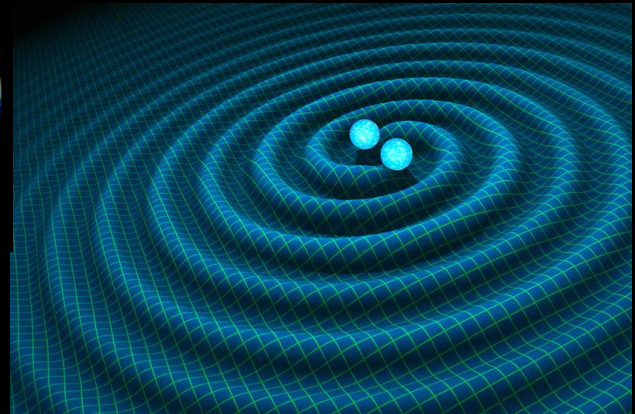
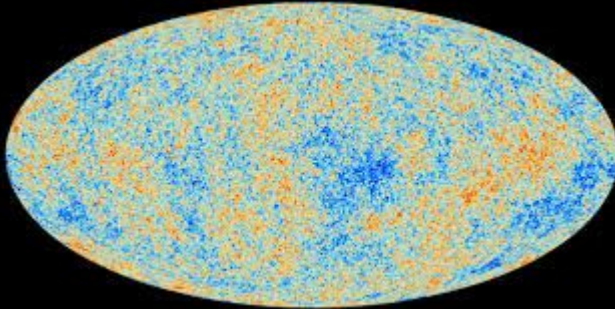
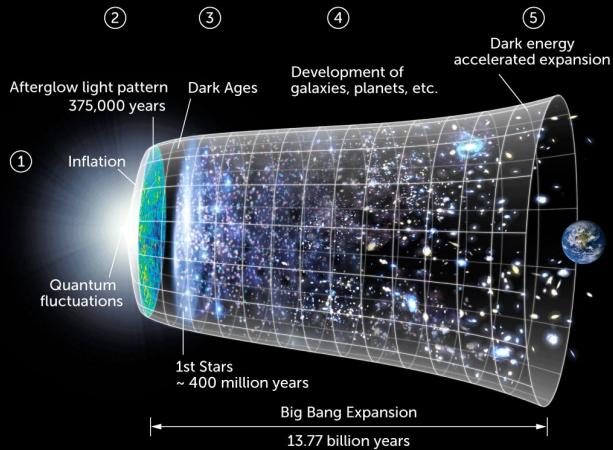
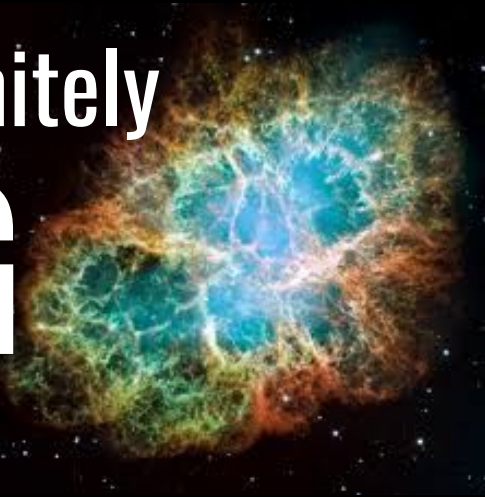


**INTRODUCING THE STANDARD  
MODEL OF PARTICLE PHYSICS  
WITH POKEMON CARDS**

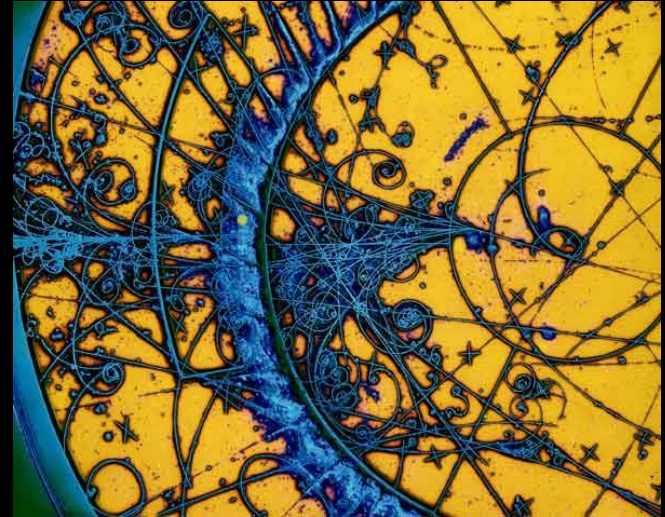
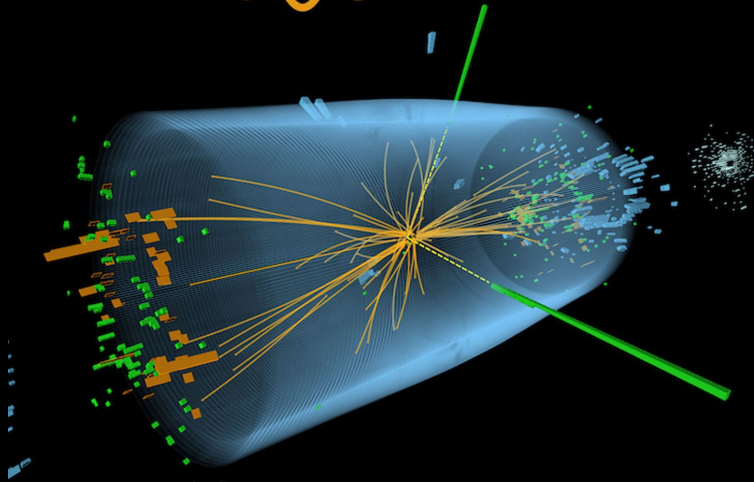
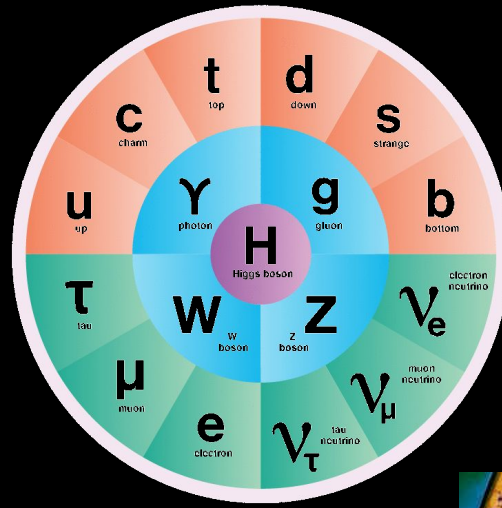
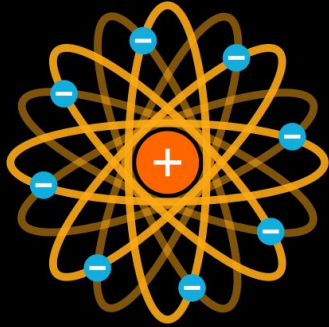
**CAMILLE SIRONNEAU**



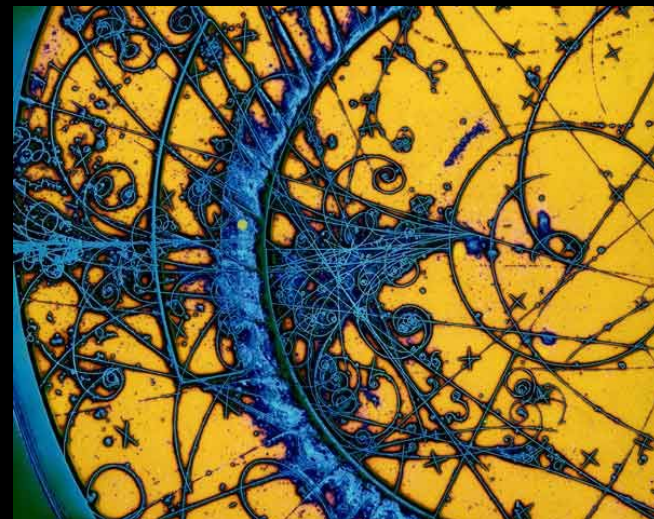
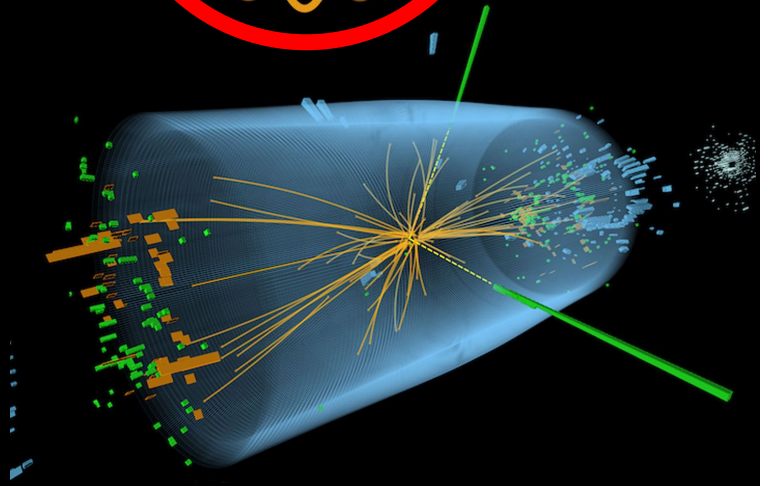
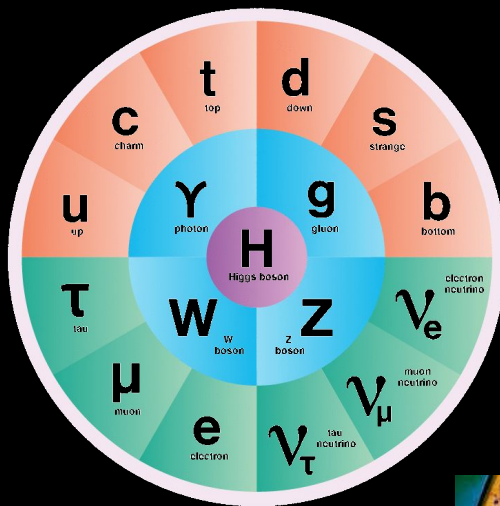
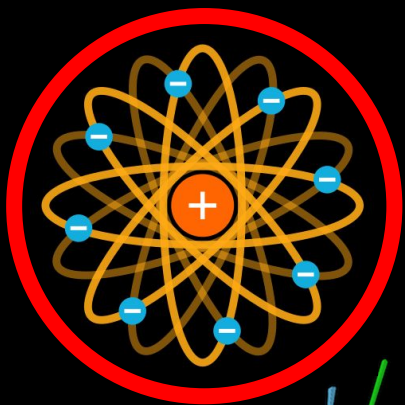
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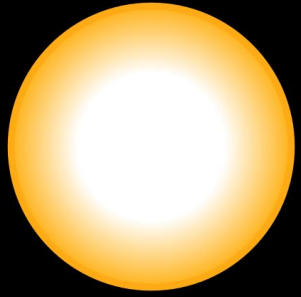


