

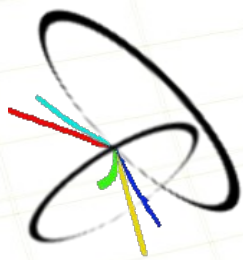
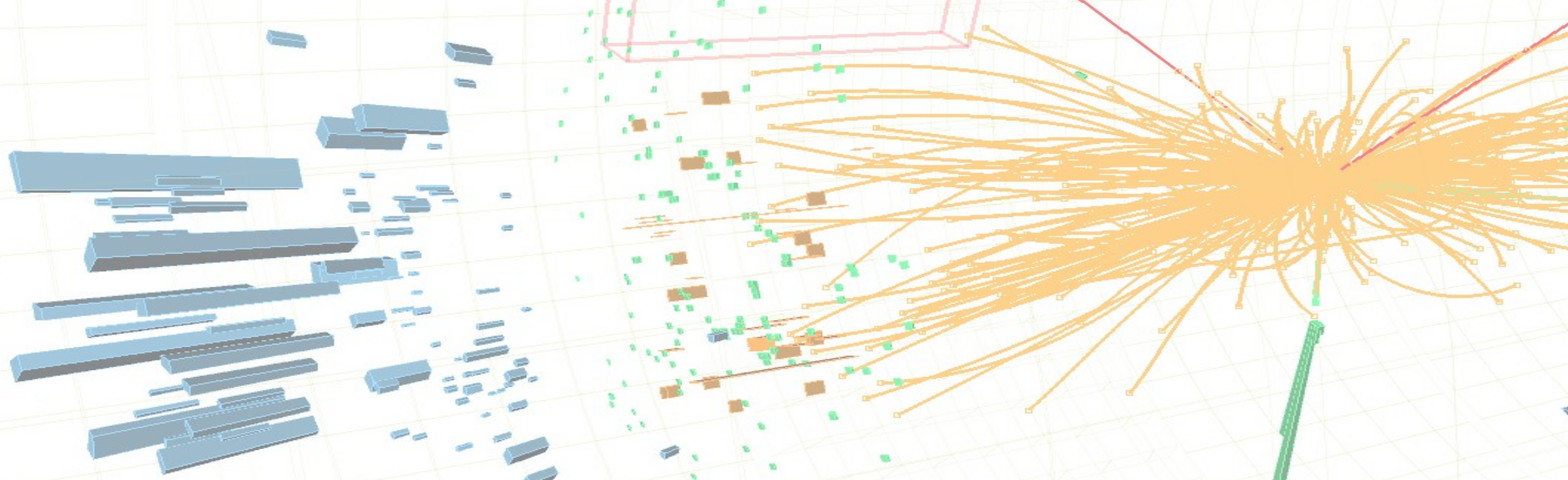


CMS Experiment at the LHC, CERN

Data recorded: 2011-May-25 08:00:19.229673 GMT(10:00:19 CEST)

