

A photograph of a long, blue particle accelerator tunnel. The tunnel is filled with complex machinery, pipes, and structural elements. The perspective is from one end of the tunnel, looking down its length. The lighting is somewhat dim, with some bright spots from overhead fixtures. The overall scene is industrial and technical.

MEDICAL APPLICATIONS IN PARTICLE PHYSICS

Valle, Maria, Laura, Adam, Anila

The Power of Particles



Following his accidental exposure to [gamma rays](#) while saving the life of Rick Jones during the detonation of an experimental bomb, Banner is physically transformed into **The Hulk** when subjected to emotional stress, at or against his will

Radiation: Good? Bad? or Both? for the Human Body

Key Idea: The energy of sub-atomic particles affect the human body in positive and negative way.

Potential Obstructions: Misconceptions about radiation being all bad, all good or make you superhuman.

Radiation is ?

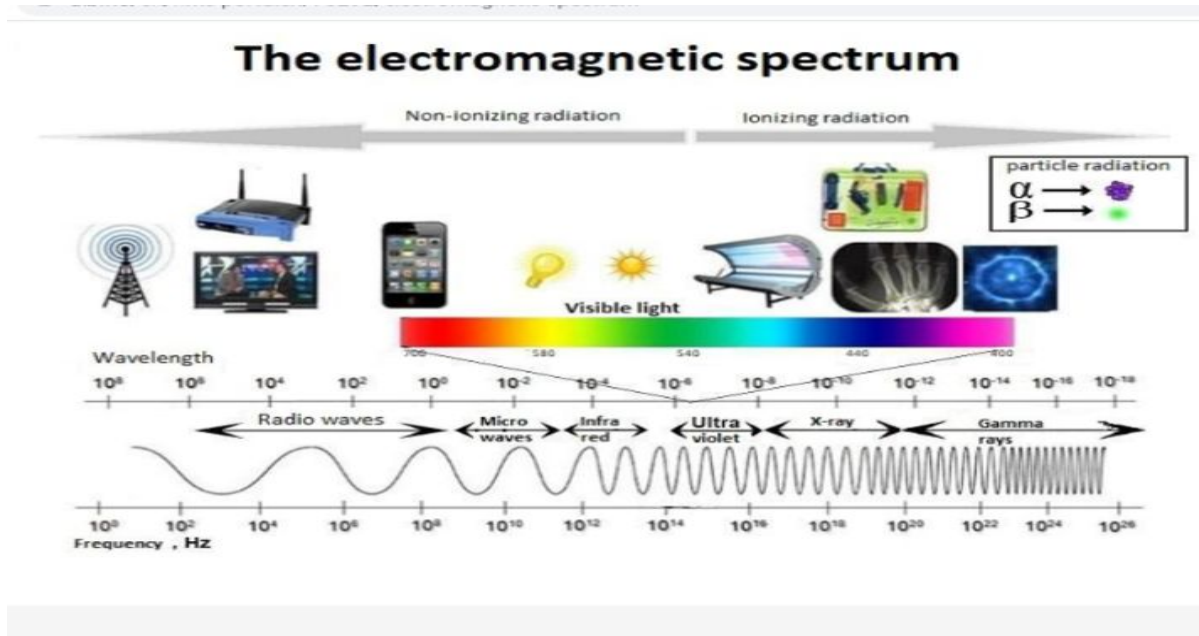
Is radiation good for the body? If so how ?

Is radiation bad for you ? If so how ?

Should radiation exposure be banned by the International Olympic Committee ?

The Electromagnetic Spectrum

Key idea: Why the EM Spectrum (... and Jeff) \ is Awesome

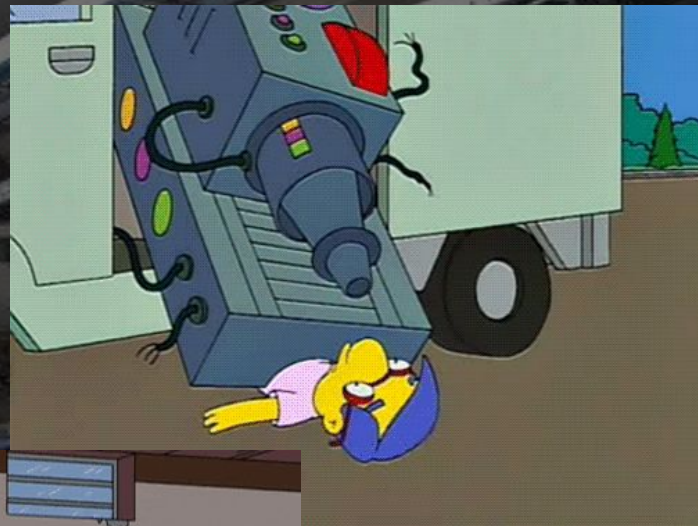


APPLICATIONS - IMAGING



What is wrong on that picture?

