ATOMIC EMISSION SPECTROMETRY

FLAME PHOTOMETRY

DR.S. ANAND GIRI

ANANLYTICAL CHEMISTRY

Ph.D. Jadavpur University

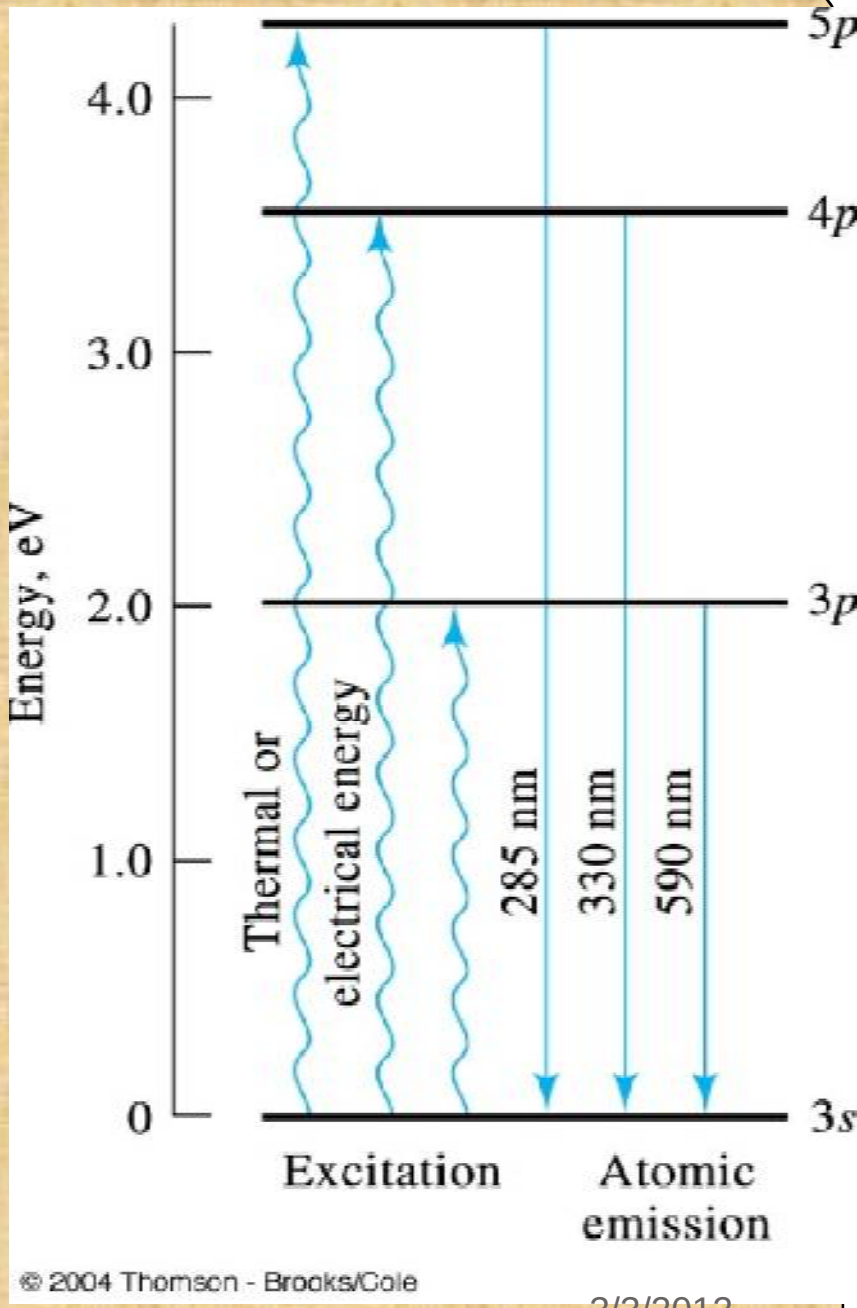
Kolkata, India

What is atomic emission?

Rapid relaxation of **excited species is accompanied by emitting of ultraviolet and visible light at discrete wavelengths (line spectra)**

The **emission of light** from atoms is measured.

