







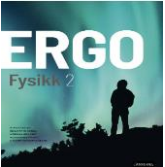


Particles for Health

Medical Applications of Particle Physics

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Curriculum & Classroom Connections

Curriculum Mapped	Theme	Key Concepts	Classroom Connections	
   नेपाल सरकार  	Fundamentals of Particle Physics	Structure of the Atom	Experiments on atomic structure, Rutherford scattering simulations	Interaction
		Quantum Physics	Discussions on medical isotopes, PET scans	
		Radioactive Decay	Calculations of half-life, simulating decay chains	
		Nuclear Reactions	Simulating fission and fusion processes	
		Types of Radiation	Identifying alpha, beta, gamma radiation with Geiger-Muller tubes	
	Medical Imaging Technologies	Photoelectric Effect	Demonstrations with photoelectric devices, observing electron emission	Detection
		X-rays	Producing and detecting X-rays, using X-ray tubes and detectors	
		Wave-Particle Duality	Labs on wave-particle behavior, double-slit experiment	
		Wave Phenomena	Experiments on interference, diffraction patterns	
		Doppler Effect	Using ultrasound machines, measuring blood flow, observing Doppler shifts	
Applications in Medical Treatment	Medical Uses of Radiation	Case studies on radiotherapy, planning, safety measures, practical sessions	Application	
	Production & Detection of Radiation	Simulations, producing radioactive isotopes, using detection devices like cloud chambers		
	Radiation Safety	Safety protocols, role-playing exercises on handling radioactive materials		

Key Ideas

- History of radioactivity
(fascinating advancement since 1896)
- Radiotherapy in cancer treatment

Current radiotherapy method

A) x-ray

B) **Particles** : Proton and Heavy ions

New state of the art : Very High Energy Electrons (VHEE) radiotherapy

- Radiation therapy is a key tool for treatment for 50-60% patients (more in the future?)
- We need technology to reach as many places as possible all over the globe, especially in countries with limited resources and access to cancer treatment.

Hope is there in.....**CERN!**



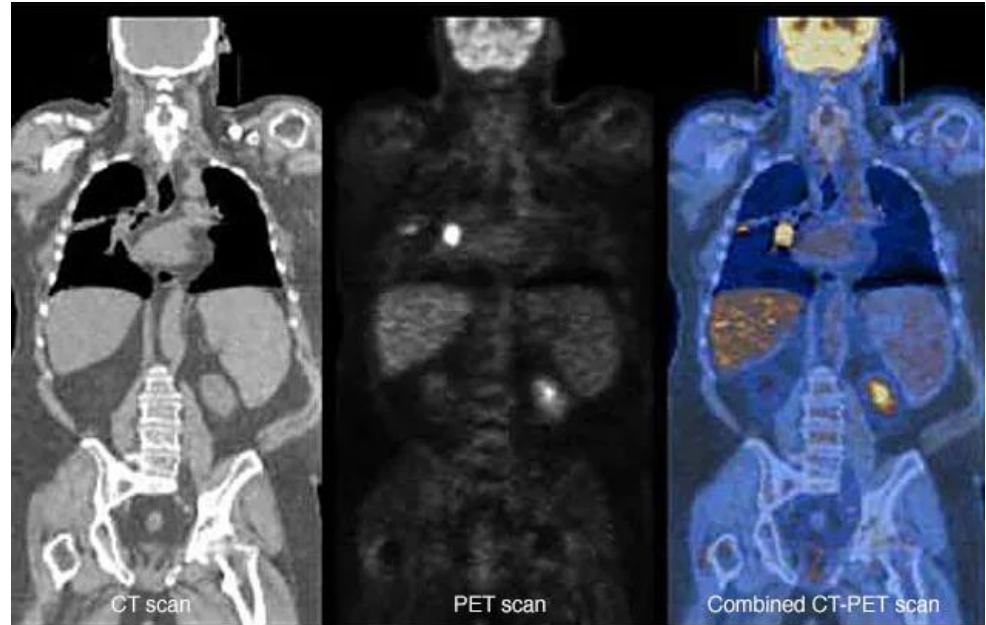
Potential Students' Conceptions & Challenges

- Radiation as hazards but it also offers potential benefits
- Particle physics in only high energy physics research
- Integrating particle physics concept with biology and medical science
- Data analysis from imaging