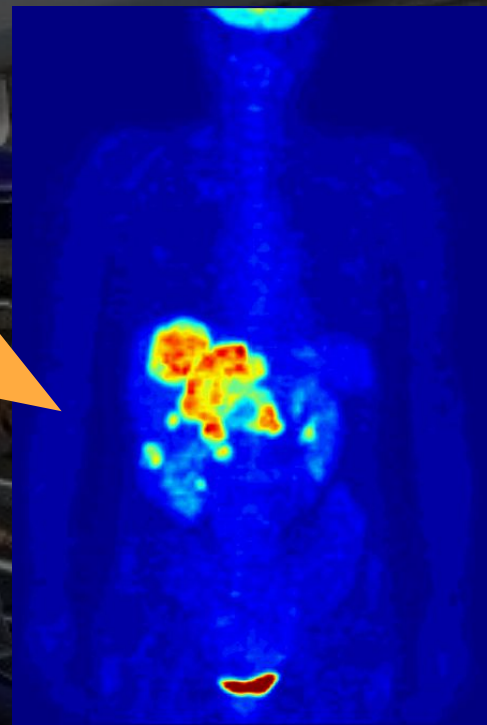
X-ray



Computed tomography (CT) Scans - x-ray in 3D



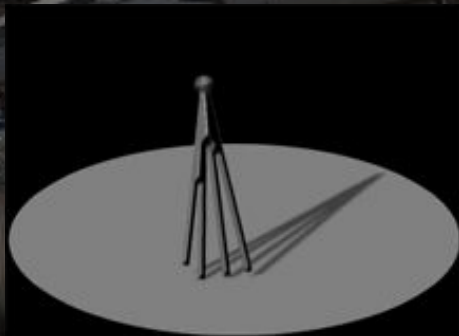
Positron Emission Tomography (PET) Scans



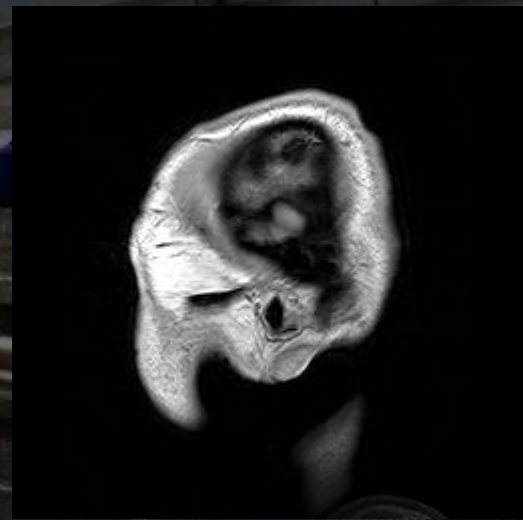
Magnetic resonance imaging (MRI)



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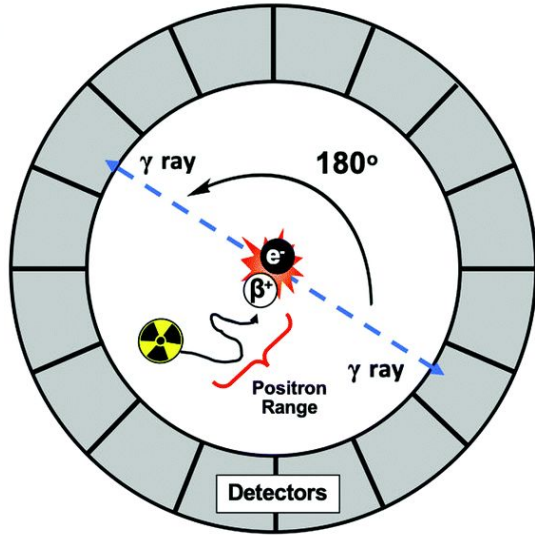


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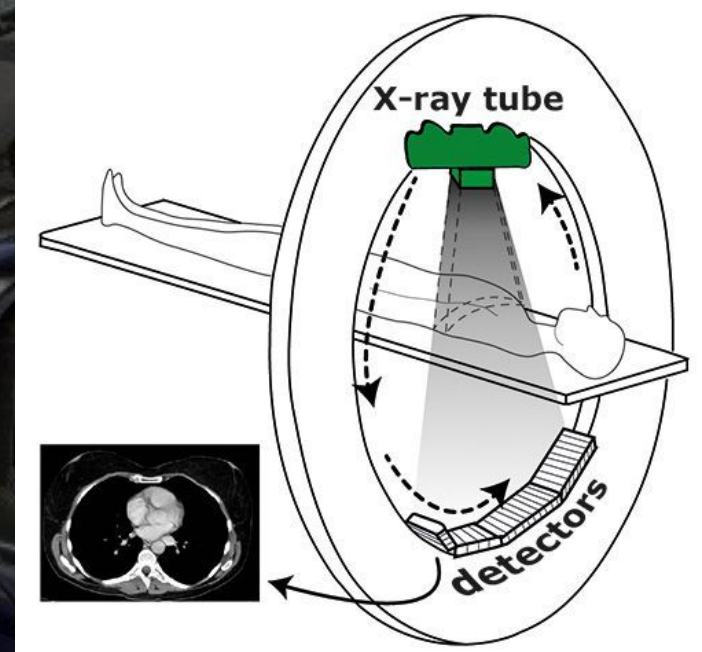


APPLICATIONS - IMAGING

B



Positron emission tomography (SPECT)



