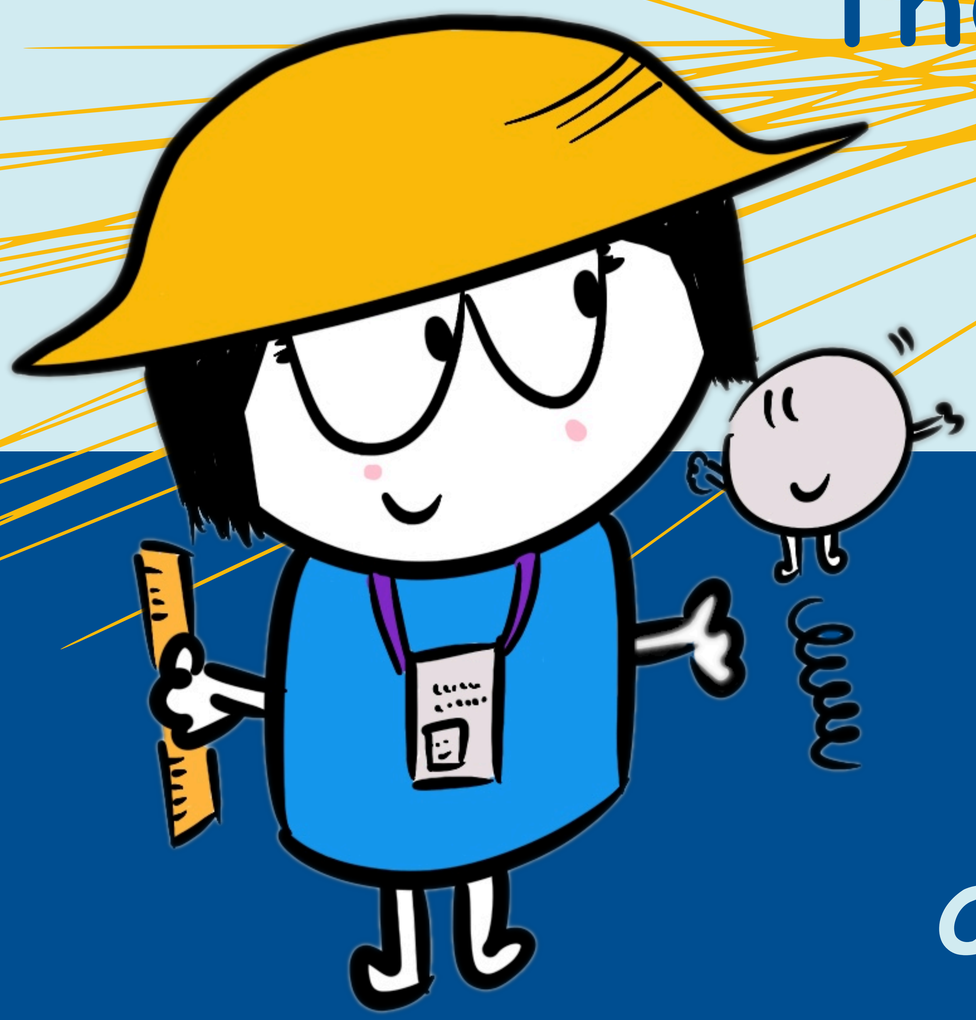
The mysterious world of

LHCb



and its funny quarks

A colouring book full of activities!

The mysterious world of

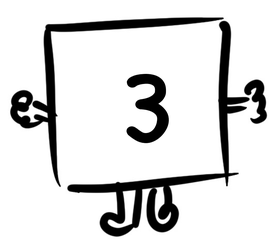
LHCb

and its funny quarks

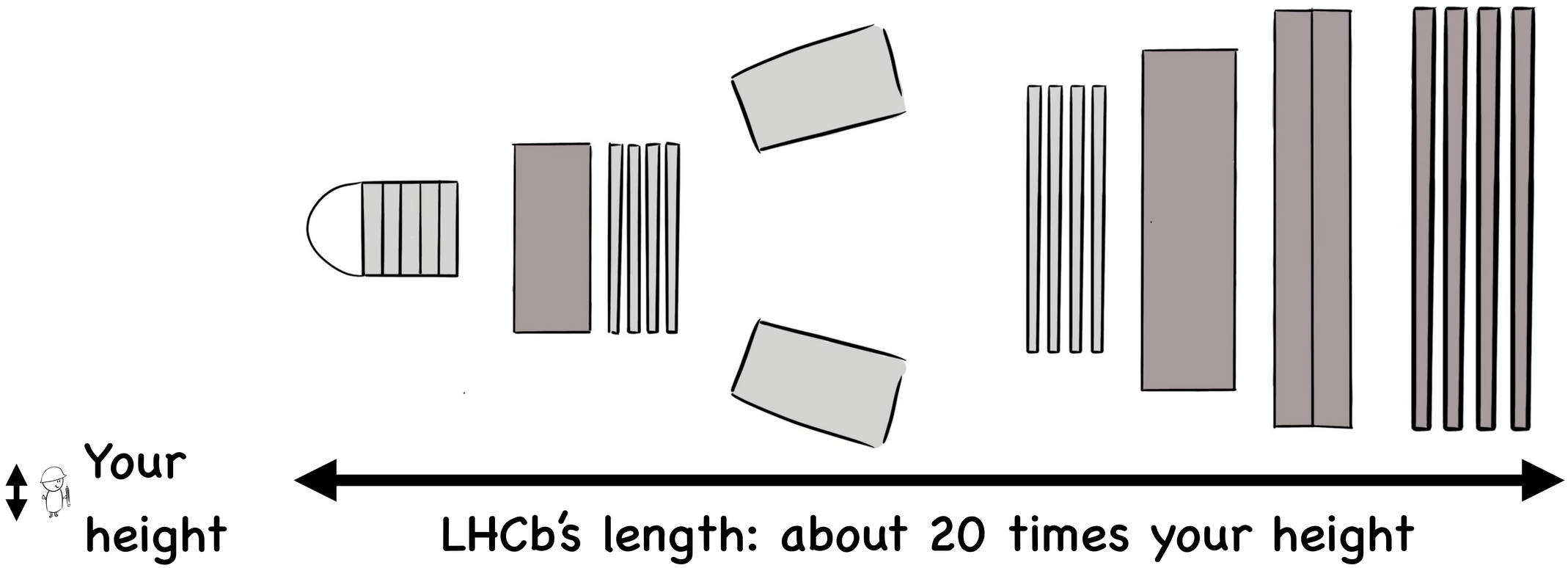
A colouring book full of activities!

The universe is full of mysteries. What are its smallest building blocks? What is the dark matter that is making the stars turn too fast? Are matter and antimatter similar?

Too many questions to be answered by only one person!