# The infinitely small

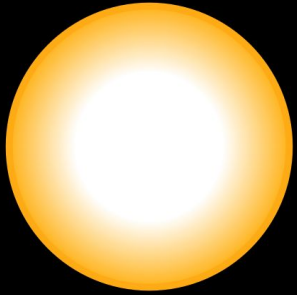


# The infinitely small

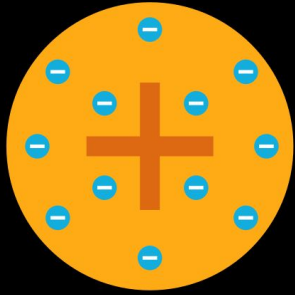




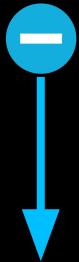
Dalton, 1803



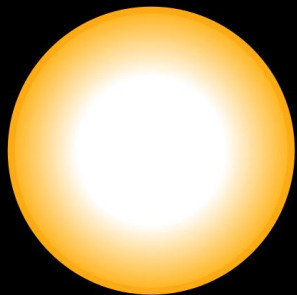
Dalton, 1803



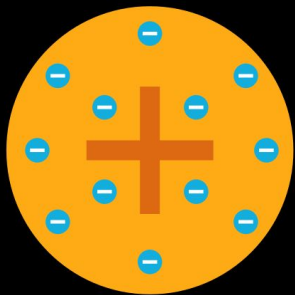
Thomson, 1904



electron  
1897



Dalton, 1803



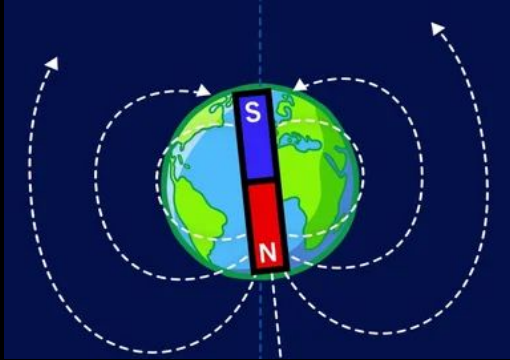
Thomson, 1904



electron  
1897

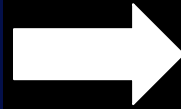
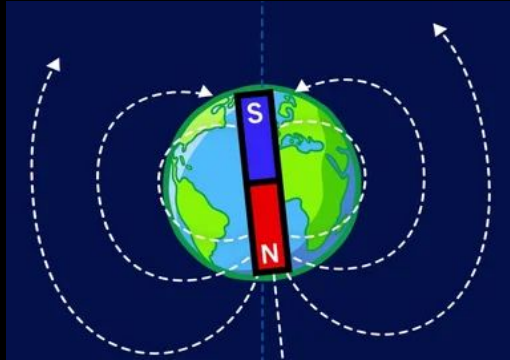


# The electromagnetic interaction



→ How is it propagated ?

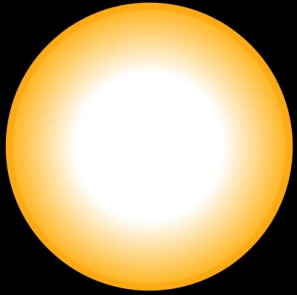
# The electromagnetic interaction



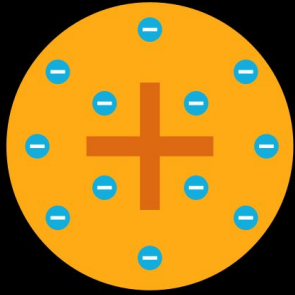
→ How is it propagated ?

Thanks to a boson !

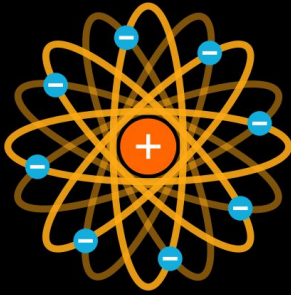




Dalton, 1803



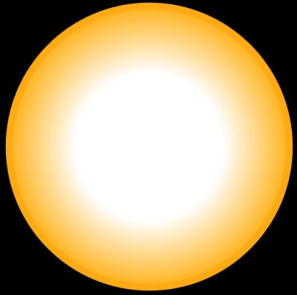
Thomson, 1904



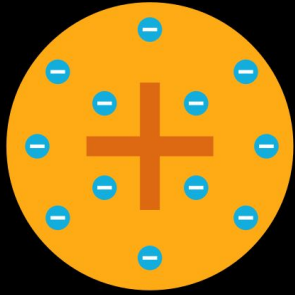
Rutherford, 1911



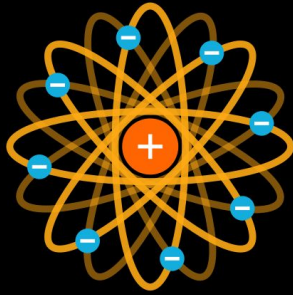
nucleus



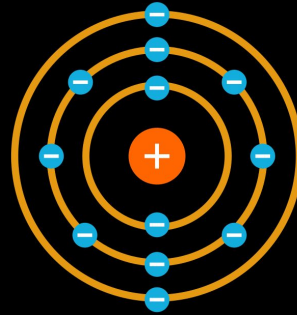
Dalton, 1803



Thomson, 1904



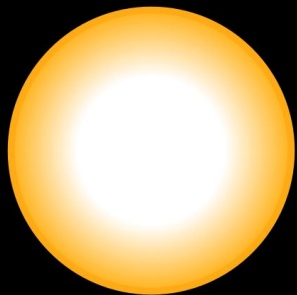
Rutherford, 1911



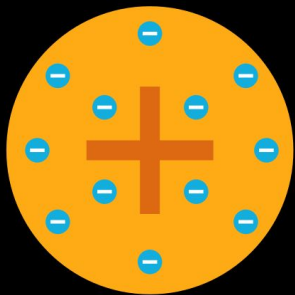
Bohr, 1913



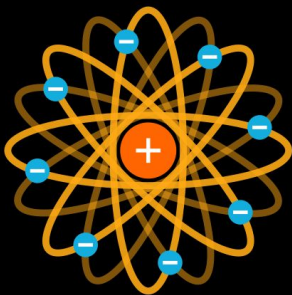
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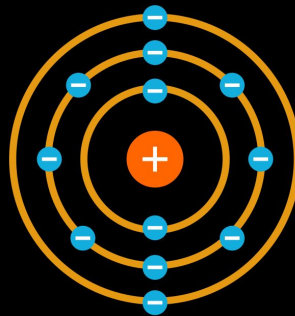
Dalton, 1803



