# Medical Image Processing

**1 Imaging Techniques**

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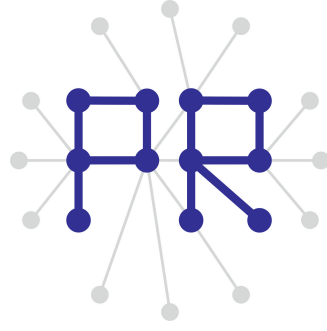

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# Radiology

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Radiology is a medical speciality that employs the use of imaging to both diagnose and treat disease visualised within the human body. Possible visualisation techniques:

- Planar x-ray and fluoroscopy
- Computed x-ray tomography and magnetic resonance
- Ultrasound and endoscopy
- Nuclear medicine
- Molecular imaging

# The electromagnetic spectrum

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- In radiology: recording of tissue properties when being exposed to electromagnetic radiation (photons)
- The energy of a photon

$$E = h\nu \text{ [J]} ; \quad h = 6.626 * 10^{-34} \text{ [Js]} ; \quad \nu \text{ [}Hz\text{]}$$

- $1 - 10^4$ Hz: Alternating current used for electrical impedance tomography
- $10^4 - 10^8$ Hz: Radio frequency used in magnetic resonance imaging (MRI)
- $10^8 - 10^{12}$ Hz: Microwaves - not relevant for medical imaging (MI)

# The electromagnetic spectrum

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- $10^{12} - 7 \times 10^{14}$ Hz: Infrared used for, e.g., near infrared imaging
- $4.6 \times 10^{14} - 6.6 \times 10^{14}$ Hz: Visible light used for light microscopy and histological imaging, endoscopy, and optical coherence tomography (OCT)
- $4 \times 10^{14} - 10^{18}$ Hz: Ultraviolet (UV) used for fluorescence imaging
- $10^{18} - 10^{20}$ Hz: x-rays
- $> 10^{20}$ Hz: $\gamma$-radiation used in nuclear medicine, but also for therapeutic purposes

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# Basic X-Ray Physics

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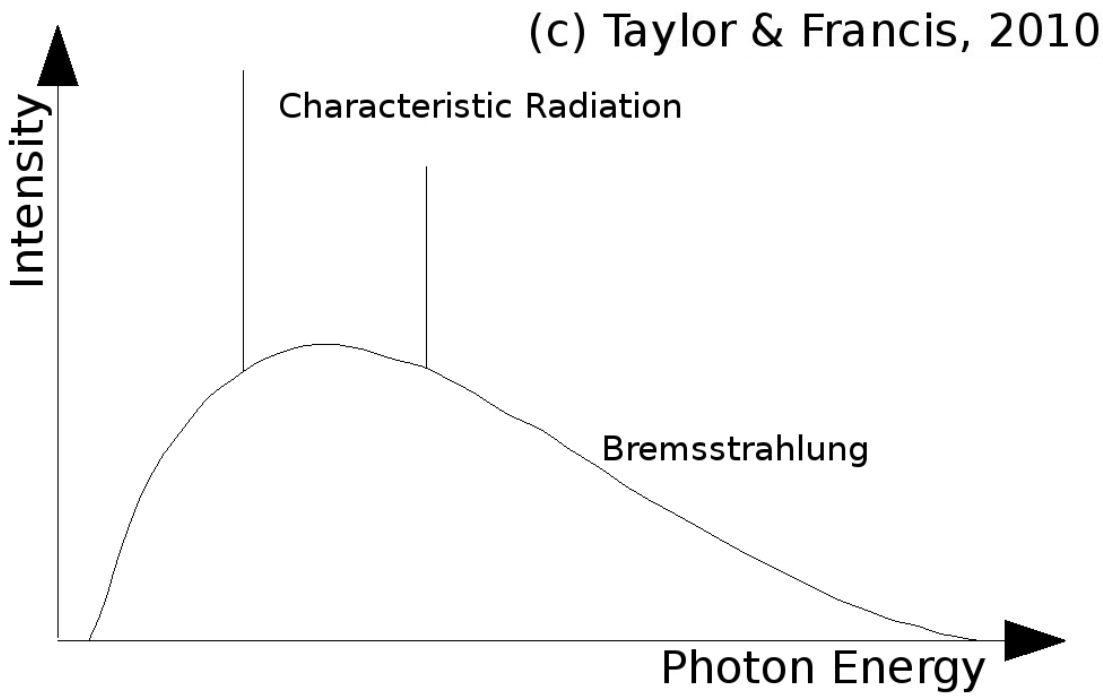

