

The universe's **biggest** mysteries: a journey to the beginning of time

Tara Shears

Universe's **biggest** mysteries

Where did it
come from?

Universe's biggest mysteries

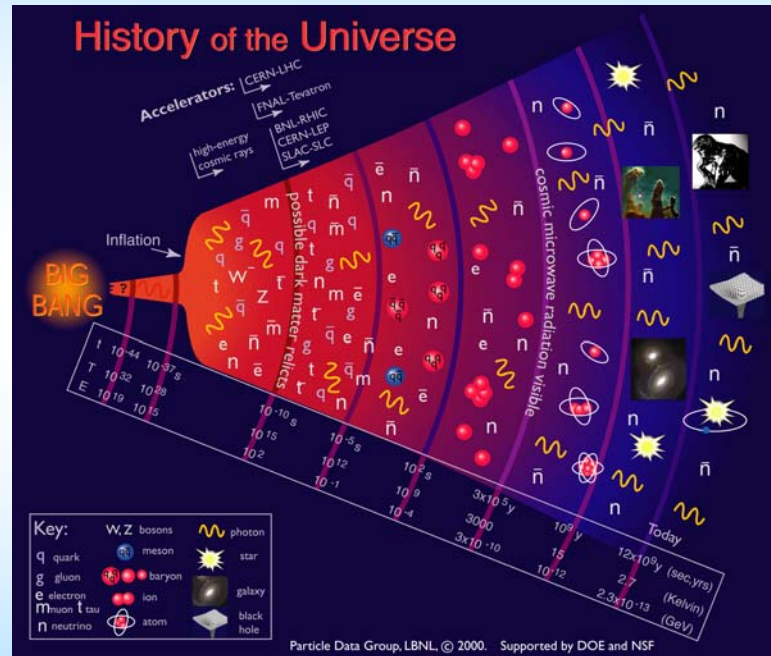
Why does it look
like this?

Universe's biggest mysteries

What is it?

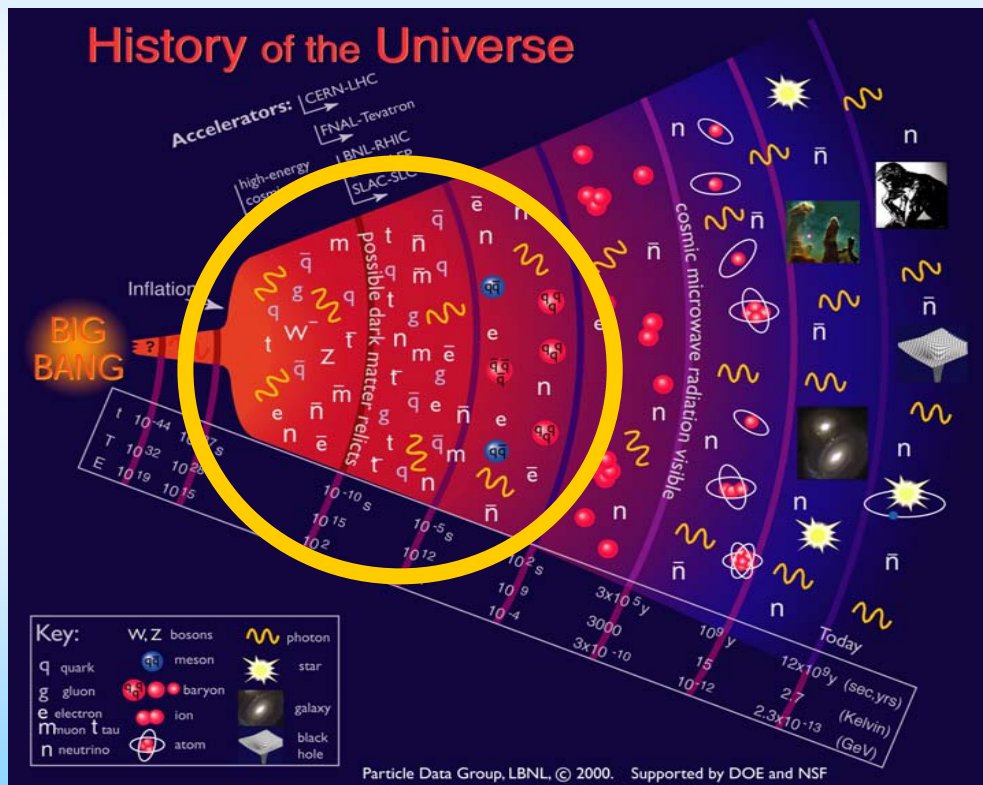
What is it
made of?

