

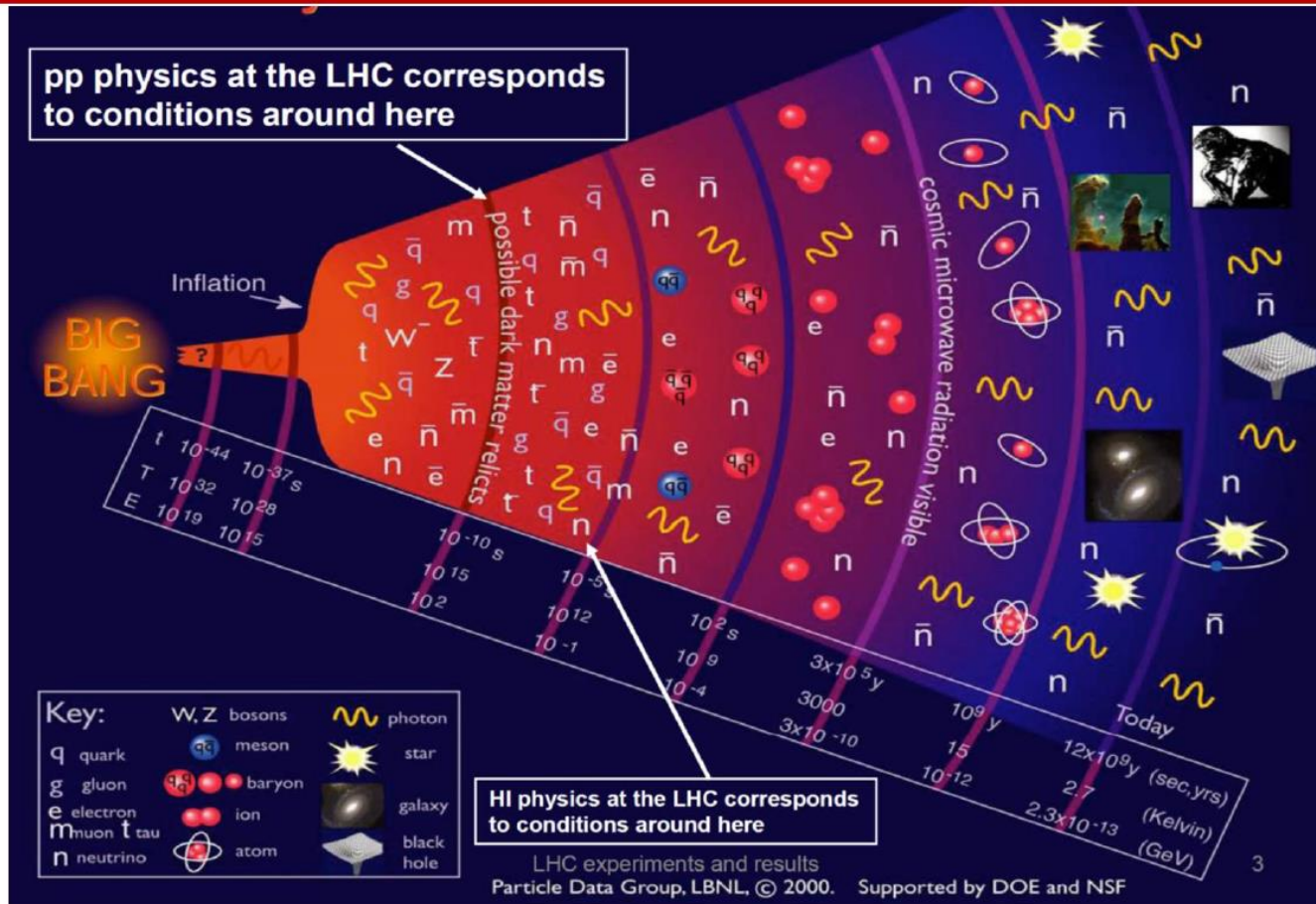
Measurement of the W-boson helicities in top decays at CMS/LHC

