# Types of X-ray Detectors

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Solid state detectors

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Charge coupled device detectors

# Types of X-ray Detectors

Gas detectors

- Ionization chamber

Scintillation counters

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# Types of X-ray Detectors

Gas detectors

- Ionization chamber
- Proportional counter

Scintillation counters

Solid state detectors

Charge coupled device detectors

# Types of X-ray Detectors

Gas detectors

- Ionization chamber
- Proportional counter
- Geiger-Muller tube

Scintillation counters

Solid state detectors

Charge coupled device detectors

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Gas detectors

- Ionization chamber
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Scintillation counters

Solid state detectors

- Intrinsic semiconductor

Charge coupled device detectors

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Gas detectors

- Ionization chamber
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Solid state detectors

- Intrinsic semiconductor
- P-I-N junction

Charge coupled device detectors

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Gas detectors

- Ionization chamber
- Proportional counter
- Geiger-Muller tube

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Solid state detectors

- Intrinsic semiconductor
- P-I-N junction
- Silicon drift

Charge coupled device detectors

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Gas detectors

- Ionization chamber
- Proportional counter
- Geiger-Muller tube

Scintillation counters

Solid state detectors

- Intrinsic semiconductor
- P-I-N junction
- Silicon drift

Charge coupled device detectors

- Indirect

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- Ionization chamber
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- Geiger-Muller tube

Scintillation counters

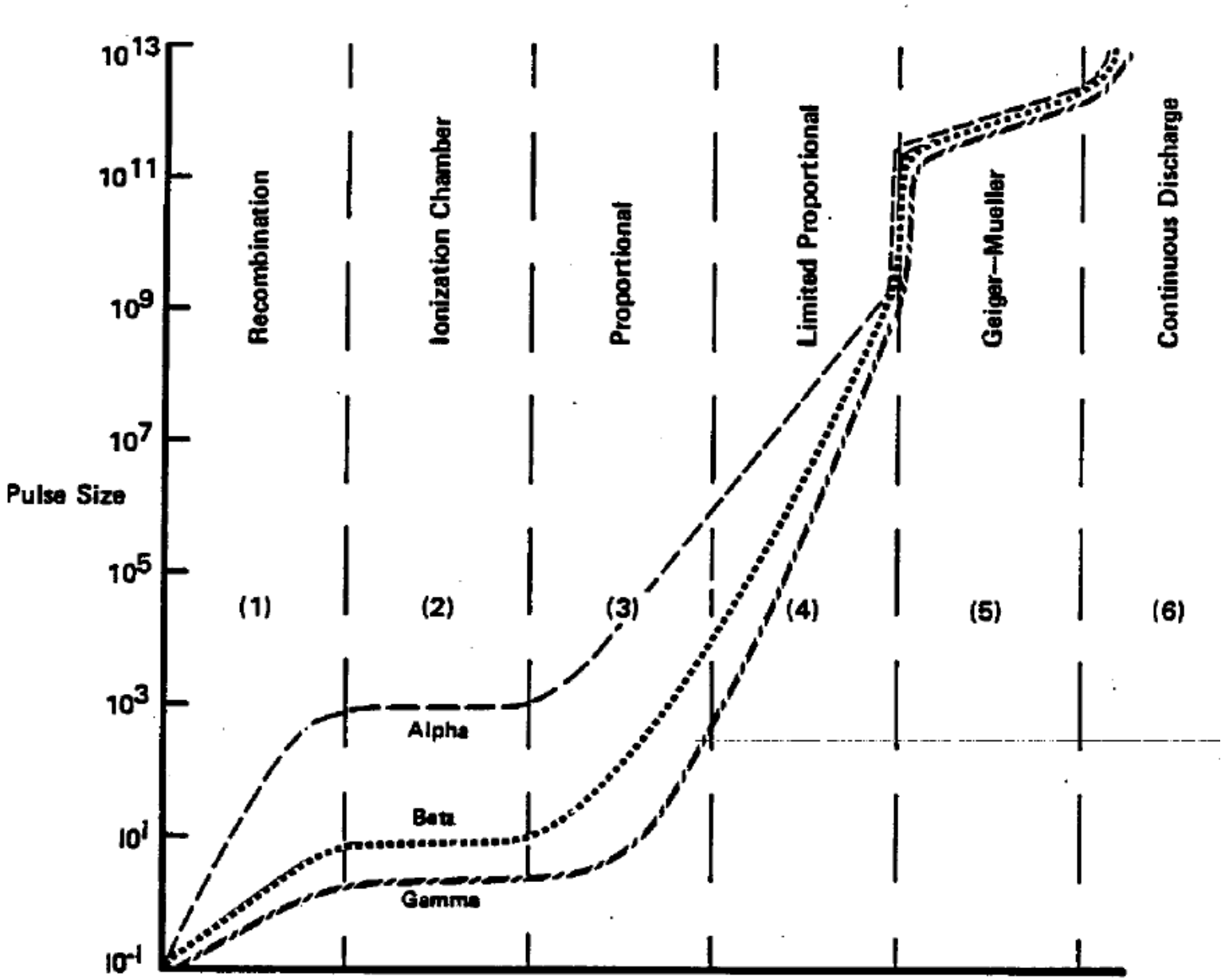
Solid state detectors

- Intrinsic semiconductor
- P-I-N junction
- Silicon drift

Charge coupled device detectors

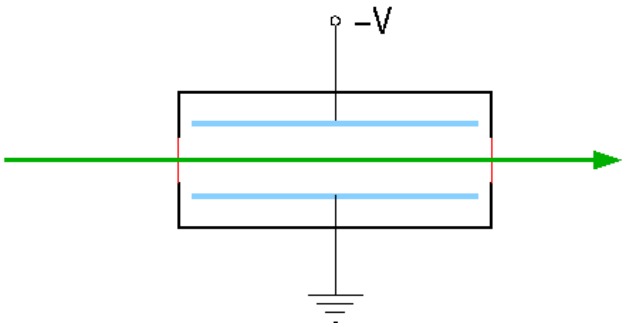
- Indirect
- Direct coupled

# Gas Detector Curve



# Ionization Chamber

Useful for beam monitoring, flux measurement, fluorescence measurement, spectroscopy.



