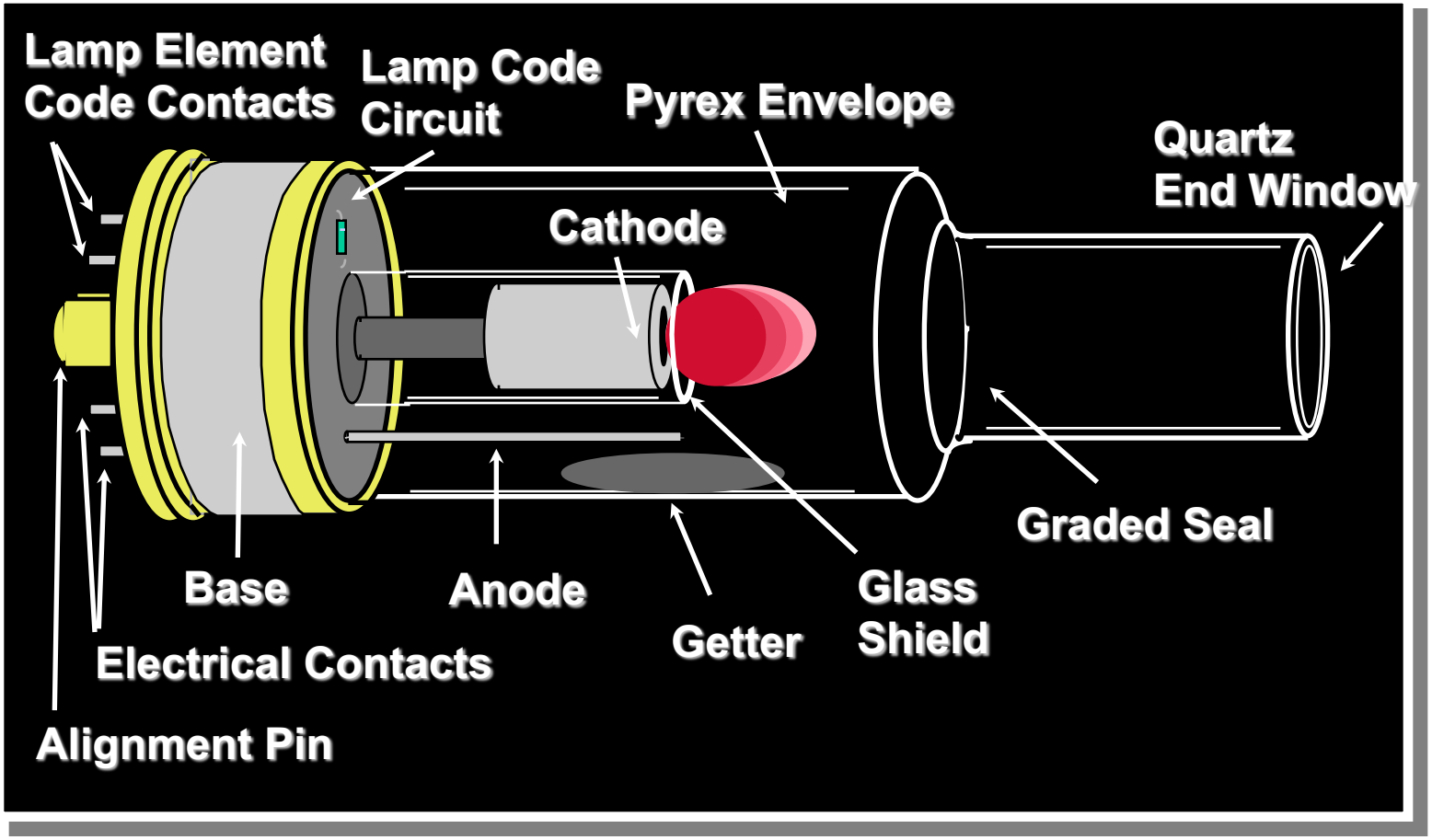
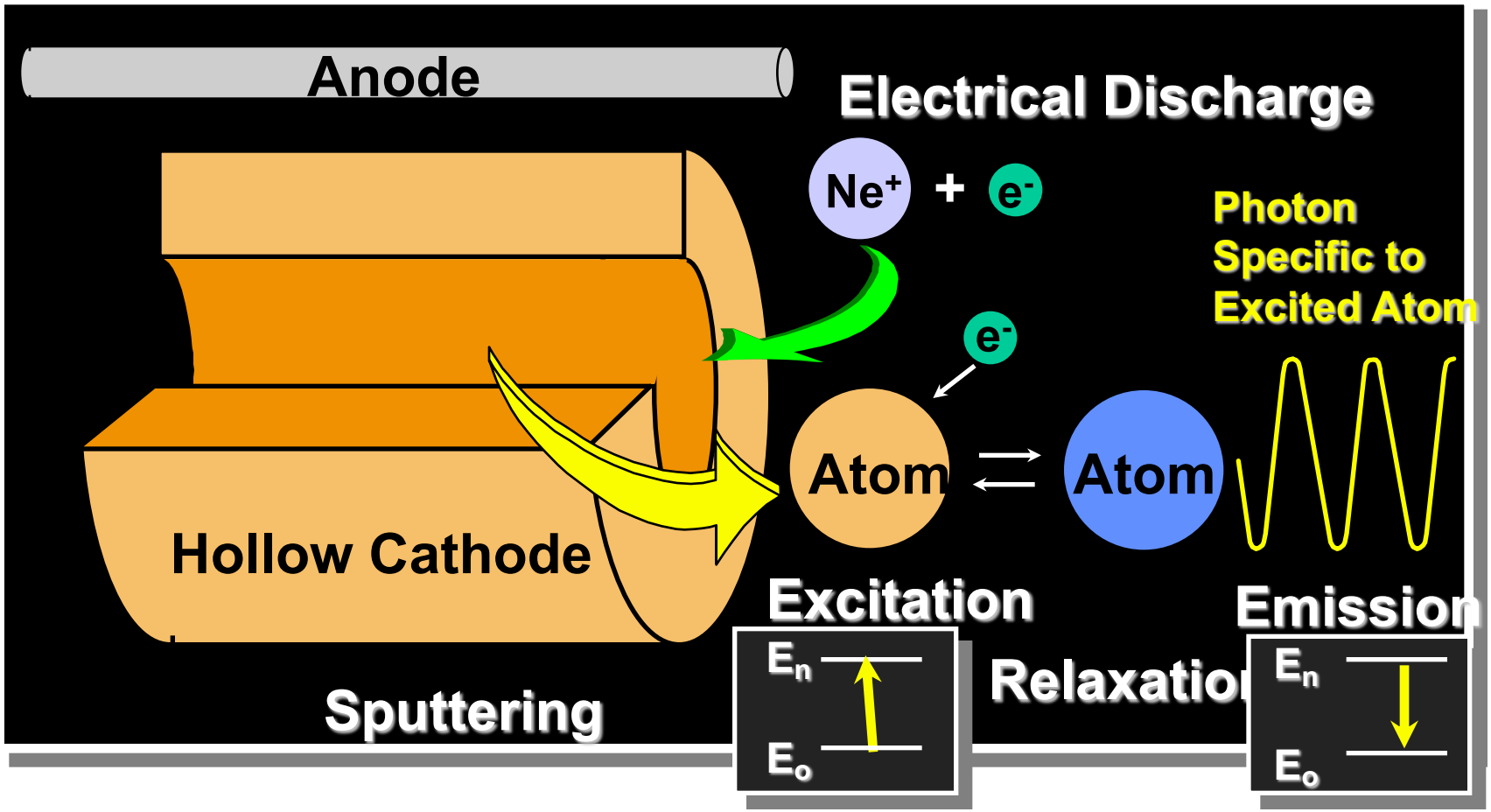
AA Light Sources