APPLICATIONS - IMAGING



Imaging method	Connection to Curriculum
X-ray	Electromagnetic spectrum; radioactivity
Computed tomography (CT) Scans - x-ray in 3D	Electromagnetic spectrum; radioactivity
Positron Emission Tomography (PET) Scans	Electromagnetic spectrum; radioactivity; nuclear reactions ($e^- + e^+$)
Magnetic resonance imaging (MRI)	Electromagnetism

APPLICATIONS - IMAGING



APPLICATIONS - TREATMENT METHODS

Key Concepts

Connection to Curriculum

Bragg Curve

**Interpreting Graphs
Ionizing Radiation**

Big to Small

Engineering Design Process

**Acceleration of
particles**

Electric and Magnetic Fields

Curriculum Connection: Engineering Design Process

Source: [BlenderArtists](#)



Source: [Spectrum IEEE](#)

Miniaturization!





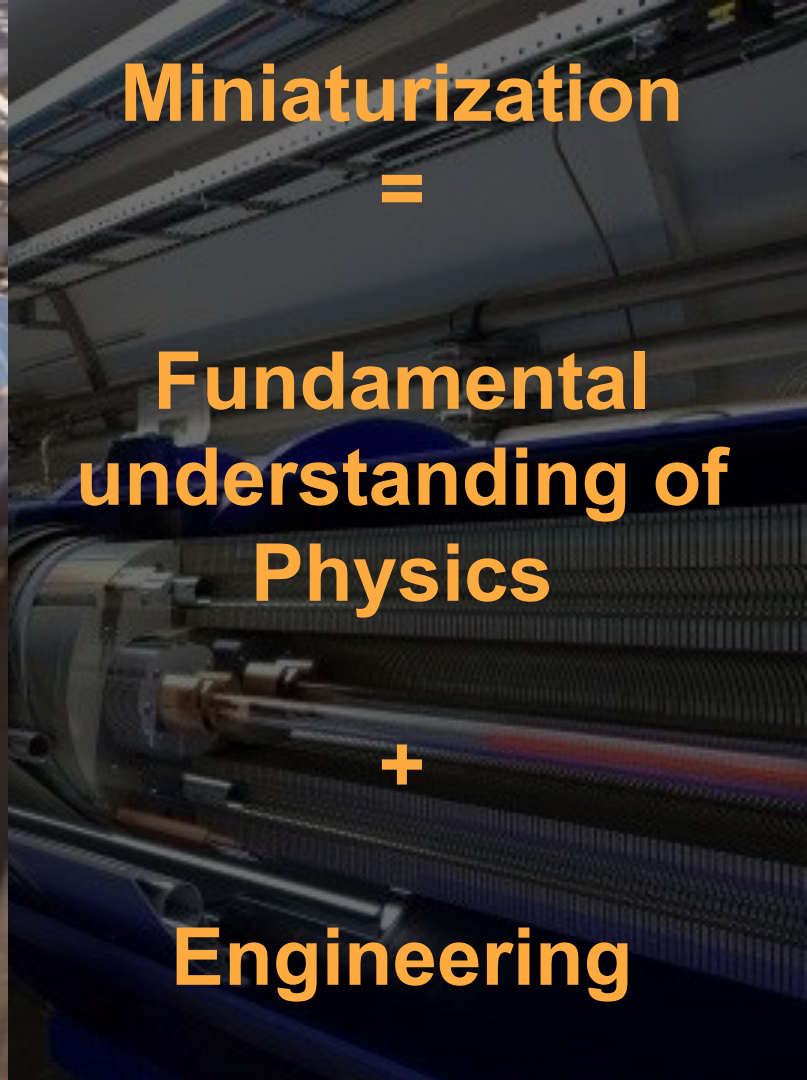
Miniaturization

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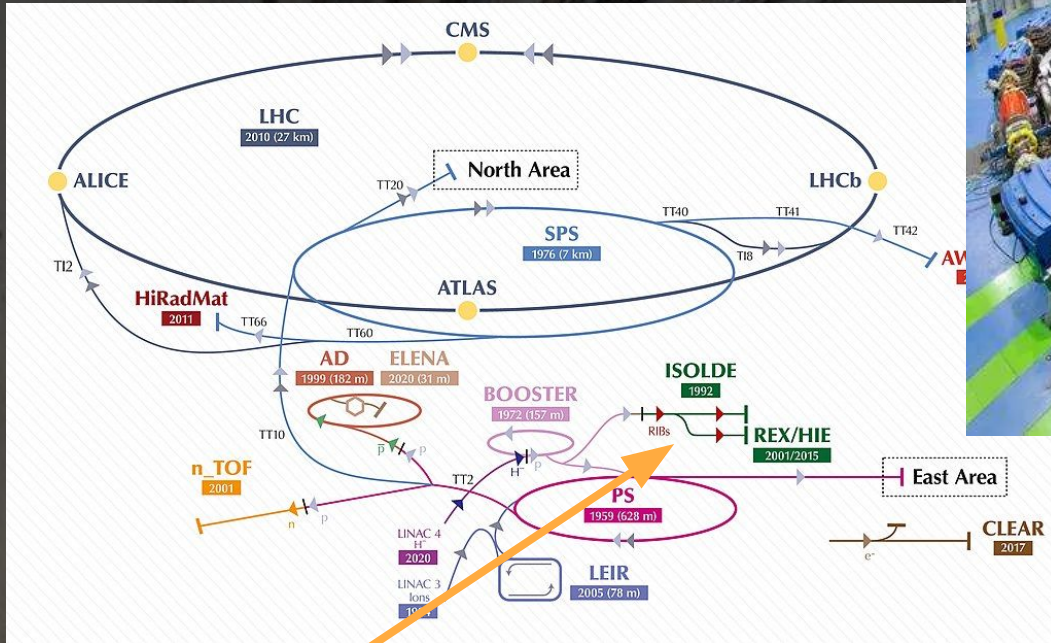
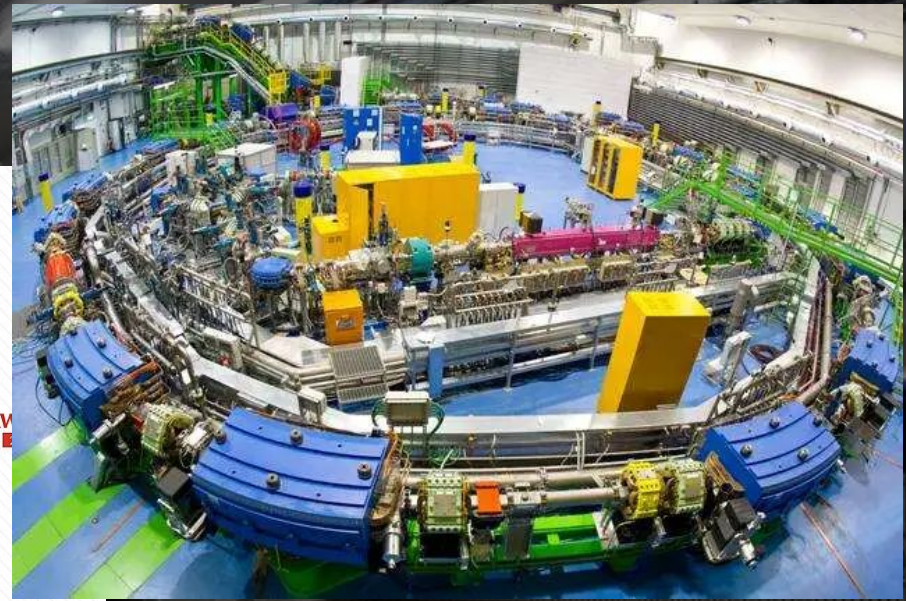
**Fundamental
understanding of
Physics**

+

Engineering



C.C. - Electric and Magnetic Fields



Source: [CERN](https://cern.ch)

1959 - Proton Synchrotron
Radius = 72 m Energy = 25 GeV

Synchrotron in Italy
Radius = 12 m
Energy = 400 MeV

Source: [CERN Courier](https://cern.ch)

