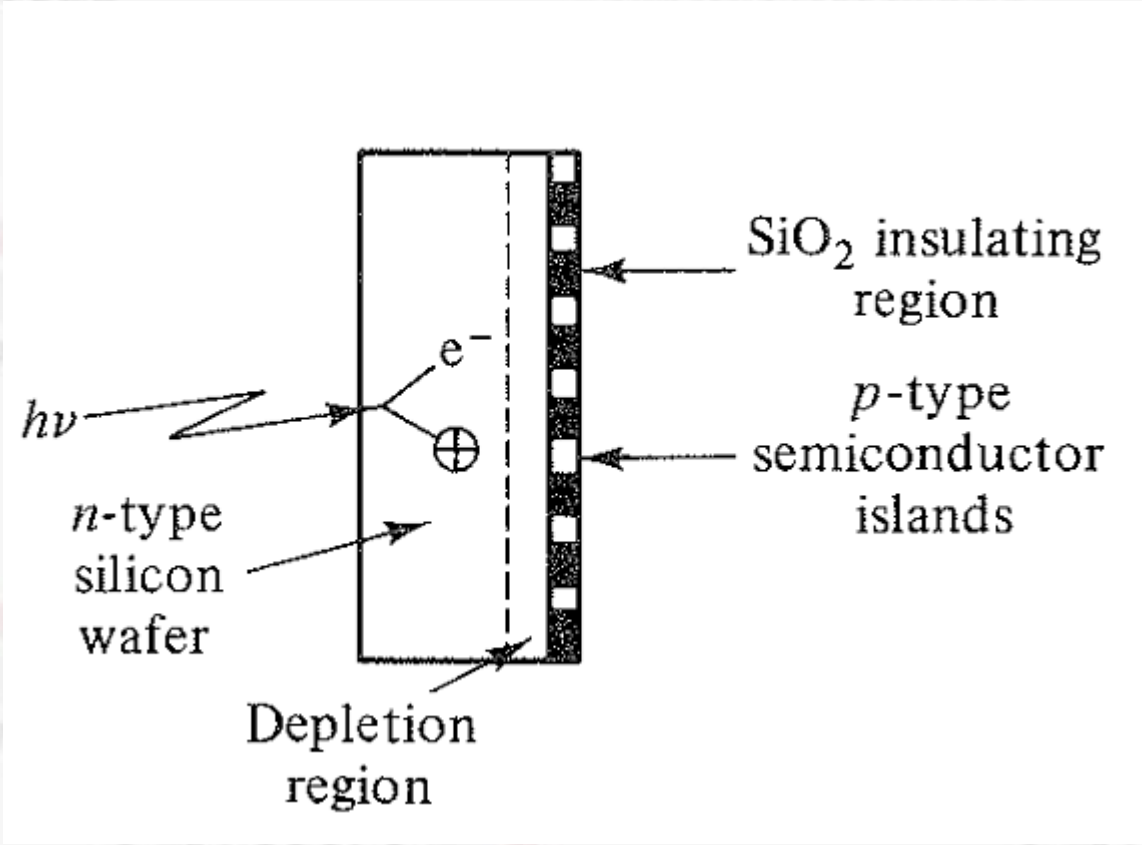
Photographic detectors

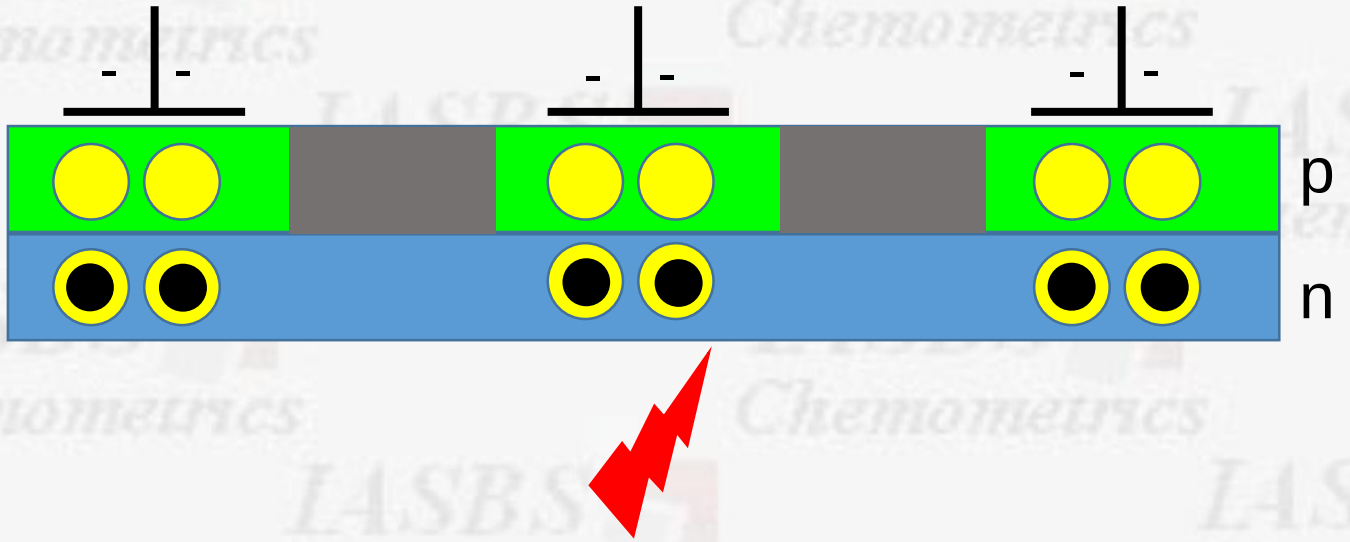
Photographic films are emulsions that contain silver halide crystals. Incident photons produce stable clusters of silver atoms within the crystal. Internal amplification is provided in the development process by an electron donor which reduces the remaining silver ions to silver atoms within the exposed crystal.

Photodiode Arrays

Each diode is initially reverse biased so that in the n-type semiconductor there are minority carriers. The biasing is turned off and photon strike the n-type semiconductor for a controlled integration time.



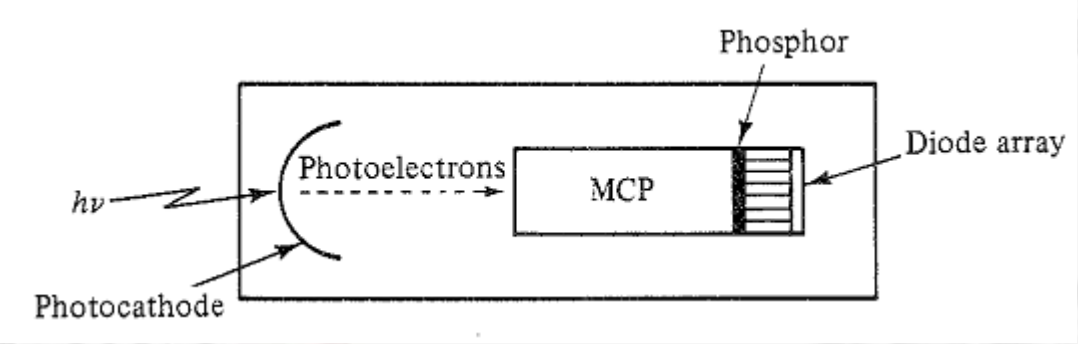
- Reverse bias for store of electrons,
- hν for discharges,
- scanning and counting of charges.