What do we know about the universe?



Older larger ... colderless energetic

What do we know about the early universe?

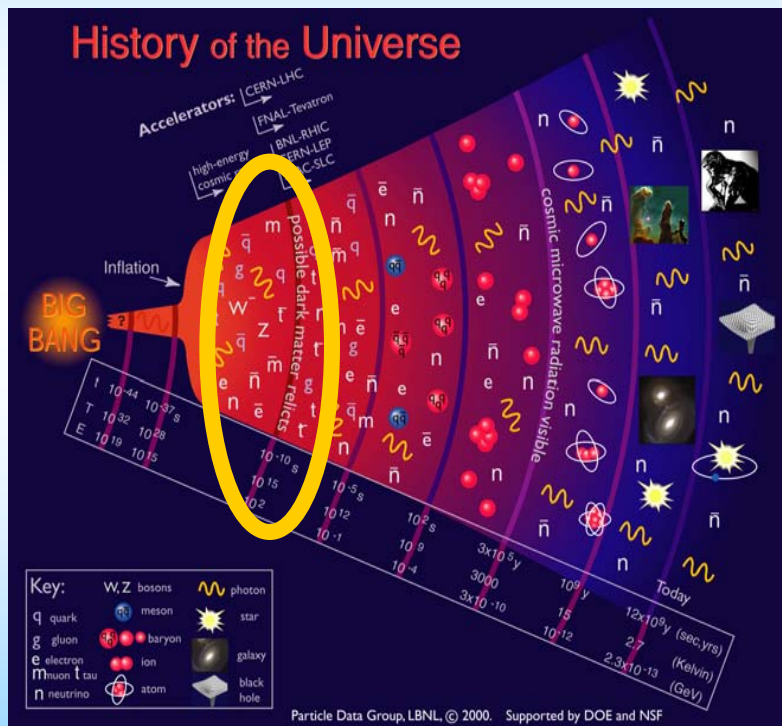


High temperatures

Universe composed of fundamental ingredients of matter

Investigate with **particle physics and particle accelerators** (rather than astrophysics and telescopes)

The Large Hadron Collider (LHC)?

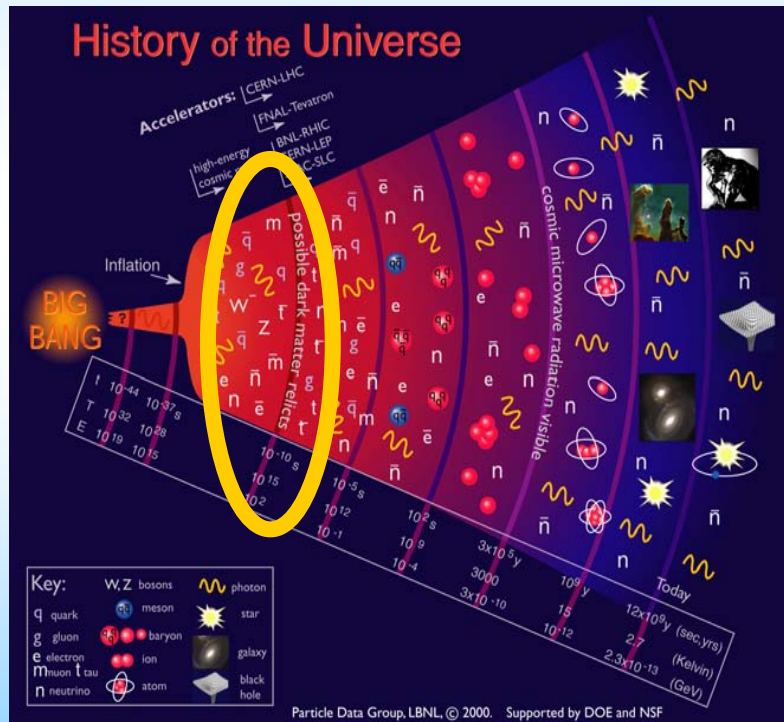


.. is the new particle accelerator that starts next year

... is the most powerful particle accelerator ever

... is our telescope on to the early universe

What will the LHC tell us?



Allows us to recreate conditions closer to Big Bang than ever before

.... to billionths of a second after!

