

# Improved Detection Capabilities by Fast Data Acquisition in ICP-MS

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# Why do we need improvements in sensitivity and scan speed



## Sensitivity

### Laser ablation

- Small samples – inclusions
- Elemental mapping - resolution
- Isotope ratio / isotopic abundance

### Speciation

- Better detection limits
- Lower injection volumes

### Single particles

- Smaller particles

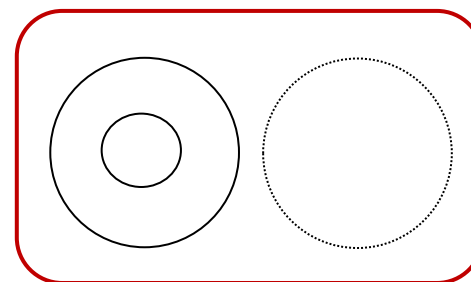
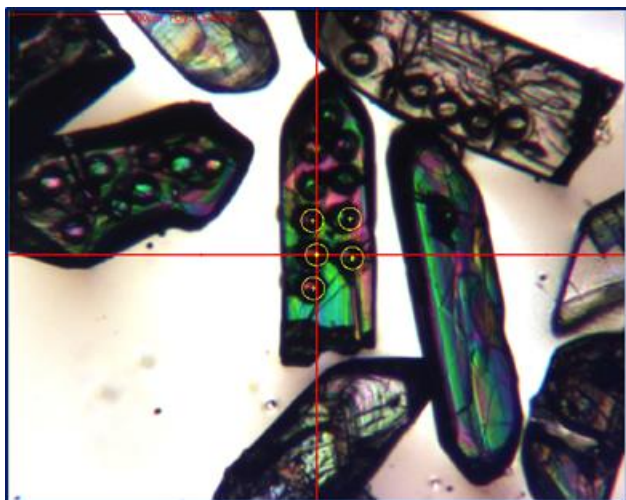
## Scan Speed

- Fast scan speed, signal is limited in time
- High sensitivity - isotopic abundance varies
- Better peak characterization
- Multi-element acquisition

# Let's talk about spot diameter

## Laser ablation on crystalline samples

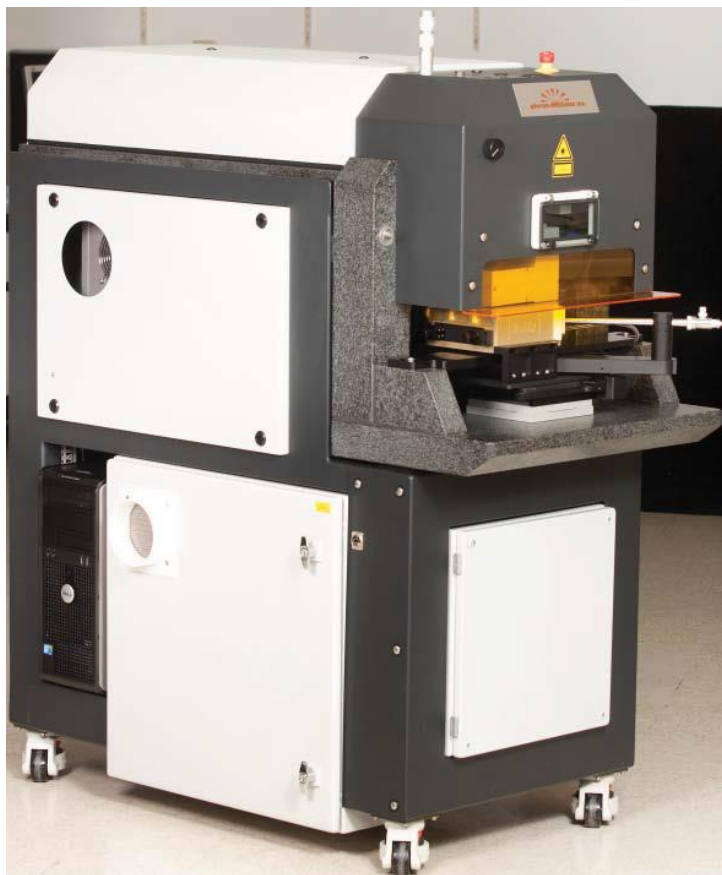
- Limited sample size means – interest in smallest possible spot sizes
- If the diameter is in-/decreased by a factor of two the amount of sample changes by a factor of 4
- To change from  $\sim 50\mu\text{m}$  to  $20\mu\text{m}$  means more than 4 times less material