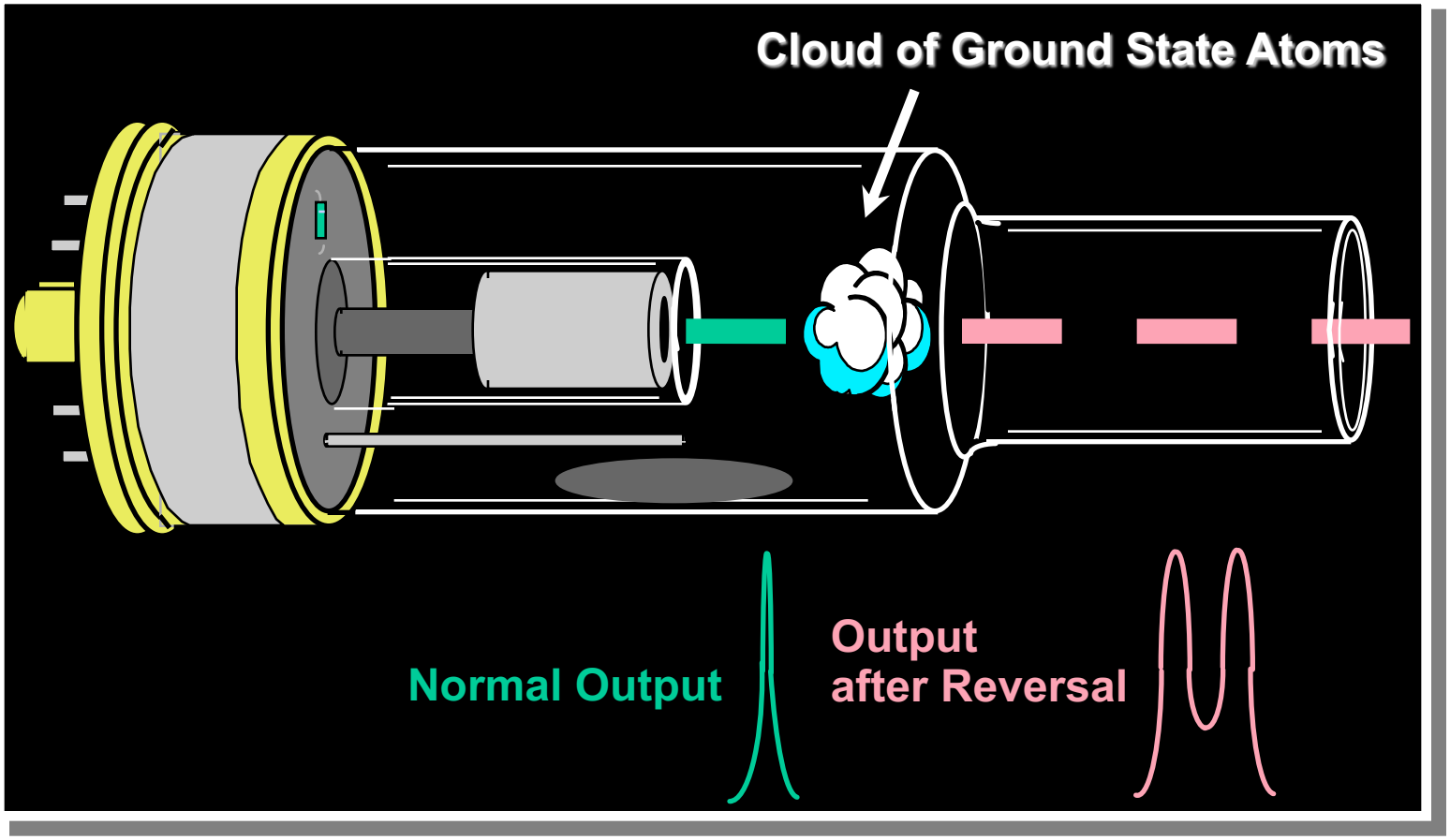
Hollow Cathode Lamp Design



HCL Operation



Self-Reversal



Choosing an Analytical Wavelength

Sample Concentration

Precision

Dillution Factors

Wavelength

- Calibration Curvature

Relative Sensitivity

- Concentration & Dilution

Relative Intensity

- Signal to noise

Lamp Data

Element	Maximum Current mA	Recommended Current mA	Wavelength	Slit nm	Relative Sensitivity	Relative Intensity
Ni	10	4	232.0	0.2	1	5
			352.5	0.2	5	100
			351.5	0.2	10	30
			362.5	0.2	500	10
Cu	10	4	324.8	0.5	1	100
			327.4	0.5	2	50
			217.9	0.2	8	3
			218.2	0.2	10	2
			222.6	0.2	40	5
			244.2	1	270	15

Multi Element Lamps

Available for:

Ag-Cd-Pb-Zn
Ag-Cr-Cu-Fe-Ni
Ca-Mg