When universe was the size of a .

What do we already know?

.... quite a lot

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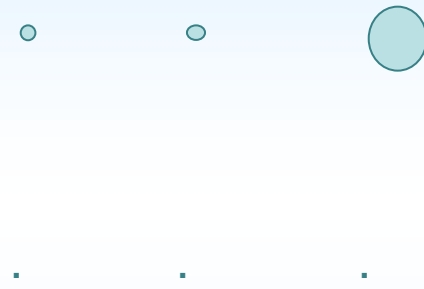
nice ...

BUT

3 mysteries

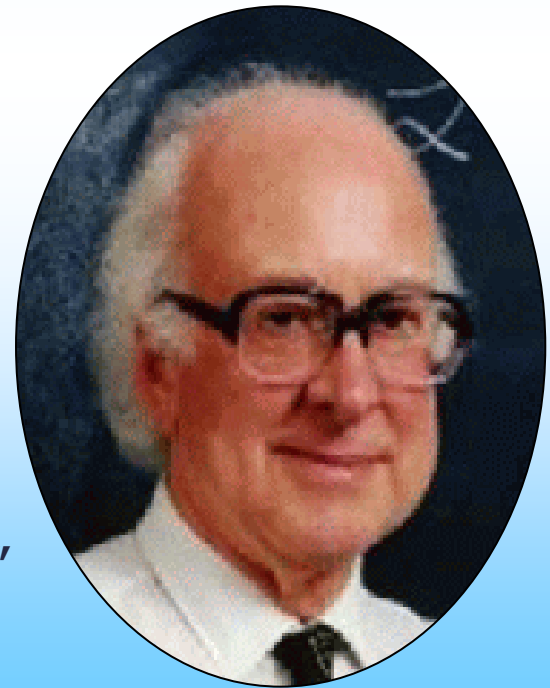
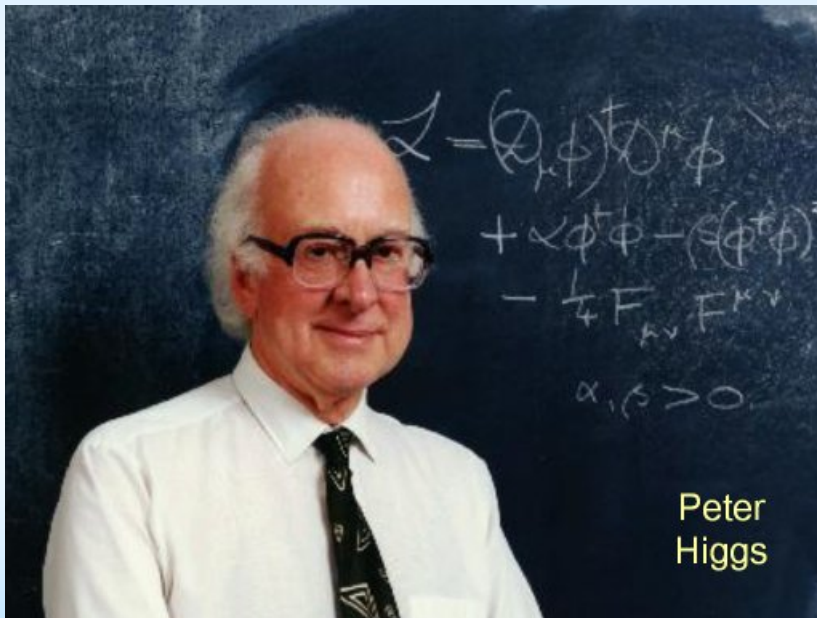


quarks



leptons

(1) What is mass?



...property mediated by "Higgs Particle"

Analogy

Interaction with Higgs particles (\rightarrow mass) \sim movement of person through medium

