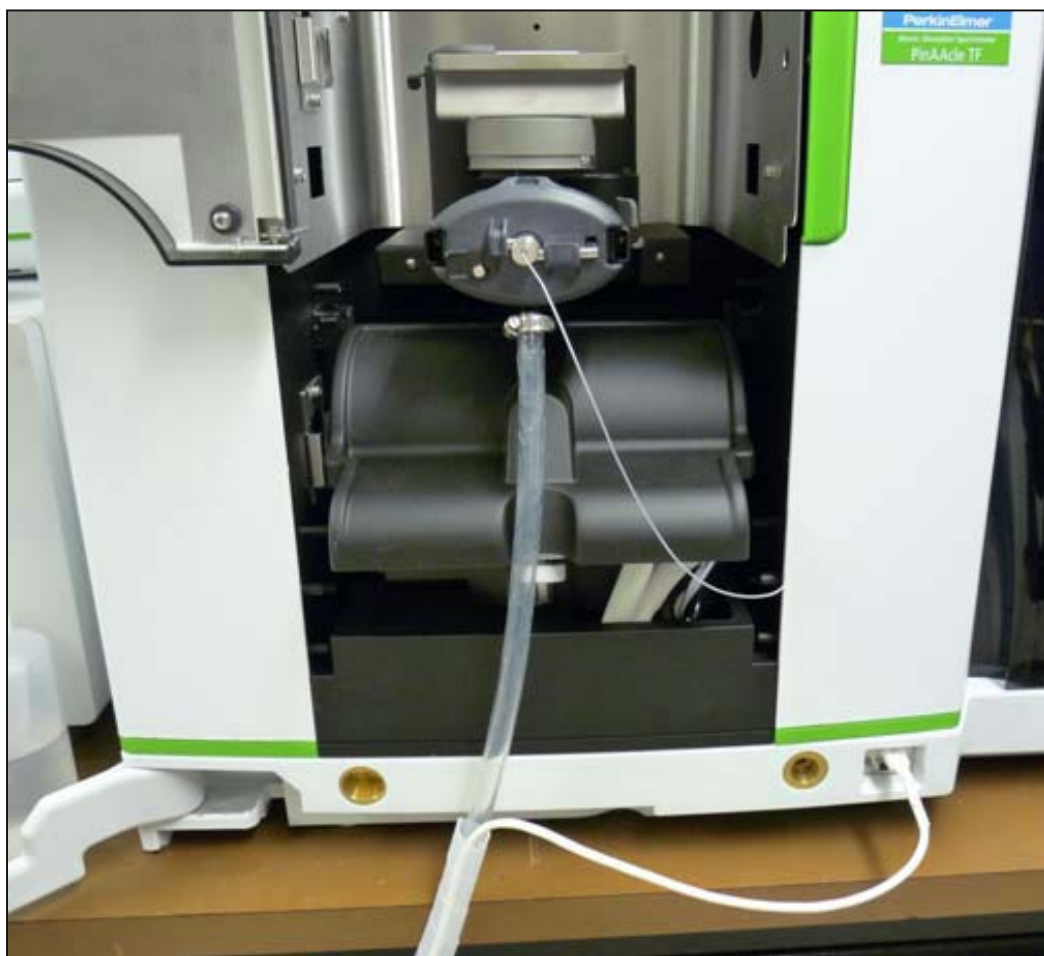
Burner Head Optimization – Burner Alignment (Pin900)



User Benefits:

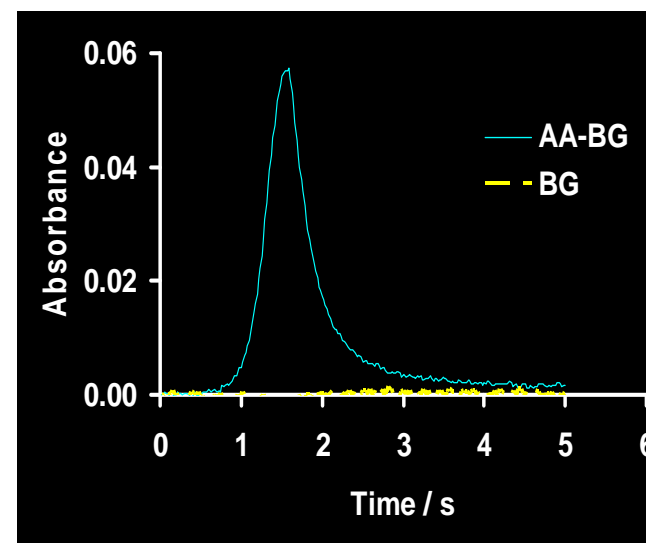
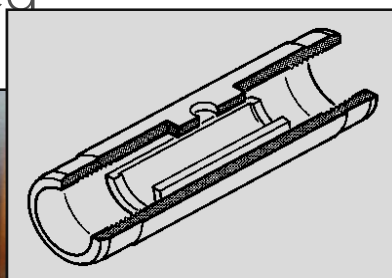
- Easy to use – can be recalled when stored
- Optimized results
- Convenience

PinAAcle 900, Stacked Atomizers

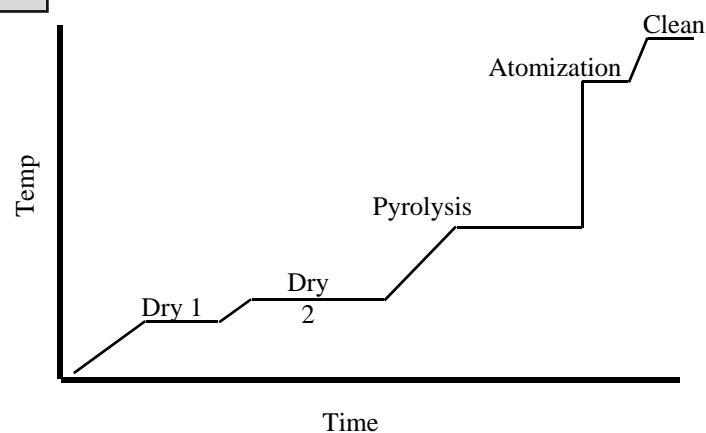


Graphite Furnace - Atomic Absorption (GF-AAS)

- Low DLs ($\mu\text{g/L}$) for many elements
- Slower than flame (45 - 90 seconds)
- Little sample consumption (μL)
- Single element technique
- Some experience is needed

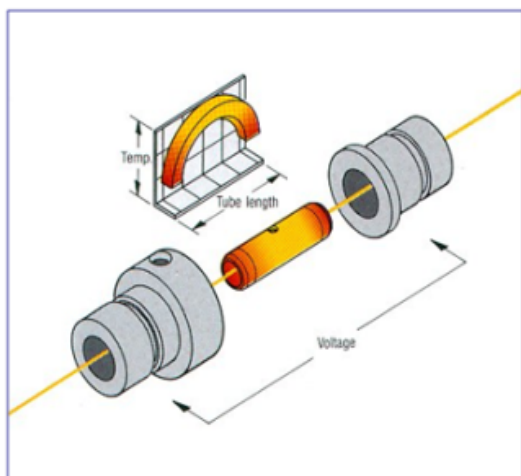


Chromium, 10 μL of 1 $\mu\text{g/L}$

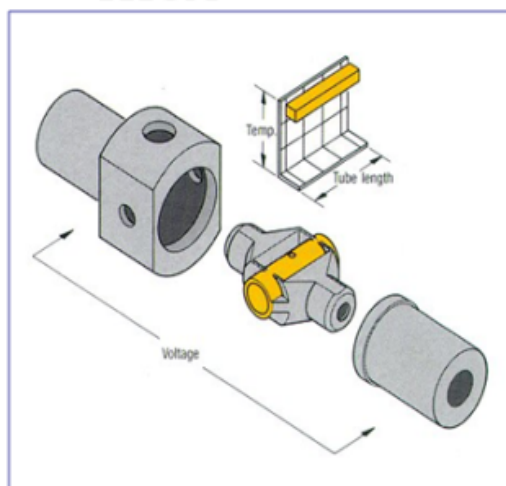


Patented Transversely Heated Graphite Atomizer

HGA

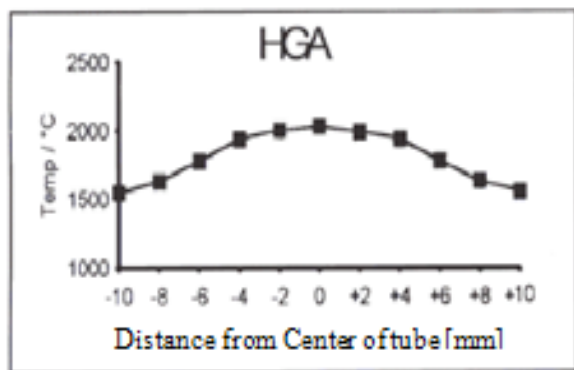


THGA

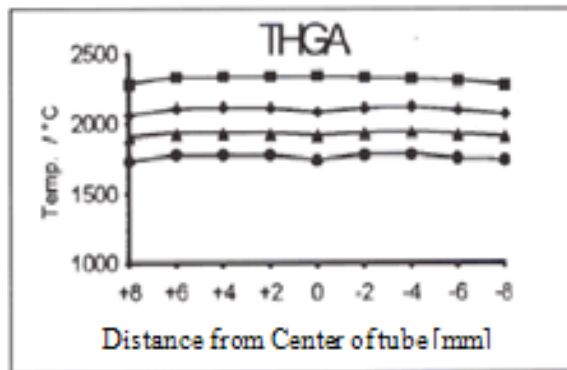


Atomization Temperatures
HGA /THGA furnaces

	HGA °C	THGA °C
As	2300	2000
Al	2500	2300
B	2650	2500
Ba	2550	2300
Cu	2300	2000
Cr	2500	2300
Fe	2400	2100
Ni	2500	2300
Pb	1800	1600
Si	2650	2350
Sn	2300	2200
Ti	2650	2500
V	2650	2400