Current State of Radiotherapy

Radiotherapy

Photons

**“X-Rays”
5 - 25 Mev**

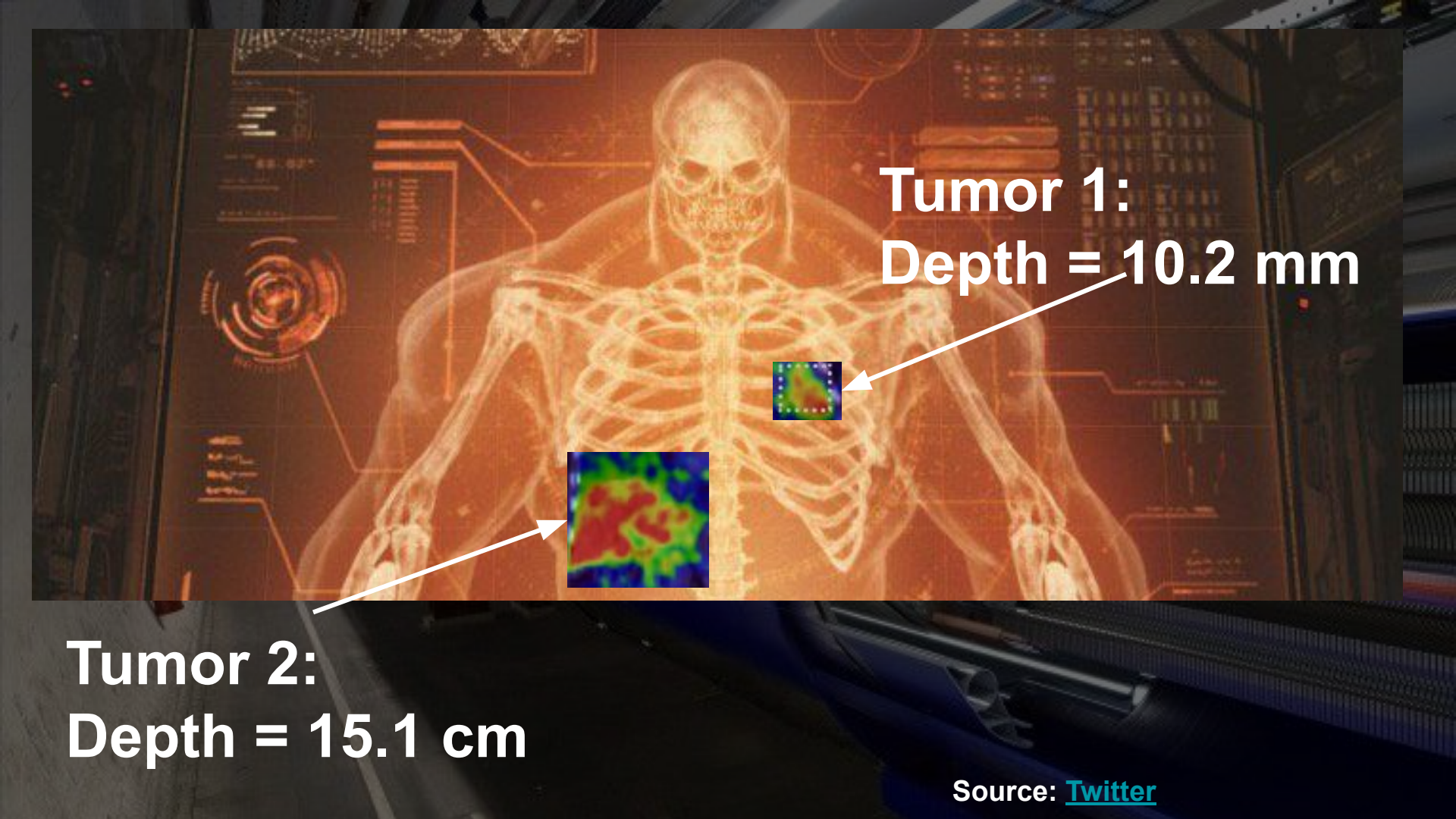
**Future:
IORT, ESRT**

Leptons

**Electrons
5 - 25 MeV**

Hadrons

**p⁺ and carbon
nuclei
50 - 400 MeV/u**



**Tumor 1:
Depth = 10.2 mm**

**Tumor 2:
Depth = 15.1 cm**

A photograph of a linear accelerator (LINAC) in a radiotherapy department. The machine is a long, blue, cylindrical