Ca-Mg-Al
Co-Mo-Pb-Zn
Cu-Fe-Mn-Zn
Cu-Fe-Si-Zn
Cu-Zn
Fe-Co-Ni-Mn-Cu-Cr
Na,K

Using Multi Element Lamps

Use all normal recommended wavelengths

Refer to Data Sheet for recommended slit width

Refer to Data Sheet for recommended lamp current

The SAME current is used for ALL elements in the lamp – may need to change in the method

Multi Element Lamps

Advantages

- More elements can be run without changing lamps
- Lower initial cost

Disadvantages

- More complex emission profile
- Some secondary lines cannot be used
- Some changes in sensitivity observed
- Operating current may be higher
- Line intensities may be lower

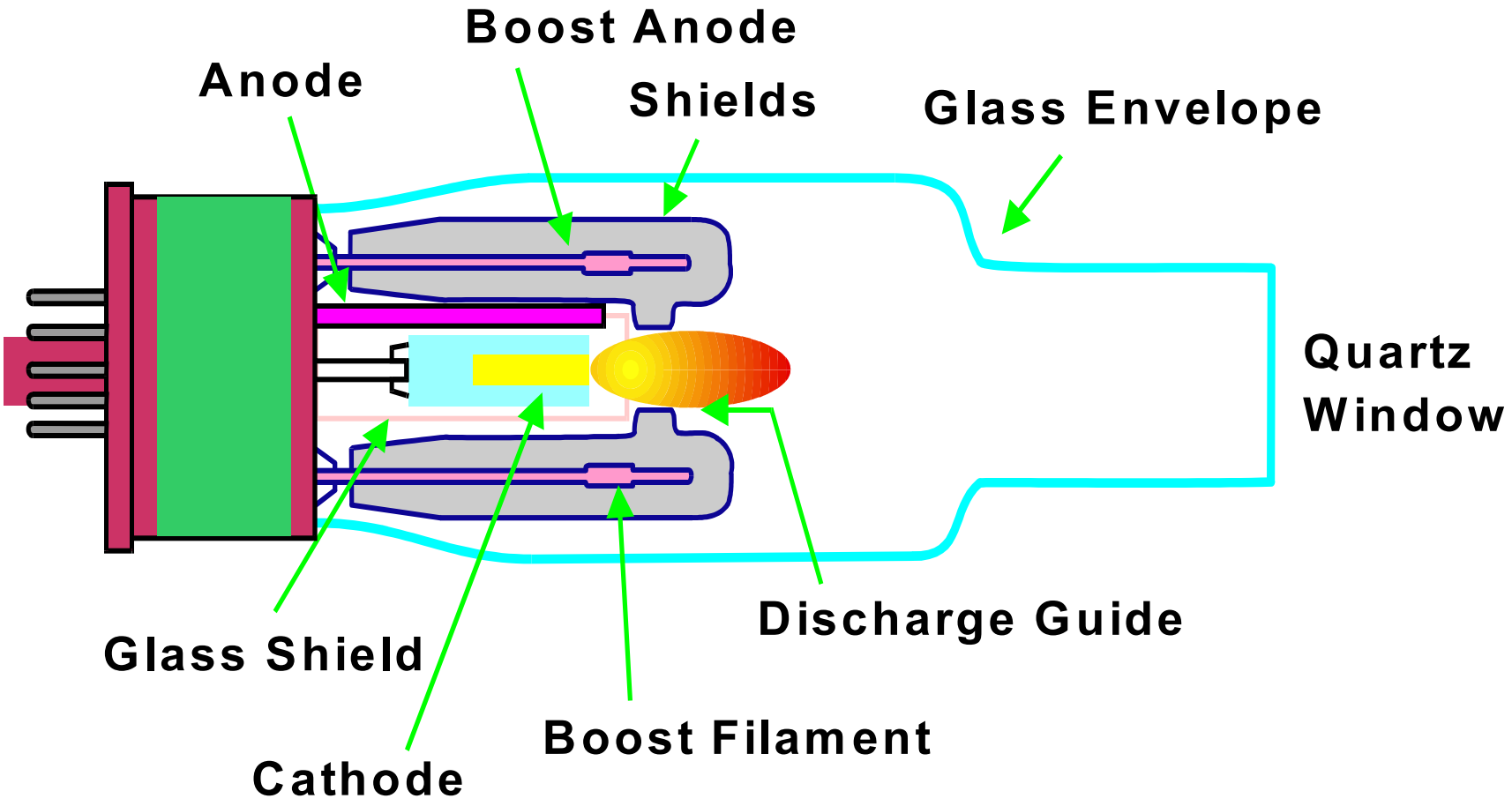
How Can We Make Lamps More Intense?