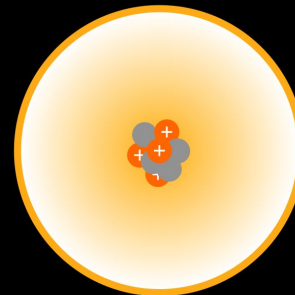
Thomson, 1904



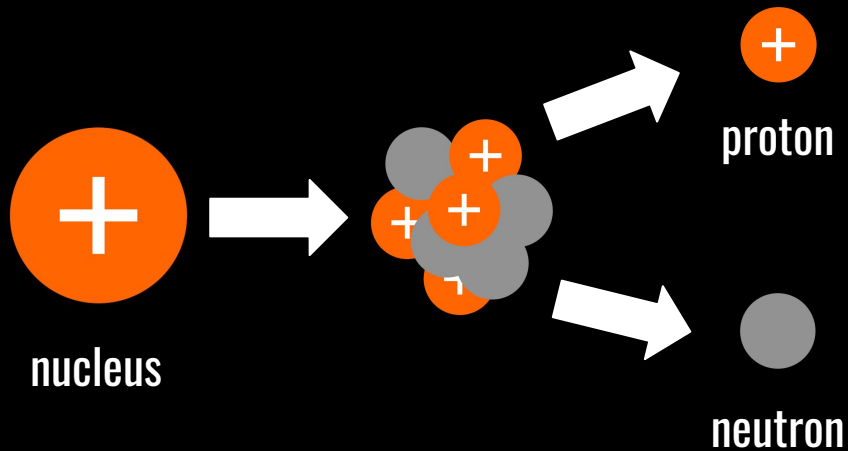
Rutherford, 1911

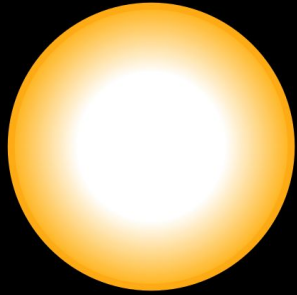


Bohr, 1913

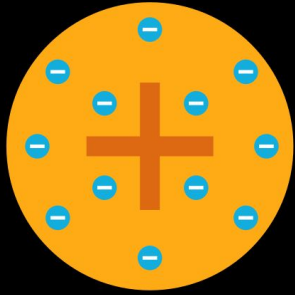


Schrödinger, 1926  
Chadwick, 1932

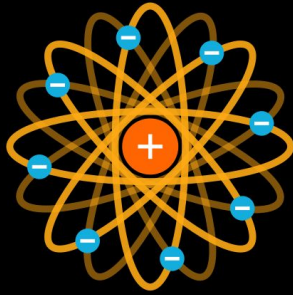




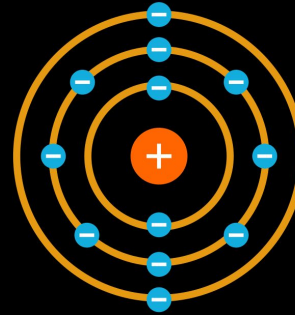
Dalton, 1803



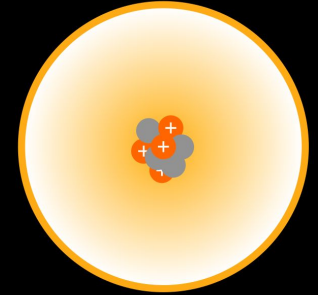
Thomson, 1904



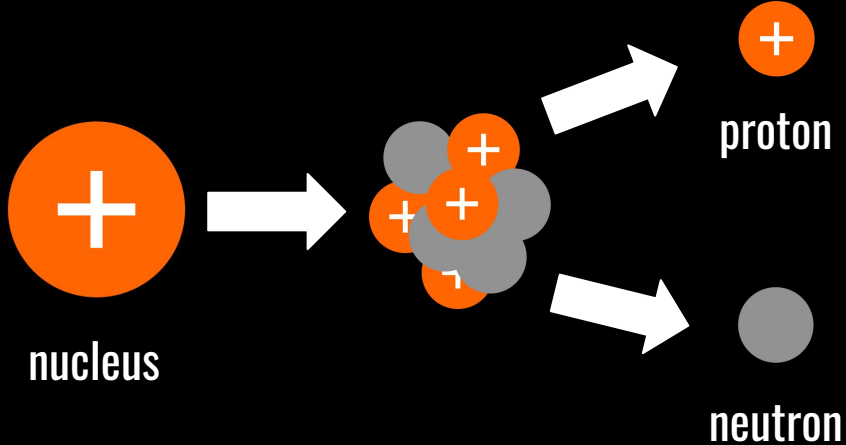
Rutherford, 1911



Bohr, 1913



Schrödinger, 1926  
Chadwick, 1932



How do protons stay bound together inside the nucleus ?

→ they should repel each other due to the electromagnetic interaction



**BASIC** **Gluon** HP **200**

NO. 7 | Binding Rainbow Pokemon | Mass : None

**Ability** **Strong Bond**  
 If you have at least 2 Quarks in play, you can bind them together. Split all damage between each bound Quark

**Color Ray** **40+**  
 Inflicts 40 base damage to an opponent Pokemon, 120 if it's a Quark or another Gluon

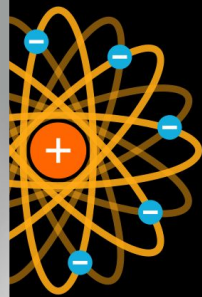
**Nuclear Energy** **150**  
 The nucleus of an atom splits in 2. The energy released deals 150 damage to every Pokemon in play

weakness x 2 | resistance -30 | retreat

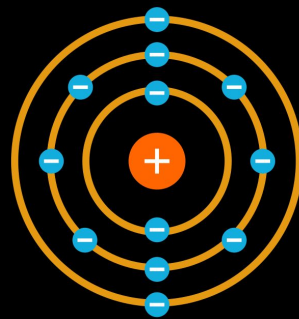
As their name might suggest, Gluons are the glue of the Standard Model. Without them, nuclei would not exist and neither would we, which would be really sad. If you meet one, thank it but don't get stuck

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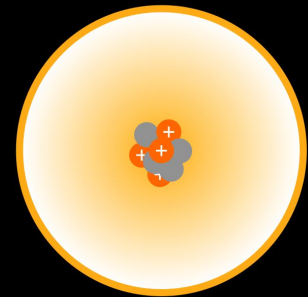
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Rutherford, 1911



Bohr, 1913

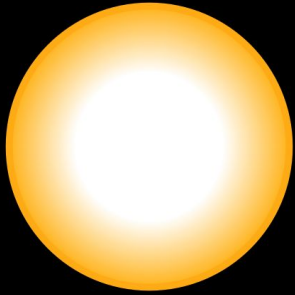


Schrödinger, 1926  
 Chadwick, 1932

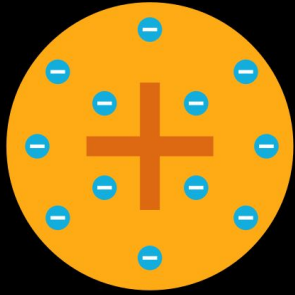
How do protons stay bound together inside the nucleus ?

**Answer: the strong interaction and its boson, the gluon !**

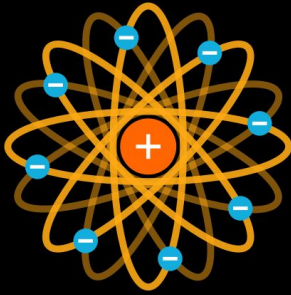
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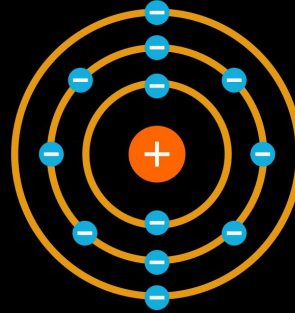
Dalton, 1803



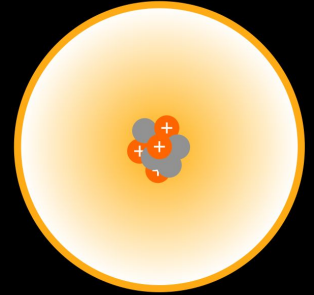
Thomson, 1904



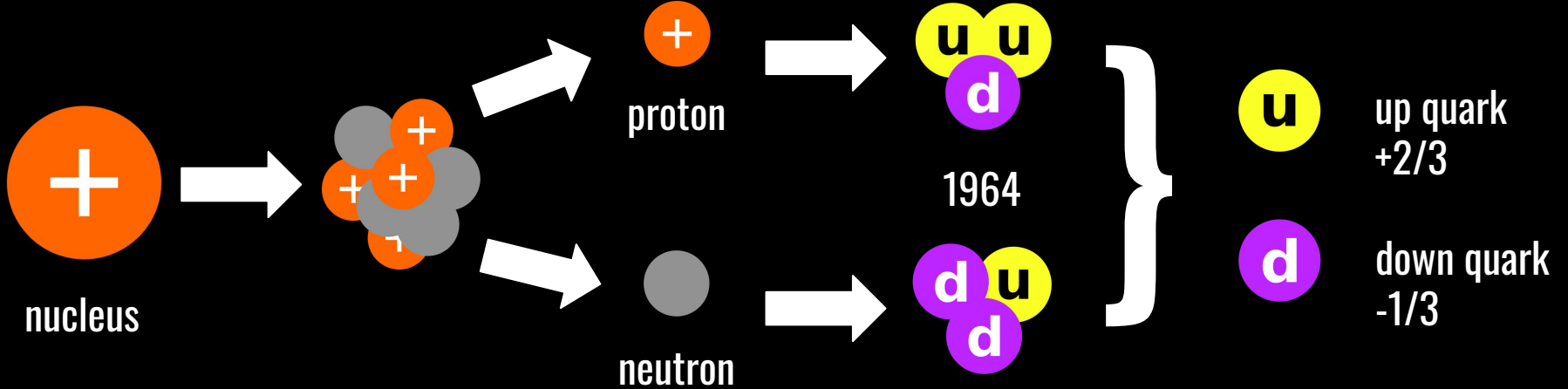
Rutherford, 1911



Bohr, 1913



Schrödinger, 1926  
Chadwick, 1932



**BASIC** Up **Quark** HP **180**

NO. 13 | Prismatic Seed Pokemon | Mass : ~2.2 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokemon

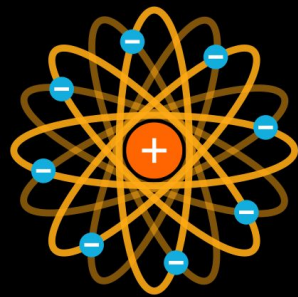
**Proton Squad** 140  
If you have 2 Up and 1 Down Quarks in play, discard them and play a Proton. This bond deals 140 damage to an enemy Pokemon

weakness x 2 | resistance -30 | retreat

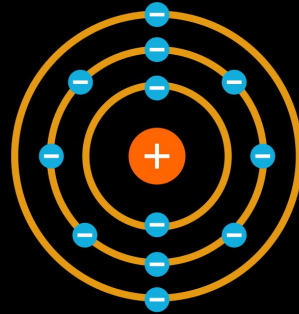
13 / 18

Positivity incarnate, we can all thank the Up Quark as, without it (and the Down, don't forget it), we would not exist. As they love hiding inside nuclei, a great deal of motivation is needed to pull them out of there

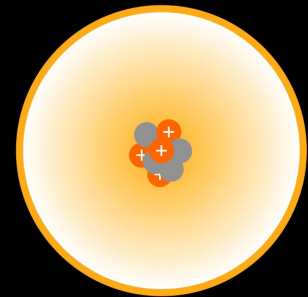
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Rutherford, 1911