# Laser ablation on zircon crystals



Photon-Machines Inc. 193nm excimer laser  
4ns pulse duration, spot size down to  $2\mu\text{m}$

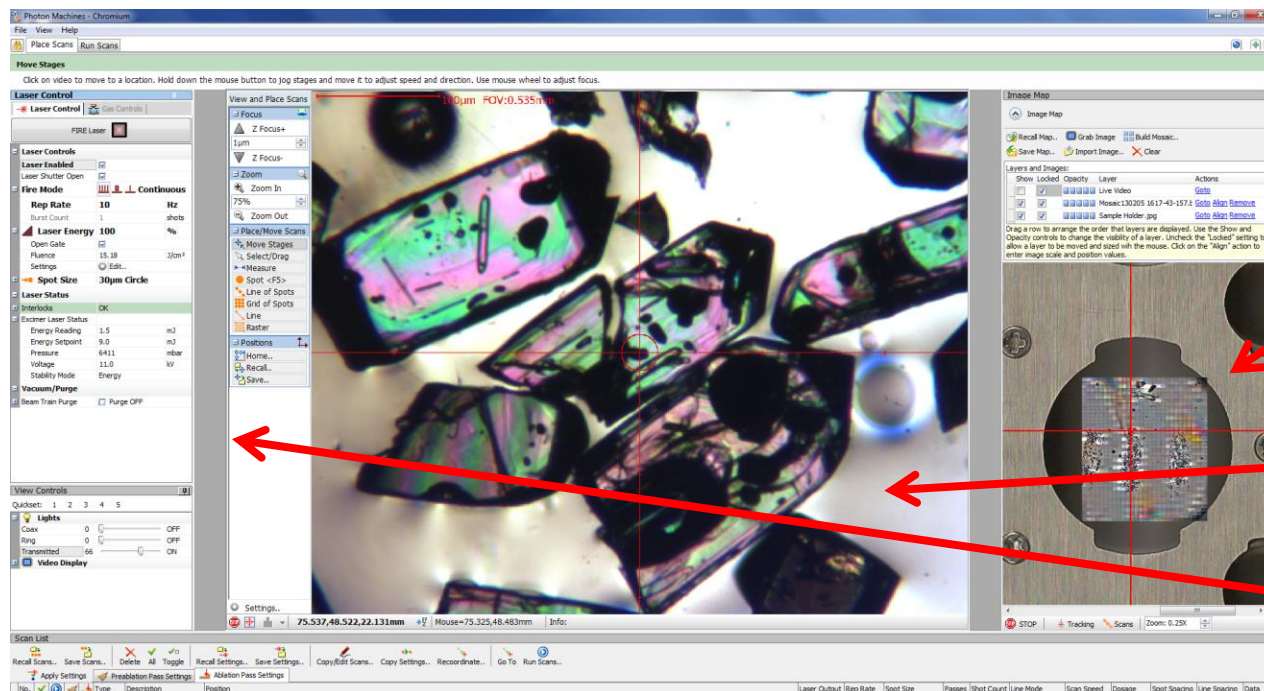


Bruker aurora Elite ICP-MS



**Bruker Corporation**

# Zircons



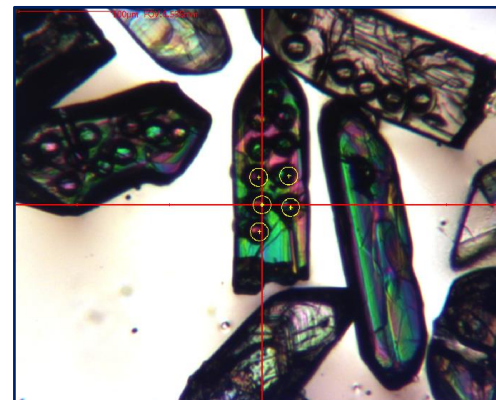
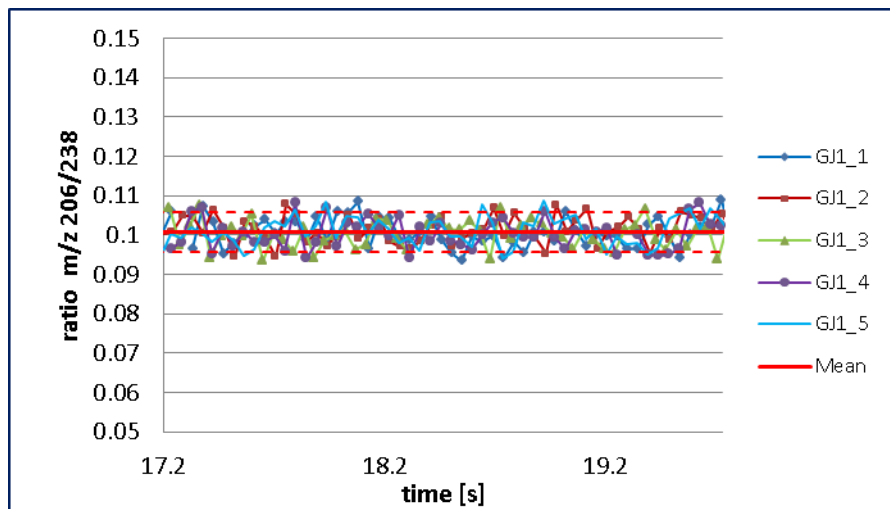
position in the  
ablation chamber

zoomed CCD  
camera view of  
the ablation site

Laser settings

Screen image of photon-machines Chromium software showing zircon crystals prior to ablation.

# Isotope ratio results for Zircon GJ1



Isotope ratio  $m/z$  206/238 from 5 individual spots vs. time

Result:

- Super precision, 206/238 0.04%  $rsd$
- Small mass bias

GJ1	207/206	206/238	207/235
<b>Average</b>	<b>0.05995</b>	<b>0.100693</b>	<b>0.8242</b>
Stdev	0.0011	4.04E-05	0.012
<b>Cust. Ref.*</b>	<b>0.06014</b>	<b>0.09761</b>	<b>0.8093</b>
1sigma	0.00001	0.00011	0.0009
<b>Factor</b>	<b>1.0030</b>	<b>0.9691</b>	<b>0.9819</b>