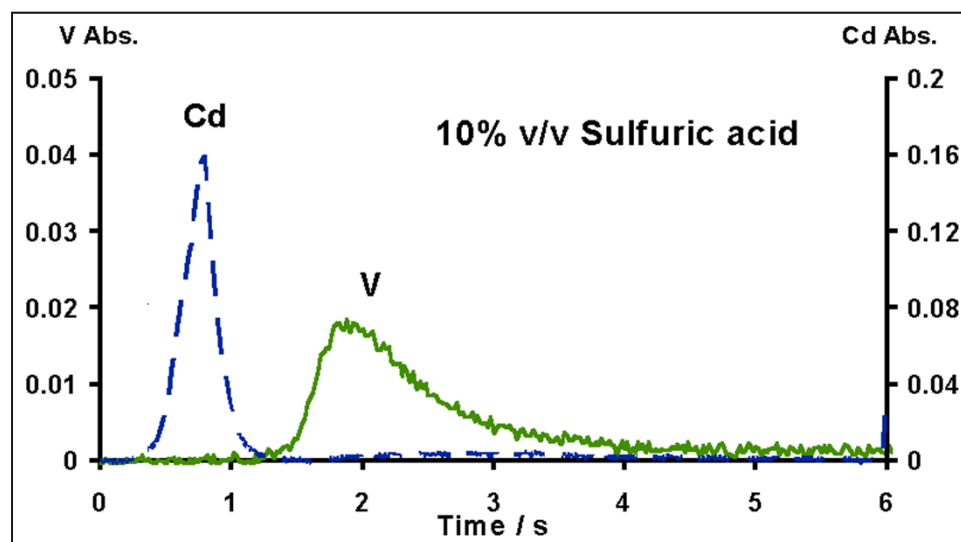
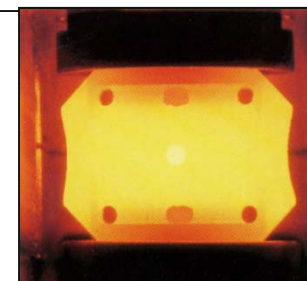
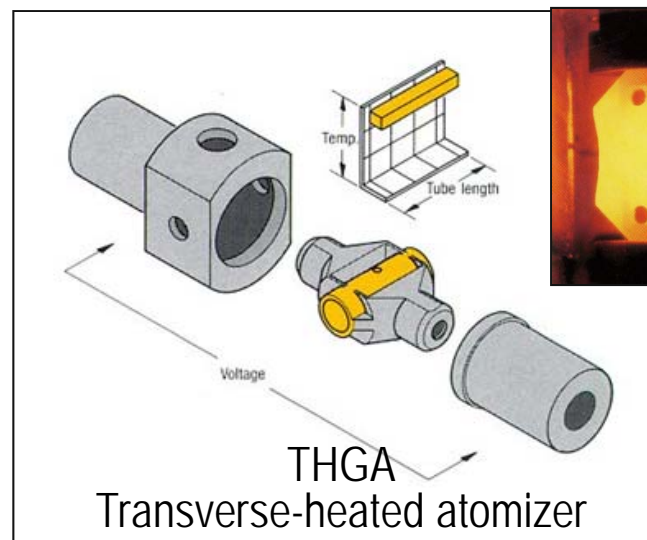
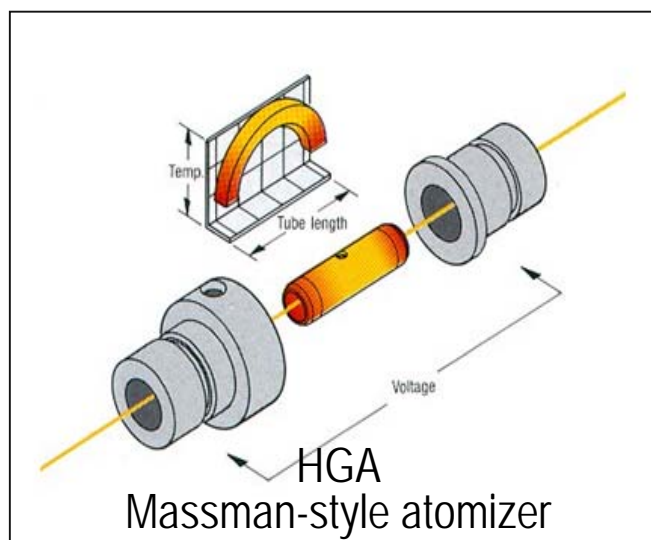
Distribution of temperatures in a HGA-tube



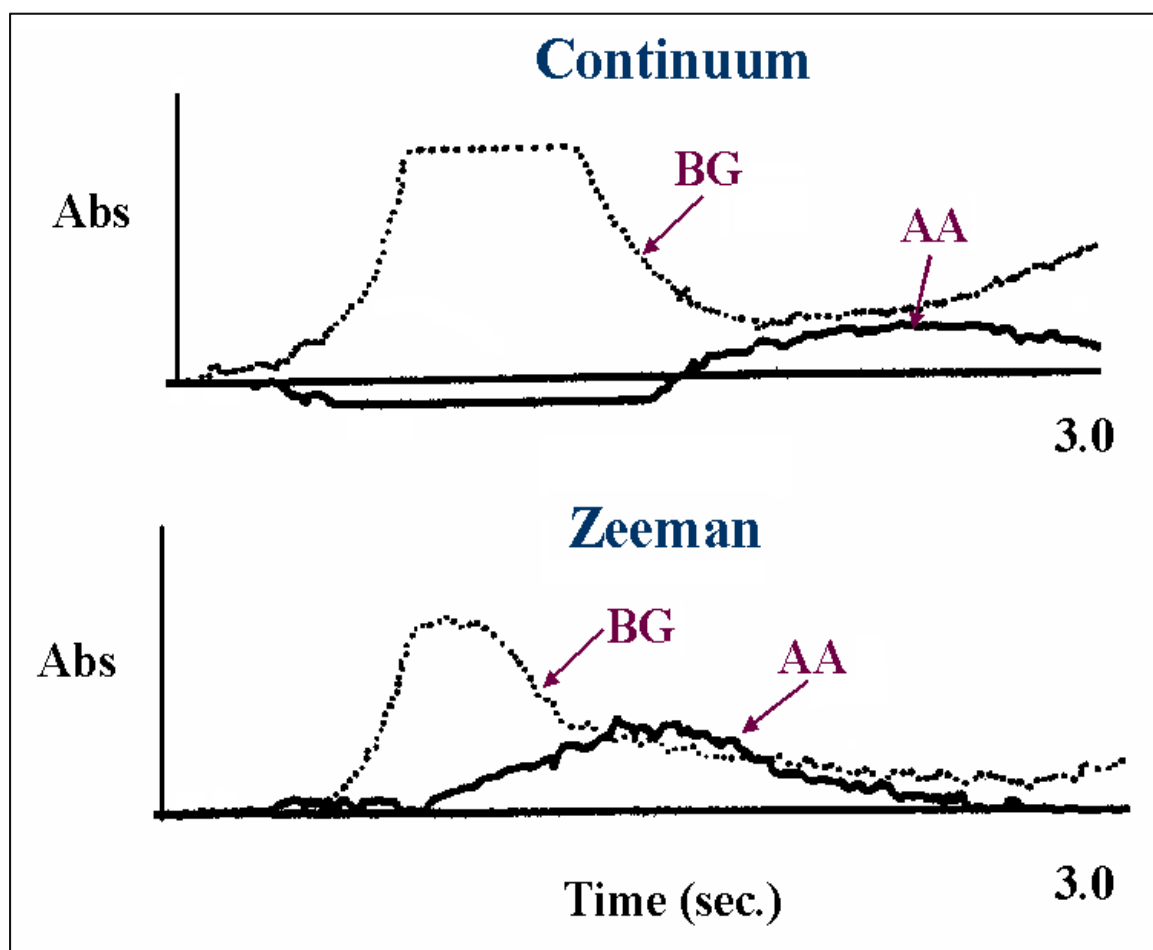
Distribution of temperatures in a THGA-tube

Temperature profiles for HGA and THGA tubes

GF technology improvements: temperature distribution



Bkgd. Correction: Continuum vs Zeeman (Se in fish tissue)



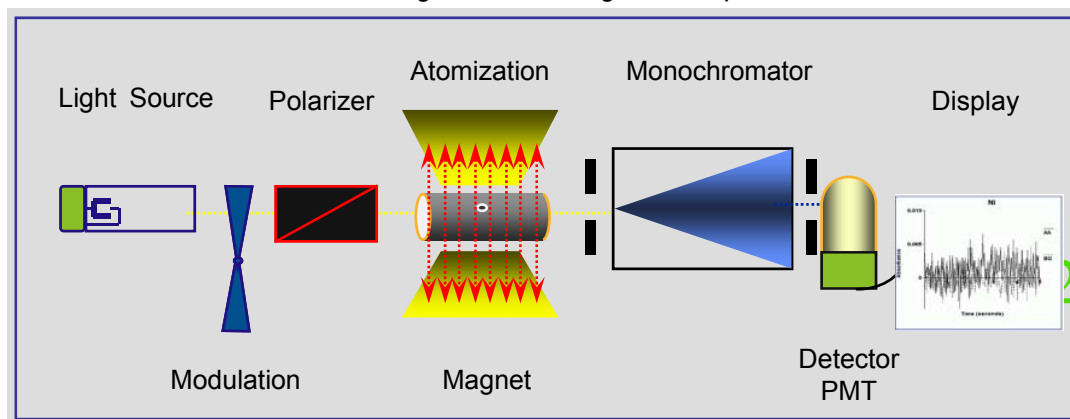
Zeeman effect properly corrects also non uniform bkgd.
(some molecular bands create structured bkgd.)