The **intensity is proportional to the concentration** of atoms in the *particular* excited state



Principle

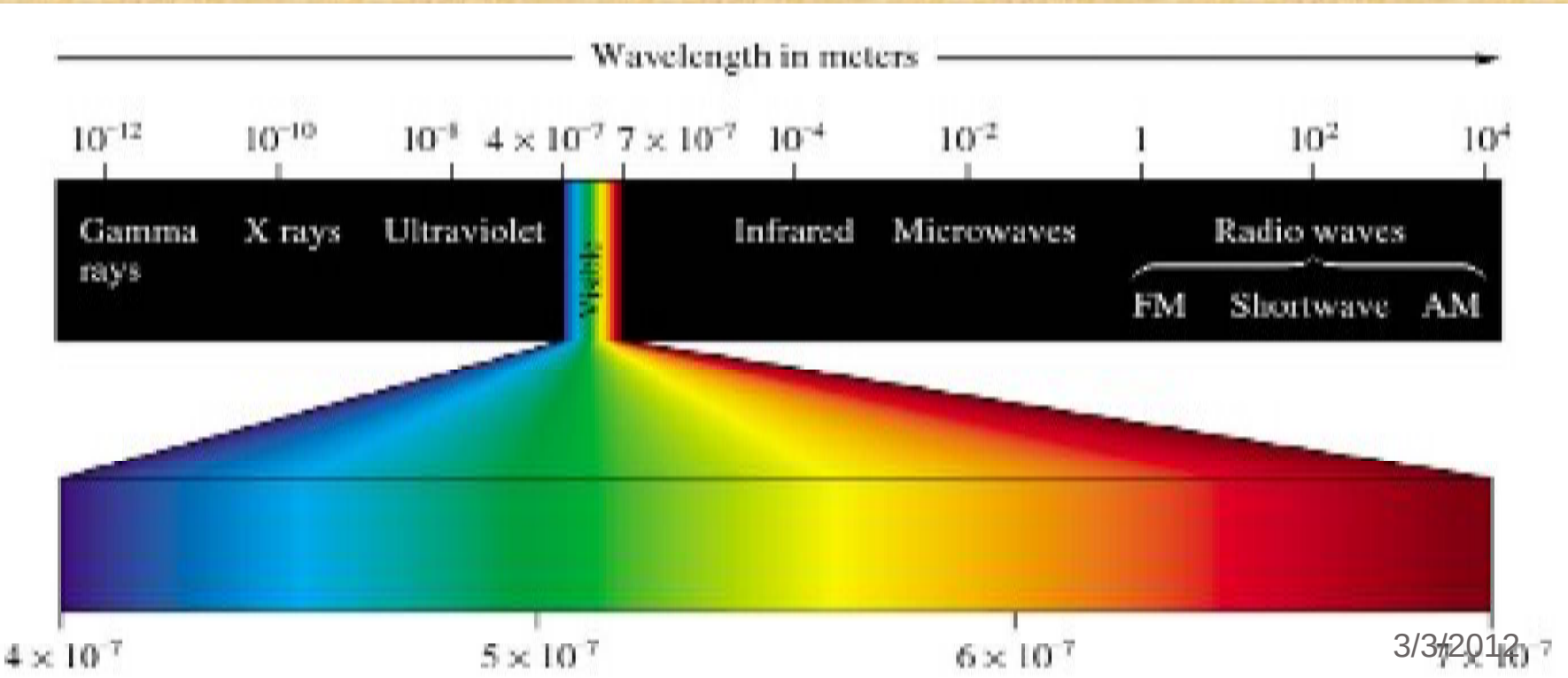
FLAME PHOTOMETRY

Excited atoms emit electromagnetic radiation.