structure with various pipes and components. A fire extinguisher is visible on the left side of the machine. The background shows a concrete wall and ceiling with various pipes and electrical conduits.

GOAL of Radiotherapy
Kill Tumor Cells while
not harming healthy
cells!

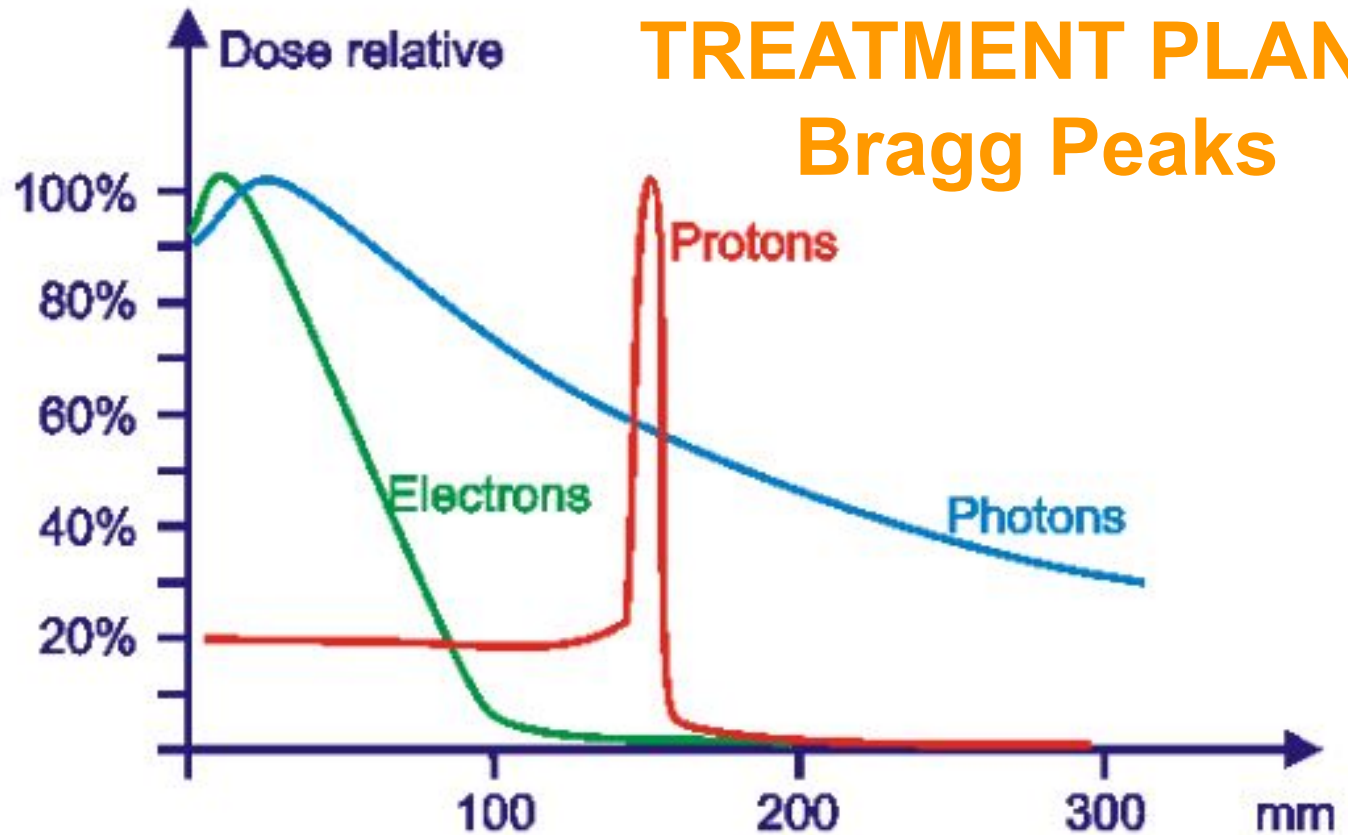
**“You have a tumor. Take
2 pills of 20 MeV
radiation and see me in
the morning!”**