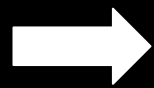
Bohr, 1913



Schrödinger, 1926  
Chadwick, 1932



proton



1964



neutron



up quark  
+2/3



down quark  
-1/3

BASIC

Up Quark

HP 180



NO. 13 | Prismatic Seed Pokemon | Mass : ~2.2 MeV

**Ability Chromodynamic**

If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** **30+**

Inflicts 30 damage to 1d4 enemy Pokemon

**Proton Squad** **140**

If you have 2 Up and 1 Down Quarks in play, discard them and play a Proton. This bond deals 140 damage to an enemy Pokemon

weakness x 2 | resistance -30 | retreat

Positivity incarnate, we can all thank the Up Quark as, without it (and the Down, don't forget it), we would not exist. As they love hiding inside nuclei, a great deal of motivation is needed to pull them out of there

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BASIC

Down Quark

HP 180



NO. 14 | Tinted Matter Pokemon | Mass : ~4.7 MeV

**Ability Chromodynamic**

If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** **30+**

Inflicts 30 damage to 1d4 enemy Pokemon

**Neutron Squad** **140**

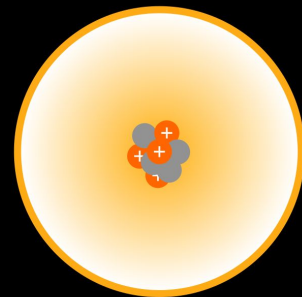
If you have 2 Down and 1 Up Quarks in play, discard them and play a Neutron. This bond deals 140 damage to an enemy Pokemon

weakness x 2 | resistance -30 | retreat

Just like the Up, the Down Quarks are everywhere around (and inside) us. However, good luck to observe one by itself, they really enjoy traveling in groups and are more often than not inseparable

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Schrödinger, 1926  
Chadwick, 1932



up quark  
+2/3



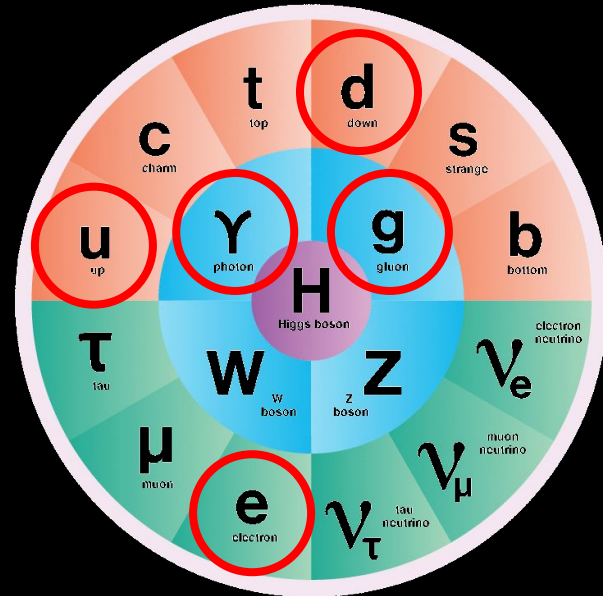
down quark  
-1/3

We have seen (to the best of our knowledge) all elementary particles that make up atoms

***THE END ?***

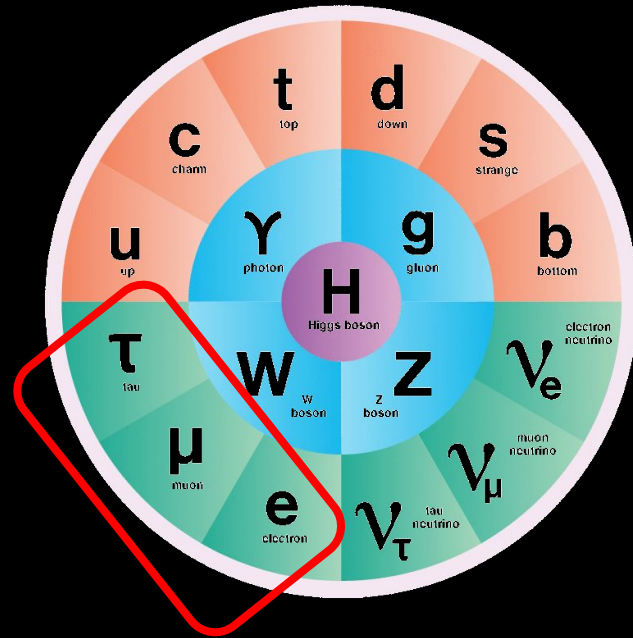
# THE END ?

Not really...



# THE END ?

Charged leptons



BASIC

Muon

HP 175 

NO. 11 | Cosmic Relativist Pokémon | Mass : ~106 MeV

**Ability** Tomography

When you play this Pokémon, your rival must show you the cards in their hand

 **Passing Through** 40



Deals 40 damage to 1d4 enemy Pokémon in its way before stopping

  **Decay** 110

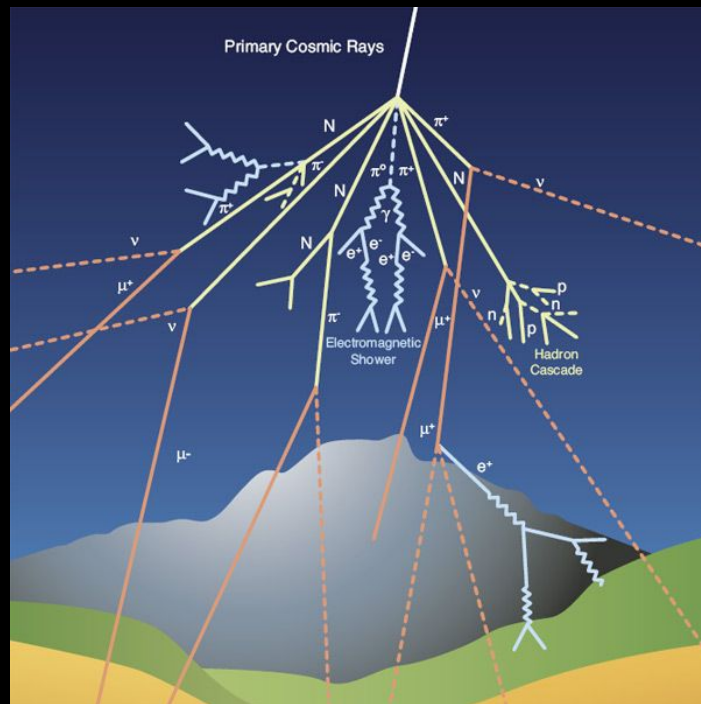
After this attack, discard the Muon and replace it with an Electron or a Neutrino (except a Tau Neutrino)

weakness  x2 | resistance  -30 | retreat  

Resulting from the decay of cosmic rays in our atmosphere, scientists were very surprised to observe it after its exhausting journey. Tiredness, like time and space, might well be relative

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→ Detected in 1936

→ ~200x heavier than electrons

→ Experimental proof of special relativity



→ Detected between 1974 and 1977

→ ~18x heavier than muons

→ Difficult to observe because they decay very quickly

BASIC

Tau

HP 200



NO. 12 | Imposing Thunder Pokémon | Mass : ~1.777 GeV

Ability

**Instability**

Roll 1d6 at the start of every turn the Tau is in play. If the result is not 1, the Tau uses the attack Decay depending on the result of the die and is then discarded



**Decay**

60+

2-3 : deal 60 damage to all enemy Pokémon. Replace the Tau by a Lepton. 4-5-6 : deal 110 damage to all Pokémon in play (including yours). The Tau is replaced by a Quark

weakness



× 2

resistance



-30

retreat

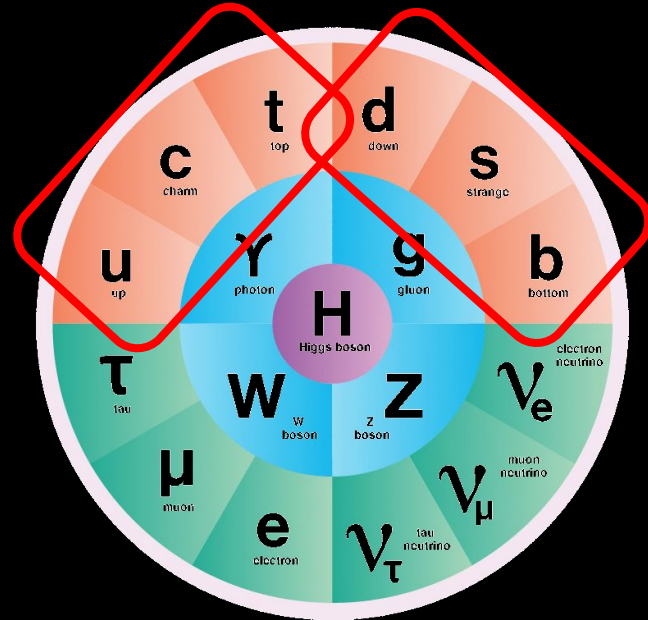


The Tau's favorite hiding technique consists in the emission of a huge amount of particles to cover its tracks (and showers). Hunting him with a SPEAR seems to have done the trick though

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# THE END ?

Quarks



**BASIC** Up Quark HP 180

NO. 13 | Prismatic Seed Pokemon | Mass: ~2.3 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

☉ **Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokemons

☉☉ **Proton Squad** 140  
If you have 2 Up and 1 Down Quarks in play, discard them and play a Proton. This bond deals 140 damage to an enemy Pokemon

weakness ☉ x 2 | resistance ☉ -30 | retreat ★★

Mostly because, we can all thank the Up Quarks, without it (and the Down, don't forget it), we would not exist. As they love hiding inside nuclei, a great deal of motivation is needed to pull them out of there.