\* S.E.Jackson et al., Chemical Geology 211, 2004, 47-69

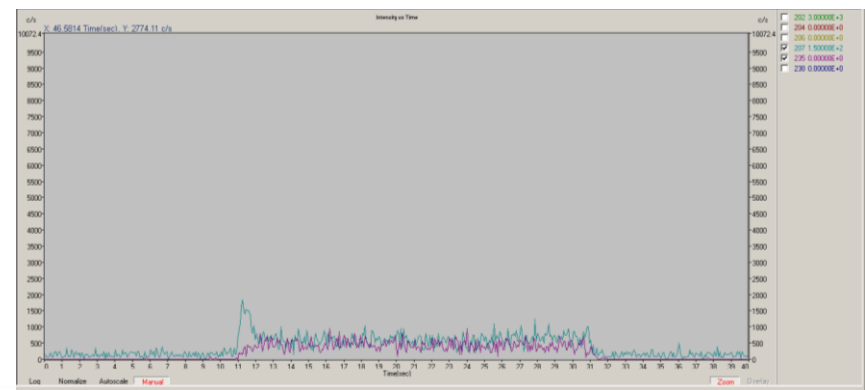
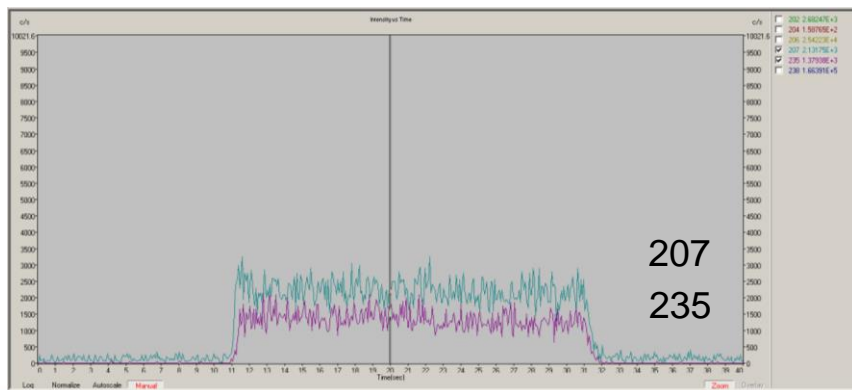
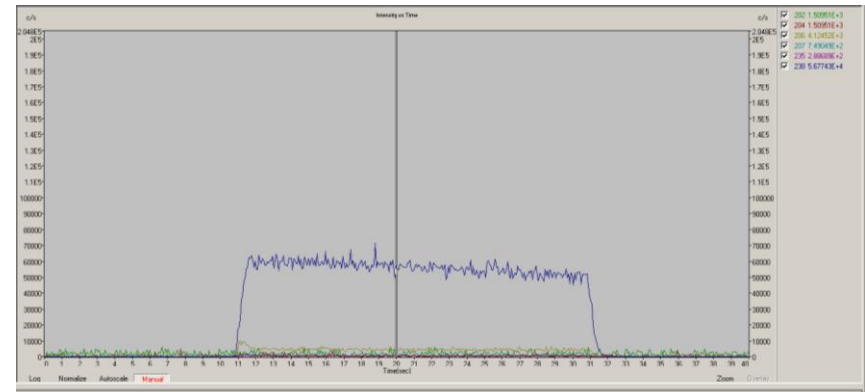
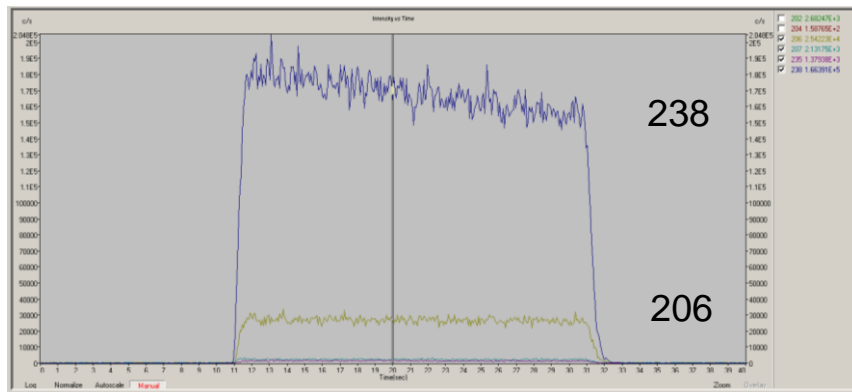
# Rutiles



- Very low concentration of  $^{207}\text{Pb}$  and  $^{235}\text{U}$
- Increased the spot to  $50\mu\text{m}$
- 100shots, 5Hz,  $6\text{J}/\text{cm}^2$

Samples: R10b and R13, Age: 1090Ma and  $505 \pm 6\text{Ma}$

A.K. Schmitt, Th. Zack, Chemical Geology 332-333, 2012, 65-73





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	206/238	207/235
ratio	0.08101	0.65512
stdev	0.0006	0.0211

Outlook:

- Improve signal stability
- Better precision



# It's all about timing...

## analysis of nanoparticles

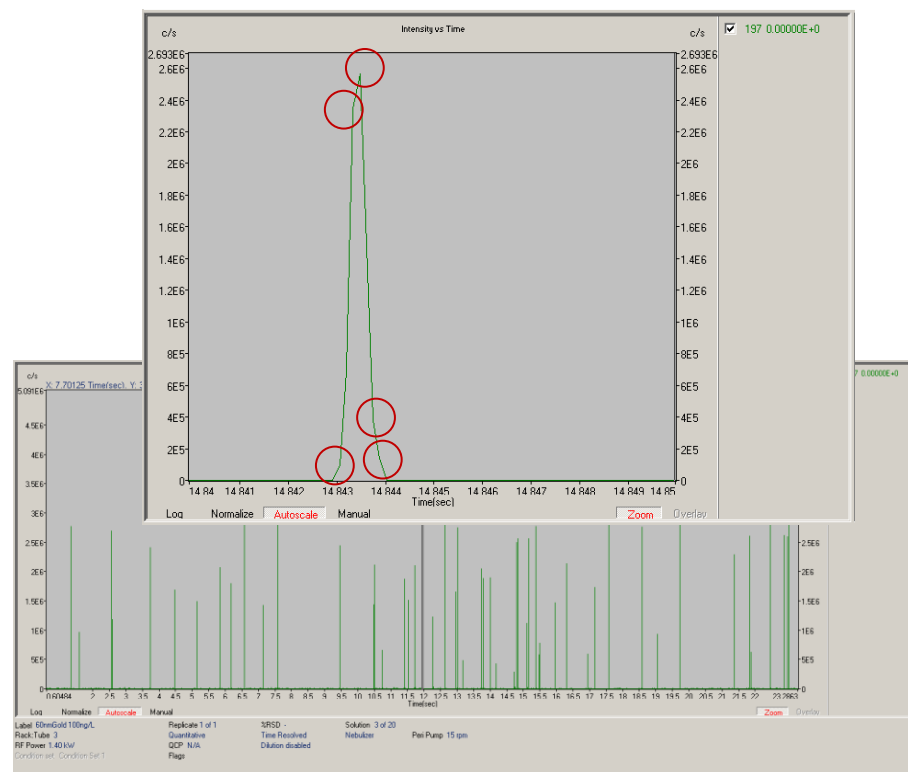
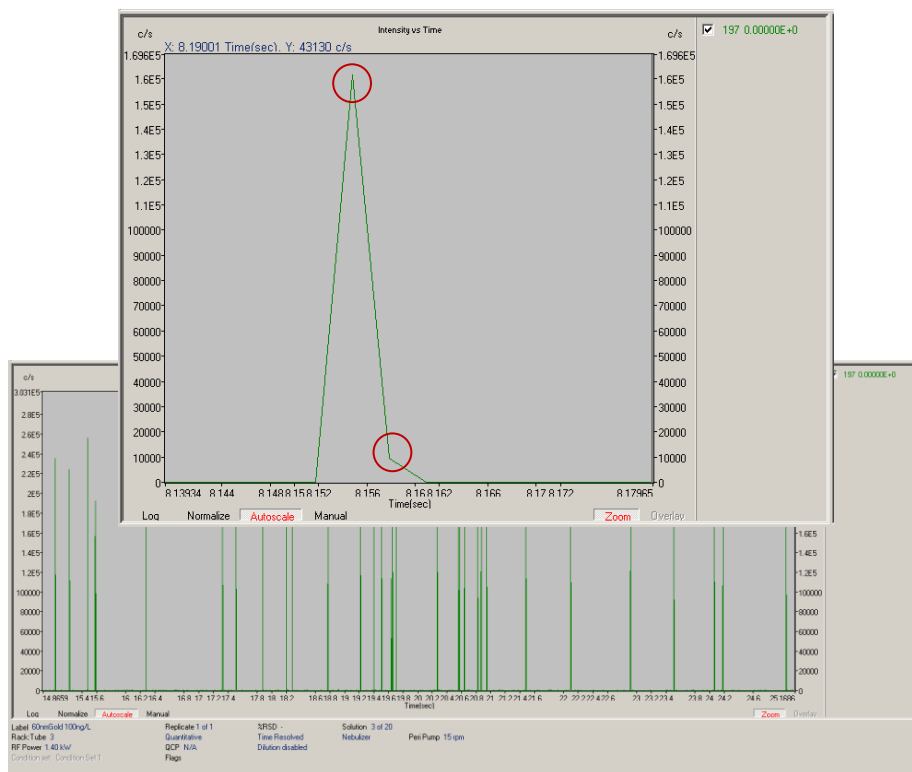


- The peak width of the ion plume entering the MS is about 300  $\mu$ s.