**What is the problem
with this treatment
plan?**

What information does the x axis tell us?

What information does the y axis tell us?

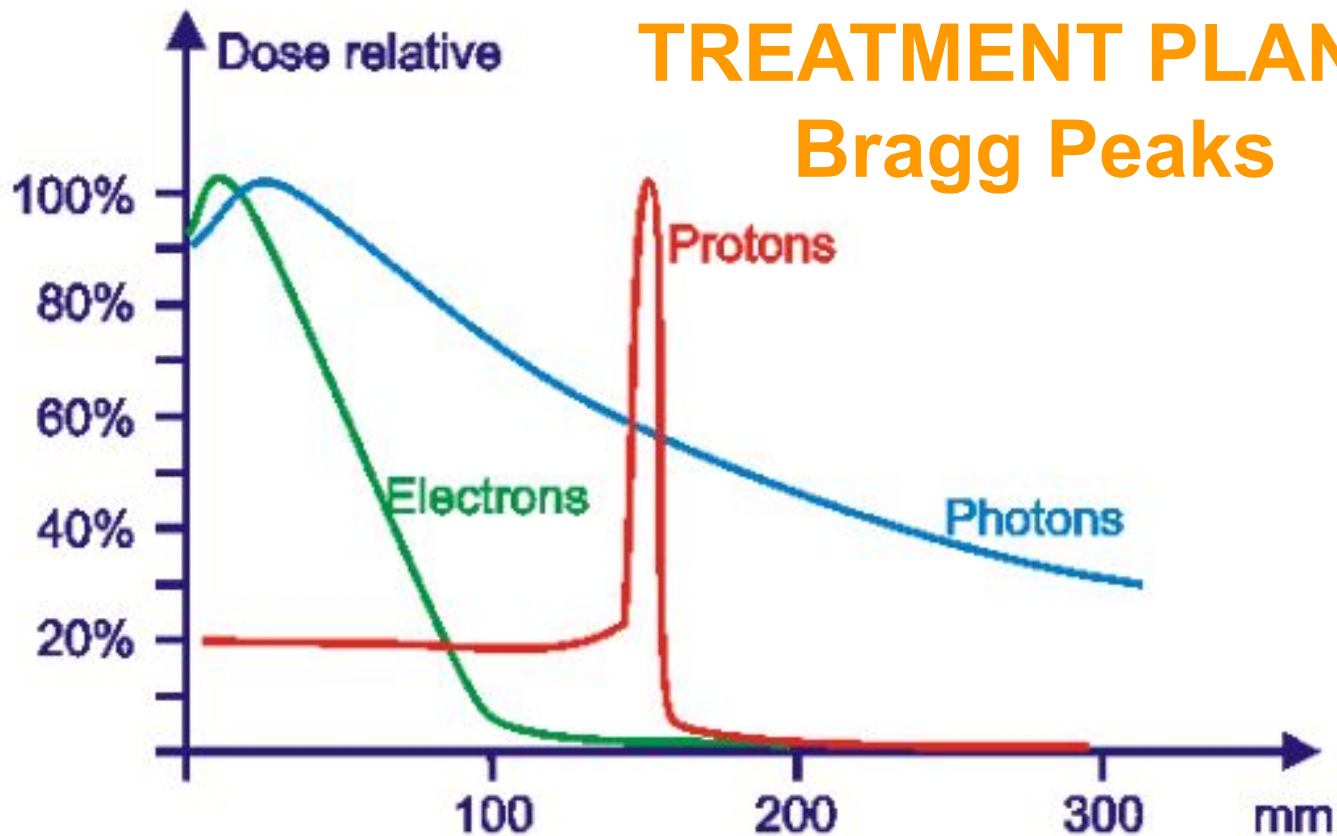


Tumor 1:

Depth = 10.2 mm

Tumor 2:

Depth = 15.1 cm



The Hulk is “Cured”!



