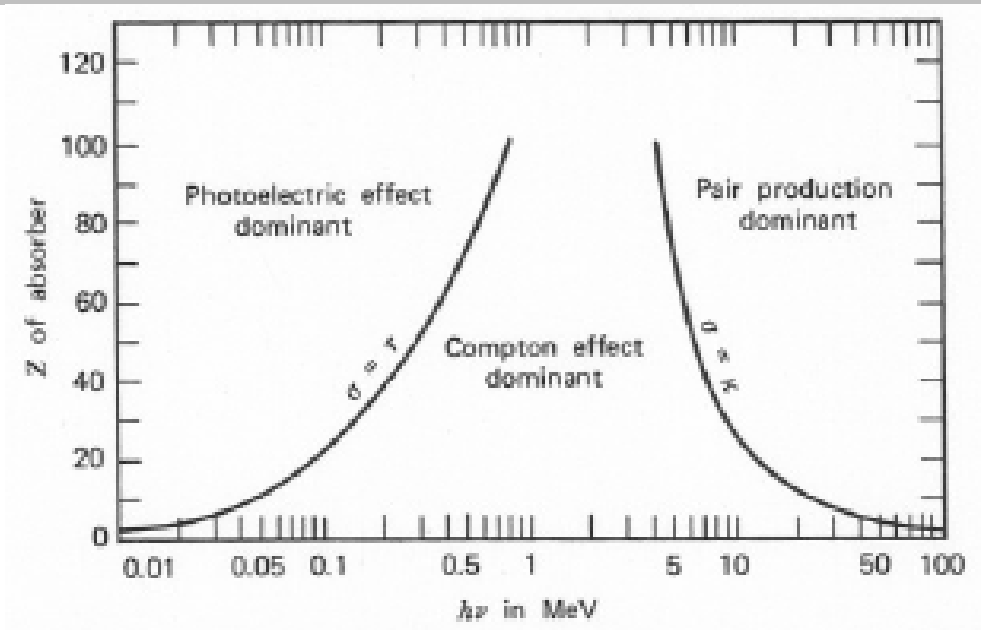
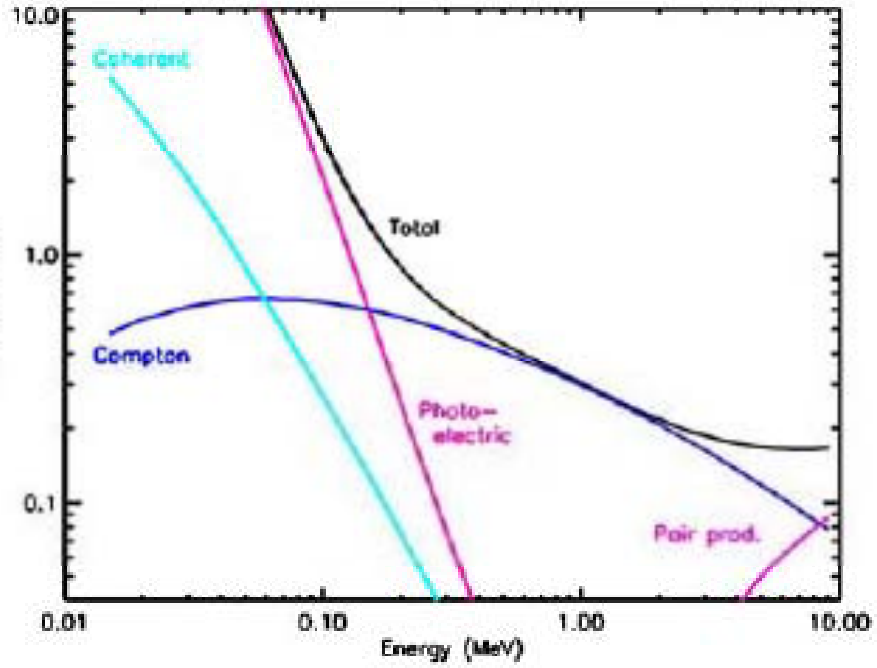
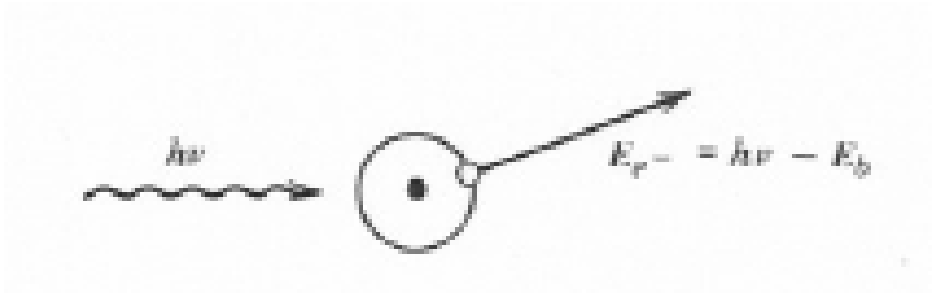
Gamma-ray spectroscopy (Introduction)

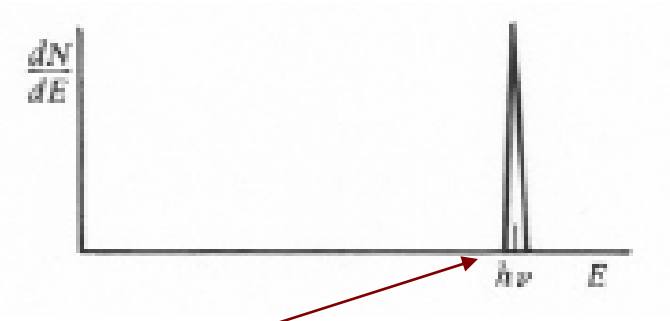
- Rayleigh Scattering.
- Photoelectric Effect.
- Compton Scattering.
- Pair Production.