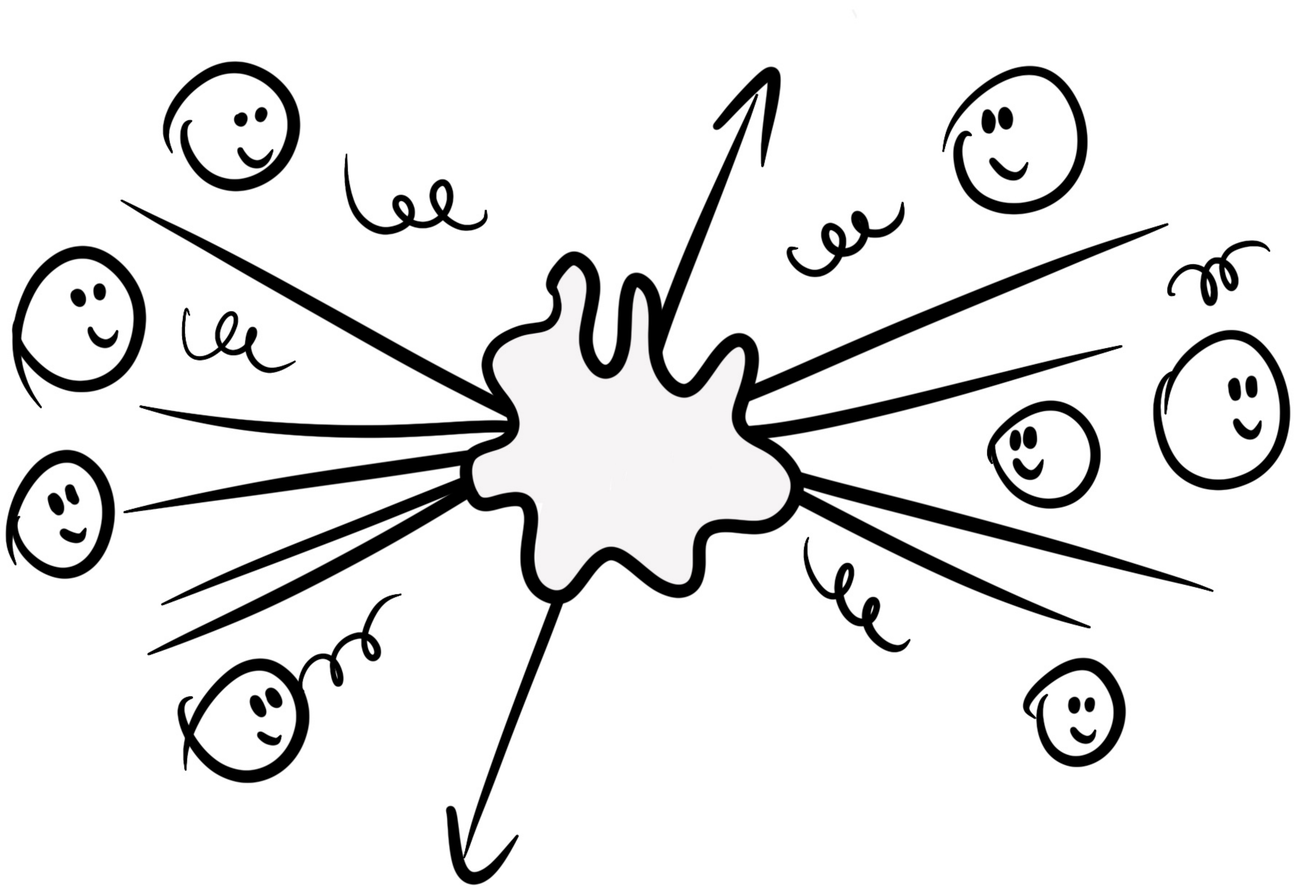


To answer these questions, scientists from the entire world joined their forces. They built a big machine called LHCb to take a picture of the tiny building blocks that make up the universe: particles.

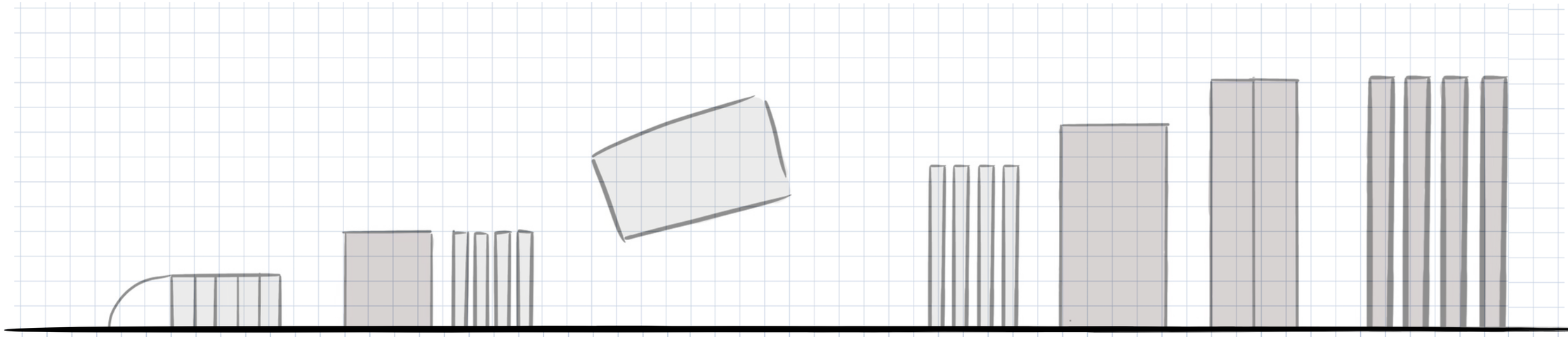


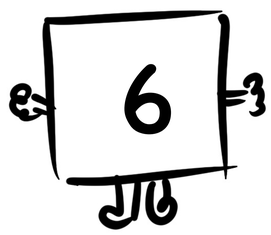
*The different parts of the detector are not represented at the same scale in this drawing.

LHCb takes a picture of particles produced by collisions of protons that circulate in the LHC accelerator at CERN.



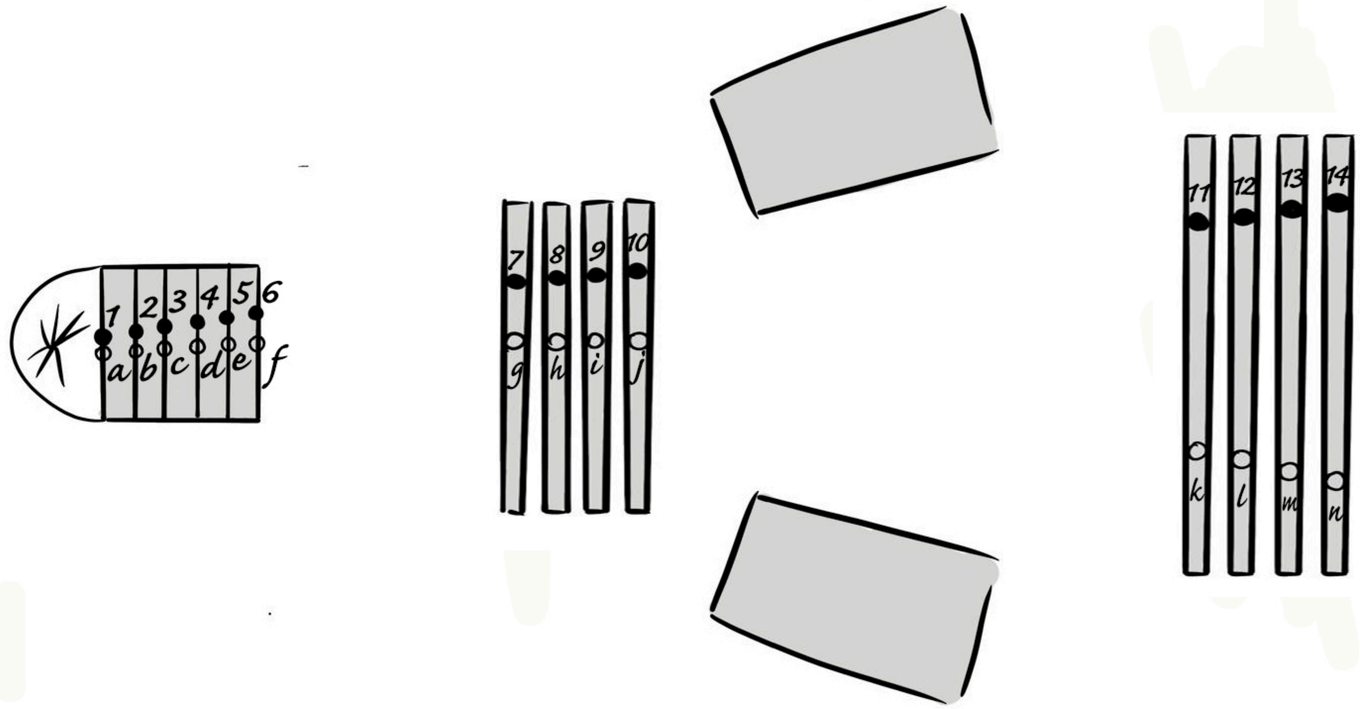
Activity: LHCb is symmetrical. Draw the missing half.





*The different parts of the detector are not represented at the same scale in this drawing.

Particles leave behind signals of their passage (like Tom Thumb's pebbles) as they go through the detector. By joining these small pebbles together, the path of the particle in LHCb can be seen. A slower particle has a path which curves more. The fastest particles have almost completely straight paths.



An electron 

A positron 

Activity: join the numbers to find the path of a particle in LHCb. Do the same with the letters to find the path of the second particle.

