UNIVERSITY OF BIRMINGHAM

The Ogden Trust

making physics matter

UKRI Science and Technology Facilities Council

THE WORLD OF PARTICLES

and their interactions

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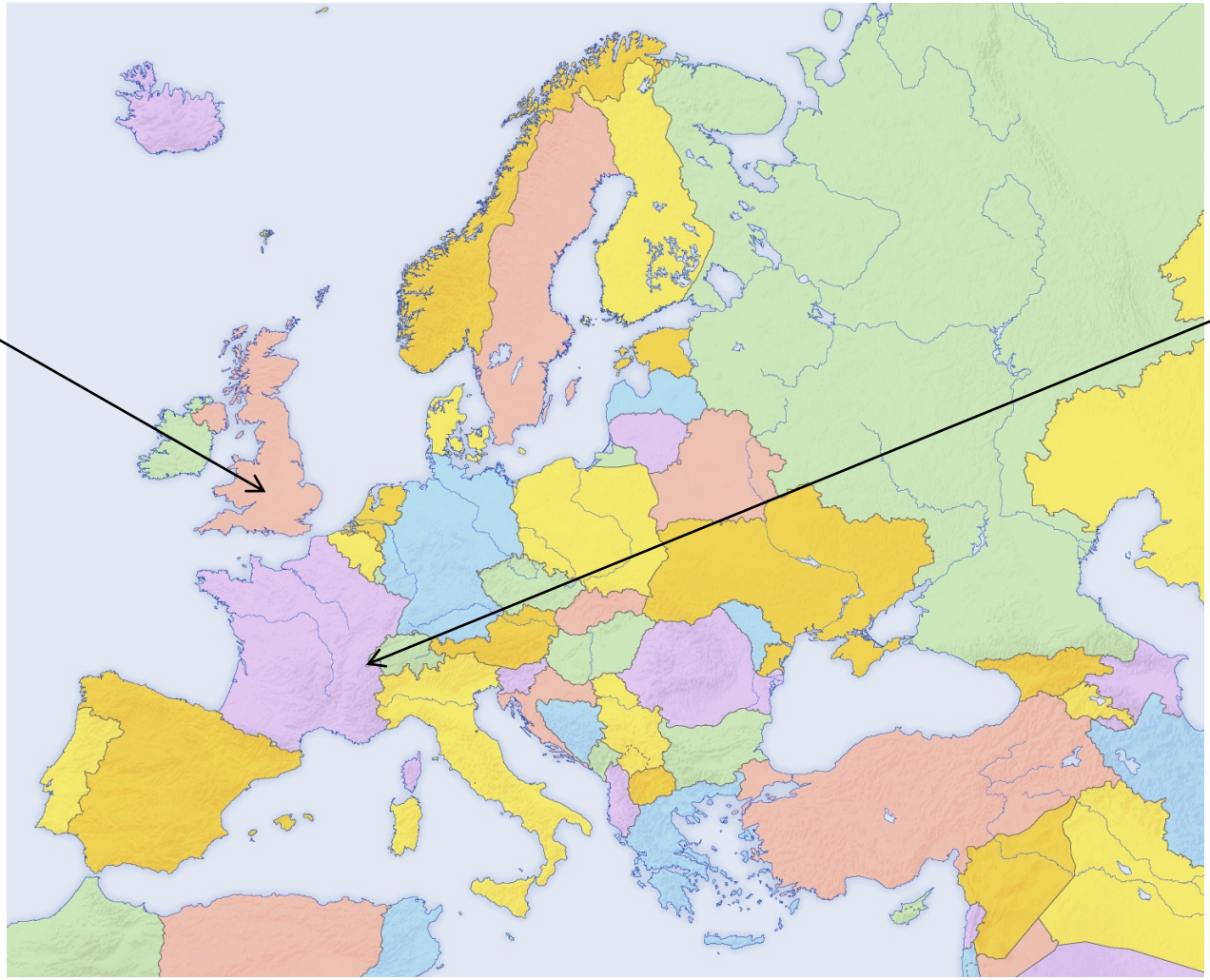
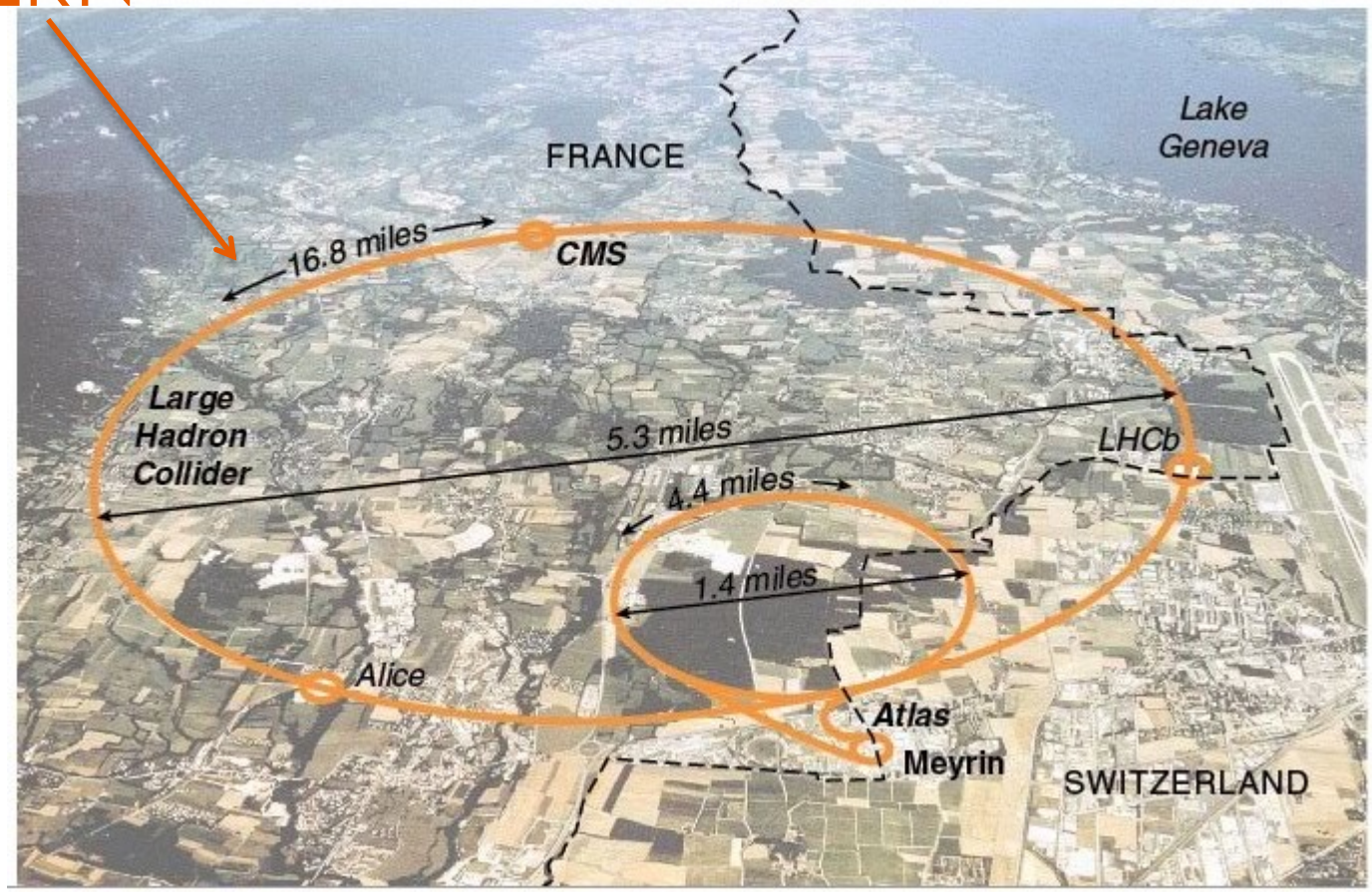
Where is CERN?



