



## Medical applications of particle physics: Global Teaching Perspectives

Chi Anye Terence

Girbovan Dorina Anca

Priedite Anda

Sapountzi Lemonia

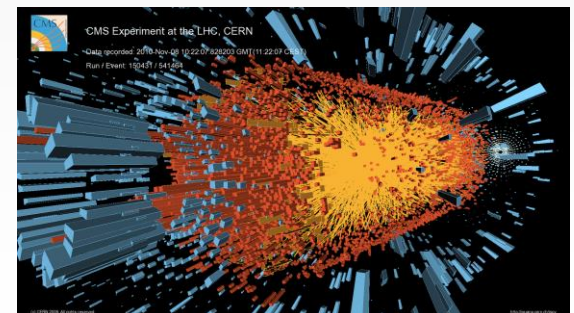
Stein Aissa





# Curriculum & classroom connections

- It should be mandatory for all students to have at least basic exposure to particle physics topics, specifically applications to medicine
- A motivating factor for students to pursue careers in related fields





# Curriculum & classroom connections



## Physics curricula of the 5 different countries:

- Effects of radioactivity in living organisms, diagnostic tools (X-rays, CAT, MRI) and their operating principles with the advantages and disadvantages of these three methods (English subsystem of education in Cameroon, for the Cambridge system in Romania, for the Ontario provincial curriculum in Canada and for the Latvian system)
- Includes PET ( Ontario - Canada)
- Greece briefly mentions the basic concepts associated with such technologies



# Curriculum & classroom connections



**Missing** in the **Physics curricula** of the 5 different countries:

- the most recent advances in the field such as hadron therapy and carbon ions
- economic and political aspects of the medical applications

**Proposal:**

- the curricula should be revised more often in order to include updated content
- the research facilities should have a stronger focus on sharing recent findings with the teaching community, through websites, workshops and the development of teaching materials.



## Key ideas



For medical application of particle physics to have meaningful instruction in high schools it is imperative for students to know why particle physics matters.

**Particle physics has revolutionized the way we look at the universe.**

Along the way, it has made significant impacts on other fields of science including medicine. In particular, CT, MRI and PET scans now allow doctors to peer inside the human body to see what is wrong.



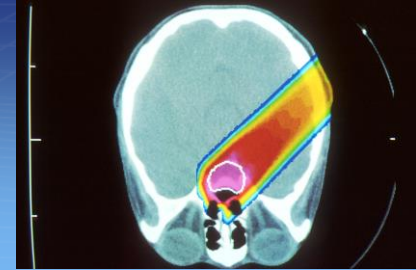
## Key ideas / Medications



- Many **medications** evolved out of particle physics research.
- Once a disease is diagnosed, it is up to the doctors to determine how best to treat it. Prescription medications are often the first choice of doctors
- Drugs developed:
  - Kaletra, one of the most prescribed AIDS medications
  - Tamiflu, an antiviral treatment that slows the spread of influenza



# Key ideas / Treatment options





- Classroom:
  - the basic physics concepts associated with the technologies, their medical purposes and effectiveness
  - the costs involved for the patients and the health care providers and general challenges in the implementation and distribution of technology
  - exploration of career paths in the field and the main functioning centers around the globe
  - a brief discussion of cancer,
  - a brief historical and conceptual discussion of antimatter might be helpful in teaching PET



# Potential student conceptions & challenges



- Most students seem to relate to the concept of X-ray imaging 
- Challenges: 
  - how the images are obtained
  - the construction and operation of the equipment
  - understanding which particles react with matter and how, according to their properties (mass, charge etc.)
  - what is their effect on living organisms





# Potential student conceptions & challenges/ Terms



- CAT, MRI and PET in particular are more challenging
  - understand which physical properties are being applied to diagnose and cure
- Certain terms are also unfamiliar for most students, in particular “resonance”, “axial tomography” and “positron”, among others



# Helpful material and resources / TES

Particle physics

Search

Refine by

1-21 of 1,898 Resources

Sort by Relevance

Discounted resources

Ages

11-14

14-16

16+

Subjects

Physics

School system

**GCSE AQA Physics - Particle Model of Matter**  
Bundles covering the unit of 'Particle Model of Matter' for the NEW AQA GCSE  
By Nteach

