

4.2 Sources

Some important source characteristics

Characteristic	Examples
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Some important source characteristics

Characteristic	Examples
Spectral output	Continuum, line, continuum plus line
Wavelength region	UV, visible, IR, microwave
Temporal behavior	Continuous, pulsed, sine wave, coherence
Radiance or spectral radiance	
Lifetime	Operating life and shelf life
Area of emission	Point source, extended source
Spatial behavior	Coherence

Incandescent lamps

Nernst glower

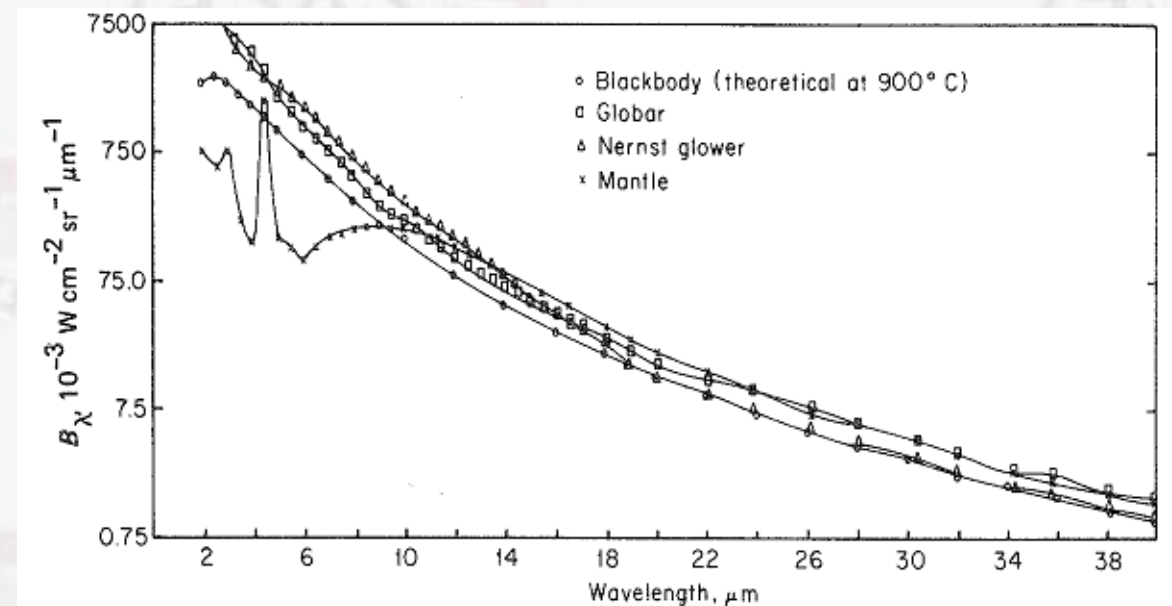
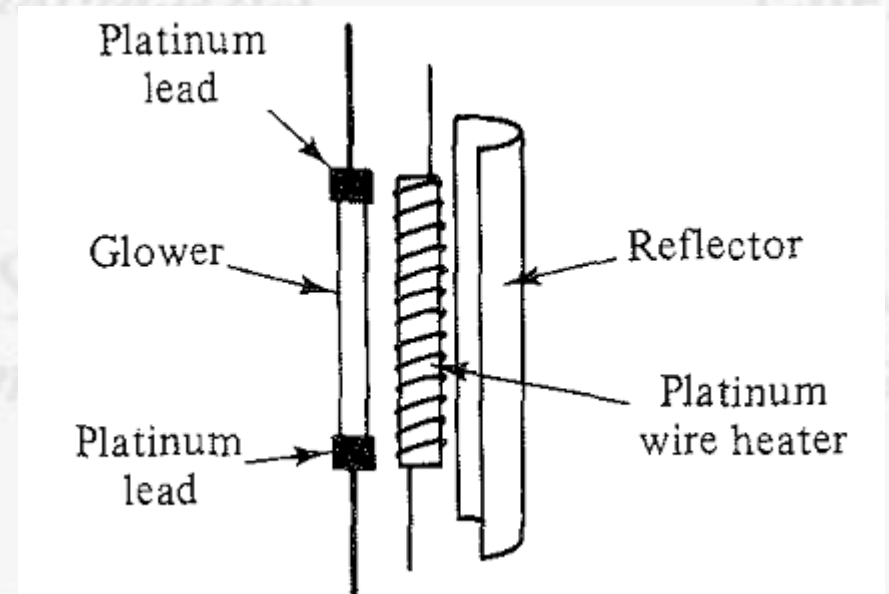
Rod of Zirconia (Semiconductor) glower
+ preheat \rightarrow conduction \uparrow ($R \downarrow$) \rightarrow $i \uparrow$!
(It must be used with a ballast resistor in
the heating circuit to prevent burn out.)