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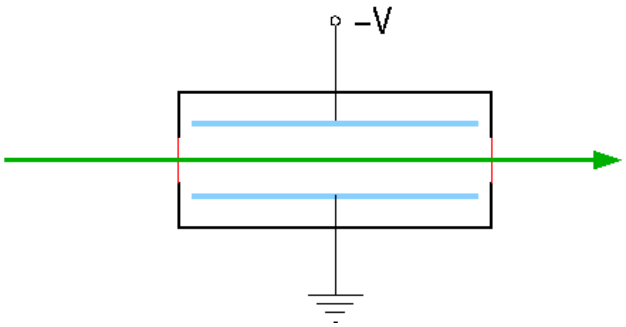


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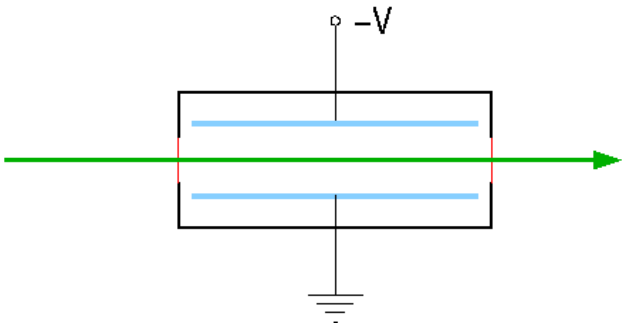


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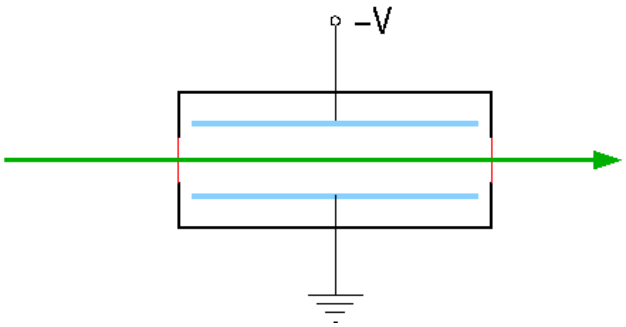


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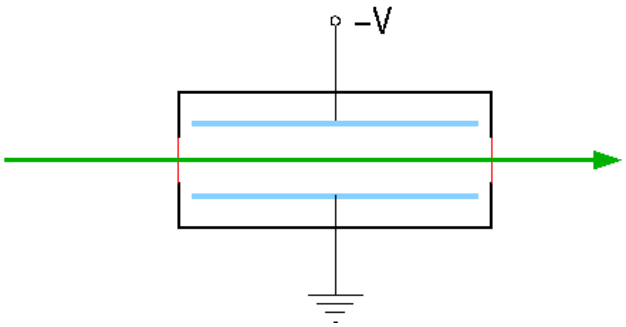


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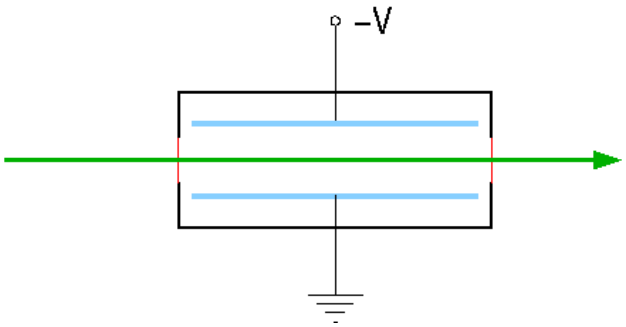


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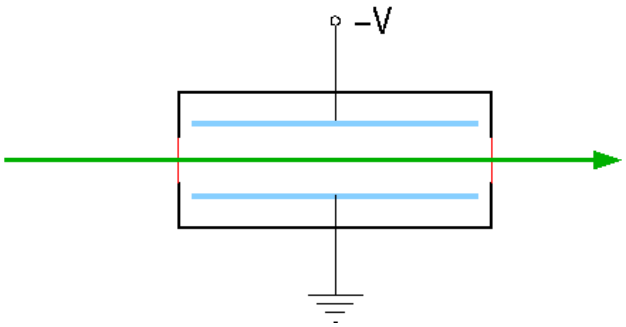