7 RESOURCES Save 43%  
£21.00 value **£11.99**

**QUARKS AND LEPTONS - FUNDAMENTAL PARTICLES AND Mesons? Bosons? Antimatter? Welcome**  
By scigeeks

(1) ★★★★★ **£3.00**

**A-level Physics Edexcel (as of 2015): Particle Physics**  
These lessons are in line with the new specification and include many questions  
By drbiophysics

(0) ★★★★★ **£14.00**

## Resource types

- Presentation (472)
- Activity (433)
- Other (429)
- Worksheet (391)
- Revision (302)
- Lesson plan (286)
- Unit of work (155)
- Assessment (101)
- Whole lesson (88)
- Game, puzzle, quiz (79)
- Display and posters (45)
- Lesson starter (10)
- Video (9)
- Homework (8)
- Clip Art (7)
- Assembly (3)
- For parents (1)
- Music (1)

<https://www.tes.com/teaching-resources>



# Helpful material and resources



Check out [MyTE](#)



[BROWSE](#) [ABOUT TE](#) [SOCIAL](#) [ABOUT ENGINEERING](#) [GET INVOLVED](#) [EDUCATIONAL STANDARDS](#)

Search



## Browse Curriculum

[Home](#) > [Browse](#) > [Curriculum](#)

Showing items 1-10 of 32

### Narrow Results

MRI

#### Curriculum Type

- Activity
- Lesson
- Curricular Unit
- Sprinkle
- Maker Challenge

What's the difference between lessons, activities, units, sprinkles, and maker challenges?

#### Grade Level

Grades K - 12

#### Subject Area

All Subject Areas

### MRI Safety Grand Challenge — Curricular Unit

**Grade Level:** 12 (11-12)

**Engineering Category:** Partial design

**Total Time:** 900 minutes

Students are given an engineering challenge: A nearby hospital has just installed a new magnetic resonance imaging facility that has the capacity to make 3D images of the brain and other body parts by exposing patients to a strong magnetic field. The...



### Solenoids — Lesson

**Grade Level:** 12 (11-12)

**Engineering Category:** Relating science and/or math concepts to engineering

**Total Time:** 50 minutes

In this lesson about solenoids, students learn how to calculate the magnetic field along the axis of a solenoid and then complete an activity exploring the magnetic field of a metal slinky. Solenoids form the basis for the magnets of MRIs. Exploring...

### Slinkies as Solenoids — Activity

**Grade Level:** 12 (10-12)

**Engineering Category:** Relating science and/or math concepts to engineering

**Total Time:** 50 minutes

Students use a classic children's toy, a metal slinky, to mimic and understand the magnetic field generated in MRI machines. The metal slinky mimics the magnetic field of a solenoid, which forms...

[www.teachengineering.org](http://www.teachengineering.org)



# Helpful material and resources / UCB

**PhET**  
INTERACTIVE SIMULATIONS

University of Colorado Boulder

**Simulations**

- New Sims
- HTML5
- Physics
  - Motion
  - Sound & Waves
  - Work, Energy & Power
  - Heat & Thermo
  - ▶ **Quantum Phenomena**

Thumbnail 1: Rutherford Scattering

Thumbnail 2: Photoelectric Effect

Thumbnail 3: Quantum Tunneling and Wave Packets

- Simulations**
- New Sims
  - HTML5
  - Physics
    - Motion
    - Sound & Waves
    - Work, Energy & Power
    - Heat & Thermo
    - ▶ **Quantum Phenomena**
    - Light & Radiation
    - Electricity, Magnets & Circuits
  - Biology
  - Chemistry
  - Earth Science
  - Math
  - By Grade Level
  - By Device
  - All Sims
  - Translated Sims
  - Teaching Resources**
  - Research**
  - Accessibility**
  - Donate**

<https://phet.colorado.edu/en/simulations>



# Best practice example

- Simulations and videos
- Field trips
- Class discussion
- Interdisciplinary lessons
- CERN





# Thank you CERN

- Merci



- Mulțumesc



- Paldies



- Ευχαριστω



- Thank you