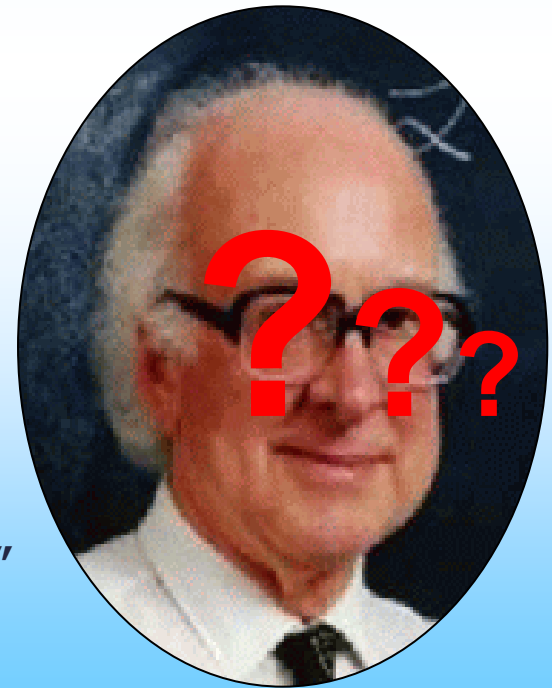
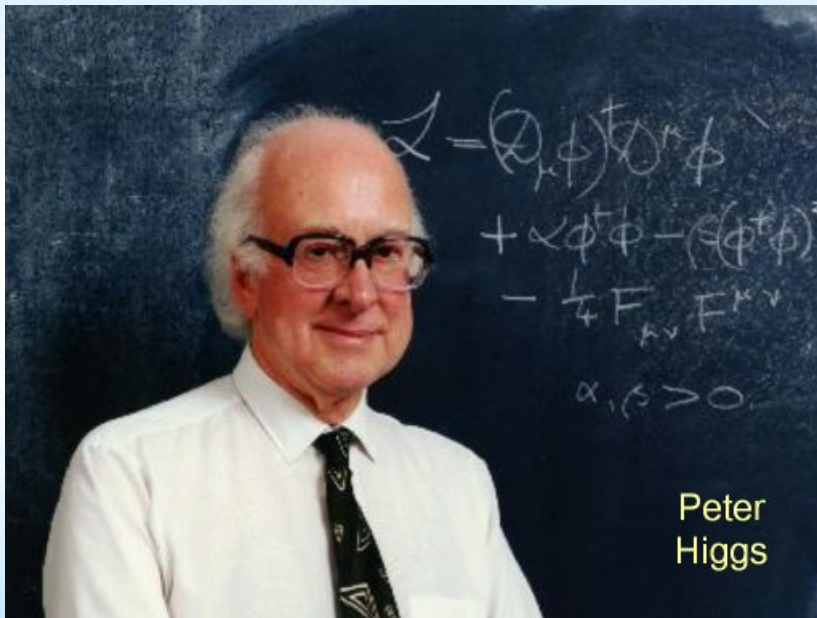
Light particles do not interact much (move fast)

More interaction – slower movement ... consider momentum – more mass conferred

Heaviest particles most interaction



What is mass?



...property mediated by "Higgs Particle"