Longitudinal Zeeman Background Correction

- With Polarizer
 - “Old” Zeeman configuration
 - Needs a polarizer for background discrimination
 - Energy loss >50%
 - PMT detector
- Without Polarizer
 - Better Zeeman configuration
 - No polarizer for background discrimination
 - No energy loss
 - SSD detector

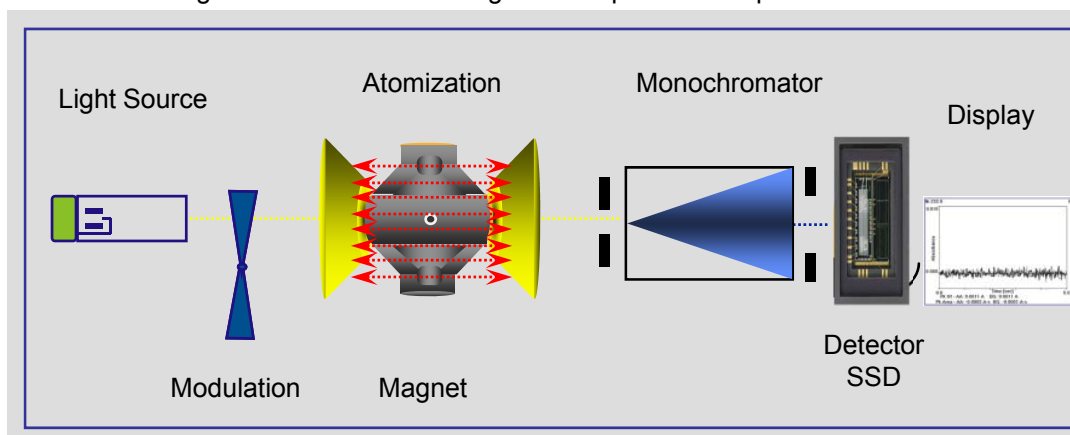
Transversal Magnetic Field

AC Zeeman Magnet Field orthogonal to optical beam

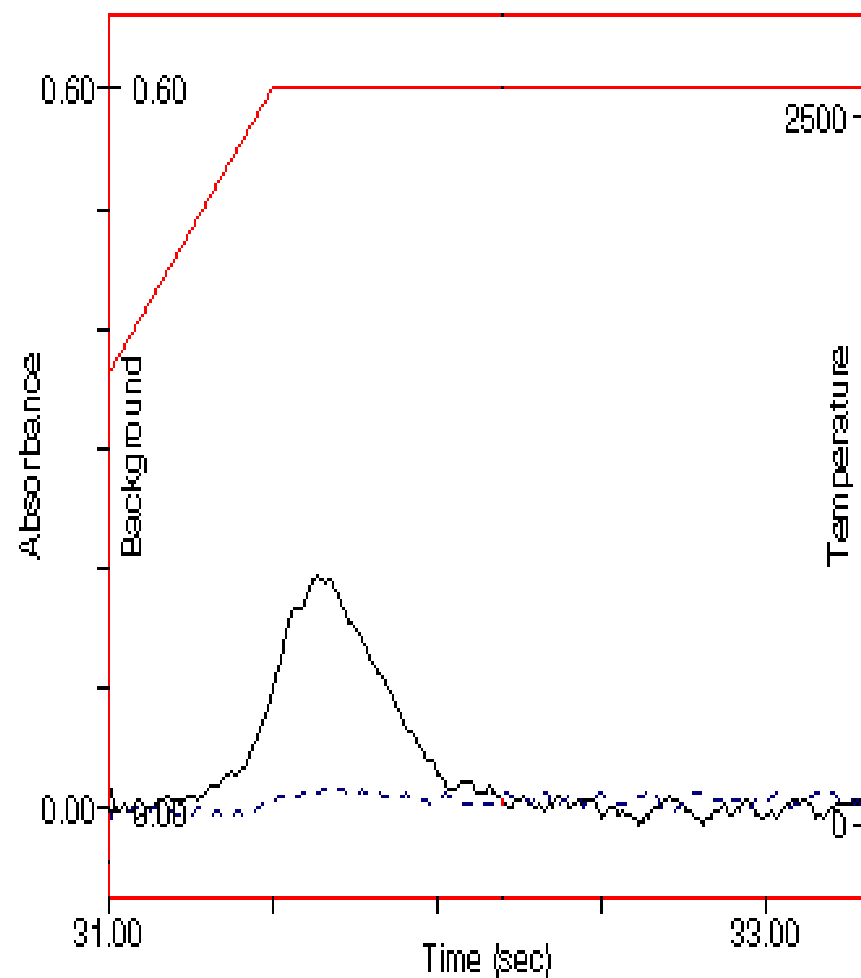


Longitudinal Magnetic Field

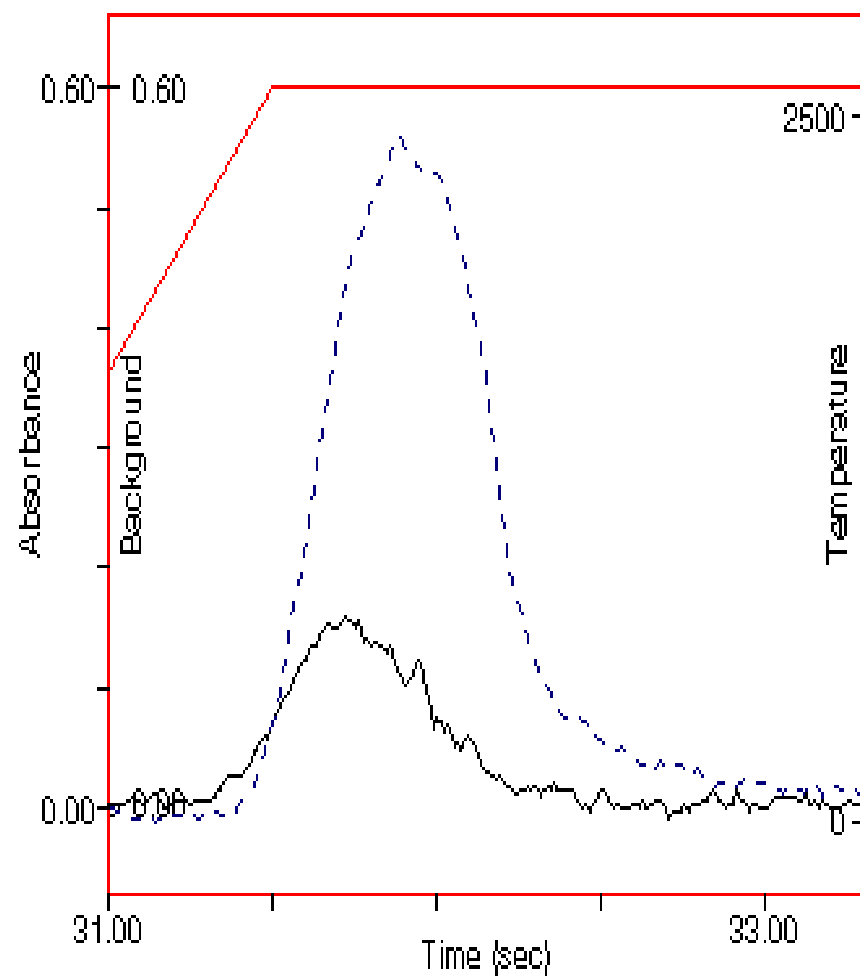
Longitudinal AC Zeeman Magnet Field parallel to optical beam