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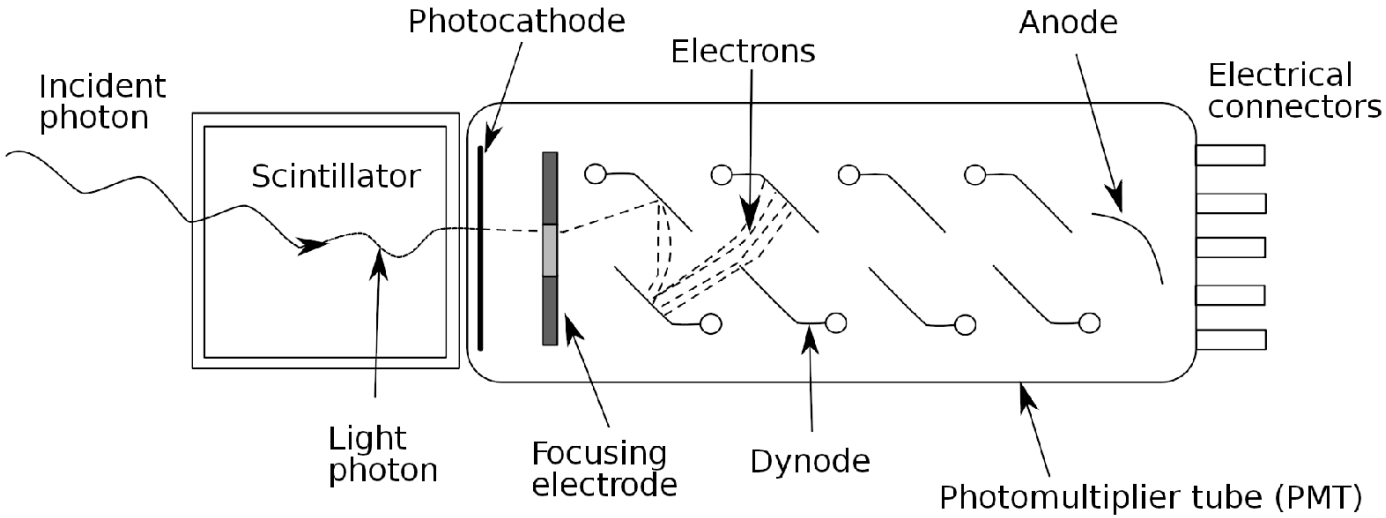
- Count rates up to $10^{11}$ photons/s/cm$^3$
- 22-41 eV per electron-hole pair (depending on the gas) makes this useful for quantitative measurements.

# Scintillation Counter

Useful for photon counting experiments



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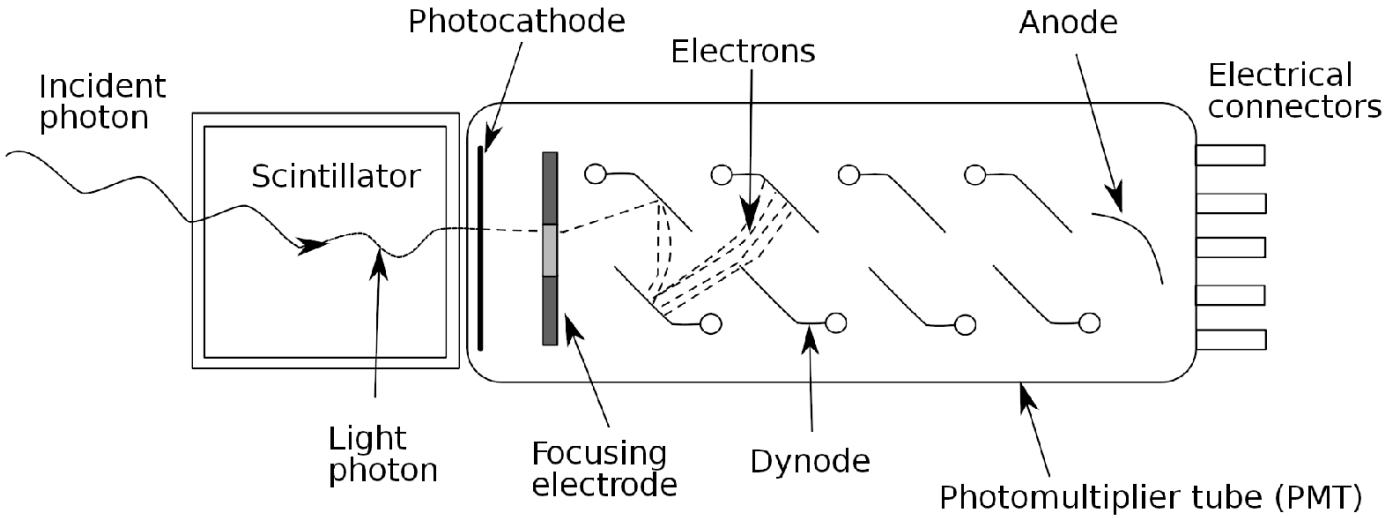