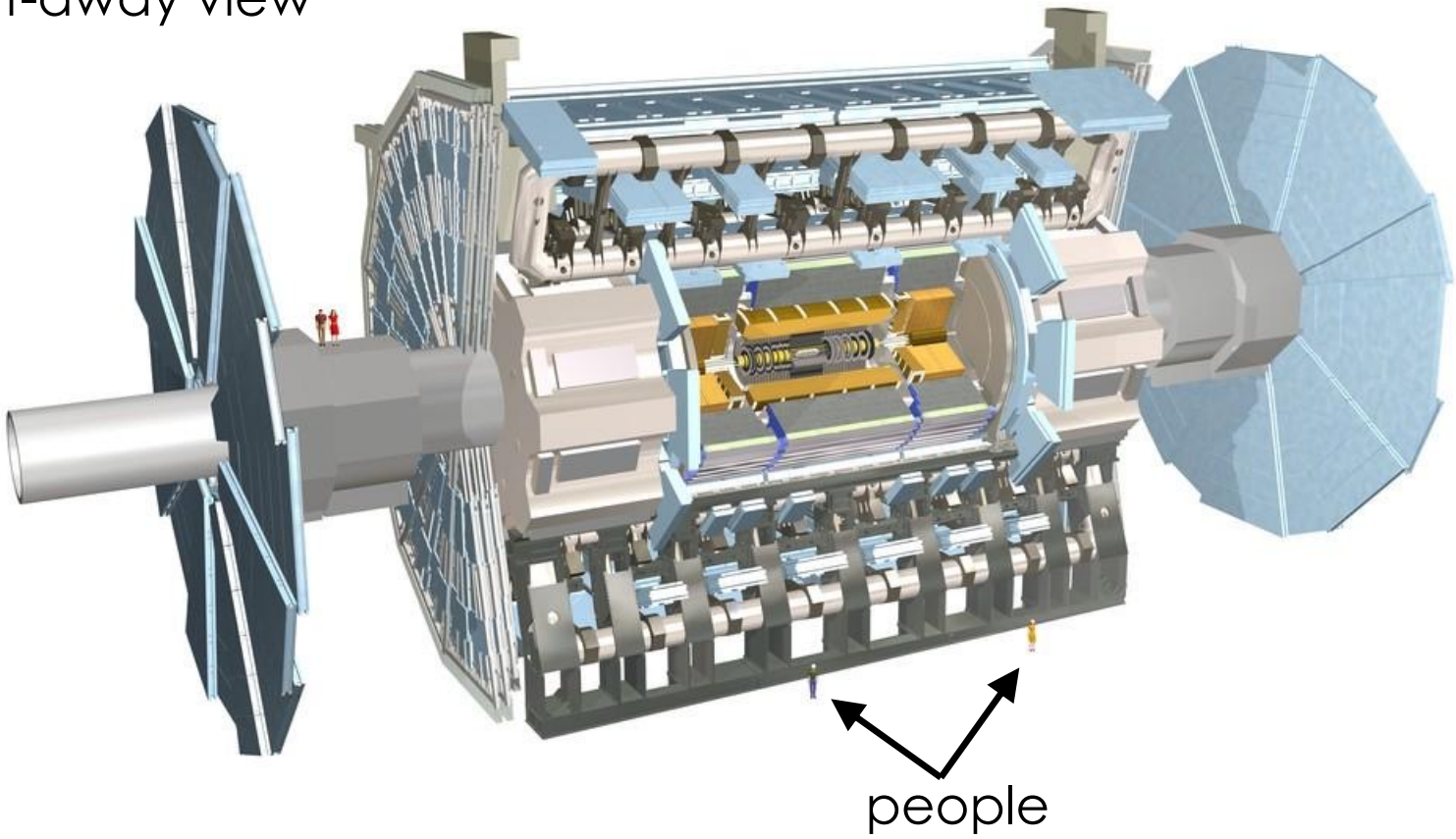
The Large Hadron Collider at CERN

CERN