Zeeman bkgd. correction

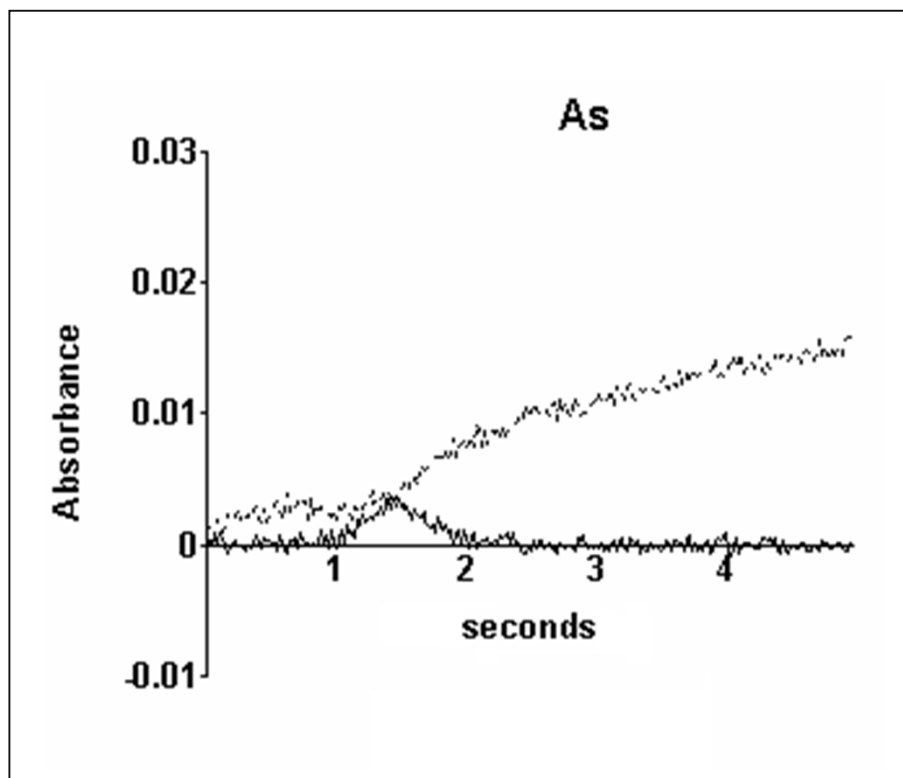


As std. 30 ug/L

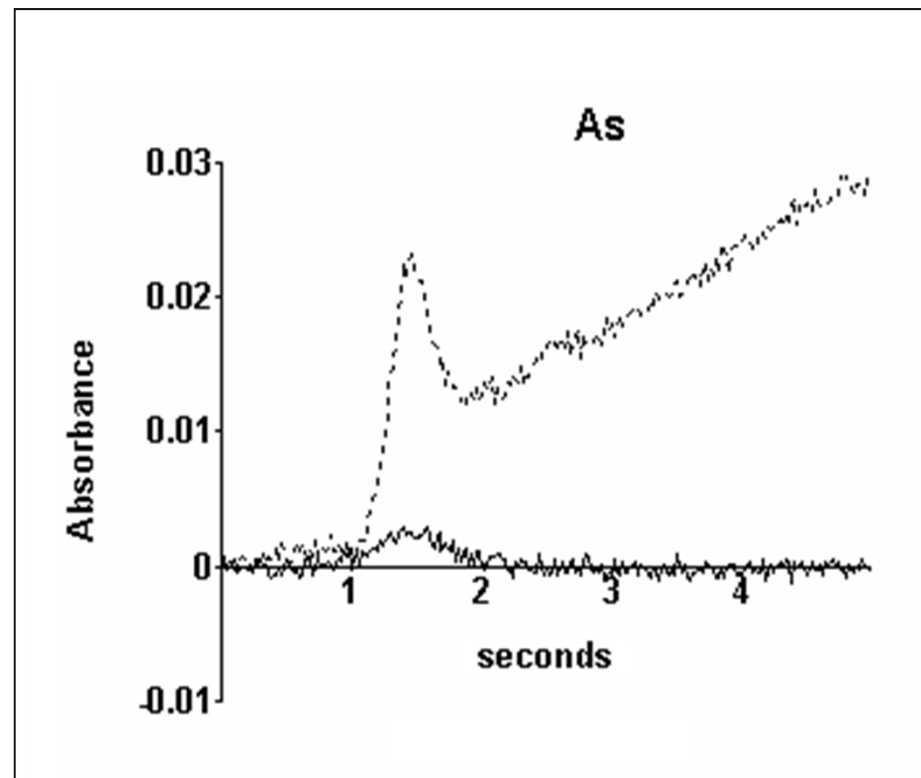


As 30 ug/L + Al 50 mg/L

Longitudinal Zeeman bkgd. correction



As 1 ug/L

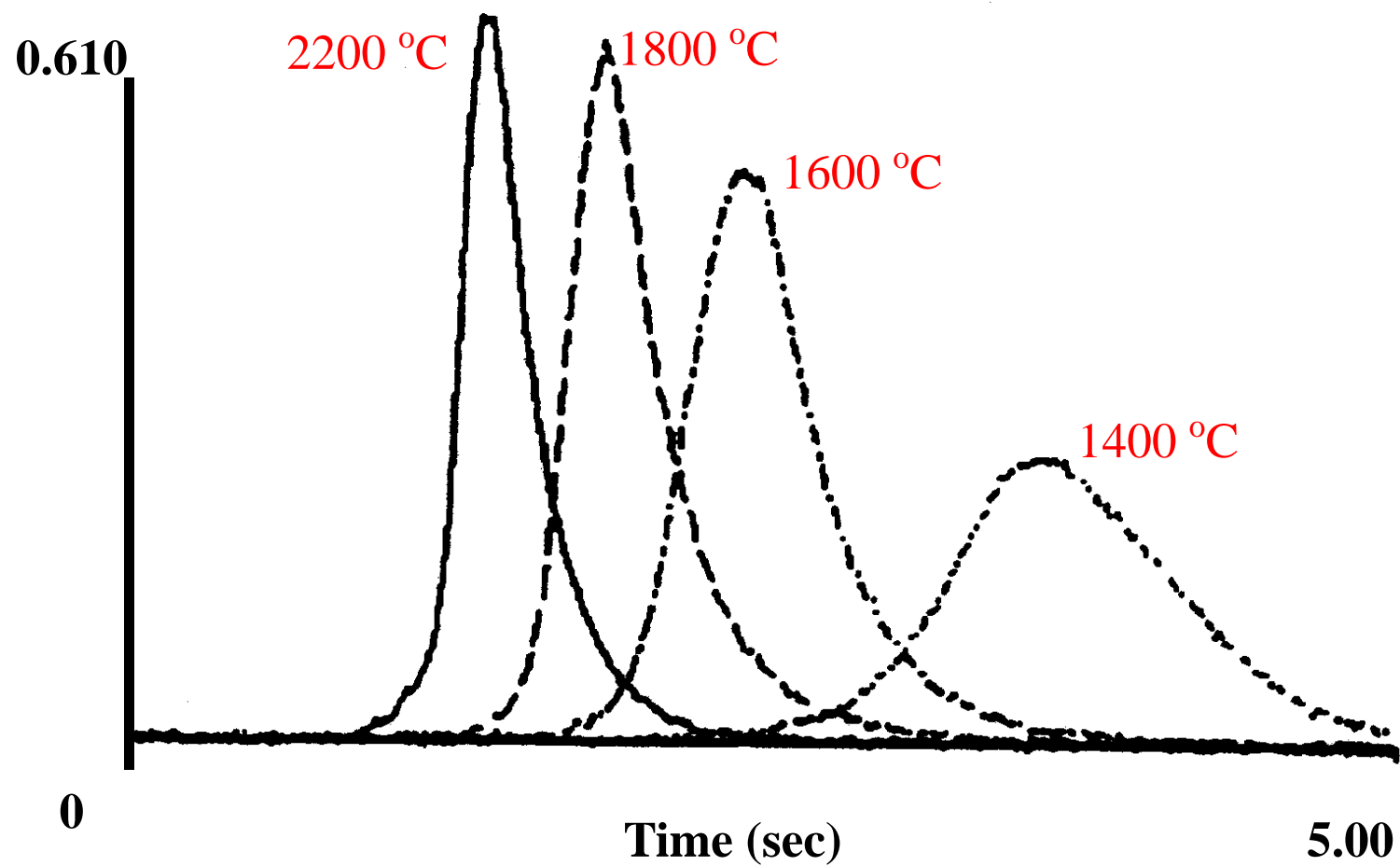


As 1 ug/L + Al 200 mg/L

Stabilized Temperature Platform Furnace

Parameter /Feature	Benefit	Proof Statements
Platform atomization Integrated platforms THGA (with & without endcaps) Integrated platform HGA tubes Uniform pyrolytic graphite coatings	Isothermal atomization Ease of use (no changing platforms) Reproducible & reliable data All elements from platform Longer tube lifetimes (corrosive samples)	Gas-phase temperature measurements (CARS) Reduced or eliminated chemical interferences Characteristic mass (m_0) stability Lifetime studies Scientific publications
Rapid, controlled furnace heating Independent of line voltage, tube parameters (<i>i.e.</i> , resistance) True Temperature Control (TTC)	Reliable day-to-day performance	Temperature measurements Refractory element performance with different voltages
Integrated Absorbance (peak area) measurements	More robust measurements Reliable day-to-day performance Independent of matrix changes	Peak area vs peak height studies
Zeeman-effect Background Correction	No user selection required Wavelength independent method Better detection limits	Interference studies Scientific publications
'Universal' Chemical Modifier Palladium/Magnesium nitrate	Faster, simpler method development Reproducible & reliable data	Interference studies Recovery measurements Scientific publications

Atomization Temperature and Signal (Pb-HGA)

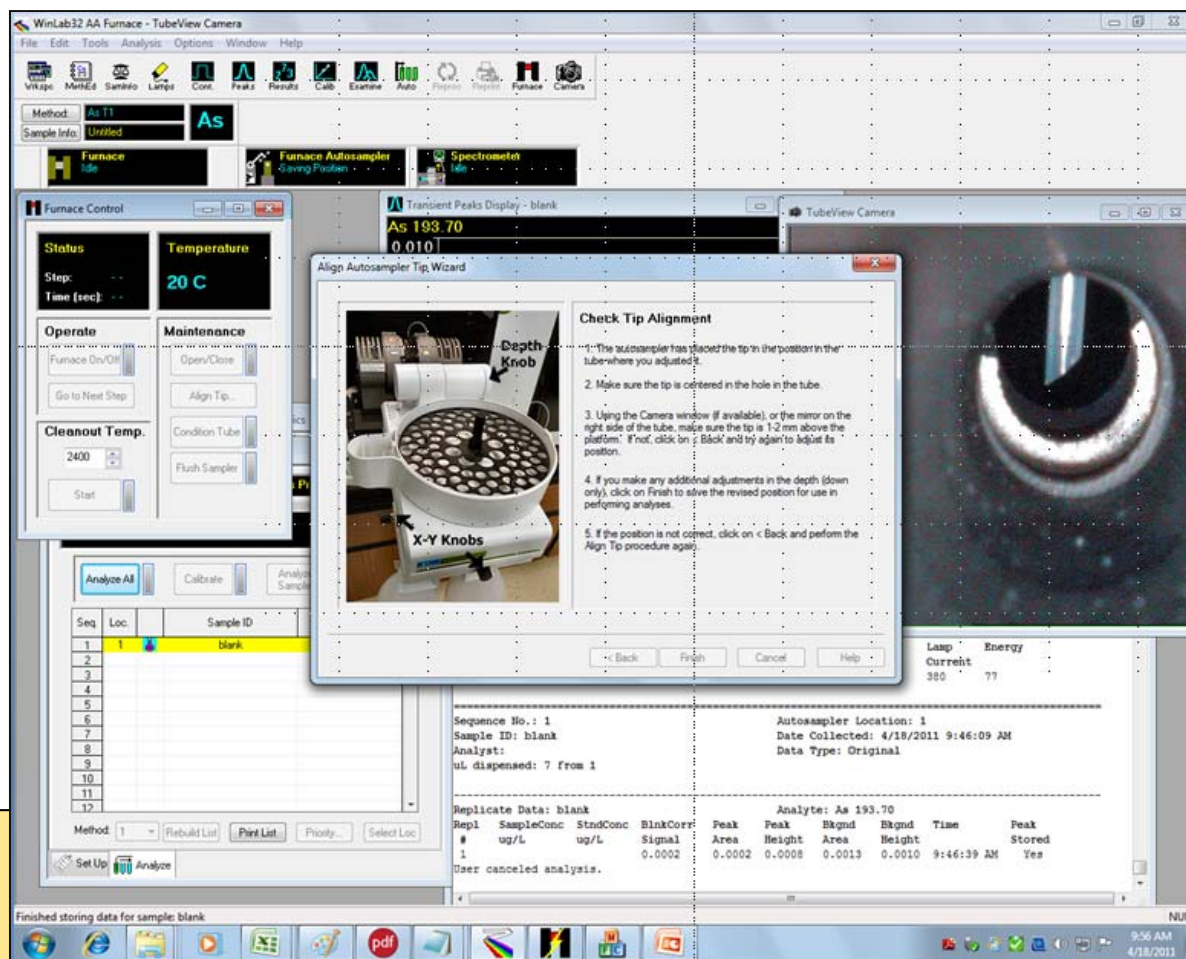


TubeView Furnace Camera

- Color TubeView Furnace Camera
- Probe Depth Alignment
- Drying and Pyrolysis monitoring