Emission in the visible region gives characteristic color

Na yellow **Ca orange**

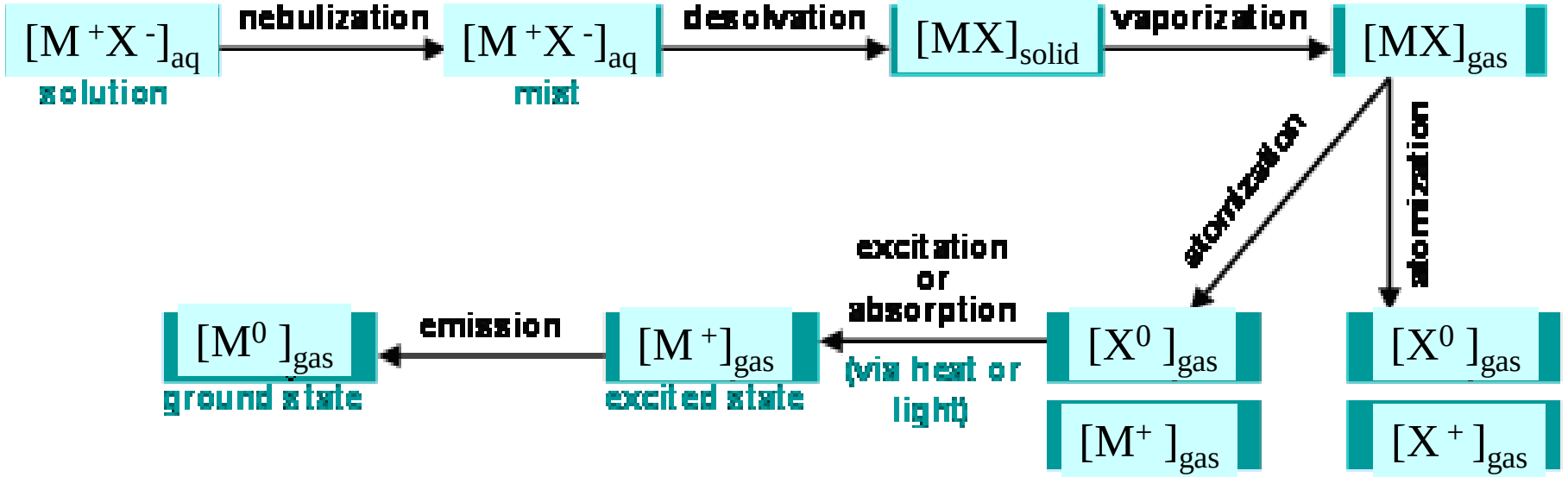
Li red **K violet**

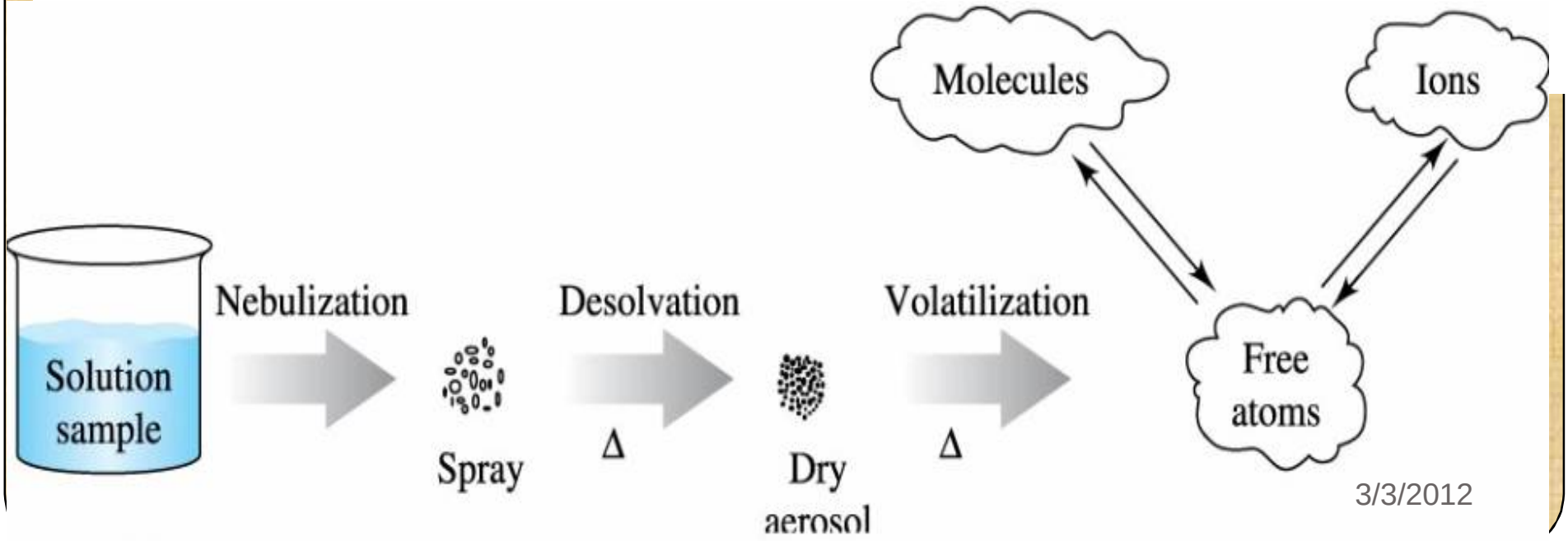


Stages of flame emission spectroscopy

1. **Emission of radiation**
   - Electrons in the excited state move back down to the ground state and emit the absorbed energy
2. **Excitation**
   - Electrons of metal atoms absorb energy from the heat of the flame
3. **Atomization**
   - metal ions are reduced to metal atoms
4. **Evaporation**
   - sample dehydration by heat & solvent evaporation