Gamma-ray spectroscopy (Introduction)





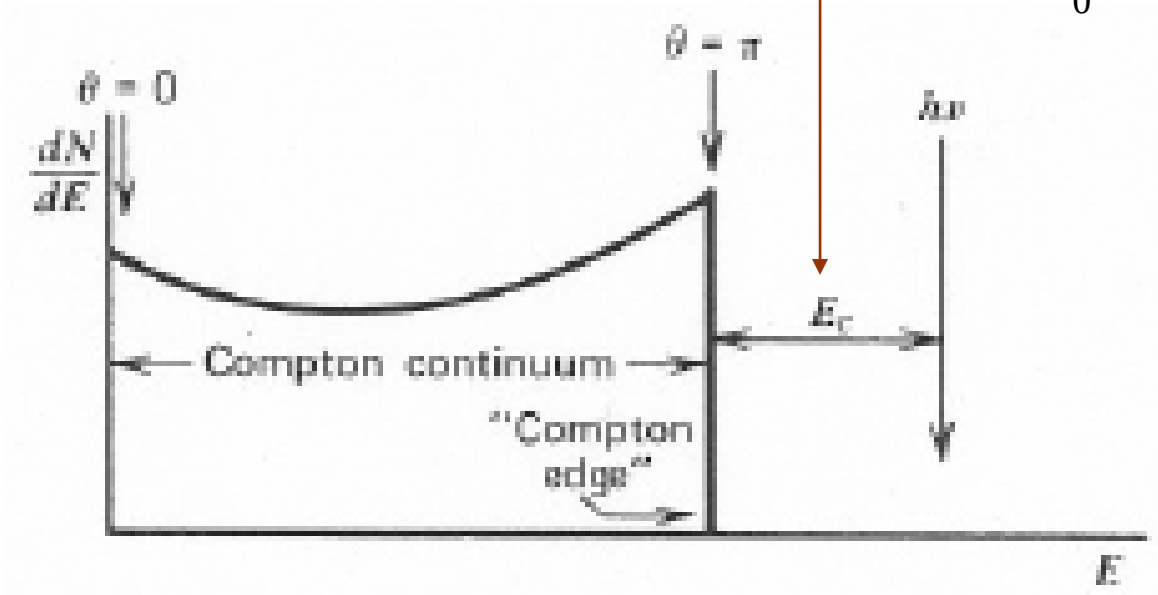
Spectrum if all energy is captured in detector.
Allows identification of gamma energy.

Gamma-ray spectroscopy (Introduction)

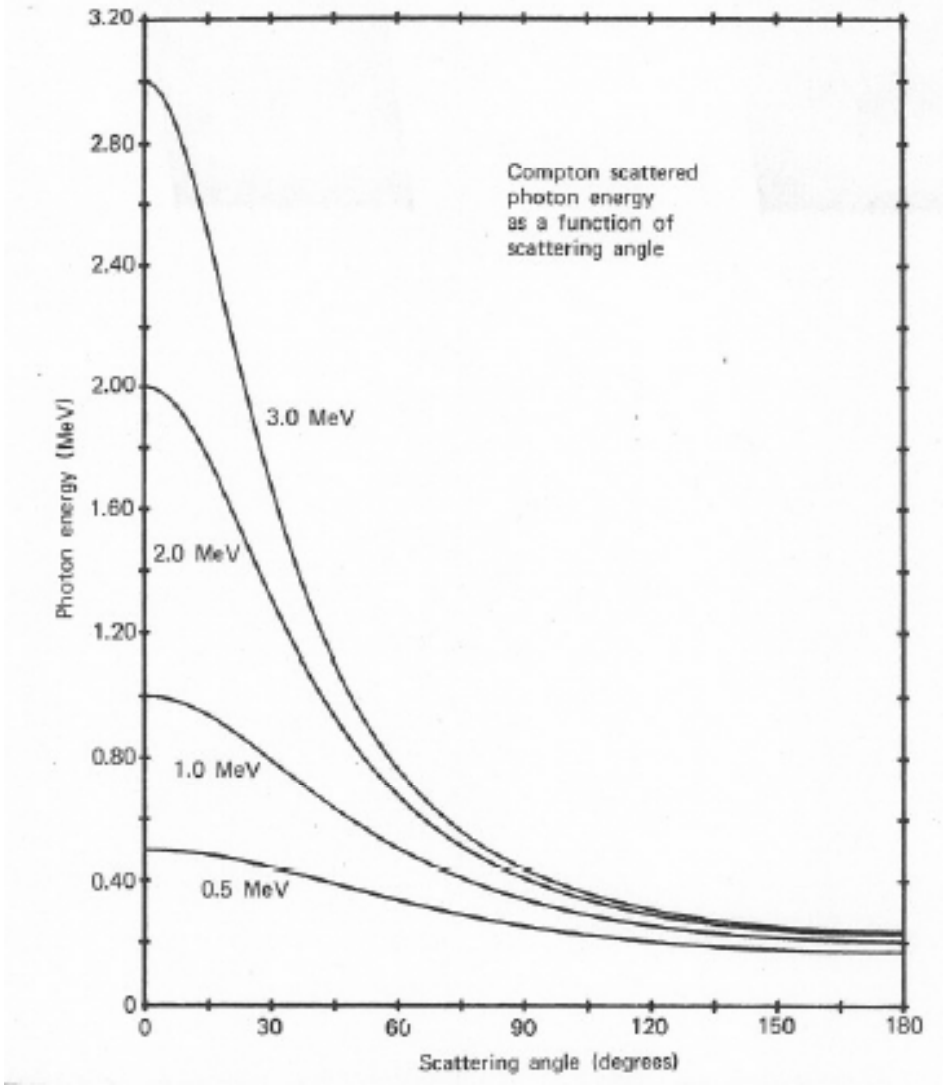
$$h\nu' = \frac{h\nu}{1+\frac{h\nu}{m_0c^2}(1-\cos\theta)}$$

