uchicago MEDICAL PHYSICS

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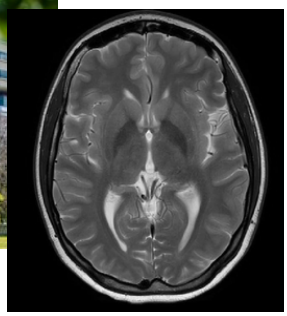
WHAT IS MEDICAL PHYSICS?

Medical physics is the application of physical sciences, engineering, and computer science to the study and improvement of medicine and healthcare!



MEDICAL IMAGING:

Medical imaging methods like Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI), Computed Tomography (CT), and ultrasound all rely on physics! Medical physicists advance imaging technologies, ensure imaging machines are functioning correctly, develop algorithms to assist clinical diagnoses, and maintain the safety of patients and staff.

RADIATION THERAPY:

Medical physicists prepare radiation treatment plans for patients using linear accelerators that use high energy fundamental particles to kill cancerous cells, oversee the implantation of radioactive "seeds" placed near tumor sites to kill cancerous cells, design radiation shielding, calculate dose delivered to body during treatment, and prevent and respond to nuclear accidents!

SELECT RESEARCH TOPICS

Computer-Aided Diagnosis
Radiation Therapy
Functional Molecular Imaging
Neurological Imaging
Computed Tomography
Magnetic Resonance Imaging
Machine Learning
Nuclear Medicine
Ultrasound

FOR MORE INFORMATION:

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PROTON THERAPY

Protons can be used instead of x-rays for radiation therapy treatment of cancer. High-speed protons are accelerated toward a tumor and decelerate quickly to come to a complete stop. This spares the healthy tissues along the way, providing a very efficient cancer treatment.

ANATOMICAL VS FUNCTIONAL IMAGING

Medical imaging is needed for both appearance (anatomy) and function (physiology) of organs. The type of medical images acquired depends on what information is wanted. CT can show anatomic images, PET can show physiologic images, and MRI can do both. Ultrasound produces live images with a machine in your hand.

COMPUTED TOMOGRAPHY (CT)

X-ray images are produced by sending ionizing radiation through a patient and measuring what comes out the other side. A CT uses a set of x-rays around a patient to reconstruct 3D images. This means that the images are "computed" from a set of images taken from different angles and pieced back together.

ULTRASOUND

Ultrasound uses sound waves to look inside the human body. By recording the time and location of the sound wave echoes, we can make an image in real time.

MACHINE LEARNING AND COMPUTER-AIDED DIAGNOSIS

When a patient comes into the clinic, a radiologist may order images to help diagnose illness. Machine learning can produce algorithms to train computers and pick up on patterns observed in medical images and help radiologists make their diagnoses.

POSITRON EMISSION TOMOGRAPHY (PET)

A 'tracer' that behaves like glucose is injected that emits positrons as it travels through the blood. The positrons annihilate with electrons to produce photons, and a detector measures these photons and can calculate where the annihilation occurred. This location is where all of the glucose is, typically marking the physiology of a tumor.

MAGNETIC RESONANCE (MRI)

MRI uses magnetic fields and particle spin to generate images of anatomy and physiology of the body. Magnets influence the spin of hydrogen atoms, similarly to how the magnetic field of the earth influences compass needles. Different types of tissues will respond differently to the same magnetic fields. This can be used to image anatomically or physiologically, for example using the difference in magnetic properties between oxygenated and deoxygenated blood to image activity in different regions of the brain!