

Intro to Medical Physics

Liz Fletcher

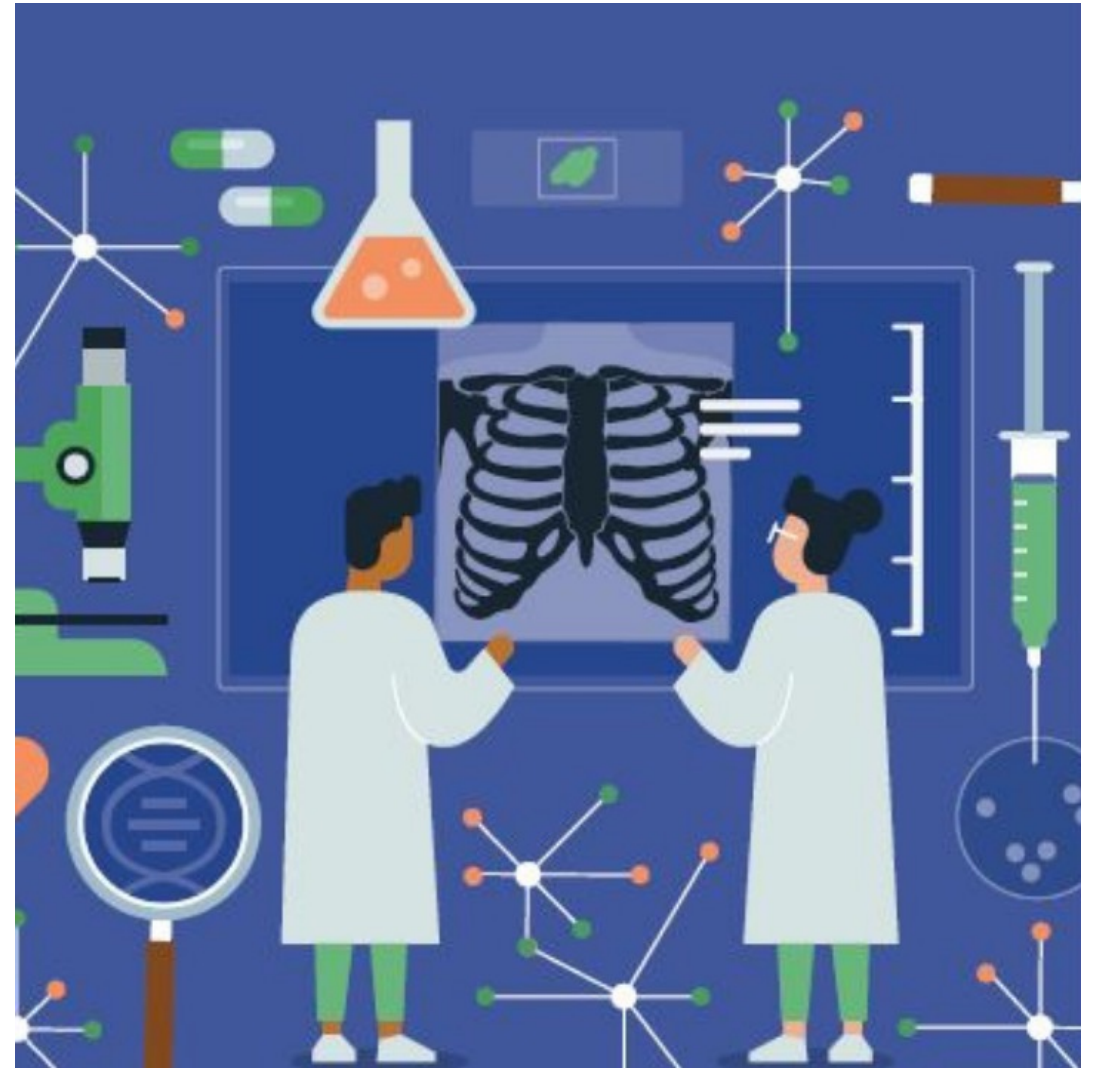
Carleton University

Summer Particle Astrophysics Workshop

May 9, 2023

Overview

- Who am I?
- What is medical physics?
- What do medical physicists do?
- How does medical physics relate to particle physics?
- Medical physics in Canada