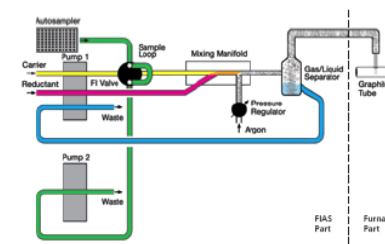
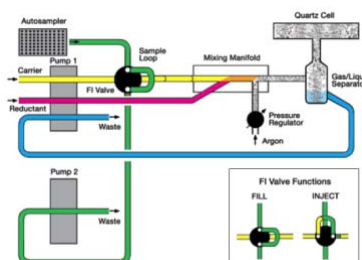
User Benefits:

- Precision
- Method development
- Reproducible results



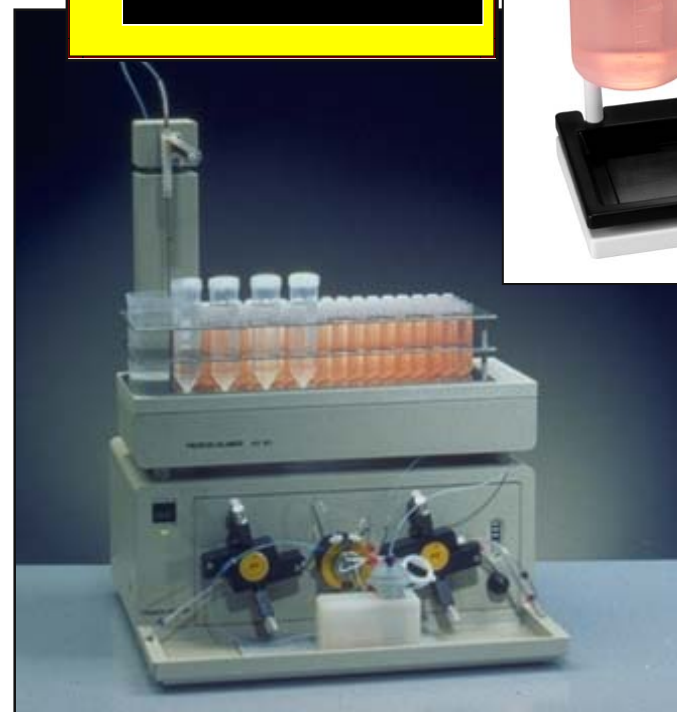
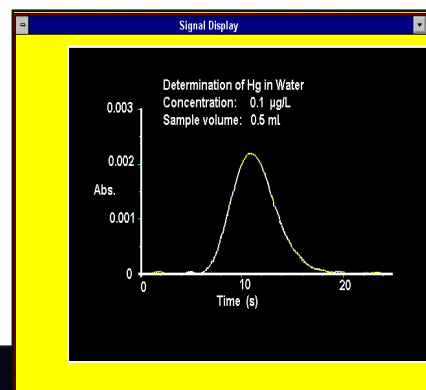
Accessories

- S10 Auto-sampler
- Flow Injection-MHS AA
- Flow Injection Flame AA
- FIAS-Furnace Coupling
- AutoPrep 50
- FAST Flame Sample Automation Platform



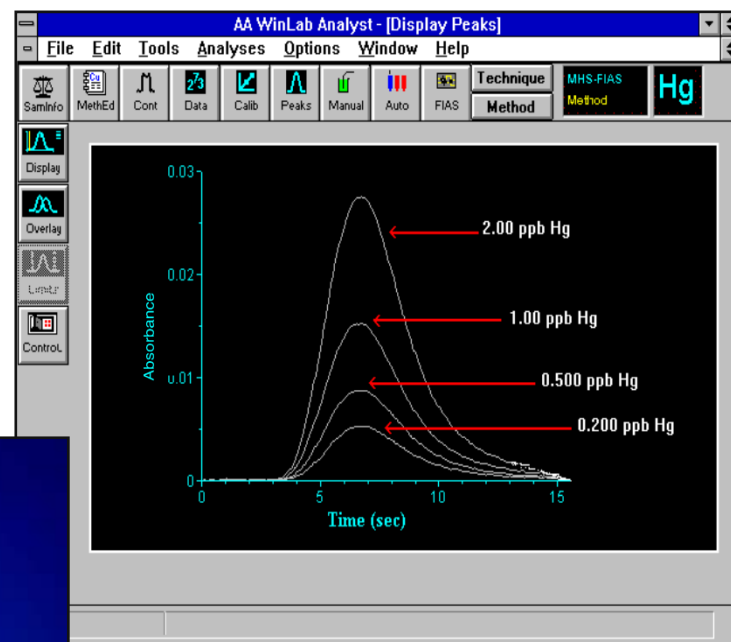
CV /Hydride generation

- Very good DLs (ug/L)
- Useful for
 - Hg; As; Sb; Se; Te; Bi; Sn
 - Typical hydrides:
 - MeH_2 , MeH_3 , MeH_4
 - i.e. AsH_3 , SbH_3 , SeH_2 , TeH_2 , BiH_3 , SnH_4 , GeH_4
- Produced by hydrogen generated from
 - NaBH_4 reactions with HCl
- The only AAS technique that is chemistry dependent

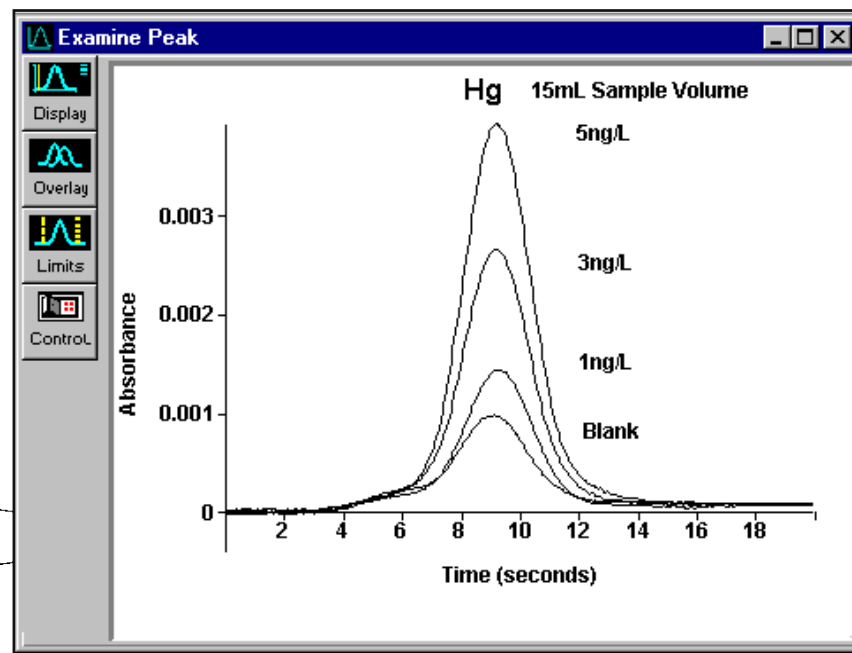
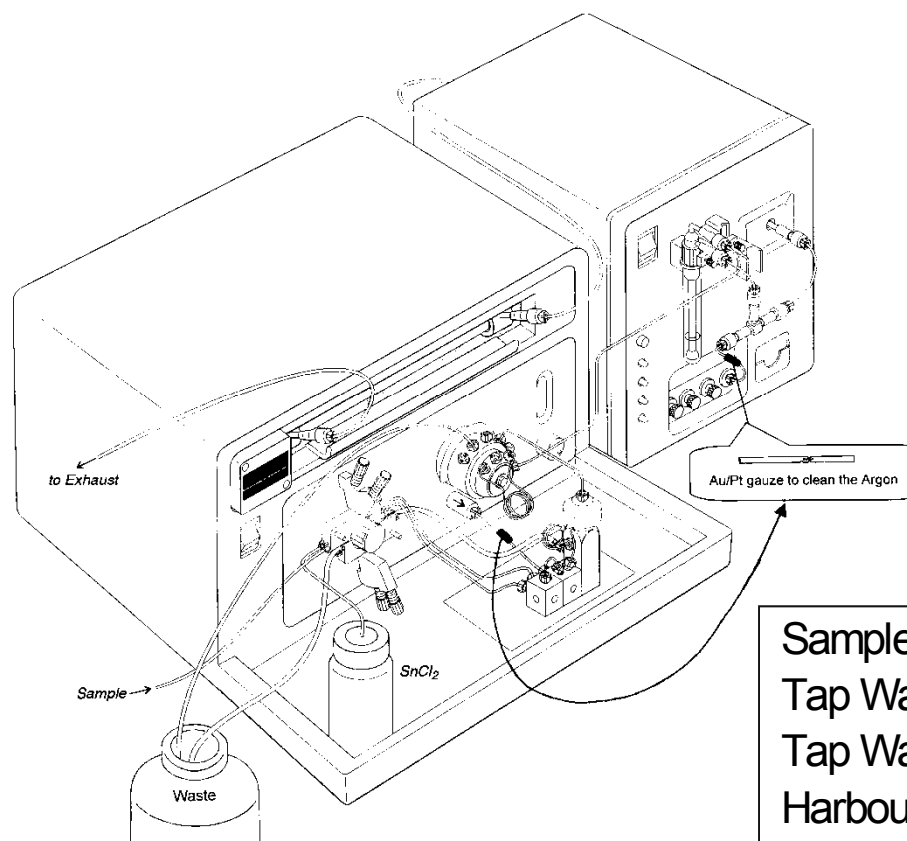


Flow Injection Mercury Systems - FIMS

- Dedicated Hg analyzer
- Determines Hg via CV-AA
- Stand alone system
- Fully automated
- Easy to operate



