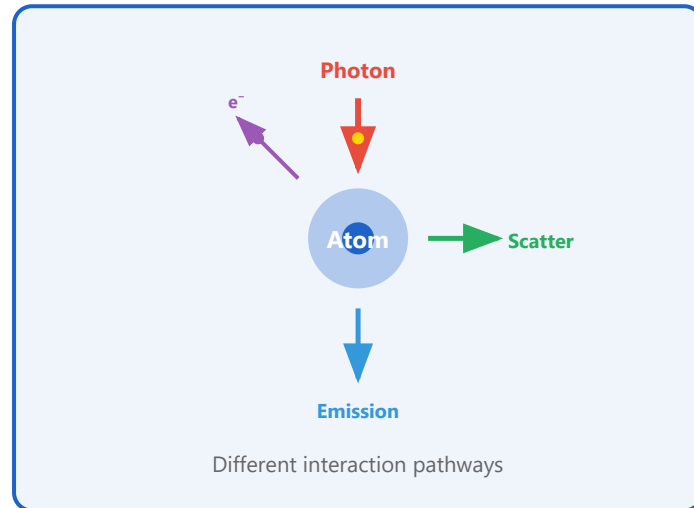


# Photon-Matter Interactions



## ● Absorption

Photon energy transferred to molecule, excites electron to higher state. Cross-section  $\sigma(\lambda)$  determines probability.

## ● Scattering

Elastic (Rayleigh, Mie) or inelastic (Raman). No energy absorption, direction change only.

## ● Photoelectric Effect

Complete photon absorption, electron ejection ( $E > \text{work function}$ ). Basis for X-ray imaging.

## ● Compton Scattering

High-energy photon-electron collision, partial energy transfer. Important for gamma rays.

## ⚠ Biological Damage Thresholds

**UV:** DNA damage, thymine dimers (<320 nm)

**Ionizing (X-ray,  $\gamma$ ):** Direct DNA breaks, ROS generation

**Visible/NIR:** Generally safe, but high intensity causes thermal damage

**Photobleaching:** Fluorophore destruction limits imaging time