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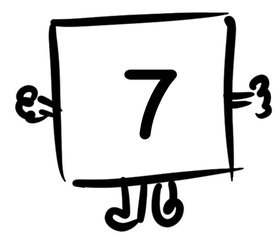
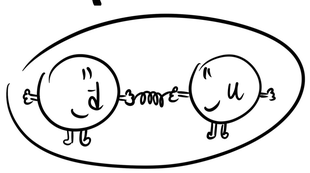


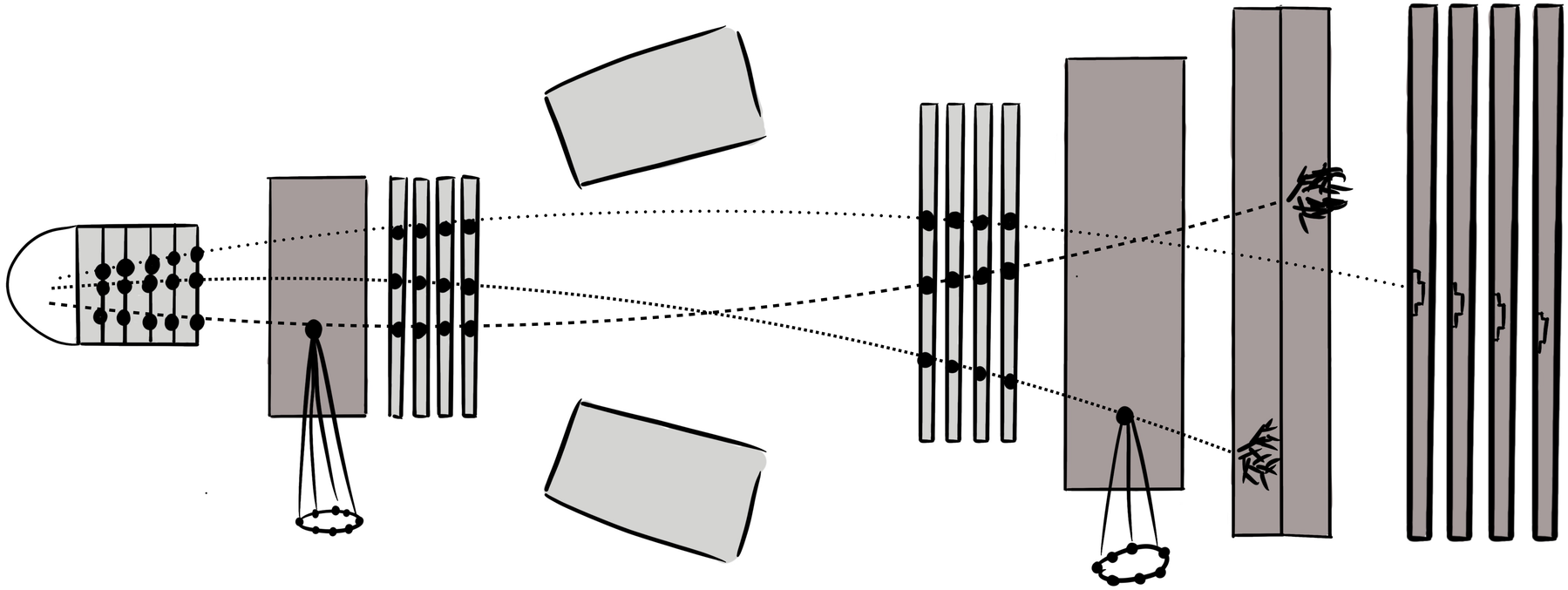
Some parts of LHCb are made to identify different particles. Like your nose lets you know what is in the oven, even if you don't see inside: you know immediately if it is fish or a chocolate cake! In LHCb, each type of particle leaves slightly different footprints that look like rings, twigs or small podiums.

A muon

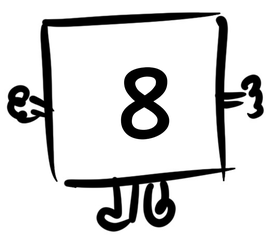
An electron

A pion





Activity: colour each type of particle in a different colour and also the footprints that they left in LHCb.



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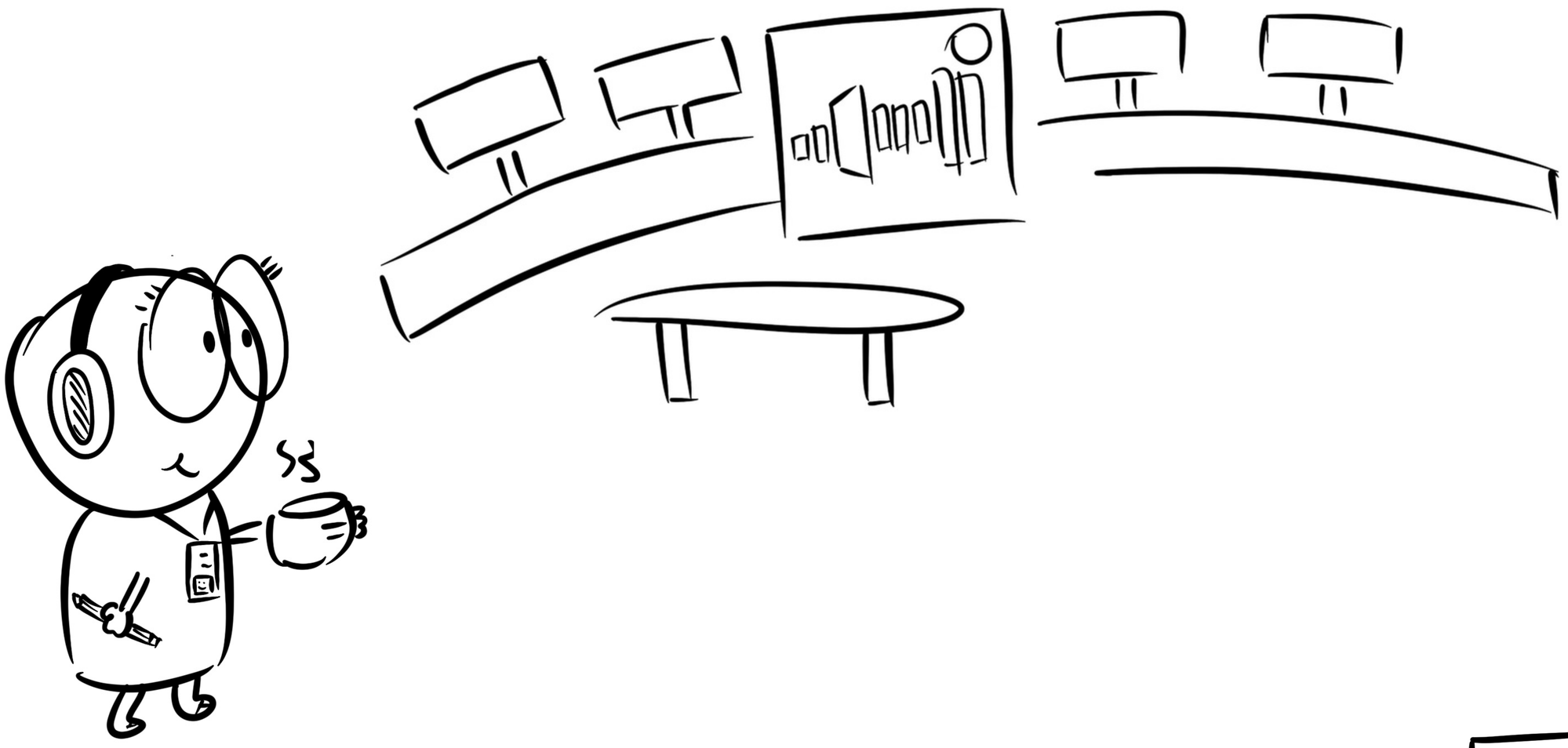
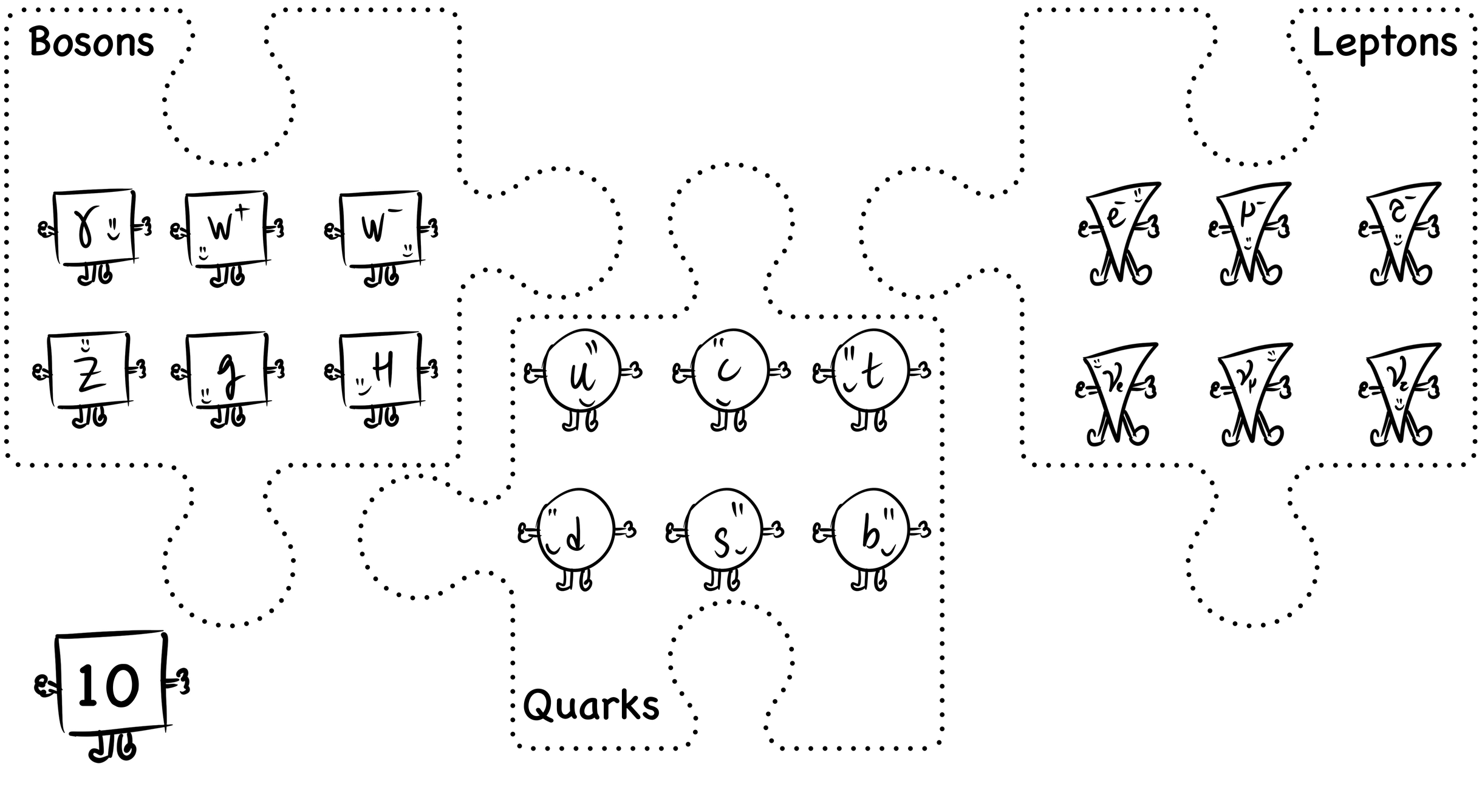
This machine, located underground, has to be monitored night and day from the control room.

