48th Stirling Physics Teachers Meeting

25 May 2023

Stirling Court Hotel, Stirling, Scotland

Bringing CERN to School

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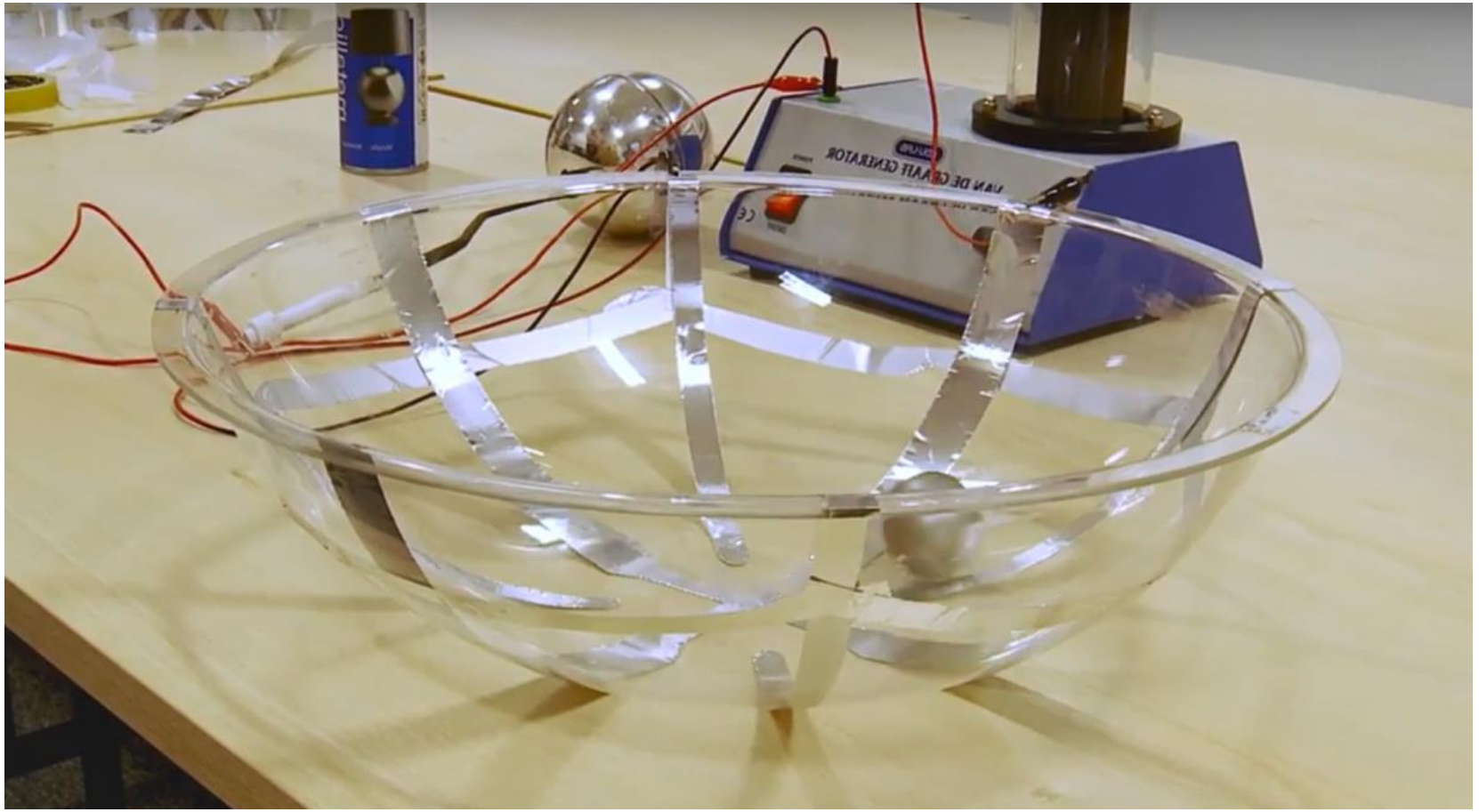
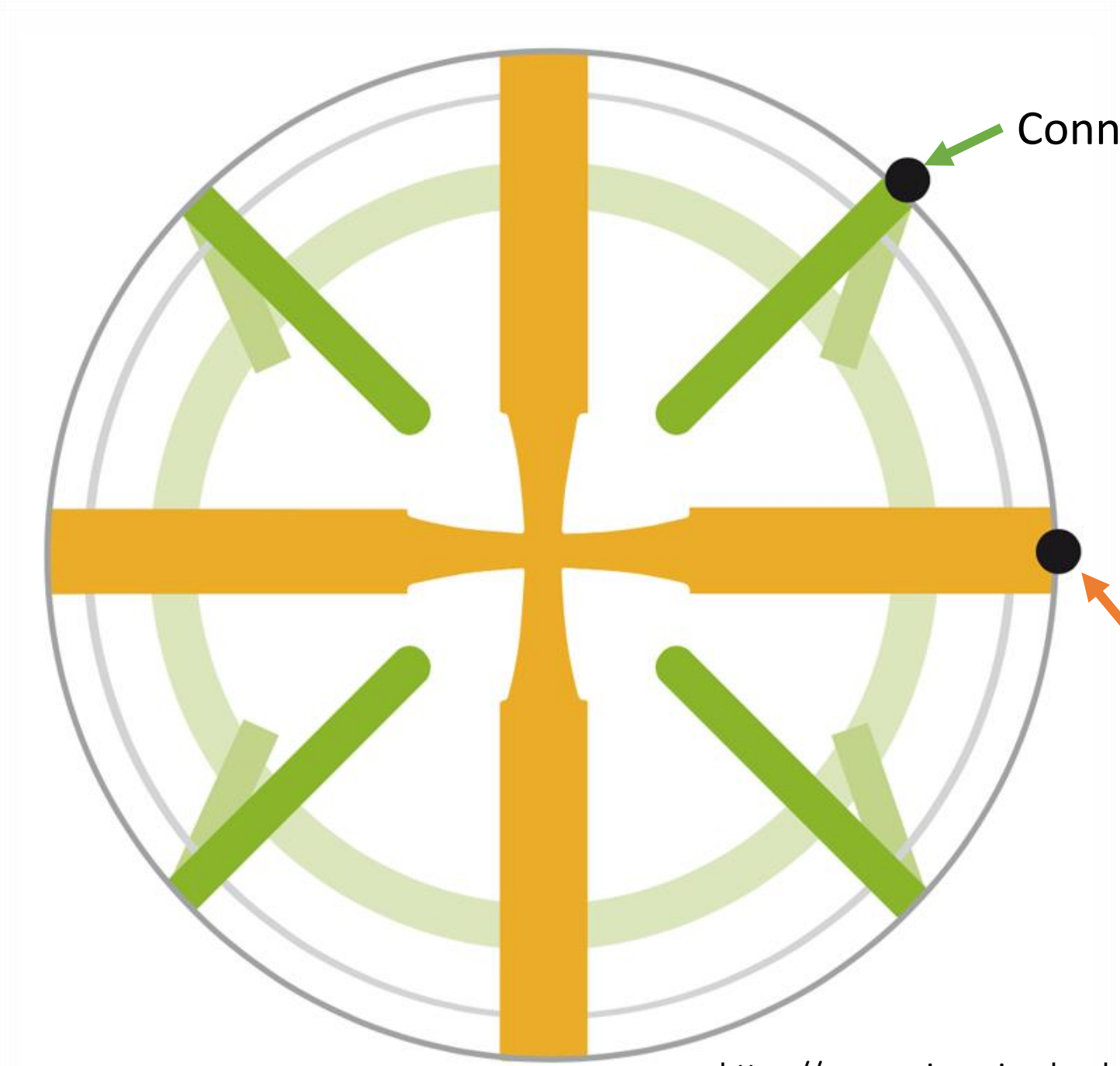
The Salad Bowl Particle Accelerator