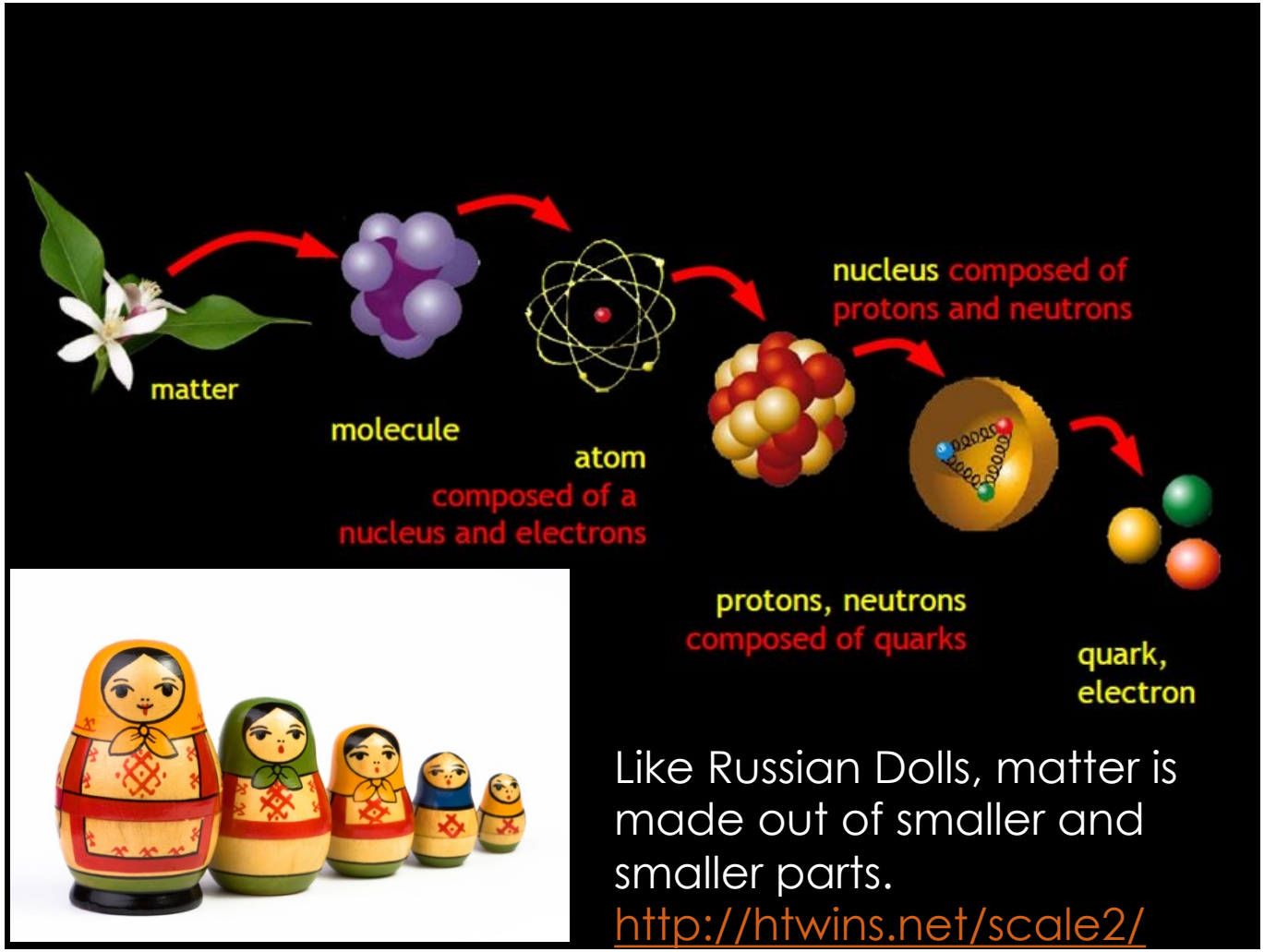


What is ATLAS?

cut-away view



What are the building blocks of materials?



