Medical Imaging

Presented by

Lec. Dr. Sarah Mahdi Obaid

Department of Medical Physics,

Al-Mustaqbal University,

Babil, Iraq

Email: sarah.mahdi@uomus.edu.iq

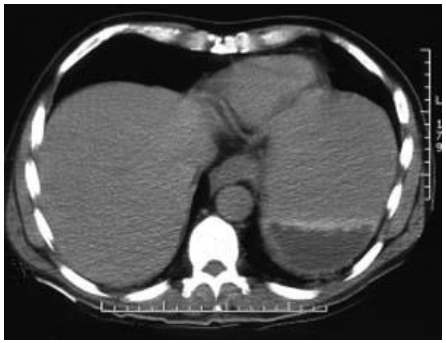
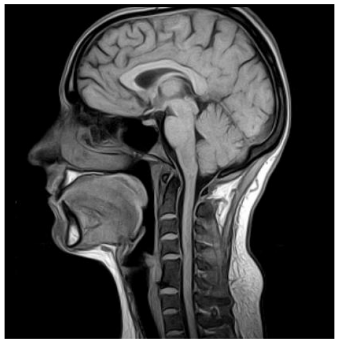
Second-year students

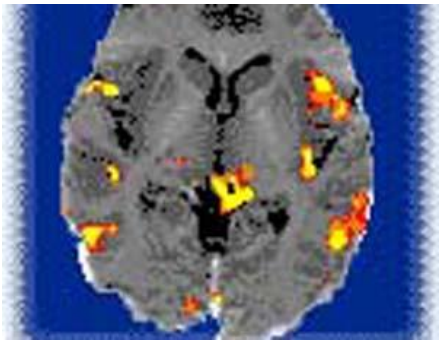
Medical Imaging

- Introduction
- Imaging technology (Modalities):
- Image quality
- Processing & analysis of medical images
- Medical Diagnosis

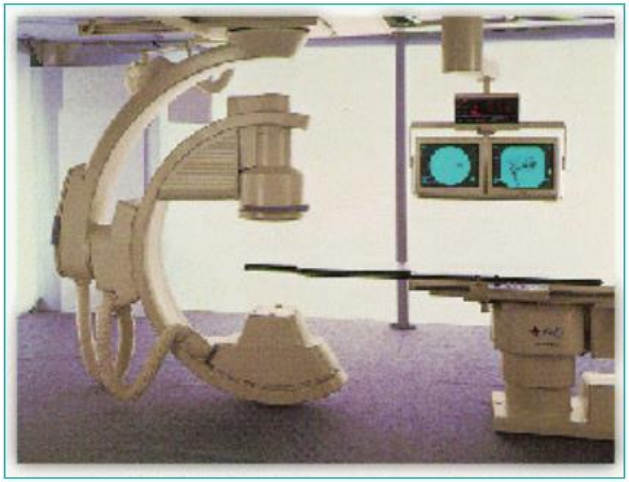
Medical Imaging

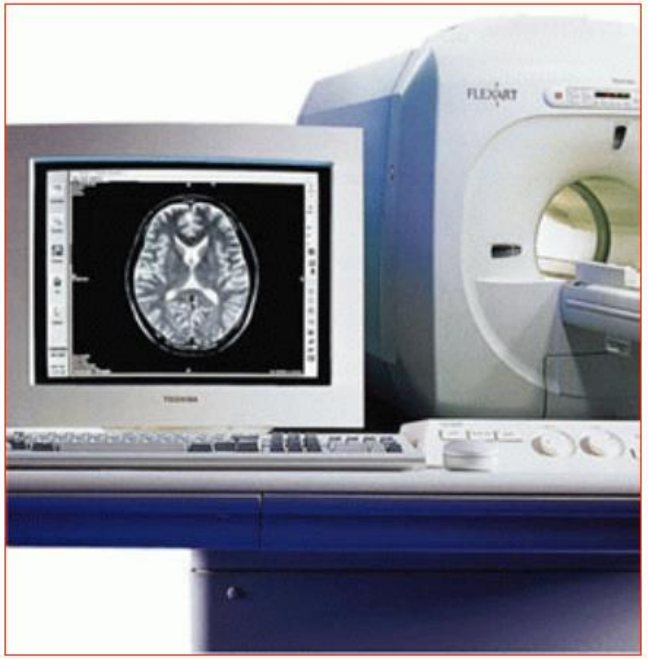
Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues (physiology).