(Temp Coeff $\rightarrow C_R < 0$)

1200 to 2000K

0.4 to 20 μm (vis, NIR, IR)

0.1 mW/cm² Sr



Incandescent lamps

Globar

SiC silicon carbide rod ($C_R > 0$) , + i \rightarrow heat (Water cooling)

1300-1500K \rightarrow Radiance: 0.1 mW/cm² Sr nm

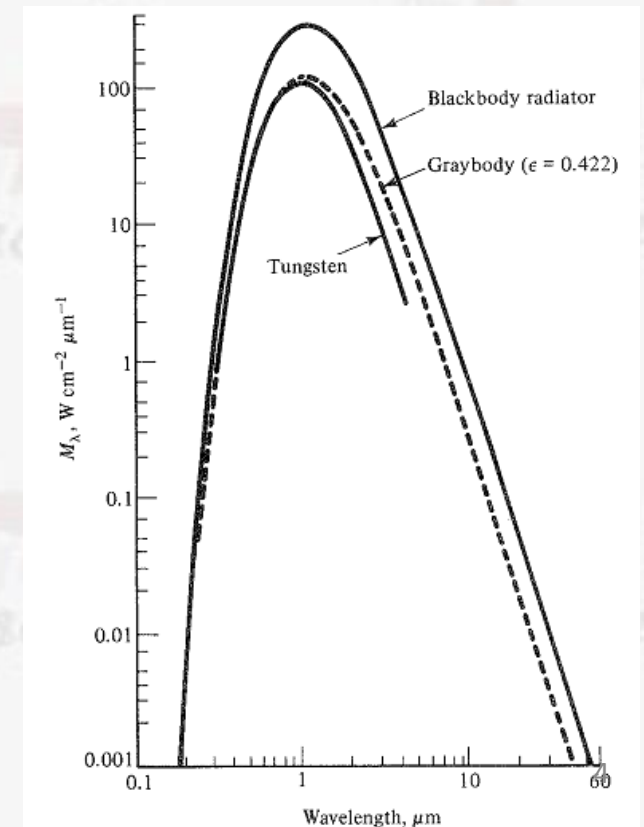
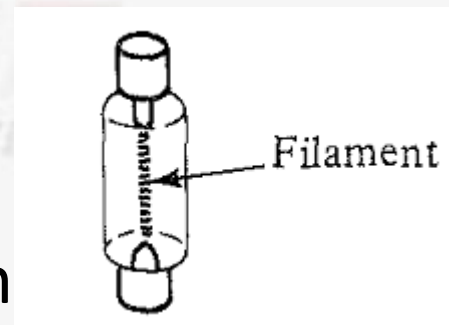
1-40 μ m (NIR, IR)

Tungsten

Ribbon, Filament, 2000-3000K
in glass window,

10 mW/cm² Sr nm, 300-3500 nm

Halogen lamp: $I_2 + W \rightarrow WI_2$

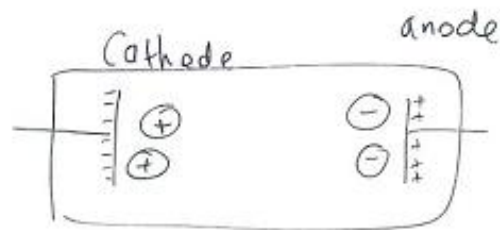


-2 Spectralect 971101 mon

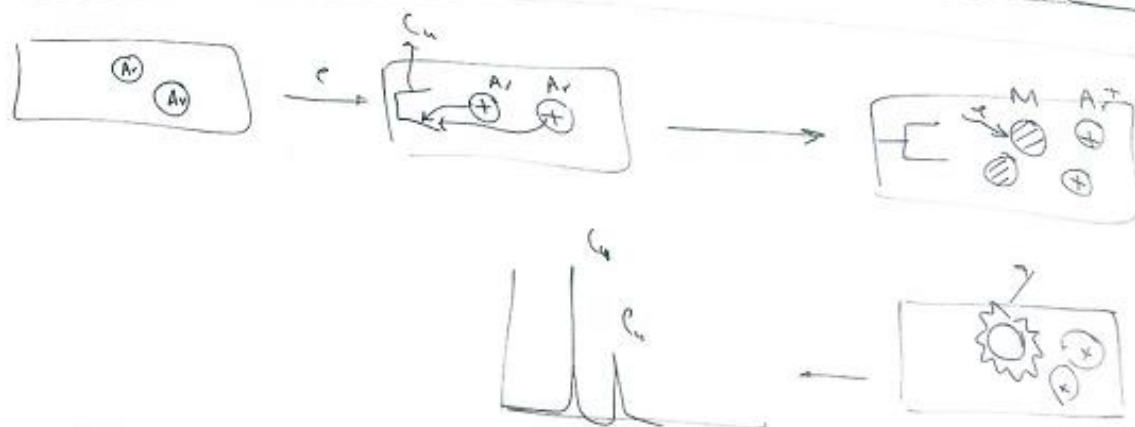
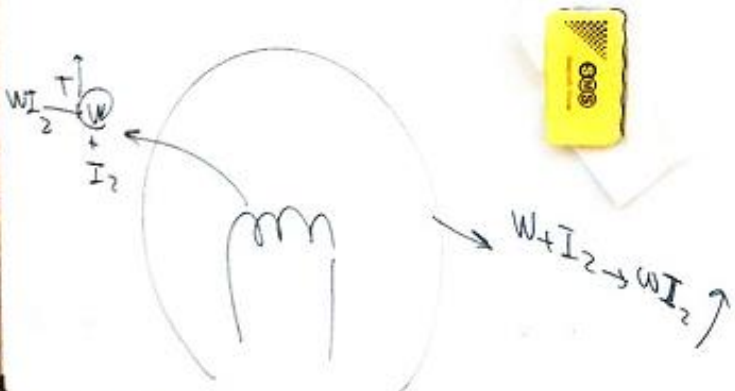
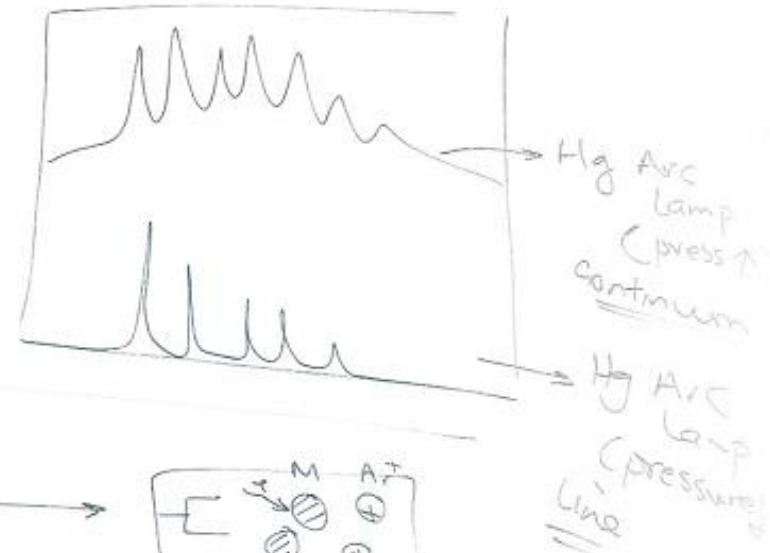
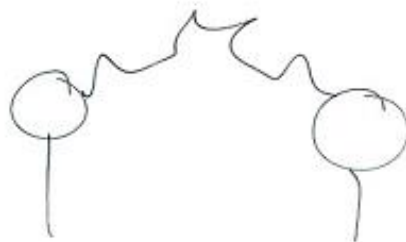
Sources:

Characteristics:

- Continuum, or Line Sources
- wavelength region (vis, IR, microwave)
- Temporal behavior (continuous, pulse, sinusoidal)
- spectral radiance

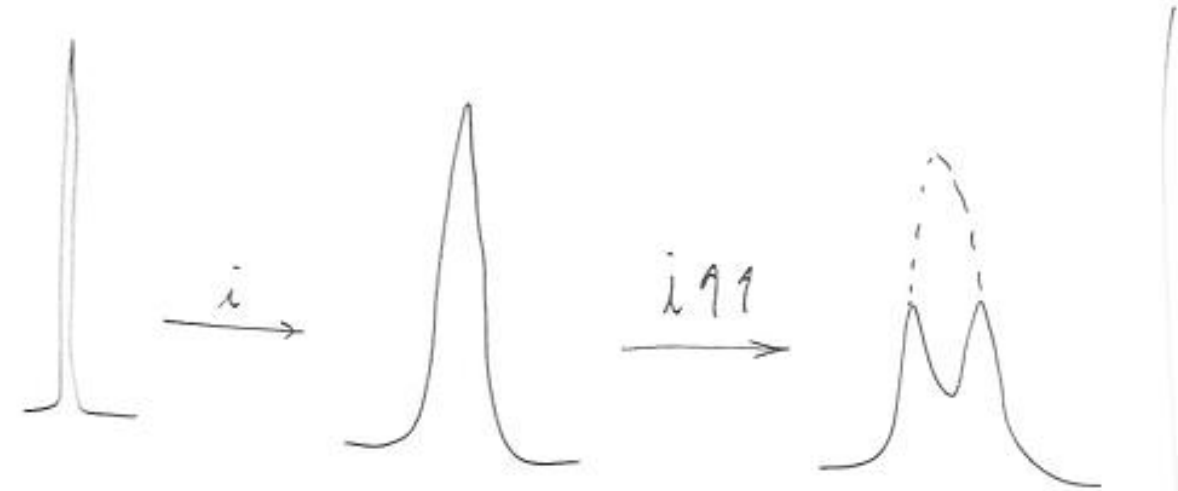


200 nm UV 330 nm Vis 800 nm NIR 2500 nm



E2 Spect Introd 971101 mon

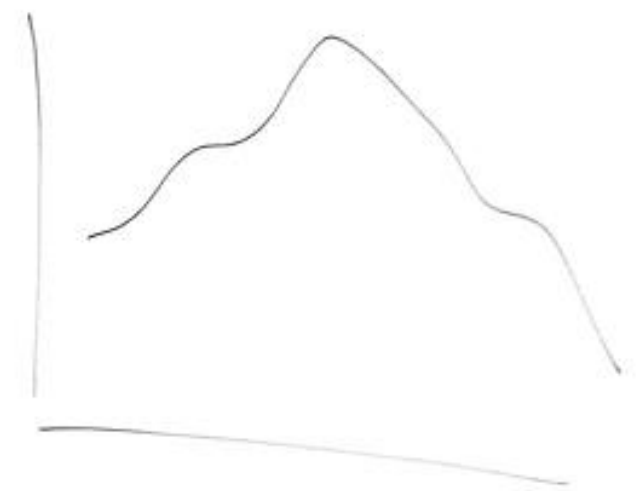
HCL



Tesla Coil (spark)
 ↓
 Start (1st ionization)