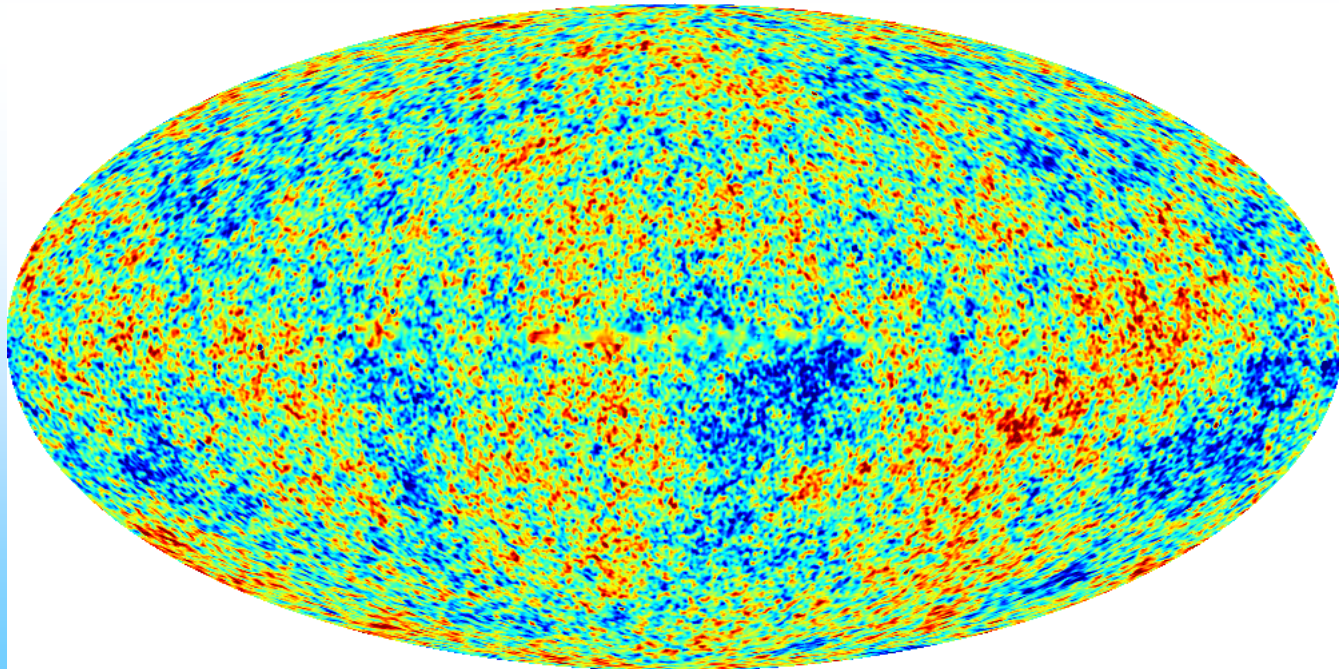
nb we haven't seen it yet

(2) antimatter

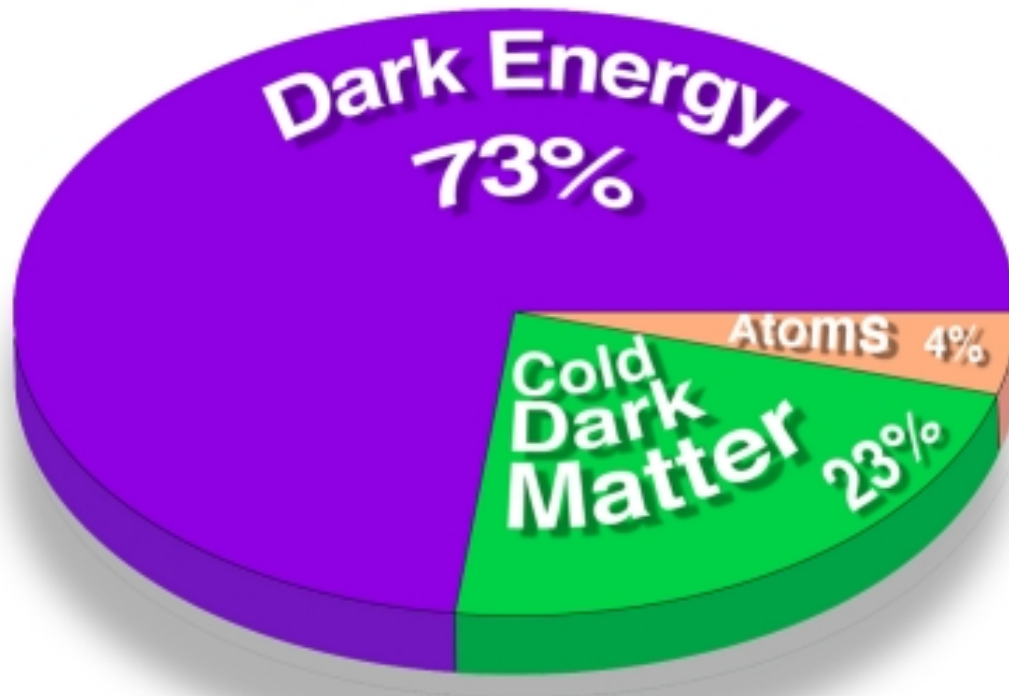
Big Bang: equal amounts of matter and antimatter created

Now: we (matter) exist

Why?



(3) and the other 96% ?



Source: Robert Kistner
Source: NASA/WMAP Science Team

Dark matter?