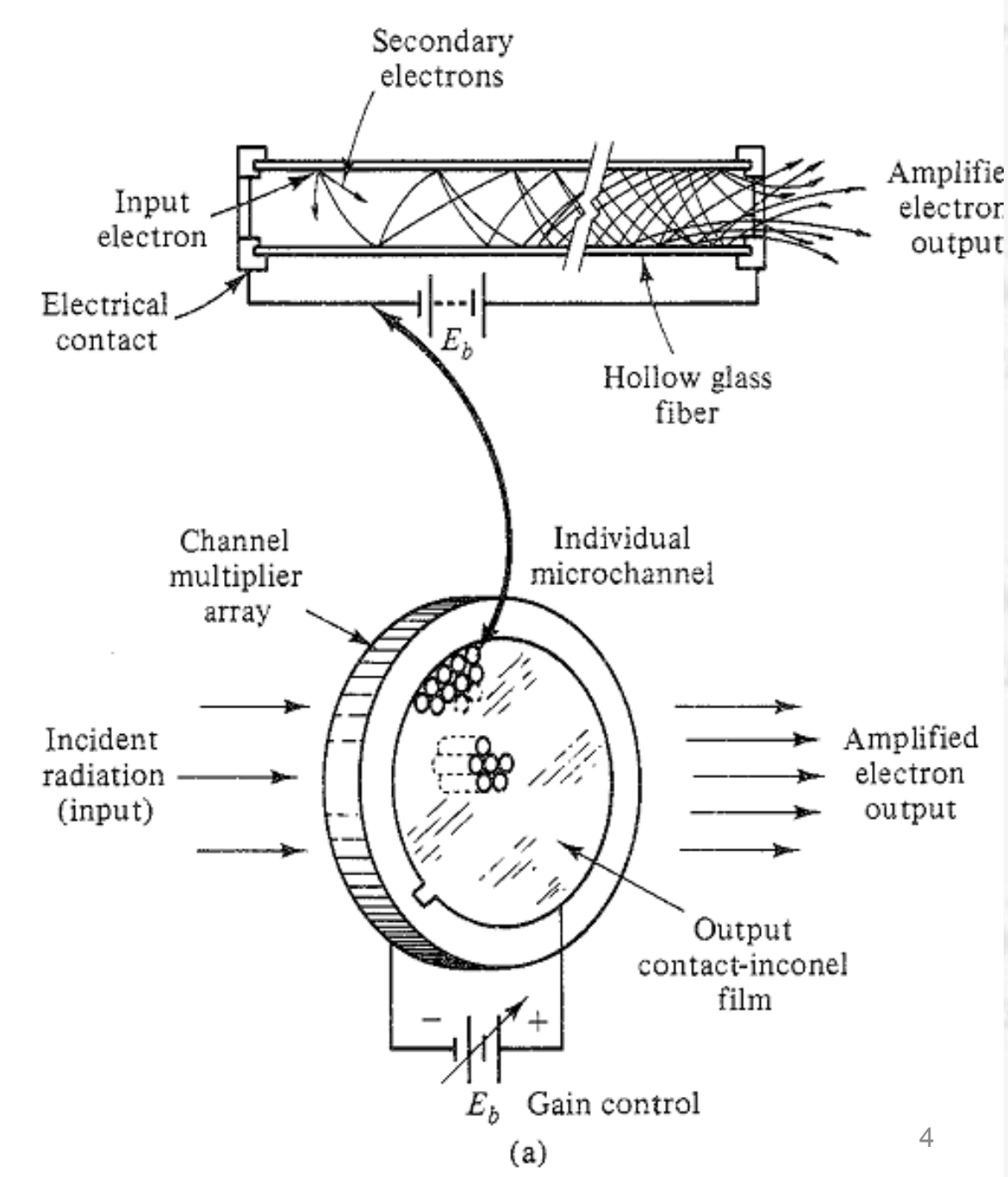


Reverse bias

MicroChannels-Plate intensified diode array MCP

Large number of hollow glass fibers (<40 μm diam)