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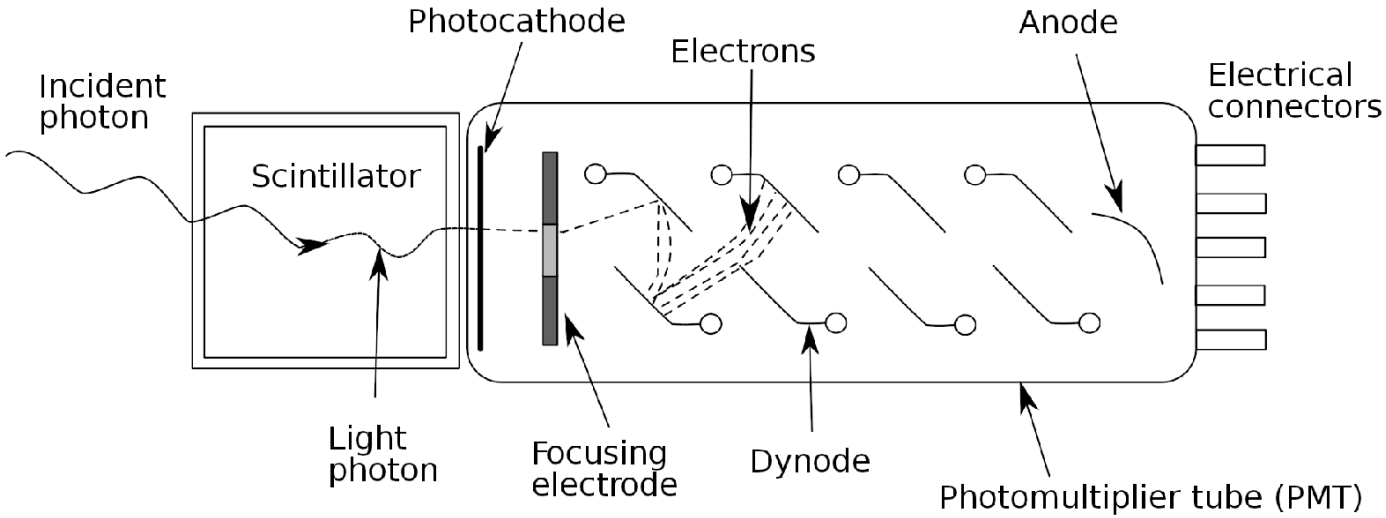


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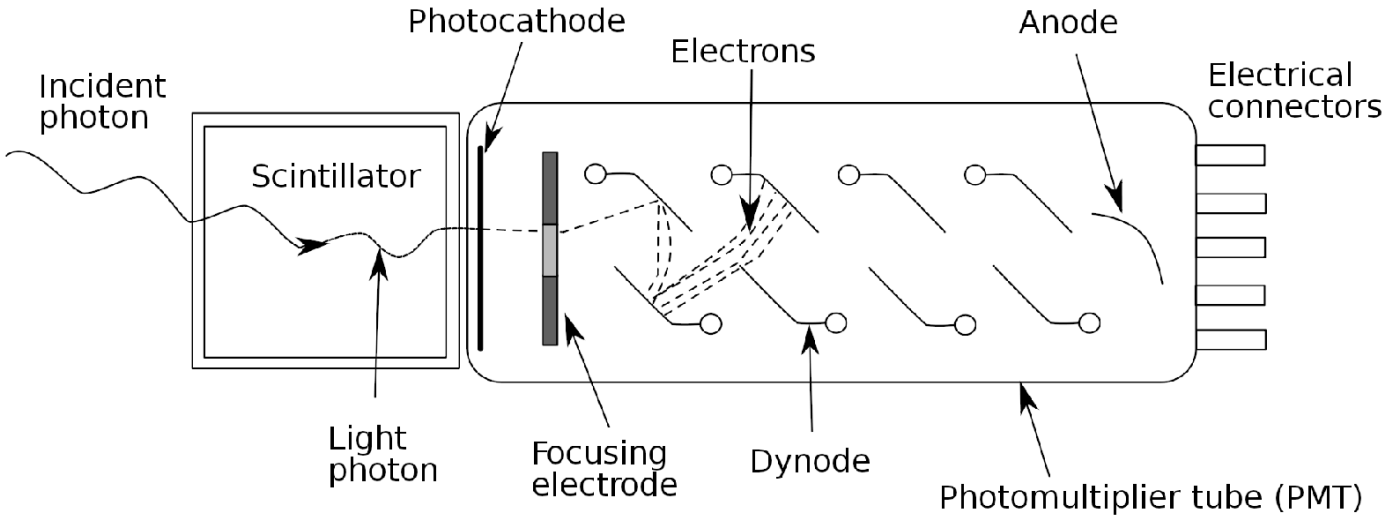


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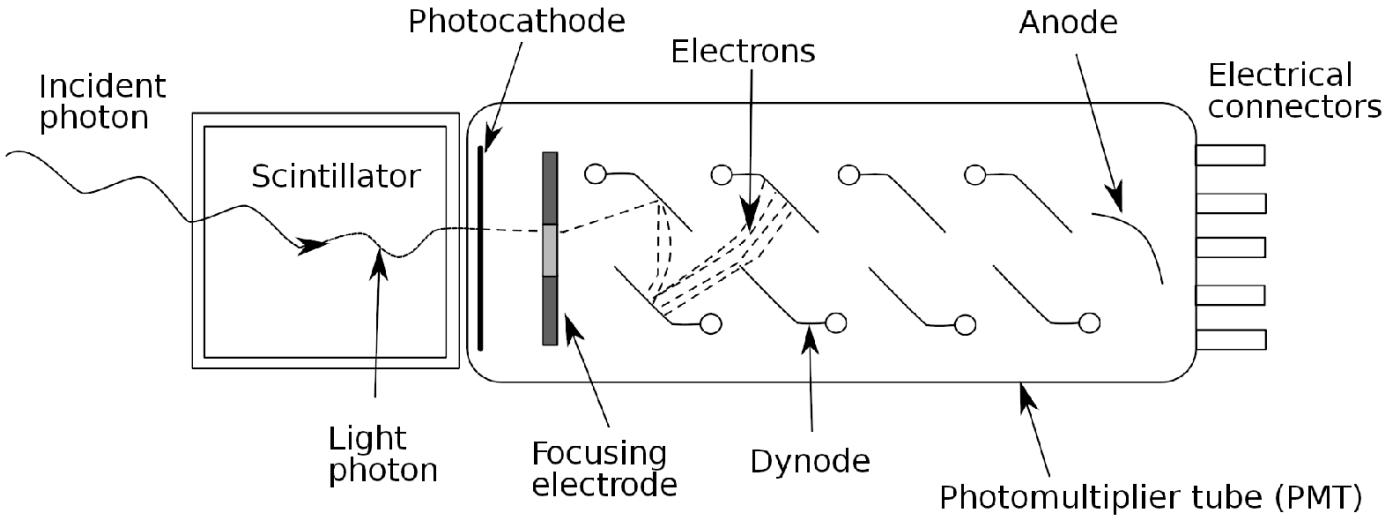


