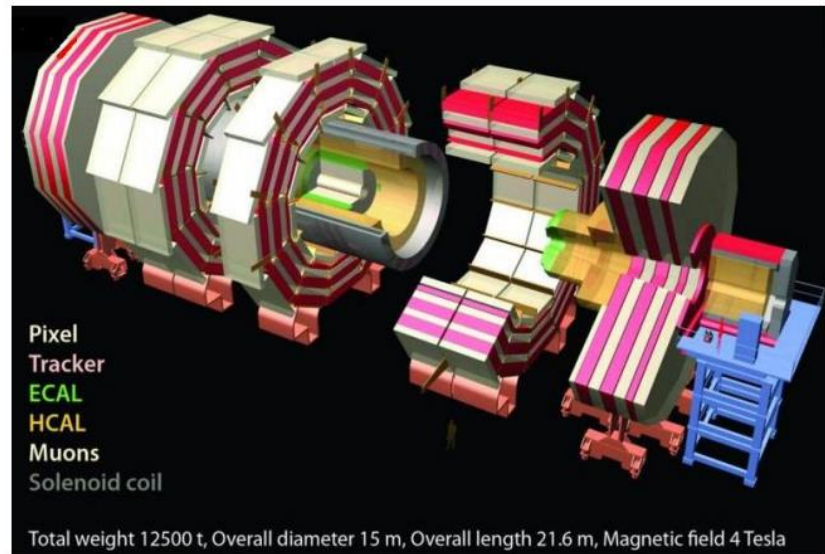
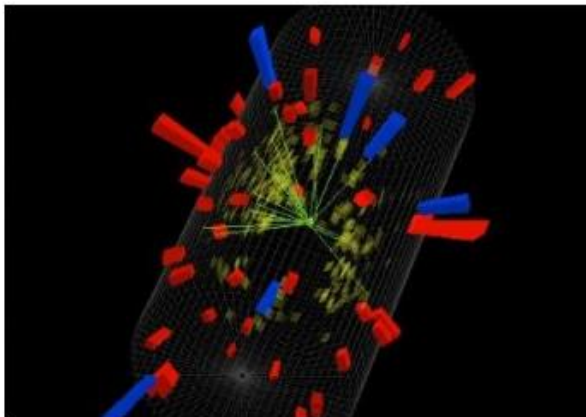


# High Energy Physics and the CMS WZH Masterclass

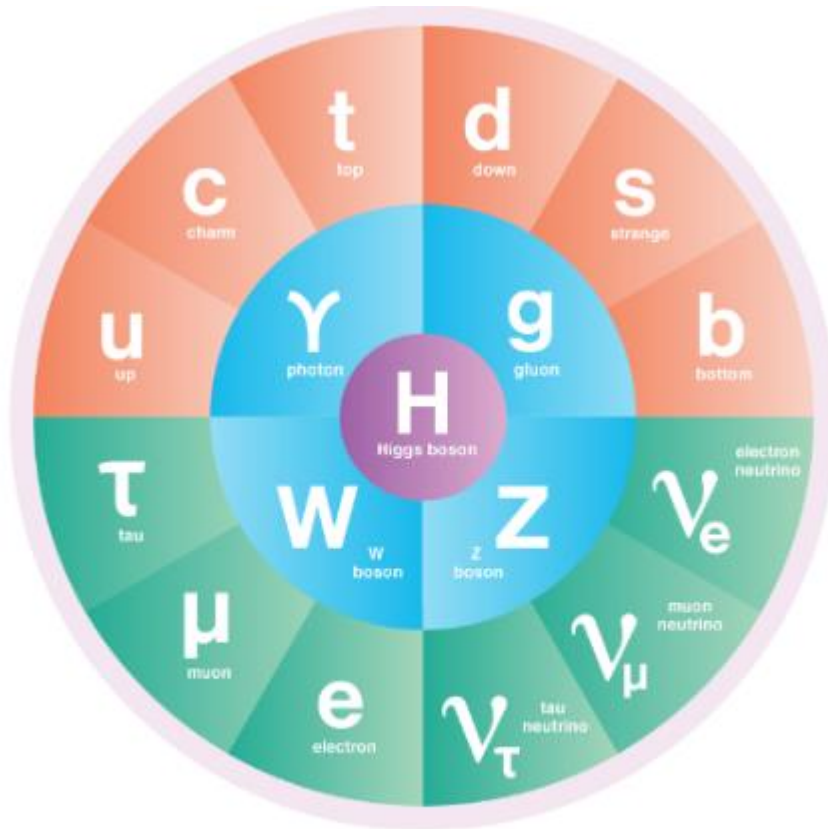


## Standard Model of Elementary Particles

		three generations of matter (elementary fermions)			three generations of antimatter (elementary antifermions)			interactions / force carriers (elementary bosons)	
		I	II	III	I	II	III		
QUARKS	mass	$\approx 2.2 \text{ MeV}/c^2$	$\approx 1.28 \text{ GeV}/c^2$	$\approx 173.1 \text{ GeV}/c^2$	$\approx 2.2 \text{ MeV}/c^2$	$\approx 1.28 \text{ GeV}/c^2$	$\approx 173.1 \text{ GeV}/c^2$	0	$\approx 124.97 \text{ GeV}/c^2$
	charge	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$	$-\frac{2}{3}$	$-\frac{2}{3}$	$-\frac{2}{3}$	0	0
	spin	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	0
		<b>u</b> up	<b>c</b> charm	<b>t</b> top	<b><math>\bar{u}</math></b> antiup	<b><math>\bar{c}</math></b> anticharm	<b><math>\bar{t}</math></b> antitop	<b>g</b> gluon	<b>H</b> higgs
		<b>d</b> down	<b>s</b> strange	<b>b</b> bottom	<b><math>\bar{d}</math></b> antidown	<b><math>\bar{s}</math></b> antistrange	<b><math>\bar{b}</math></b> antibottom	<b><math>\gamma</math></b> photon	
		<b>e</b> electron	<b><math>\mu</math></b> muon	<b><math>\tau</math></b> tau	<b><math>e^+</math></b> positron	<b><math>\bar{\mu}</math></b> antimuon	<b><math>\bar{\tau}</math></b> antitau	<b>Z</b> $Z^0$ boson	
		<b><math>\nu_e</math></b> electron neutrino	<b><math>\nu_\mu</math></b> muon neutrino	<b><math>\nu_\tau</math></b> tau neutrino	<b><math>\bar{\nu}_e</math></b> electron antineutrino	<b><math>\bar{\nu}_\mu</math></b> muon antineutrino	<b><math>\bar{\nu}_\tau</math></b> tau antineutrino	<b><math>W^+</math></b> $W^+$ boson	<b><math>W^-</math></b> $W^-$ boson

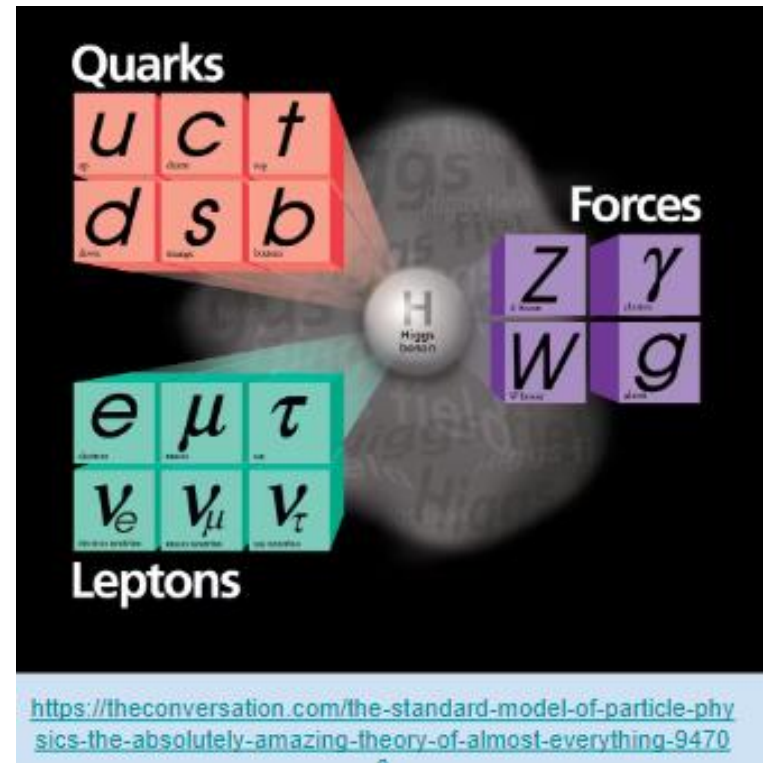
GAUGE BOSONS  
VECTOR BOSONS

SCALAR BOSONS



● QUARKS   
 ● LEPTONS   
 ● BOSONS   
 ● HIGGS BOSON

<https://www.energy.gov/science/doe-explainsthe-standard-model-particle-physics>



<https://theconversation.com/the-standard-model-of-particle-physics-the-absolutely-amazing-theory-of-almost-everything-9470>