Useful Material & Resources

- Dosanjh, M. (2017) *From Particle Physics to Medical Applications*. ResearchGate. DOI: [10.1088/978-0-7503-1444-2ch1](https://doi.org/10.1088/978-0-7503-1444-2ch1)
- Accelerator Technology in Medicine
<https://videos.cern.ch/record/1541891>
- FLASH overview:
<https://videos.cern.ch/record/2762058>
- Prof. Manjit Dosanjh
- *Citizen of the World*



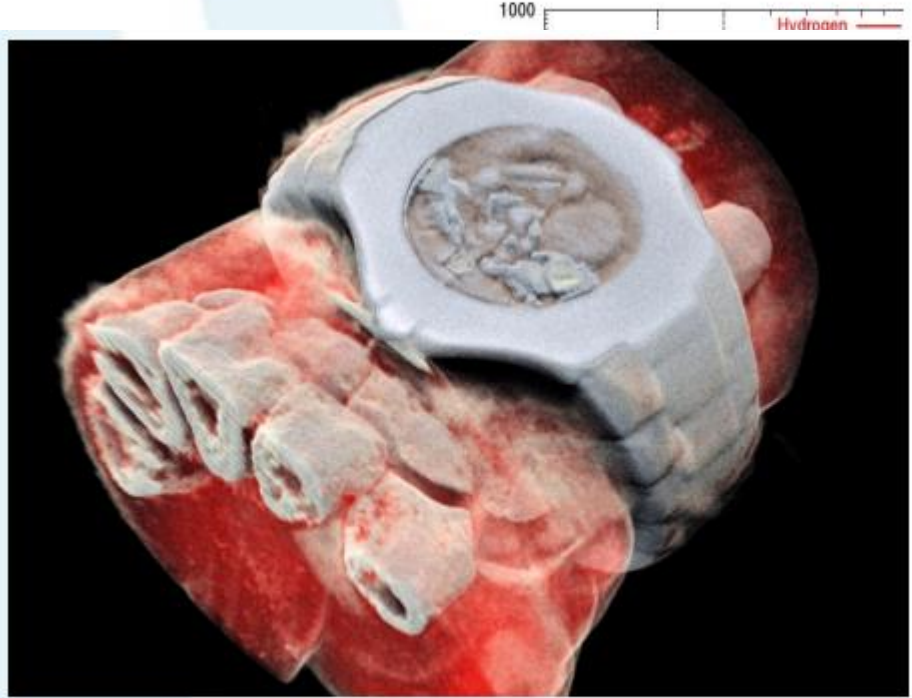
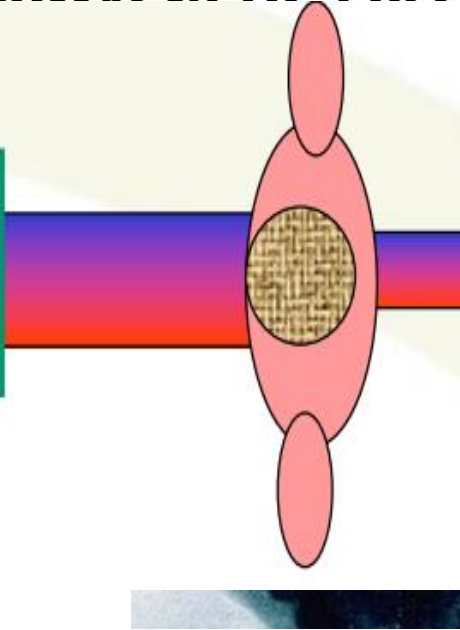
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Best Practice Example

MARS
spectral CT

THE ELECTROMAGNETIC SPECTRUM

Xray
source



First 3D colour x-ray human image

HST2024 Study Group 2

Mazina (Nepal), Jethromel (Philippines), Shaima (Norway), Francisco (Spain), Antonio (Australia)

How has our thinking changed?

- Spin off of accelerator technology
- Variety of applications from particle physics research (CT, PET, Combination, FLASH)
- Diagnostic tools and treatments for cancer and other diseases
- Unequal distribution of these machines per capita
- The power of teaching to inspire future generations
- The more you learn, the less you realize you know!

Goodbye Message:

It is not goodbye; the magnet of nature could gather us one day again. Then, don't forget to greet me with a CERN greeting. :-)