NP / SP

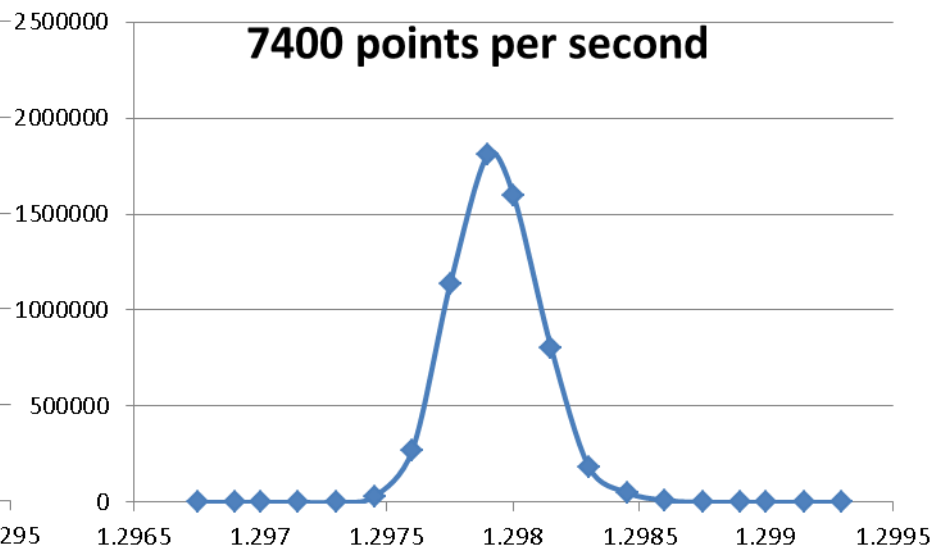
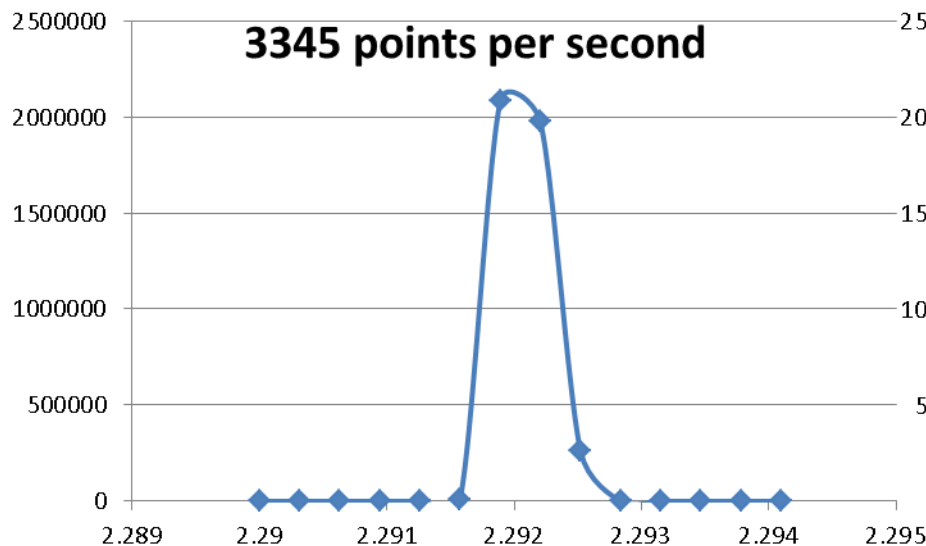
3ms dwell time

100 $\mu$ s dwell time



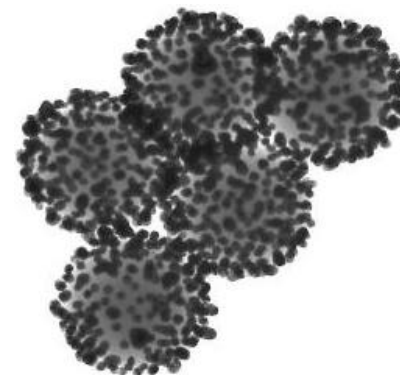
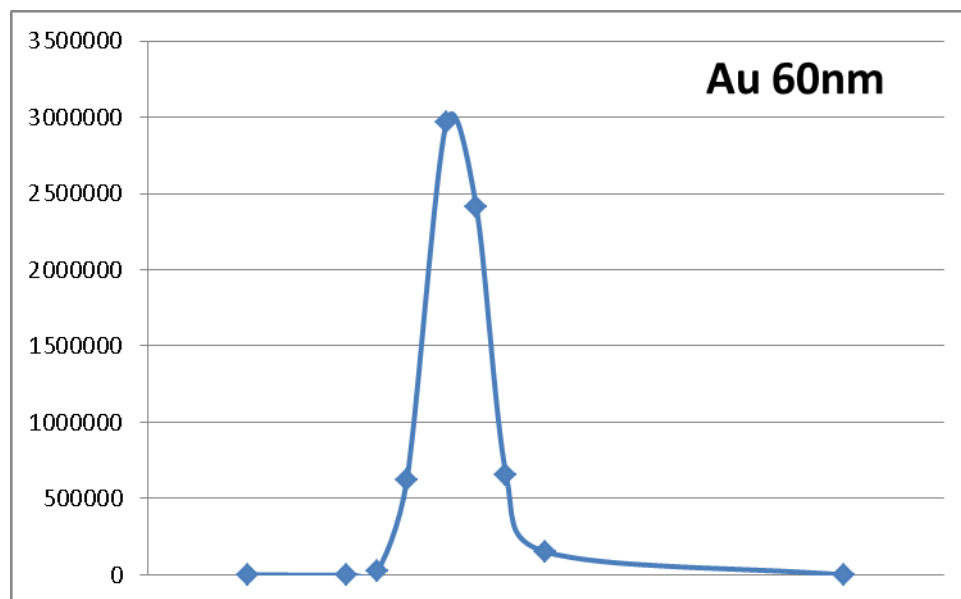
# Acquisition of single particles