Run / Event: 165633 / 394010457

# Resultados del taller W/Z/H



cfp

CIEMAT

física de partículas



EXCELENCIA  
MARÍA  
DE MAEZTU

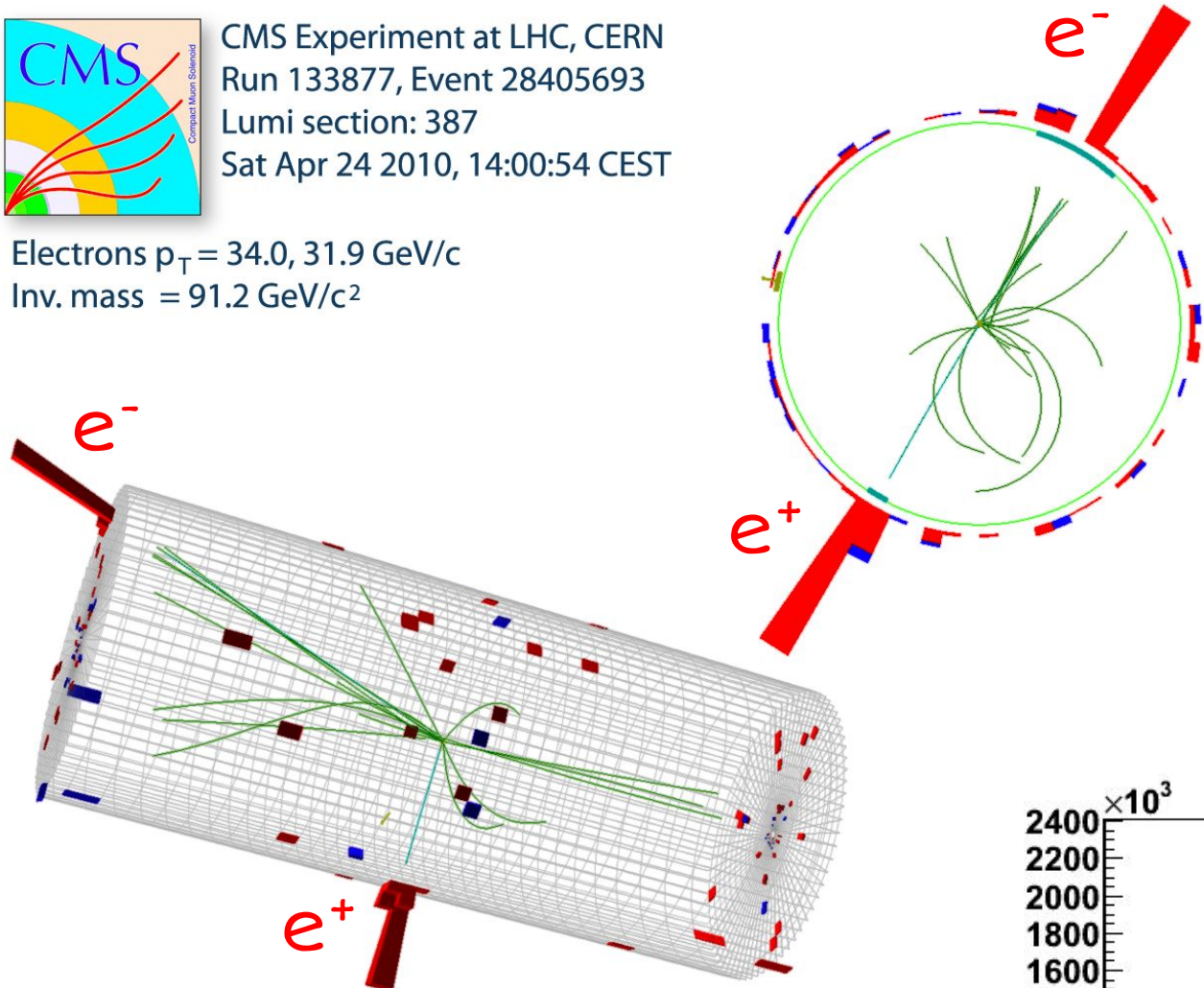
Pablo García Abia

*Programa en español para  
profesores, CERN, julio 2018*



CMS Experiment at LHC, CERN  
Run 133877, Event 28405693  
Lumi section: 387  
Sat Apr 24 2010, 14:00:54 CEST

Electrons  $p_T = 34.0, 31.9$  GeV/c  
Inv. mass =  $91.2$  GeV/c<sup>2</sup>

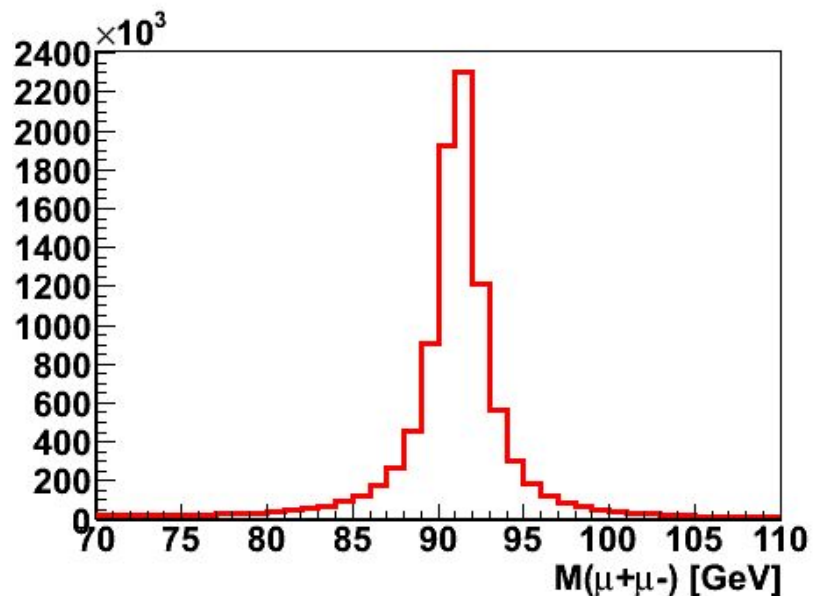


## Candidato a Z:

2 *leptones*  
*cargados* del  
mismo sabor  
(e,  $\mu$ ) y carga  
opuesta.

Balanceados en  
el plano  
transverso.

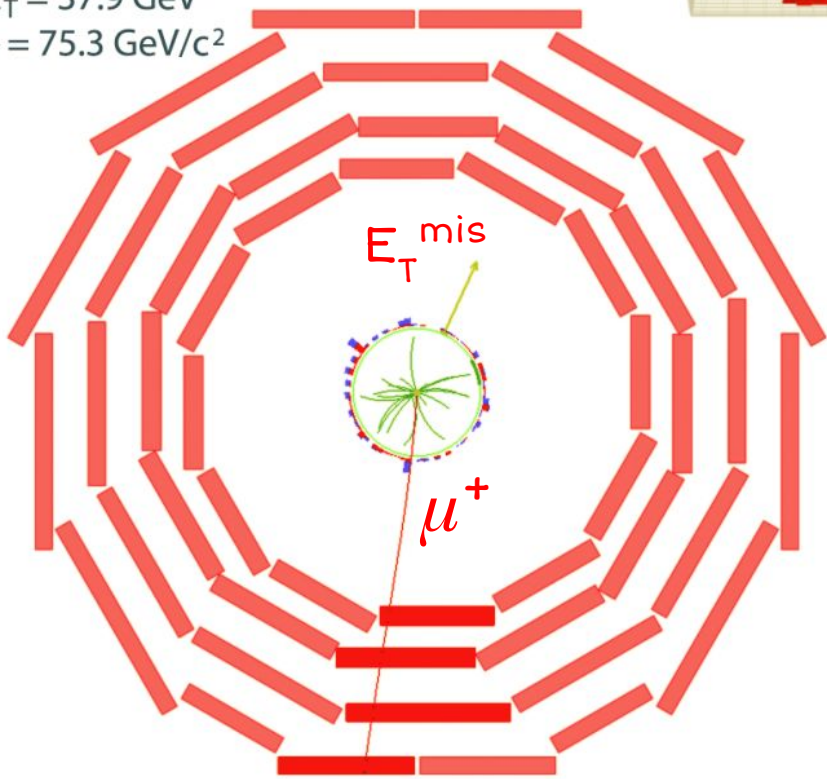
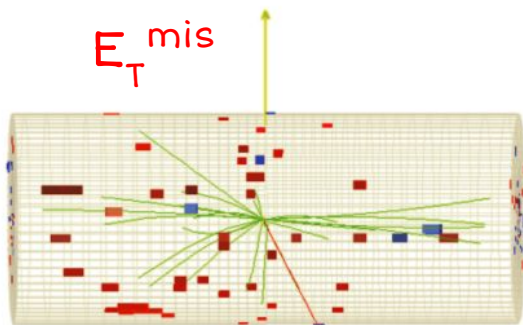
$$pp \rightarrow Z + X \rightarrow e^+ e^- + X$$