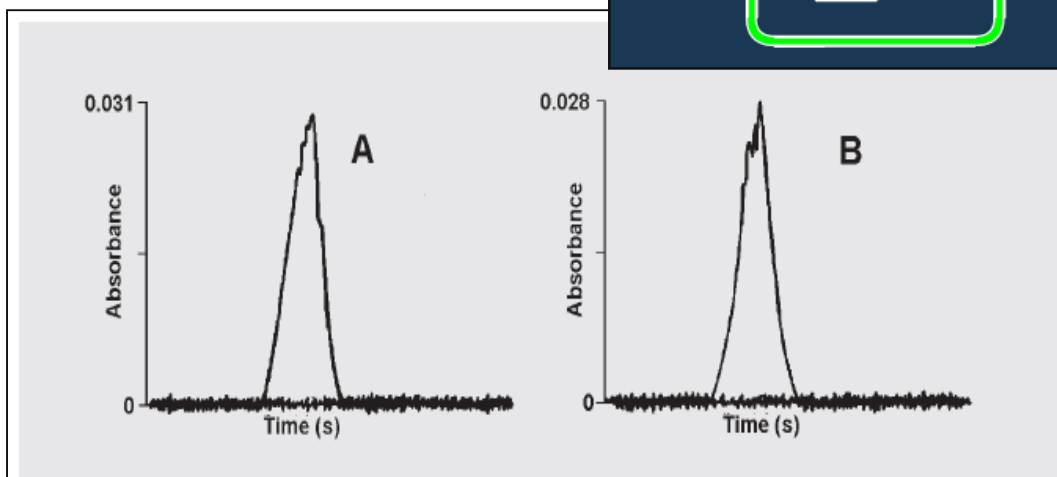
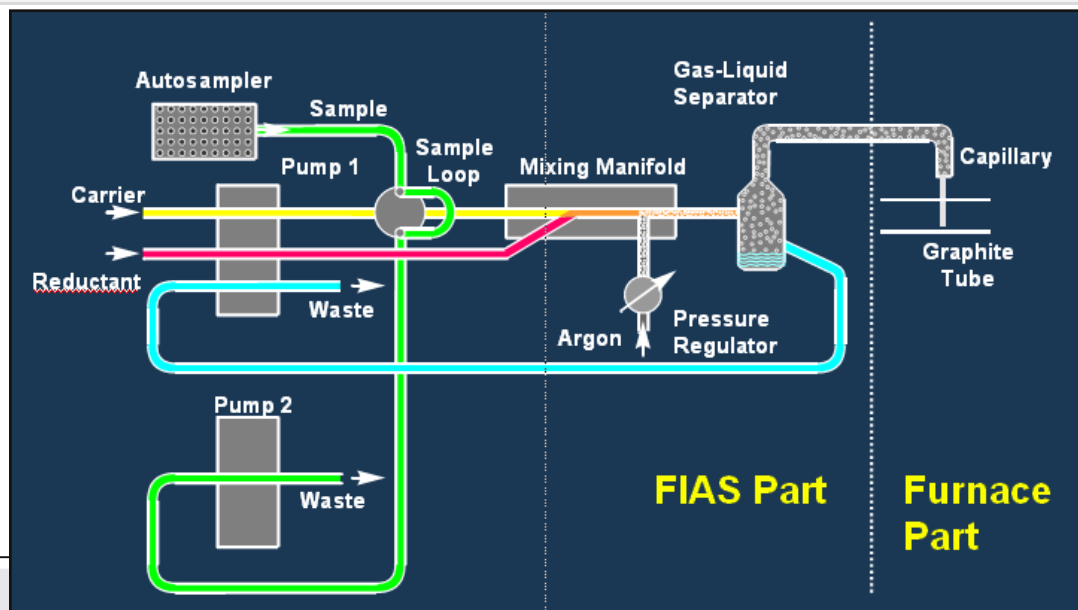
Hg determination with pre-concentration by Amalgamation



Sample	Concentration ng/L	Recovery (%)*
Tap Water 1	0.55 (0.10)	105
Tap Water 2	0.72 (0.14)	103
Harbour Water 1	2.93 (0.07)	89
Harbour Water 2	2.89 (0.06)	92
Waste Water	0.69 (0.02)	111
Treatment Plant		

FIAS-Furnace Coupling

- Features
 - Separation of matrix and analytes
 - Controlled atomization
 - Fully automated
 - Easy to use
 - Integrated software

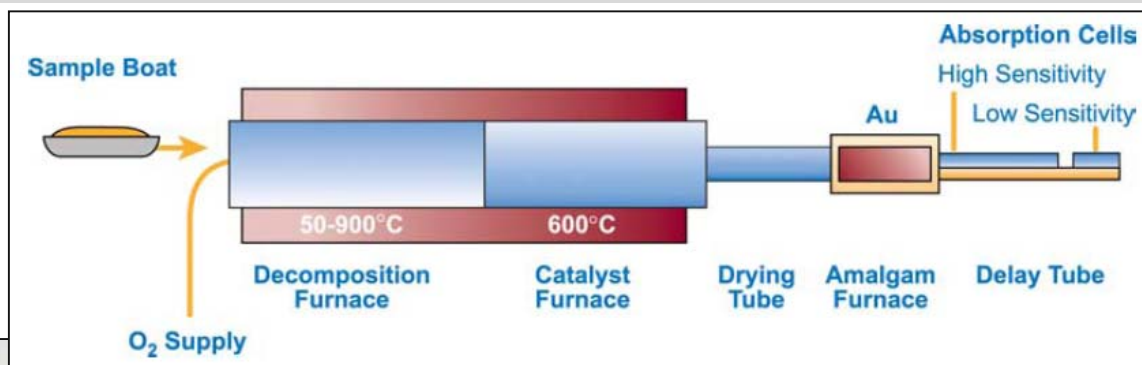


Ultratrace determinations of 25 ng/L As: A) in aqueous reference solution; B) in saturated NaCl (3 mL sample volume).

► Benefits

- Reliable analysis of difficult elements in very complex and difficult samples
- Improved detection limits
- More reliable analysis

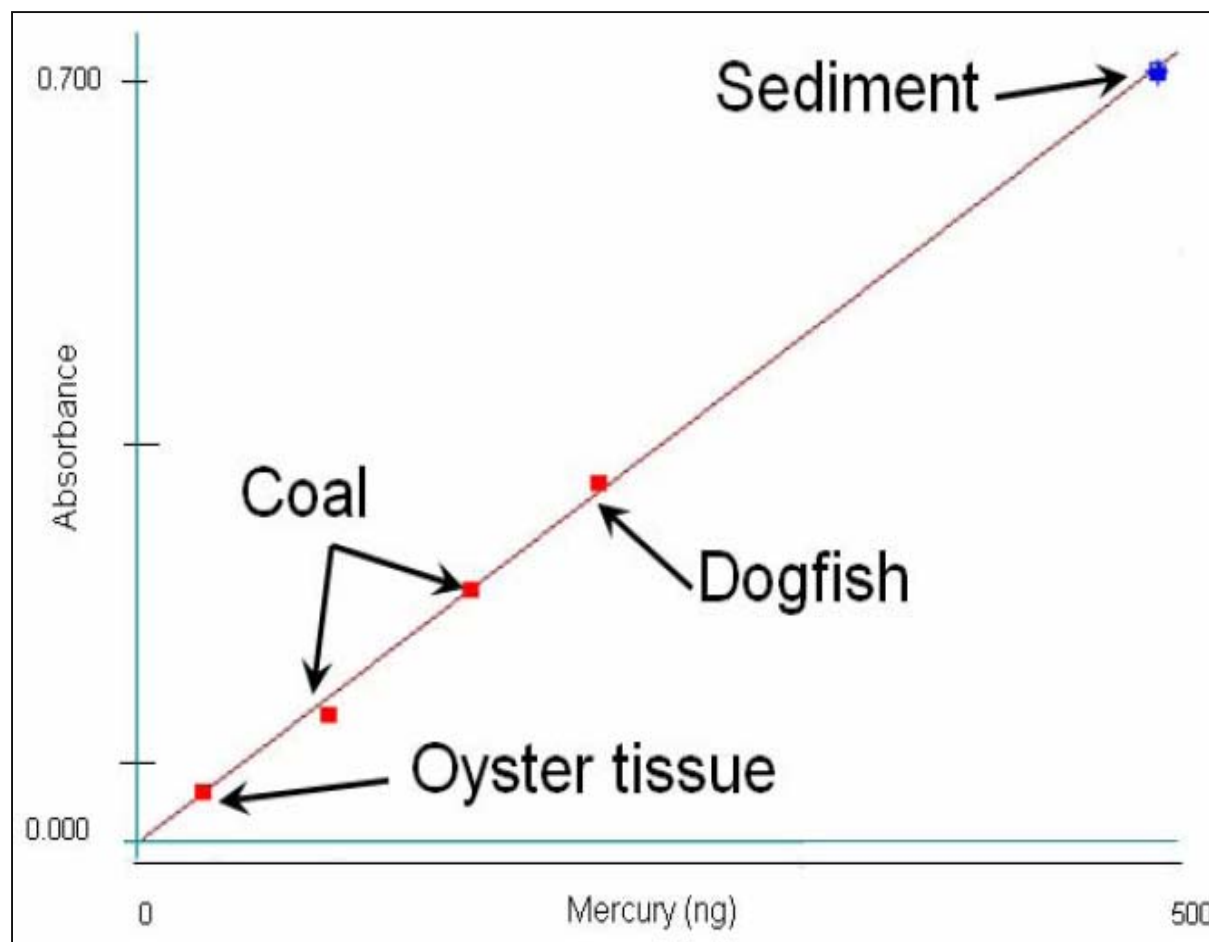
SMS 100, dedicated Hg analyzer in solids and liquids



- Soils
- Sediments
- Geologicals
- Coal
- Foundry scrap
- Plastics
- Sewage/ Sludge
- Blood
- Paints
- Animal Tissues
- Marine Tissues
- Tobacco
- Vegetation
- Cement