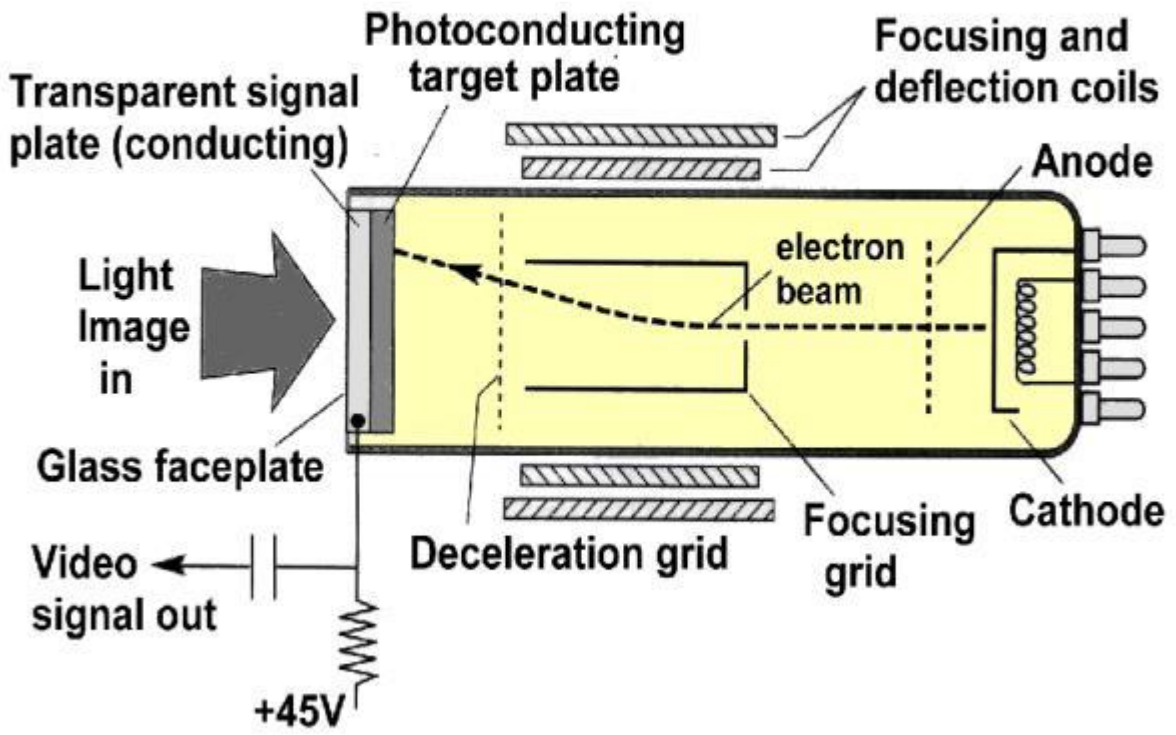




Vidicon tubes

2D blooming

ISIT
Intensified silicon
intensified target



Charge-Coupled Device

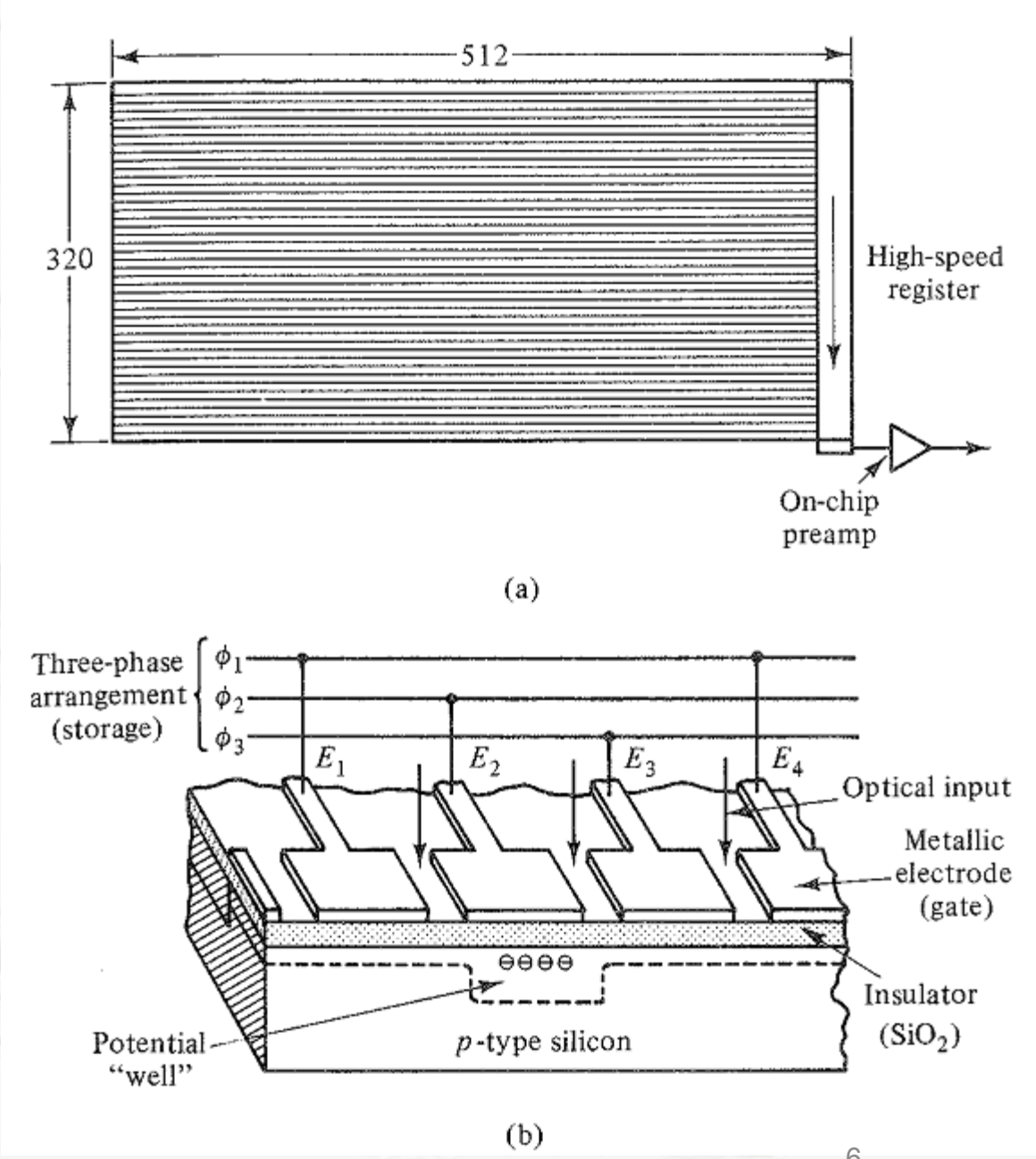
Charge-couple device (CCD) is solid-state.

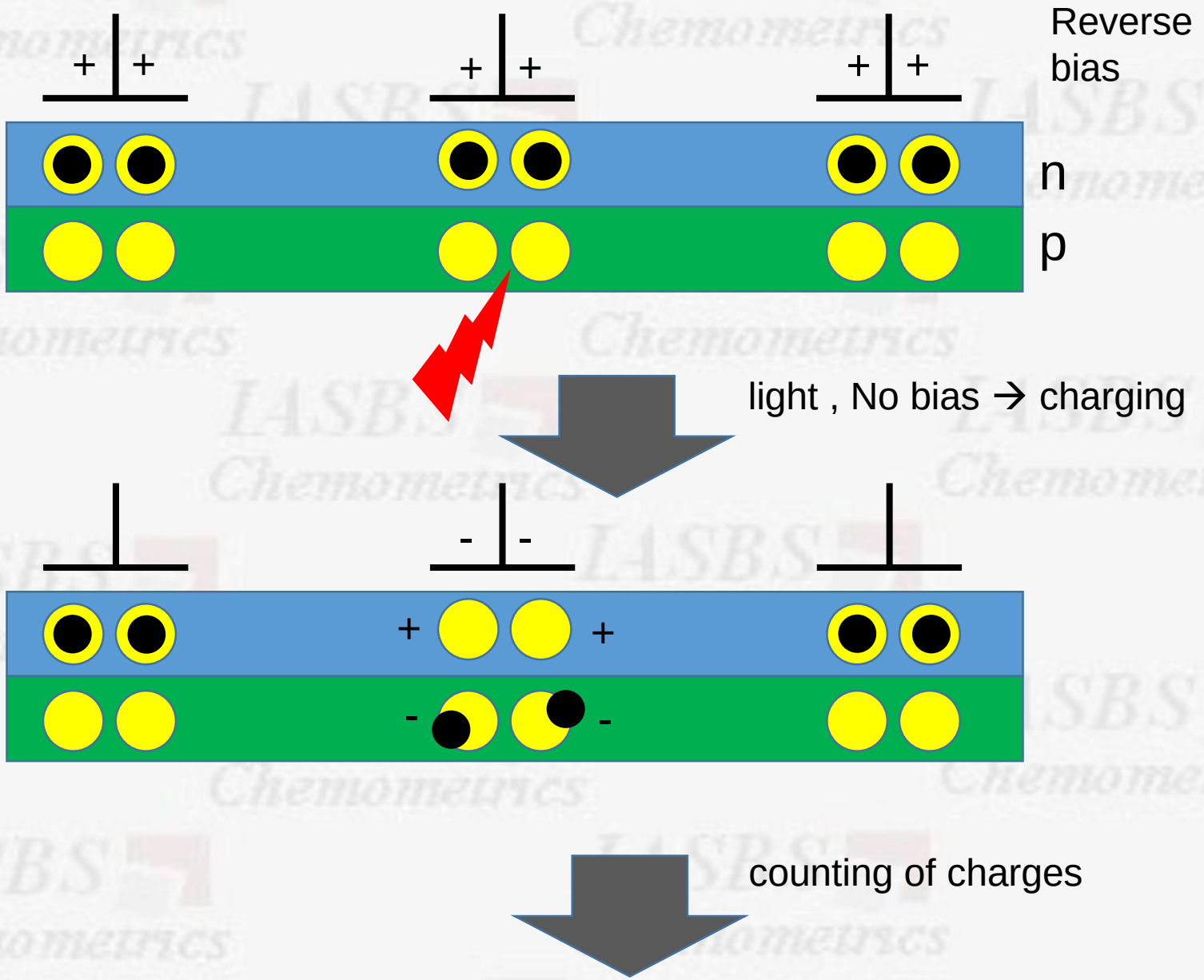
With this device, the charge generated by photons are collected and stored in metal-oxide-semiconductor capacitor.

Each pixel consists of a thin conducting electrode and a thin insulating oxide layer on top of a p type silicon substrate.

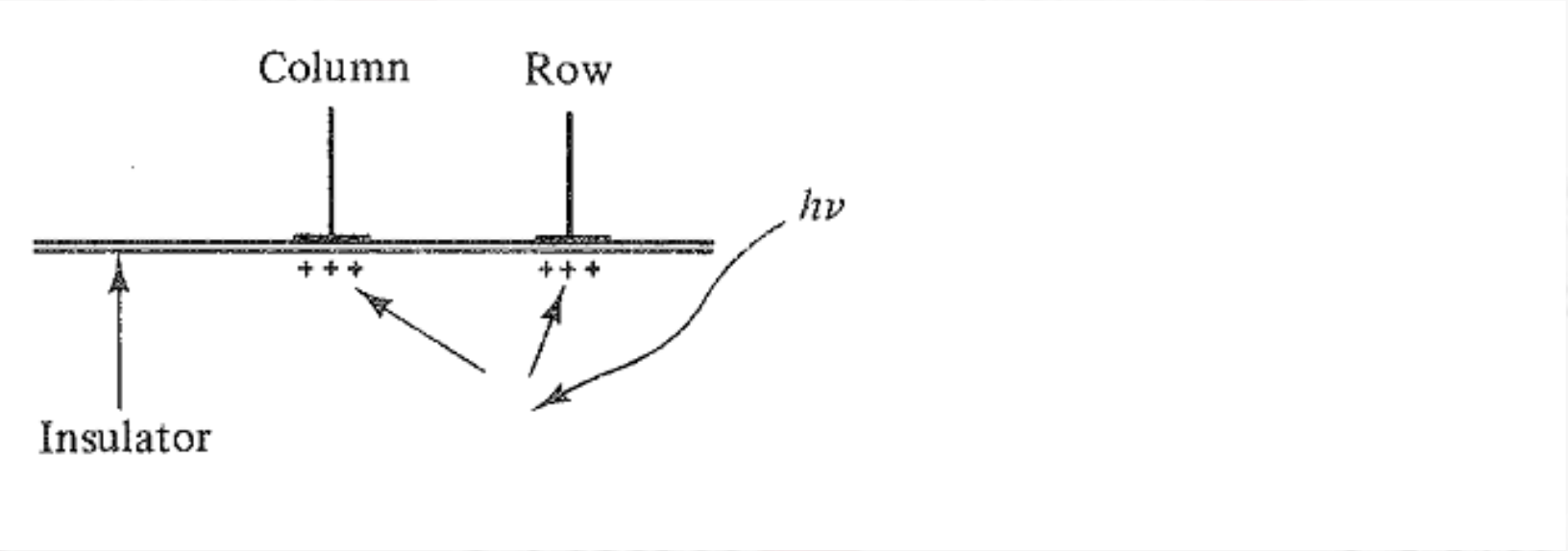
The MOS capacitors are reversed biased by a positive applied to metallic electrode.