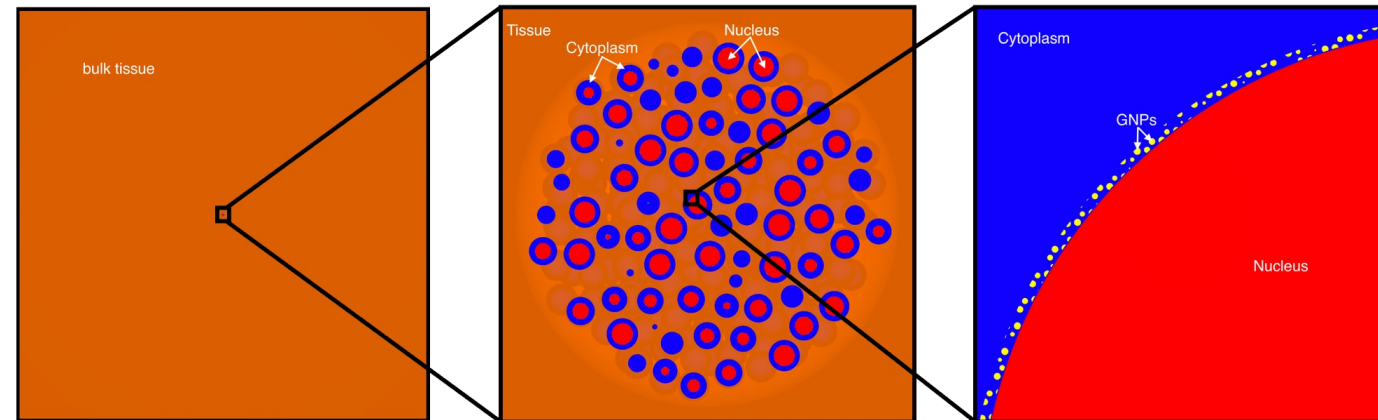


<https://www.hopkinsmedicine.org/news/articles/medical-physics-a-rapidly-evolving-field>

Who am I?

Bio:

- BSc at Queen's
 - honours physics
- MSc at Queen's
 - particle physics with SNO+
- PhD at Carleton
 - medical physics with CLRP
 - working on Monte Carlo modelling of novel radiotherapy techniques



What is medical physics?

“... an applied branch of physics concerned with the application of the concepts and methods of physics to the diagnosis and treatment of human disease”

- American Association of Physicists in Medicine

What do medical physicists do?