CMS Experiment at LHC, CERN  
Run 133875, Event 1228182  
Lumi section: 16  
Sat Apr 24 2010, 09:08:46 CEST

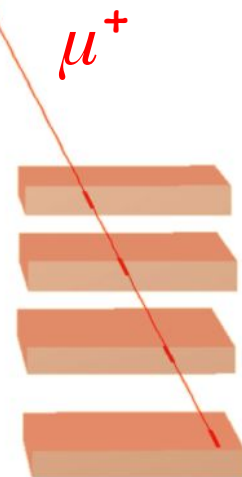
Muon  $p_T = 38.7$  GeV/c  
 $ME_T = 37.9$  GeV  
 $M_T = 75.3$  GeV/c<sup>2</sup>



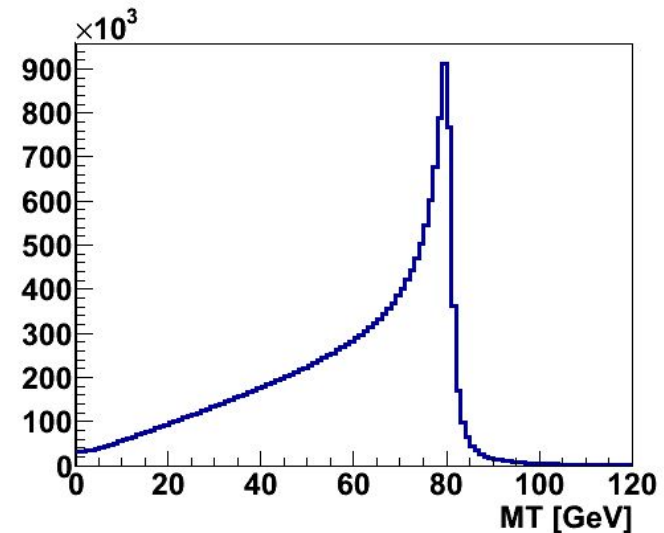
## Candidato a W:

1 *leptón cargado* (e,  $\mu$ ) y un *neutrino* ( $E_T^{mis}$ ).

El neutrino se manifiesta por la *falta aparente de conservación de energía-momento*.