Like Russian Dolls, matter is made out of smaller and smaller parts.
http://htwins.net/scale2/

The particle zoo: the Quark family

 **Name:** Up **Surname:** Quark	 **Name:** Charm **Surname:** Quark	 **Name:** Top **Surname:** Quark
 **Name:** Down **Surname:** Quark	 **Name:** Strange **Surname:** Quark	 **Name:** Beauty **Surname:** Quark

The particle zoo: the Lepton family

 **Name:** Electron **Surname:** Lepton	 **Name:** Muon **Surname:** Lepton	 **Name:** Tau **Surname:** Lepton
 **Name:** Electron Neutrino **Surname:** Lepton	 **Name:** Muon Neutrino **Surname:** Lepton	 **Name:** Tau Neutrino **Surname:** Lepton

The particle zoo: the Boson family

 **Name:** Gluon **Surname:** Boson	 **Name:** Photon **Surname:** Boson	 **Name:** Z **Surname:** Boson
 **Name:** W Plus **Surname:** Boson	 **Name:** W Minus **Surname:** Boson	 **Name:** Higgs **Surname:** Boson

Matter and Anti-matter

Matter: with one white feature e.g. white hat

Anti-matter: with the same feature in black e.g. black hat

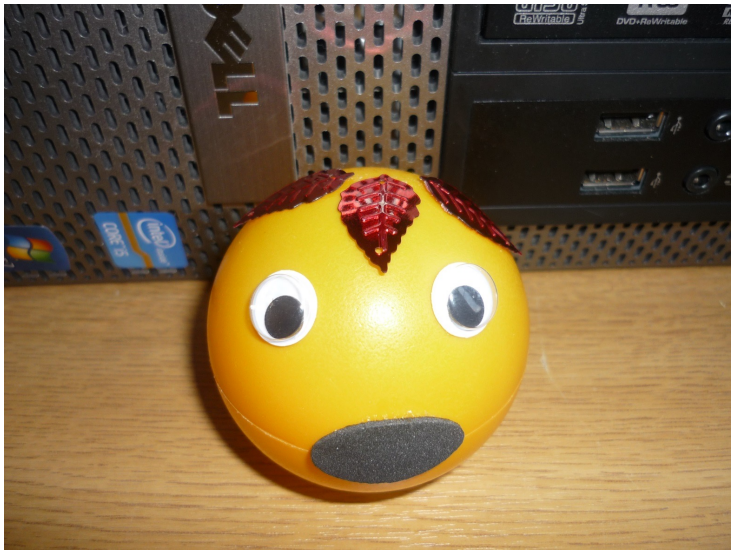
Task 1: Happy Families game

Your aim is to collect all six members of any of the families:

- Quarks
- Anti-quarks
- Leptons
- Anti-leptons
- Bosons

The player who collects the most families is the winner.

Task 2: Make your own particle !



You Will Need!

- Felt shapes/Soft balls
- Glue dots
- Tissue paper
- Pipe cleaners
- Feathers/Sequins/Googly eyes
- Pens/pencils

- Read the trump card of your particle
- Design your particle and draw your design on the trump card
- Give mass to your particle by adding plasticine
- Make your particle using the resources

Task 3: Snap game

Your aim is to collect as many cards as you can from the families of quarks, leptons, bosons.