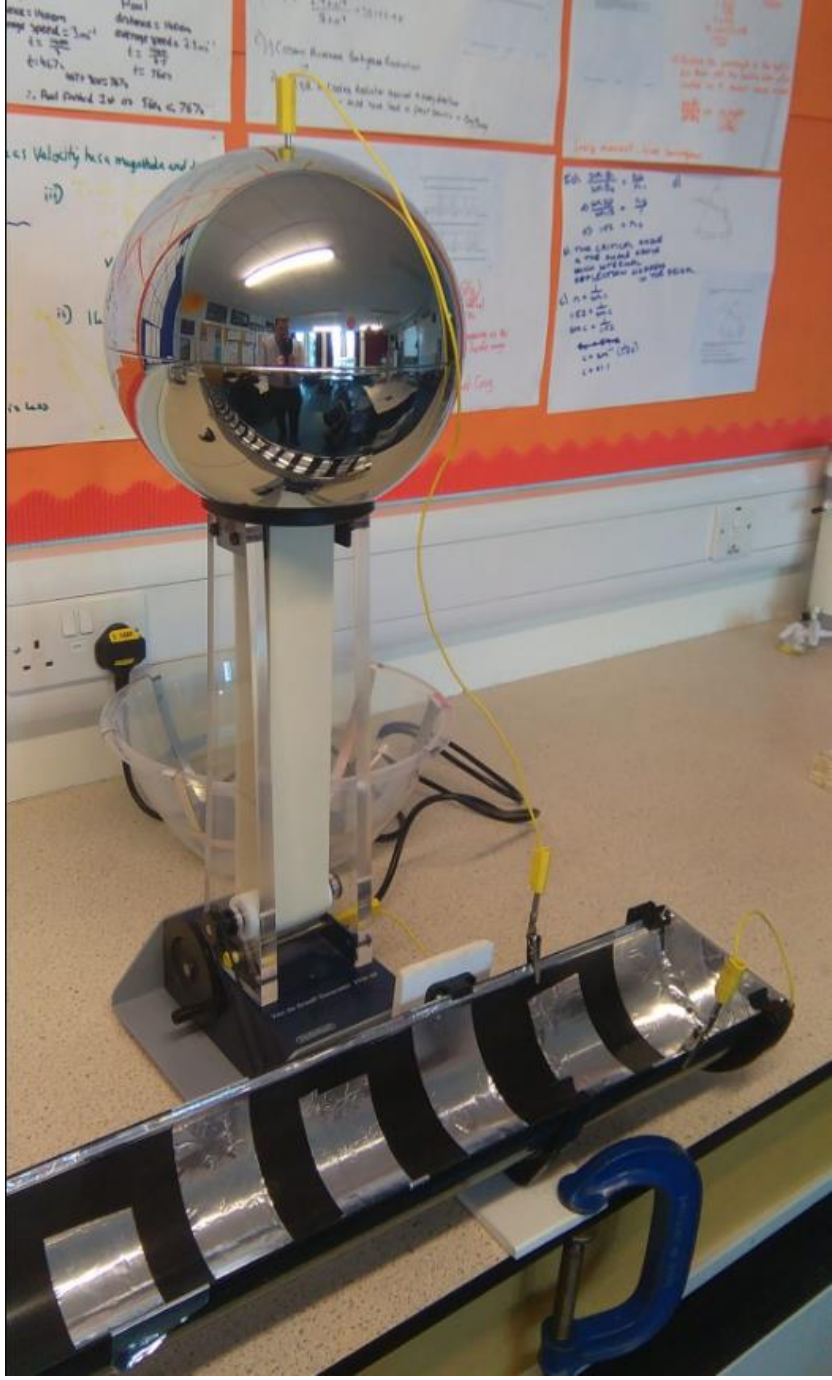
https://www.scienceinschool.org/article/2017/particle-accelerator-your-salad-bowl/



https://www.scienceinschool.org/article/2017/particle-accelerator-your-salad-bowl/