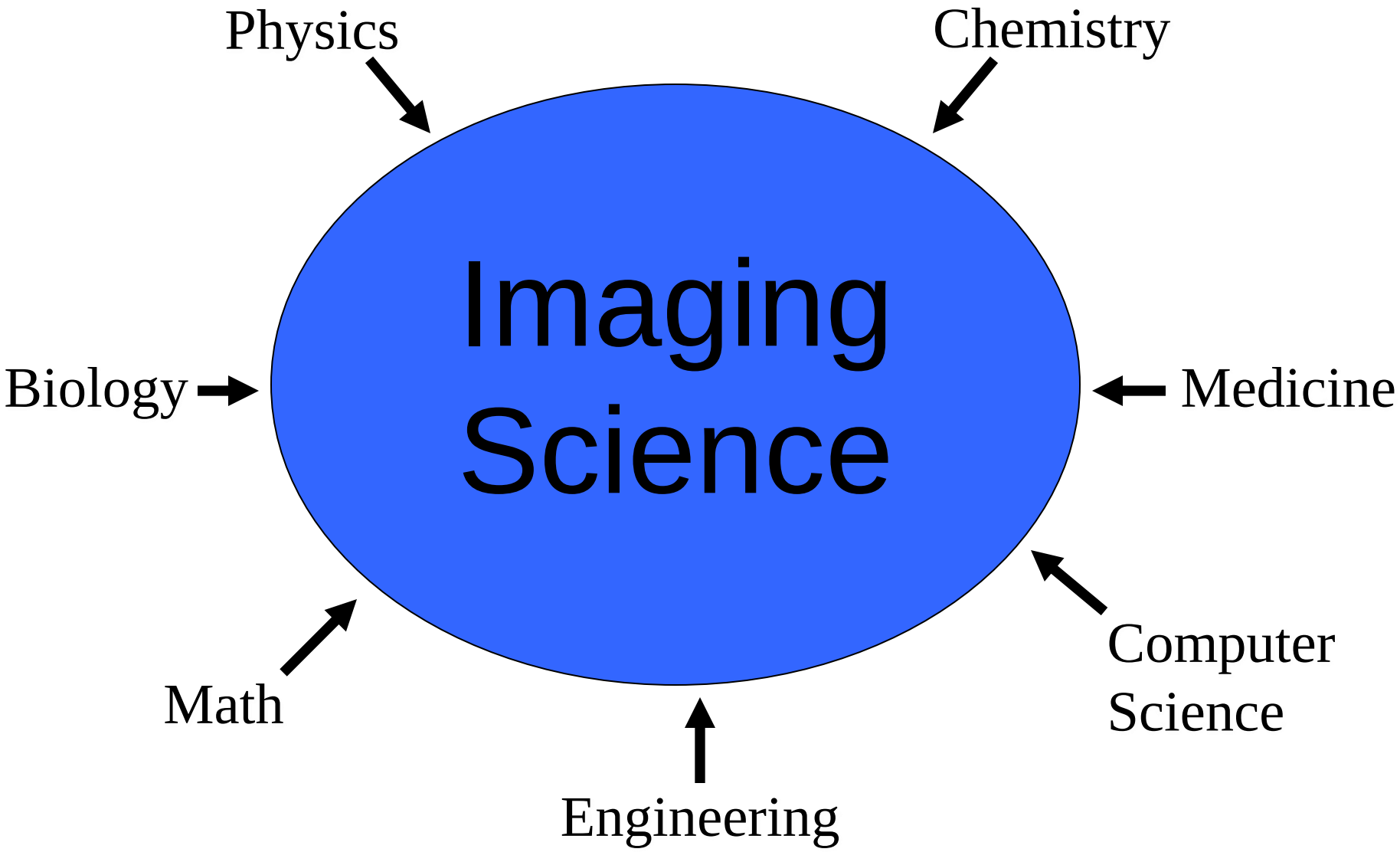
Medical Modalities





The Goal of Medical Imaging

- Better visualization (enhancement) of the structure or function in the living or non-living organism, animal or human.
- To acquire useful information about physiological processes or organs of the body.
- Work with physicians to meet their diagnostic and treatment evaluation needs.
- Involves collaborations with mathematicians, physicists, engineers, chemists and biologists.


