

Medical Applications of Particle Physics

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This is Federico.

Federico is 17
years old.

Federico lives in Italy.



Federico is very
smart.



Federico doesn't care
much about Physics.

Federico just wants to play guitar, go camping with friends, and tell the tales of life through his stamps.



Federico
is an
Italian
Stallion.



This is what Federico knows.

Federico is very smart.

6.4.2 Fundamental particles

Learning outcomes

Learners should be able to demonstrate and apply their knowledge and understanding of:

- (a) particles and antiparticles; electron–positron, proton–antiproton, neutron–antineutron and neutrino–antineutrino
- (b) particle and its corresponding antiparticle have same mass; electron and positron have opposite charge; proton and antiproton have opposite charge
- (c) classification of hadrons; proton and neutron as examples of hadrons; all hadrons are subject to both the strong nuclear force and the weak nuclear force
- (d) classification of leptons; electron and neutrino as examples of leptons; all leptons are subject to the weak nuclear force but not the strong nuclear force
- (e) simple quark model of hadrons in terms of up (u), down (d) and strange (s) quarks and their respective anti-quarks
- (f) quark model of the proton (uud) and the neutron (udd)
- (g) charges of the up (u), down (d), strange (s), anti-up (\bar{u}), anti-down (\bar{d}) and the anti-strange (\bar{s}) quarks as fractions of the elementary charge e
- (h) beta-minus (β^-) decay; beta-plus (β^+) decay
- (i) β^- decay in terms of a quark model;
$$d \rightarrow u + {}_{-1}^0e + \bar{\nu}$$
- (j) β^+ decay in terms of a quark model;
$$u \rightarrow d + {}_{+1}^0e + \nu$$
- (k) balancing of quark transformation equations in terms of charge
- (l) decay of particles in terms of the quark model.

This is what Federico needs to know.
Federico does not care.

6.5.2 Diagnostic methods in medicine

Learning outcomes

Learners should be able to
apply their knowledge of

- (a) medical tracers; fluorine-18
- (b) gamma camera; scintillator; display; for
- (c) diagnosis using
- (d) positron emission; annihilation of positron; of image
- (e) diagnosis using PET scanning.

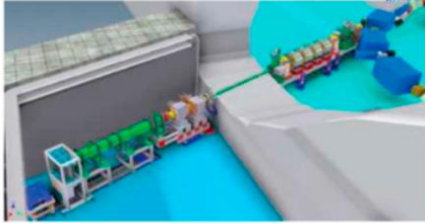
Teacher Challenge

How Do we
Deal with
Federico?

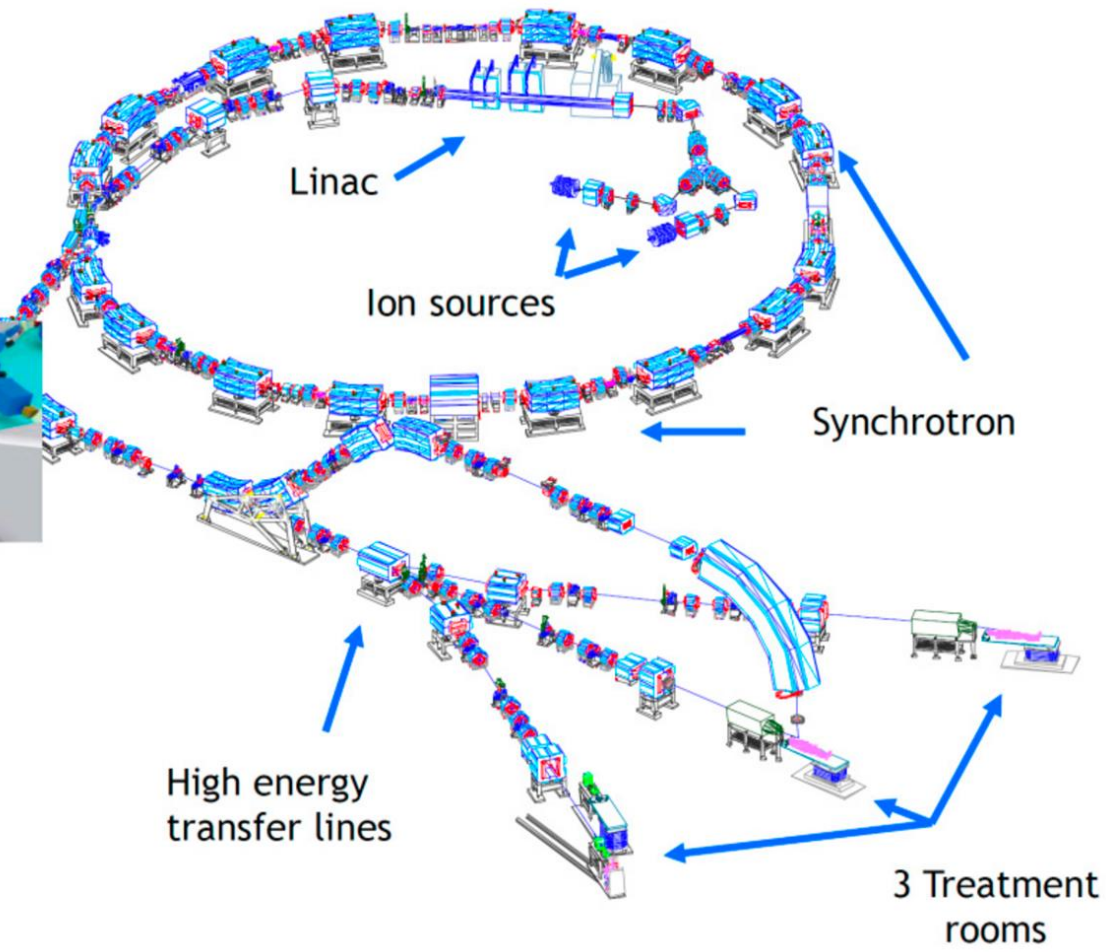
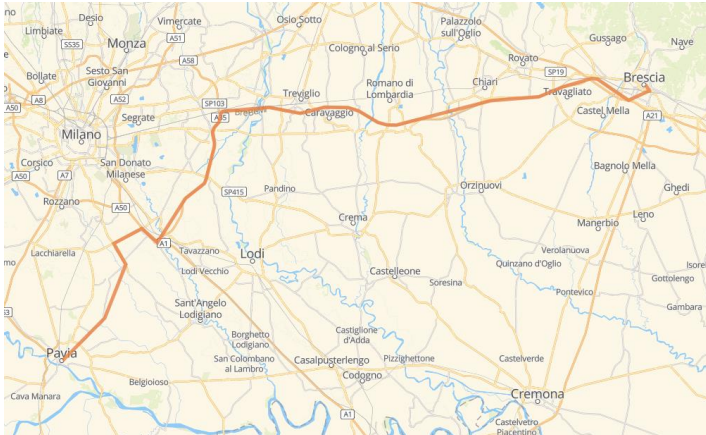
How do we meet Federico's needs?
Physics?