MOS: Metal oxide semiconductor




Reverse bias
n
p
light , No bias → charging
counting of charges

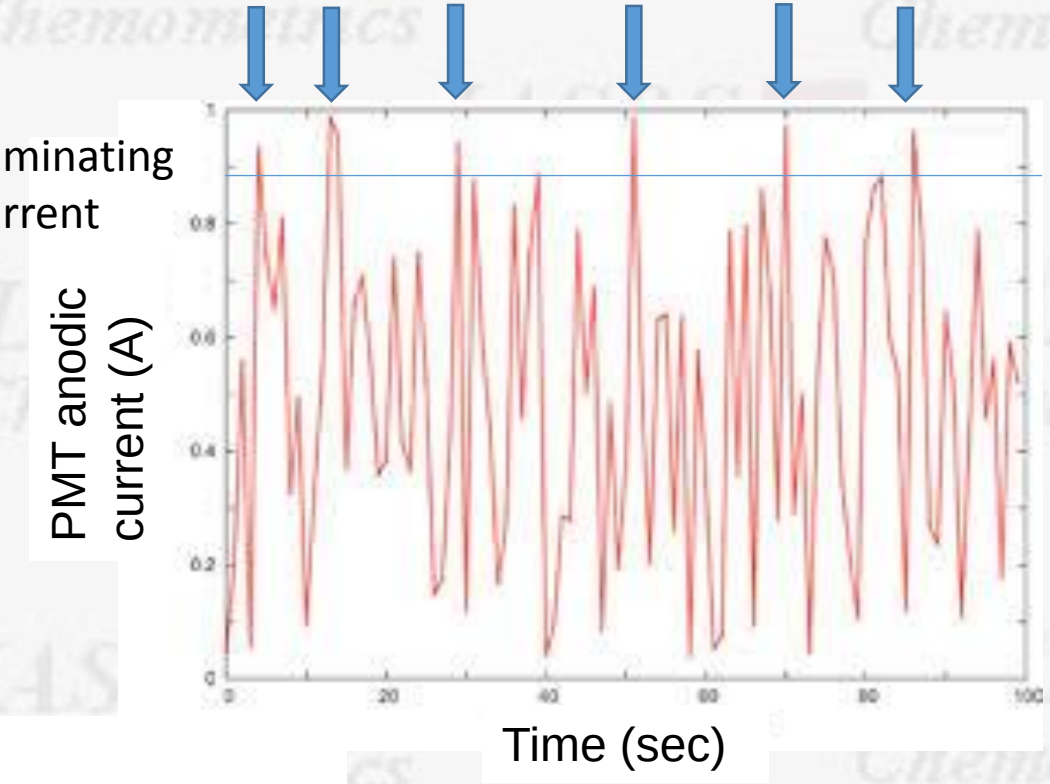
Charge Induced Device

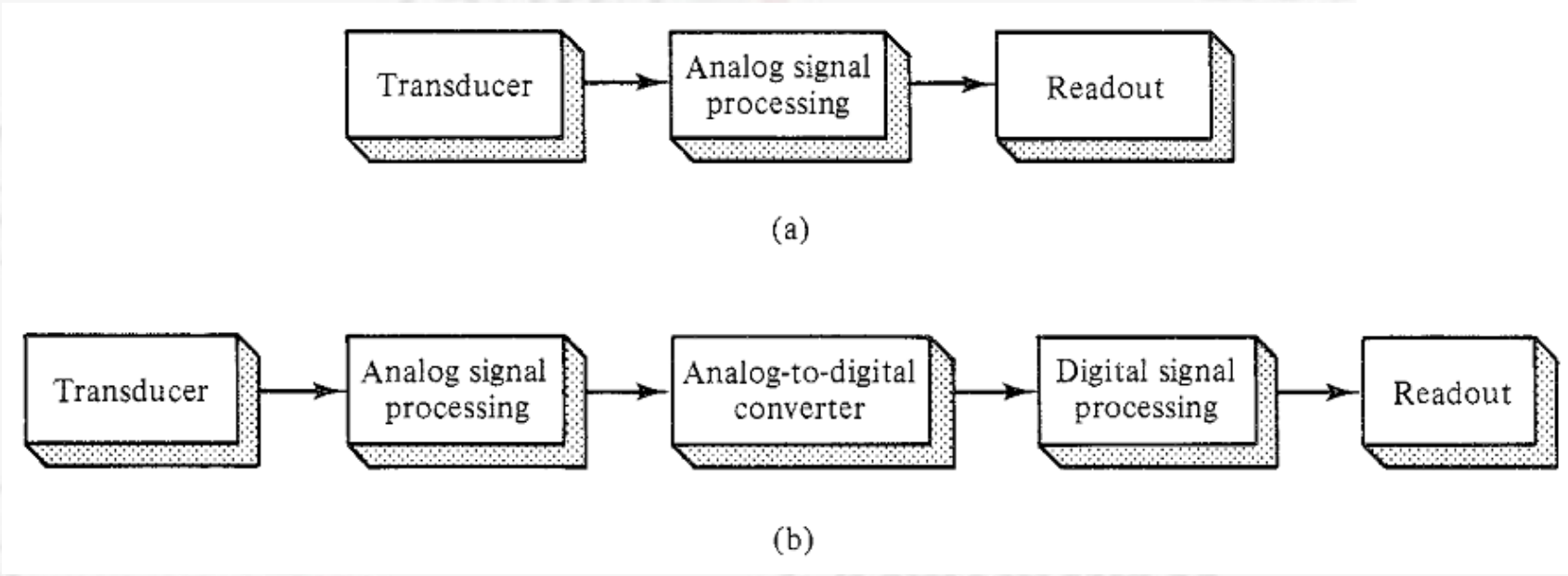


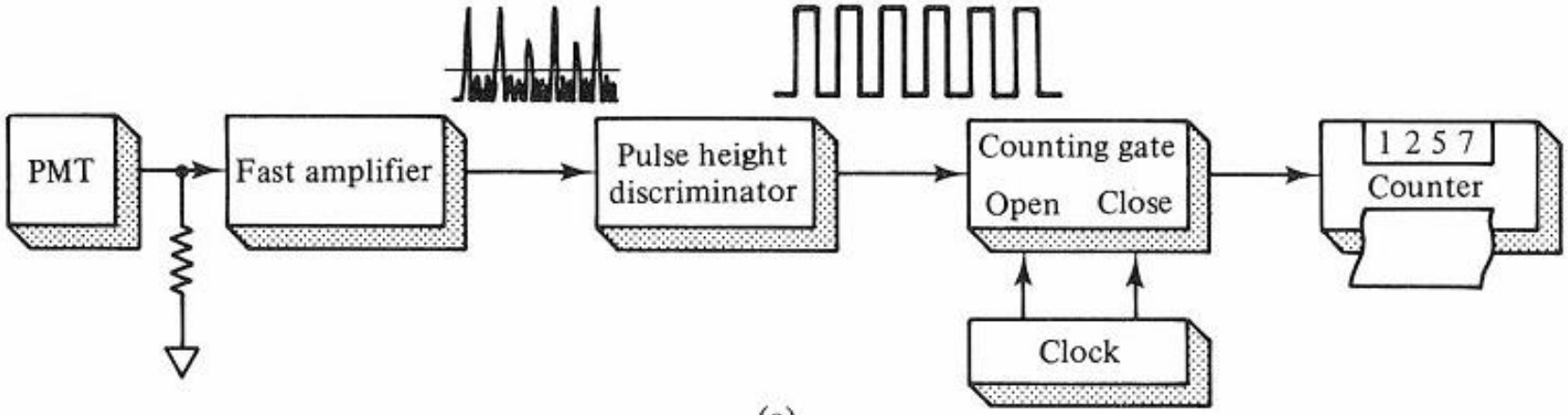
In each cycle (<sec)