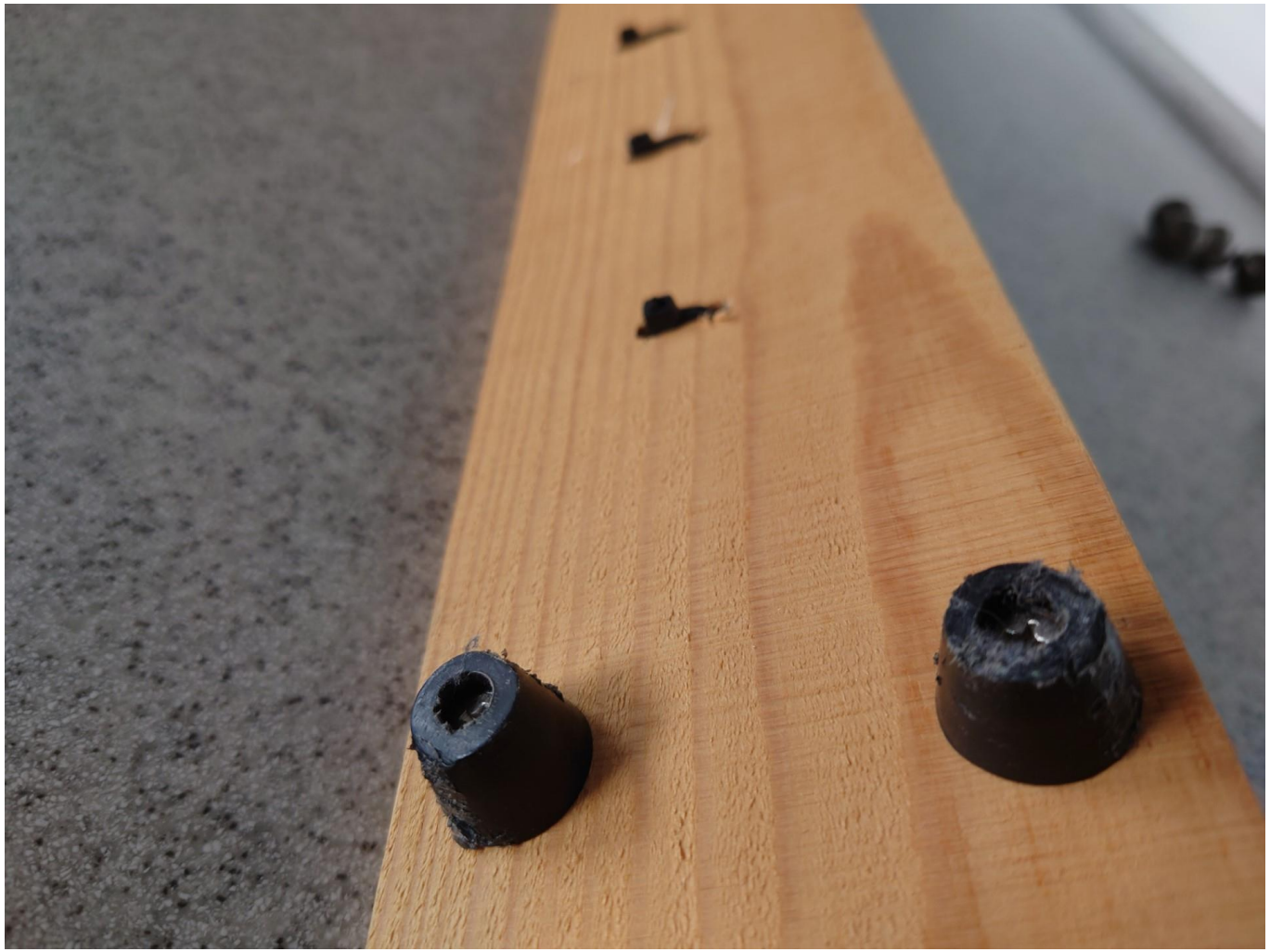
The Linear “Guttering” Accelerator

(thanks to Drew Burrett for this invention and the photographs)