Physics
Chemistry
Imaging Science
Biology
Medicine
Math
Computer Science
Engineering

Major Modalities

- **Radiography**
  - ✓Fluoroscopy
  - ✓Mammography
- **Computed Tomography (CT)**

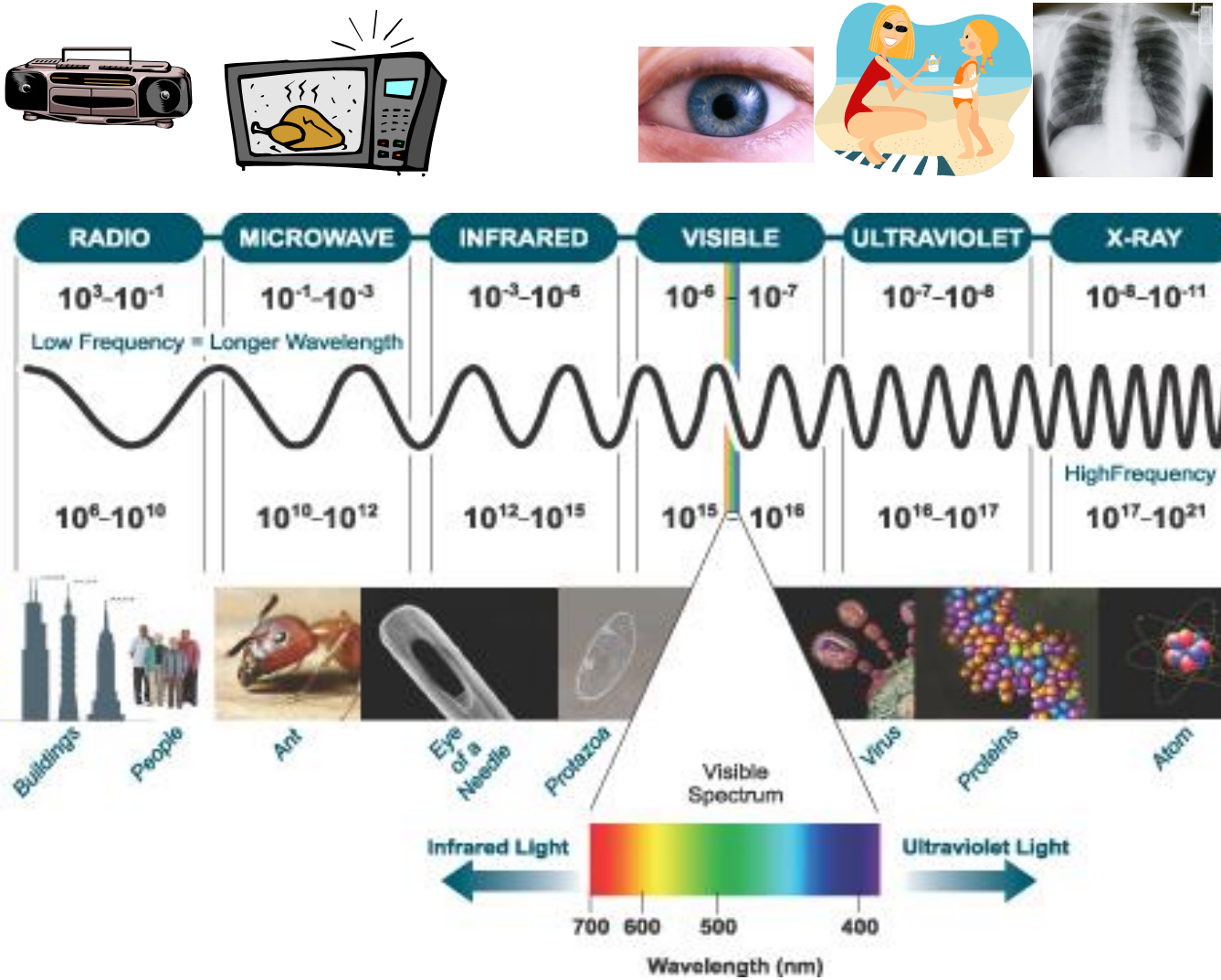
X-RAY

- **Magnetic Resonance Imaging (MRI)**
- **Ultrasound Imaging**
- **Doppler Ultrasound Imaging**
- **Nuclear Medicine Imaging**
  - ✓Single Photon Emission Computed Tomography (SPECT)
  - ✓Positron Emission Tomography (PET)

Medical imaging of the human body requires some form of energy!

- Visible light, which has limited ability to penetrate tissues at depth, is used in dermatology (skin photography), gastroenterology and obstetrics (endoscopy), and pathology (light microscopy).