We could increase the lamp current - but this results in the following undesirable changes

- The atom cloud extends beyond excitation region and cools down
- Atoms in the atom cloud may absorb light from the lamp (self-reversal)
- This causes broadening of the emission line and increased calibration curvature

The High Intensity UltrAA Lamp

The Varian UltrAA Lamp



UltrAA Lamp Operation

2 anodes are fitted inside the UltrAA lamp:

- one for the normal HCL discharge
- the second for a separate boost discharge which is directed across the cathode

Electrons emitted by a heated filament are passed through the atom plume to re-excite the atoms by collision

This increases the emission intensity of the lamp

UltrAA Lamps - Elements Available

Single Element UltrAA Lamps

Sb	Cu	Mn	Si
As	Ge	Ni	Te
Bi	Au	Pd	Tl
B	Fe	Pt	Sn
Co	Pb	Se	

Multi Element UltrAA Lamps

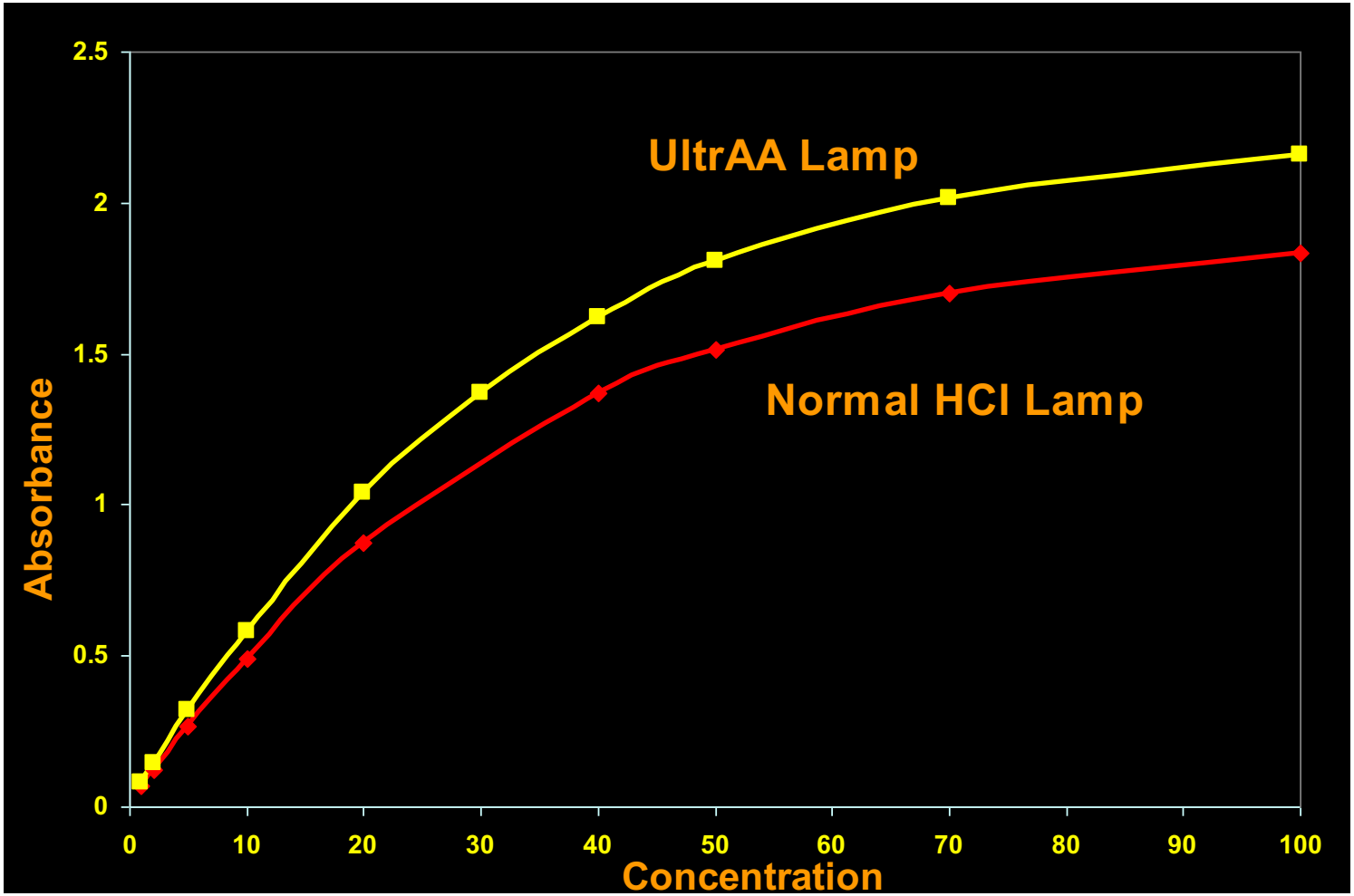
Ag-Cr-Cu-Fe-Ni	Cu-Fe-Mn-Zn
Ag-Cd-Pb-Zn	Cu-Fe-Si-Zn
As-Cu-Fe	Cu-Zn
Ca-Mg-Al	Fe-Co-Ni-Mn-Cu-Cr
Co-Mo-Pb-Zn	Ni-Se