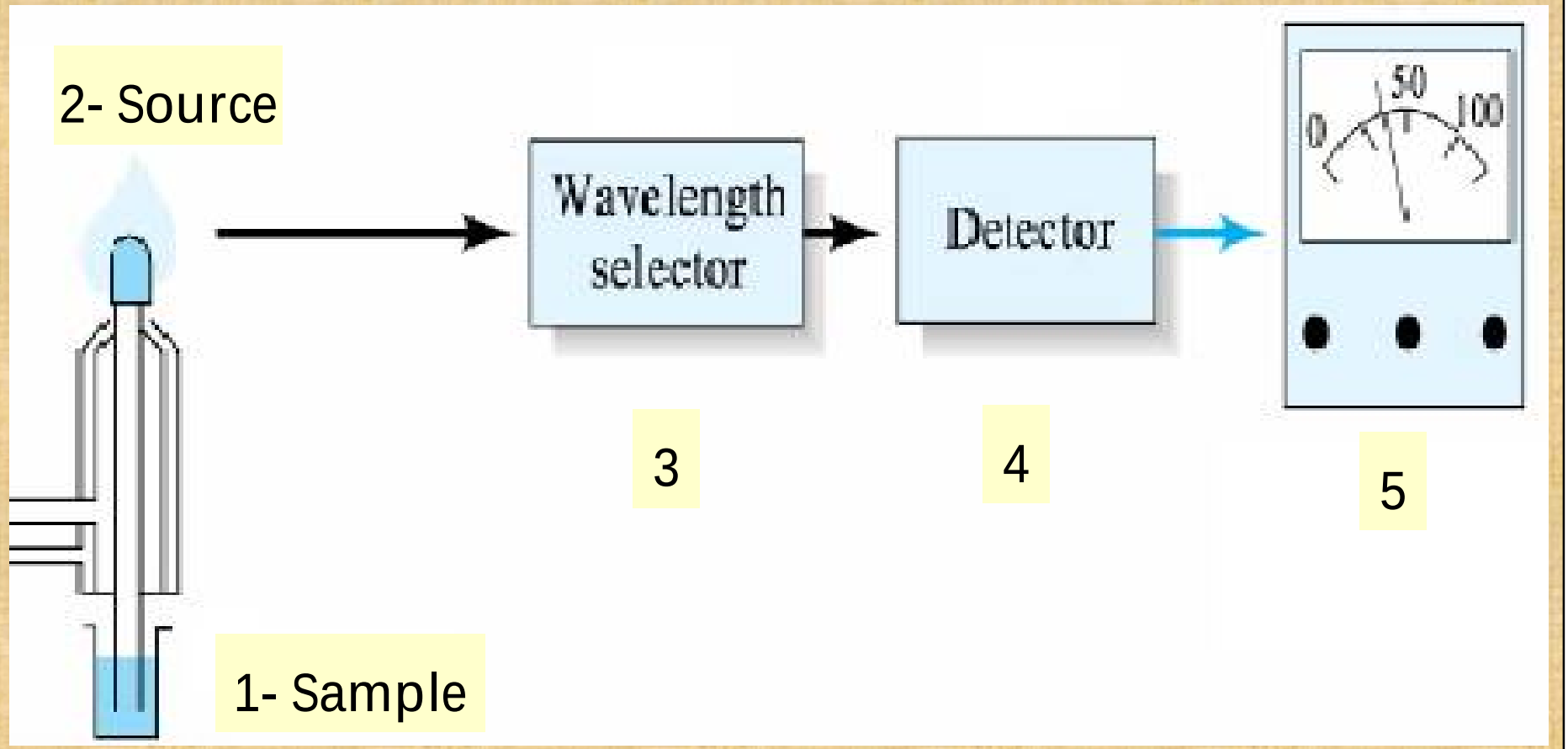
Principle of atomic emission spectrometry





Instrumentation

Basic Components of an Atomic Emission Spectrometer



Radiation source and detector are in 90° direction

1. Sample container

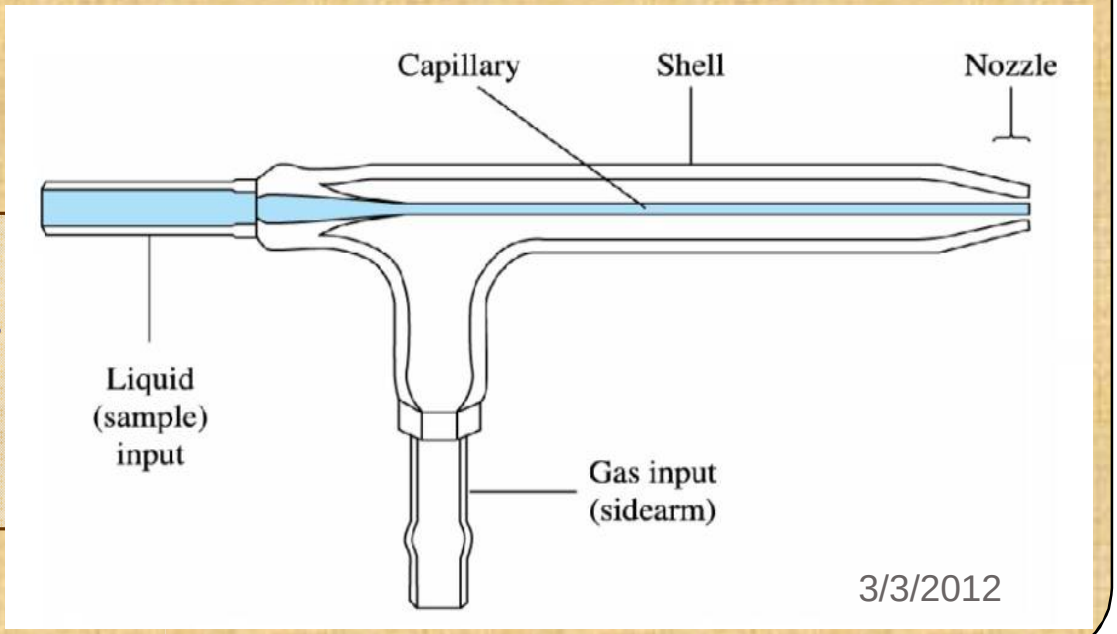
Sample solutions are aspirated from an external container (beaker)