- 3-4 points will not always give the correct signal
- not reliable to measure unknown samples
- 7-8 points reproduce a complete signal that allows integration and give the basis for analysis of unknown samples



# Detection limit for Nanoparticles

- 60nm Gold nanoparticle
- Dwell time: 100 $\mu$ s
- Sensitivity – 300 counts



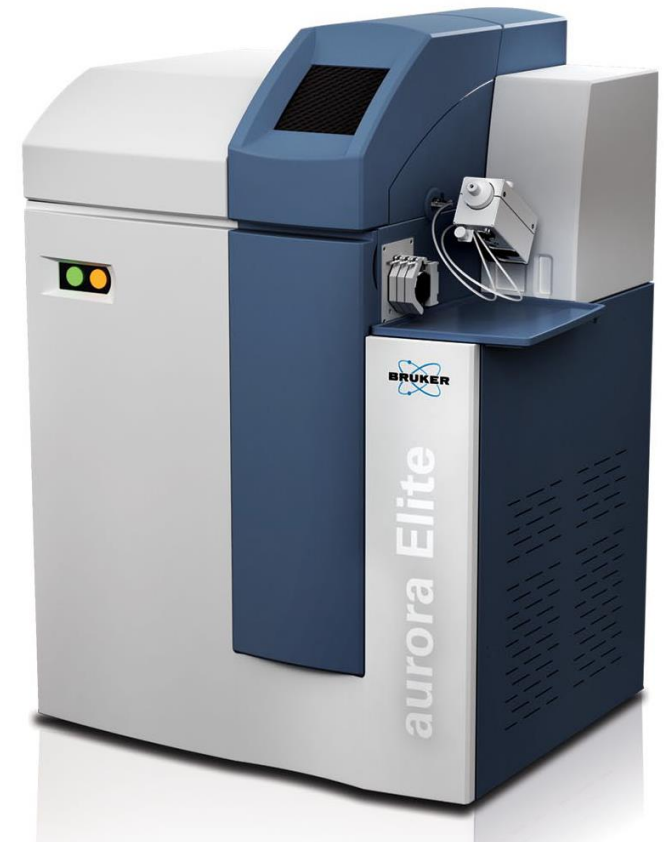
# Enhanced performance through membrane desolvation