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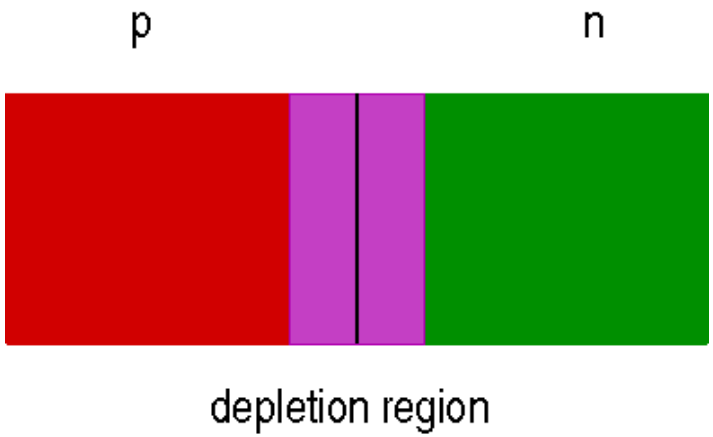
- Light strikes a thin photocathode which emits electrons into the vacuum portion of a photomultiplier tube.
- Photoelectrons are accelerated in steps, striking dynodes and becoming amplified.
- Output voltage pulse is proportional to initial x-ray energy.

# Solid State Detectors

Open circuit p-n junction has a natural depletion region



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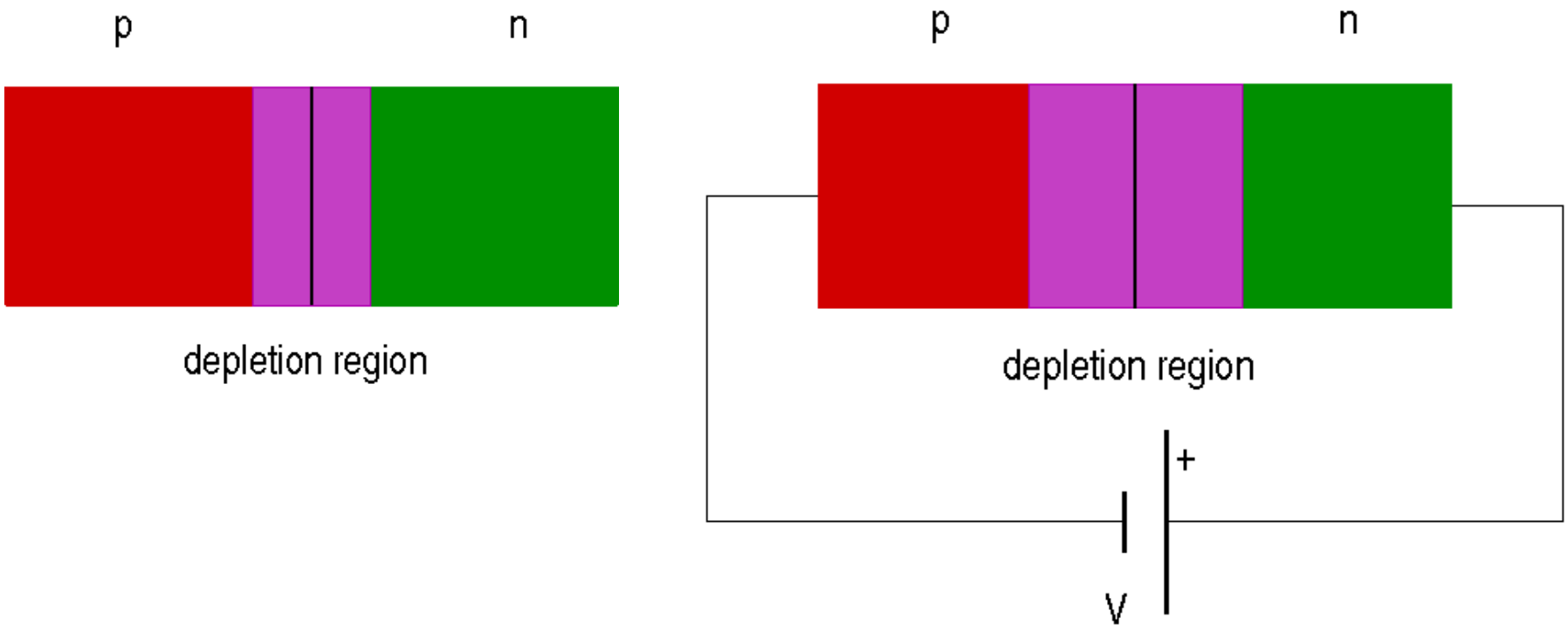