- Application of negative charge on electrodes (forward bias)
- Striking photons → e hole separation (induced charge).
  (amount of charge is proportional to light intensity)
- Collection of positive charges around negative electrodes.
- termination of bias application and counting of charge

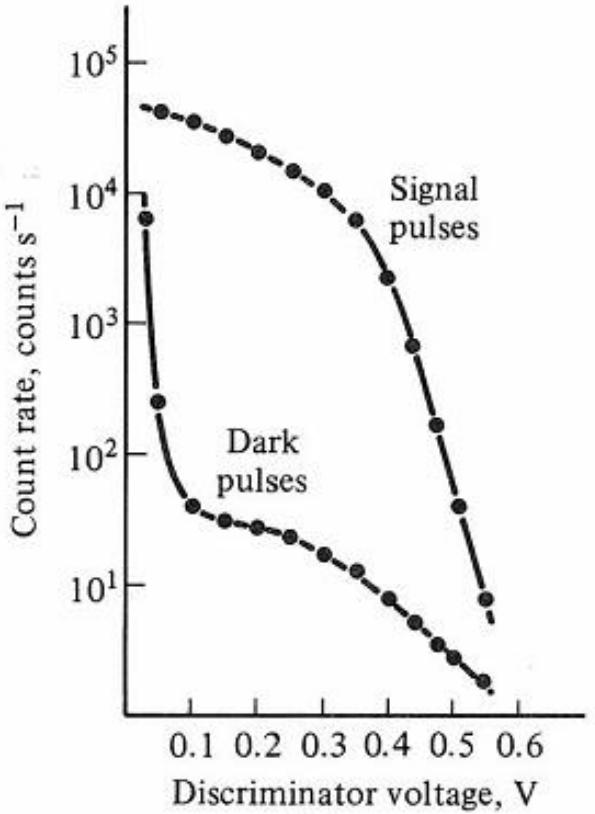
Photon counting in PMT



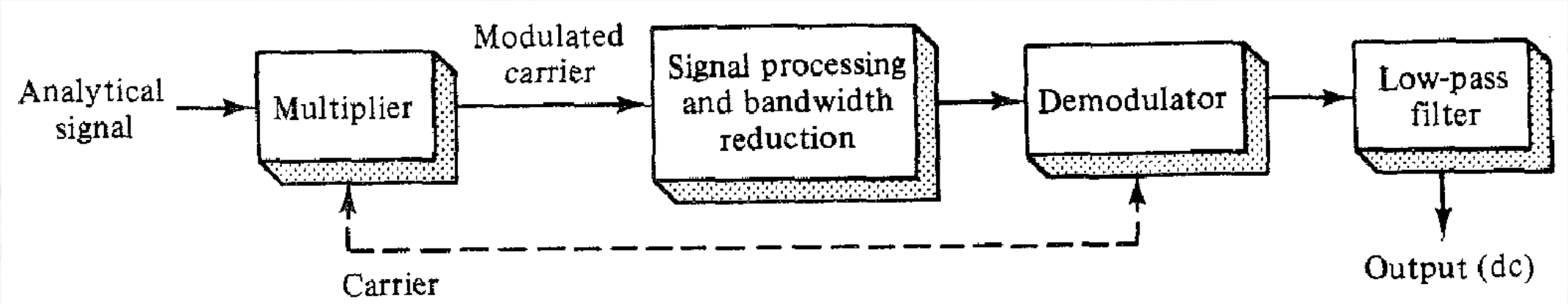



PMT
Fast amplifier
Pulse height discriminator
Counting gate
Open
Close
1 2 5 7
Counter
Clock

(a)


10^5
10^4
10^3
10^2
10^1
Count rate, counts s^{-1}
Signal pulses
Dark pulses
0.1 0.2 0.3 0.4 0.5 0.6
Discriminator voltage, V

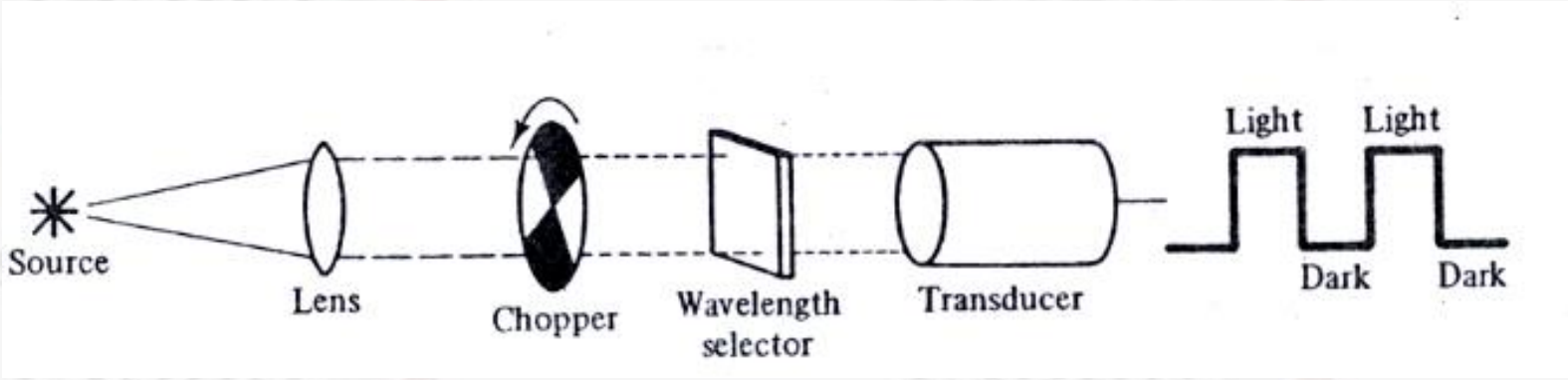
(b)