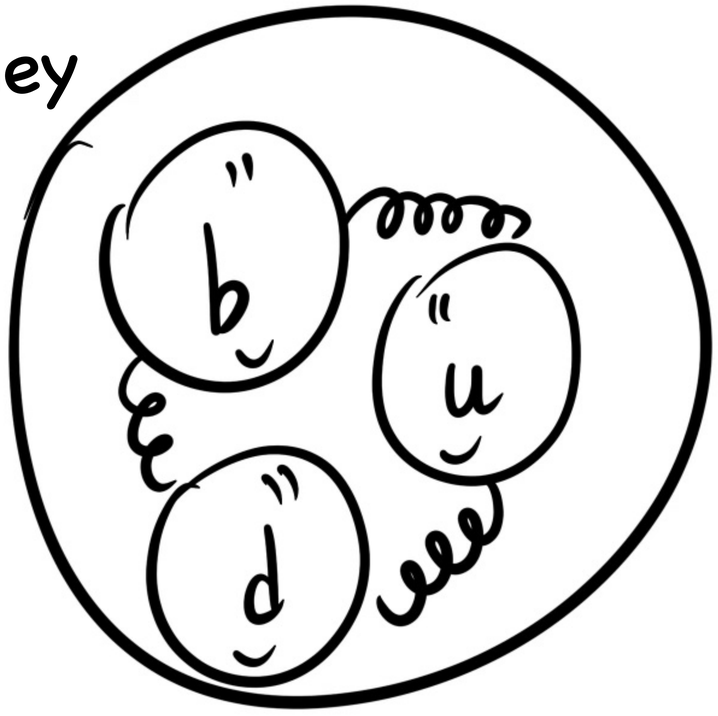


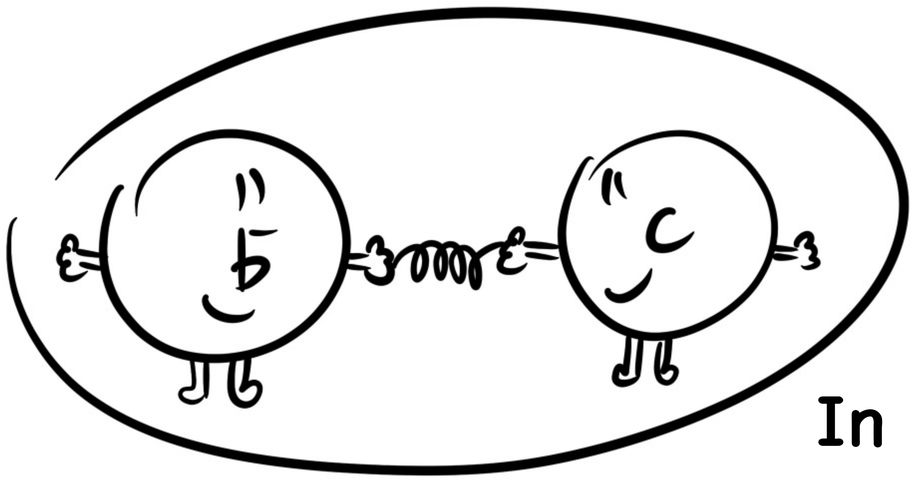
Thanks to LHCb, it is possible to study the smallest building blocks that make up the universe: the fundamental particles. There are three different groups: the bosons, the quarks and the leptons.



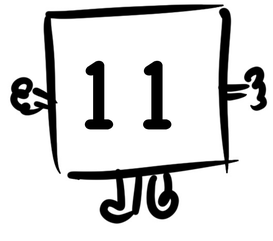
Quarks are very special: they always travel as a group and constitute a larger particle.

In a group of three, they constitute a baryon.

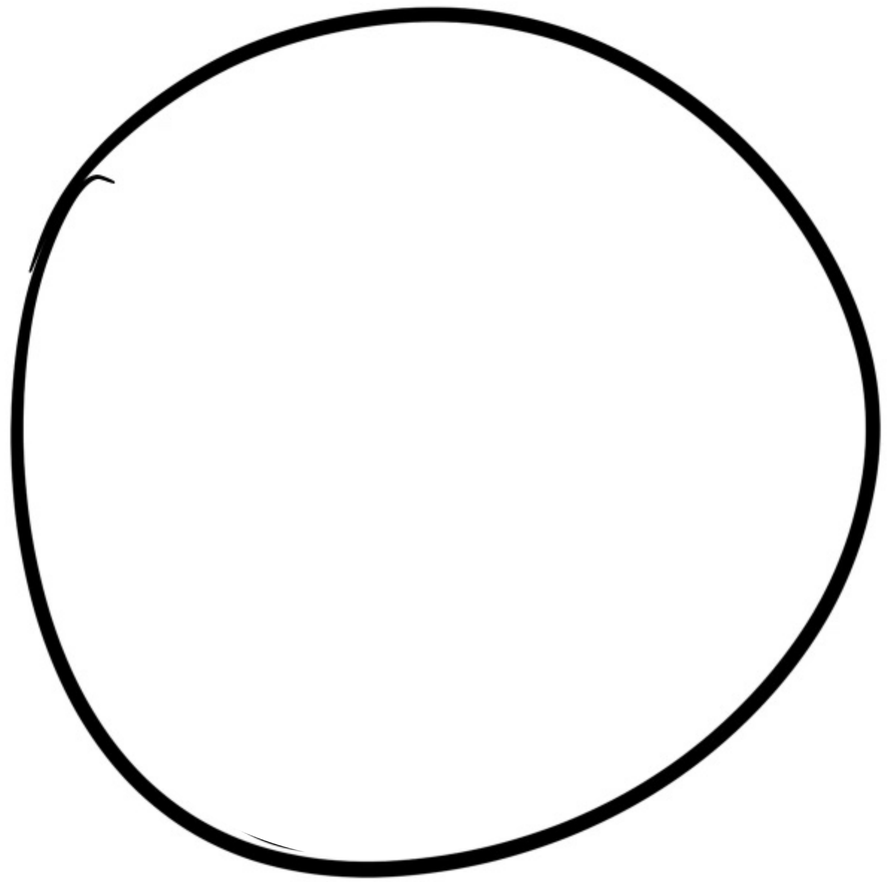




In a group of two, they constitute a meson.