UltrAA Lamps

Varian's boosted discharge lamps provide:

- Improvements in intensity
- Extended lifetime
- Improved sensitivity
- Improved calibration linearity

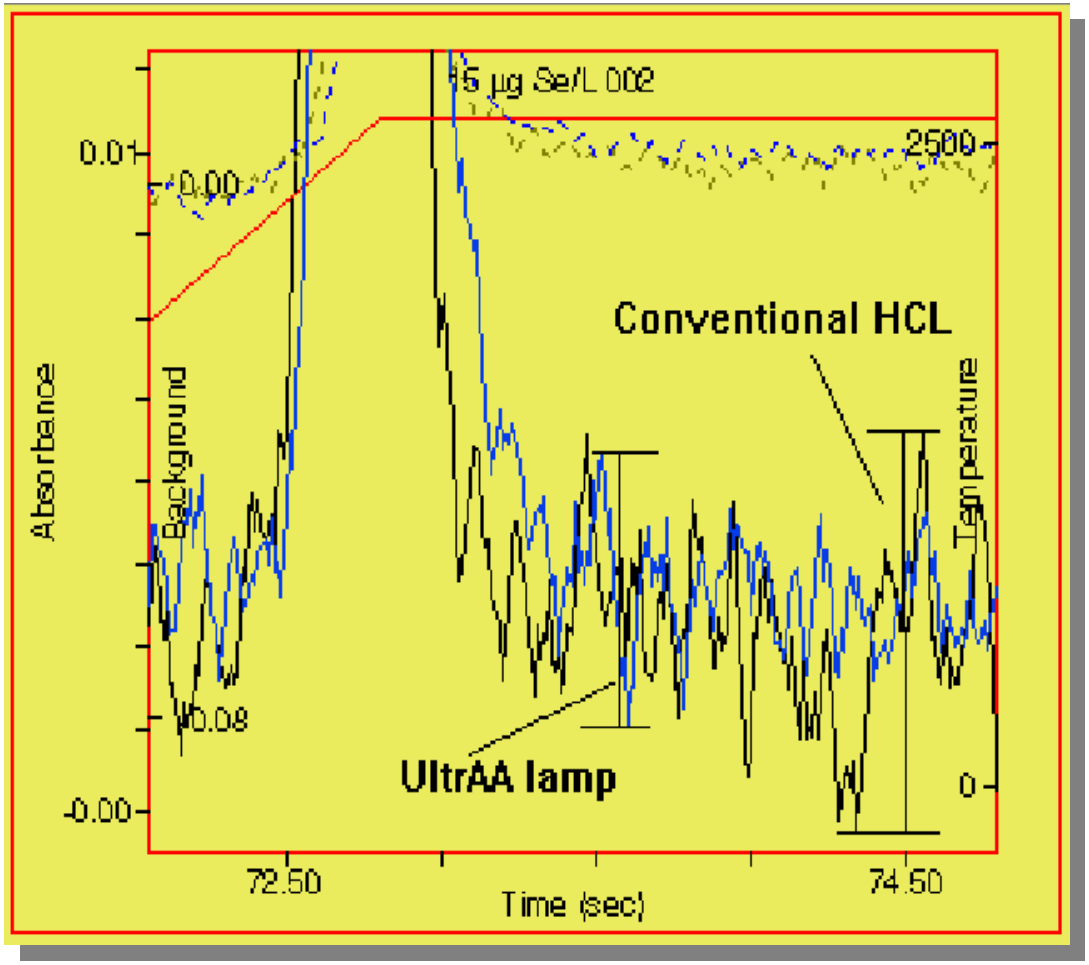
Lead Lamp Comparison



Advantages of UltrAA Lamps

Reduced baseline noise

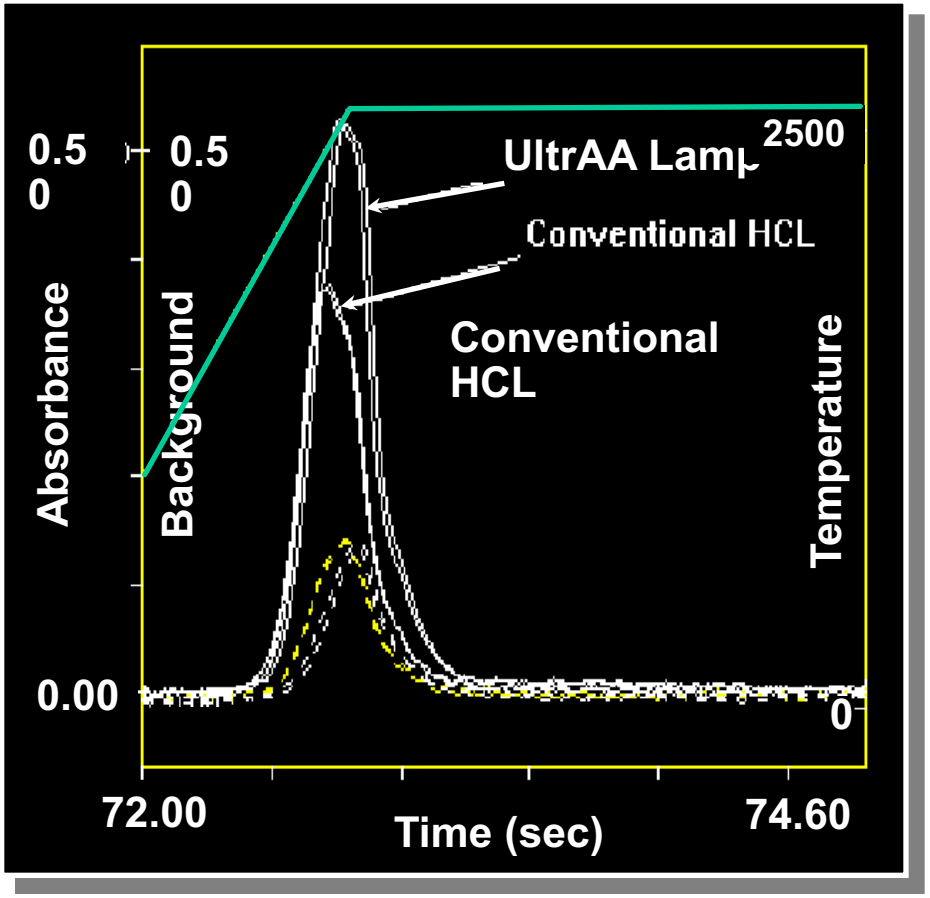
Peak to peak baseline noise for Se is 0.013 Abs. for the conventional HCL compared with 0.008 Abs. for the UltrAA Lamp