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→ Discovered in 1964 at the same time as the up and down quarks

→ ~20x heavier than the down

**BASIC** Down Quark HP 180

NO. 14 | Tinted Matter Pokemon | Mass: ~4.7 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

☉ **Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokemons

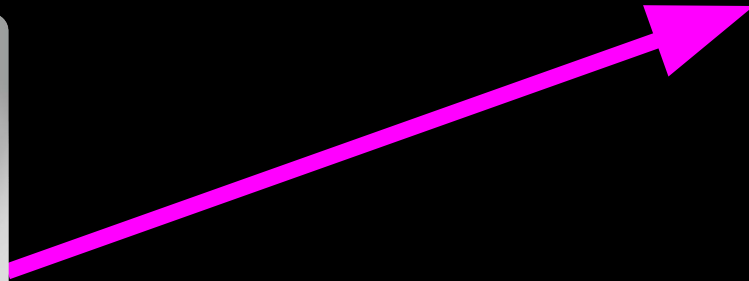
☉☉ **Neutron Squad** 140  
If you have 2 Down and 1 Up Quarks in play, discard them and play a Neutron. This bond deals 140 damage to an enemy Pokemon

weakness ☉ x 2 | resistance ☉ -30 | retreat ★★

Just like the Up, the Down Quarks are everywhere around (and inside) us. However, good luck to observe one by itself, they really enjoy traveling in groups and are more often than not inseparable.

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**BASIC** Strange Quark HP 210

NO. 16 | Eccentric Pigment Pokemon | Mass: ~95 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

☉ **Jet** 40+  
Inflicts 40 damage to 1d4 enemy Pokemons

☉☉ **Quark Gluon Plasma** 120  
Summons the power of the primordial quark gluon plasma to inflict 120 damage to an enemy Pokemon. All Quarks in play become free

weakness ☉ x 2 | resistance ☉ -30 | retreat ★★

A physical proof that strangeness is a gift, this little Quark was a pioneer in its field. It might not create matter but it is certainly an agent of kaons... Ahem, chaos next to the Up and Down Quarks

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**BASIC** Up Quark HP 180



NO. 12 | Prismatic Seed Pokémon | Mass: ~2.3 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokémon

**Proton Squad** 140  
If you have 2 Up and 1 Down Quarks in play, discard them and play a Proton. This bond deals 140 damage to an enemy Pokémon

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

Minority incarnate, we can all thank the Up Quark as without it (and the Down, don't forget it), we would not exist. As they love hiding inside nuclei, a great deal of motivation is needed to pull them out of there.

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→ Predicted in 1964  
 → Existence confirmed in 1974  
 → ~630x heavier than the up

**BASIC** Down Quark HP 180



NO. 14 | Tinted Matter Pokémon | Mass: ~4.7 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokémon

**Neutron Squad** 140  
If you have 2 Down and 1 Up Quarks in play, discard them and play a Neutron. This bond deals 140 damage to an enemy Pokémon

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

Just like the Up, the Down Quarks are everywhere around (and inside) us. However, good luck to observe one by itself, they really enjoy traveling in groups and are more often than not inseparable.

14 / 18

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**BASIC** Strange Quark HP 210



NO. 16 | Eccentric Pigment Pokémon | Mass: ~95 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 40+  
Inflicts 40 damage to 1d4 enemy Pokémon

**Quark Gluon Plasma** 120  
Summons the power of the primordial quark gluon plasma to inflict 120 damage to an enemy Pokémon. All Quarks in play become free

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

A physical proof that strangeness is a girl, this little Quark was a prisoner in its field. It might not create matter but it is certainly an agent of chaos... Ahem, charm next to the Up and Down Quarks.

16 / 18

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**BASIC** Charm Quark HP 230



NO. 15 | Colorful Fascination Pokémon | Mass: ~1.27 GeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 50+  
Inflicts 50 damage to 1d4 enemy Pokémon

**Bewitchment** 90  
Inflicts 90 damage to an opponent Pokémon. The Charm Quark can't be attacked for 1d4 rounds afterwards

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

When it was discovered, the Charm brought an enchanting symmetry to particle physics. It was even called a "magical object allowing to vanquish evil" by too avid players of Dungeons and Dragons

15 / 18

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**BASIC** Up Quark HP 180



NO. 12 | Prismatic Seed Pokemon | Mass: ~2.2 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

☉ **Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokemons

☉☉ **Proton Squad** 140  
If you have 2 Up and 1 Down Quarks in play, discard them and play a Proton. This bond deals 140 damage to an enemy Pokemon

weakness ☉ x 2 | resistance ☉ -30 | retreat ★★

Mostlyly Incarnate, we can all thank the Up Quark as without it and the Down, don't forget it, we would not exist. As they love being inside nuclei, a great deal of motivation is needed to pull them out of there

13 / 18

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**BASIC** Charm Quark HP 230



NO. 15 | Colorful Fascination Pokemon | Mass: ~1.27 GeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

☉ **Jet** 50+  
Inflicts 50 damage to 1d4 enemy Pokemons

☉☉ **Bewitchment** 90  
Inflicts 90 damage to an opponent Pokemon. The Charm Quark can't be attacked for 1d4 rounds afterwards

weakness ☉ x 2 | resistance ☉ -30 | retreat ★★

When it was discovered, the Charm brought an enchanting symmetry to particle physics. It was even called a "magical object allowing to vanquish evil" by too wild players of Dungeons and Dragons

15 / 18

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→ Predicted in 1973  
→ Existence confirmed in 1977  
→ ~45x heavier than the strange

**BASIC** Down Quark HP 180



NO. 14 | Tinted Matter Pokemon | Mass: ~4.7 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

☉ **Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokemons

☉☉ **Neutron Squad** 140  
If you have 2 Down and 1 Up Quarks in play, discard them and play a Neutron. This bond deals 140 damage to an enemy Pokemon

weakness ☉ x 2 | resistance ☉ -30 | retreat ★★

Just like the Up, the Down Quarks are everywhere around (and inside) us. However, good luck to observe one by itself, they really enjoy traveling in groups and are more often than not inseparable

14 / 18

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**BASIC** Strange Quark HP 210



NO. 16 | Eccentric Pigment Pokemon | Mass: ~95 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

☉ **Jet** 40+  
Inflicts 40 damage to 1d4 enemy Pokemons

☉☉ **Quark Gluon Plasma** 120  
Summons the power of the primordial quark gluon plasma to inflict 120 damage to an enemy Pokemon. All Quarks in play become free

weakness ☉ x 2 | resistance ☉ -30 | retreat ★★

A physical proof that strangeness is a girl. This little Quark was a prisoner in its field. It might not create matter but it is certainly an agent of chaos... Ahem, chaos next to the Up and Down Quarks

16 / 18

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**BASIC** Bottom Quark HP 270



NO. 18 | Iridescent Beauty Pokemon | Mass: ~4.18 GeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

☉ **Jet** 60+  
Inflicts 60 damage to 1d4 enemy Pokemons

☉☉ **B-Tagging** 40+  
Discard this card and deal 1d6x40 damage to split between all enemy Pokemons. Your rival must then tell you how many Bottom Quarks they have

weakness ☉ x 2 | resistance ☉ -30 | retreat ★★

Bottom Quarks are particularly cherished by scientists looking to study processes not explained by the Standard Model. For an unknown reason, they appear to be really big fans of the cartoon Babar

18 / 18

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**BASIC** Up Quark HP 180



NO. 12 | Prismatic Seed Pokemon | Mass: ~2.2 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokemons

**Proton Squad** 140  
If you have 2 Up and 1 Down Quarks in play, discard them and play a Proton. This bond deals 140 damage to an enemy Pokemon

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

13 / 18

Mostly inanimate, we can all thank the Up Quark as without it (and the Down, don't forget it), we would not exist. As they love hiding inside nuclei, a great deal of motivation is needed to pull them out of there.

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**BASIC** Charm Quark HP 230



NO. 15 | Colorful Fascination Pokemon | Mass: ~1.27 GeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 50+  
Inflicts 50 damage to 1d4 enemy Pokemons

**Bewitchment** 90  
Inflicts 90 damage to an opponent Pokemon. The Charm Quark can't be attacked for 1d4 rounds afterwards

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

15 / 18

When it was discovered, the Charm brought an enchanting, symmetry by particle physics. It was even called a "magical object allowing to vanquish evil" by boe and players of Dungeons and Dragons

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→ Existence confirmed in 1995  
→ ~130x heavier than the charm

**BASIC** Top Quark HP 300



NO. 17 | Chromatic Introvert Pokemon | Mass: ~173 GeV

**Ability Friend of the Higgs**  
When you play this card, your rival must tell you how many Higgs Bosons they have

**Decay** 180  
The next round after playing the Top, it decays and inflicts 180 damage to all enemy Pokemons. Roll 1d100 to know which Quark will replace it  
1-98 : Bottom, 99 : Strange, 100 : Down

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

17 / 18

To this day, the Top Quark is the most massive elementary particle we know. Because of its short lifetime, it is sadly unable to form bonds with other Quarks before decaying, making it also the loneliest of all elementary particles

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**BASIC** Down Quark HP 180



NO. 14 | Tinted Matter Pokemon | Mass: ~4.7 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokemons

**Neutron Squad** 140  
If you have 2 Down and 1 Up Quarks in play, discard them and play a Neutron. This bond deals 140 damage to an enemy Pokemon

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

14 / 18

Just like the Up, the Down Quarks are everywhere around (and inside) us. However, good luck to observe one by itself, they really enjoy traveling in groups and are more often than not inseparable

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**BASIC** Strange Quark HP 210



NO. 16 | Eccentric Pigment Pokemon | Mass: ~95 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 40+  
Inflicts 40 damage to 1d4 enemy Pokemons

**Quark Gluon Plasma** 120  
Summons the power of the primordial quark gluon plasma to inflict 120 damage to an enemy Pokemon. All Quarks in play become free

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

16 / 18

A physical proof that strangeness is a girl, this little Quark was a pioneer in its field. It might not create matter but it is certainly an agent of chaos... Ahem, chaos next to the Up and Down Quarks

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**BASIC** Bottom Quark HP 270



NO. 18 | Iridescent Beauty Pokemon | Mass: ~4.18 GeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 60+  
Inflicts 60 damage to 1d4 enemy Pokemons

**B-Tagging** 40+  
Discard this card and deal 1d6x40 damage to split between all enemy Pokemons. Your rival must then tell you how many Bottom Quarks they have

weakness  $\times 2$  resistance  $-30$  retreat  $\star \star$

18 / 18

Bottom Quarks are particularly cherished by scientists looking to study processes not explained by the Standard Model. For an unknown reason, they appear to be really big fans of the cartoon Buba!