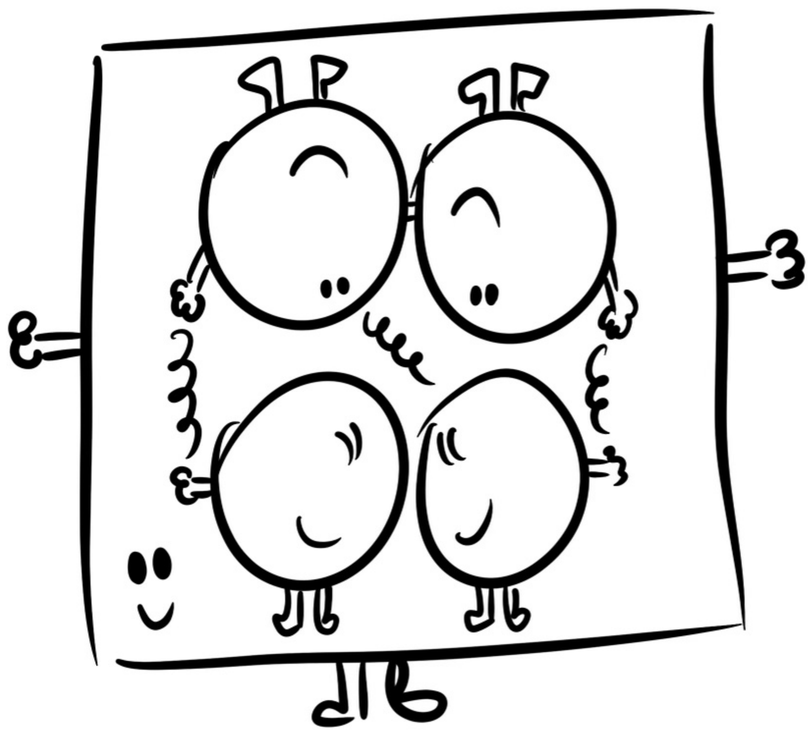


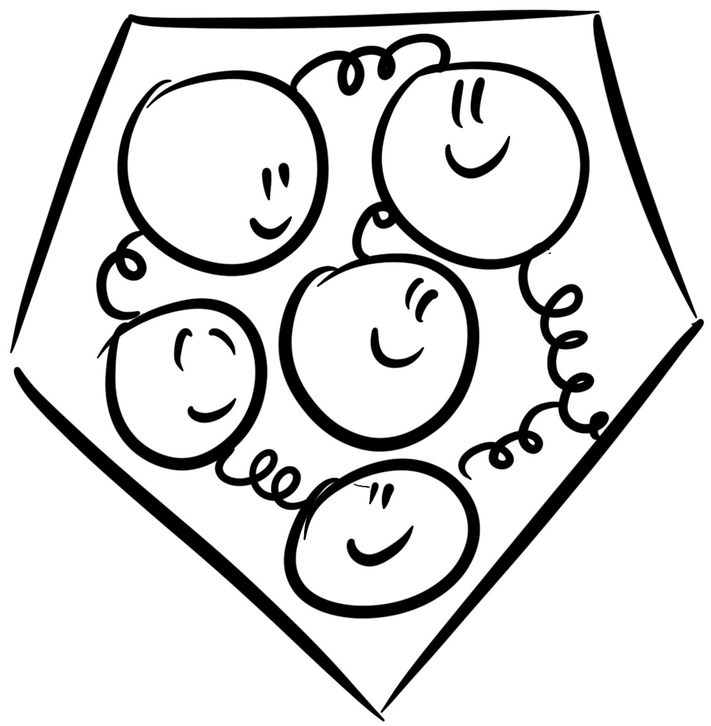
For example, a proton is a particle made up of two up quarks (denoted by a small "u") and one down quark (denoted by a small "d").



Activity: draw in the circle three quarks that make up the proton.
You can take inspiration on how to draw the up quark and the down quark from page 10.

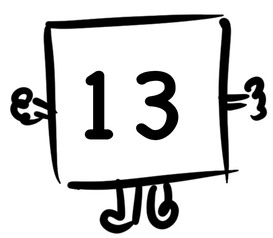
At LHCb, even groups of four quarks were observed!
This is called a tetraquark.



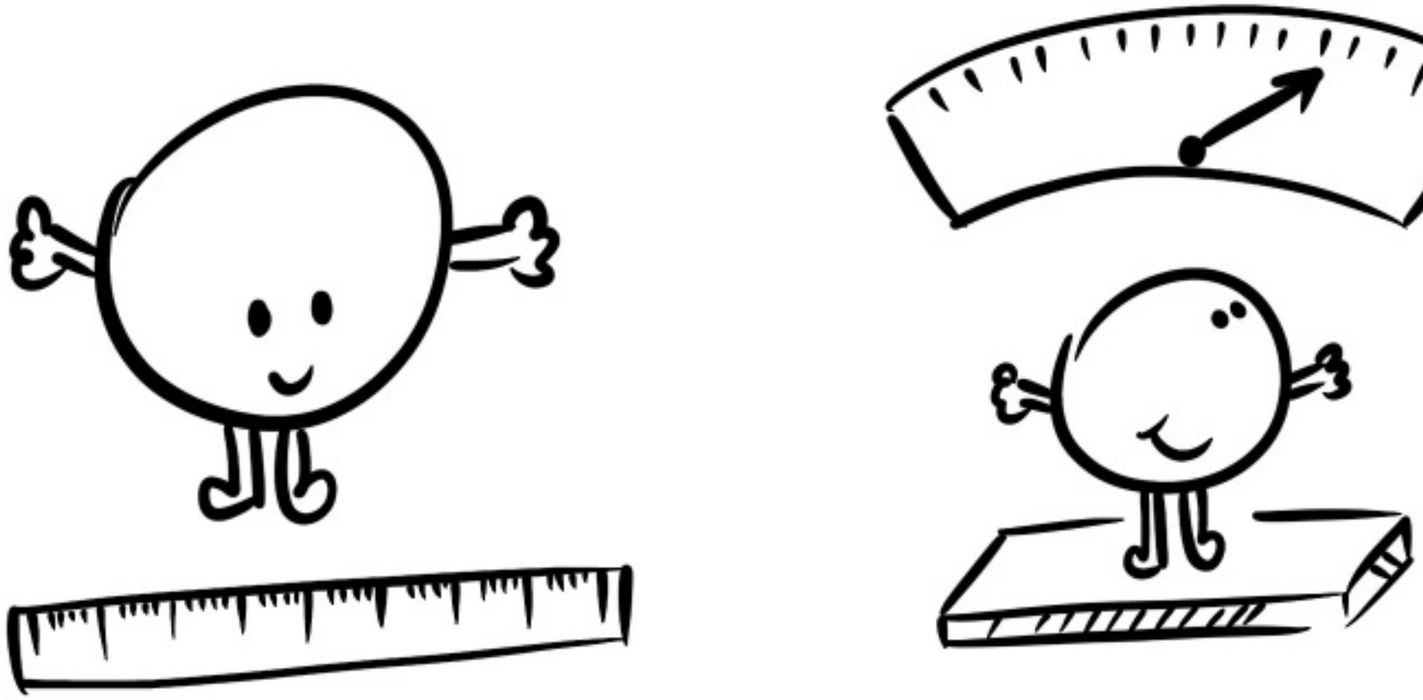


And even groups of five quarks, called pentaquarks, were seen.