## All chemistry from just a few particles?

**UP QUARK**  
DISCOVERED: 1969

**MATTER PARTICLE**

Mass:	2 MeV/c <sup>2</sup>
Electric Charge:	+2/3
Strong Charges:	blue, red, green
Weak Charge:	+1/2
Lifetime:	unlimited

**DOWN QUARK**  
DISCOVERED: 1969

**MATTER PARTICLE**

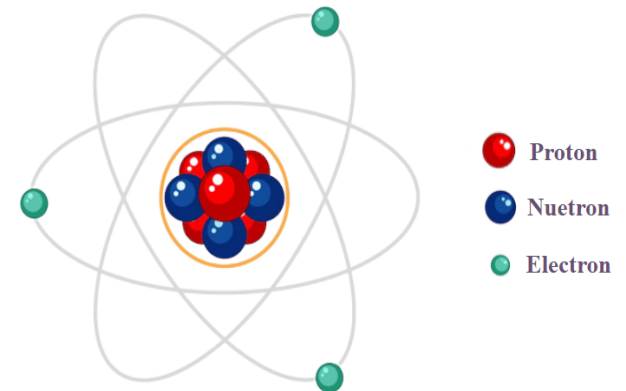
Mass:	5 MeV/c <sup>2</sup>
Electric Charge:	-1/3
Strong Charges:	blue, red, green
Weak Charge:	-1/2
Lifetime:	900 s

**ELECTRON**  
DISCOVERED: 1897

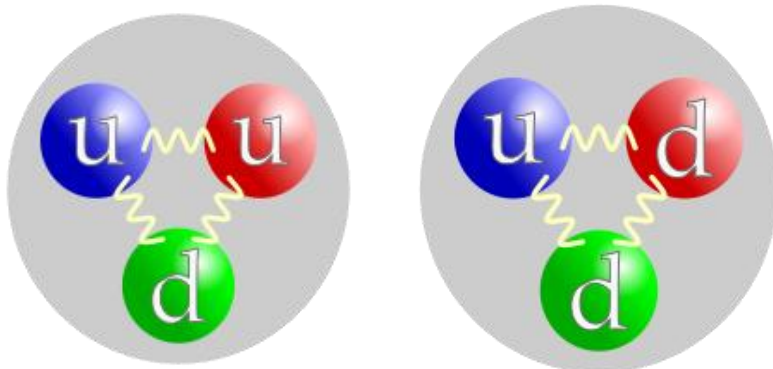
**MATTER PARTICLE**

Mass:	0.511 MeV/c <sup>2</sup>
Electric Charge:	-1
Strong Charges:	-
Weak Charge:	-1/2
Lifetime:	unlimited

### Structure of Atom



protons and neutrons



*Is that all?*

*Maybe not.*



## What holds the atom together?

And what about these?

**GLUON**  
DISCOVERED: 1979

EXCHANGE PARTICLE

Mass:	0
Electric Charge:	0
Strong Charges:	red, blue, green + antired, antiblue, antigreen
Weak Charge:	0
Lifetime:	unlimited
Range:	$10^{-15}$ m

**PHOTON**  
DISCOVERED: 1905

EXCHANGE PARTICLE

Mass:	0
Electric Charge:	0
Strong Charges:	-
Weak Charge:	0
Lifetime:	unlimited
Range:	unlimited

**W<sup>+</sup> BOSON**  
DISCOVERED: 1983

EXCHANGE PARTICLE

Mass:	$80.4 \cdot 10^6$ MeV/c <sup>2</sup>
Electric Charge:	+1
Strong Charges:	-
Weak Charge:	+1
Lifetime:	$3 \cdot 10^{-25}$ s
Range:	$10^{-16}$ m

**W<sup>-</sup> BOSON**  
DISCOVERED: 1983

EXCHANGE PARTICLE

Mass:	$80.4 \cdot 10^6$ MeV/c <sup>2</sup>
Electric Charge:	-1
Strong Charges:	-
Weak Charge:	-1
Lifetime:	undefined
Range:	undefined

**Z BOSON**  
DISCOVERED: 1983

EXCHANGE PARTICLE

Mass:	$91.2 \cdot 10^6$ MeV/c <sup>2</sup>
Electric Charge:	0
Strong Charges:	-
Weak Charge:	0
Lifetime:	undefined
Range:	undefined

**ELECTRON NEUTRINO**  
DISCOVERED: 1956

MATTER PARTICLE

Mass:	$< 2 \cdot 10^6$ MeV/c <sup>2</sup>
Electric Charge:	0
Strong Charges:	-
Weak Charge:	+1/2
Lifetime:	undefined

**MUON NEUTRINO**  
DISCOVERED: 1962

MATTER PARTICLE

Mass:	$< 2 \cdot 10^6$ MeV/c <sup>2</sup>
Electric Charge:	0
Strong Charges:	-
Weak Charge:	+1/2
Lifetime:	undefined

**TAU NEUTRINO**  
DISCOVERED: 2000

MATTER PARTICLE

Mass:	$< 2 \cdot 10^6$ MeV/c <sup>2</sup>
Electric Charge:	0
Strong Charges:	-
Weak Charge:	+1/2
Lifetime:	undefined

**MUON**  
DISCOVERED: 1937

MATTER PARTICLE












Mass:	106 MeV/c <sup>2</sup>
Electric Charge:	-1
Strong Charges:	-
Weak Charge:	-1/2
Lifetime:	$2.2 \cdot 10^{-6}$ s

**TAU**  
DISCOVERED: 1975

MATTER PARTICLE

Mass:	1777 MeV/c <sup>2</sup>
Electric Charge:	-1
Strong Charges:	-
Weak Charge:	-1/2
Lifetime:	$2.9 \cdot 10^{-13}$ s