Self reversal
 ↓
 Background correction

LED: light emitting diode



Standard

II. Arc lamps

H₂, D₂,

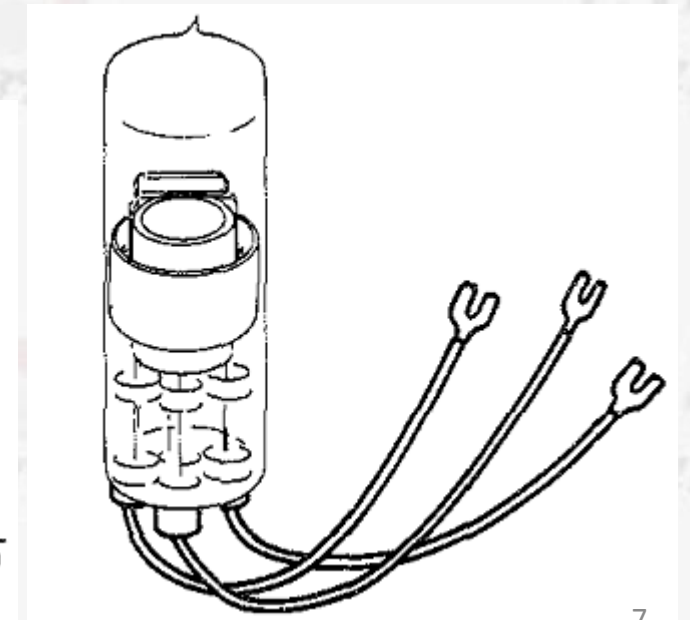
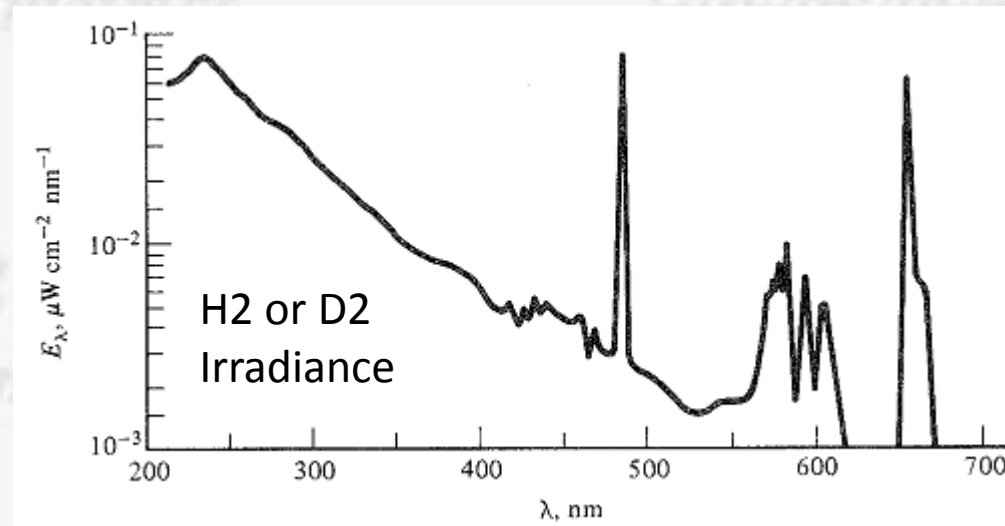
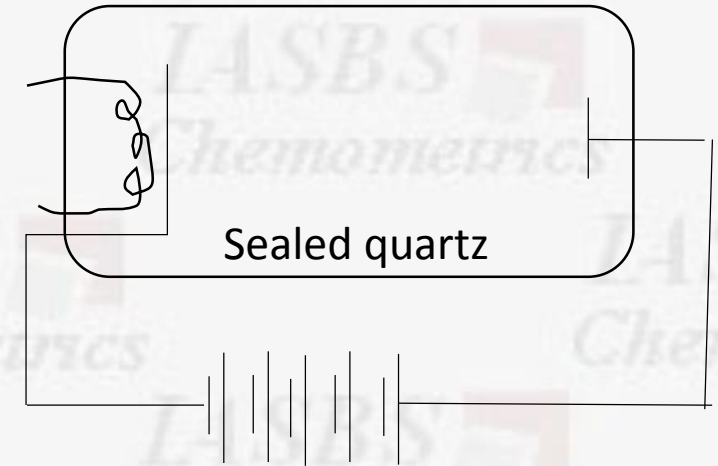
Xe: 200-1000nm