Matrix Independent Analysis

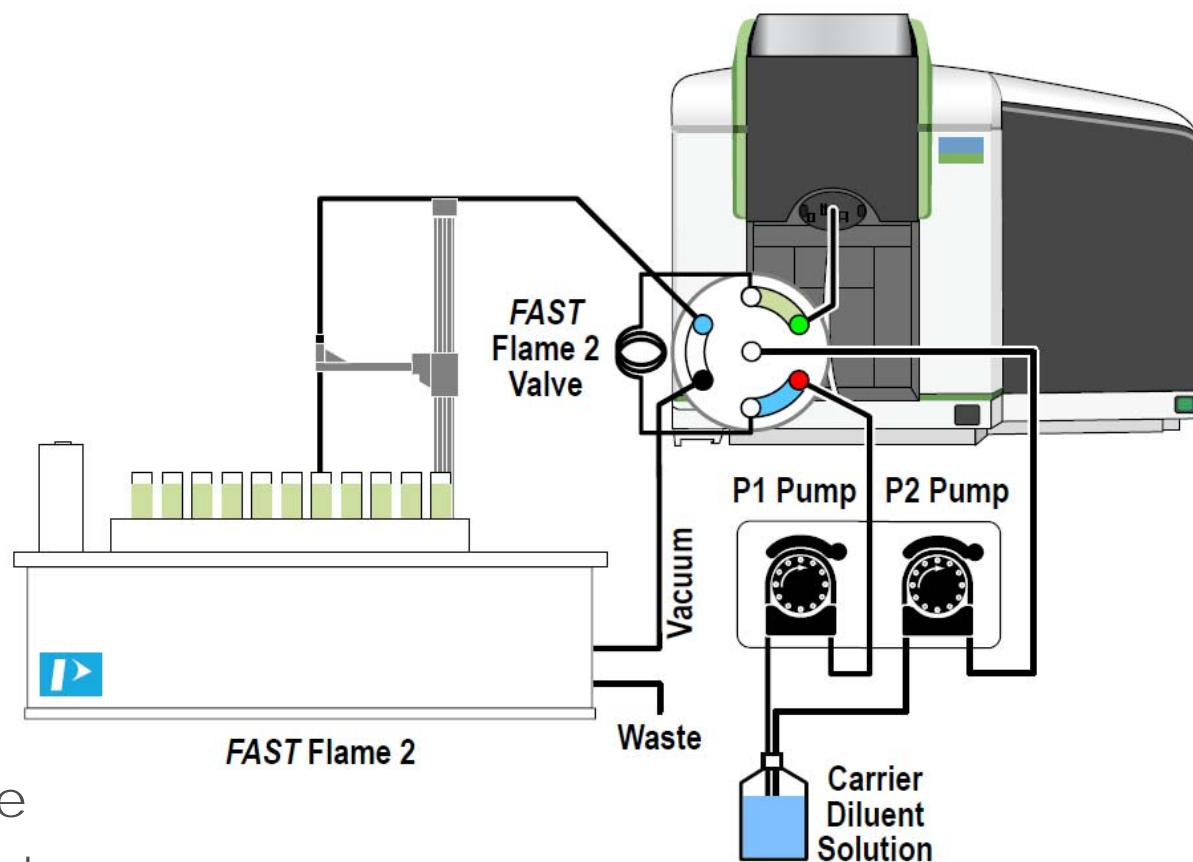
- Calibrate once for many sample types.
- No matrix effects are found when the calibration curve is created using certified reference materials as standards
- see EPA GRAPHS...



FAST Flame 2 with SC2 Autosampler (2-trays)

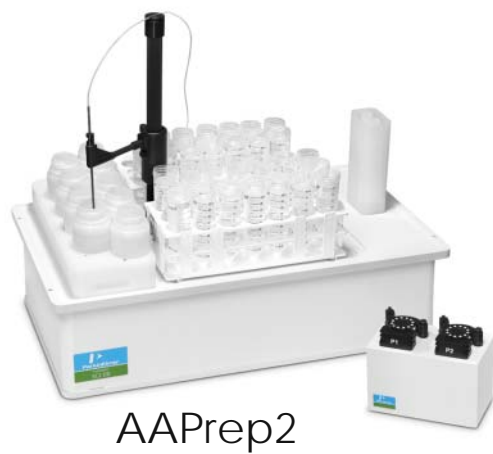


FAST Flame 2 – Schematic Diagram



- Pump 1 carries sample
- Pump 2 delivers diluent
 - Pump 1 + Pump 2 = Constant
 - $DF = (Pump\ 1 + Pump\ 2) / Pump\ 1$

FAST Flame Sample Automation Platform



AAPrep2



FAST Flame 1



FAST Flame 2

Titan MPS™ Sample Preparation System



Microwave Digestion

Ideal for: Difficult sample types and regulated laboratories

Common Applications: Plant waste streams, alloys, pigments, simple and precious metal ores and heavy organic samples




Overview: Microwave digestion provides high-performance, pressure digestion using sealed vessels to deliver complete sample digestion, allowing total elemental measurement. Able to digest difficult sample types quickly and completely, microwave digestion provides the most accurate sample preparation. Using ultra-clean sealed digestion vessels, the Titan MPS avoids loss of volatile analytes and prevents sample contamination from the working environment. With its high performance, microwave digestion is ideal for mining/geologic, environmental, petrochemical and pharmaceutical industries.

The Titan MPS microwave sample preparation system delivers the instrument-ready solutions you need for high throughput and reliable results. With its Direct Pressure Control™ (DPC) and Direct Temperature Control™ (DTC) sensing technologies, the Titan MPS system accurately monitors digestion reactions and the sample temperature in each digestion vessel to provide outstanding reaction control and deliver consistent digestion results.



The right vessel for the right application

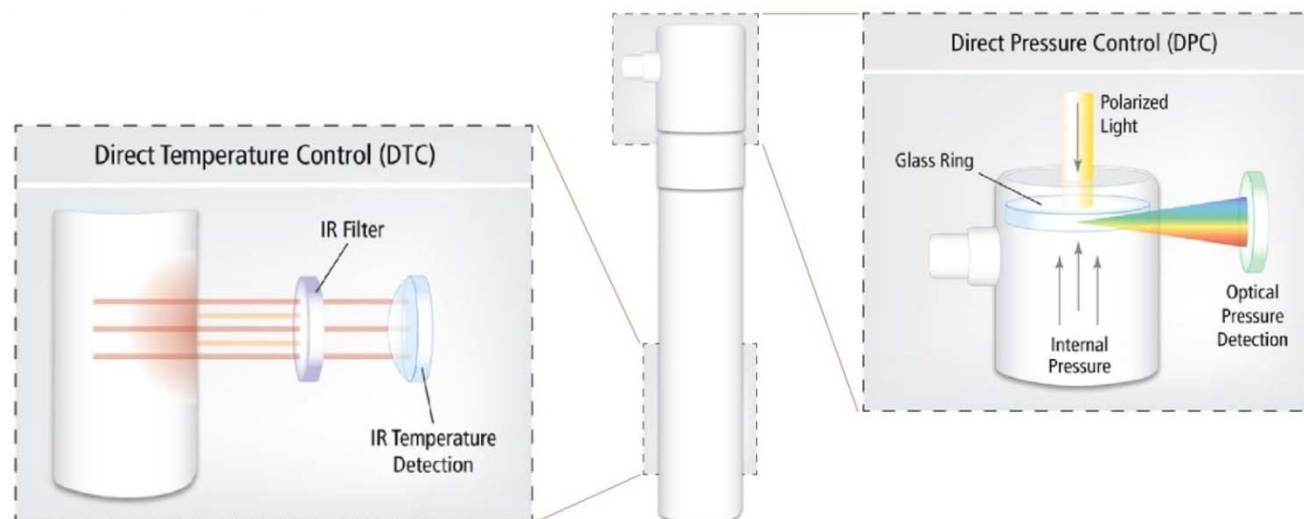
- **Standard 75mL vessel**
 - 16-vessels configuration
 - For a majority of applications
- **High Pressure 100 mL vessel**
 - 8-vessels configuration
 - For high pressure applications

		
260°C	Temperature	260°C
40 Bar	Pressure	100 Bar
75 mL	Volume	100 mL
PTFE-TFM	Material	PTFE-TFM
All vessels come with a 1 year warranty		

Sophisticated sensing technology

Effortless contact-free and connection-free optical sensing

- Direct Temperature Control (DTC)TM
 - Reference quality sample temp. monitoring for every vessel
 - Unsurpassed temperature control
- Direct Pressure Control (DPC)TM
 - Reference vessel pressure sensing
 - Simple, inexpensive and robust



DTCTM

Intelligently filter out the IR signal of the vessel, allowing direct measurement of the sample temperature without interference.

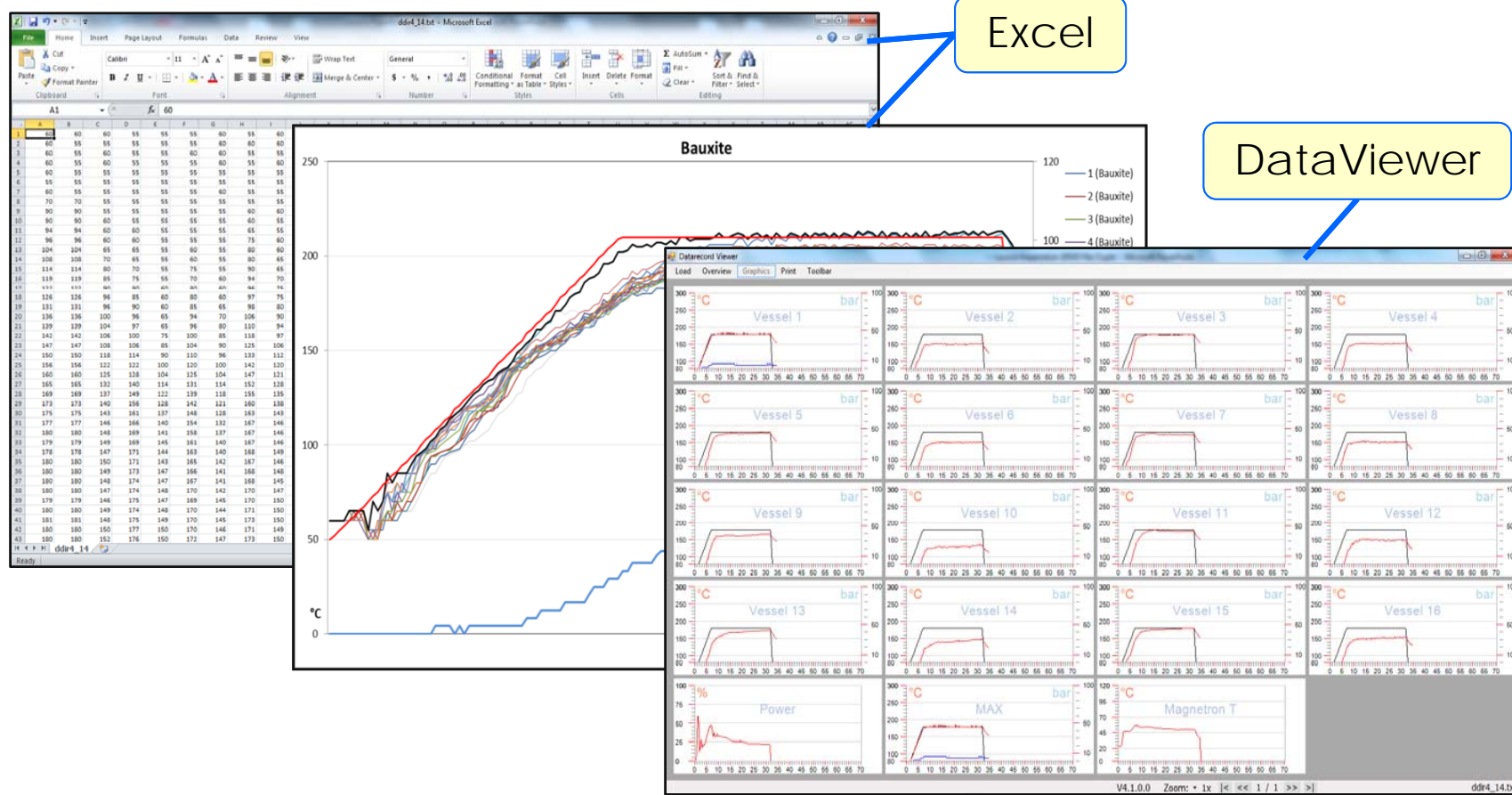
Theory of Operation

DPCTM

A reference beam of light is sent through a prism and glass ring. Pressure on the glass ring is measured via the shift in reference beam wavelength.