$$E_c = \frac{h\nu}{1+2\frac{h\nu}{m_0c^2}}$$

$$E_e = h\nu - h\nu' = \frac{\frac{h\nu}{m_0c^2}(1-\cos\theta)}{1+\frac{h\nu}{m_0c^2}(1-\cos\theta)}$$



Gamma-ray spectroscopy (Introduction)



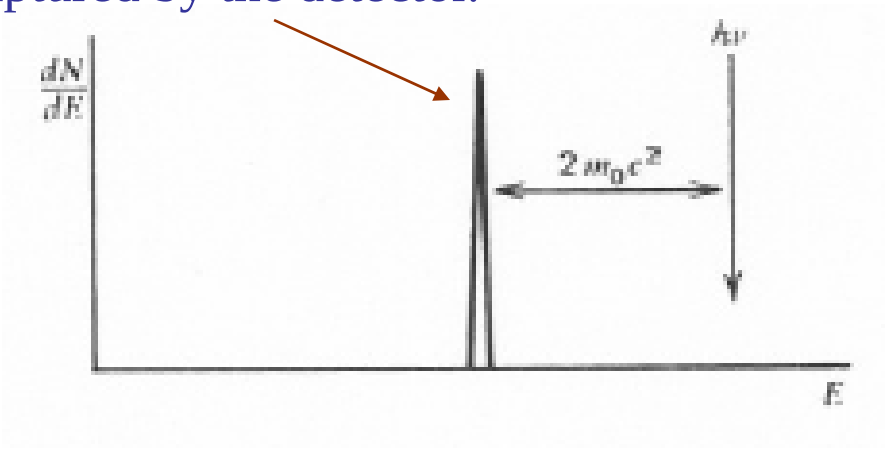
Reproduce the graph.

Gamma-ray spectroscopy (Introduction)

$$E_{e^-} + E_{e^+} = h\nu - 2m_0c^2$$

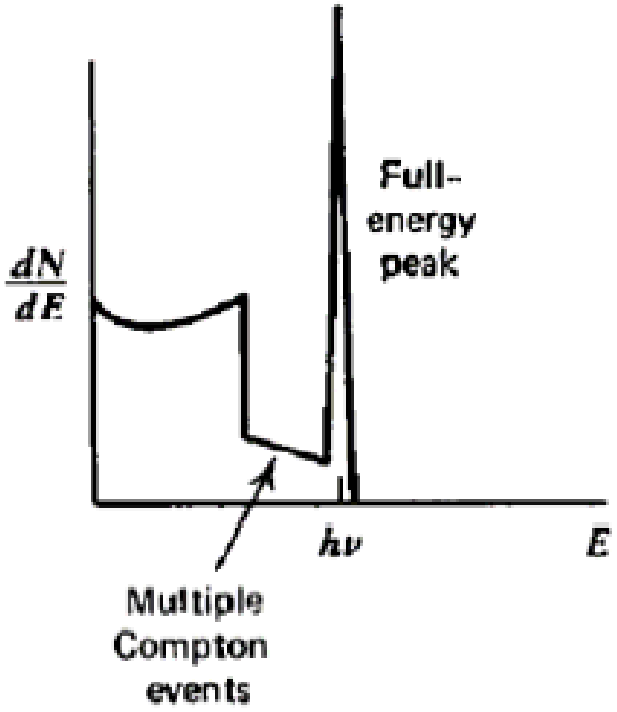
Rest mass of electron and positron. Gamma must have 1.022 MeV minimum energy for PP to occur.