- All disciplines in medicine use direct visual observation, which also utilizes visible light.

Electromagnetic spectrum



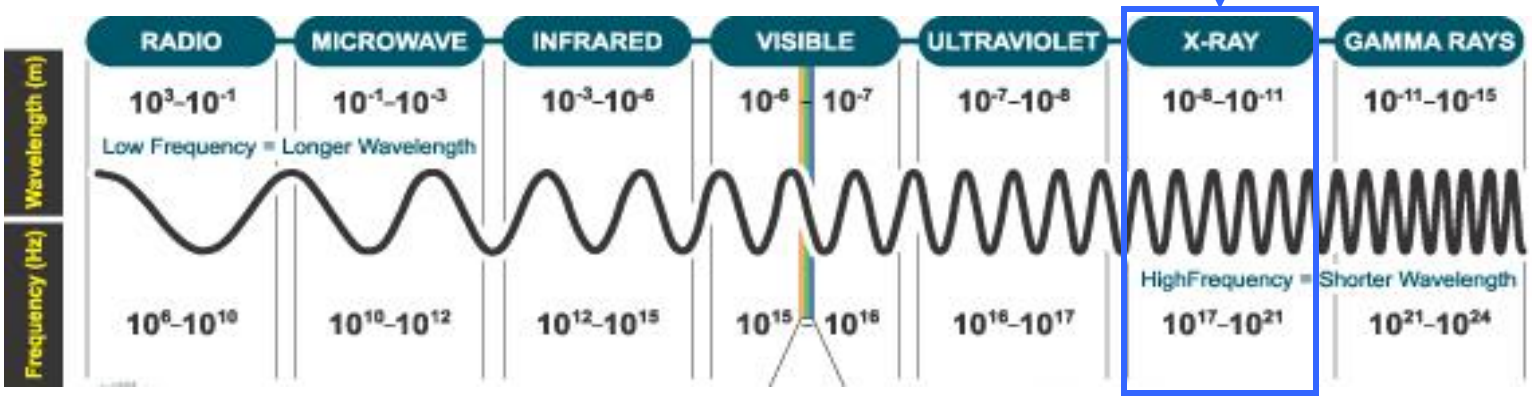
In diagnostic radiology, the electromagnetic spectrum outside the visible light region is used for medical imaging!

X-rays are used in mammography and computed tomography (CT).

- In the medical imaging techniques used in radiology, the energy used to produce the image must be capable of penetrating tissues.
- If energy were to pass through the body and not experience some type of interaction (absorption or scattering), then the detected energy would not contain any useful information regarding the internal anatomy, and thus it would not be possible to construct an image of the anatomy using that information.