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**Up Quark** HP 180



NO. 12 | [Prismatic Seed Pokemon] | Mass: ~2.3 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokemons

**Proton Squad** 140  
If you have 2 Up and 1 Down Quarks in play, discard them and play a Proton. This bond deals 140 damage to an enemy Pokemon

weakness  $\otimes \times 2$  resistance  $\ominus -30$  retreat  $\star \star$

Mostly incarnate, we can all thank the Up Quark as without it (and the Down, don't forget it), we would not exist. As they love being inside nuclei, a great deal of motivation is needed to pull them out of there

13 / 18

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**Charm Quark** HP 230



NO. 15 | [Colorful Fascination Pokemon] | Mass: ~1.27 GeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 50+  
Inflicts 50 damage to 1d4 enemy Pokemons

**Bewitchment** 90  
Inflicts 90 damage to an opponent Pokemon. The Charm Quark can't be attacked for 1d4 rounds afterwards

weakness  $\otimes \times 2$  resistance  $\ominus -30$  retreat  $\star \star$

When it was discovered, the Charm brought an enchanting symmetry to particle physics. It was even called a "magical object allowing to vanquish evil" by too and players of Dungeons and Dragons

15 / 18

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**Top Quark** HP 300



NO. 17 | [Iridescent Beauty Pokemon] | Mass: ~173 GeV

**Ability Chromodynamic**  
When you play this card, you can show how many Bottom Quarks you have in play. The Top Quark will replace it and inflicts 98 damage to all enemy Pokemons. Know which Quark will replace it 1-98 : Bottom, 99 : Strange, 100 : Down

weakness  $\otimes \times 2$  resistance  $\ominus -30$  retreat  $\star \star$

To this day, the Top Quark is the most massive elementary particle we know. Because of its short lifetime, it is solely unable to form bonds with other Quarks before decaying, making it also the kindest of all elementary particles

17 / 18

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**Down Quark** HP 180



NO. 14 | [Tinted Matter Pokemon] | Mass: ~4.7 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 30+  
Inflicts 30 damage to 1d4 enemy Pokemons

**Neutron Squad** 140  
If you have 2 Down and 1 Up Quarks in play, discard them and play a Neutron. This bond deals 140 damage to an enemy Pokemon

weakness  $\otimes \times 2$  resistance  $\ominus -30$  retreat  $\star \star$

Just like the Up, the Down Quarks are everywhere around (and inside) us. However, good luck to observe one by itself, they really enjoy traveling in groups and are more often than not inseparable

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**Strange Quark** HP 210



NO. 16 | [Eccentric Pigment Pokemon] | Mass: ~95 MeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 40+  
Inflicts 40 damage to 1d4 enemy Pokemons

**Quark Gluon Plasma** 120  
Summons the power of the primordial quark gluon plasma to inflict 120 damage to an enemy Pokemon. All Quarks in play become free

weakness  $\otimes \times 2$  resistance  $\ominus -30$  retreat  $\star \star$

A physical proof that strangeness is a girl, this little Quark was a pioneer in its field. It might not create matter but it is certainly an agent of kaons... Ahem, chaos next to the Up and Down Quarks

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**Bottom Quark** HP 270



NO. 18 | [Iridescent Beauty Pokemon] | Mass: ~4.18 GeV

**Ability Chromodynamic**  
If you have more than one Quark in play, you can combine them to form Mesons or Baryons

**Jet** 60+  
Inflicts 60 damage to 1d4 enemy Pokemons

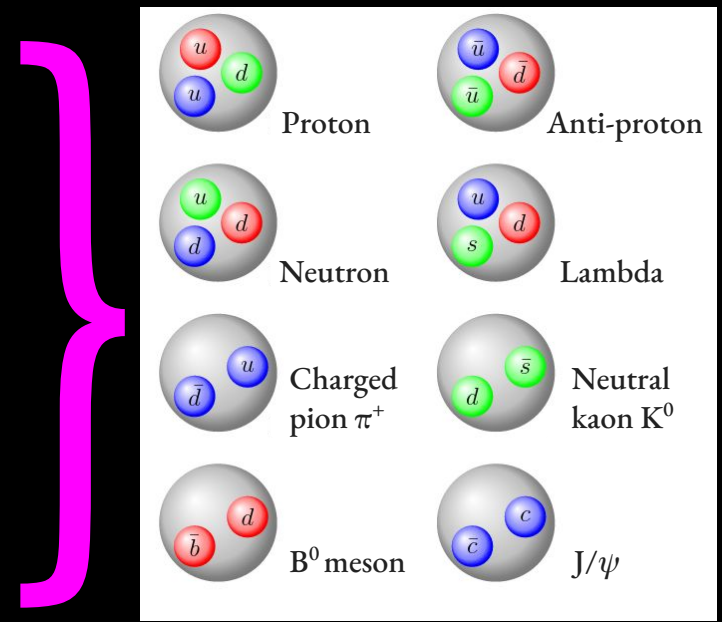
**B-Tagging** 40+  
Discard this card and deal 1d6x40 damage to split between all enemy Pokemons. Your rival must then tell you how many Bottom Quarks they have

weakness  $\otimes \times 2$  resistance  $\ominus -30$  retreat  $\star \star$

Bottom Quarks are particularly cherished by scientists looking to study processes not explained by the Standard Model. For an unknown reason, they appear to be really big fans of the cartoon Bubu

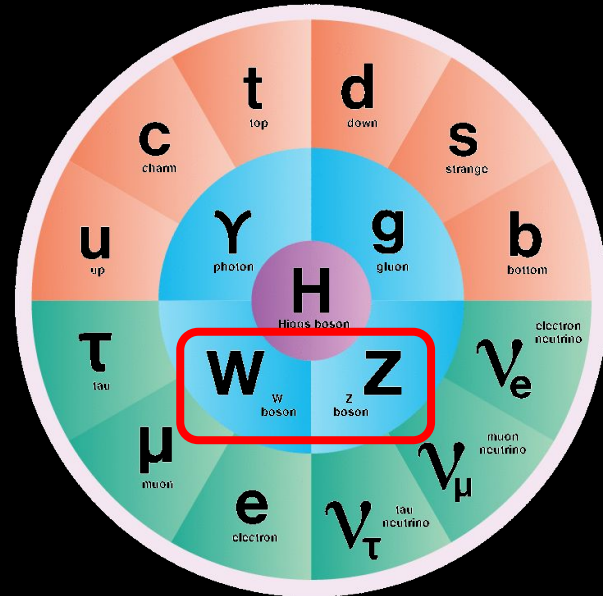
18 / 18

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# THE END ?

The  $W^{+/-}$  and Z bosons  
→ a new interaction !



# The weak interaction

**BASIC** Boson **W +/-** HP **220**

NO. 8 | Radioactive Antitheses Pokemon | Mass : -80 GeV

**Ability** **Charged Weak Current**  
 Once a round you can :  
 • Switch a charged Lepton in play with a Neutrino of the same flavor from your hand (and vice-versa)  
 • Switch a + (-) charged Quark in play with a - (+) charged Quark from your hand

**Stellar Fusion** **120**  
 The energy from the nuclear fusion in the core of stars inflicts 120 damage to every enemy Pokemon

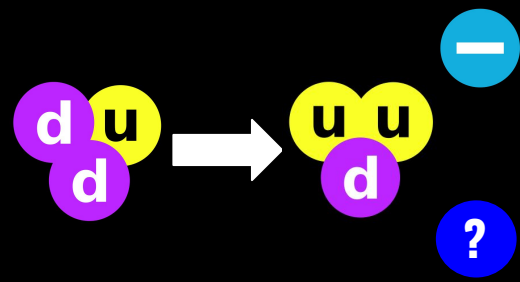
weakness x2 | resistance -30 | retreat

Contrary to the Z Boson, the W Bosons can be seen as agents of mischief and chaos. Particularly enjoying transforming their friends, beware not to anger them. They could have a quite... nuclear reaction

08 / 18

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- Predicted in 1933
- Responsible for radioactive decay
- Existence of the W et Z bosons confirmed in 1983
- 3 massive bosons: 2 with an electrical charge and one neutral



**BASIC** Boson **Z** HP **250**

NO. 9 | Universal Neutrality Pokemon | Mass : -91 GeV

**Ability** **Active Constraint**  
 While this card is in play, there can't be more than 3 Neutrinos in play at the same time

**Weak Charge** **70**  
 Deals 70 damage to one of the opponent's Pokemon. This attack has no effect on Gluons and Photons

**Neutrino Scattering** **100**  
 Inflicts 100 damage to an enemy Neutrino, which then has to switch places with another Pokemon in play

weakness | resistance | retreat

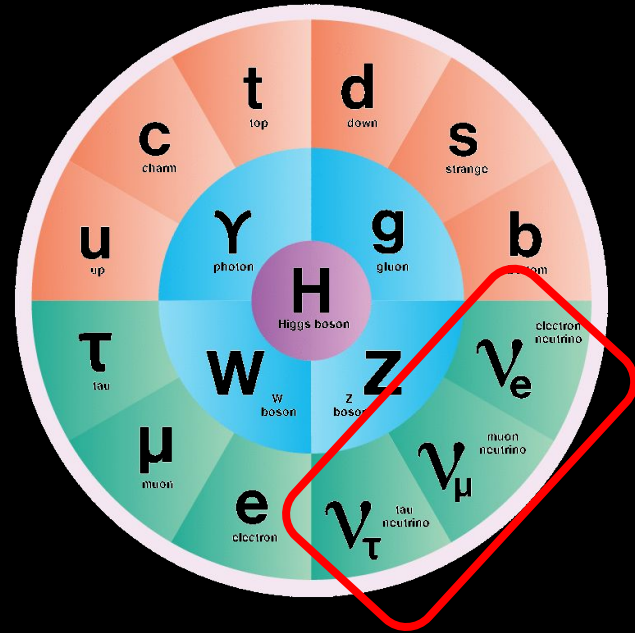
The Z Boson exudes an aura of serenity and absolute neutrality. Despite this appearance, it remains a vector of change in the Standard Model, as is the way of the bosons