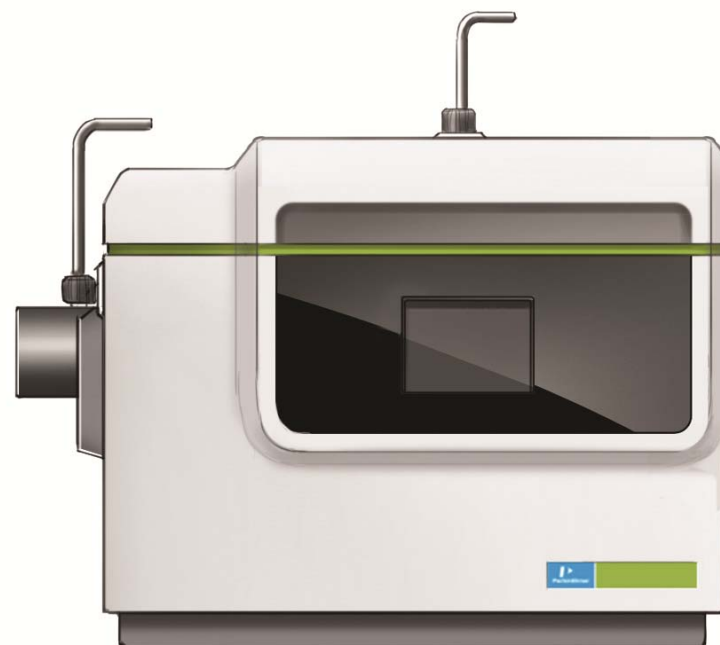
Digestion data exporting for analysis, reporting and archiving

- Export data to an easily readable, common numeric format
- Import into Excel or use the included Windows based DataView



Titan and Safety

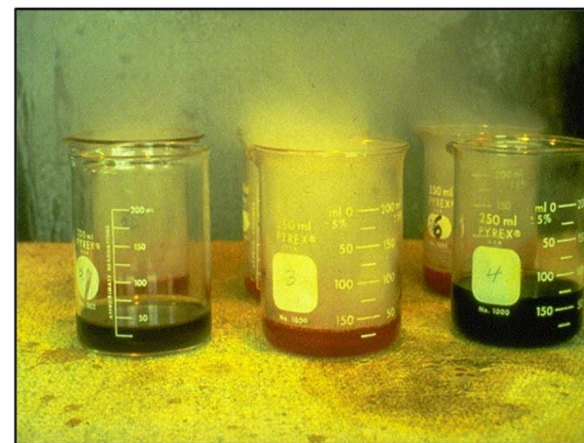
- Hardware interlocks
 - Lid, power supply, inverters, magnetrons, oven body
- Software interlocks
 - Lid, DTC, DPC, vessel venting
- Vessel burst resistance
 - Elastic, gas containment manifold
- CE/NRTL/FCC certification



Hot Plates (Open Digestion)

The Good:

- Cheap
- Easy methods
- Large sample volumes



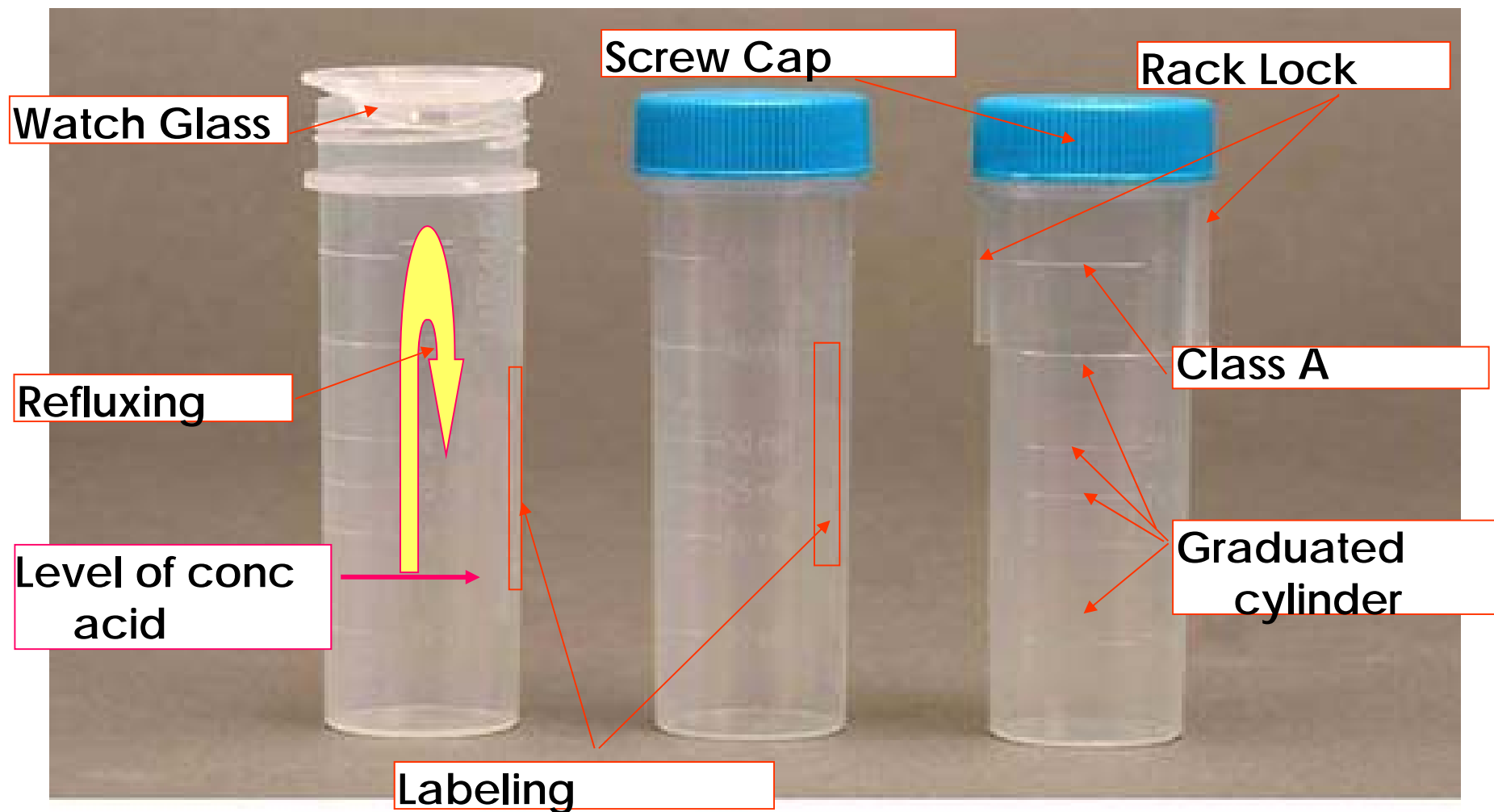
The Bad:

- Not suitable for Mercury
- Corrosion, short lifetime
- Poor Temperature Control
- Contamination of Sample
- Safety

Sample Preparation Block

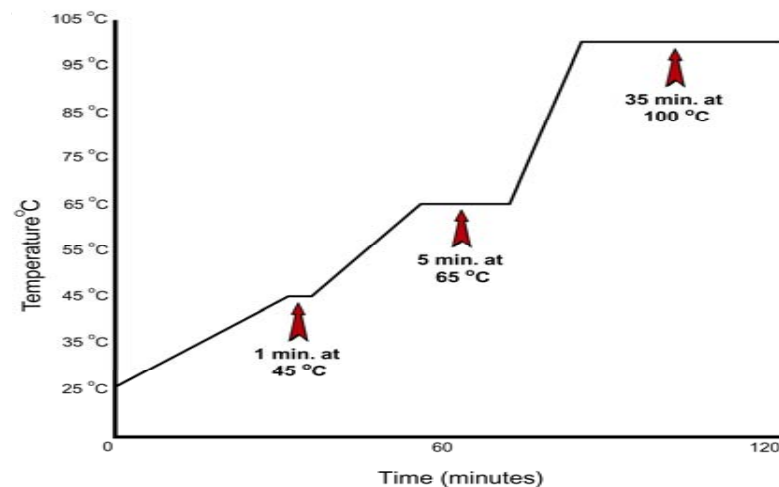
- An acid resistant graphite heating block
 - Reduced sample contamination
- Corrosion - Teflon coated, Kydex, Corian
- Temperature Uniformity - Heating Material
- Sample temperature control – SPB probe
- Number of samples - 24; 48 or 72





Typical Application For Touch Screen Controller

- Touch Screen Controller
 - Ideal for complex digestions at multiple temperatures
 - Ideal for method development
 - Typical Samples
 - Animal feeds, pet foods, human
 - Biological samples
 - Plastics



Thank you for your attention.

? Any questions ?

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