Imaging

- Using physics to look inside people from the outside

Nuclear Medicine

- Using physics to look inside people from the inside

Radiation Oncology

- Treating disease (cancer) using physics



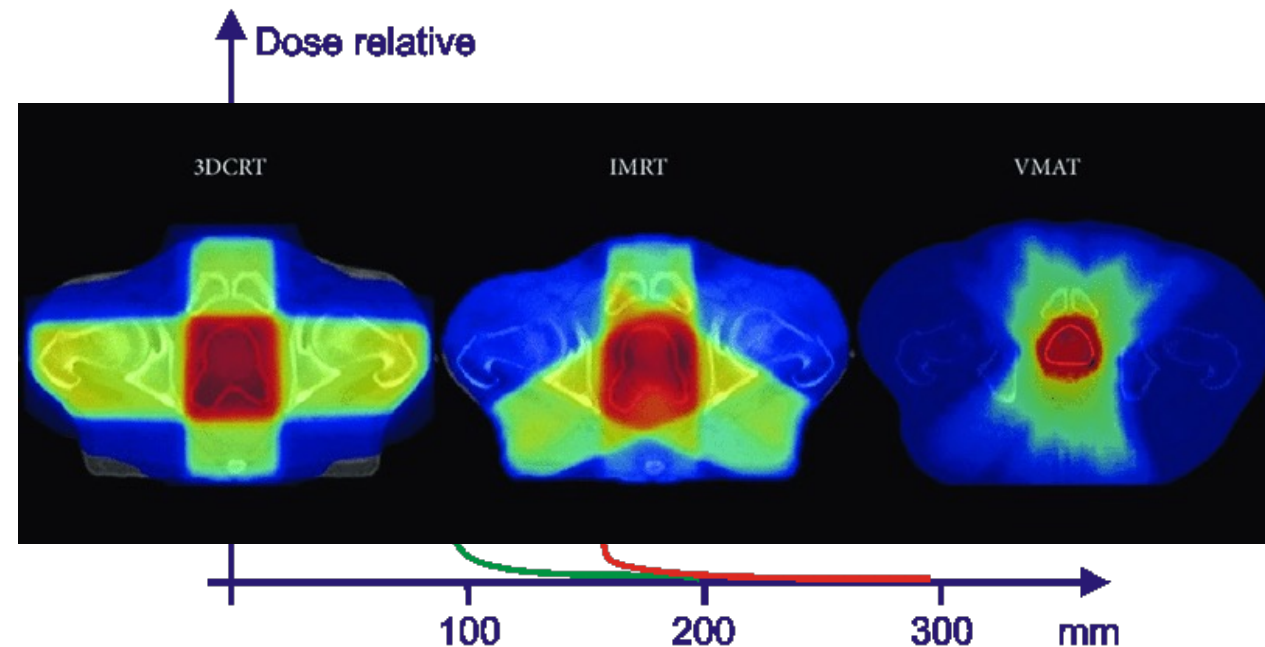
<https://www.nghs.com/mri>

<https://www.digirad.com/what-is-spect-imaging-and-how-does-it-work/>

<https://www.urologysanantonio.com/prostate-cancer/radiation-therapy>

How does this relate to particle physics?

- It is particle physics! We just have a different target
- All the same physical interactions
- All the same physical principles
- Even some of the same technology!



<https://physics.stackexchange.com/questions/169665/dose-depth-curve-of-photons-vs-protons>
<https://www.mgcancerhospital.com/volume-modulated-arc-therapy-vmat/>

Particle accelerators

Linear Accelerators

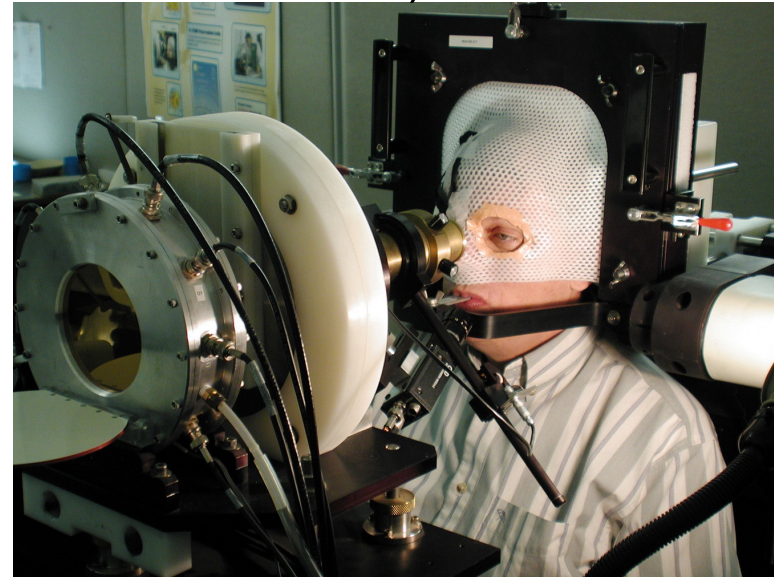
- Used for radiotherapy
- Electrons accelerated across a potential of a few MV, then hit a target to produce a photon beam



https://www.iaea.org/sites/default/files/styles/original_image_size/public/medical-linear-accelerator.jpg?itok=kXues4AQ

Cyclotrons

- Used to generate isotopes for nuclear medicine (^{18}F , ^{11}C , ^{13}N , $^{99\text{m}}\text{Tc}$)
- Also used to generate particle beams for treatment (protons, neutrons, carbon)