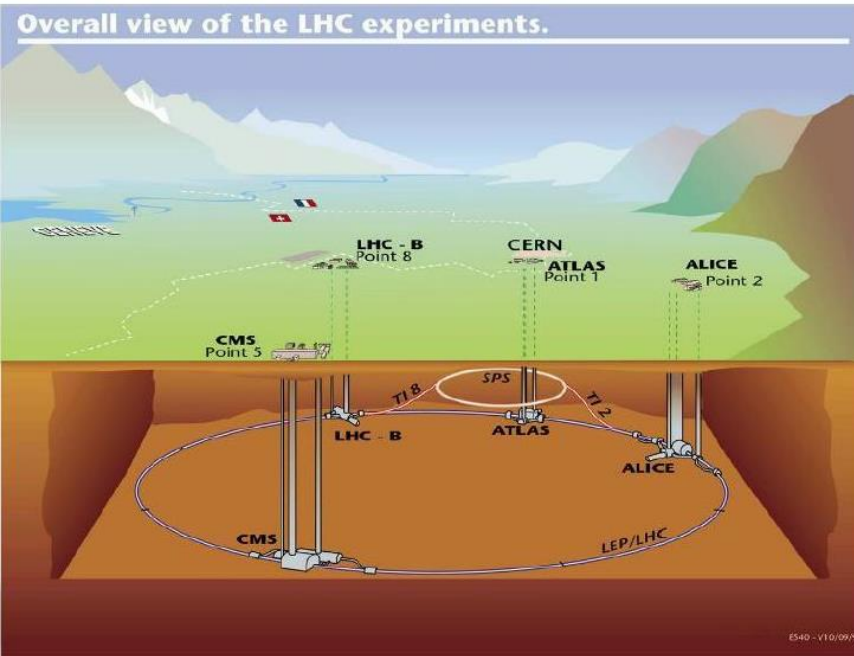
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Ινστιτούτο Πυρηνικής & Σωματιδιακής Φυσικής

3^η ΗΜΕΡΙΔΑ ΕΝΗΜΕΡΩΣΗΣ ΦΟΙΤΗΤΩΝ ΤΟΥ ΔΠΜΣ
‘ΦΥΣΙΚΗ ΚΑΙ ΤΕΧΝΟΛΟΓΙΚΕΣ ΕΦΑΡΜΟΓΕΣ’

The LHC purpose





39 Countries, 169 Institutes, 3170 scientists and engineers (including about 800 students) July 2010

TRIGGER, DATA ACQUISITION & OFFLINE COMPUTING
Austria, Brazil, CERN, Finland, France, Greece, Hungary, Ireland, Italy, Korea, Lithuania, New Zealand, Poland, Portugal, Switzerland, UK, USA

TRACKER
Austria, Belgium, CERN, Finland, France, Germany, Italy, Mexico, New Zealand, Switzerland, UK, USA

CRYSTAL ECAL
Belarus, CERN, China, Croatia, Cyprus, France, Italy, Portugal, Russia, Serbia, Switzerland, UK, USA

PRESHOWER
Armenia, CERN, Greece, India, Russia, Taiwan

FORWARD CALORIMETER
Hungary, Iran, Russia, Turkey, USA

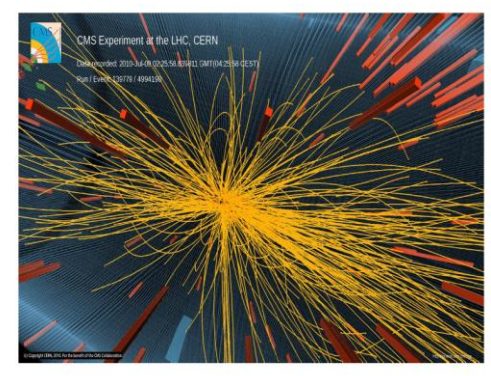
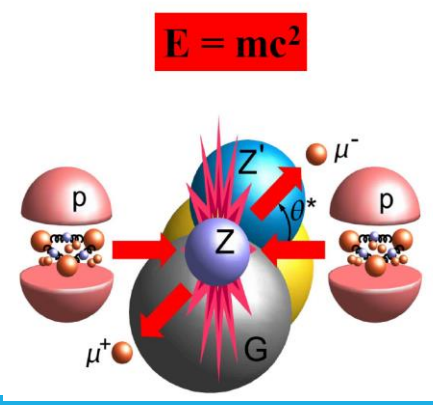
FEET
Pakistan, China

HCAL
Barrel: Bulgaria, India, USA
Endcap: Belarus, Bulgaria, Georgia, Russia, Ukraine, Uzbekistan
HO: India

MUON CHAMBERS
Barrel: Austria, Bulgaria, CERN, China, Germany, Hungary, Italy, Spain
Endcap: Belarus, Bulgaria, China, Colombia, Egypt, Korea, Pakistan, Russia, USA