Source: [Looper](#)

Source: [Reddit](#)



Medical *Misapplications*



Radiation quackery



- Toothpaste
- Thorium
- Manufacturer claim: Antibacterial action
- ~1920-1945
- Germany

Author Suit

Photo taken in Technisches Museum Wien (Vienna Technical Museum) cropped and edited

https://en.wikipedia.org/wiki/Doramad_Radioactive_Toothpaste

Radiation quackery

- Cosmetic products
- Radium and Thorium
- Manufacturer claim:
Activate circulation,
firm the tissue...
- ~1930-1950
- France



Radiation quackery

- Virility enhancer
- Radium
- Manufacturer claim: Applies energizing gamma rays
- ~1920-1930
- USA

<https://edition.cnn.com/2014/04/08/living/gallery/e-squire-grooming-habits/index.html>



NEW ENERGY FOR WEAK, SAGGING MEN



Testone Radium Energizer and Suspensory
Contains 20 Micrograms Refined, Measured Radium

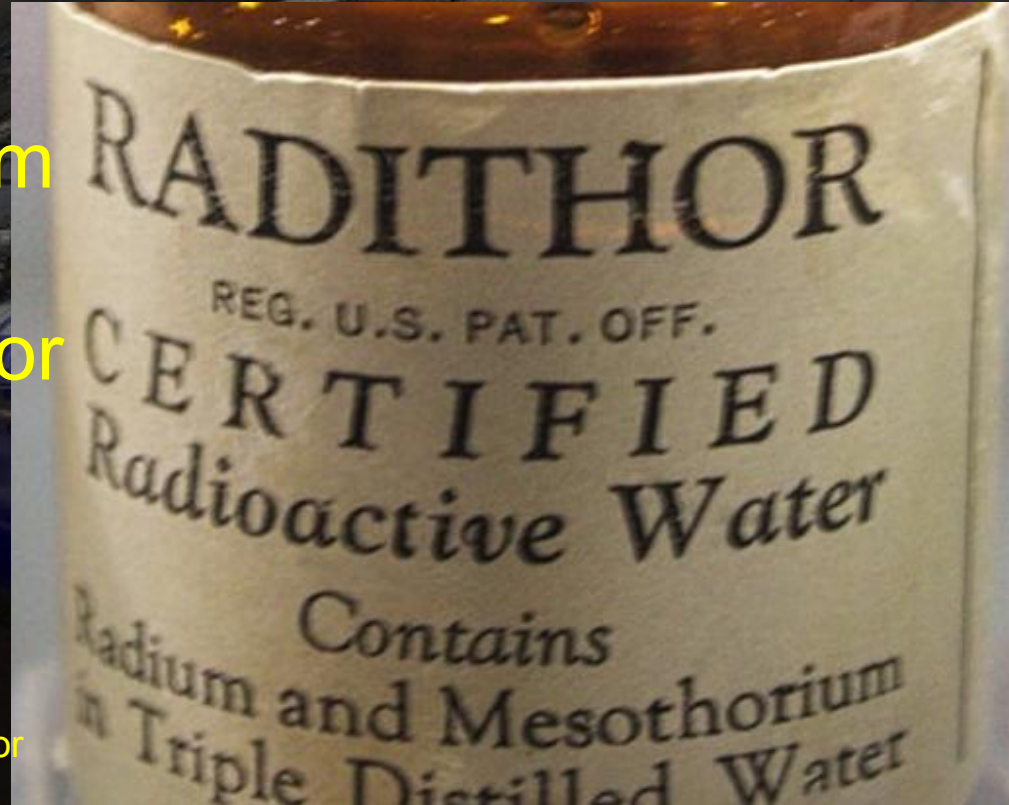
For that sagging, dragging weight that pulls you down and saps your energy—and for losing up and finishing strength in that act of all male activity—the Testone Radium Energizer and Suspensory is your answer!

We GUARANTEE that the Testone Radium Apparatus contains only purified, highly refined radium salts, free from all known toxic substances. Actually contains 20 micrograms of this precious substance.

Radiation quackery

- Radium, mesothorium
- Manufacturer claim: Energizing; “A cure for the living dead”
- ~1918-1928
- USA

<https://www.mcgill.ca/oss/article/quackery/radithor>



NEWS

Tech

ADVERTISEMENT

Anti-5G necklaces found to be radioactive

17 December 2021



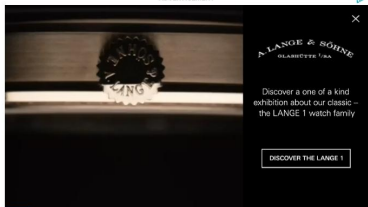
Necklaces and accessories claiming to "protect" people from 5G mobile networks have been found to be radioactive.

The Dutch authority for nuclear safety and radiation protection (ANVS) issued a warning about ten products it found gave off harmful ionising radiation.

It urged people not to use the products, which could cause harm with long-term wear.

There is no evidence that 5G networks are harmful to health.