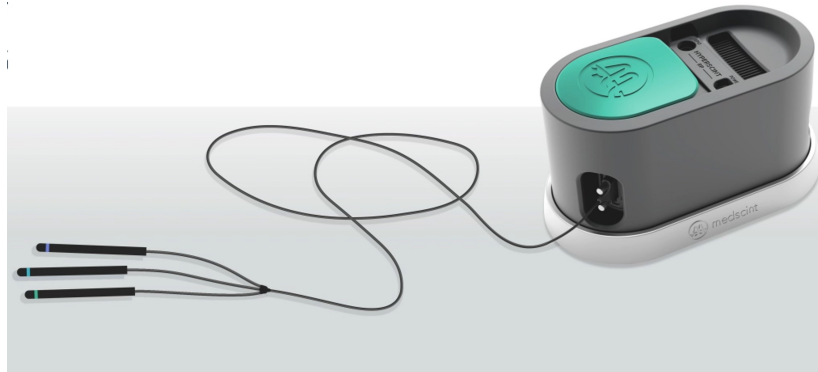
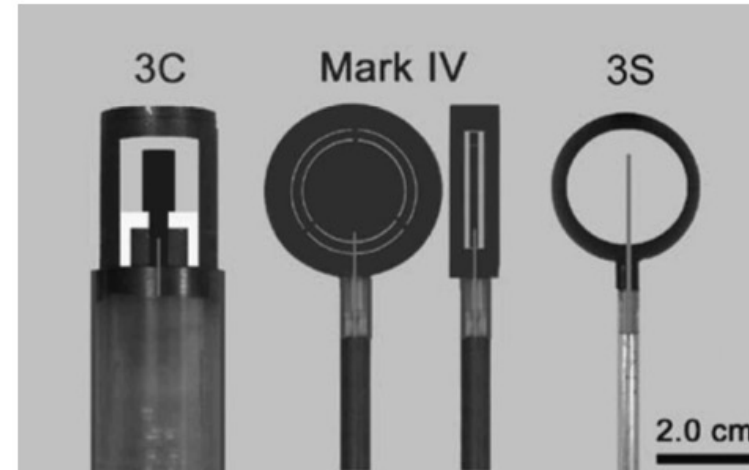


https://www.thestar.com/news/insight/2014/01/12/toronto_cyclotron_set_to_spur_leap_in_nuclear_medicine.html

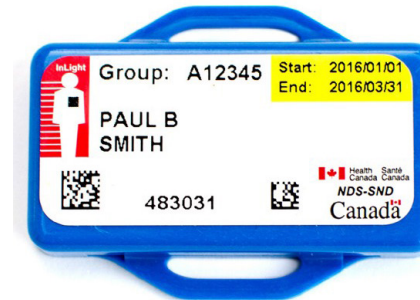
<https://www.triumf.ca/galleries/image/69-proton-therapy>

Radiation detectors (dosimeters)

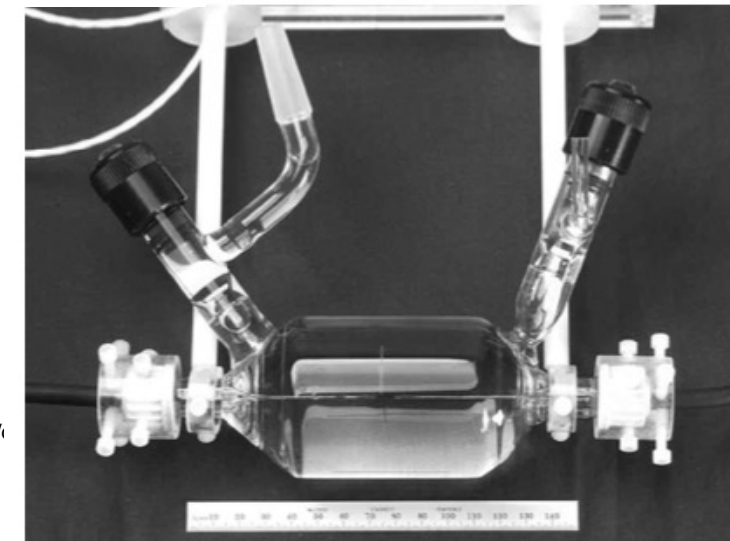
- Measure the absorbed dose to a person
- Measure the output of a linac or source