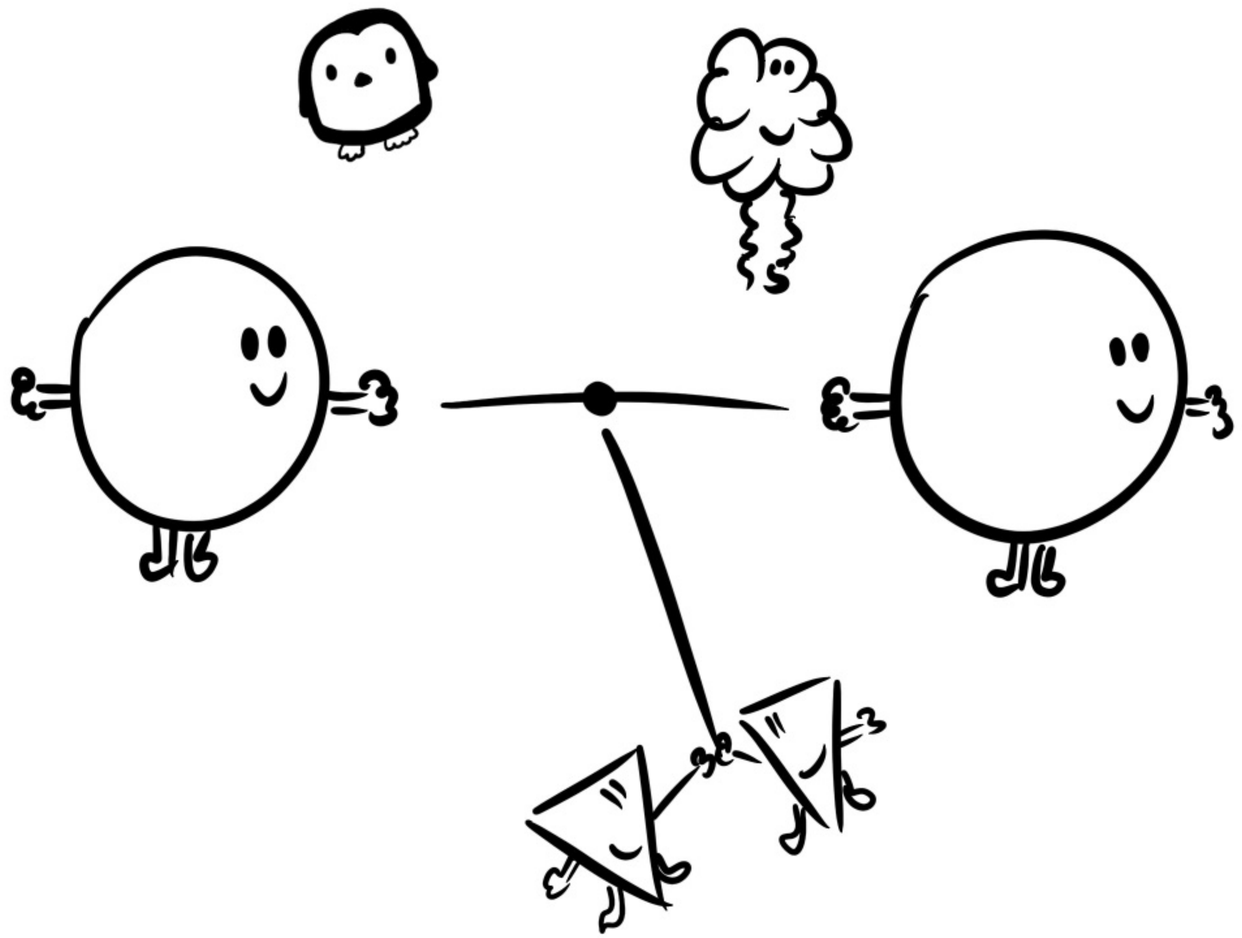
Pentaquarks and tetraquarks are very rare, but they are important for understanding how quarks bond with each other.



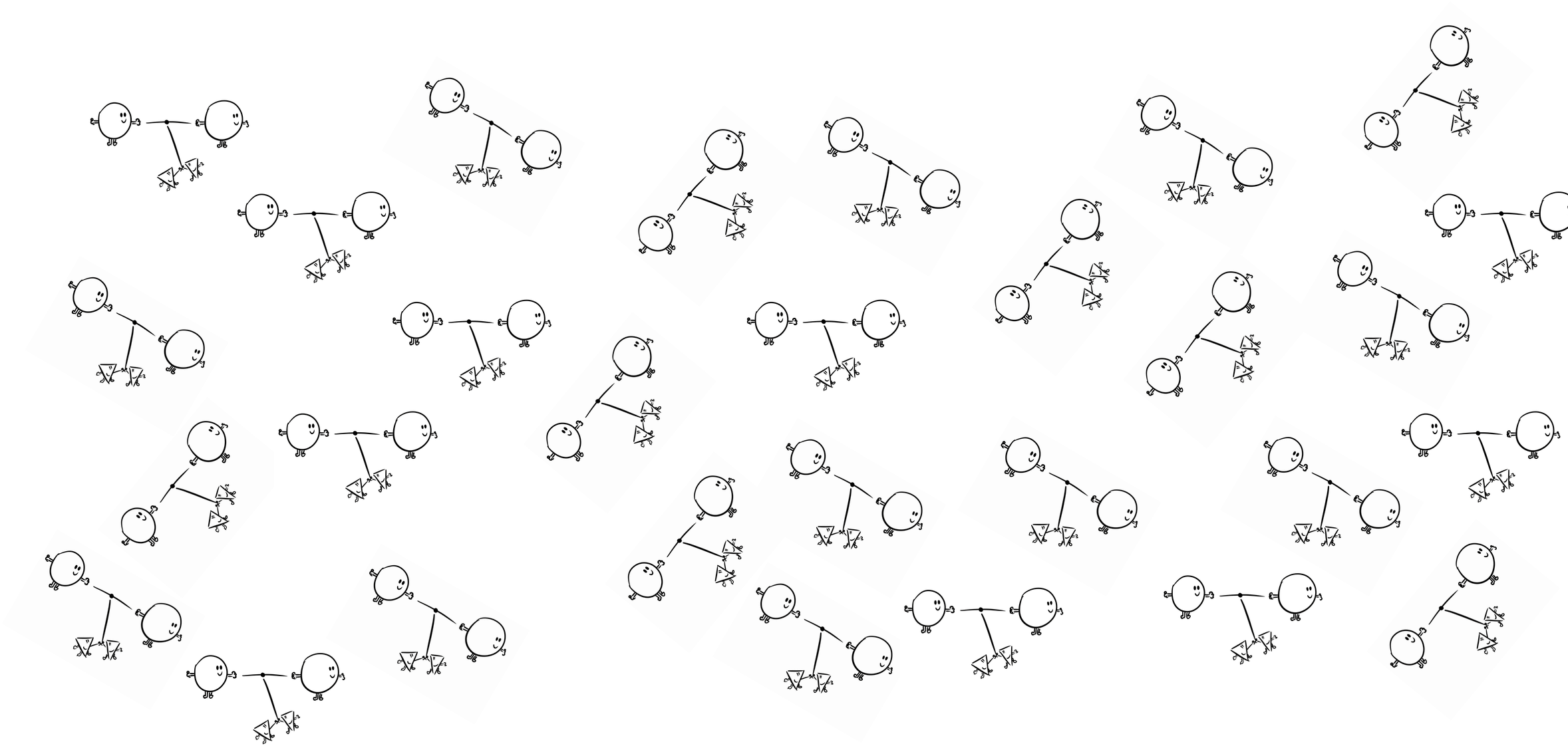
To better understand the particles, scientists try to measure their mass very precisely. And you, do you know your mass?

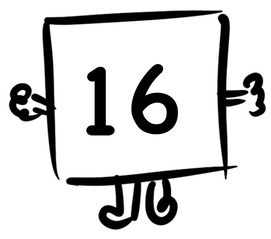


Quarks can also disappear to produce other particles.
This can be seen as a disintegration.



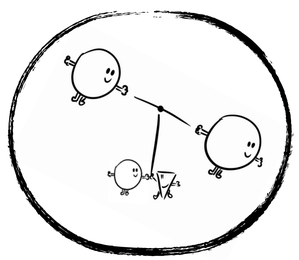
The frequency of a given disintegration can be evaluated by counting how many such disintegrations are produced.



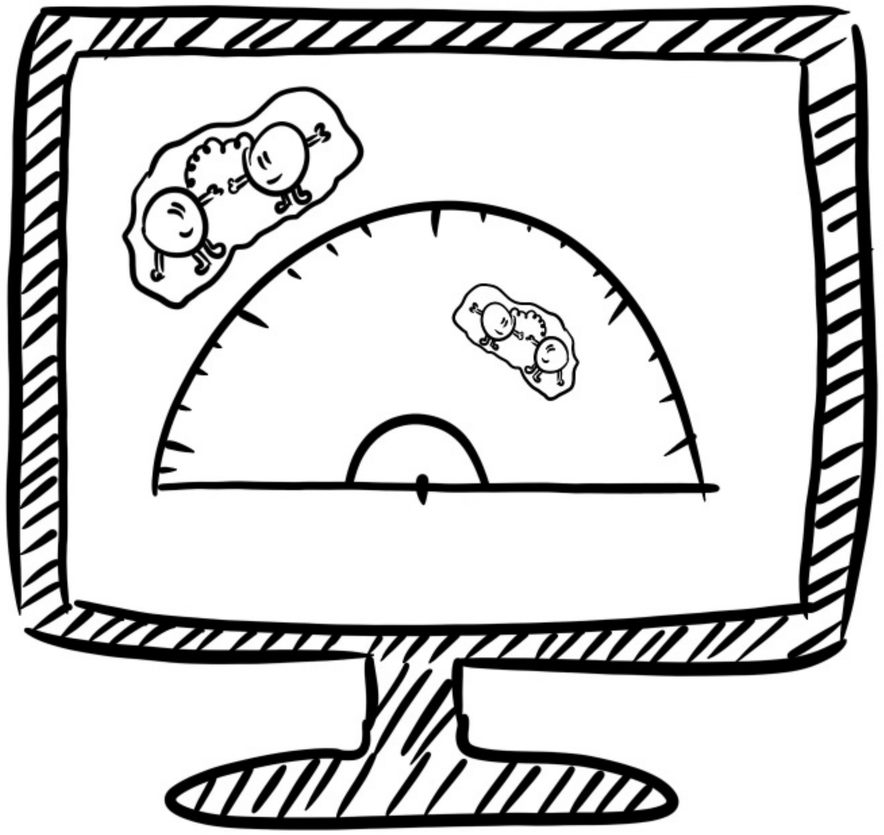


Activity: how many disintegrations do you count?