UltrAA Lamp Increased Sensitivity

Increased sensitivity

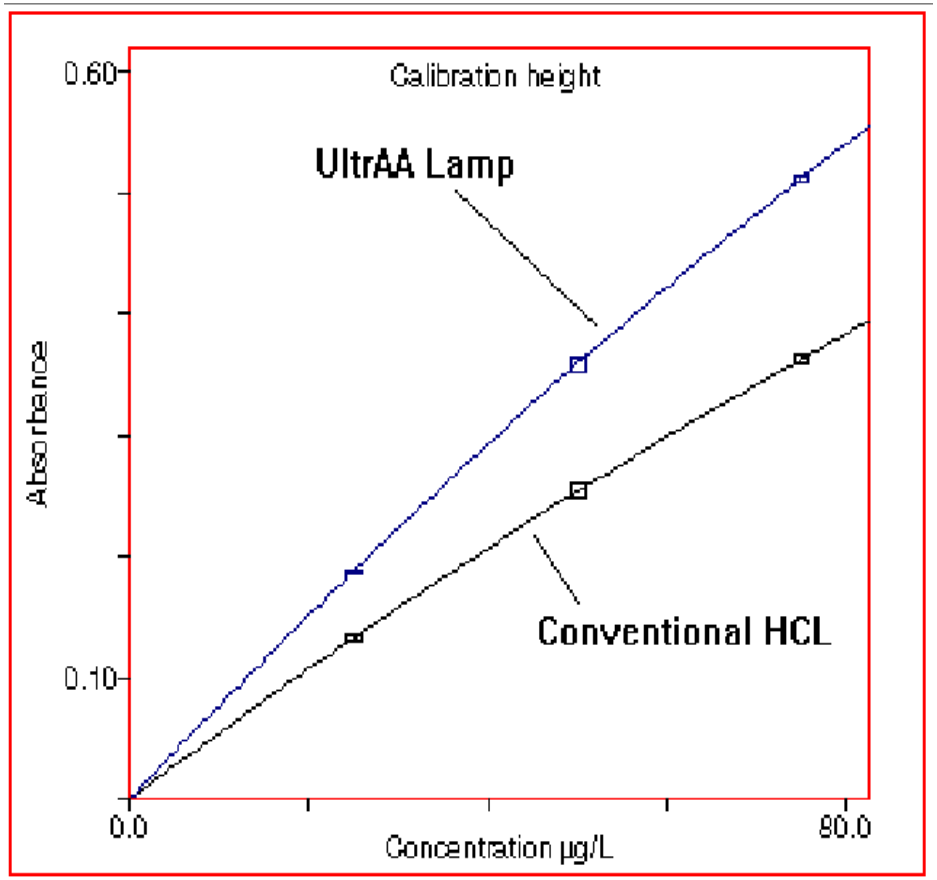
- Typical signals for 75 µg/L Se are illustrated



Advantages of UltrAA Lamps

Enhanced calibration linearity

- Typical calibrations for Se using standards of 25, 50 and 75 ug/L Se are illustrated