https://www.stuckwithphysics.co.uk/2016/03/model-linear-accelerator/

Gauss Rifle Magnetic Linear Accelerator



https://www.first4magnets.com/blog/how-to-make-a-gauss-rifle/

Lascells Cloud Chamber

- One in every local authority.
- Great alternative to dry ice variant
- No dry ice or water required
- Integrated power supply
- Teachers guide available for this

(email gw07colquhounpeter@glow.sch.uk if there isn't one with your kit)

https://lascells.com/product-detail/cloud-chamber/

https://www.youtube.com/watch?v=zKyvZ6zFv66

The PARTICLE ZOO

ELEMENTARY PARTICLES of THE STANDARD MODEL:

WE SELL THE SMALLEST THINGS IN THE UNIVERSE

The PARTICLE ZOO

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The app is free!
but is only on Apple: (

Top Quark

Quarks

CLASSIFICATION: Fermion > Quark

SPIN: $\frac{1}{2}$

Wikipedia

CHARGE: $+\frac{2}{3}$

MASS: 169-173 GeV

SYMBOL: t

●●●●●●●●●●●●○○ LIGHT HEAVY

BUY

The massive and extremely short-lived **TOP QUARK** is too unstable to be found in any baryons or mesons. The last of the six quarks to be discovered, it wasn't until 1995 at Fermilab that physicists finally observed this (predicted) particle. It is the most massive observed particle in the Zoo and usually decays into a bottom quark via the weak interaction.

Bottom Quark

Quarks

CLASSIFICATION: Fermion > Quark

SPIN: $\frac{1}{2}$

Wikipedia

CHARGE: $-\frac{1}{3}$

MASS: 4.13-4.37 GeV

SYMBOL: b

●●●●●●●●●●●●○○○ LIGHT HEAVY

BUY

The **BOTTOM QUARK** is about four times the mass of the proton and is easily identified in experiments. Originally named "beauty," the bottom quark was discovered in 1977 by Leon Lederman's group at Fermilab. It is often the decay product of the short-lived top quark and would be a decay product of the Higgs boson.

Photon

Bosons

CLASSIFICATION: Boson

SPIN: 1

CHARGE: 0

MASS: 0

SYMBOL: γ

Wikipedia

LIGHT HEAVY

BUY

The massless wavicle we know and love, the **PHOTON**, better known as light, always travels at the speed of light and communicates the electromagnetic force in many forms from microwaves to gamma rays. About 1012 photons of sunlight fall on a pinhead each second. Displaying both wave and particle characteristics, photons were first postulated by Einstein in 1905.

Gluon

Bosons

CLASSIFICATION: Boson

SPIN: 1

CHARGE: 0

MASS: 0

SYMBOL: g

Wikipedia

LIGHT HEAVY

BUY

The **GLUON** is the force-carrying particle of the strong nuclear force, which holds quarks together and binds the nucleus of atom. Discovered in 1979, it is stable, massless, and comes in 8 color states. At extremely high temperatures, quarks and gluons fluidly mix into a quark- gluon plasma. It is theorized that gluons can interact with each other and form glueballs.


Leptons
Quarks
Leptons
Quarks
Leptons
Bosons
Quarks
CLASSIFICATION: Fermion > Quark
SPIN: ½
CHARGE: +⅔
MASS: 1.5-3.3 MeV
SYMBOL: u
The UP QUARK is the smallest of the six quarks and is subject to the strong force. A proton contains two up quarks (and one down quark) so the up quark is very important for everyday life. As it comprises all the physical matter we see around us, it is, of course, stable. It was one of the first quarks to be discovered (in 1964).
BUY

To create particle cards you need….