Some types of disintegrations are very rare: sometimes only one in 1,000,000,000 of the disintegrations is special.

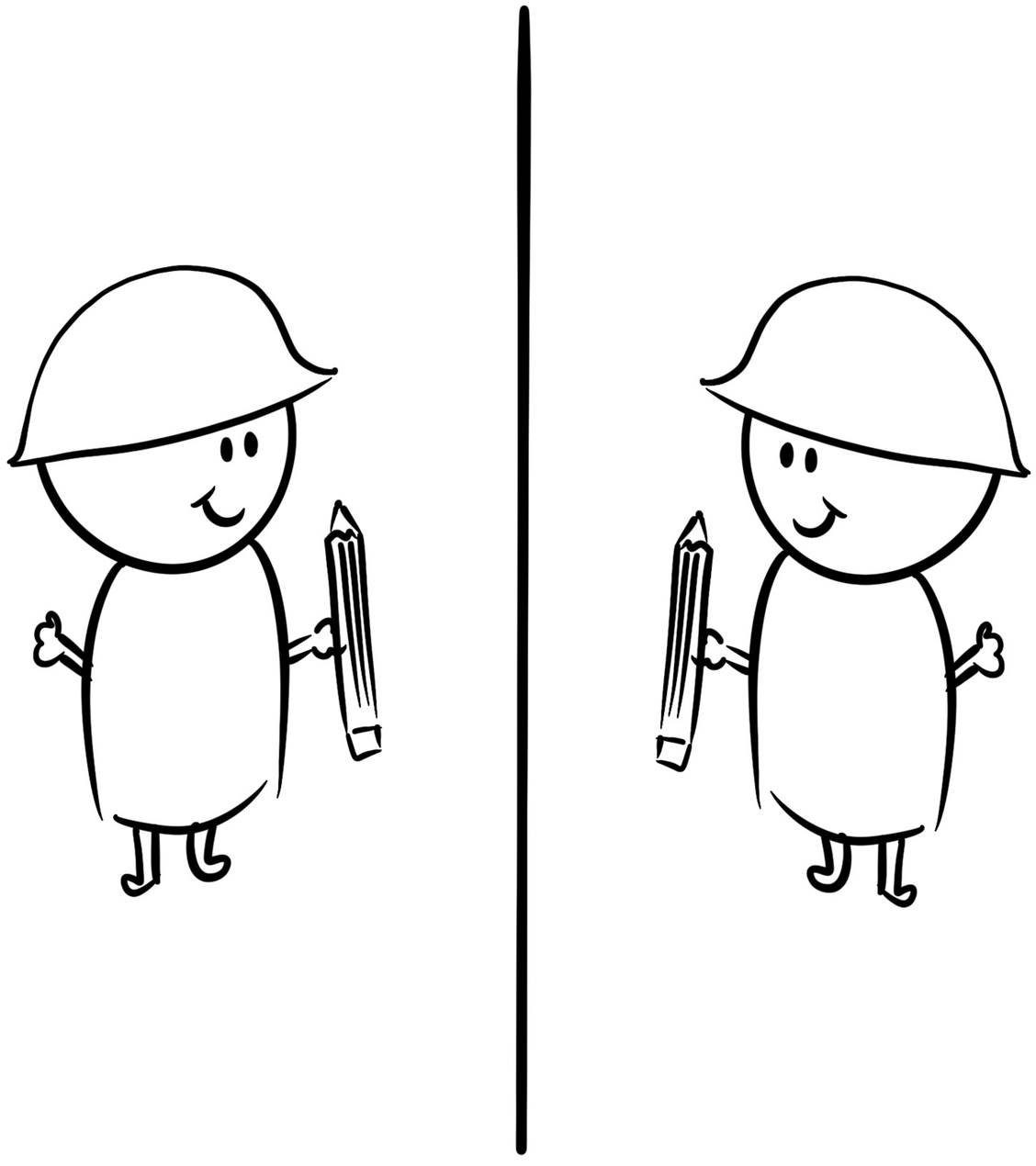
Activity : find the rare disintegration  among the others.

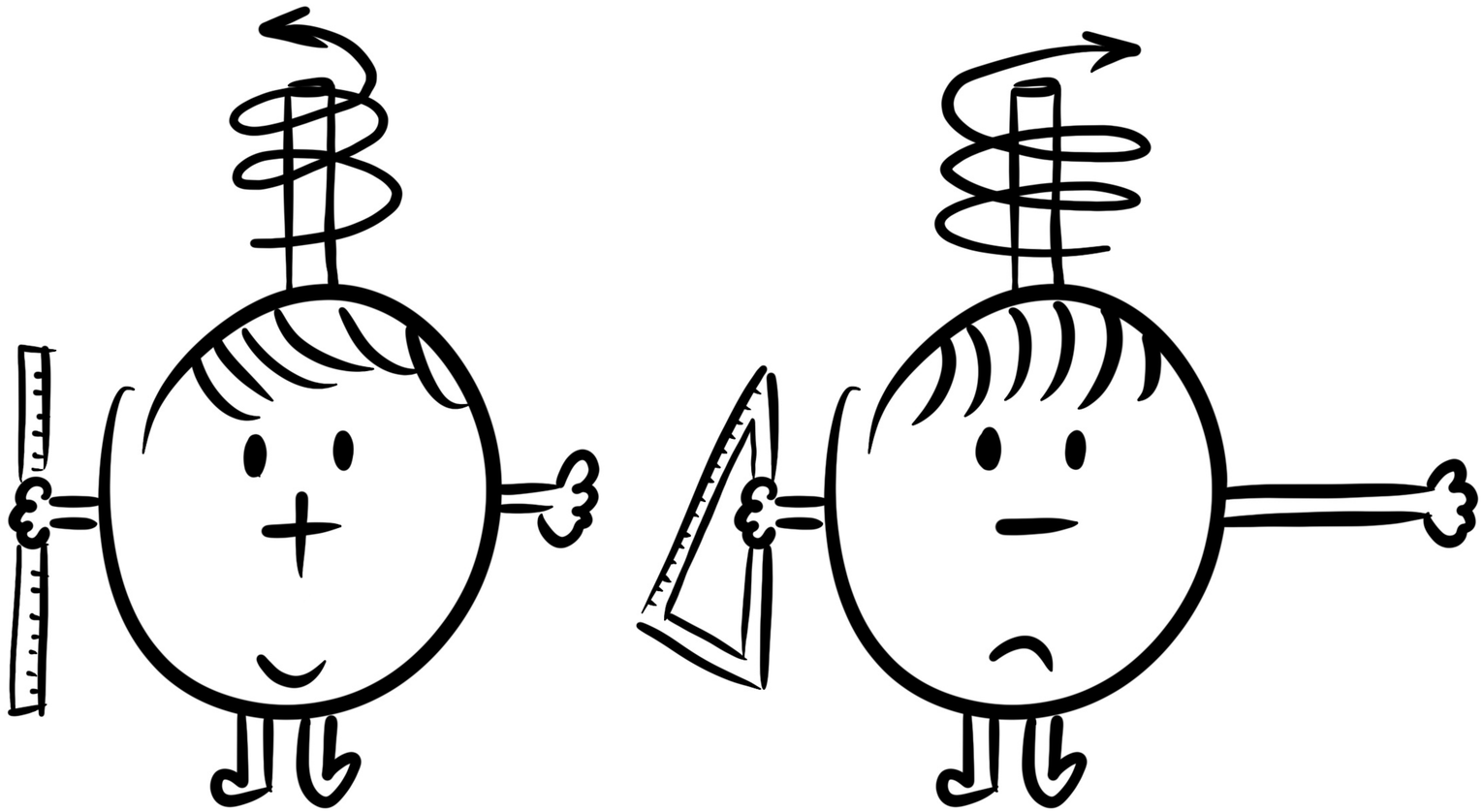
By studying these rare disintegrations, one can try to find the differences between matter and antimatter.



It is a bit like finding the differences between an object and its reflection in the mirror.

When you look at yourself in the mirror, do you see any differences between you and your reflection?



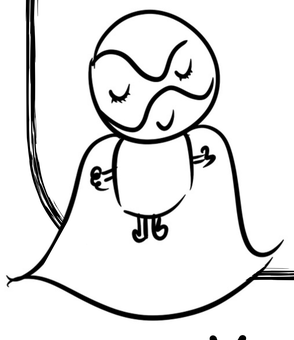


Activity: find the six differences between matter and antimatter.

