Interactions of Photons with Matter – Photonuclear Disintegration
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Lecture Objectives
• Identify and describe the process of photonuclear disintegration
• Recognize the implications of photonuclear disintegration in radiation therapy

Description of process
• Type 2a process
  • Photon interacts with nucleus and is completely absorbed
Description of process

• Nuclear binding energies are typically around 6-7 MeV per nucleon.
• Consequently, photons with sufficiently high energies can interact with a nucleus resulting in emission of one or more nuclear particles, e.g. (γ,n), (γ,p), (γ,α)

Description of process

• Thresholds are > 6 MeV for emission of single nucleon
• Thresholds are > 15 MeV for emission of two nucleons
• Photonuclear disintegration important for photon beams of energy > 15 MeV

Description of process

• Interaction cross-sections are higher for heavy metals such as those near the radiation source
  – Neutrons are created deep in the head of a therapy unit
Neutron hazards

- Patients receive total body neutron dose. May need to provide shielding, especially for fetus
- Head and collimators become radioactive so there is a gamma dose rate in the collimator – not really a hazard to the therapists

Neutron hazards

- Neutrons scatter, so need to account for appropriate shielding for high-energy linac rooms
  - Good practice mandates consideration of neutron production in shielding design for linacs producing beams of energy 10 MV or greater