## Like antimatter...

<p><b>ANTI-UP QUARK</b> DISCOVERED: 1969</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>2 \text{ MeV}/c^2</math> Electric Charge: <math>-2/3</math> Strong Charges: <b>antiblu</b>, <b>antired</b>, <b>antigreen</b> Weak Charge: <math>-1/2</math></p> <p>Lifetime: <b>unlimited</b></p>	<p><b>ANTI-CHARM QUARK</b> DISCOVERED: 1974</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>1300 \text{ MeV}/c^2</math> Electric Charge: <math>-2/3</math> Strong Charges: <b>antiblu</b>, <b>antired</b>, <b>antigreen</b> Weak Charge: <math>-1/2</math></p> <p>Lifetime: <math>10^{-12} \text{ s}</math></p>	<p><b>ANTI-TOP QUARK</b> DISCOVERED: 1995</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>173 \cdot 10^3 \text{ MeV}/c^2</math> Electric Charge: <math>-2/3</math> Strong Charges: <b>antiblu</b>, <b>antired</b>, <b>antigreen</b> Weak Charge: <math>-1/2</math></p> <p>Lifetime: <math>6 \cdot 10^{-25} \text{ s}</math></p>	<p><b>ELECTRON ANTI-NEUTRINO</b> DISCOVERED: 1956</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>&lt; 2 \cdot 10^{-4} \text{ MeV}/c^2</math> Electric Charge: <math>0</math> Strong Charges: <math>-</math> Weak Charge: <math>-1/2</math></p> <p>Lifetime: <b>undefined</b></p>	<p><b>MUON ANTI-NEUTRINO</b> DISCOVERED: 1962</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>&lt; 2 \cdot 10^{-4} \text{ MeV}/c^2</math> Electric Charge: <math>0</math> Strong Charges: <math>-</math> Weak Charge: <math>-1/2</math></p> <p>Lifetime: <b>undefined</b></p>	<p><b>TAU ANTI-NEUTRINO</b> DISCOVERED: 2000</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>&lt; 2 \cdot 10^{-4} \text{ MeV}/c^2</math> Electric Charge: <math>0</math> Strong Charges: <math>-</math> Weak Charge: <math>-1/2</math></p> <p>Lifetime: <b>undefined</b></p>
<p><b>ANTI-DOWN QUARK</b> DISCOVERED: 1969</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>5 \text{ MeV}/c^2</math> Electric Charge: <math>+1/3</math> Strong Charges: <b>antiblu</b>, <b>antired</b>, <b>antigreen</b> Weak Charge: <math>+1/2</math></p> <p>Lifetime: <math>900 \text{ s}</math></p>	<p><b>ANTI-STRANGE QUARK</b> DISCOVERED: 1969</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>100 \text{ MeV}/c^2</math> Electric Charge: <math>+1/3</math> Strong Charges: <b>antiblu</b>, <b>antired</b>, <b>antigreen</b> Weak Charge: <math>+1/2</math></p> <p>Lifetime: <math>5 \cdot 10^{-8} \text{ s}</math></p>	<p><b>ANTI-BOTTOM QUARK</b> DISCOVERED: 1977</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>4200 \text{ MeV}/c^2</math> Electric Charge: <math>+1/3</math> Strong Charges: <b>antiblu</b>, <b>antired</b>, <b>antigreen</b> Weak Charge: <math>+1/2</math></p> <p>Lifetime: <math>2 \cdot 10^{-12} \text{ s}</math></p>	<p><b>POSITRON</b> DISCOVERED: 1932</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>0.511 \text{ MeV}/c^2</math> Electric Charge: <math>+1</math> Strong Charges: <math>-</math> Weak Charge: <math>+1/2</math></p> <p>Lifetime: <b>unlimited</b></p>	<p><b>ANTI-MUON</b> DISCOVERED: 1937</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>106 \text{ MeV}/c^2</math> Electric Charge: <math>+1</math> Strong Charges: <math>-</math> Weak Charge: <math>+1/2</math></p> <p>Lifetime: <math>2.2 \cdot 10^{-6} \text{ s}</math></p>	<p><b>ANTI-TAU</b> DISCOVERED: 1975</p>  <p>ANTIMATTER PARTICLE</p> <p>Mass: <math>1777 \text{ MeV}/c^2</math> Electric Charge: <math>+1</math> Strong Charges: <math>-</math> Weak Charge: <math>+1/2</math></p> <p>Lifetime: <math>2.9 \cdot 10^{-13} \text{ s}</math></p>

**Let's throw things at each other and study them to see what happens.**





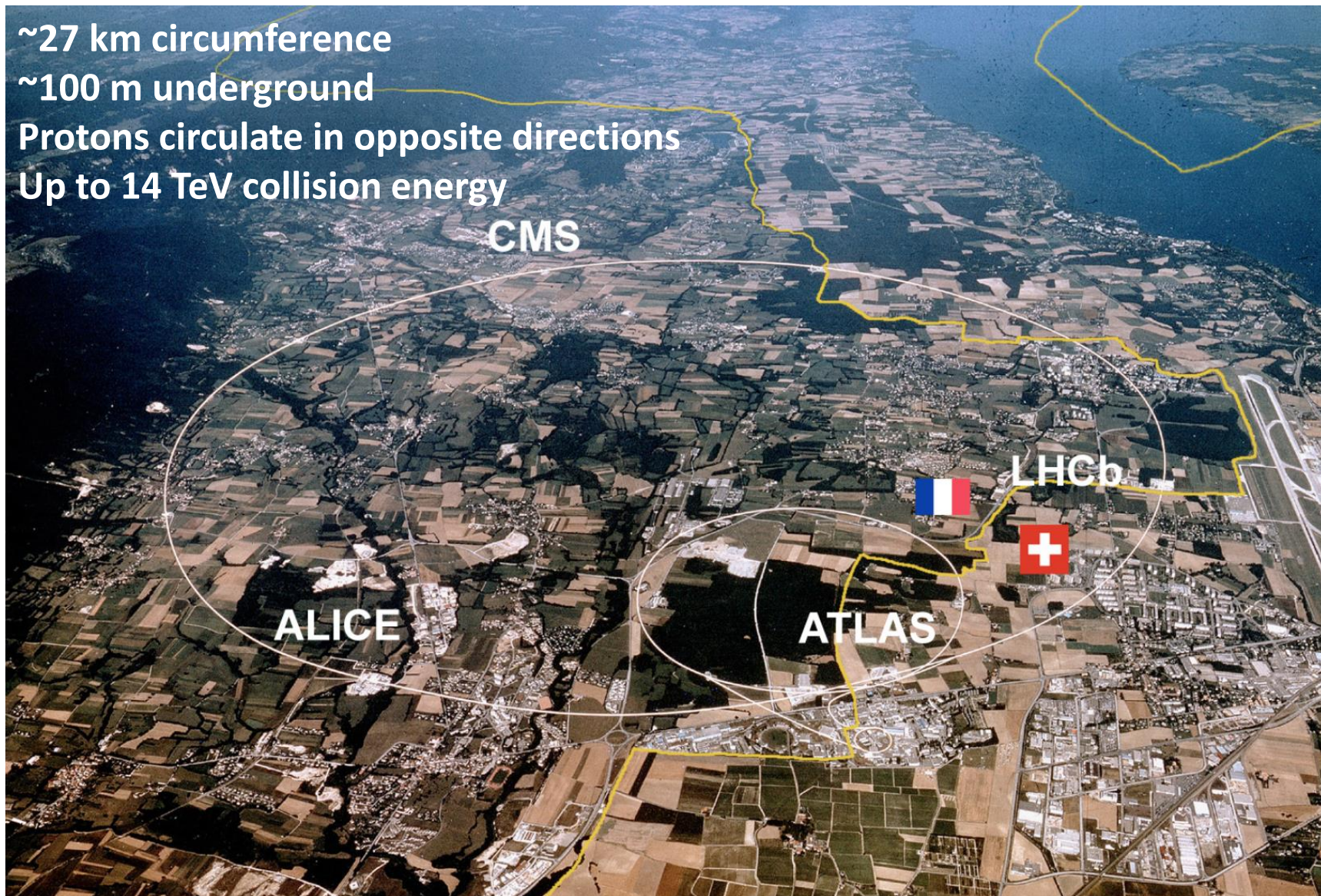


~27 km circumference

~100 m underground

Protons circulate in opposite directions

Up to 14 TeV collision energy



## Generic Design

Cylinders wrapped around the beam pipe

From inner to outer . . .