How do we meet Federico's needs?
Particle Physics?
How applicable and
relevant is Particle Physics and
the world?





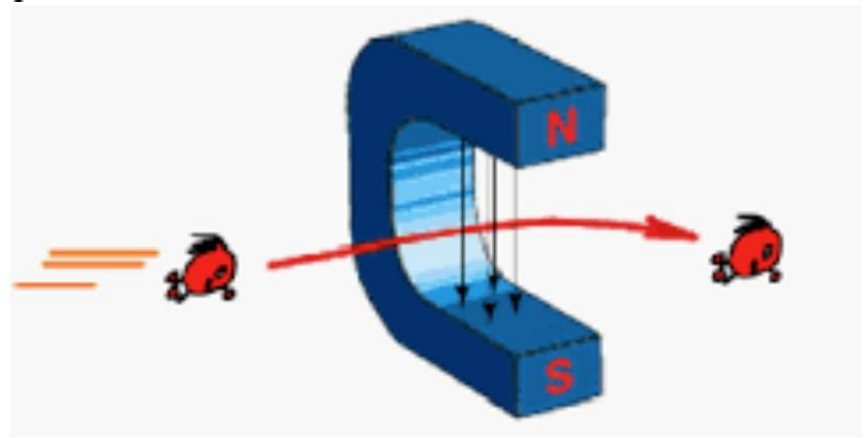
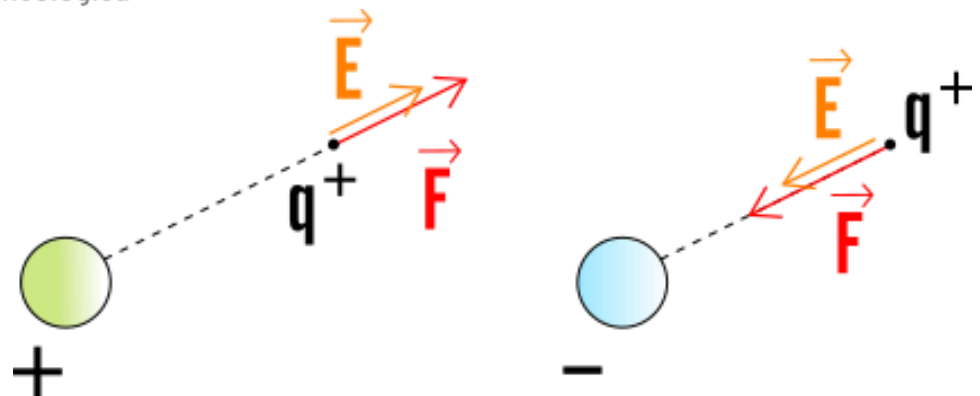
Research room



CNAO

Centro Nazionale di Adroterapia Oncologica









Who is your Federico?

How could you inspire
your Federico in
Particle Physics?

Radon Gas Exposure: 2nd Leading Cause of Lung Cancer

Radon measurements are required in NJ for all real estate transactions.

Students will use small containers of activated charcoal (found in cat litter) to sample home radon levels.

Relative radon levels will be compared using homemade cloud chambers.

Students may have recent home measurements for calibration.

Other particle tracks will be observed and discussed.

Resources

- A Level Physics OCR Specification:
<https://www.ocr.org.uk/images/171726-specification-accredited-a-level-gce-physics-a-h556.pdf>
- CNAO: <https://fondazionecnao.it/en/>
- http://hpschapters.org/njhps/science_teachers.php
- https://cdn.egu.eu/static/e638df8d/newsletter/eggs/eggs_32.pdf
- <https://spark.iop.org/collections/teaching-medical-physics>
- <https://njaapt.wildapricot.org/Websites-for-Physics-Teachers>
- <https://perimeterinstitute.ca/teachers>
- <https://per.web.cern.ch/resources>
- <https://www.epa.gov/radtown/particle-accelerators-and-radiation-research>
- <https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1617web-1294055.pdf>
- <https://www.classcentral.com/course/medical-applications-particle-accelerato-12557>

What next?

I have taught Physics for 27 years in my old Government school in India

- I have been the Principal/Education leader in my school since 1st April, 2023.
- I will encourage my fellow colleagues to teach Particle Physics in the school curriculum.
- I encourage you, as leaders and teachers, to think of how you can bring Particle Physics into your schools.