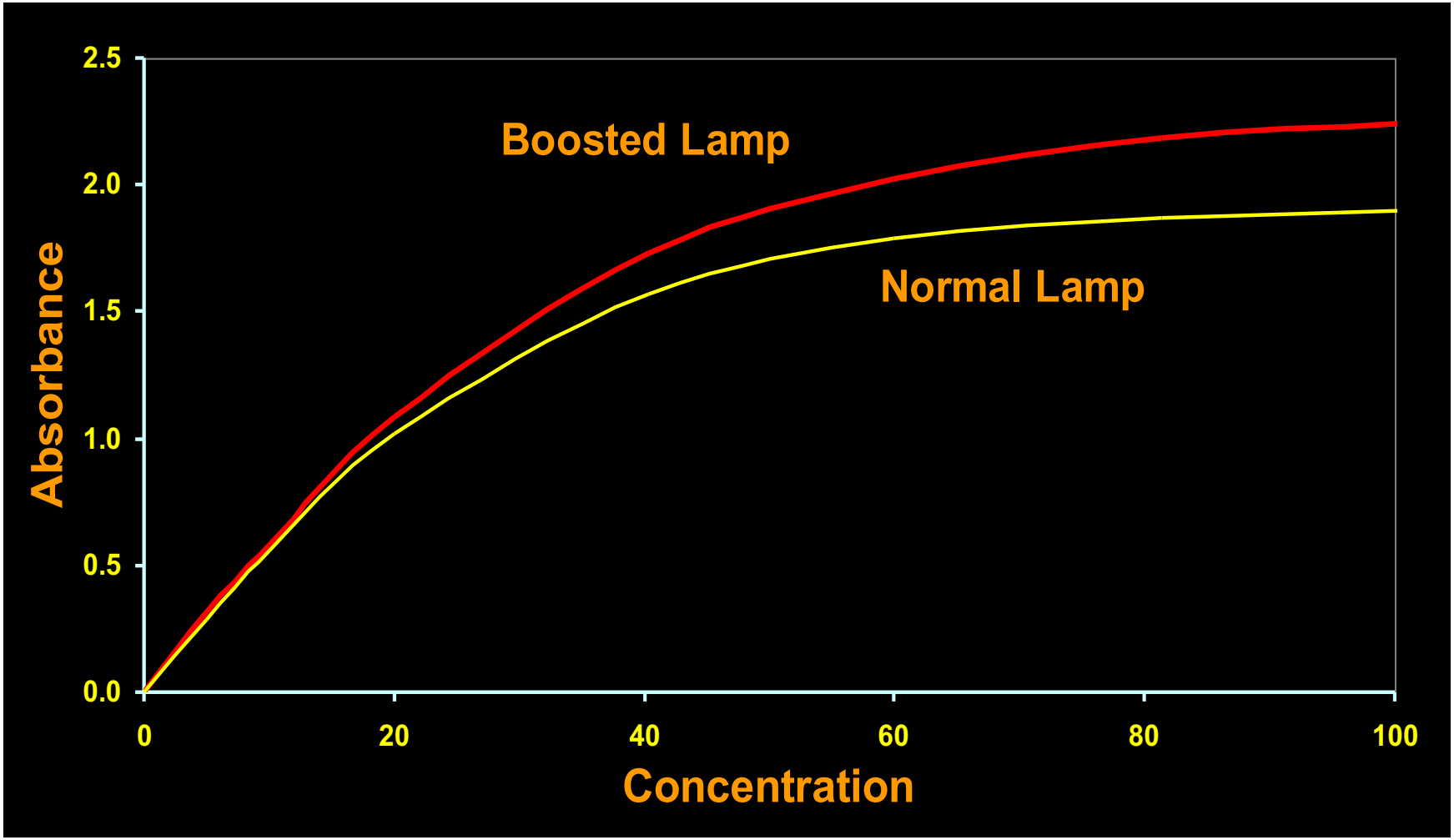


Advantages of UltrAA Lamps

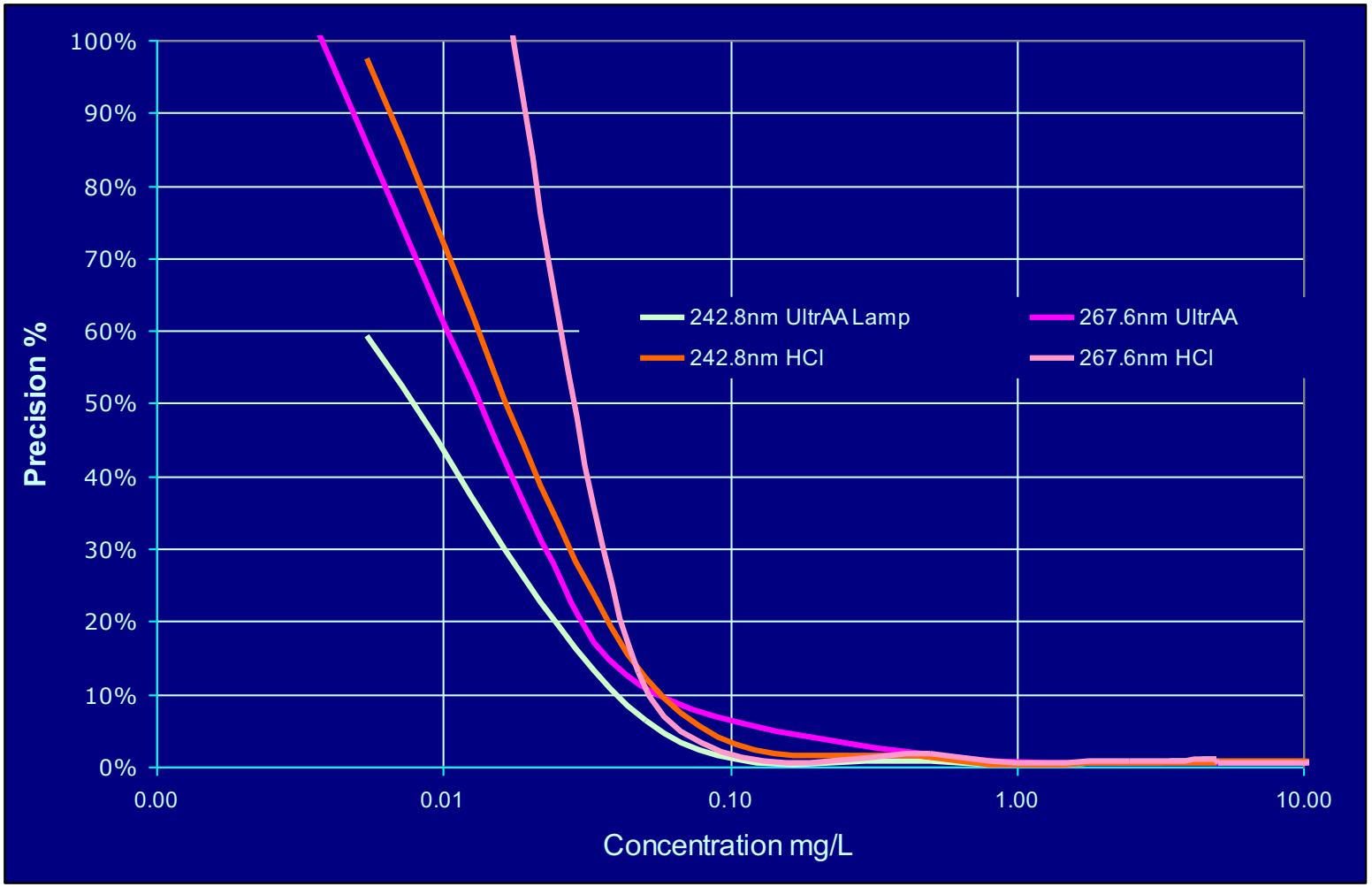
Improved Characteristic Concentrations and Detection Limits