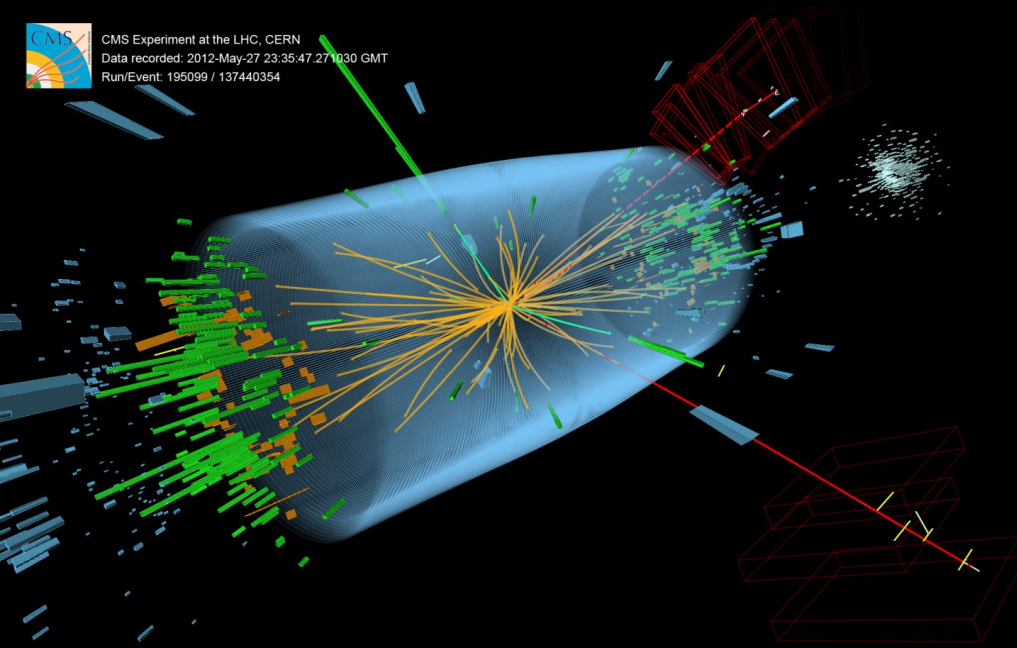


$$pp \rightarrow W + X \rightarrow \mu^+ \nu + X$$





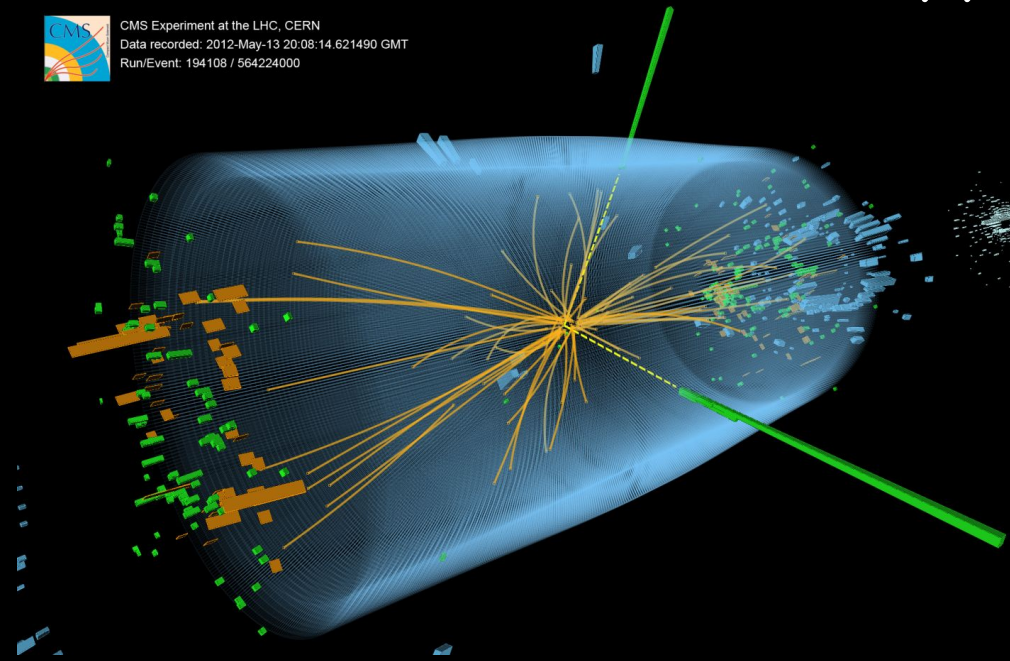
CMS Experiment at the LHC, CERN  
Data recorded: 2012-May-27 23:35:47.271030 GMT  
Run/Event: 195099 / 137440354



$H \rightarrow ZZ \rightarrow 4\ell$



CMS Experiment at the LHC, CERN  
Data recorded: 2012-May-13 20:08:14.621490 GMT  
Run/Event: 194108 / 564224000



$H \rightarrow \gamma\gamma$

# Resultados

Total:

Muon	Electron	W	W-	W+	NP	Higgs	Zoo	Sum	e/mu	W+/W-
301	292	61	145	233	154	8	58	659	0.97	1.61
26	10	5		0	3	7	5	0	2	17
27	10	13		0	12	8	3	0	2	25
28	13	22		0	10	16	9	1	6	42
29	9	7		4	1	4	7	0	1	17
30	20	21		0	17	14	10	0	9	50
31	44	43		10	14	43	20	0	13	100
32	13	16		6	5	11	7	1	2	32
33	13	8		0	6	10	5	1	0	22
34	22	14		0	14	13	9	0	0	36
35	49	49		2	25	46	25	1	1	100
36	8	3		0	0	0	11	1	0	12
37	44	47		34	12	24	21	1	8	100
38	6	8		0	2	6	6	0	0	14
39	12	14		3	11	8	4	0	3	29
40	9	5		0	7	6	1	1	10	25

# Resultados

Total:

Muon	Electron	W	W-	W+	NP	Higgs	Zoo	Sum	e/mu	W+/W-
301	292	61	145	233	154	8	58	659	0.97	1.61

SLTP:  $e/\mu = 0.97$

CMS:  $e/\mu = 1$

SLTP:  $W^+/W^- = 1.61$

CMS:  $W^+/W^- \approx 1.60$

# Resultados

Total:

Muon	Electron	W	W-	W+	NP	Higgs	Zoo	Sum	e/mu	W+/W-
301	292	61	145	233	154	8	58	659	0.97	1.61

SLTP:  $e/\mu = 0.97$

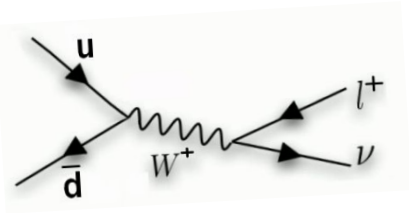
CMS:  $e/\mu = 1$

SLTP:  $W^+/W^- = 1.61$

CMS:  $W^+/W^- \approx 1.60$

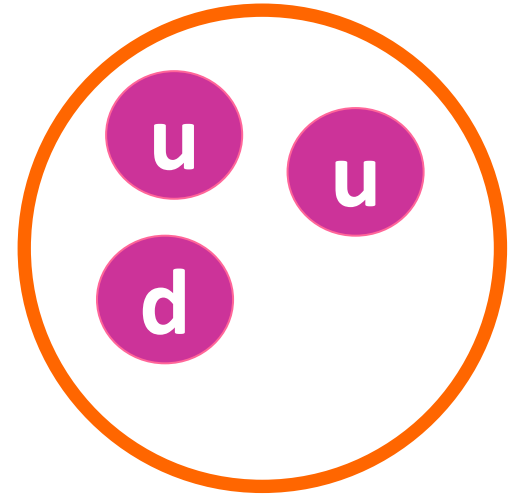
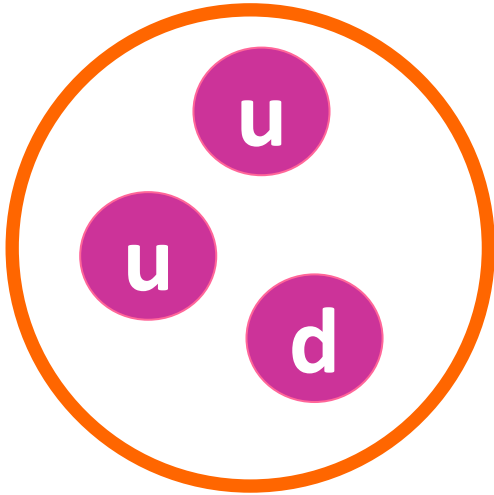
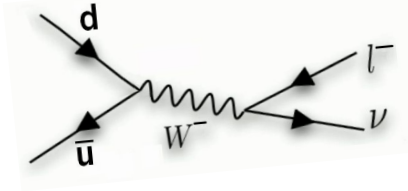
Error en las medidas:  $\sqrt{N}/N \approx 0.04$ , donde  $N = 659$