A nebulizer convert solutions into a fine aerosol spray

1- a small plastic tube, used to suck up the sample solution

2- a side arm, at right angle to the plastic tube for the oxidant flow

The rapid flow of the oxidant through the side arm creates suction in the sample tube called Venturi effect



2. Flame

Flame Photometers are equipped with *Turbulent Flow* burners → nebulizer + burner = single unit

	Turbulent flow
Advantages	Introduces a relatively large and representative sample into the flame (sample flow rate ≈ 1 to 3 ml/min).
Disadvantages	(a) Short path length. Clogging of tip occurs frequently. (b) Noisy flame (c) Sample is nebulized at the tip, (on the burner head). Large sample droplets are not eliminated.

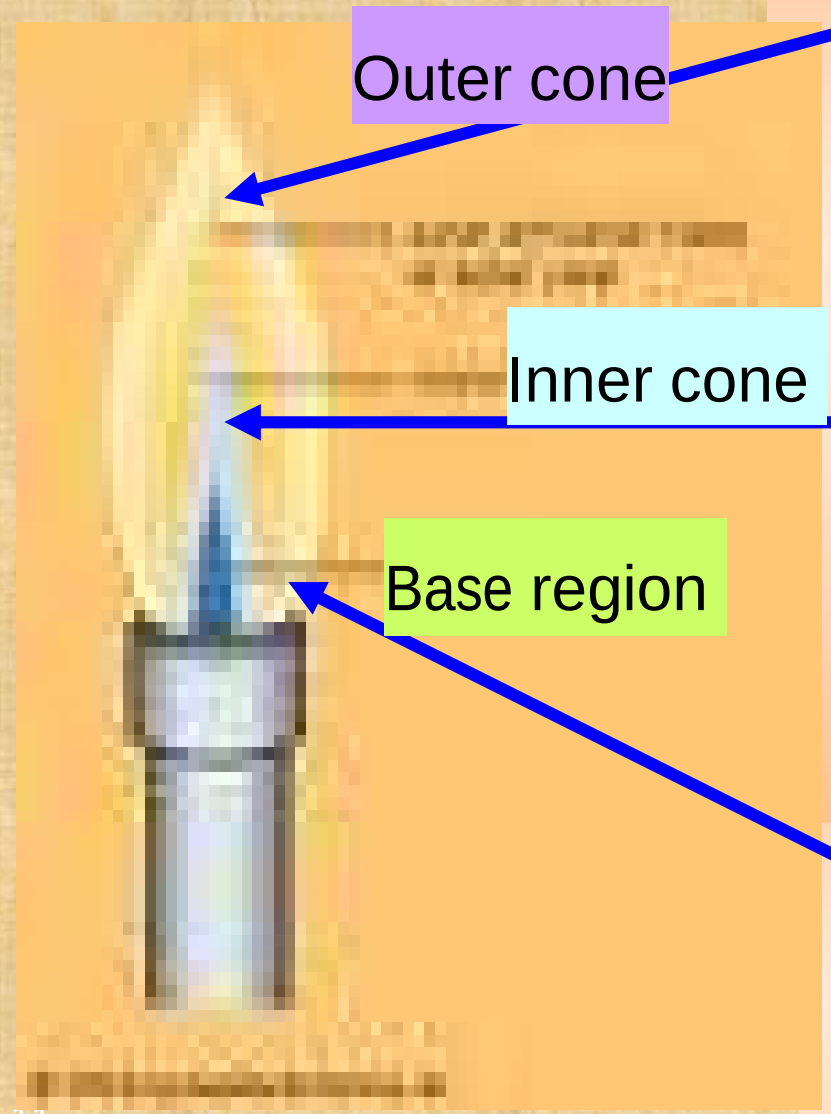
2. Flame

Type of fuel and oxidant

↳ **acetylene and air**

↳ **↑ temperature (2300 K)**
↓ burning rate

Process in the flame



3- Atoms and ions are dispersed into the atmosphere.
4- Oxidation may take place before the dispersion.