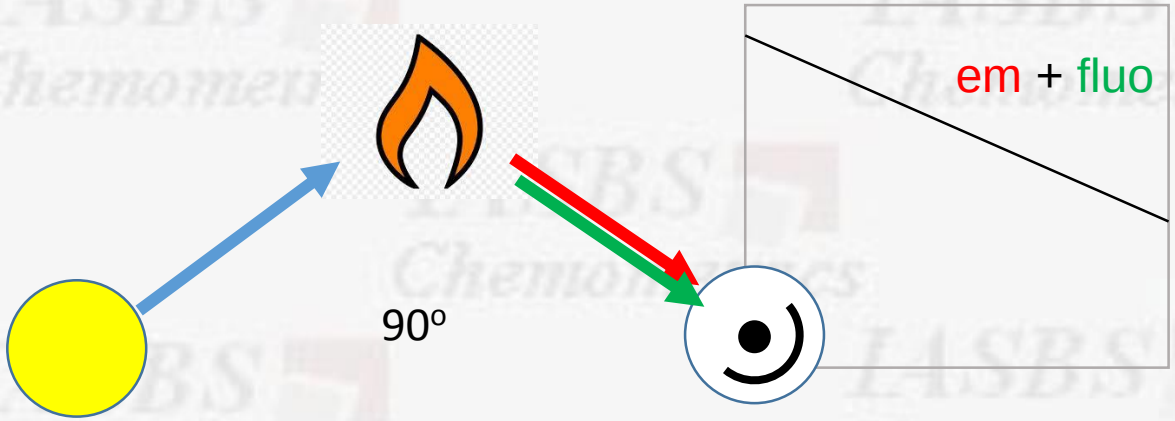


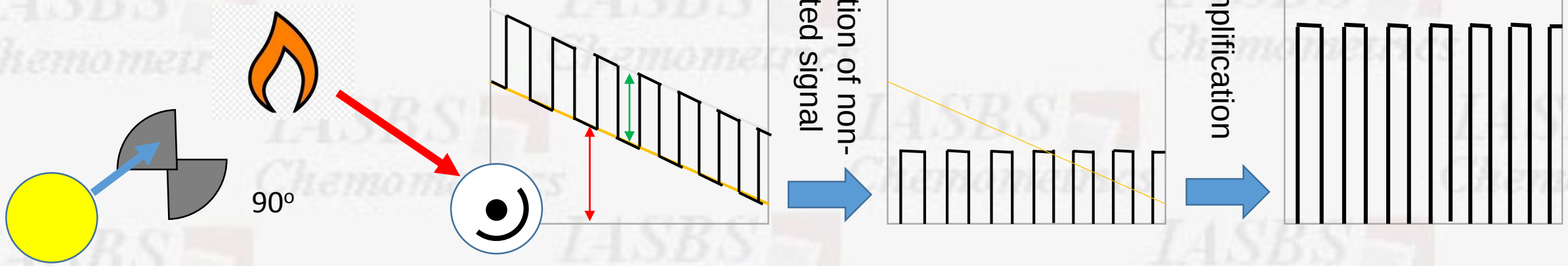
General principle of modulation. The multiplication step produce a carrier wave that varies in amplitude in accordance with variations of the analytical signal amplitude.

✓Source Modulation

It is usually best to modulate as early in measurement process as feasible so as to achieve the maximum freedom from noise . Source modulation in absorption or photoluminescence spectroscopy also allows discrimination against any emission by the sample in that the resulting ac output of the transducer is referenced to the dc emission level which is present during both half-cycles.

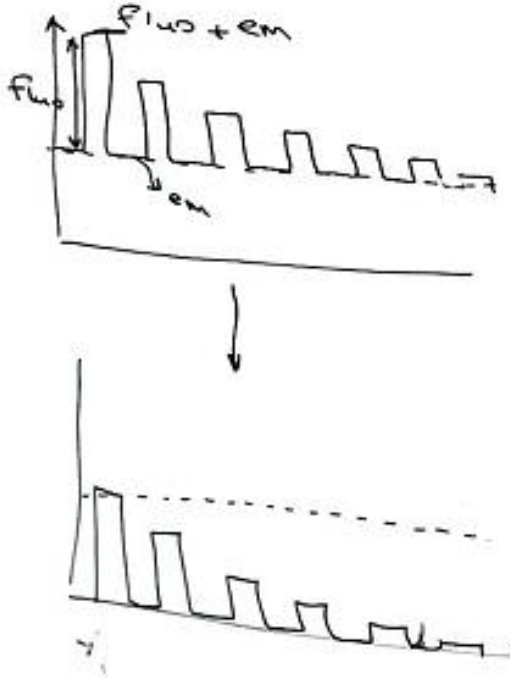



em + fluo
90º

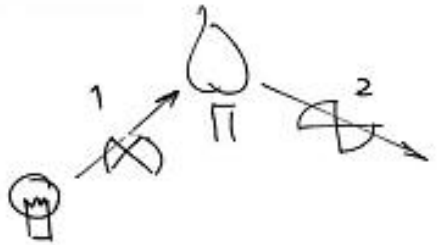

90º
Elimination of non-modulated signal
Amplification
Demodulation

G2 Spect Introd 971117 wed

Modulation :

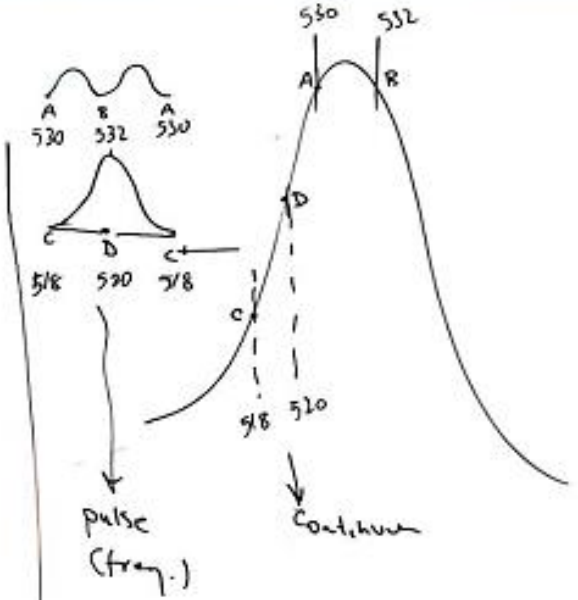


2 Sondtion



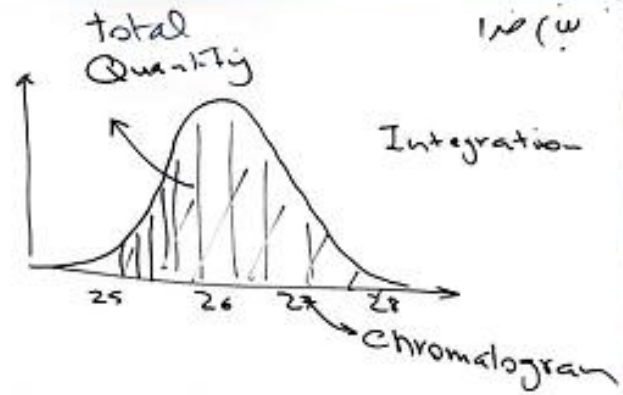
Sample - blank - Sample - blank

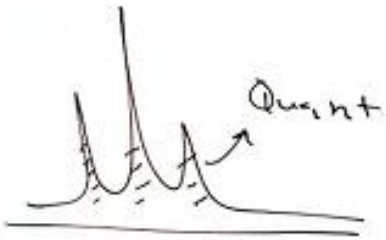
Sample modul.

