

# Antimatter research

Presented by

Kafiye Atay

Francis Murillo Emralino

Eva Holthe Enoksen

Bruno Hartmann

Zorah Devi Thanimalay



# Curriculum links to Antimatter Research

Grade 11

Grade 10

Grade 08



# Curriculum links to Antimatter Research

Grade 11 electric, magnetic fields

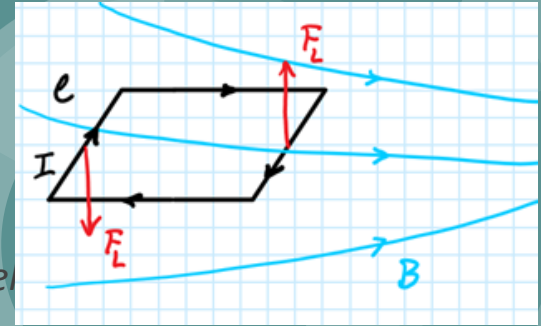
charged particles  
motion

$F_{\text{Lorentz}}$

+ opposite charge „twin“ elements

...mirror symmetry

...current loop model



...magnetic trap

Grade 10

Grade 08

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*...magnetic trap*

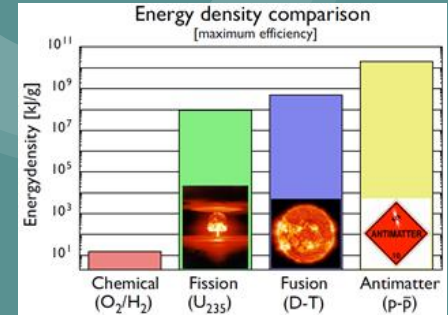
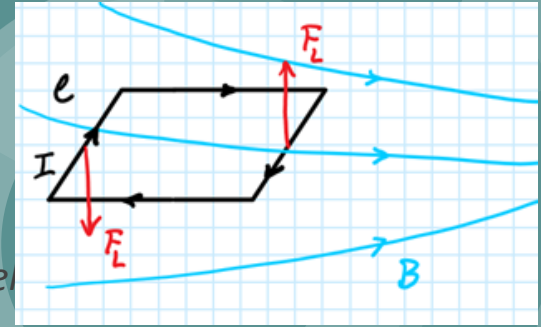
Grade 10 nuclear physics:

protons, neutrons  
fission, fusion

$$E = \Delta m \cdot c^2$$

Grade 08

+ opposite charge „twin“ elements  
*...mirror symmetry*  
*...current loop model*



+ antimatter  
+ annihilation

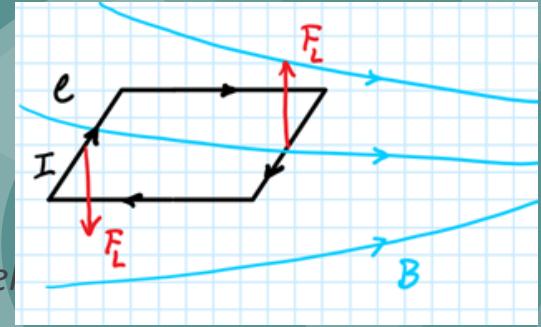
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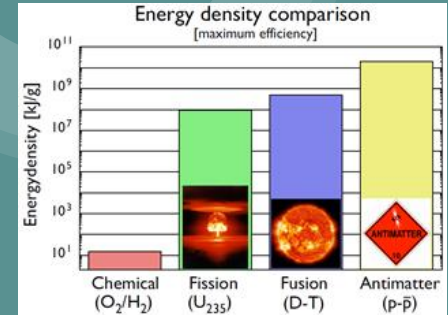
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+ antimatter  
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Grade 08 p<sup>+</sup>, e<sup>-</sup>

electric forces

+ p<sup>-</sup>, e<sup>+</sup>

annihilation

+

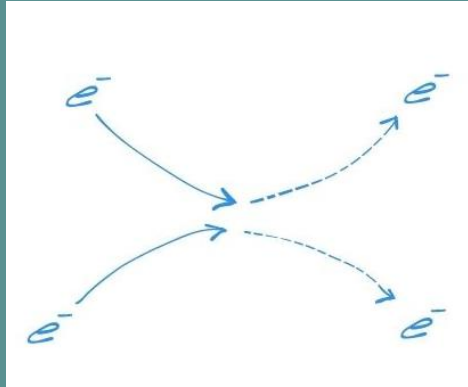
→ atomic model



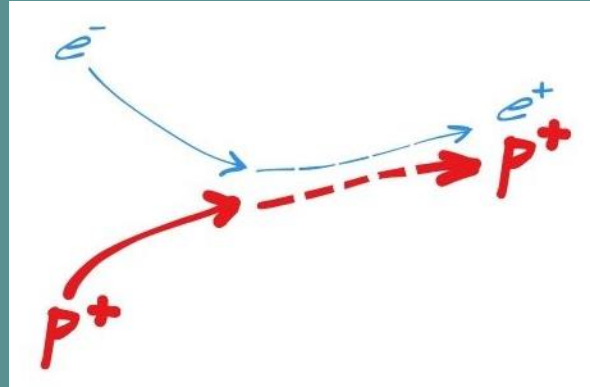
# Key ideas

The universe consists of four elementary building blocks: protons, antiprotons, electrons and positrons. Protons and positrons are positively charged. Antiprotons and electrons are negatively charged. Particles move in straight lines when not interacting.