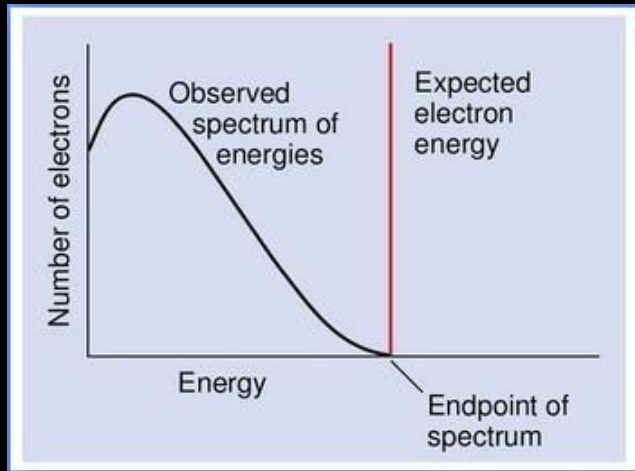
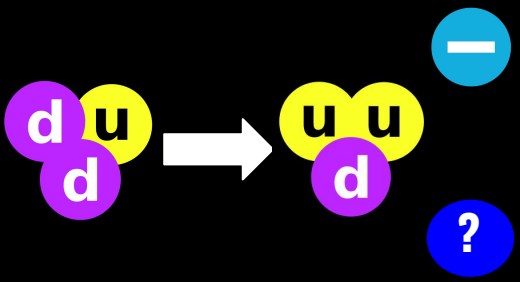
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# THE END ?

Neutrinos  
→ Neutral leptons





- First hypothesis of their existence in 1930 to explain the energy spectrum of electrons emitted via  $\beta$  decay
- Supposed to be massless
- First direct detection in 1956

BASIC

# Muon Neutrino

HP 150



NO. 2 | Flying Wonder Pokemon | Mass : 7 eV

## Ability Weak Interaction

Cancel all damage of types ⚡ and ☺

**Cosmic Ray** 90-

For every 10 damage inflicted to the Muon Neutrino, the attack damage decreases by 5

**Track** 30x

Target a rival Pokemon in play and inflict 30 damage during 1d4 rounds

weakness x 2 | resistance -30 | retreat

As discrete as its siblings, the Muon Neutrino is often considered to be the calmest and most peaceful. Beware though, the more energetic ones can be very aggressive

02 / 18

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→ Predicted in the 1940s  
→ Detected in 1962



→ Predicted directly after the discovery of the tau lepton  
→ Detected in 2000



BASIC

# Tau Neutrino

HP 180



NO. 3 | Flying Enigma Pokemon | Mass : ? eV

## Ability Weak Interaction

Cancel all damage of types ⚡ and ☺

**Bizaray** 90

Your rival must tell you a particle physics joke. If you laugh, the attack misses, otherwise it deals 90 damage

**Double Double** 70-

Roll a d10. On a 10 : deals 70 damage to all enemy Pokemons. Otherwise, inflicts 50 damage to every Pokemon (including yours)

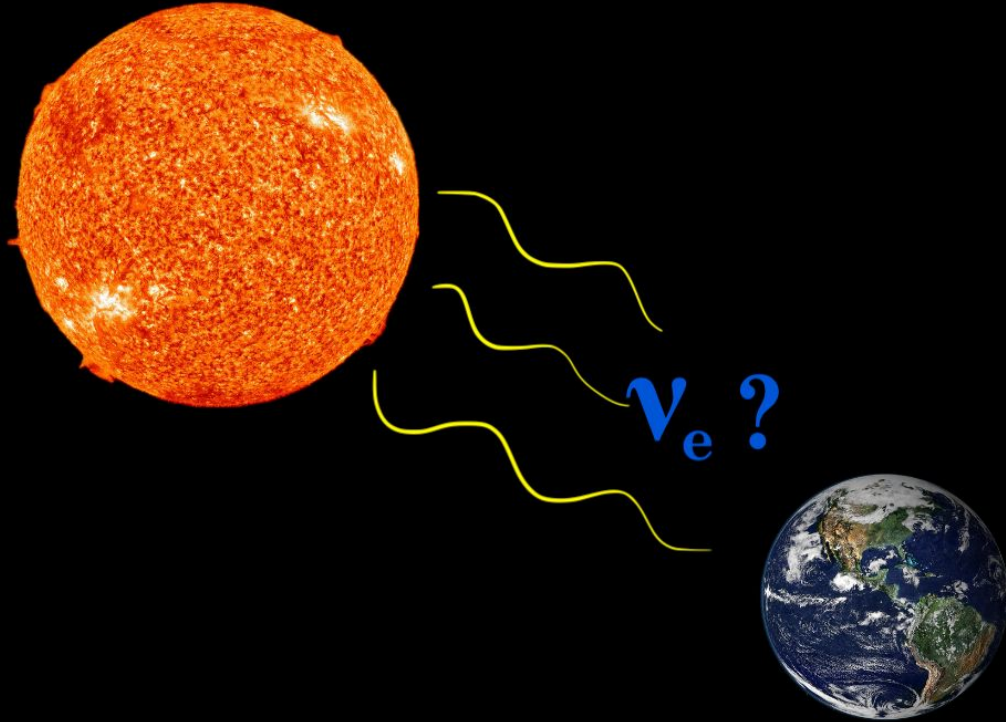
weakness x 2 | resistance -30 | retreat

Even for experts, seeing a Tau Neutrino is a real challenge! Only a few have succeeded, which makes it the most coveted Neutrino. I read somewhere you can use IceCubes to bait them, I might try

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# Neutrino oscillations

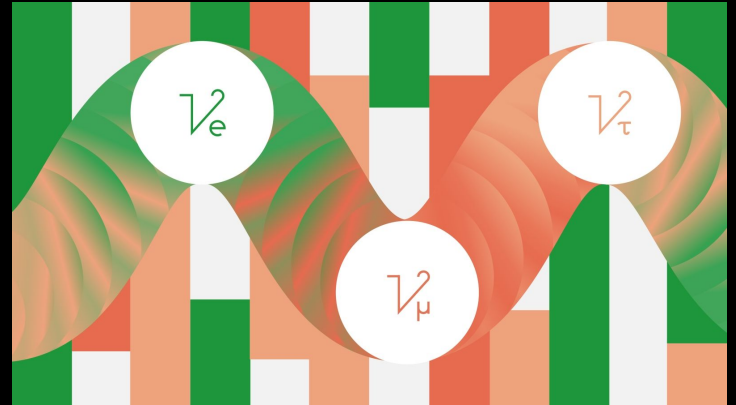
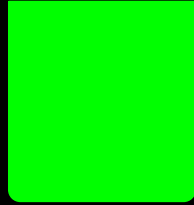
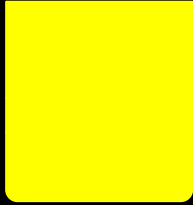
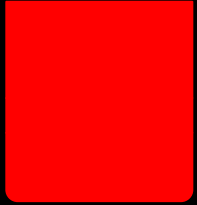


While trying to observe neutrinos produced by the Sun, different experiments detected 2 to 3 times less neutrinos than predicted

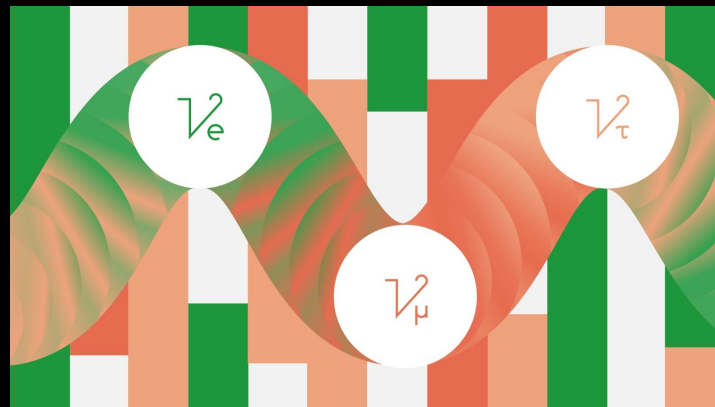
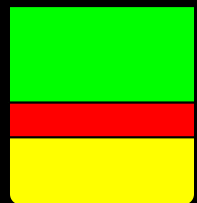
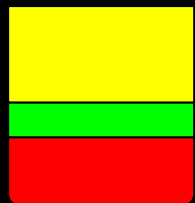
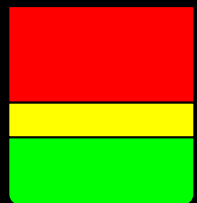
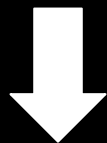
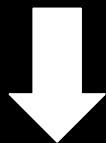
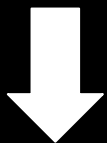
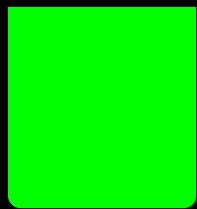
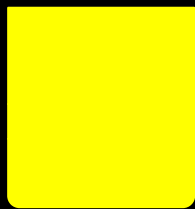
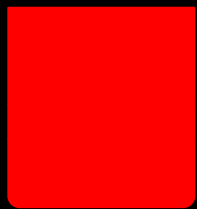
→ Where did the neutrinos go ?