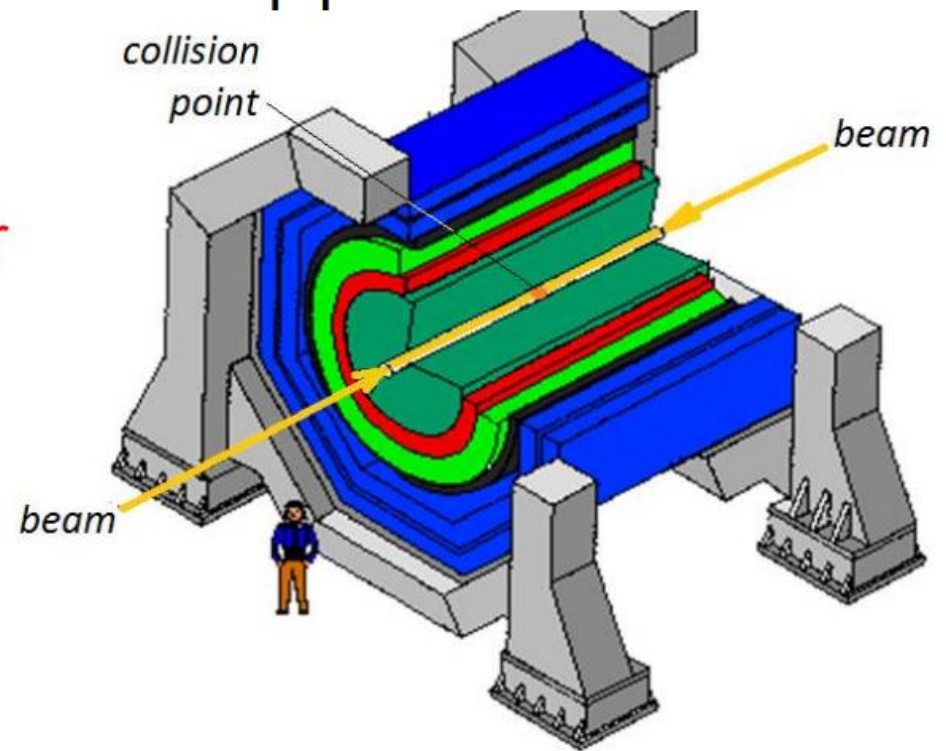
Tracking

Electromagnetic calorimeter

Hadronic calorimeter

Magnet\*

Muon chamber

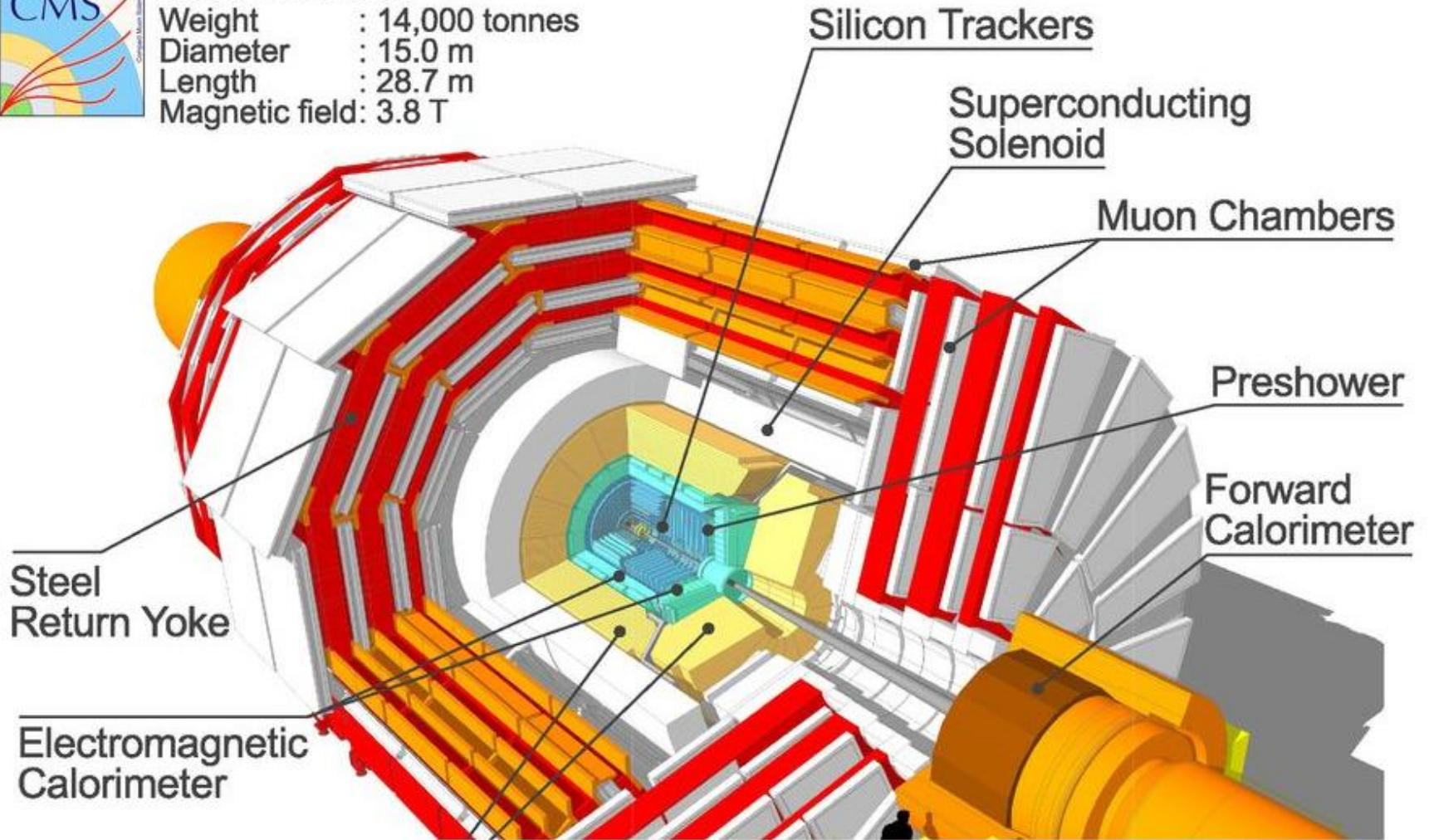


\* *location of magnet depends on specific detector design*



## CMS Detector

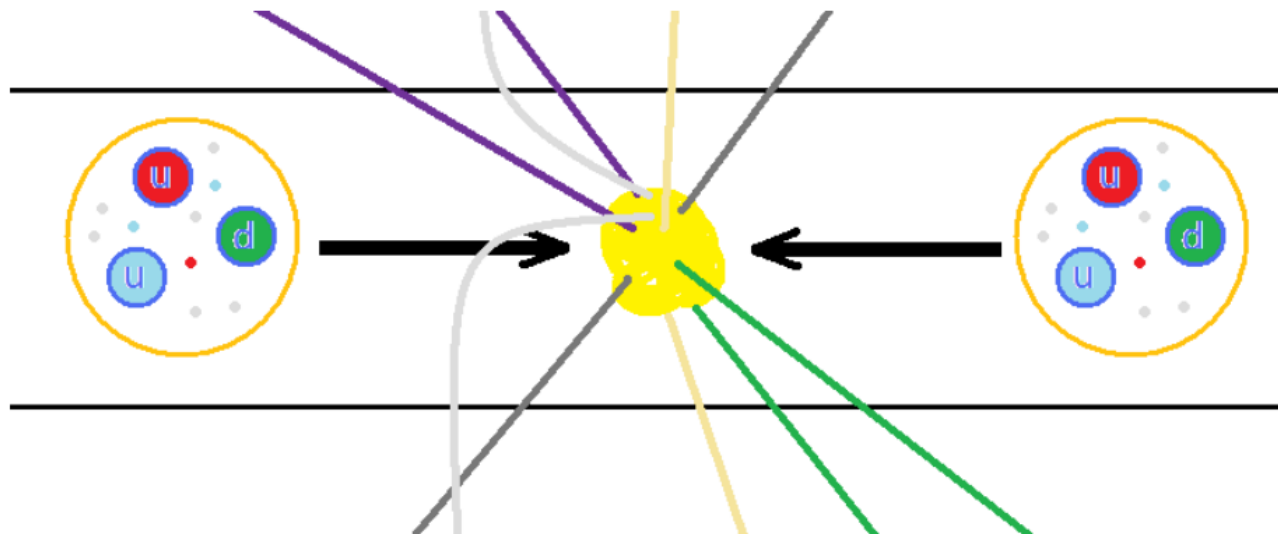
Weight : 14,000 tonnes  
Diameter : 15.0 m  
Length : 28.7 m  
Magnetic field: 3.8 T



# Protons collide inside CMS

The LHC accelerates protons to almost 7500 times the energy equivalent of their mass. The protons circulate in opposite directions and collide in the center of CMS.

But protons are not just particles: they are more like bags of quarks and gluons. When protons collide, all sorts of very short-lived particles can be made from all that energy.