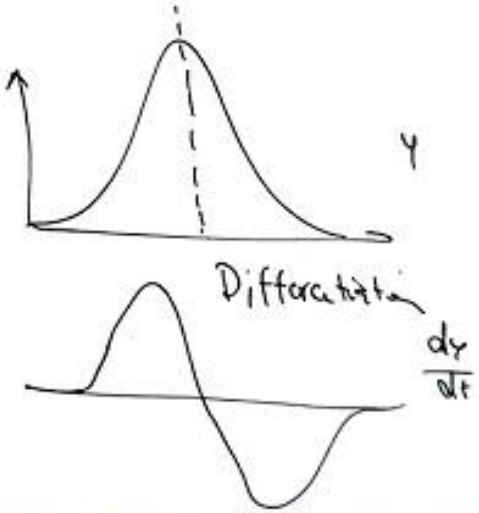


operational amplifierr

A = - log T





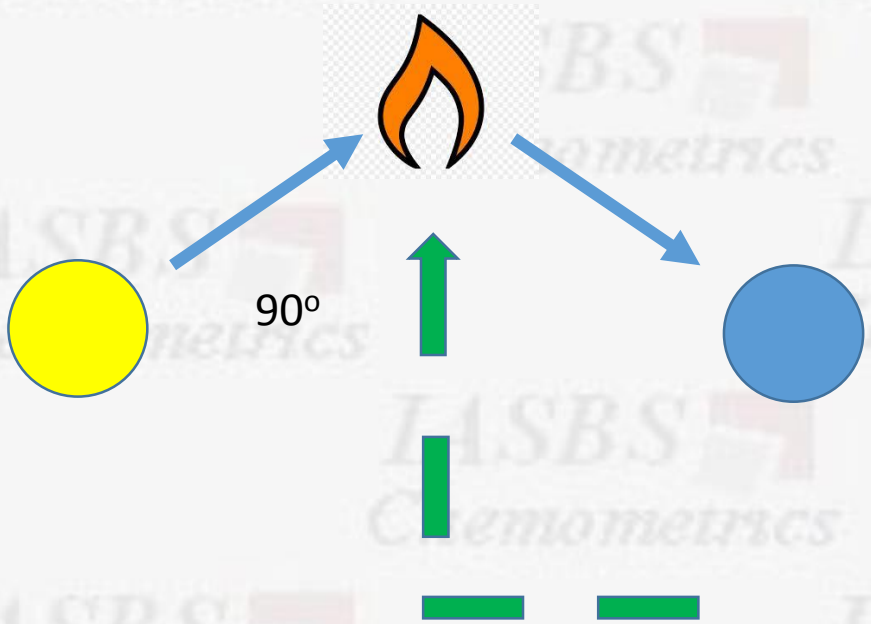


✓Sample modulation

$$E_{Lt} = E_L + E_{bgL} + E_{sc} + E_E + E_{bgE} + E_d$$

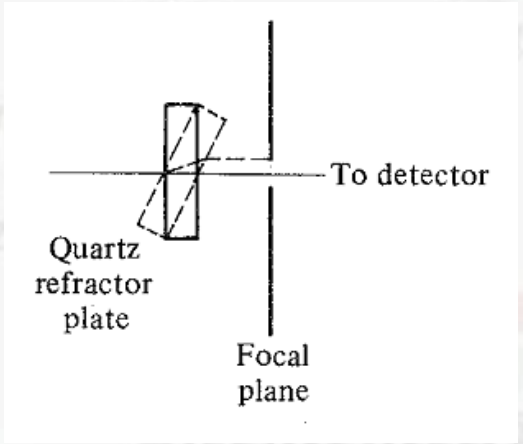
Blank

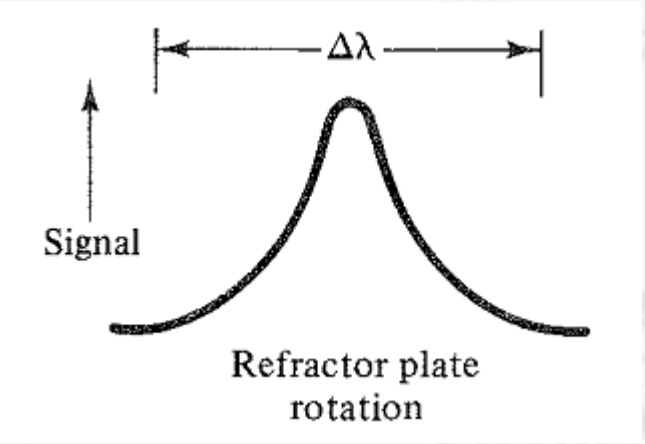
Sample modulation allows automatic referencing of sample information to that of the blank which can automatically provide correction for blank interferences if the blank is ideal. Unfortunately, most sample modulation techniques operate at only a few hertz, which is often not far enough removed from the noisy dc region to achieve much improvement in S/N.

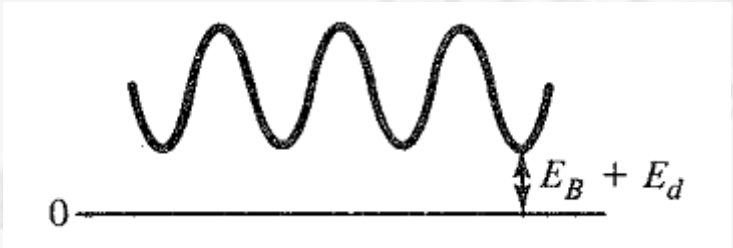


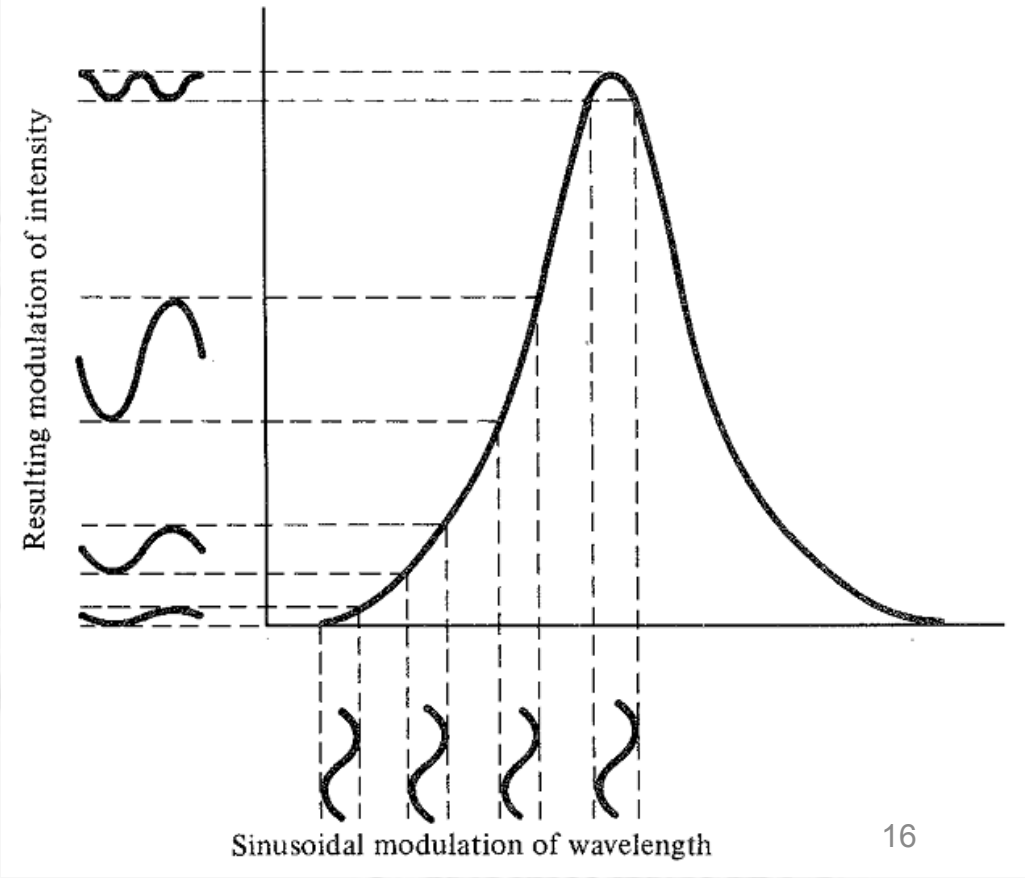
Wavelength modulation

Is the repetitive variation of the wavelength range observed by the detector. This can be accomplished by repetitively scanning a monochromator back and forth across a fixed-wavelength range.