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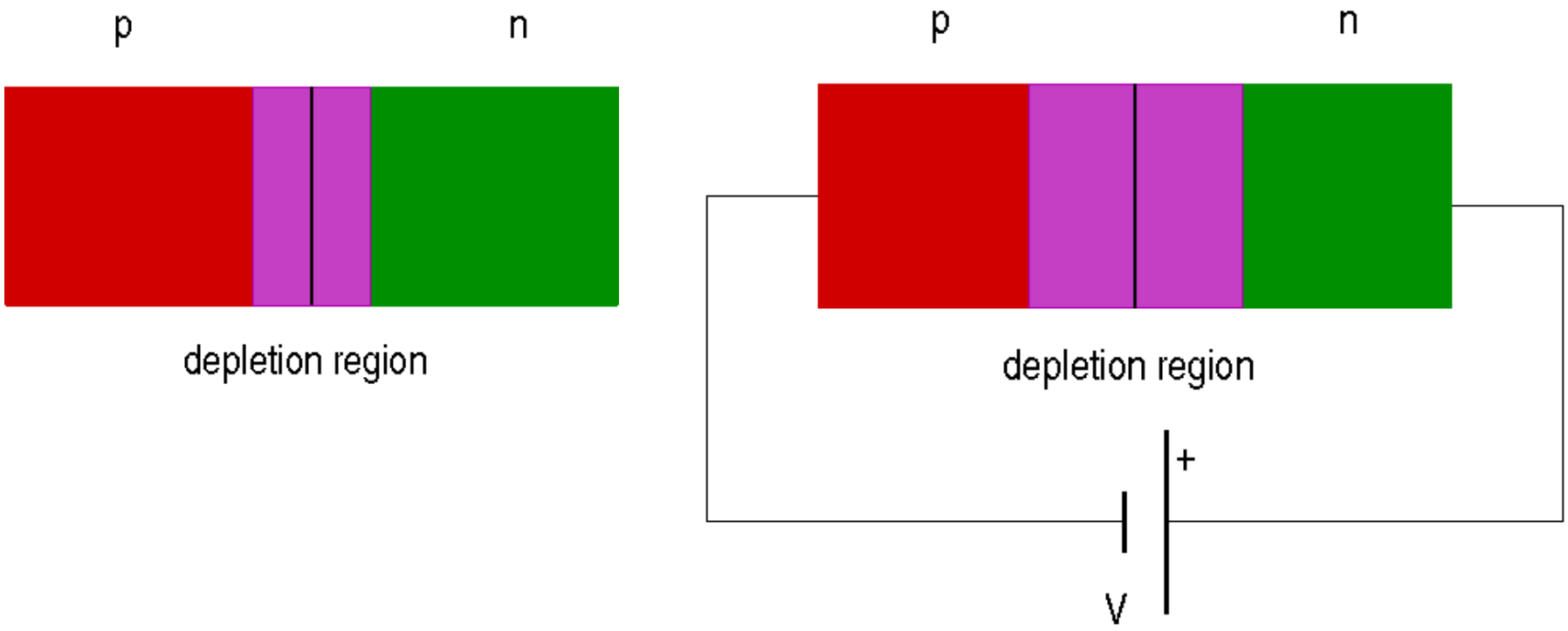
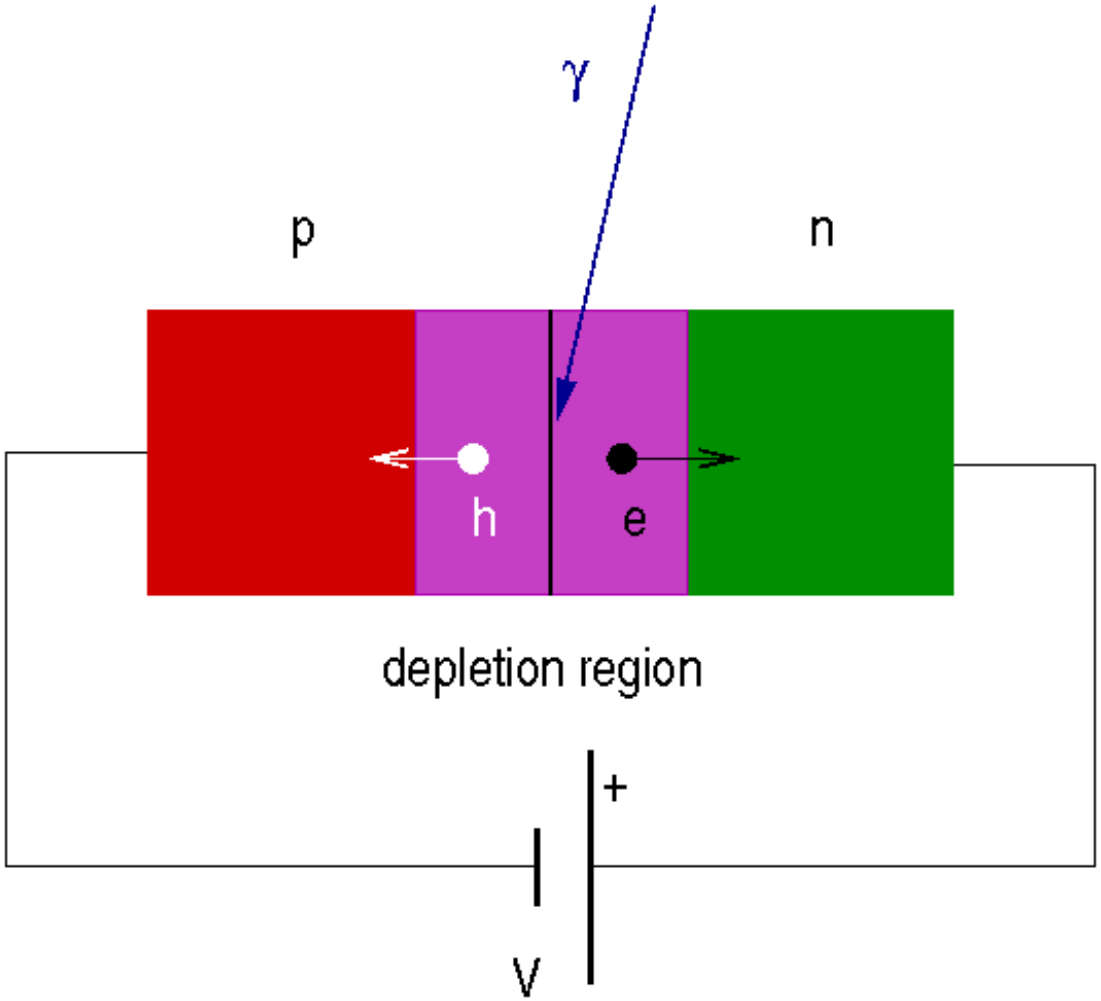