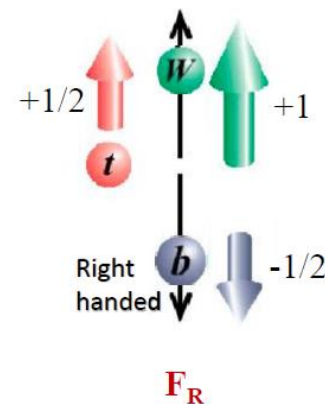
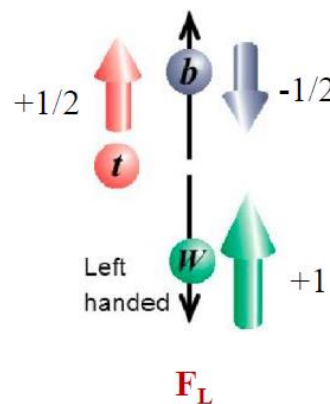
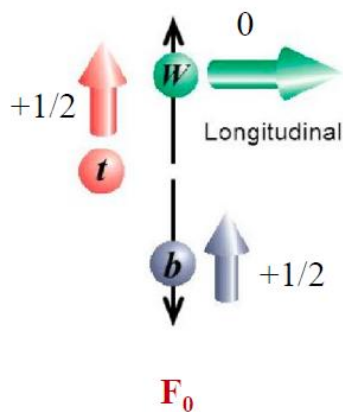
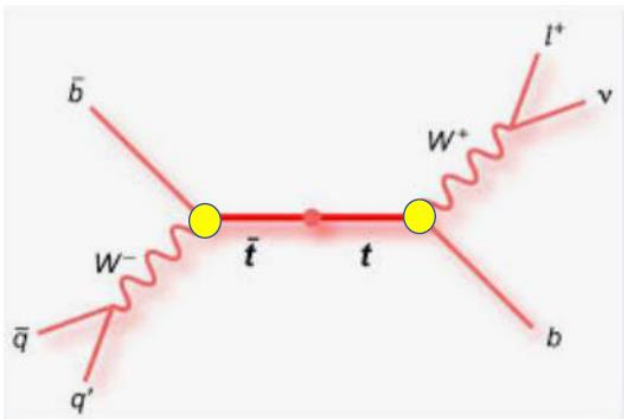
SUPERCONDUCTING MAGNET & YOKE
All countries in CMS contribute to Magnet financing

Total weight	: 14000 tonnes
Overall diameter	: 15.0 m
Overall length	: 28.7 m
Magnetic field	: 3.8 T



Motivation:

The measurement is sensitive to the Wtb vertex structure;
new physics from anomalous Wtb couplings



V-A suppressed

CMS (8 TeV)

Phys. Lett. B 762 (2016) 512

$$F_0 = 0.681 \pm 0.012 \text{ (stat)} \pm 0.023 \text{ (syst)},$$

$$F_L = 0.323 \pm 0.008 \text{ (stat)} \pm 0.014 \text{ (syst)}, \text{ and}$$

$$F_R = -0.004 \pm 0.005 \text{ (stat)} \pm 0.014 \text{ (syst)}$$

ATLAS (8 TeV)

Eur. Phys. J. C 77 (2017) 264

$$F_0 = 0.709 \pm 0.019 \text{ (stat+syst)},$$

$$F_L = 0.299 \pm 0.015 \text{ (stat+syst)}, \text{ and}$$

$$F_R = -0.008 \pm 0.014 \text{ (stat+syst)}$$

$$\frac{1}{\Gamma} \frac{d\Gamma}{d\cos\theta} = \frac{3}{8} (1 - \cos\theta)^2 \mathbf{F}_L + \frac{3}{8} (1 + \cos\theta)^2 \mathbf{F}_R + \frac{3}{4} \sin^2\theta \mathbf{F}_0, \quad \theta \equiv \theta^*$$

$F_0 = 0.687 \pm 0.005$, $F_L = 0.311 \pm 0.005$, $F_R = 0.0017 \pm 0.0001$
 (Phys. Rev. D **81** (2010) 111503), $m_t = 172.8 \pm 1.3$ GeV

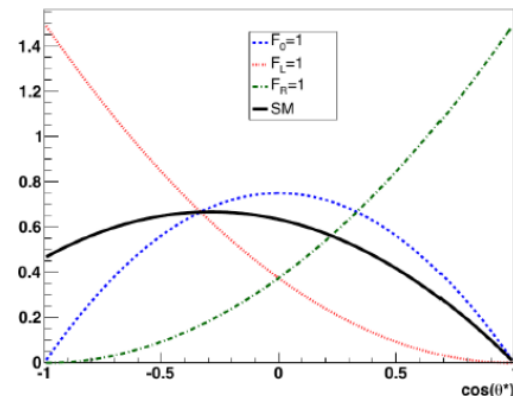
Can we do better by changing the ‘sensitive variable’?

- We propose a different approach to extract the W-helicity

- 1 $\Delta\Phi(\ell, \text{jet})$
- 2 $M_{\ell b}$

Previous Measurements

- Based on $\cos(\theta^*) \rightarrow$ Strong discriminant power



- $\cos(\theta^*)$ needs the reconstruction of the top process ($t\bar{t}$ or single top)
- $t\bar{t}$ kinematic fit introduces a dependency of top mass.



W helicities TOPICS



- Measure the W helicities with **different** sensitive variable
 - $\cos(\Theta^*)$
 - $\Delta\phi(l, jet)$
 - M_{lb}
- Estimate basic backgrounds with data driven methods (Wjets & QCD)
- Investigate methods to reconstruct the ttbar system

Why should I do it?

- Get in touch with the real **Particle Physics** World
- Analyze **LHC data**
- Search for **New Physics** / Measure the **Standard Model**
- Learn advanced **analysis techniques & tools**