Element	Wavelength nm	UltrAA Lamp	Conventional HCL
Characteristic Concentration (in μg/L with 20μL sample)			
As	193.7	0.25 - 0.3	0.31
Pb	283.3	0.15 - 0.26	0.26
Se	196.0	0.49 - 0.5	0.85 - 2.2
Detection Limits (3 sigma in μg/L with 20μL sample)			
As	193.7	0.35 - 0.7	0.3 - 1.4
Pb	283.3	0.18 - 0.23	0.8
Se	196.0	0.28 - 0.57	1.1 - 3.1

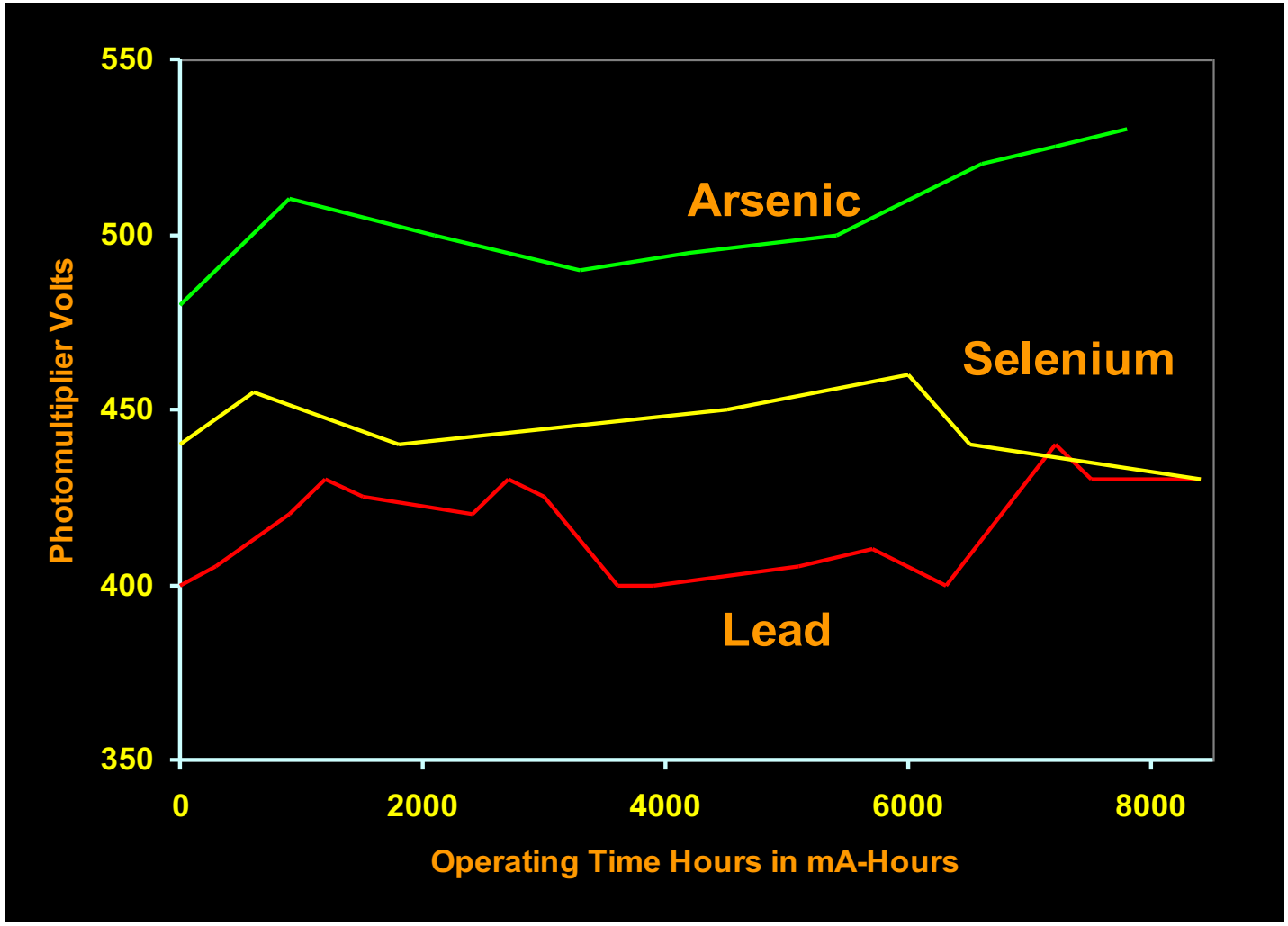
Gold Lamp Comparison



Comparison of Gold UltrAA and Normal Lamps at Detection Limit Levels



Lifetime of UltrAA Lamps



Key Benefits of the UltrAA Lamp

Improved analytical performance

- Lower baseline noise levels
- Increased sensitivity
- Lower detection limits
- Enhanced calibration linearity

Greater reliability

Longer lamp lifetimes