The Major Imaging Modalities

- Magnetic Resonance Imaging (MRI)
- **X-ray Imaging**
- Computed Tomography (CT)
- Positron Emission Tomography (PET)
- Ultrasound (US)



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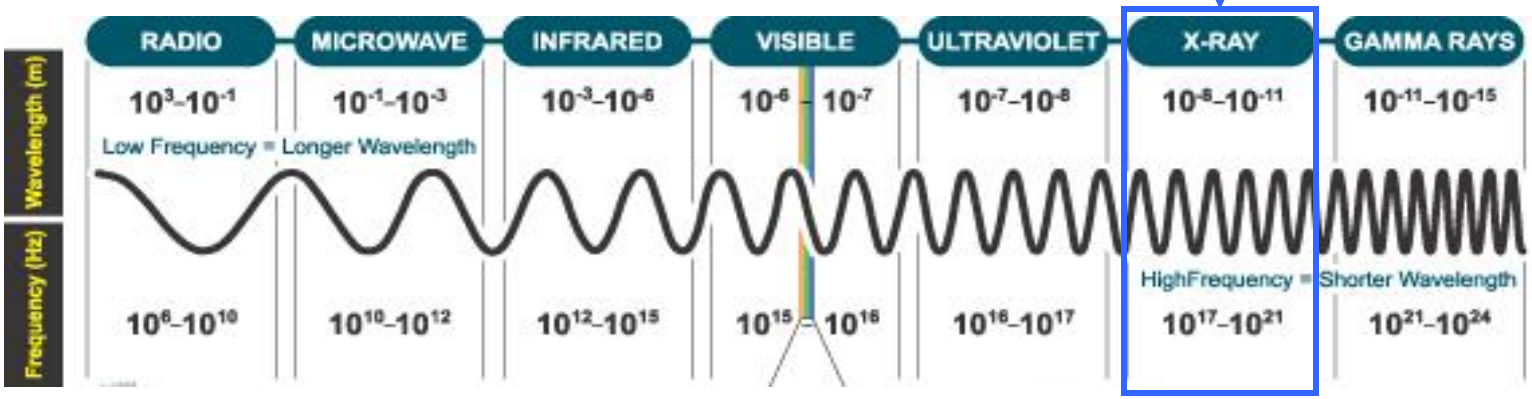

In diagnostic MRI, the electromagnetic spectrum outside the visible light region is used for medical imaging!

- Radiofrequency (RF) is used in magnetic resonance imaging (MRI).

The Major Imaging Modalities

- **Magnetic Resonance Imaging (MRI)**
- X-ray Imaging
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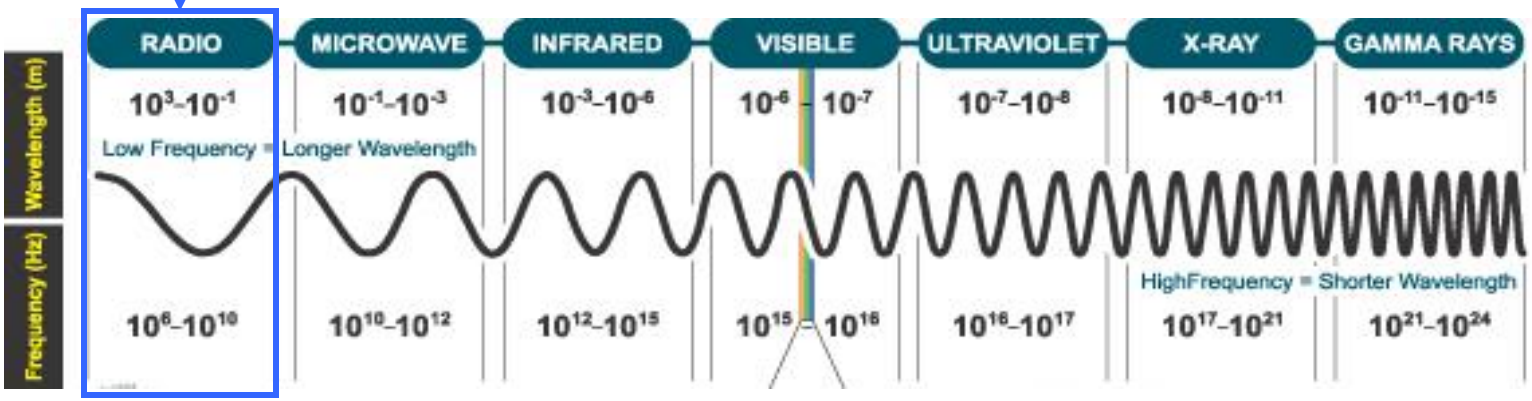

In diagnostic nuclear medicine images, the electromagnetic spectrum outside the visible light region is used for medical imaging!