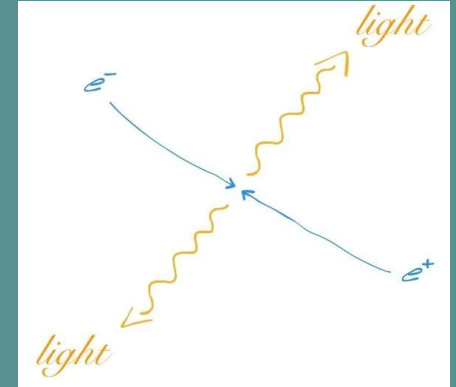
Particles interact in three ways.



Repulsion



Formation of atoms



Annihilation

**Who wants to  
play a game?**

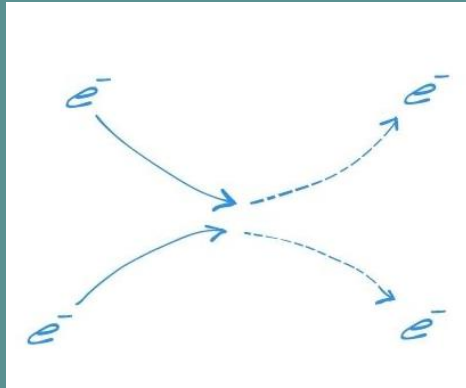


# Game rules

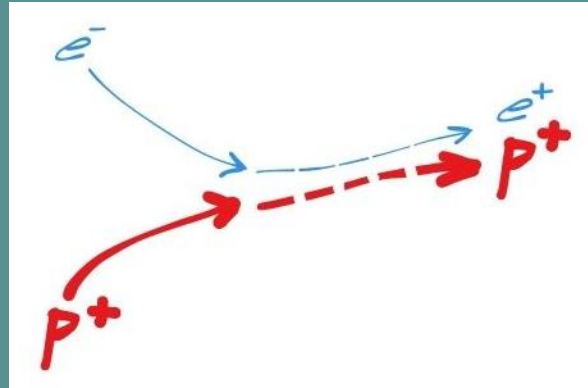
Remember:

- Walk slowly
- Freeze if I clap
- No talking except when interacting

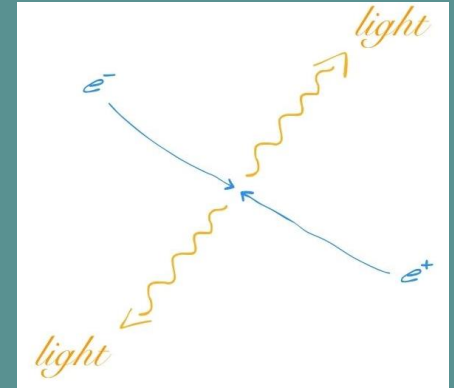
You will take the role of protons, antiprotons, electrons and positrons, as indicated on the sticky notes.  
You move in straight lines when not interacting.  
You interact by shaking hands. Charged matter cannot interact with neutral matter.



Repulsion: Continue in a different direction



Formation of atoms: Create a bound system by linking arms.



Annihilation: Sit down





## What happened?

- Matter and antimatter formed atoms and antiatoms
- Antimatter and matter was annihilated
- A slight imbalance at the beginning affected the result

# STUDENTS' CONCEPTION & CHALLENGES



- Positron can be misinterpreted as proton
- Referring to proton as elementary particles
- If antimatter has reverse charge of matter, then does Antimatter has reverse look from matter? How would the colours be?

# STUDENTS' CONCEPTION & CHALLENGES

- Is there any antimatter left from Big Bang? What will happen if the antimatter touches matter?
- Understanding the rules of the game and to carry out effectively
- How to we see antimatter? Do we need special glasses?

# Helpful Material and Resources

- Young age & challenge
- First talk about antimatter : all first ideas comes from science-fiction.
- Resources clarifies misconceptions
- Using simple examples, then show the real science facts.
- More Modern Physics at younger age
- Catching more attention - in an exciting way
- Increasing the chances - amount of interest in STEM education.

# Resources

- [Particle Adventure](#) (The Fundamental of Matters and Force)
- [3D Periodic Table](#) and [Interactive Periodic Table](#)
- [AAPT-Antimatter Teaching Module](#)
- [The Matter with Antimatter](#) (Youtube Video)
- [PhET Interactive Simulations](#) (Isotopes and Atomic Mass)
- [Antimatter Teaching Modules for students aged 14-15](#) (pdf)
  
- [What Star Trek Teaches Us about Antimatter](#) - Phil Kesten - Thought Leaders - Illuminate (scu.edu)
- [ClassHook | Antimatter Explosion](#)
- [Antimatter in the classroom](#) - CERN Bulletin
- [Antimatter Matters - Lesson](#) - TeachEngineering