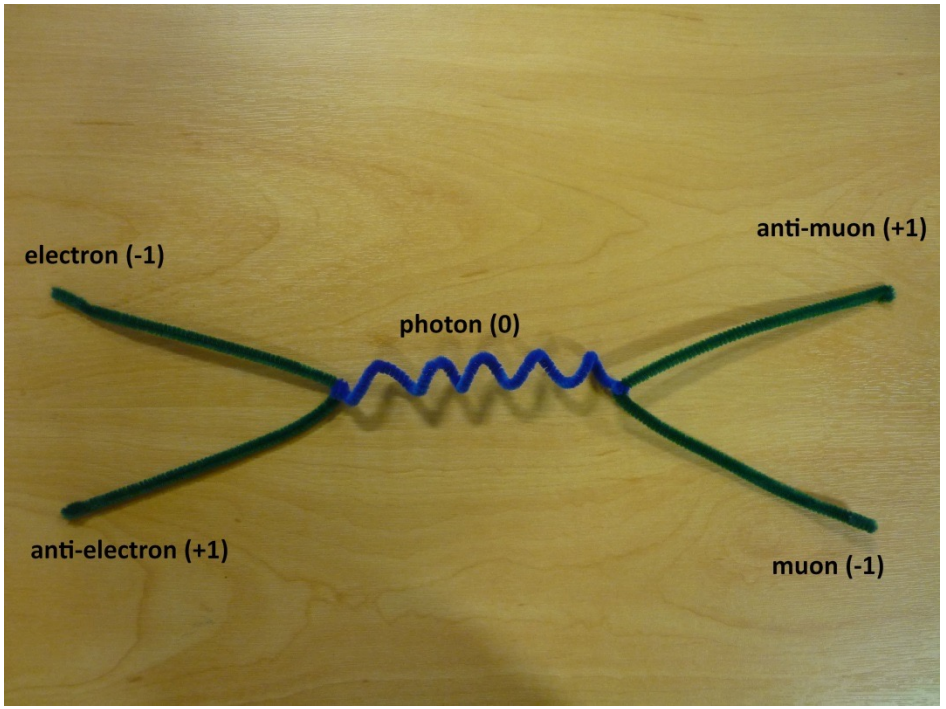
The player who collects the most cards is the winner.

Shout 

when particles **LIKE** each other!

Task 4: Write your own particle story

- Particles meet with each other
- Particles can turn into other particles and then to new particles
- Particle meetings follow the rules of likes and dislikes



Build your own story using pipe cleaners and following one of the examples given.

Example of a story

One sunny day Jimmy the **electron** and Molly the **anti-electron** were playing in their garden eating cookies and drinking orange juice. Jimmy started feeling really hot from the sun. Molly said "oh poor you…". She took his hand to comfort him but suddenly…they both disappeared!

In their place a very greedy **photon** appeared who started eating all the cookies. The cookies were many and the photon got bigger and bigger until… it exploded with a big "splat" sound!

Left behind were two chatty **muons** who immediately started to discuss the wonders of this world and how too many cookies in one go are bad for you…

Feynman Diagrams:

Additional Material
For High School Students

References

- Slide 2: Europe map from http://commons.wikimedia.org/wiki/Atlas_of_Europe
- Slide 3: map of LHC from http://imgarcade.com/1/lhc-map/
- Slide 4: ATLAS from http://atlas.ch/
- Slide 5: building blocks of matter from http://rooksheathscience.com/2014/06/, Russian dolls from http://www.kzero.co.uk/
- Slides 6, 7,8, 9: the particle zoo from http://www.particlezoo.net/
- Slide 12 snap image from http://www.milwaukeemarketingresults.com/Snap-/13194572?pid=283521
- Slide 14: cartoon 1 from http://www.picturesof.net/ cartoon 2 from https://chefpeterpang.wordpress.com/ and cartoon 3 from https://www.colourbox.com