# Asimetría en la producción de $W^\pm$



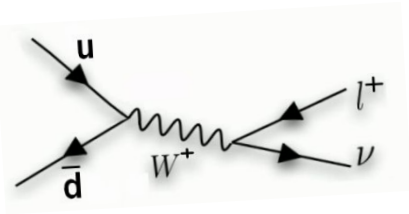
$$u\bar{d} \rightarrow W^+$$

$$\bar{u}d \rightarrow W^-$$



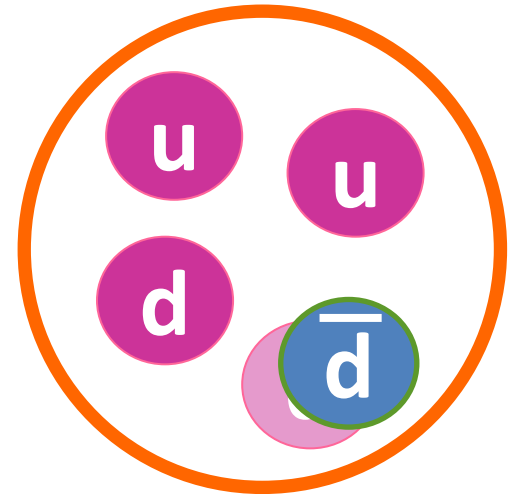
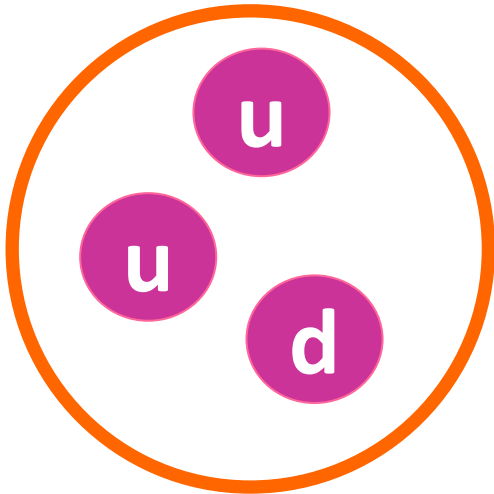
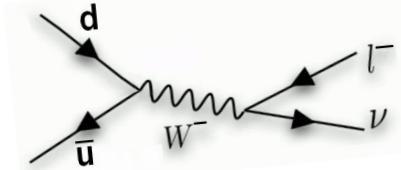


# Asimetría en la producción de $W^\pm$

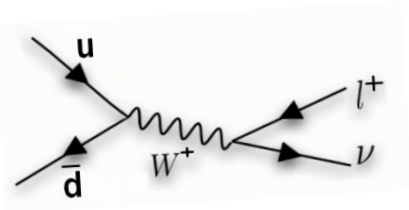


$$u\bar{d} \rightarrow W^+$$

$$\bar{u}d \rightarrow W^-$$

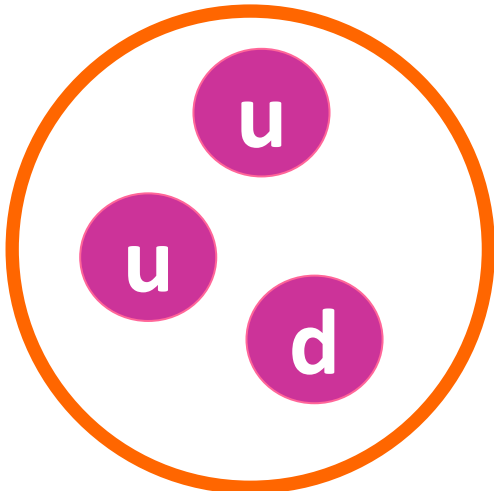
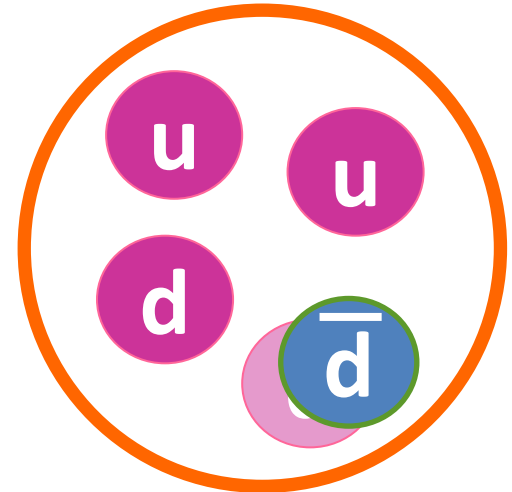
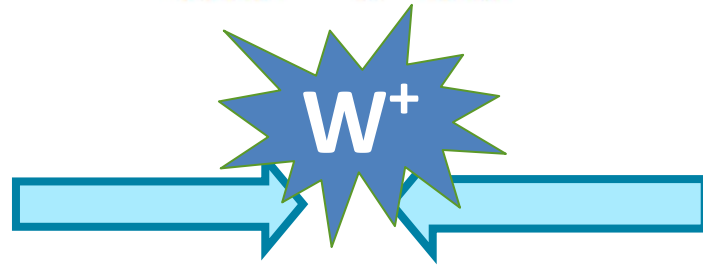
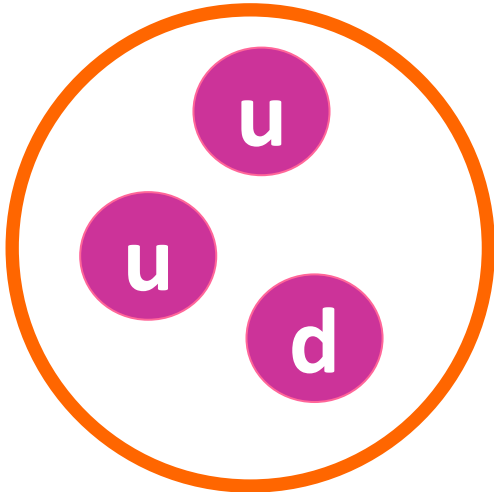
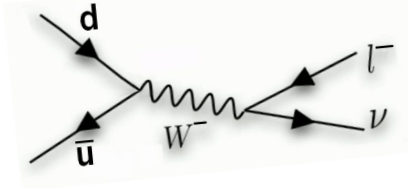