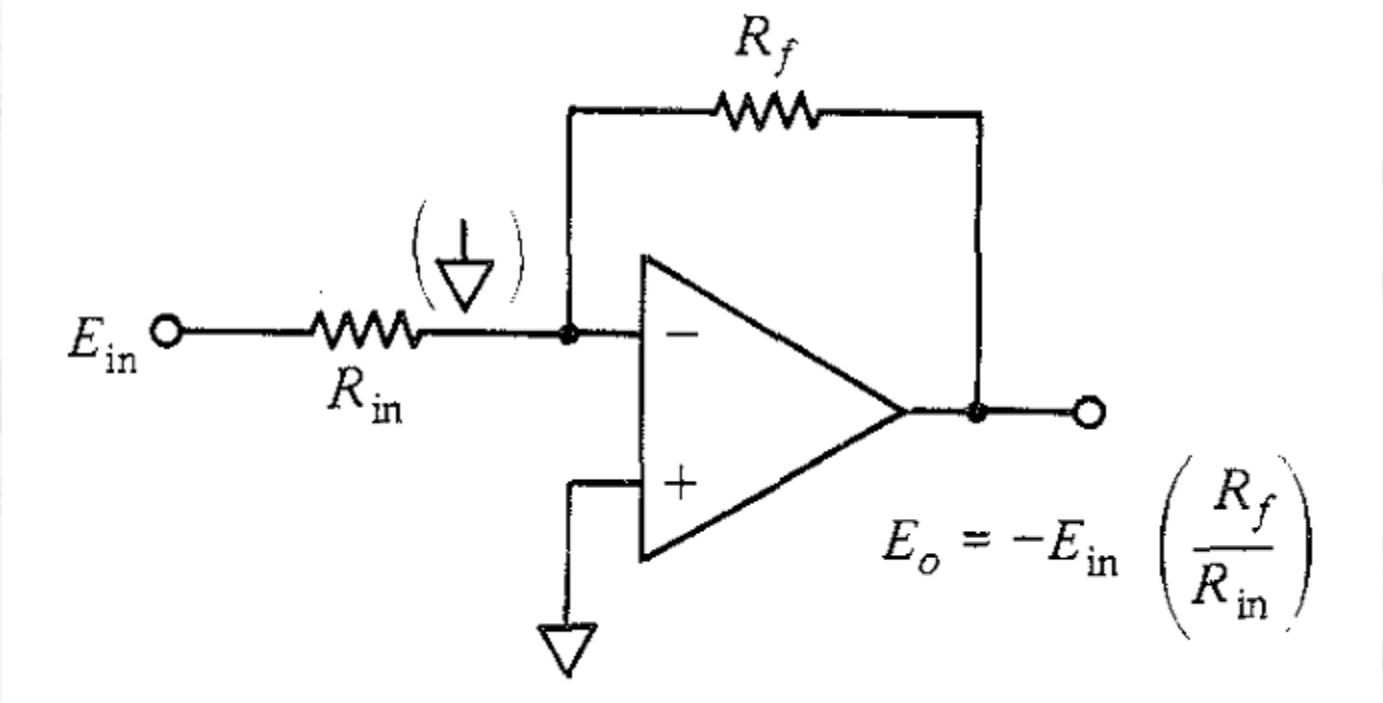




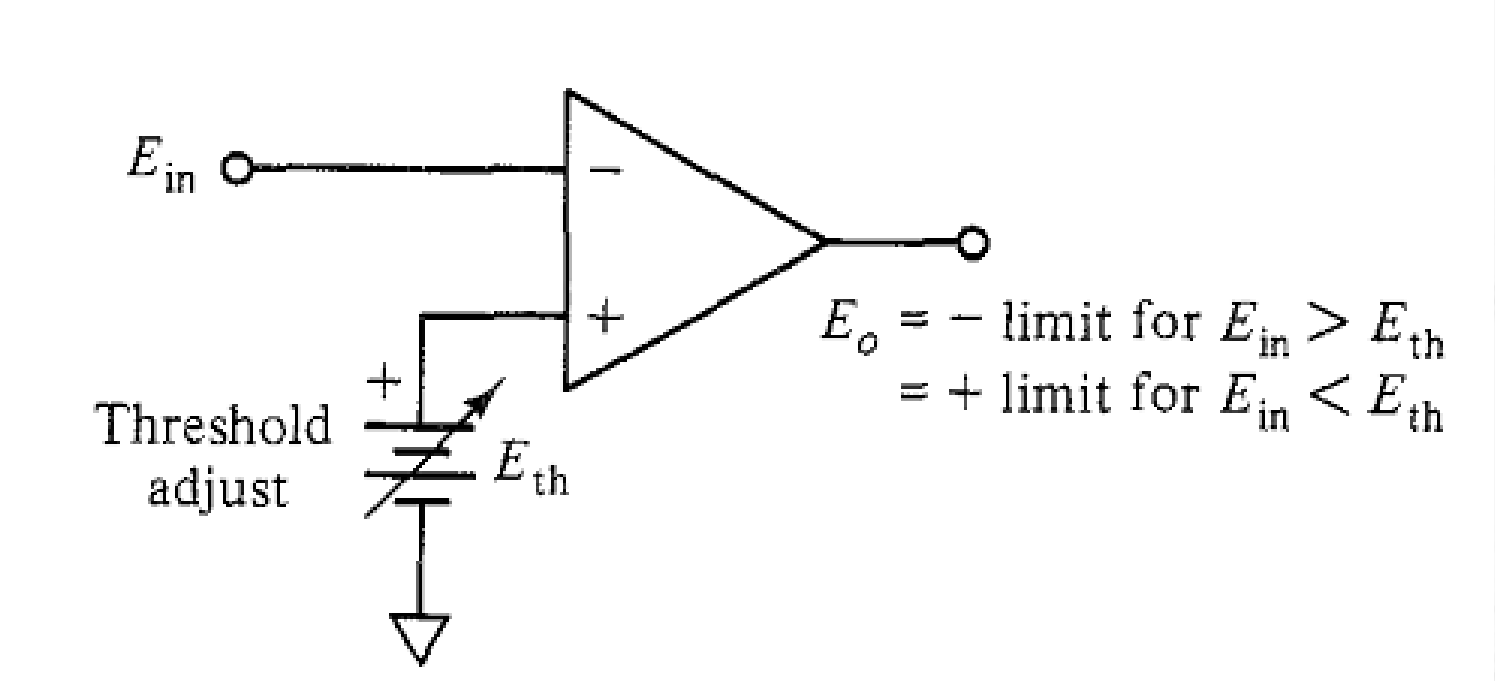
Modulating magnetic field

Will be discussed when dealing with HCL for atomic absorption

Invertor + amplifier

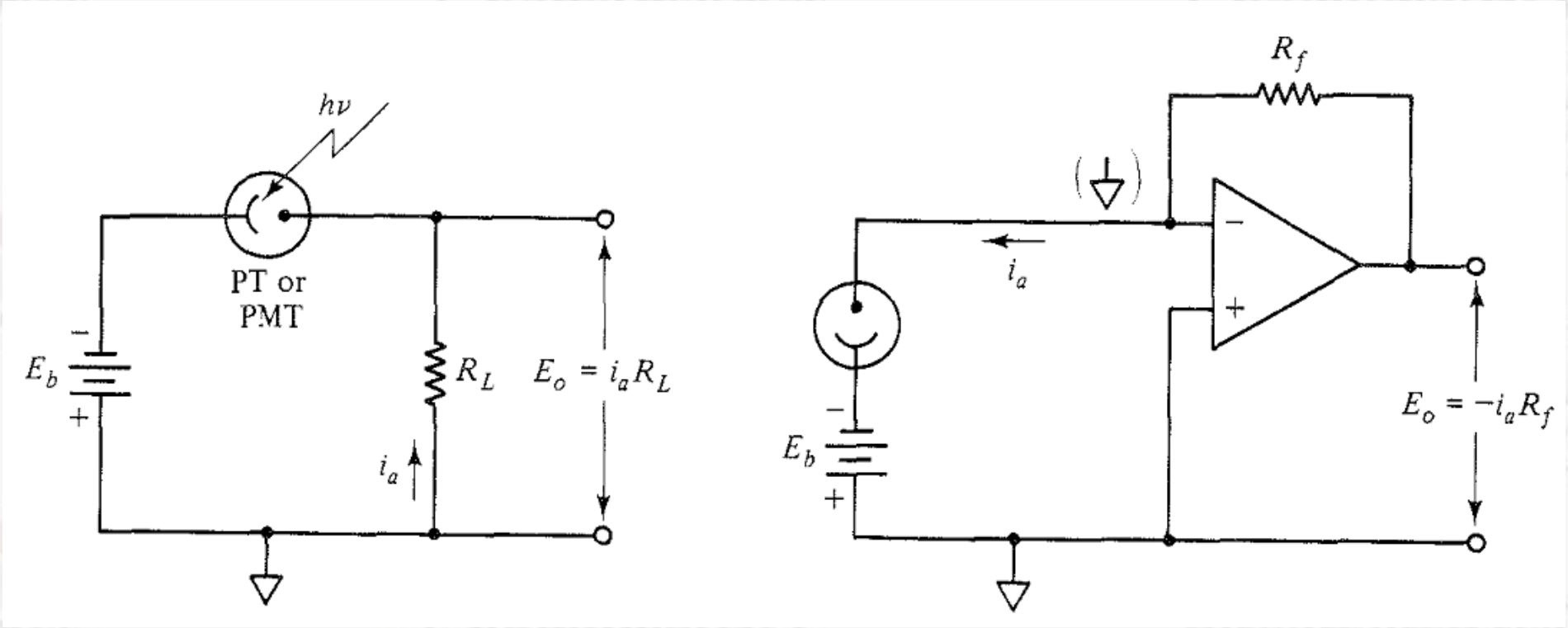


Descriminator



i to V convertor

f: feed back



Old:

Recent: OpAmp based