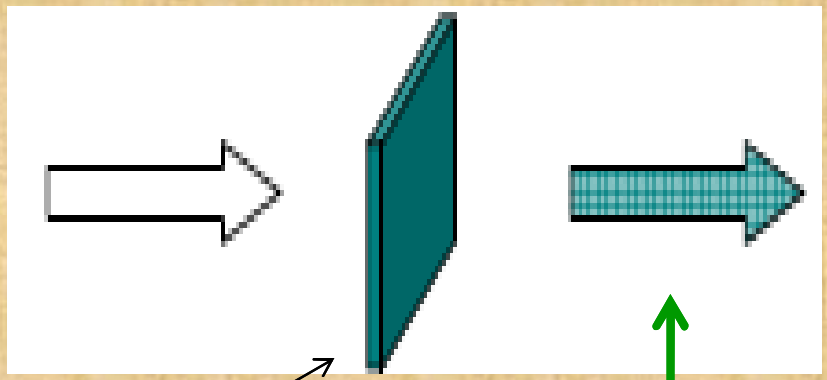
2- Solid particles are carried by the air-fuel velocity: atomization, excitation and relaxation take place

1- Solvent evaporates leaving the fine solid particles behind.

Instrumentation

3. Wavelength Selector

To isolate a narrow wavelength band from the continuous wavelength of the electromagnetic spectrum



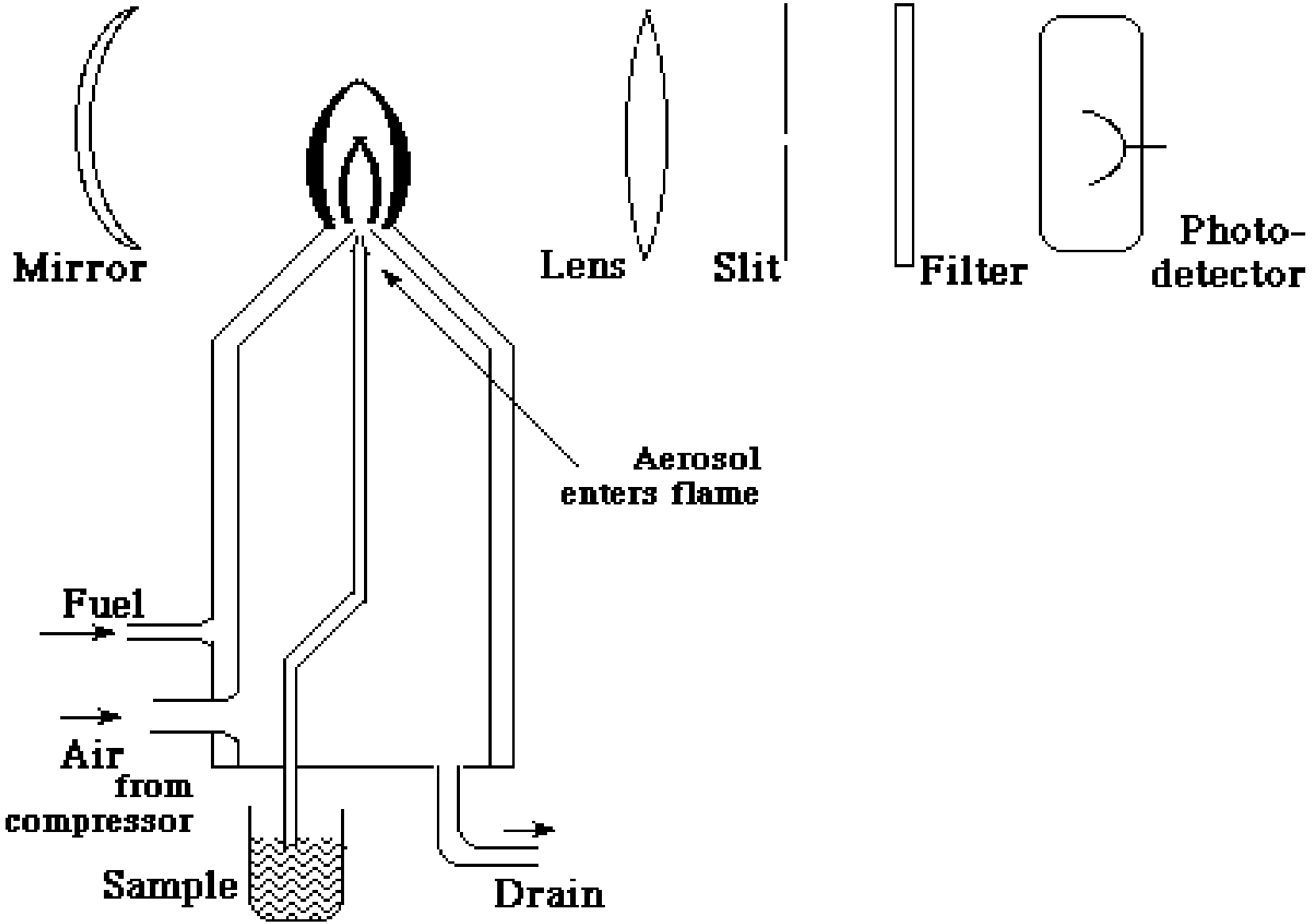
Bandwidth is the section of the band that is allowed to pass through