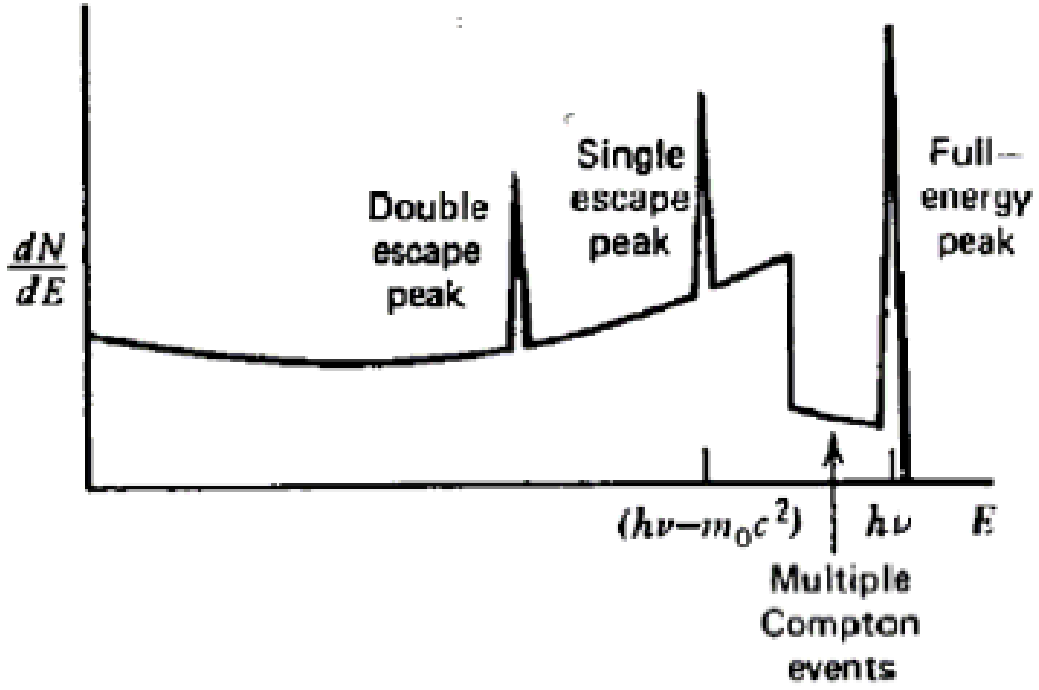
Single peak if electron and positron "kinetic" energies are captured by the detector.



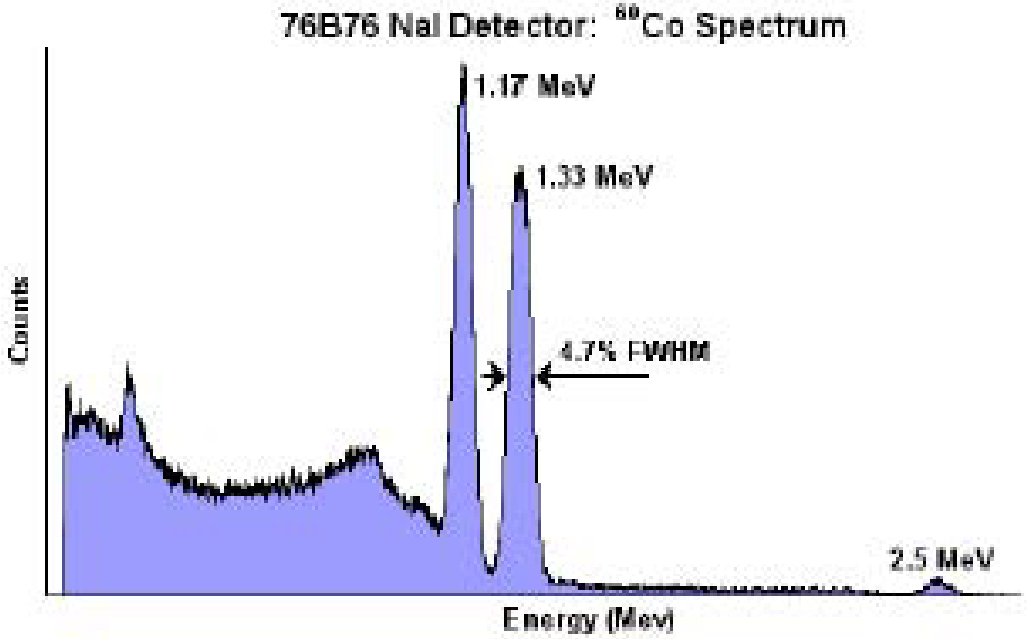
Two annihilation photons are then created when positron recombines with an electron. This photon may or may not be captured, causing single and double escape peaks in the spectrum (effect of crystal dimensions).