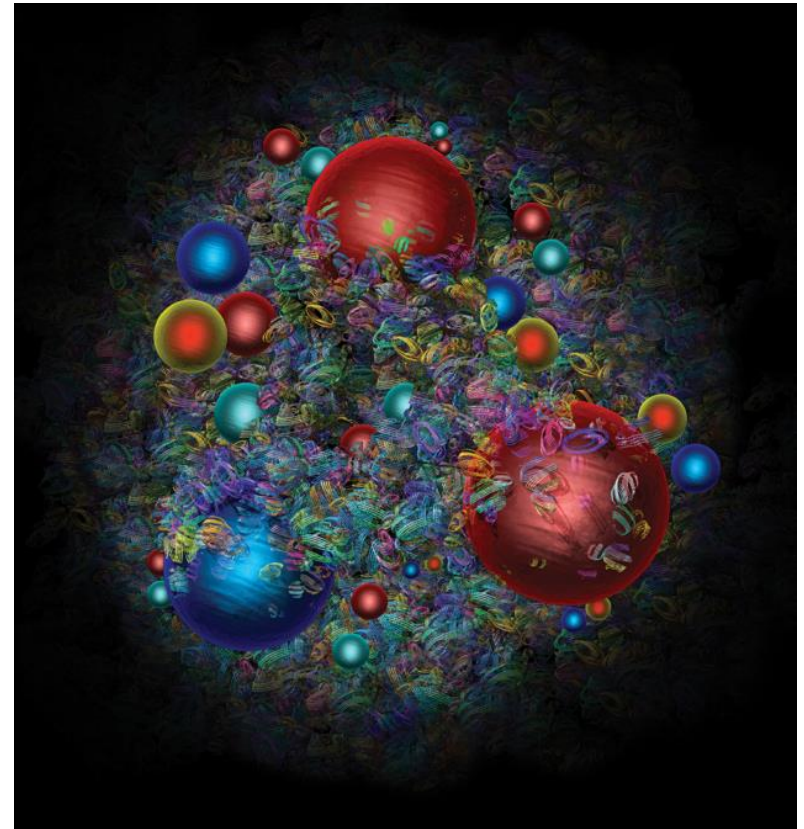
# What do the protons tell us?

We learn from what proton collisions produce:

*W bosons* give us clues to the proton structure...and they also present a mystery.

*Z bosons* decay (sort of) like lighter particles but are also needed to sort out Higgs data.

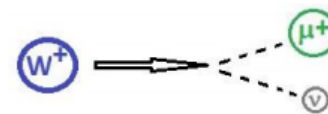
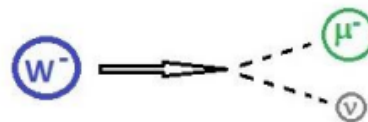
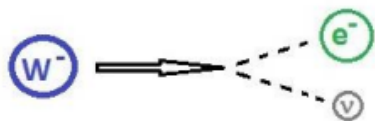
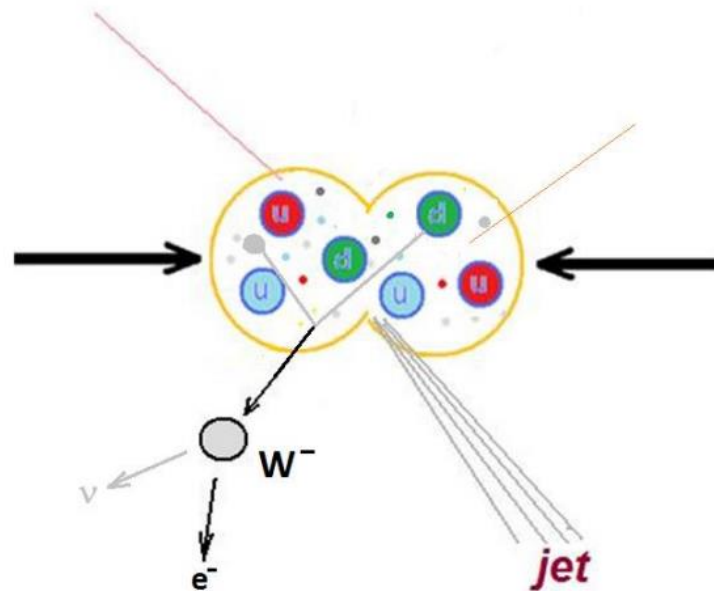
*Higgs bosons*, well, are Higgs bosons, the new kid on the block!



Artist's image of a proton from CERN Courier. [Learn more here](#) and [even more here](#).

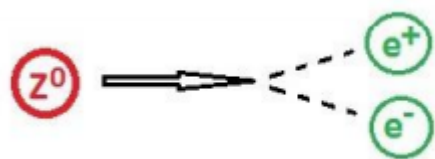
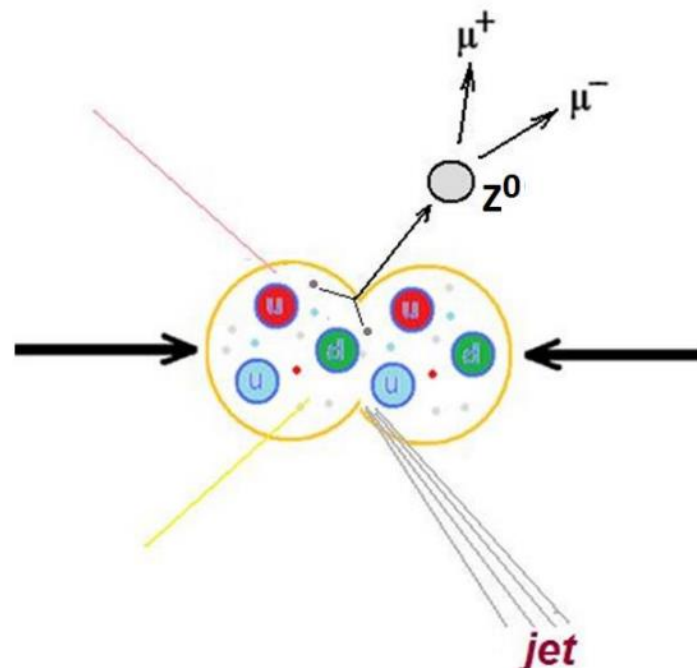
The + or – charged W boson enables radioactive decay by transforming neutrons into protons.

It decays into a neutrino and another lepton. Since CMS cannot detect the neutrino directly, we can call this a one-lepton event.



The Z boson is a neutral cousin of the W. It enables the “weak neutral current”.

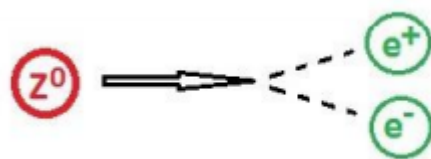
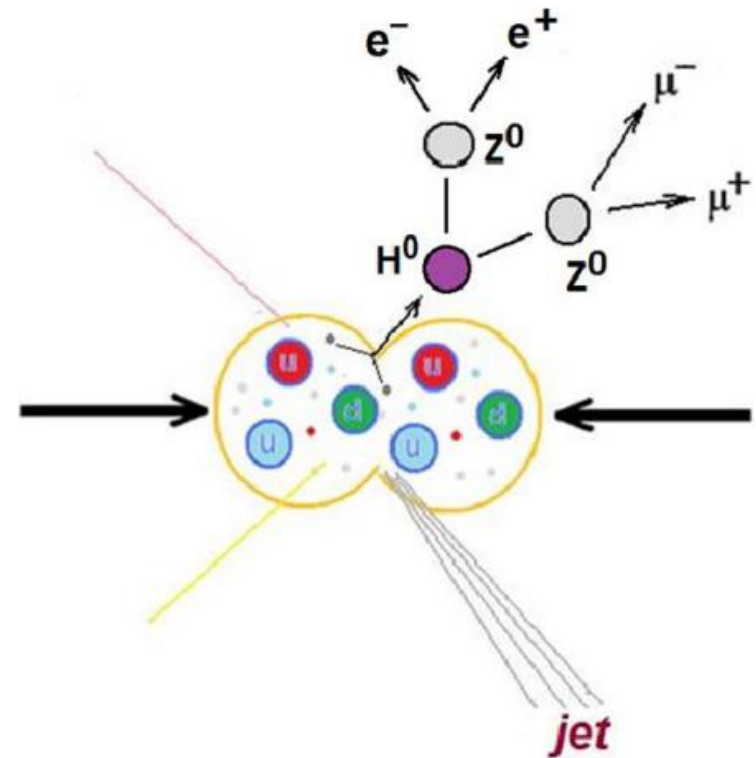
It decays into two leptons of the same type but opposite charge – electron and positron or muon and antimuon. It has other decay paths but we are not looking for these.