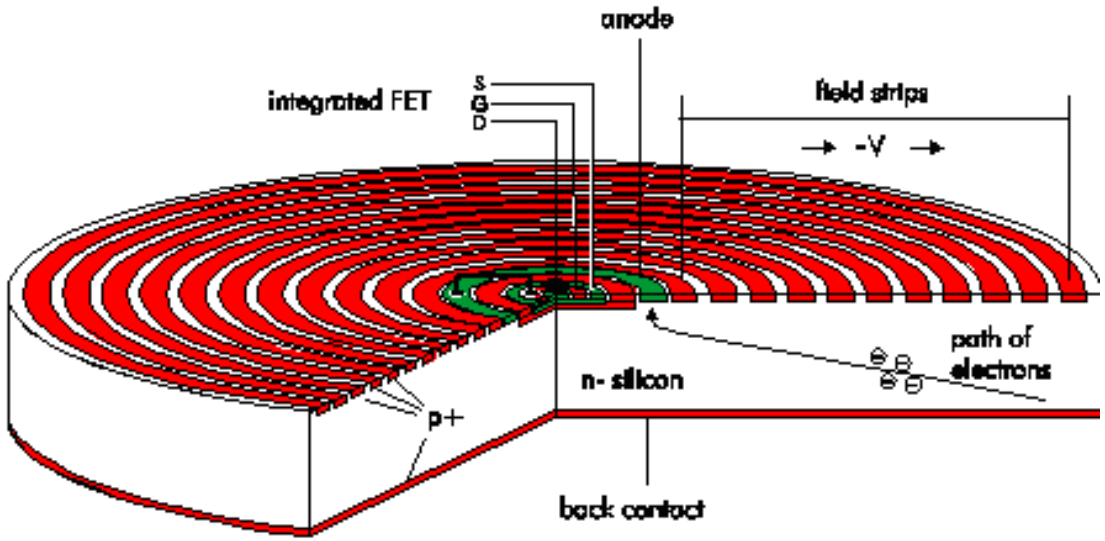

When reverse biased, the depletion region grows creating a higher electric field near the junction