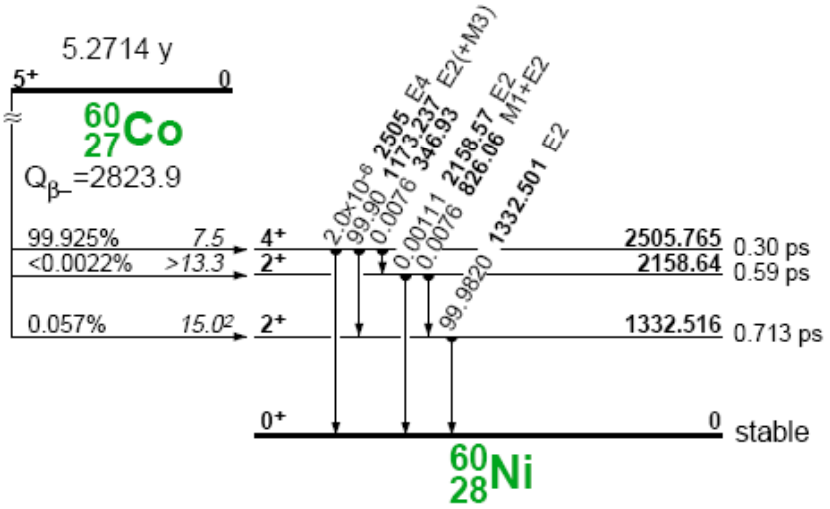
Gamma-ray spectroscopy (Introduction)



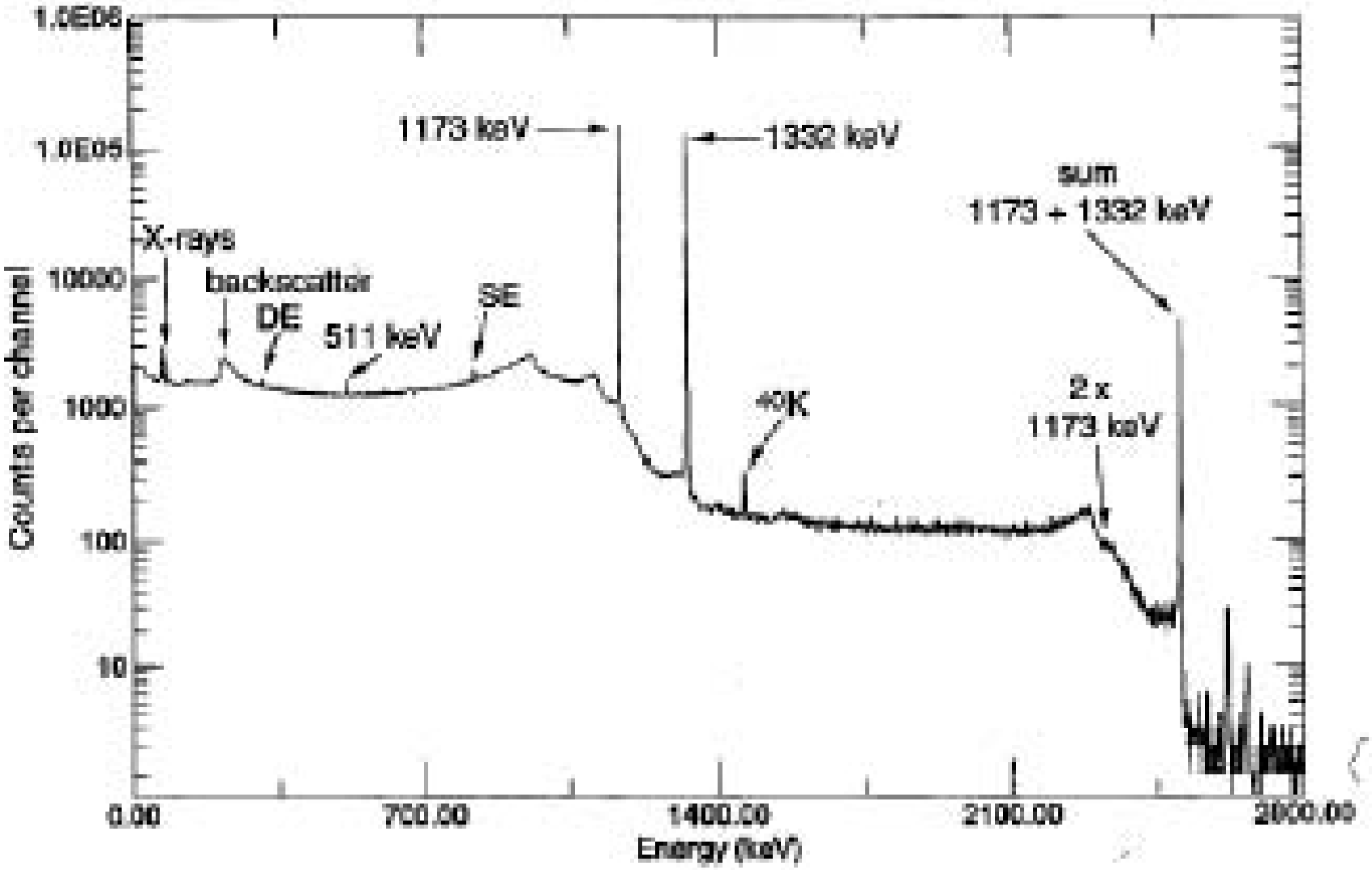


Gamma-ray spectroscopy (Introduction)