# The Principle of an X-ray Tube

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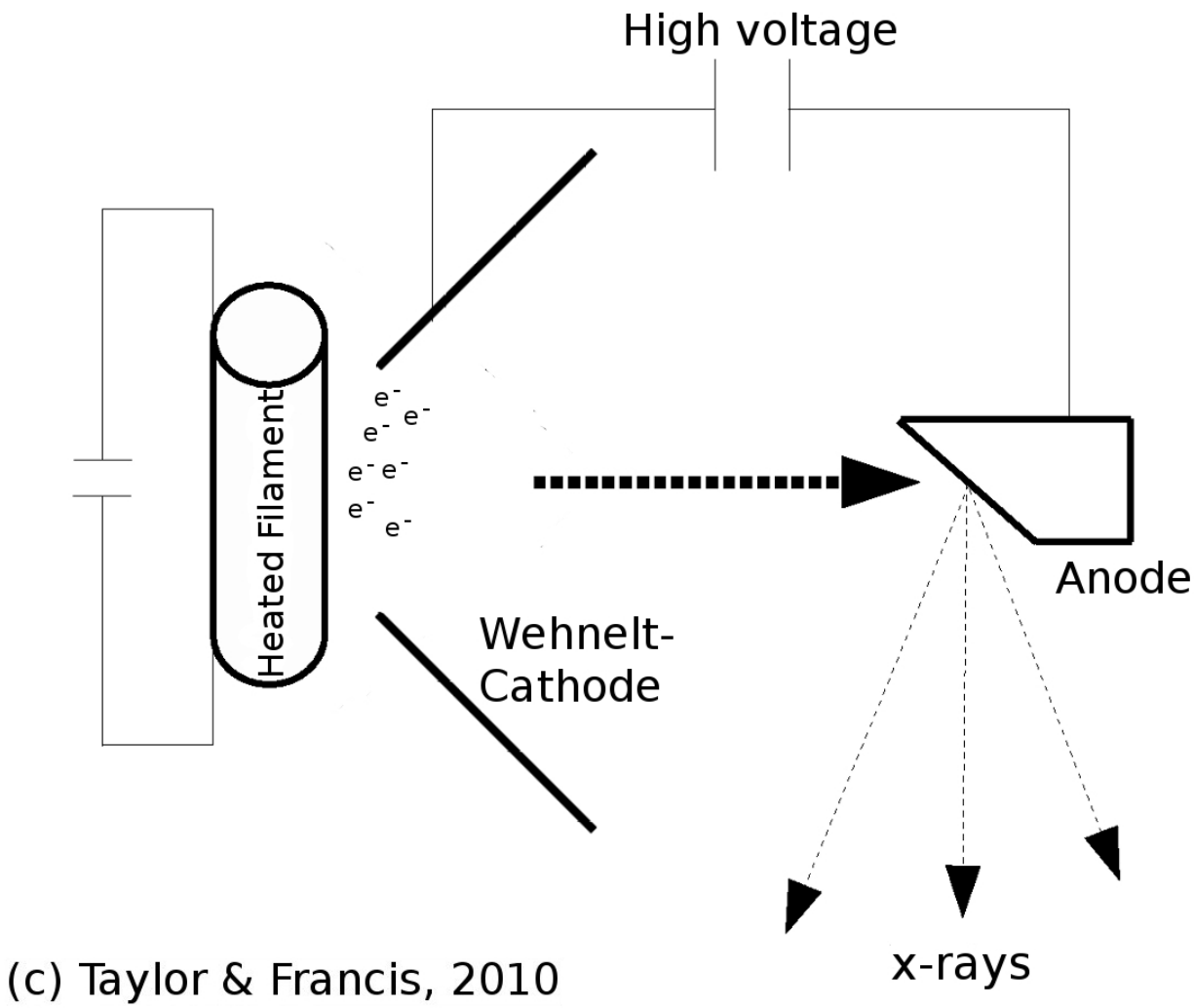