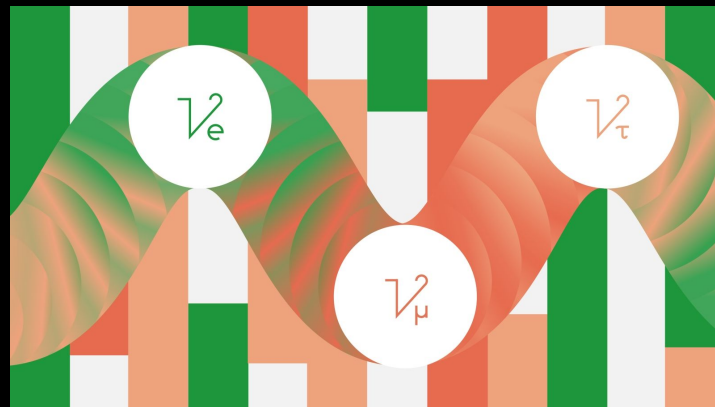
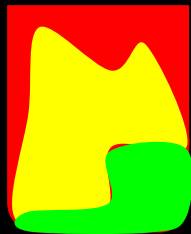
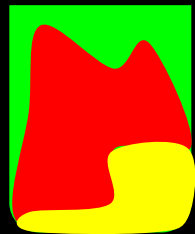
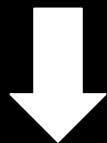
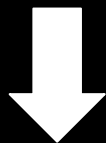
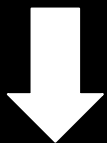
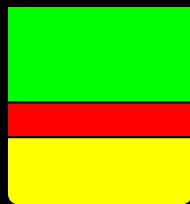
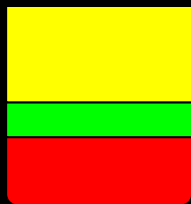
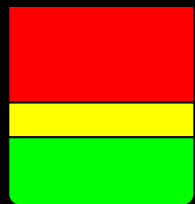
# Neutrino oscillations

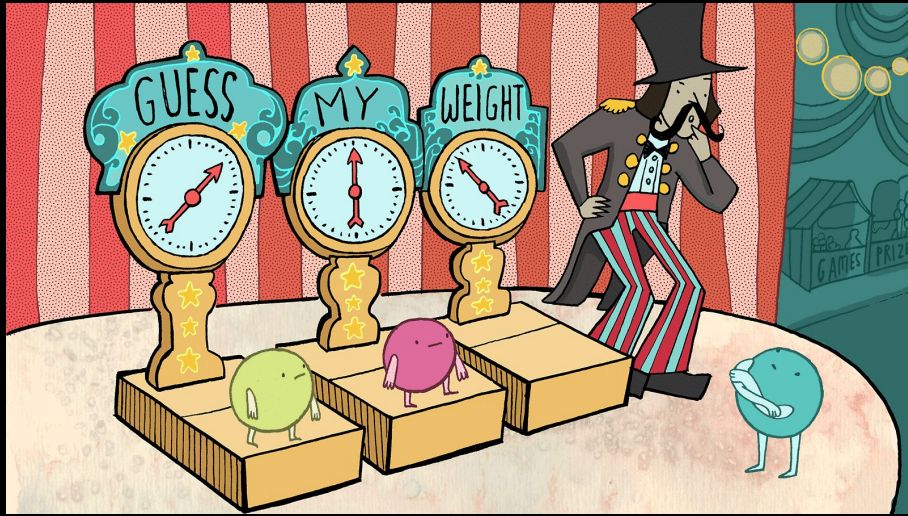


# Neutrino oscillations



# Neutrino oscillations

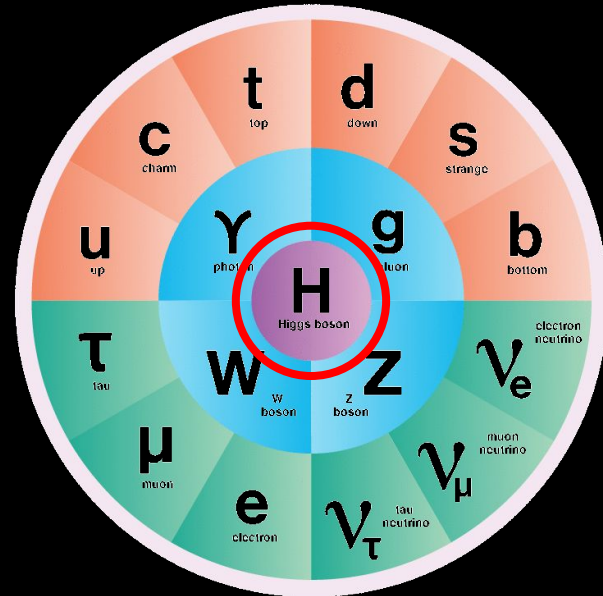


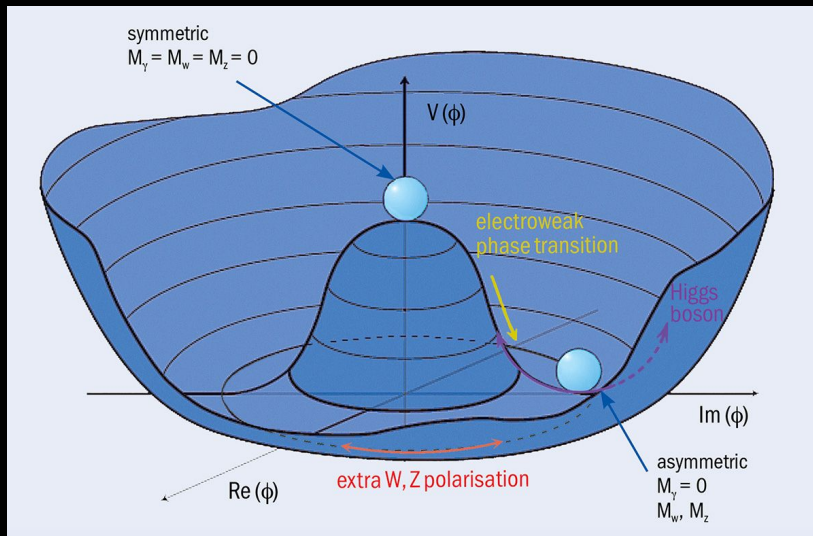


→ Still many questions to be answered regarding the behavior and properties of neutrinos !

# THE END ?

The Higgs boson





- Existence predicted in 1964
- Theory of the Higgs mechanism explaining how some particles gain their mass, including the W and Z bosons
- Detected in 2012 at the LHC

**BASIC** Boson **Higgs** HP **100**

NO. 6 | Sliding Sombrero Pokemon | Mass : ~125 GeV

**Ability** **Decay**

When this Pokemon loses all its HP, replace it by another massive particle from your hand

**Sombrero Punch** 50+

Generates mass with its hat. The targeted Pokemon is dealt 50 damage, or 100 if it is a W or Z Boson

**Symmetry Breaking** 70

If you find a particular symmetry in the playing field, inflicts 70 damage to every Pokemon involved

weakness **★ x 2** | resistance **👁️ -30** | retreat **★**

We could say that the Higgs Boson is the latest addition to the Standard Model. Even though its hat can seem comical, it is essential in the understanding of many properties in particle physics

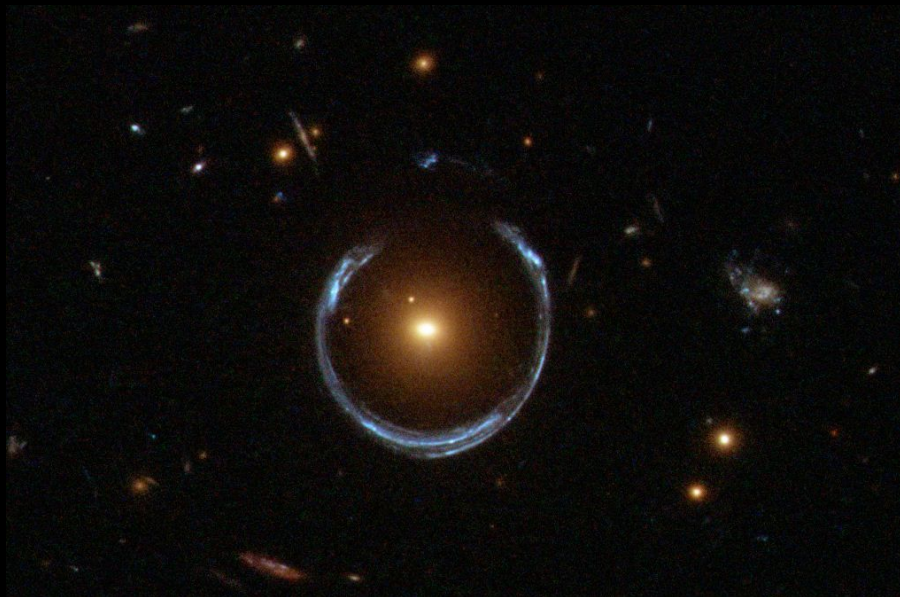
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***THE END !***

***FOR NOW...***

# Dark Matter



**BASIC** Dark Matter **HP 150**



NO. 4 | Shy Mouse Pokemon | Mass : ?

**Ability** **Invisibility**  
Cancel all damage of types ⚡ and ☹️. Only sensitive to physical attacks

**Gravitational Lensing**  
Once per round while this card is in play, if another one of your Pokemons is attacked, you can deflect the attack and split the damage between the ally and an enemy Pokemon

weakness 🏹 × 2 | resistance ⚡ -60 | retreat ⚔️

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Even though we are not able to see them, it is said that they are 5 times more abundant in the Universe than visible Pokemons. Their mysterious nature (and gravitational effect) can cause some serious attraction

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