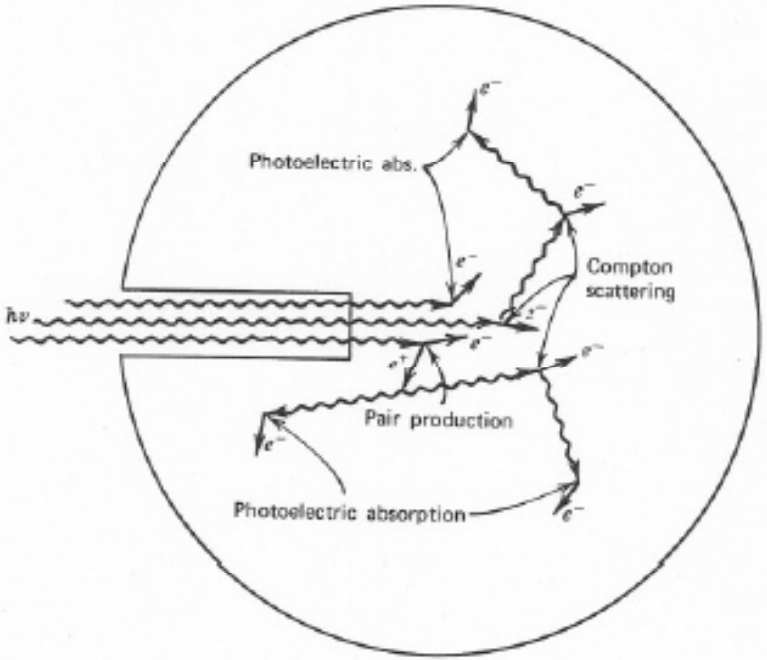


Gamma-ray spectroscopy (Introduction)

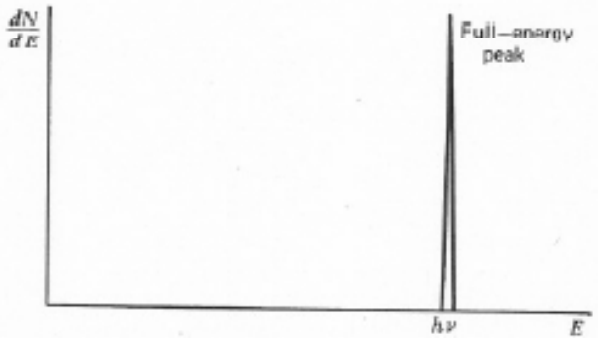


Gamma-ray spectroscopy (Introduction)

Very large detector. All secondary radiation, including Compton scattered gamma rays, Bremsstrahlung, and annihilation photons, are captured in detector volume