# Asimetría en la producción de $W^\pm$

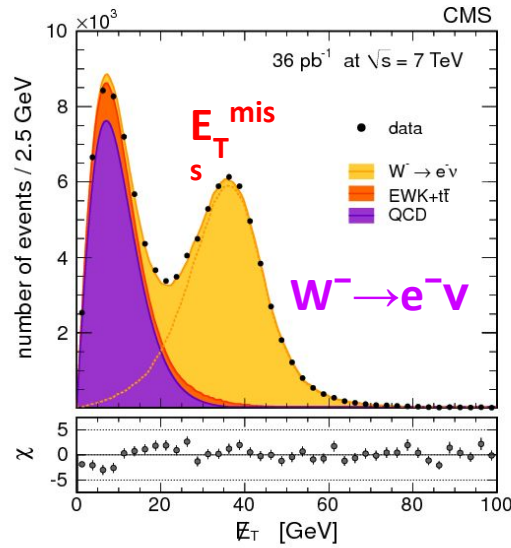
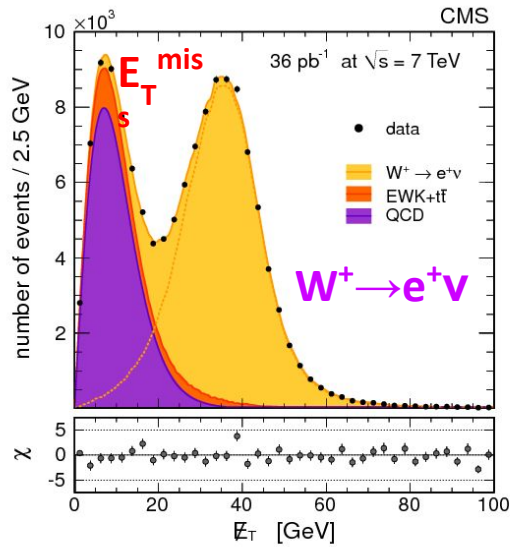


$$u\bar{d} \rightarrow W^+$$

$$\bar{u}d \rightarrow W^-$$

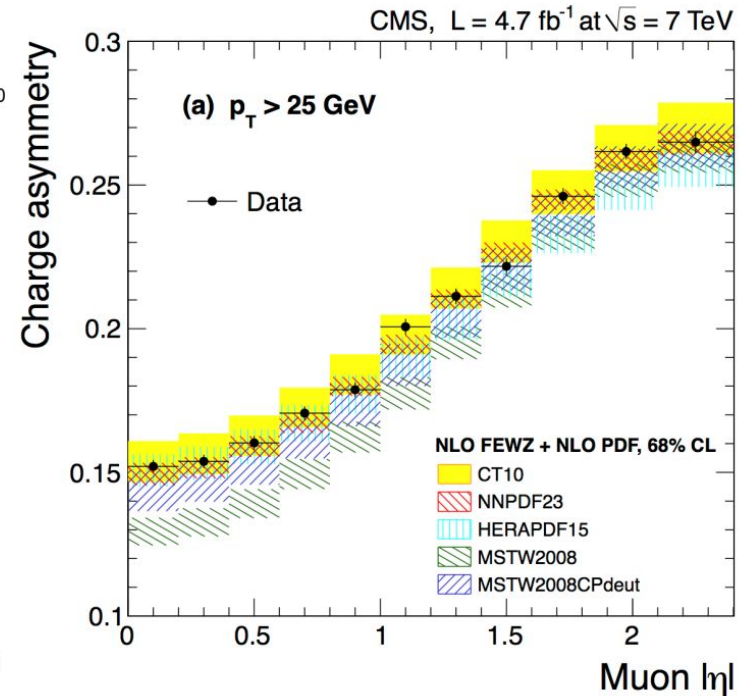
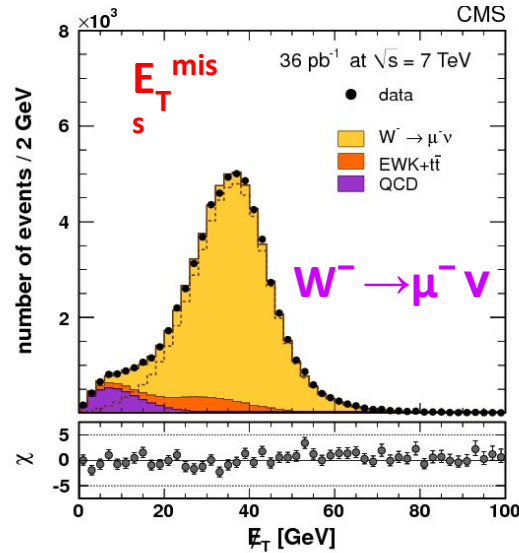
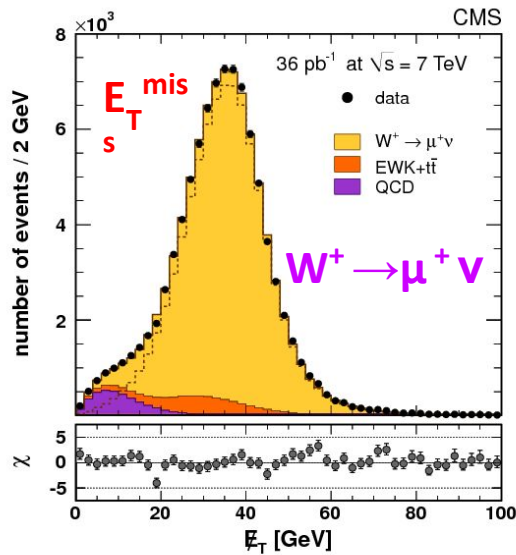