Thanks to LHCb, we hope to answer some of the big questions about the universe! After all, everyone, no doubt like you, has new questions to explore.

Activity: draw on this page what you find most mysterious in the world!

It is your turn!



You can send your drawing to lhcb-kidbook@cern.ch to be put on the board: https://lhcb-outreach.web.cern.ch/lhcbkidbook

Glossary and word puzzles

Crossword Puzzle

HORIZONTAL

2. Particle made up of five quarks.

5. Disappearance of a particle to produce another particle.

6. Particle made up of three quarks.

7. A large machine used to take a picture of particles and study the differences between matter and antimatter.

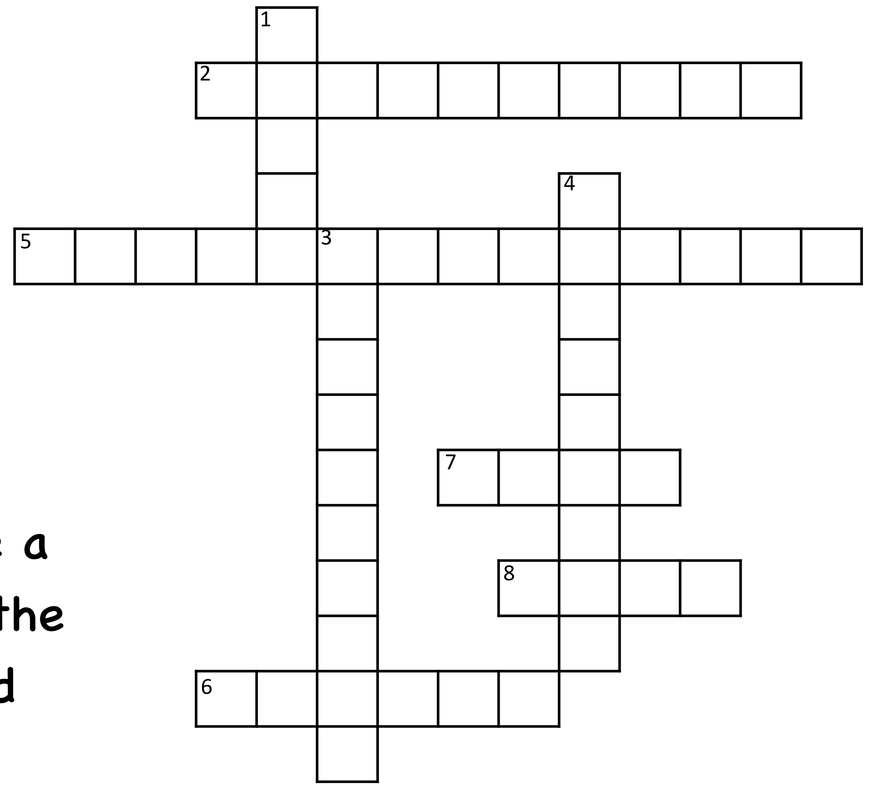
8. Place where particles are studied in Geneva.

VERTICAL

1. Particle made up of two quarks.

3. Particle made up of four quarks.

4. The smallest bricks that make up the universe.



Word Search Puzzle

T M F D M F M Y S T E R Y S
E P V Z E G Y X I N F K P Q
L P H A N T I M A T T E R Y
W O R R Q S E V I I M J Y S
S T F O A R R C L M R U A F
N H K P T E Q O T A E D B M
M G E S W O Z L W O P U O E
A R G X L I N L C I R T S S
S Y M M E T R I C A L R O T
S J Q I P Q S S I Z E P N B
P E B M T E P I Z V O W A R
O T D A O M B O I A B H M E
B A R R N S B N O L R Q O L
K P O B H M U Z Q M J Y F K

Antimatter
Boson
Collision
Detector
Lepton
Mass
Mystery
Proton
Symmetrical
Universe

Illustrated by Yasmine Amhis
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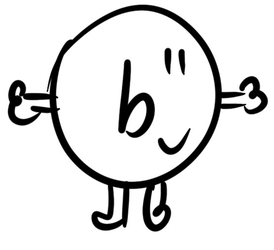
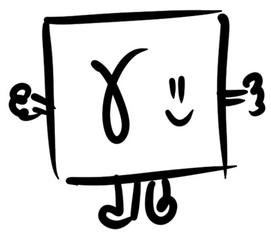
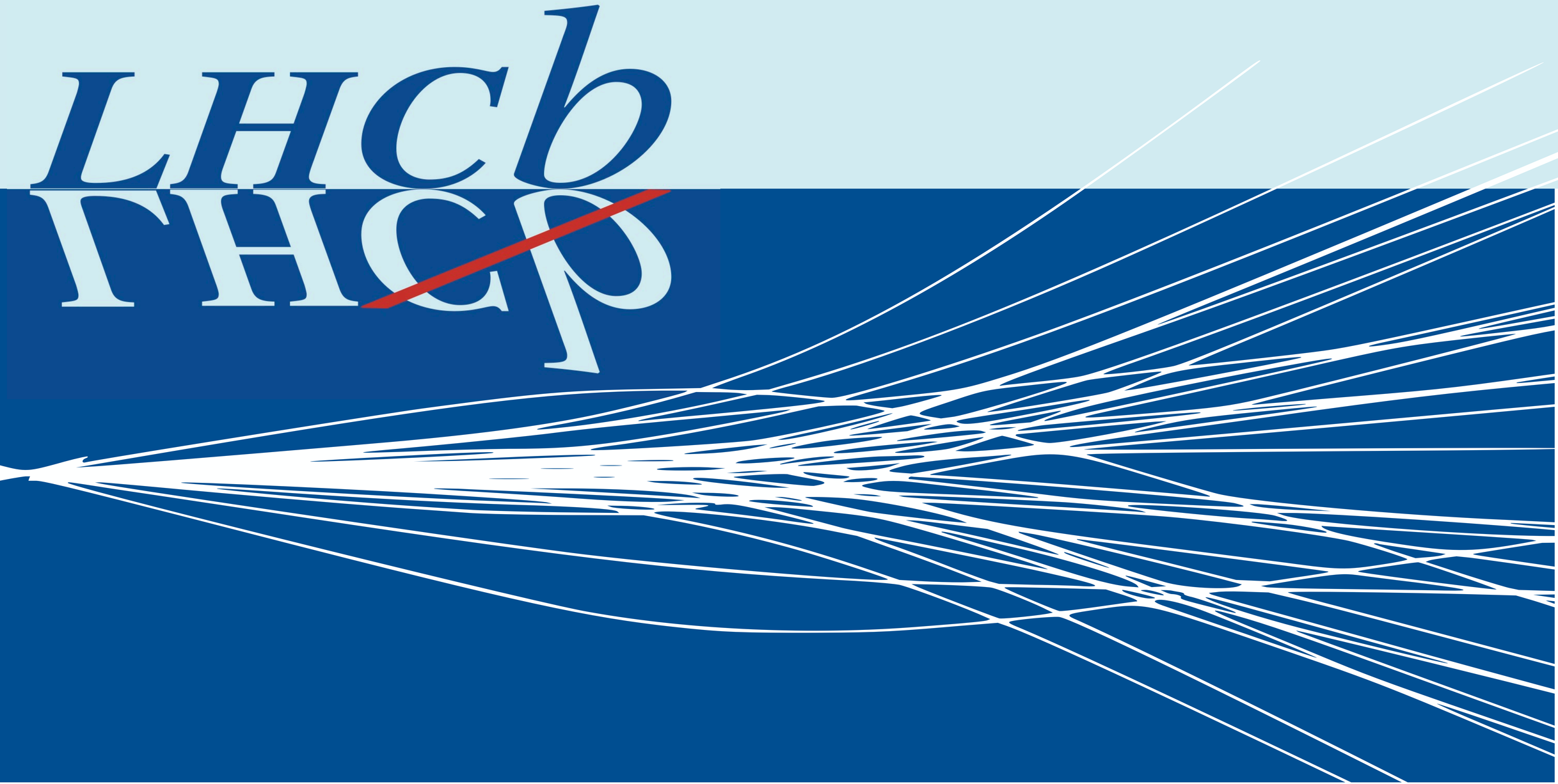


The characters "Tiny creatures at CERN" (©2025 by Yasmine Amhis) are created by Yasmine Amhis.
You can find their adventures at this link:
https://www.yasmineamhis.com



If you want to discover the LHCb detector and follow the latest news of the collaboration, you can find everything here:
https://lhcb-outreach.web.cern.ch/


LHCb