- Gamma rays in nuclear medicine.

The Major Imaging Modalities

- Magnetic Resonance Imaging (MRI)
- X-ray Imaging
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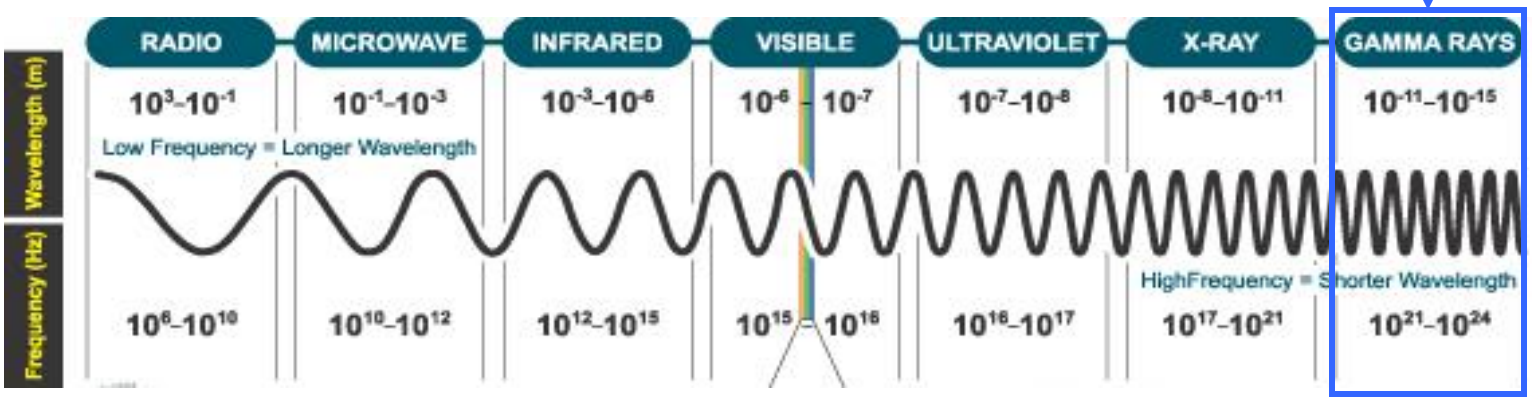
- **Positron Emission Tomography (PET)**
- Ultrasound (US)



In diagnostic US images, the electromagnetic spectrum outside the visible light region is used for medical imaging!