# Asimetría en la producción de $W^\pm$

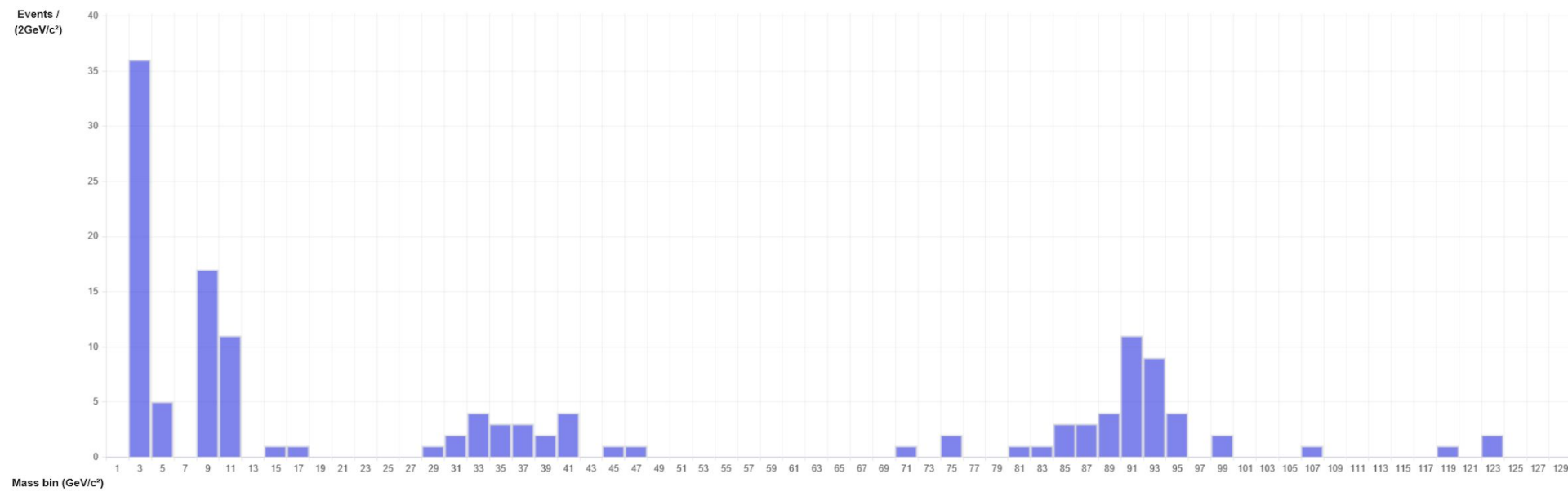


CMS:  $A = 0.23$

SLTP:  $A = 0.21$



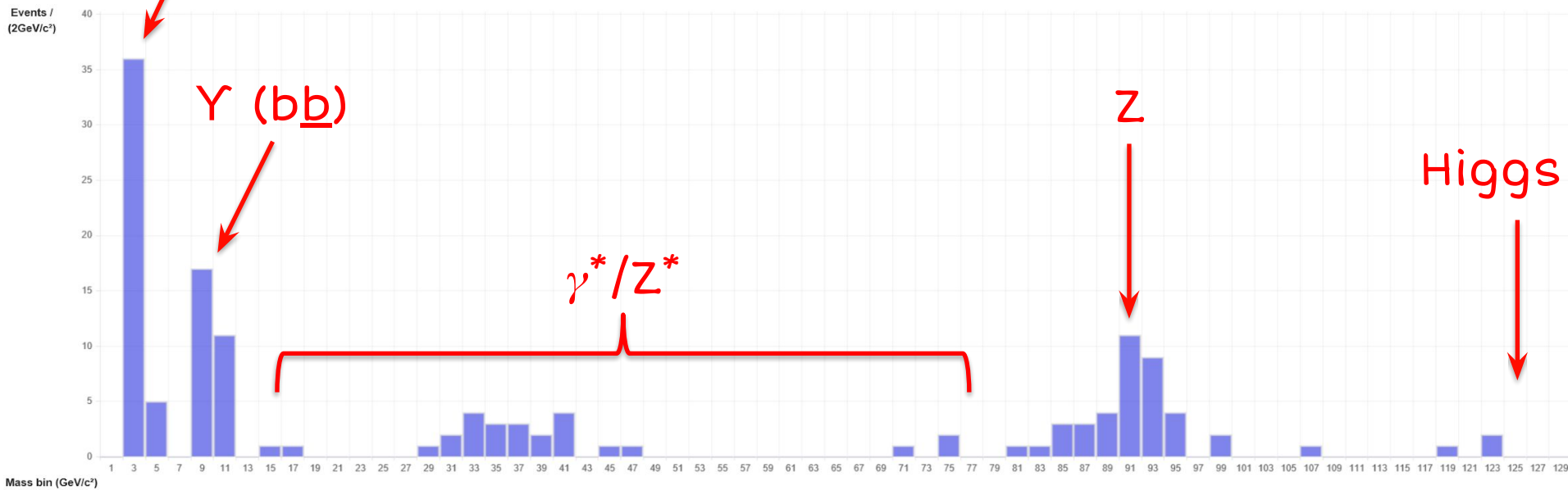
# Espectro de masa de $e^+e^-$ y $\mu^+\mu^-$