<https://medscint.com/2021/07/28/hs-rp200-new-hyperscint/>



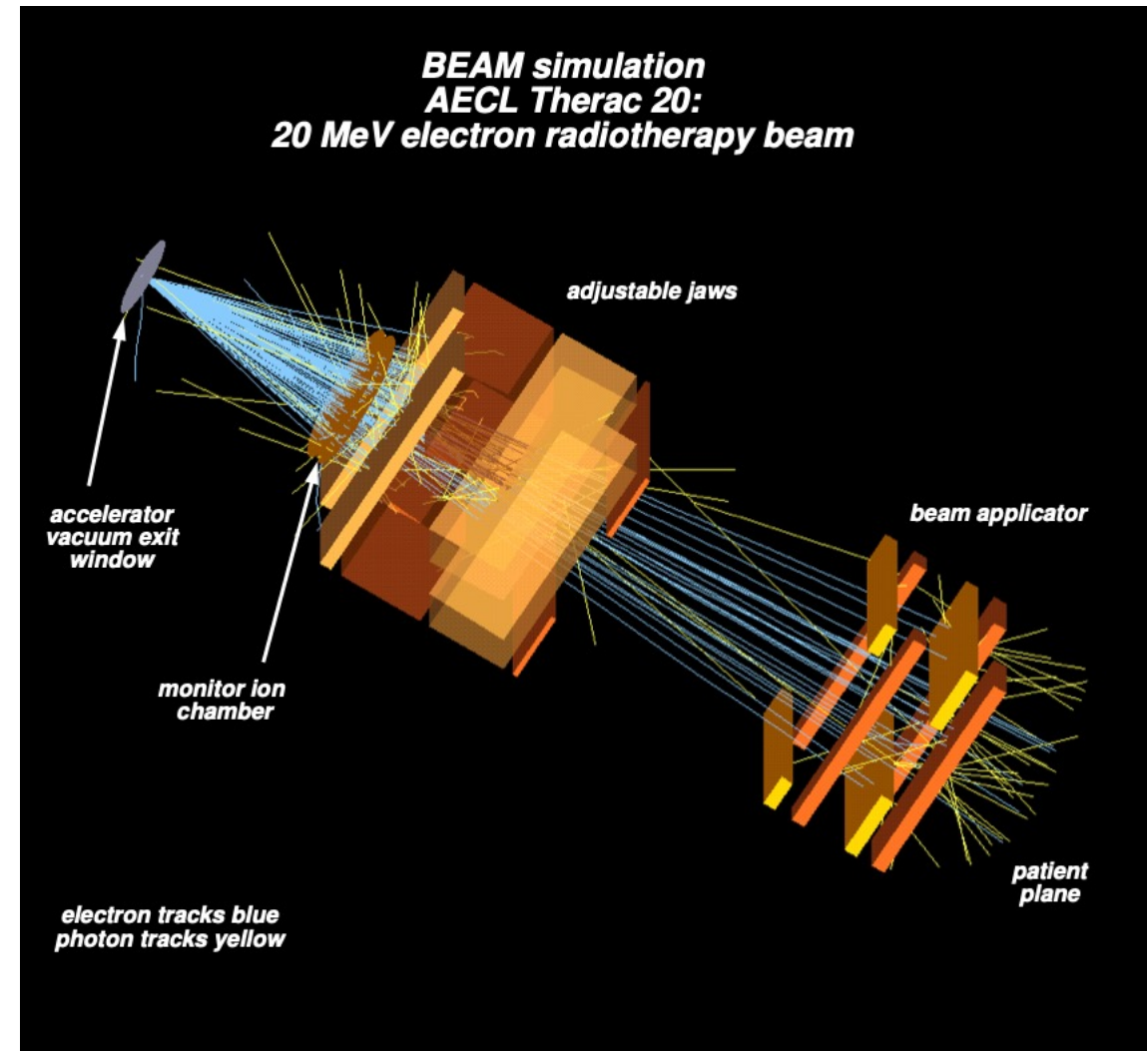
<https://www.canada.ca/en/health-canada/services/>



Phys. Med. Biol. 51 (2006) 1503–1521

Monte Carlo simulations

- MC is used to model particle transport and energy deposition
- Codes like EGSnrc, Penelope, Geant4-DNA, ALGEBRA



NRCC Report PIRS-0509(A)revL

Where do medical physicists work?

Hospitals

- Clinical physicists doing treatment planning, QA/QC, imaging

Research

- Academia or government (NRC, Health Canada)

Industry

- Designing/building imaging/treatment equipment
- Radiation protection
- Production of medical isotopes

Medical physics in Canada

- 18 graduate programs, 13 of which are CAMPEP accredited
- 13 accredited residency programs
- ~500 clinically certified physicists
- ~550 members in COMP

**THE CANADIAN
COLLEGE
OF PHYSICISTS
IN MEDICINE**



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Thanks!

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