Colour printer, laminator, particle zoo app.

Instructions

Load up the app on your Iphone/android and take screen shots of each of the particle info screens. (If you have a small class, I would limit it to the fundamental/well known ones.) Save the pictures to your PC, then paste them all on to a word document. Print out in colour, then laminate!

Alternatively, just use the word document that's already made up.

You will need the following…

- Felt
- Pipe Cleaner
- Googly Eyes
- Scissors
- Glue

Order from arts and crafts website like www.ypo.co.uk
Alternatively beg/borrow/steal from your school's art department.

1. Collect the appropriate felt, eyes and pipe cleaner to go with your particle.
2. Construct your model using the scissors and glue provided. Make it about the size of your hand.
3. Create an A5 info sheet for your particle. Remember and make your writing quite big as it will go on the wall.
4. As well as the name of the particle, it should include information about it’s classification, charge, mass, symbol and the date it was discovered.

	Fermions			bosons	
	1st generation	2nd generation	3rd generation		
quarks	u up(⅔)	c charm (⅔)	t top (⅔)	g photon	force carriers
	d down (- ⅓)	s strange (- ⅓)	b bottom (- ⅓)	g gluon	
leptons	n_e electron neutrino (0)	n_m muon neutrino (0)	n_t tau neutrino (0)	Z Z boson	
	e electron (-1)	m muon (-1)	t tau (-1)	W W boson	

Baryons
Proton, p
Neutron, n

Hypothetical
Graviton, G
Tachyon

Theoretical
Higgs Boson, H
Dark Matter


1st generation
2nd generation
3rd generation
quarks
leptons
bosons
baryons
hypothetical
theoretical
force carriers
UP QUARK
CHARM QUARK
Down Quark
Strange Quark
CLASSIFICATION: FERMION > QUARK
CHARGE: -1/3
MASS: 70-150 MeV
SYMBOL: S
DATE OF DISCOVERY: 1964
ELECTRON NEUTRINO
MUON NEUTRINO
MUON
PHYSICS
PARTICLE ZOO


bosons
hypothetical
theoretical
force carriers
quarks
"If you think you understand quantum mechanics, you don't

al

HIGGS BOSON

Classification: Boson

Spin: 0

Charge: 0

Mass: 96-129 GeV

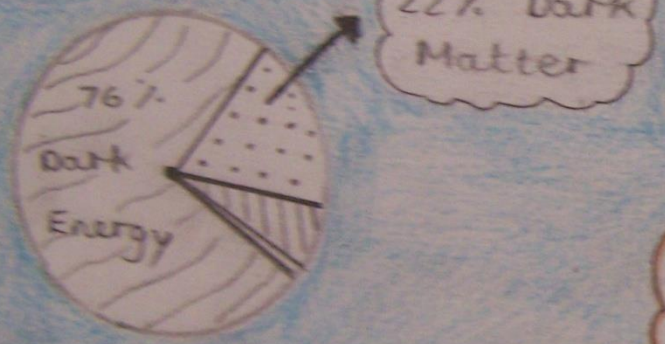
Symbol: H

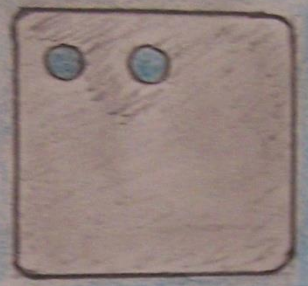
Light Heavy

V

DARK MATTER

Classification : Theoretical





- 3.6% intergalactic dust
- 0.4% stars, cats, people, pudding. etc

Dark Matter is the name given to a material in the Universe that does not emit or reflect light, but is necessary to explain the observed gravitational effects in the stars and galaxies. Along with this dark energy, this mysterious stuff comprises 96% of the Universe.

Some Physicists believe supersymmetric partner particles (SUSY) to be a candidate for dark matter.

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