# Espectro de masa de $e^+e^-$ y $\mu^+\mu^-$

$J/\psi$  ( $c\bar{c}$ )

Events /  
(2GeV/c<sup>2</sup>)



# Espectro de masa de $e^+e^- \gamma \mu^+\mu^-$

$J/\psi (c\bar{c})$

Events /  
(2GeV/c<sup>2</sup>)

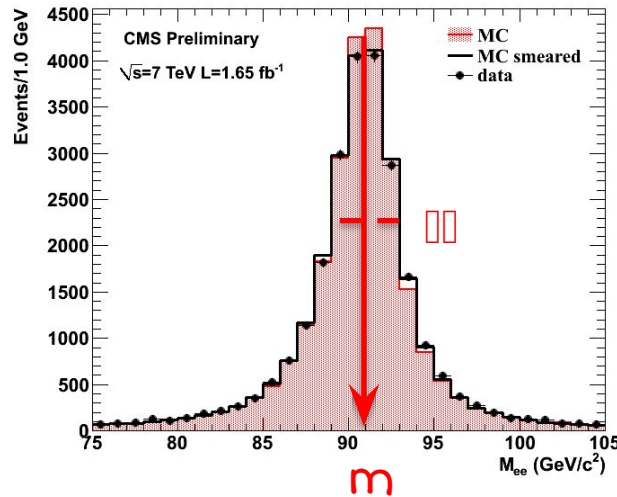
$\Upsilon (b\bar{b})$

$\gamma^*/Z^*$

Z

Higgs

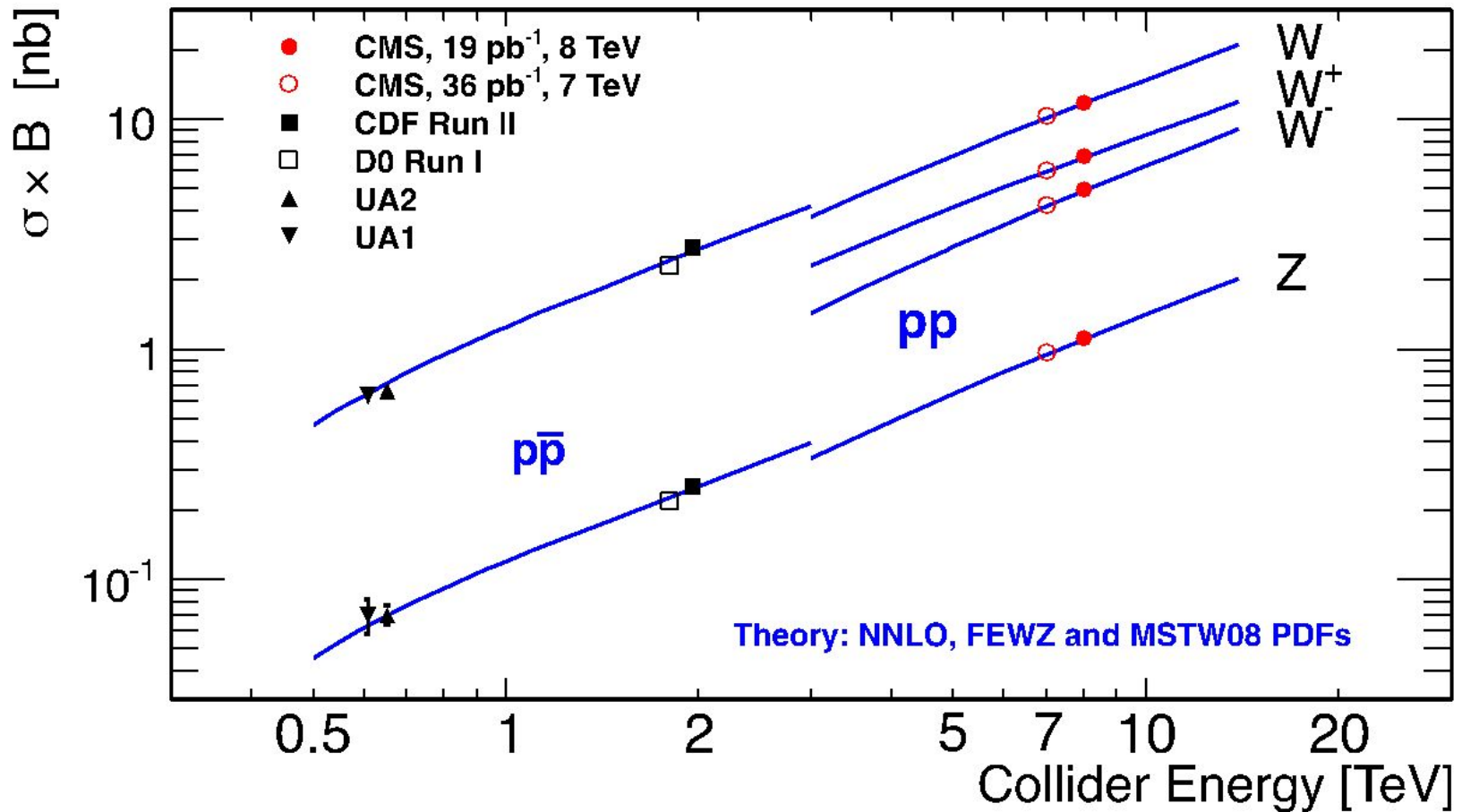
34



$$W/Z \approx \sigma(W)/\sigma(Z)$$

CMS:  $W/Z \approx 12$

SLTP:  $W/Z \approx 12.9$  (439/34) !!



# !!! FELICIDADES !!!