H₂ or D₂: 200-400nm

Cathode bombardment by cations

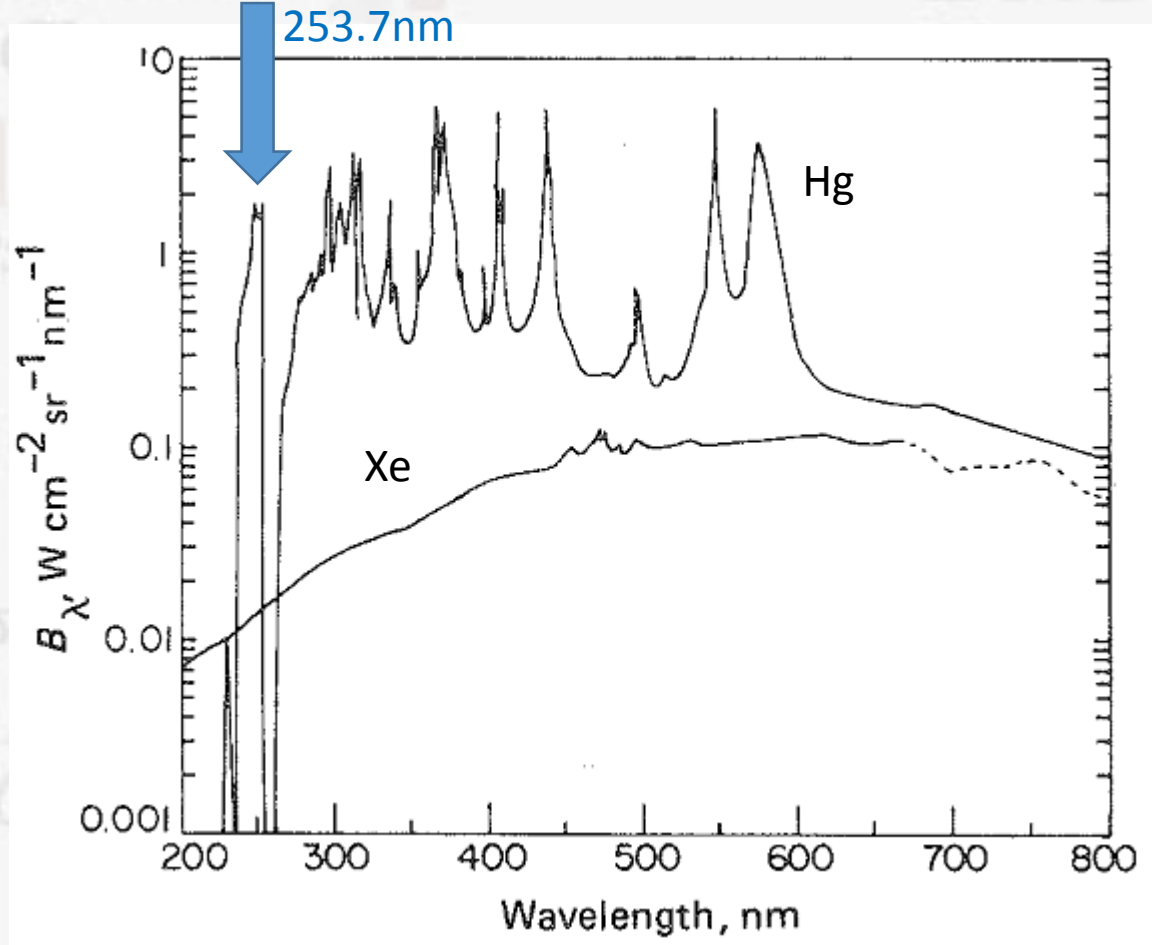
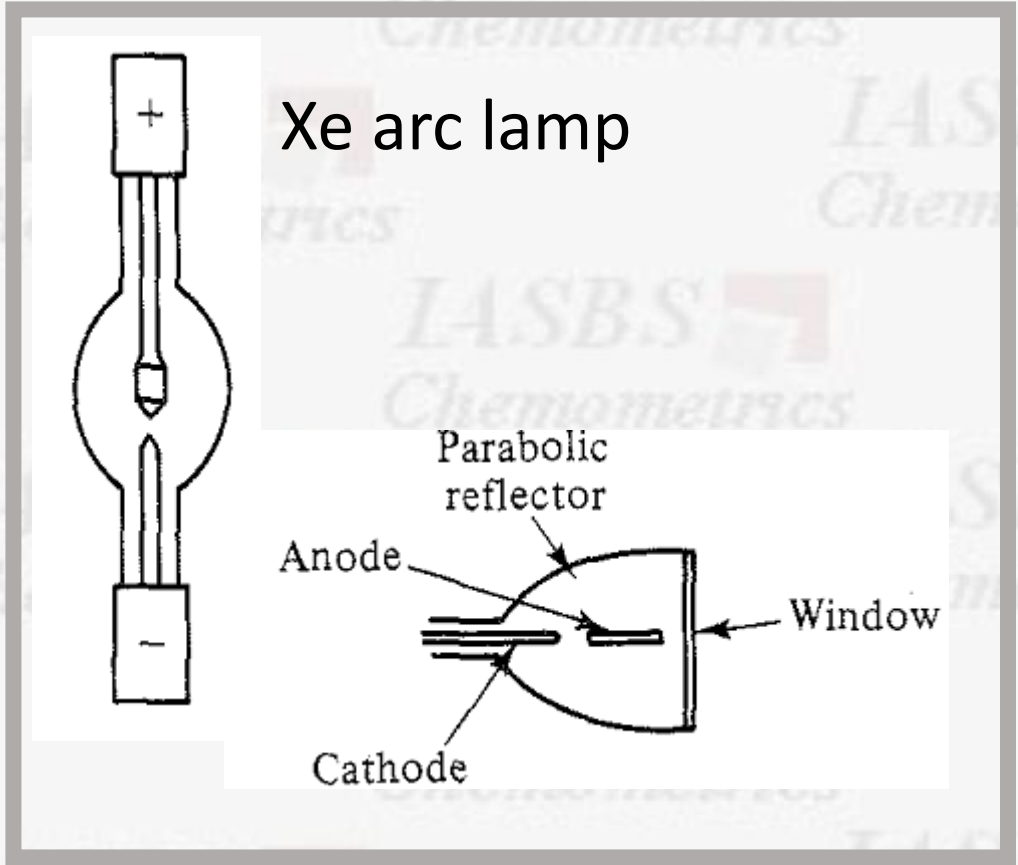
→ emission of e

heated cathode



II. Arc lamps

Xe, metal vapor (few tors to 100atm)



High pressure: Continuum + line
low pressure(Hg, Cd or Ga < 10mmHg):
line source

+ ballast resistor to control current.