# An X-ray Tube

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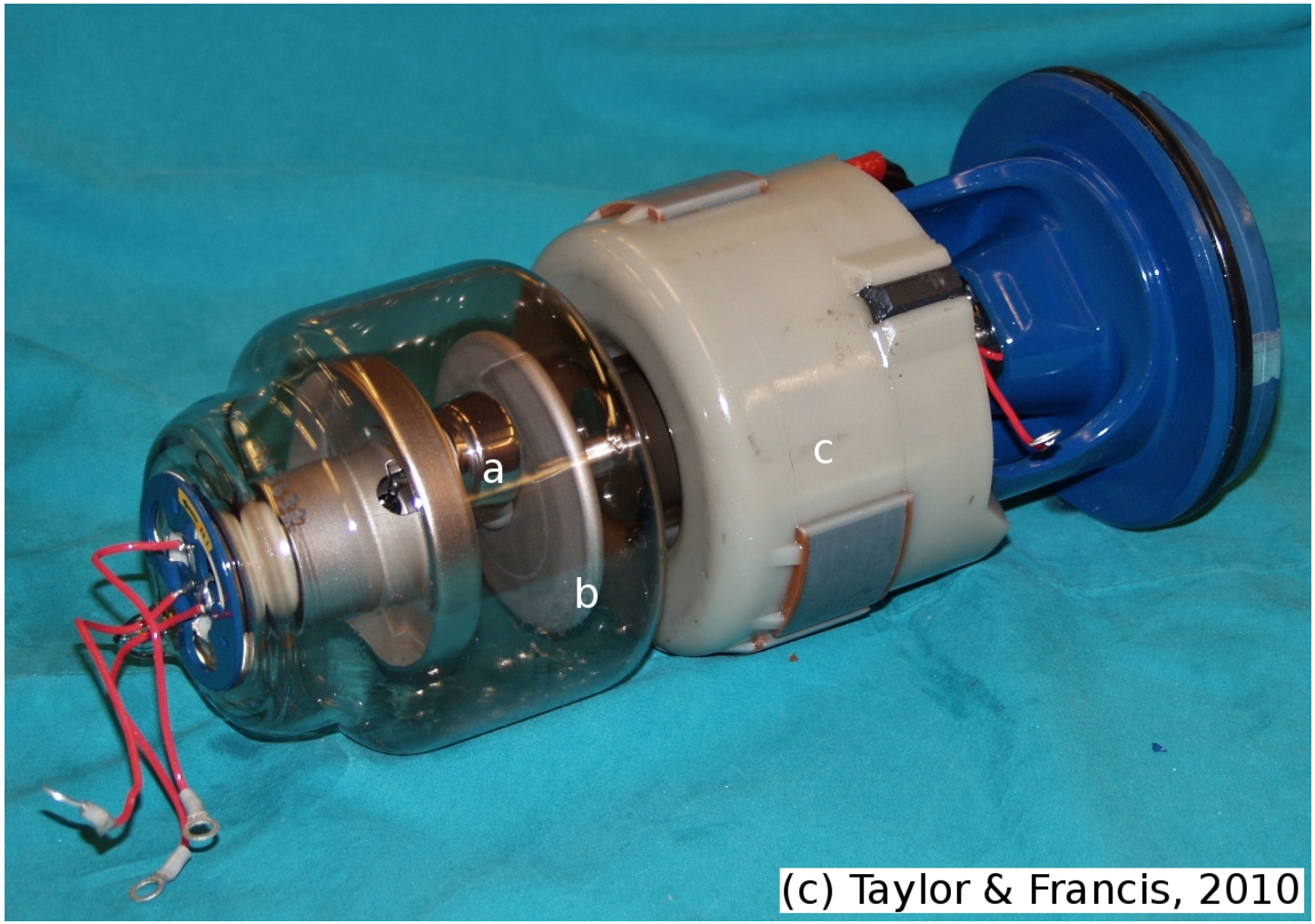