# Four-lepton events

The Higgs boson is an expression of the field that gives other particles mass.

One decay mode of the Higgs is into two Z bosons, which themselves promptly decay. Thus we can get 2 muons and 2 electrons or 4 muons or 4 electrons.

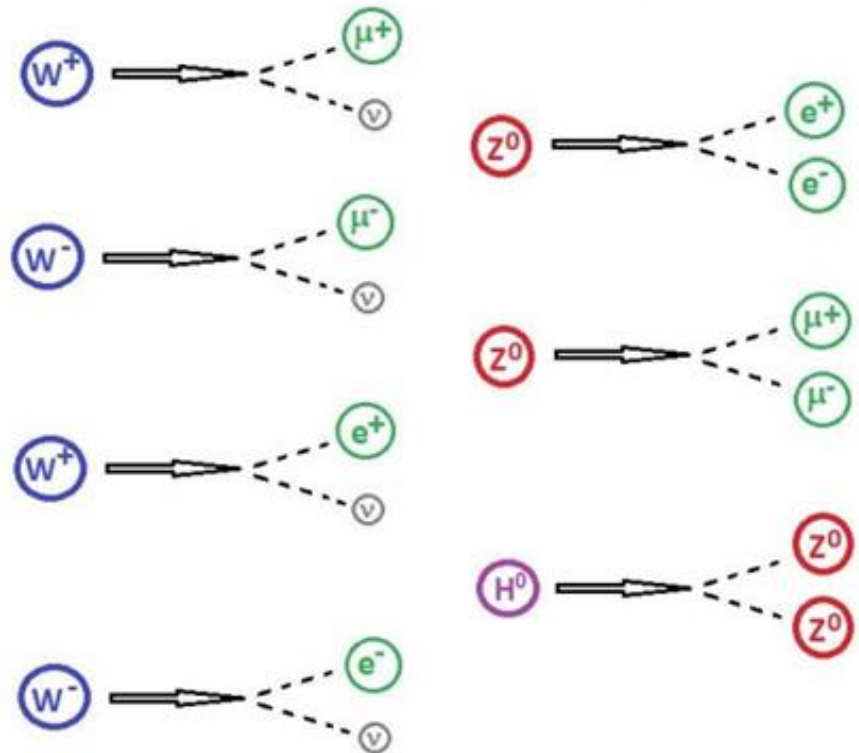




Because bosons only travel a tiny distance before decaying, CMS does not “see” them directly.

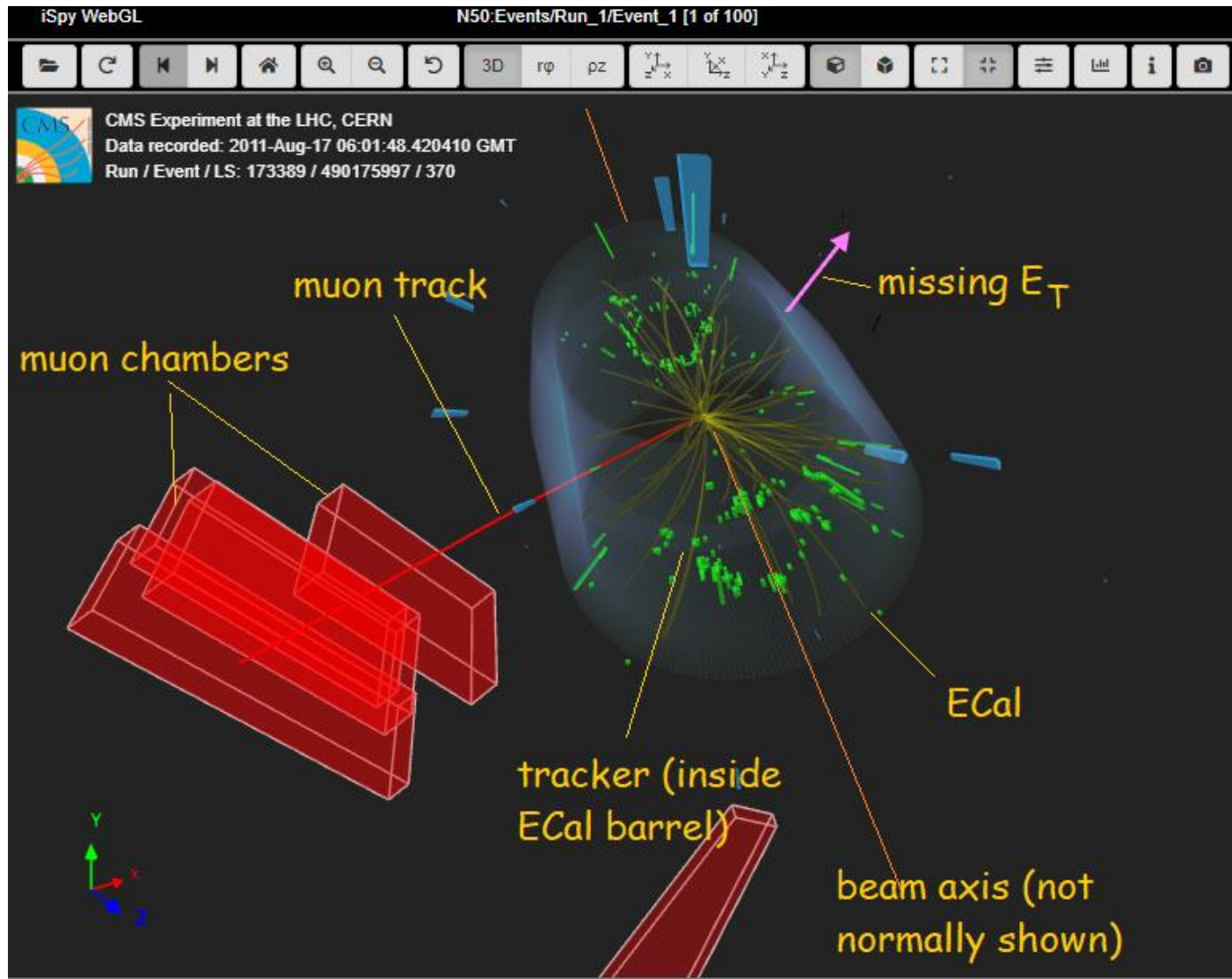
CMS *can* detect :