Common continuum sources

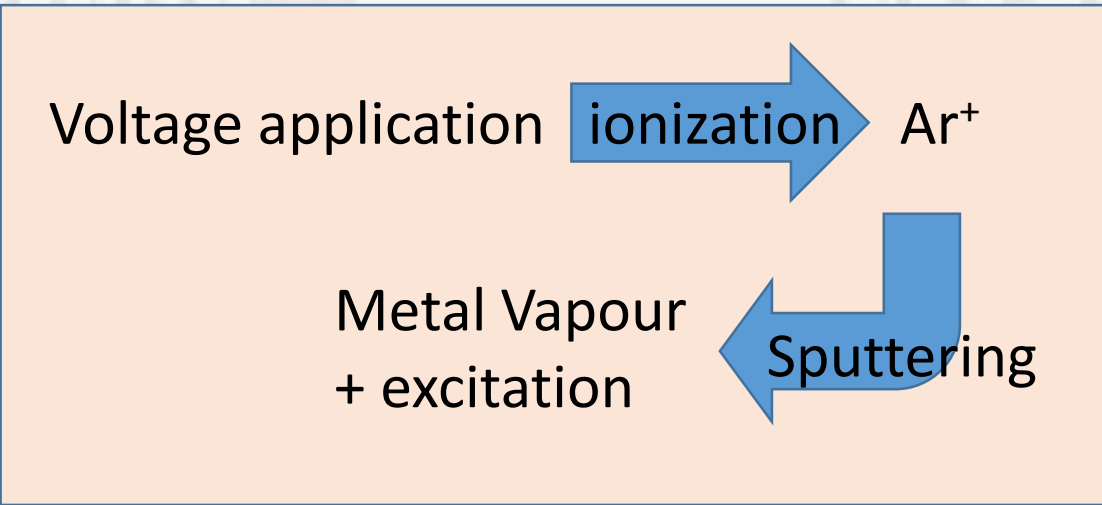
Type	Radiating material	Window or envelope material	Wavelength range	Approximate ^a spectral radiance (W cm ⁻² nm ⁻¹ sr ⁻¹)
Nernst glower	Rod of zirconia, yttria, or thoria at 1200–2000 K	None	0.4–20 μm	10 ⁻⁴
Globar	Rod of silicon carbide at 1300–1500 K	None	1–40 μm	10 ⁻⁴
Tungsten	Tungsten filament at 2000–3000 K	Glass	320–2500 nm	10 ⁻²
Quartz-iodine (T ≤ 3600 K)	Tungsten filament	Quartz	200–3000 nm	5 × 10 ⁻²
Hydrogen or deuterium	Arc discharge in a few torr of H ₂ or D ₂	Quartz	180–370 nm	5 × 10 ⁻³
Xenon arc	Arc discharge in >10 atm Xe	Quartz	200–1000 nm	10 ⁻¹

^aValues are rough approximations at specific wavelengths: for Nernst glower and globar, λ ≈ 10 μm; for tungsten, λ = 500 nm; for quartz-iodine with iodine scavenger, λ = 400 nm; for H₂, λ = 250 nm; for Xe arc, λ = 500 nm (75-W lamp).

Line sources

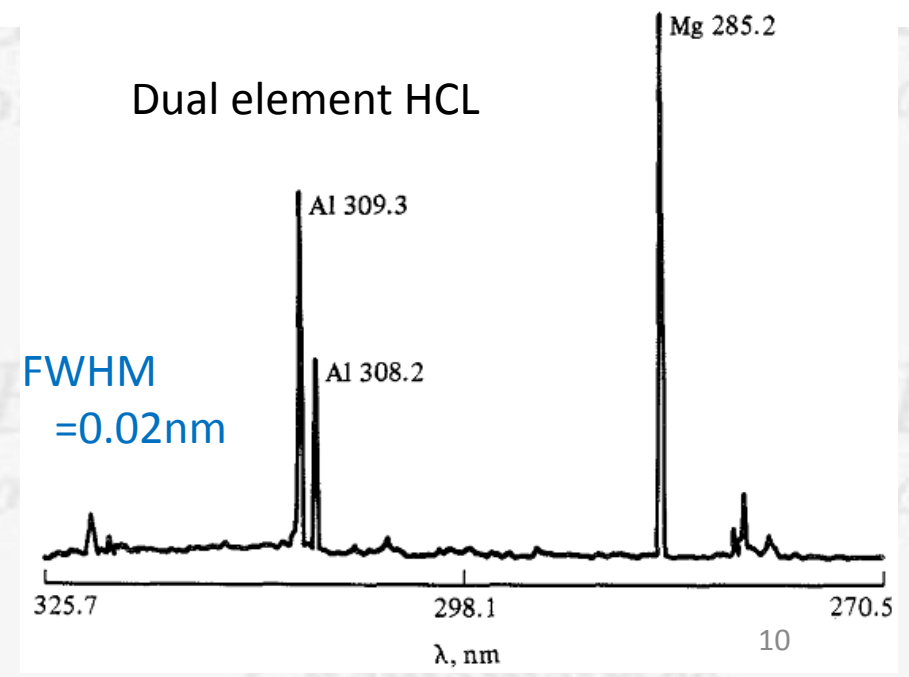
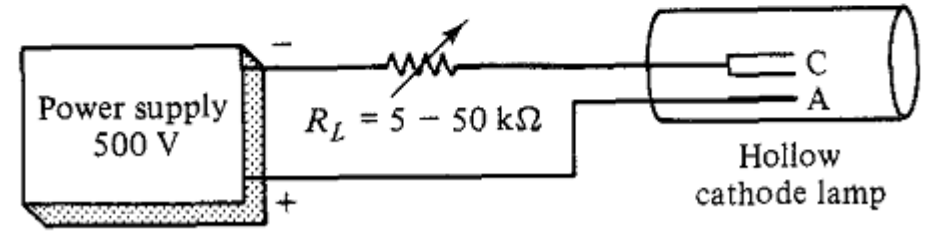
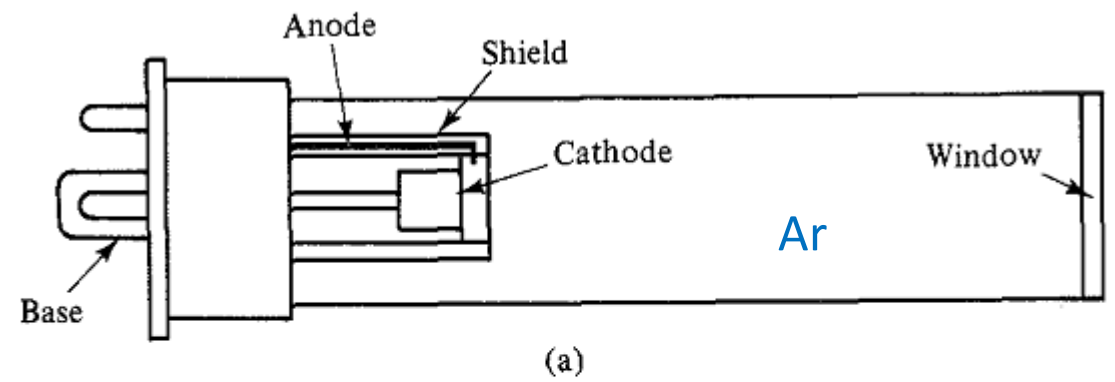
- Low pressure arc lamp
- **Hollow cathode lamp**