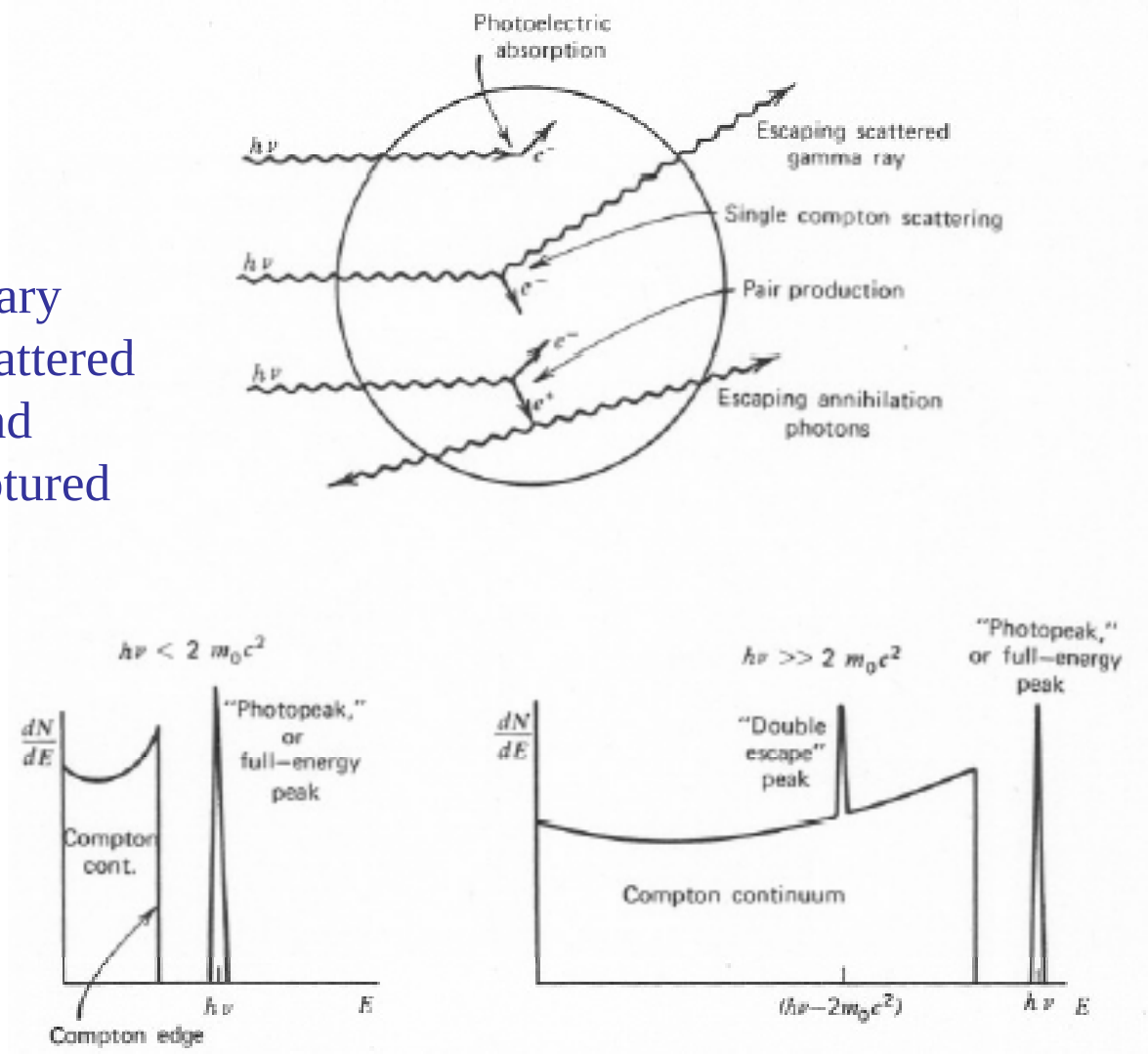


Large photofraction (fraction of full energy events) is desired in any detector



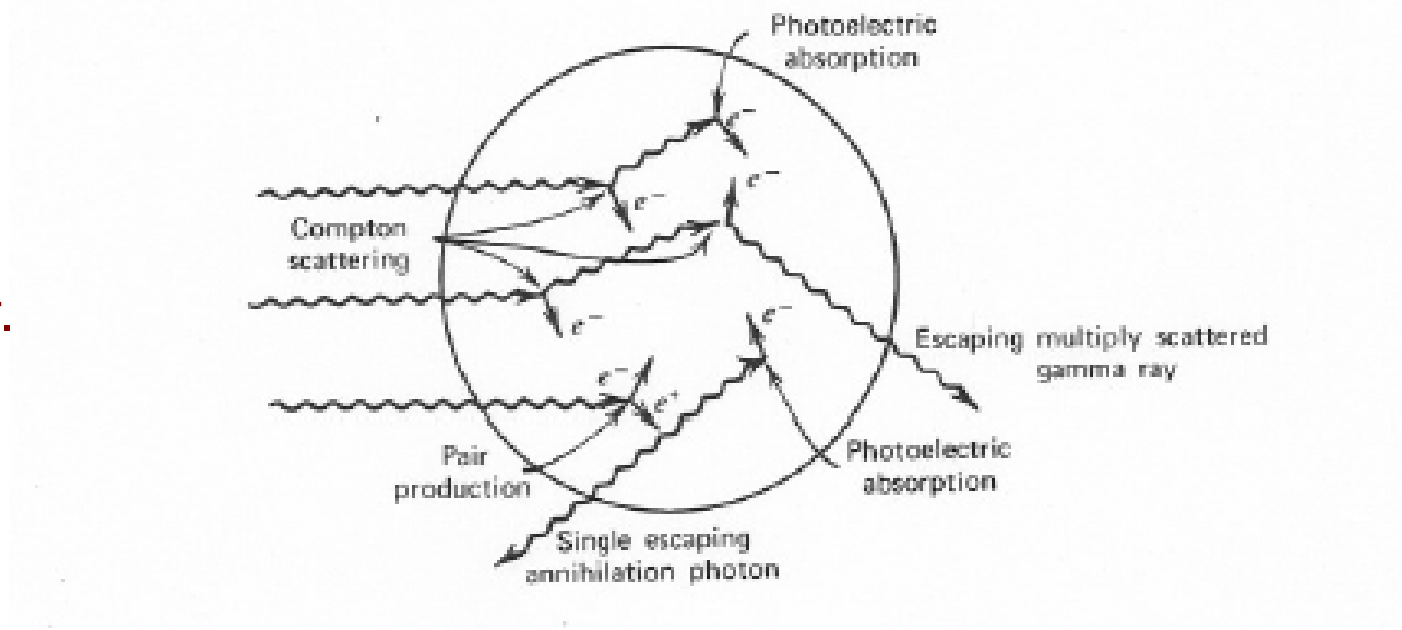
Gamma-ray spectroscopy (Introduction)

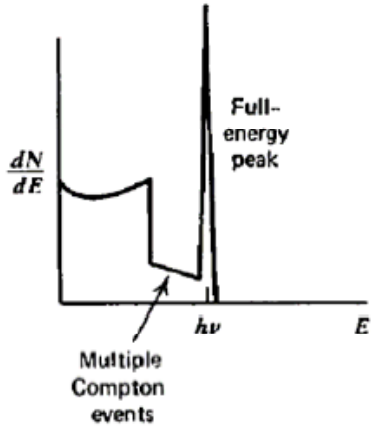
Very small detectors. All secondary radiation, including Compton scattered gamma rays, Bremsstrahlung, and annihilation photons, are not captured in detector volume (escaping).