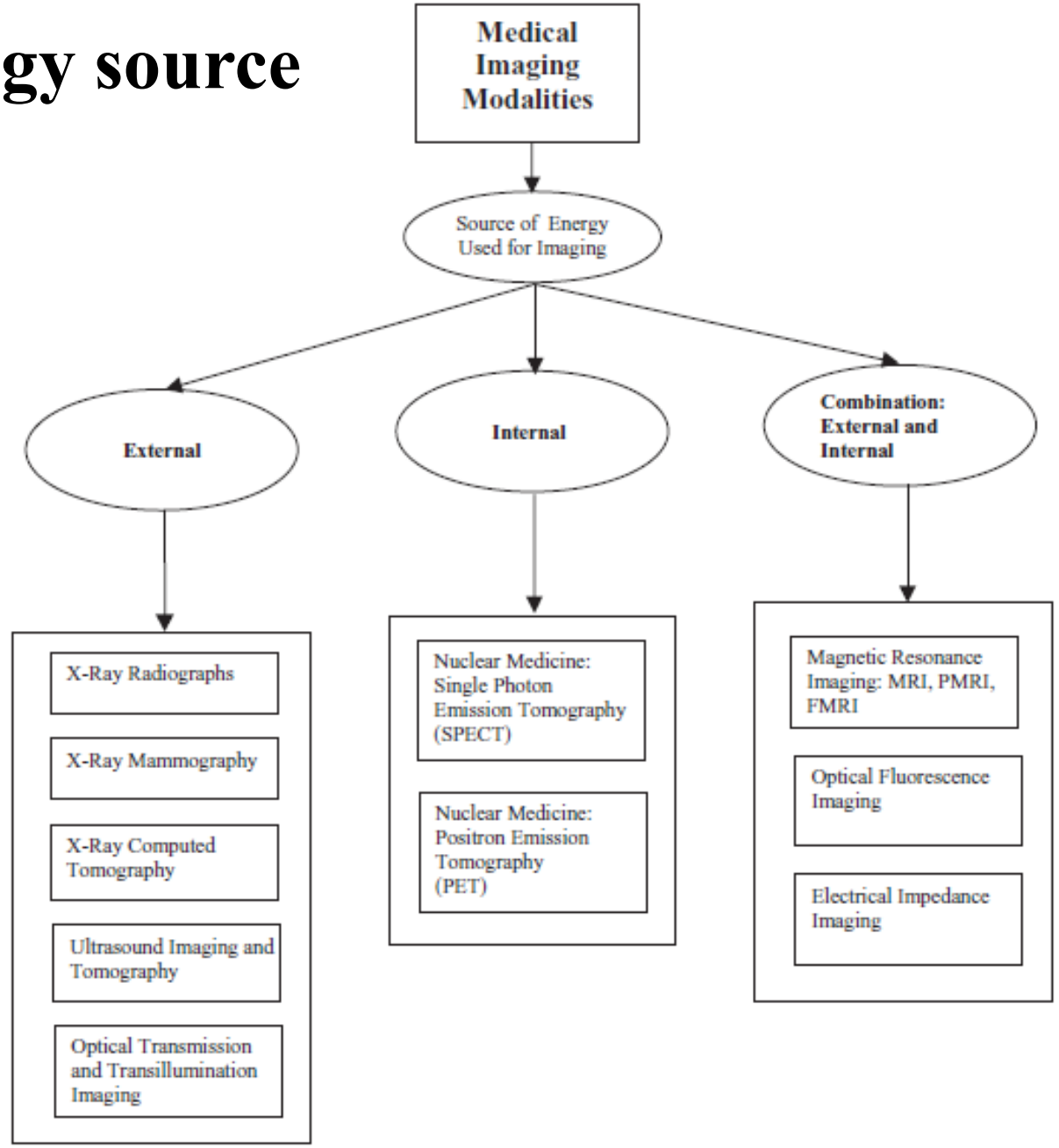
- Mechanical energy, in the form of high-frequency sound waves, is used in ultrasound imaging.

Energy source

Most medical imaging required the energy that used to penetrate the body's tissues also interacts with those tissues.

In nuclear medicine imaging, **radioactive substances** are injected or ingested, and it is the physiological *interactions* of the agent that give rise to the information in the images.

Energy source



Important Points

- The diagnostic utility of a medical image relates both to the technical quality of the image and the conditions of its acquisition.
- The assessment of image quality in medical imaging involves a great deal of technical evaluation. In most cases, the image quality that is obtained from medical imaging devices involves compromise !

  i.e (**better x-ray images** can be made when the **radiation dose to the patient is high**,

  better MRI images can be made when the **image acquisition time is long,**

  and **better ultrasound images** result when the **ultrasound power levels are large**)
- **patient safety and comfort** must be considered when acquiring medical images; thus, excessive patient dose in the pursuit of a perfect image is not acceptable. Rather, the power and energy used to make medical images require a **balance between patient safety and image quality.**

Medical Imaging Processing

Medical imaging processing is the process that used to analyze the medical imaging to reveal internal features that may help for clinical inspection and medical intervention (determination of the identity of a possible disease or disorder).