Majority of elements
(Separately or multielements)



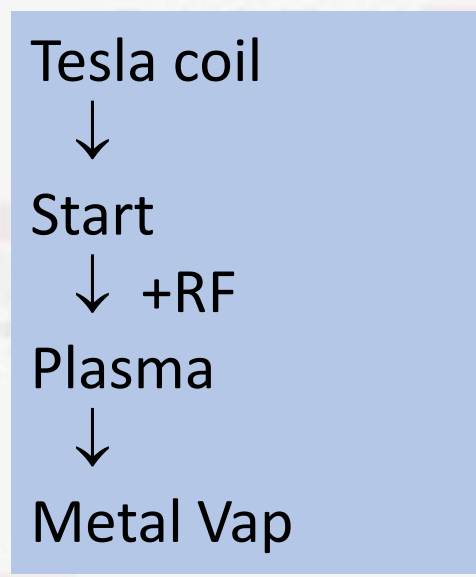
$i \uparrow \rightarrow$ line broadening
Self absorption
(\rightarrow self reversal)

Atomic Fluoresc \rightarrow HCL strong pulse $i_{aver} \ll i_{max}$

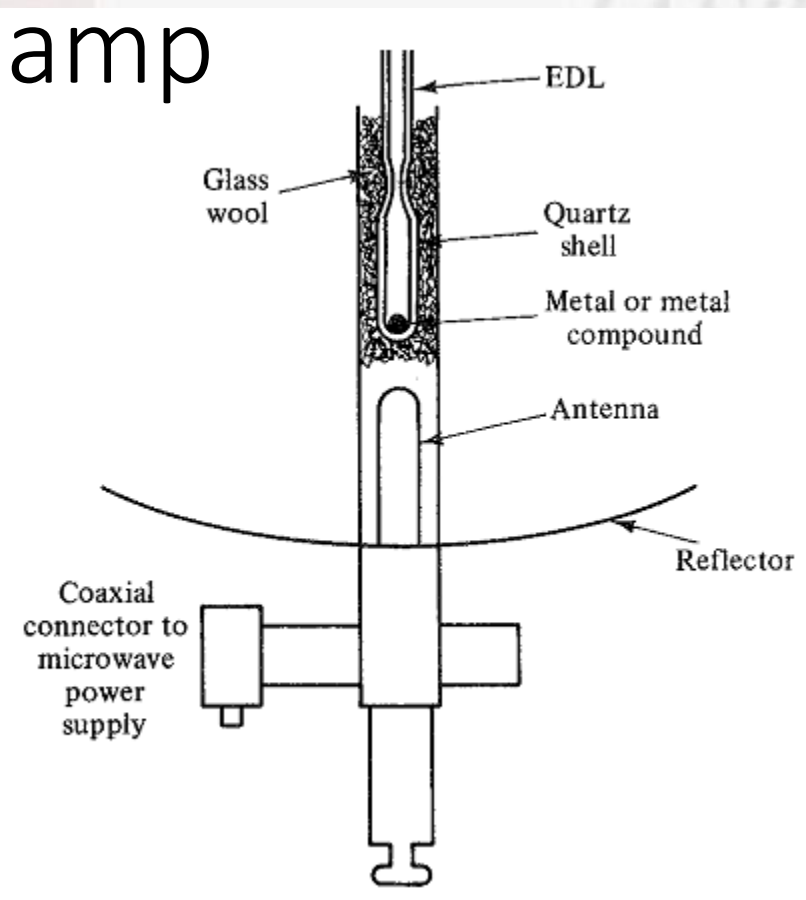


Line sources

- Electrodeless discharge lamp



Radiance : 40x HCL

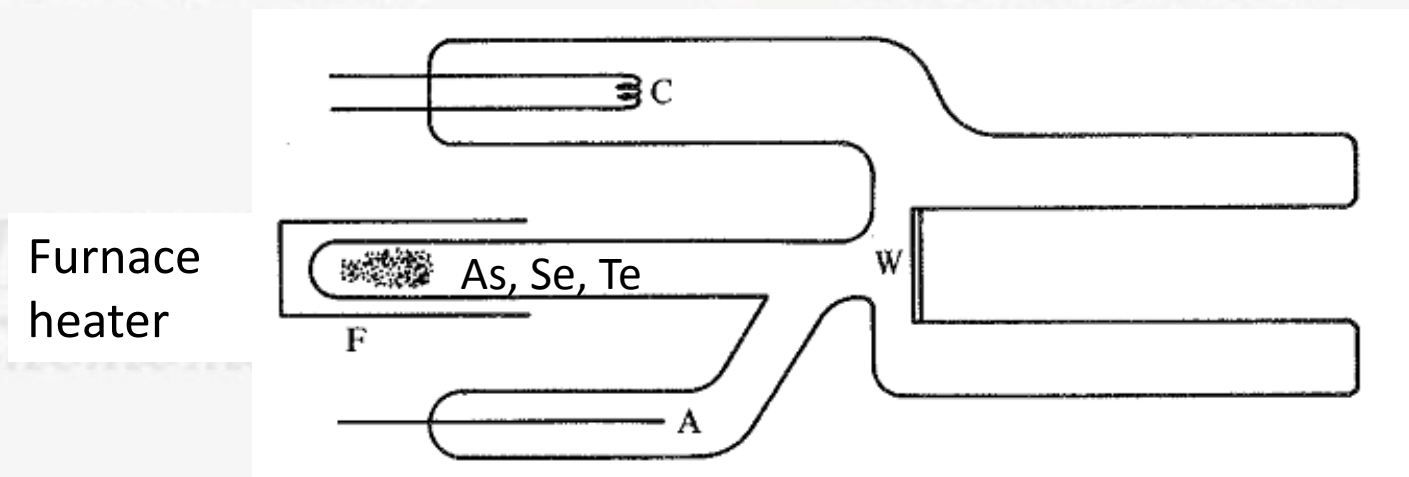


As, Se, Ti, Hg

RF: 2450 MHz

Line sources

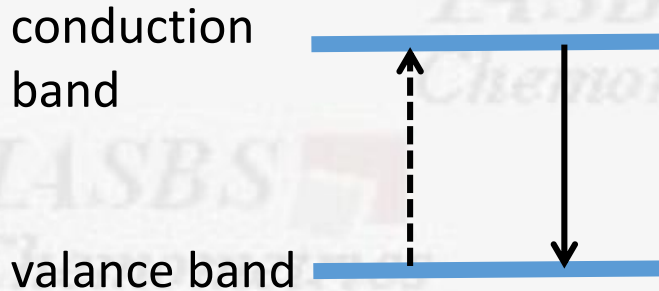
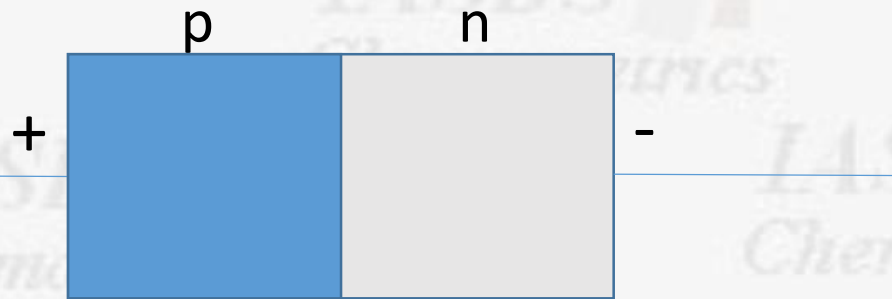
- Thermal gradient lamp (TGL)