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1 hour ago

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2 hours ago

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東亞投資
eastspring investments

憑藉我們在 11 個亞洲市場建立無可比擬的業務網絡，把握亞洲投資機會。

7 個類別

- 東亞投資 - 日本動力 股票基金
- 東亞投資 - 亞洲高收益 債券基金
- 東亞投資 - 亞洲科技股 債券基金

<https://www.bbc.com/news/technology-59703523>



Radiation quackery

*The Radium Water
Worked Fine Until
His Jaw Came Off*

* * *

Cancer Researcher Unearths
A Bizarre Tale of Medicine
And Roaring '20s Society

By RON WINSLOW

Staff Reporter of THE WALL STREET JOURNAL
In 1927, a steel mogul and socialite

<http://www.digitalhistoryproject.com/2011/10/american-golf-in-1903-walter-j-travis.html>



EBEN M. BYERS, OF THE ALLEGHENY COUNTRY CLUB, WHO DEFEATED TRAVIS IN LAST YEAR'S CHAMPIONSHIP TOURNAMENT, AND WAS THE RUNNER-UP BOTH IN 1902 AND IN 1903.

From a photograph by Falk, New York.

The Goiânia 1987 accident



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THE FUTURE

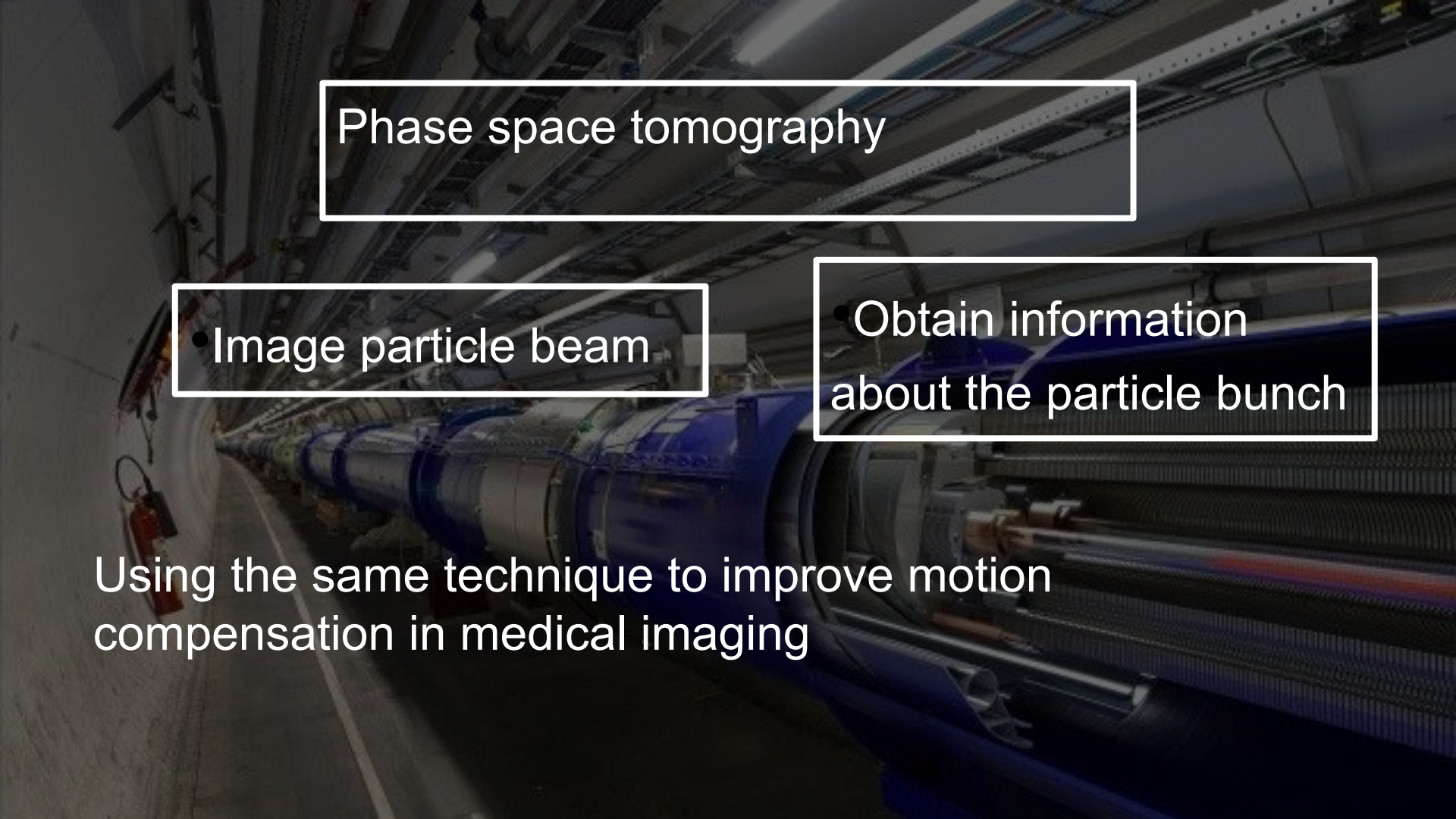


Future scope in imaging

- • Detector development
- • Data analysis techniques
- • Radiation therapy
- • Imaging in extreme environments
- • New imaging modalities

Future scope of beam therapy in Particle Physics

- • Improved treatment accuracy
- • Enhanced particle beams
- • Research into new particles
- • Accessibility and affordability



Phase space tomography

- Image particle beam

- Obtain information about the particle bunch

Using the same technique to improve motion compensation in medical imaging