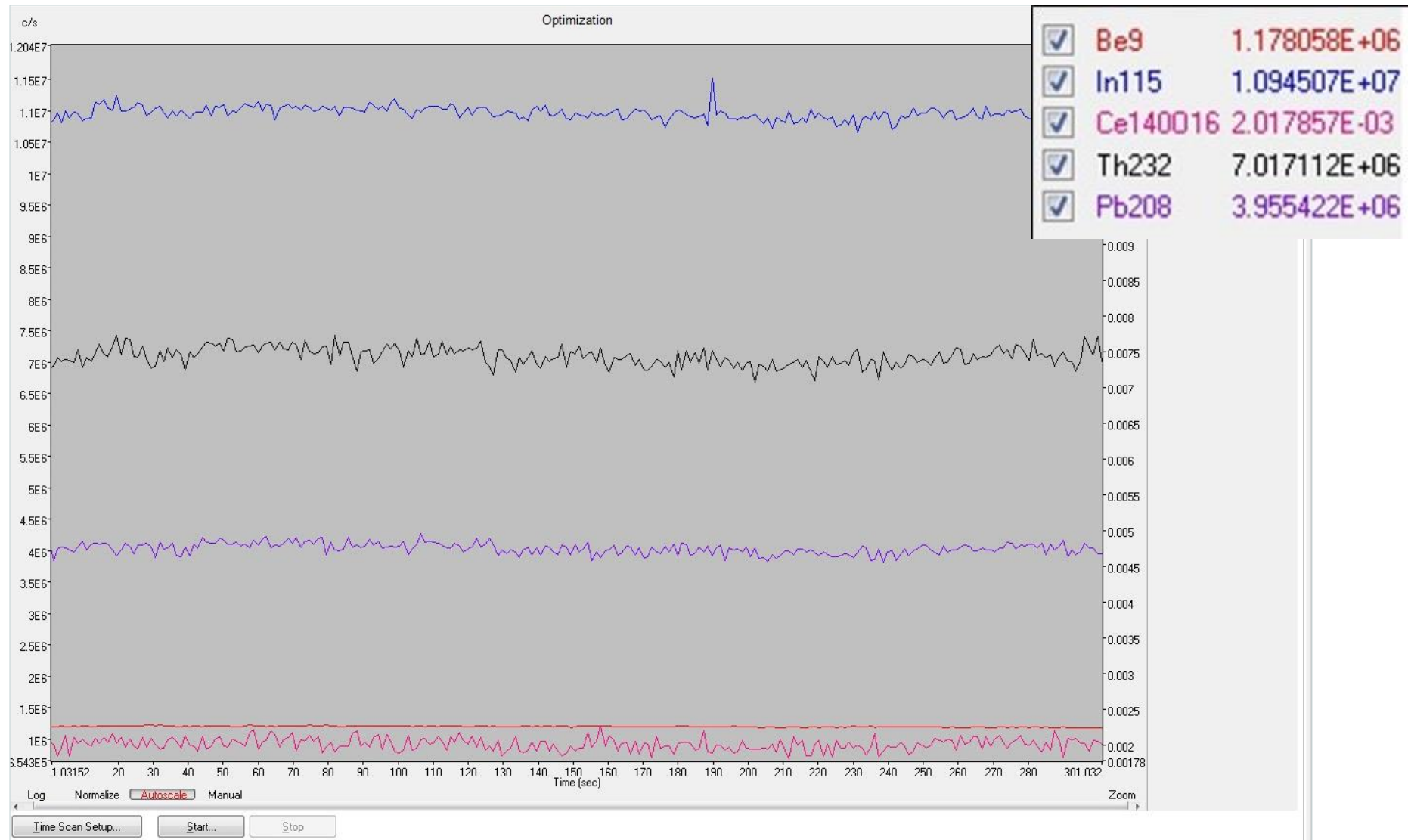
Have you ever seen  $>10\text{Mio cps/ppb}$ ...at 0.2% oxides



+



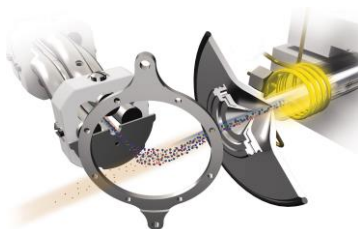
# Cetac AridusII + Bruker aurora Elite



# Summary

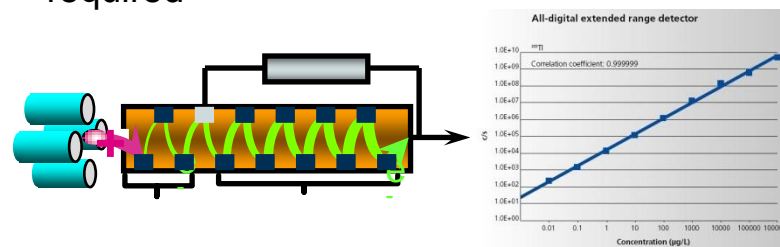
## Unmatched Sensitivity

- High efficiency plasma and ion optic
- Excellent detection limits
- Attractive to laser ablation and other application markets



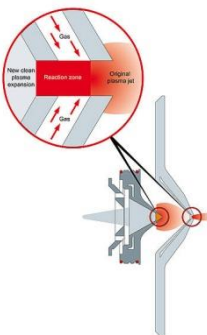
## All-digital Detection System

- Only detector to offer  $10^9$  working range in pulse-counting (digital) mode.
- No cross-calibration of digital-analog modes required



## Simplified Interference Management

- Innovative Collision-Reaction Interface (CRI)
- Removes interferences at plasma interface, not the ion beam
- Simplified setup and maintenance



## Low Maintenance Design

- Hollow ion mirror design requires no cleaning
- No need for additional cleaning / replace of interference management technology



# Thank you for your attention !



## The Science of Sensitivity