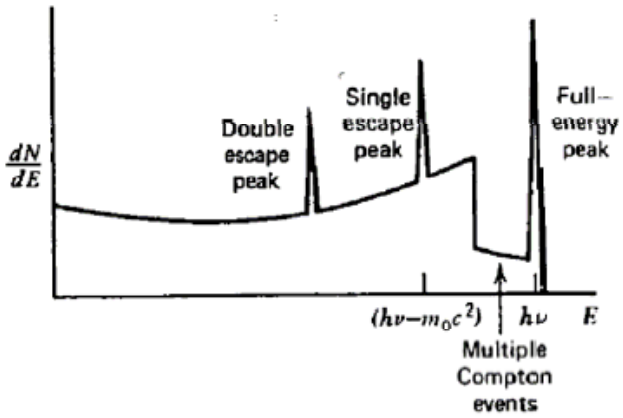


Gamma-ray spectroscopy (Introduction)

A typical detector.



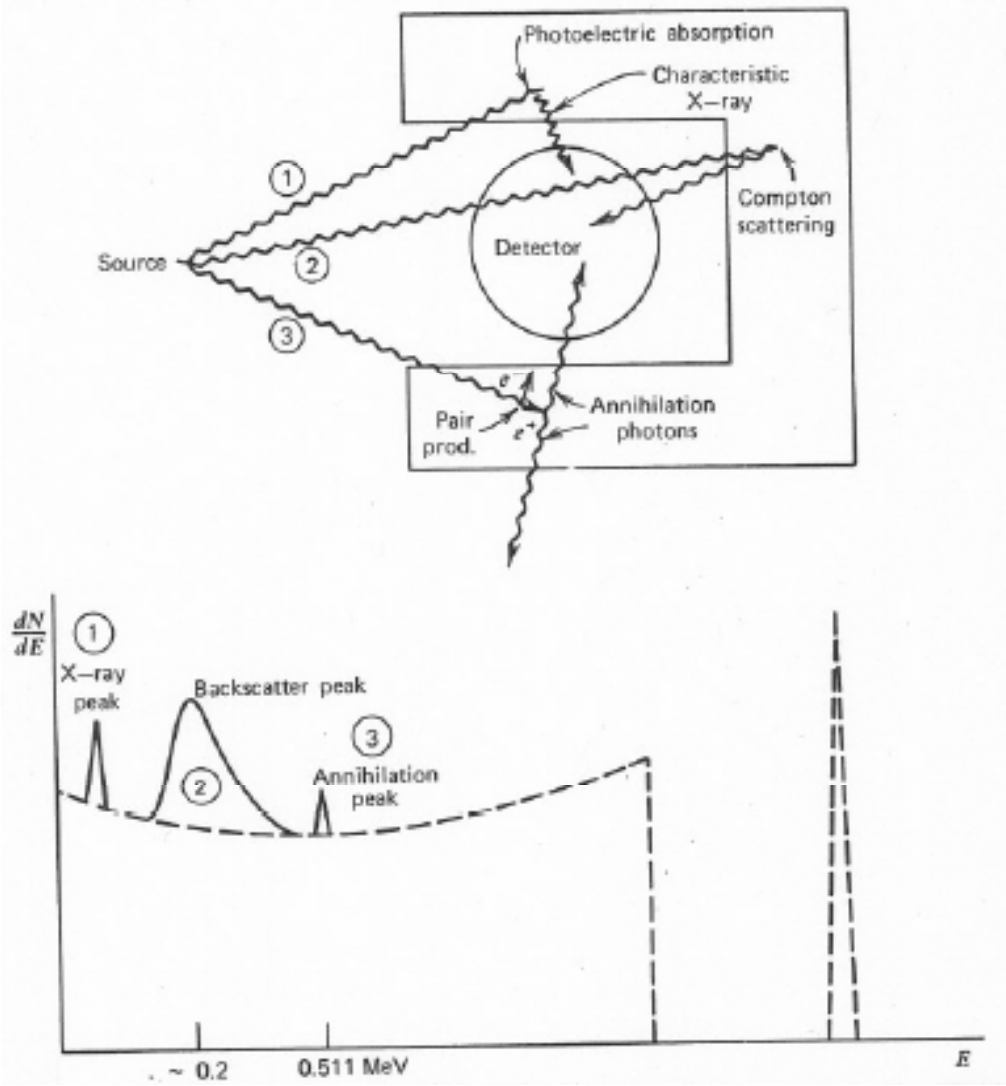




Gamma-ray spectroscopy (Introduction)

Effect of surrounding material.

Detectors are normally shielded to minimize as much as possible the counting of ambient background radiation.



Gamma-ray spectroscopy (Introduction)

- Peak area determination.
- Peak-to-total ratio.
- Peak-to-Compton ratio.
- Relative efficiency.
- Absolute efficiency.
- Total efficiency.
- Solid angle.
- Energy Resolution.
- Dead time.
- Resolving time.
- Anti-coincidences.
- Coincidences.
- Summation effects.
- True coincidences.
- Random coincidences.

- Attenuation coefficient.
- Mass attenuation coefficient.
- Mean-free path.

Gamma-ray spectroscopy (Introduction)

Compton suppression.
"Anti-coincidences".
What if cascades are present?
Coincidences.