Filters are used for wavelength selection
Filters are *colored glasses* allow absorption in the visible region only

The narrowness of the bandwidth the high resolution is obtained

4. Detector

Light sensors such as photomultiplier tubes or photodiodes


Mirror
Lens
Slit
Filter
Photo-
detector
Aerosol
enters flame
Fuel
Air
from
compressor
Sample
Drain

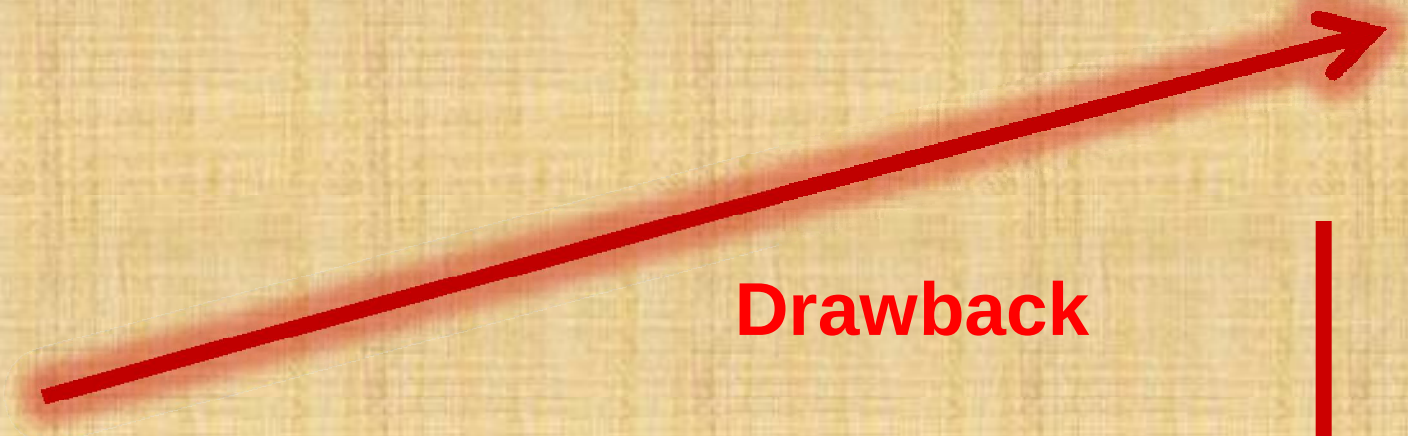
Advantages of flame photometry