Miscellaneous sources

- **LED**

pn- junction + forward bias



GaAs	GaP	SiC
900nm	650nm	580nm

FWHM < 50 nm, 5V, 0.25A

- **Fluorescent lamp**

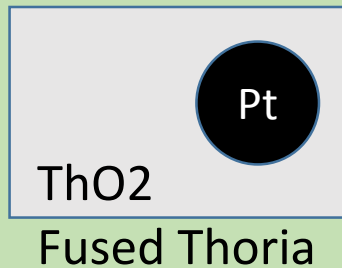
Hg arc + luminescent powder on wall

Application in :
photochemical reactions



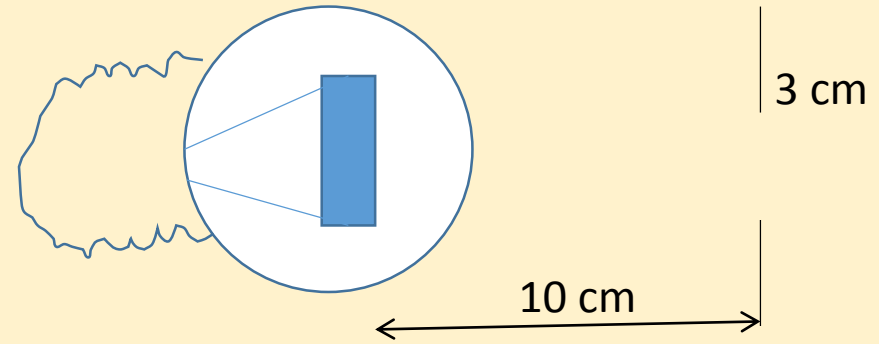
Standard sources:

- Primary standard photon sources



~standard
for black
body

Tungsten Ribbon



Standard for B_λ

250nm to 2.5 μm

Hot cathode discharge tube:

Filling ^{86}Kr \rightarrow Orange line (in vacuum)

605.7802105 nm

Standard for λ