- electrons
- muons
- photons

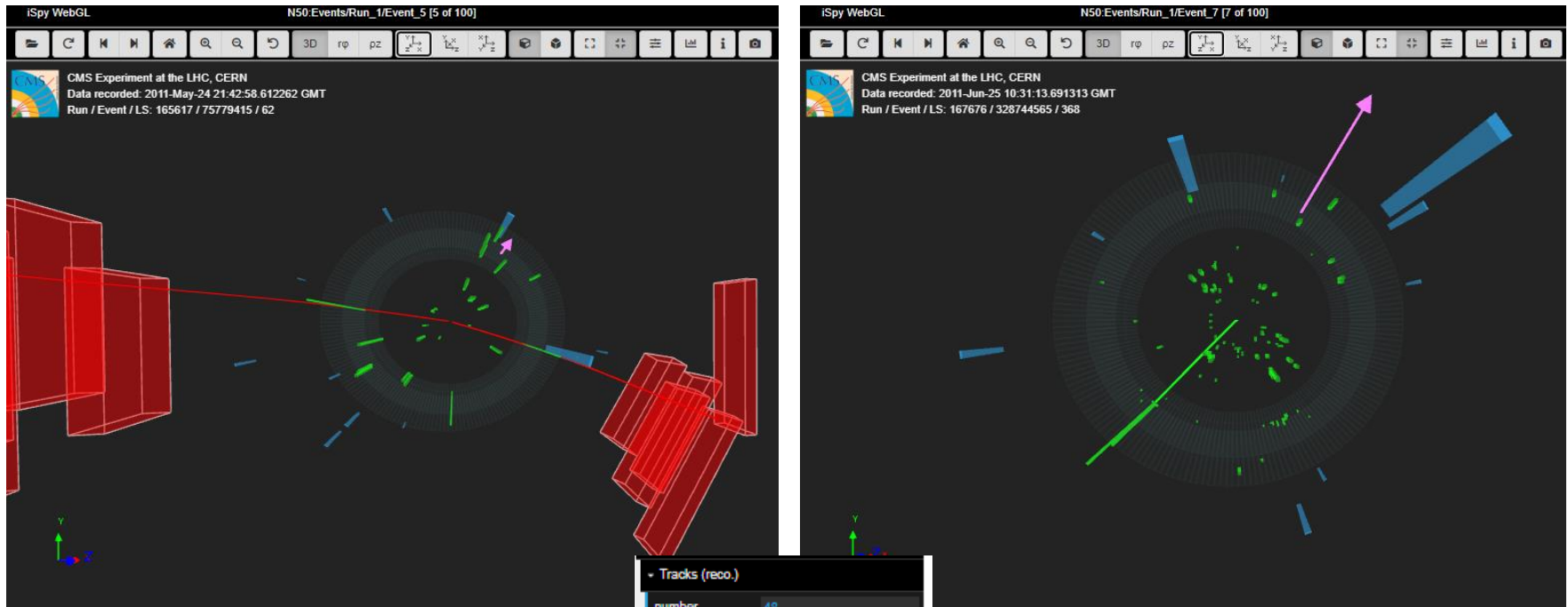


CMS can infer:

- neutrinos from “missing energy”

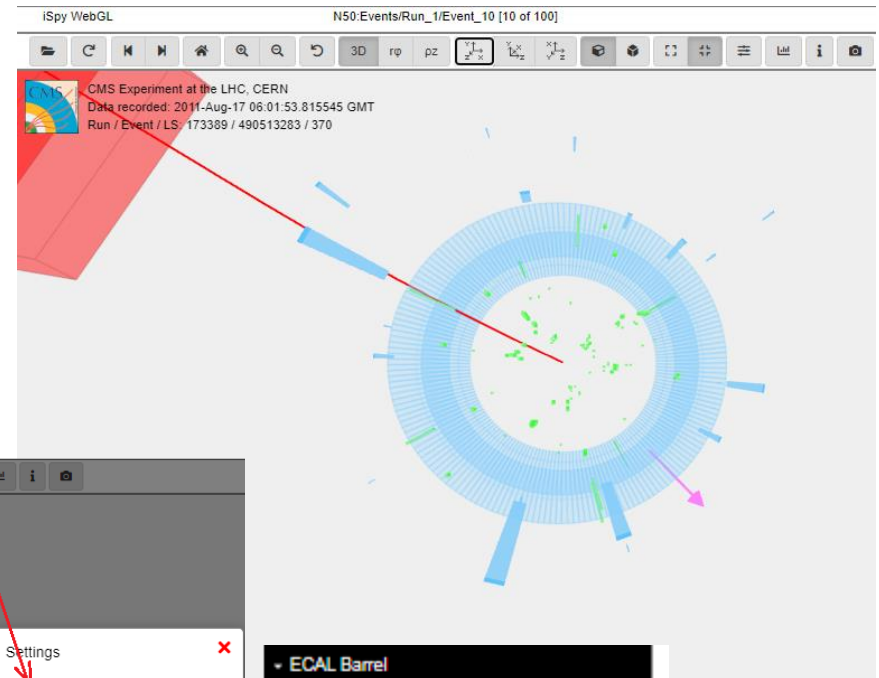
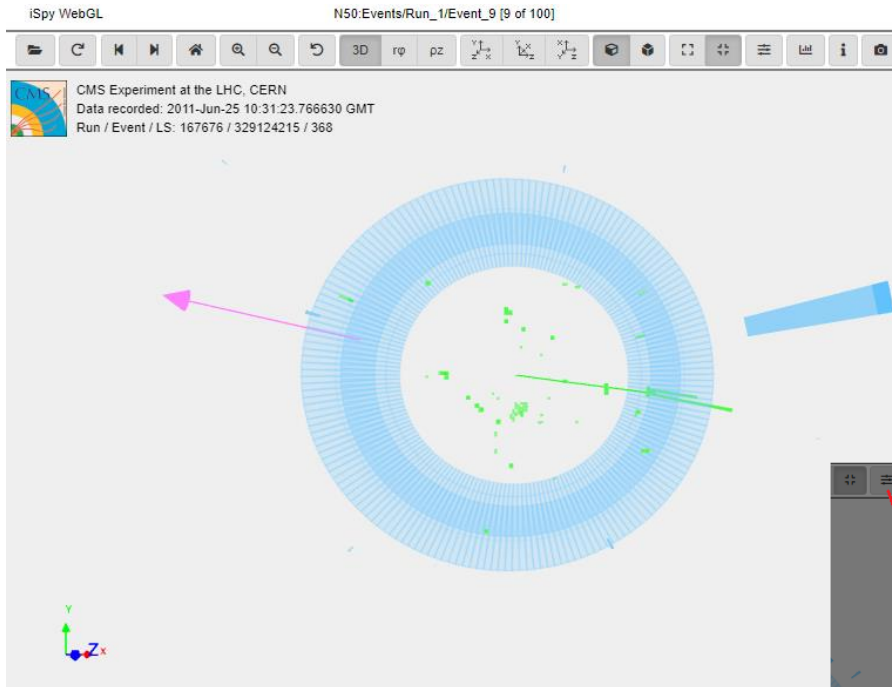


Which of these events is 1-, 2-, or 4-lepton? Which flavors of leptons? What else do you see?

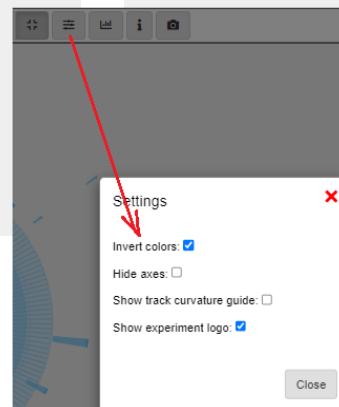


Note Tracks (reco) turned OFF. →

Which of these events is 1-, 2-, or 4-lepton? Which flavors of leptons? What else do you see?



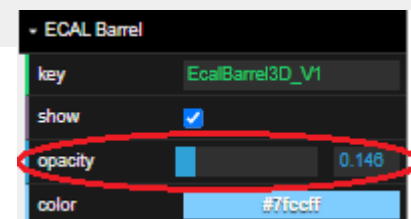
Note Inverted Colors and increased ECal Barrel opacity.



Settings

- Invert colors:
- Hide axes:
- Show track curvature guide:
- Show experiment logo:

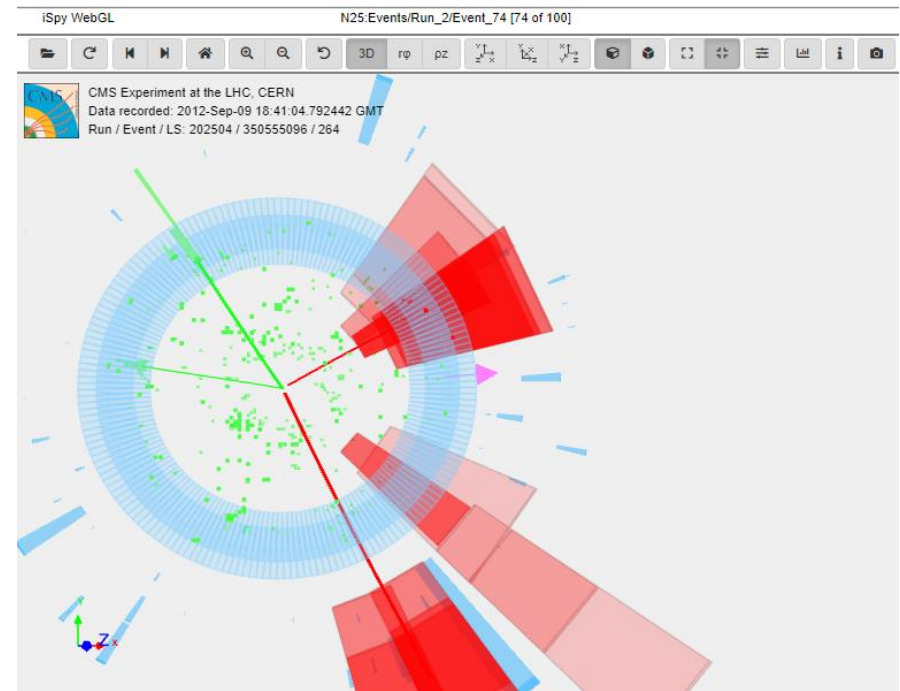
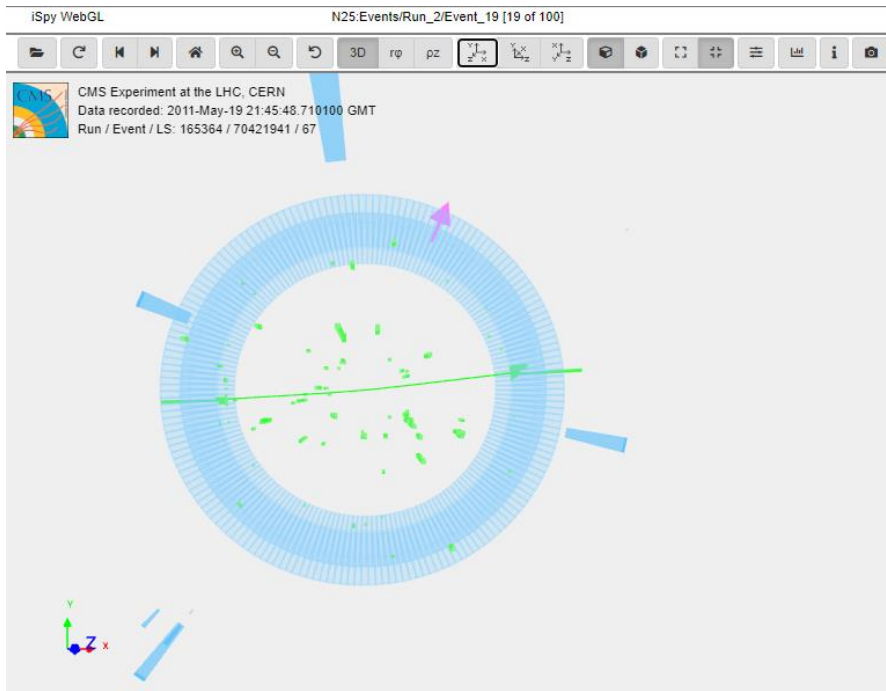
Close



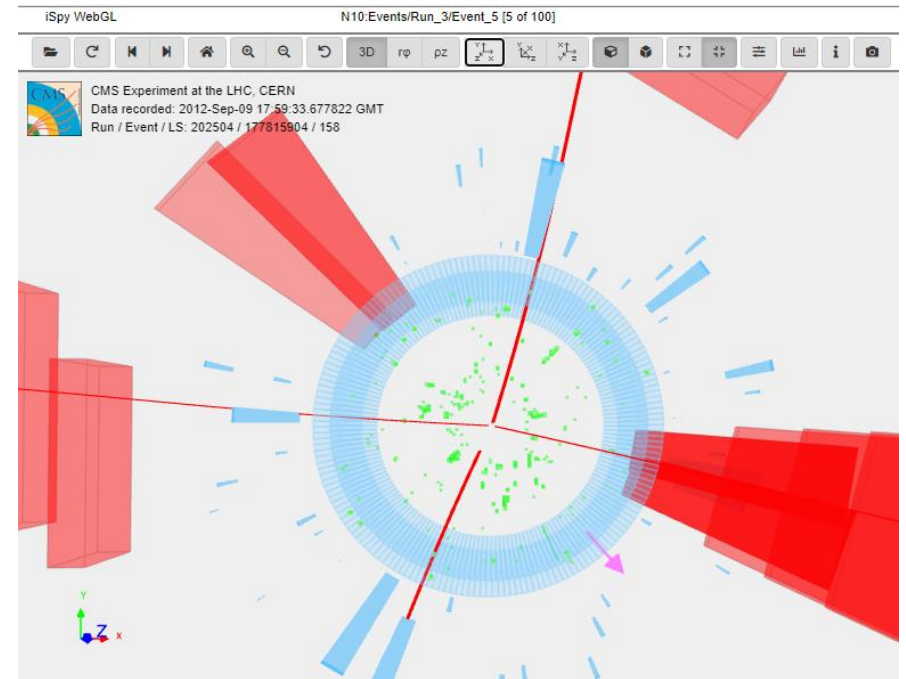
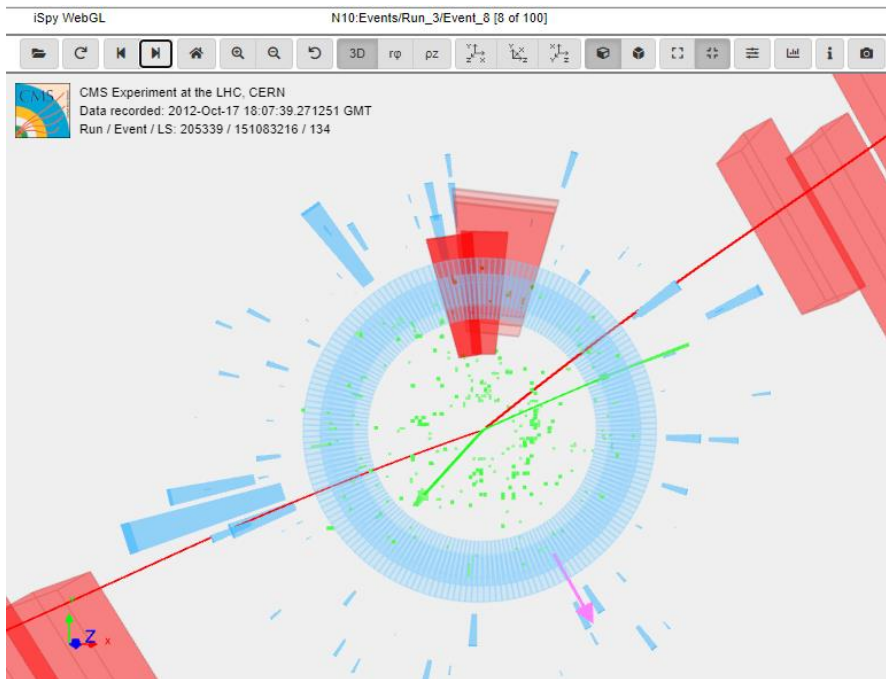
ECAL Barrel

- key: EcalBarrel3D\_V1
- show:
- opacity: 0.148
- color: #7fccff

**Which of these events is 1-, 2-, or 4-lepton? Which flavors of leptons? What else do you see?**



**Which of these events is 1-, 2-, or 4-lepton? Which flavors of leptons? What else do you see?**



# Google Sheet analysis

Sandbox CMS Masterclass Analysis Sheet ☆ 📄 🌐

File Edit View Insert Format Data Tools Extensions Help

🔍 Menu 100% \$ % .0 .00 123 Defaul... - 10 + B I A

A1 fx Event ID Nos.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	Event ID	Nos.	Final State - choose only one per row						Primary State - choose only one per row						If NP, enter	Lepton counts			W boson counts				Event					
2	File	Event	e-nu	mu-nu	ee	mumu	4e	4mu	2e2mu	W+	W-	W±	NP	Zoo	Mass (GeV)	e	mu	e/mu	W+	W-	W±	W+/W-	Zoo	Zoo	Display			
3	25.1	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		14	17	.82	1	3	1	0.333333	0					
4		2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2.28	±3.74	±4.12		±1.	±1.73	±1.							
5		3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	87.15													
6		4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.79													
7		5	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6.74													
8		6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
9		7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.71													
10		8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	7.30													
11		9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	86.43													
12		10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	276.26													
13		11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	243.15													
14		12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	88.47													
15		13	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
16		14	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
17		15	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
18		16	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
19		17	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
20		18	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
21		19	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
22		20	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
23		21	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
24		22	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
25		23	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
26		24	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
27		25	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
28		26	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
29		27	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														