# Attenuation and Imaging

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- Beer - Lambert law of attenuation of x-rays

$$I(s) = I_0 e^{-\mu s}$$

$I_0$- initial number of photons
$s$- thickness of the absorber
$\mu$- material specific quantity

- The principle of x-ray imaging is based on the different attenuation in tissue

# Attenuation Effects

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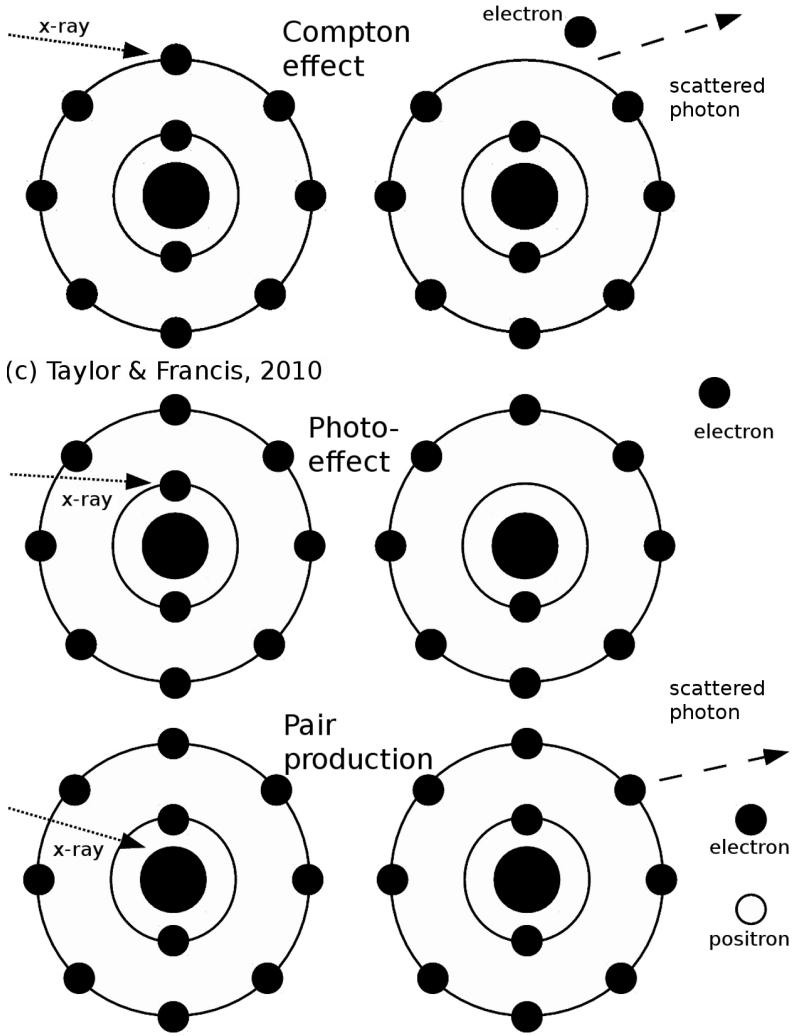

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# CT Principles

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A Video about CT

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# MRI Principles

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