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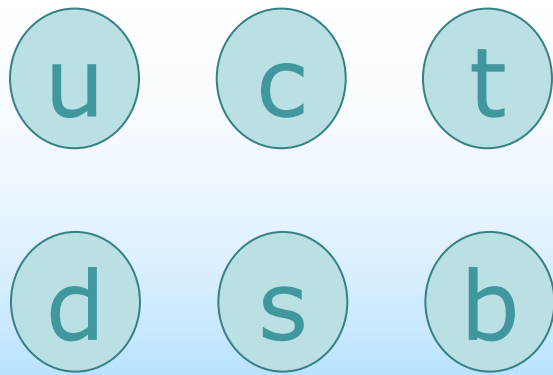
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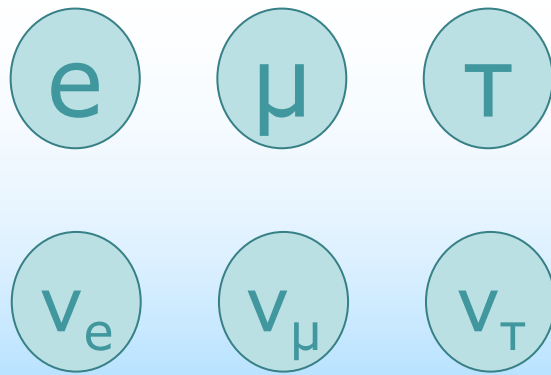
quarks

leptons

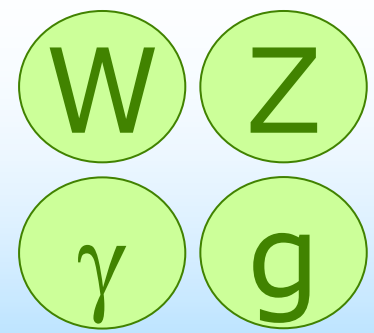
bosons



(s)quarks

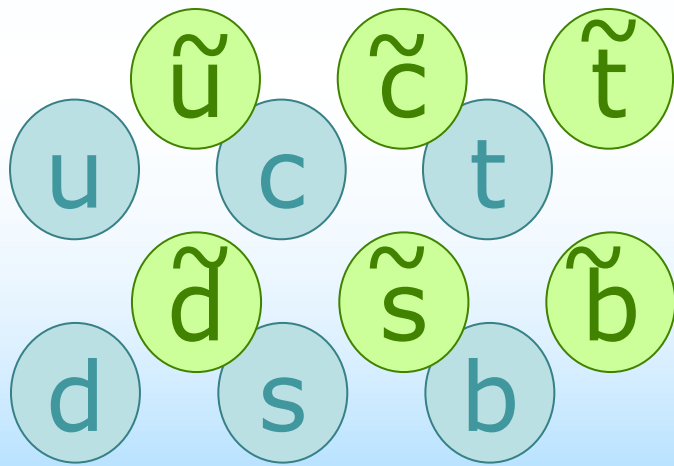


(s)leptons

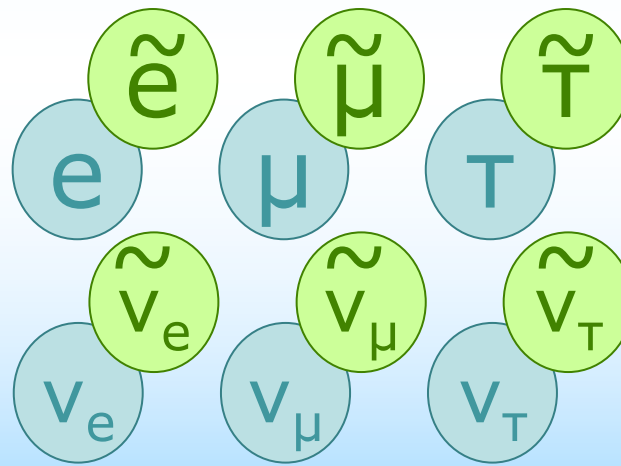


(s)bosons

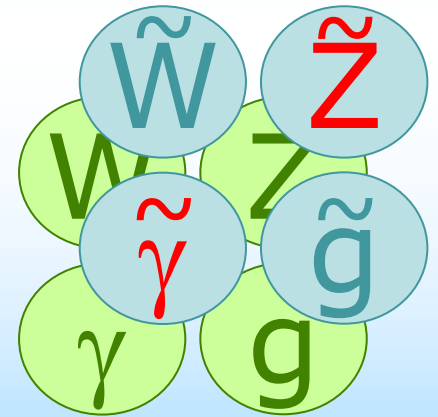
Dark matter?



(s)quarks



(s)leptons



(s)bosons

Many mysteries....

How many dimensions?

What is mass?

What about **gravity**?

Where did all the **antimatter** go?

4 forces?

12 matter particles?

Mini **black holes**?

??

What about the other 96% of the universe

How do we find answers?

... study the universe at even earlier times

... using particle accelerators and detectors

look for new forms of matter

the unexpected