# Ge Detector Operation



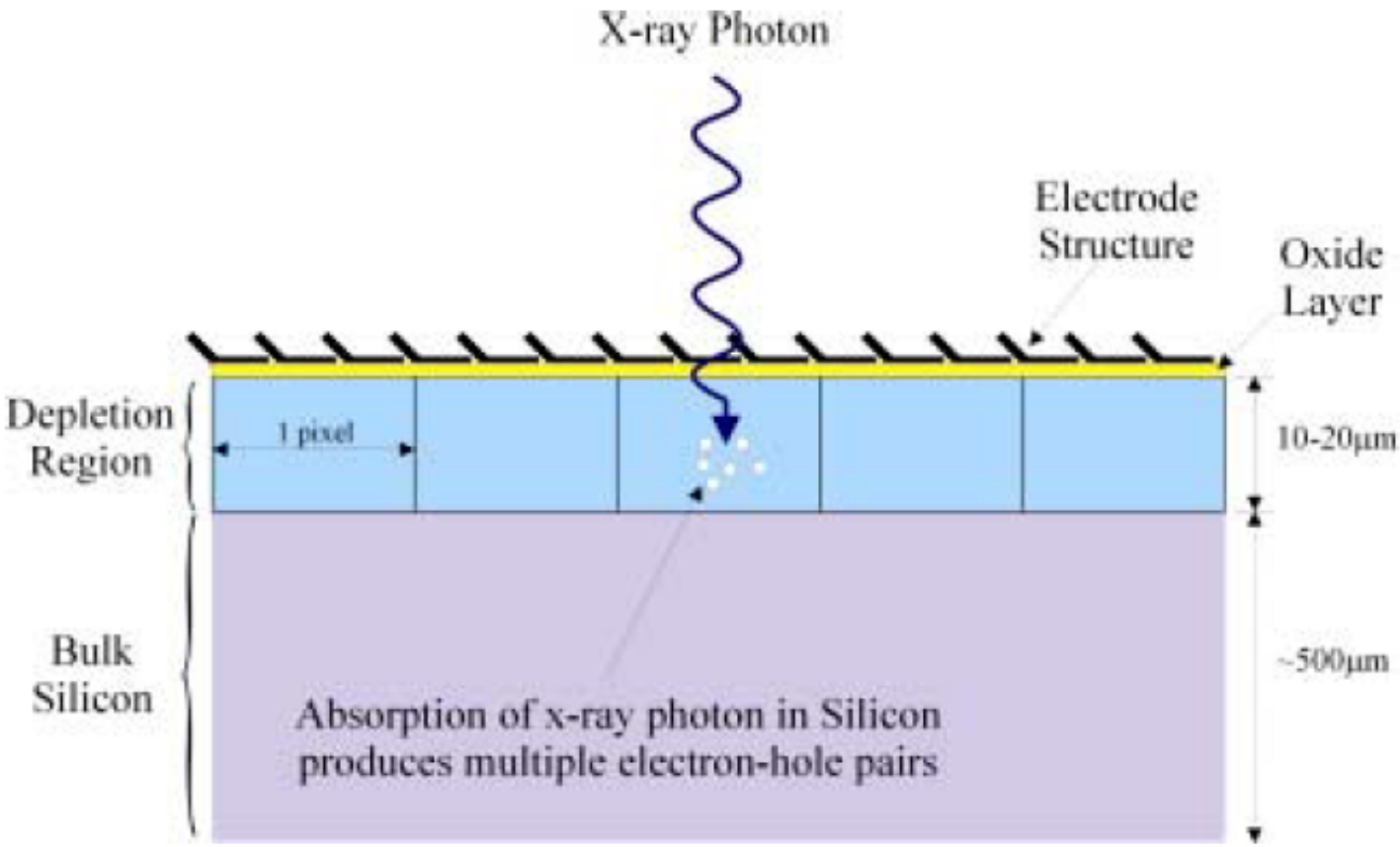
# Silicon Drift Detector

Same principle as intrinsic or p-i-n detector but much more compact and operates at higher temperatures

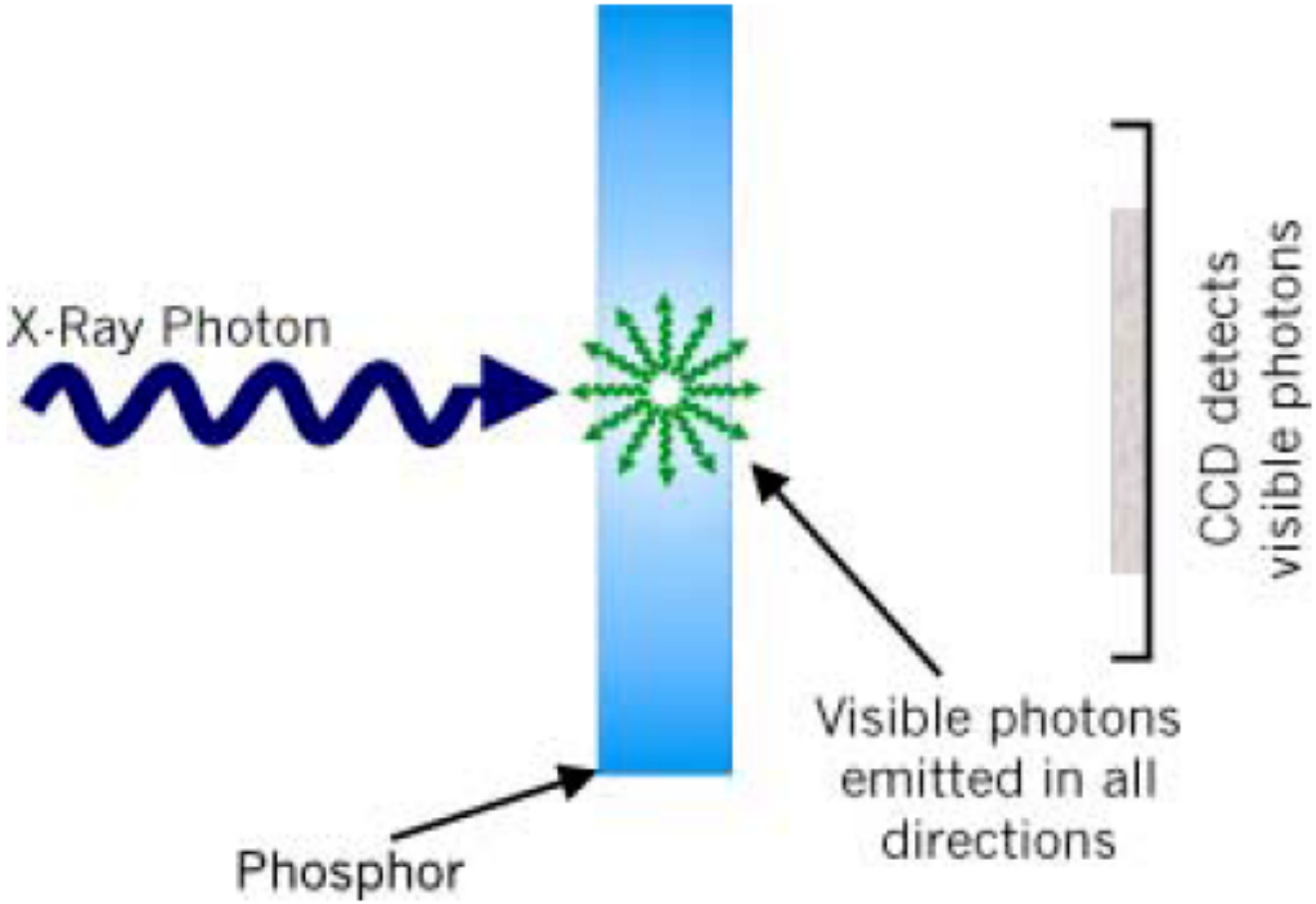



Relatively low stopping power is a drawback

# CCD Detectors - Direct



# CCD Detectors - Indirect



# CCD Detectors - Lightpipe Taper