simple Instrumentation

cheap

sensitive

Less maintenance



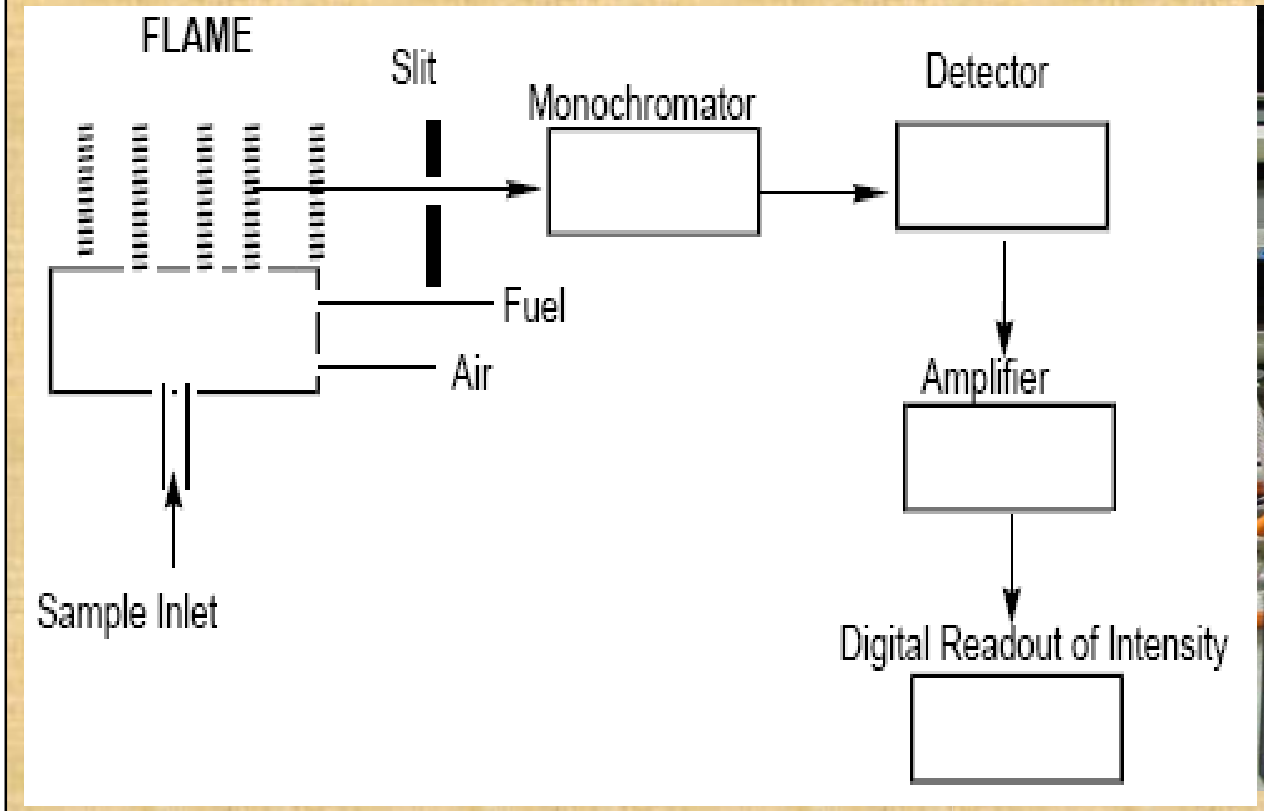
Drawback

Limited application

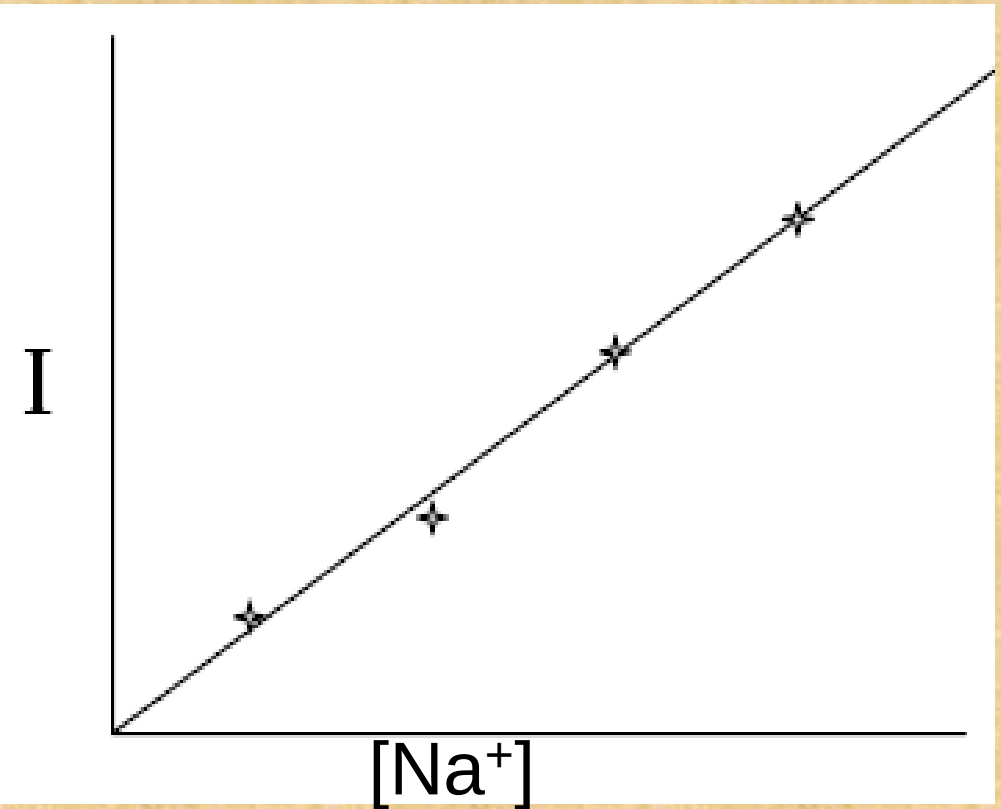
An application of AES;

Determination of Sodium

Flame emission photometer.



The method is based on the fact that intensity increases linearly with the Na^+ concentration



$y = mx + b$

$I = slope*[Na^+] + y\text{-}int$

Solve for $[Na^+]$ of your unknowns