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

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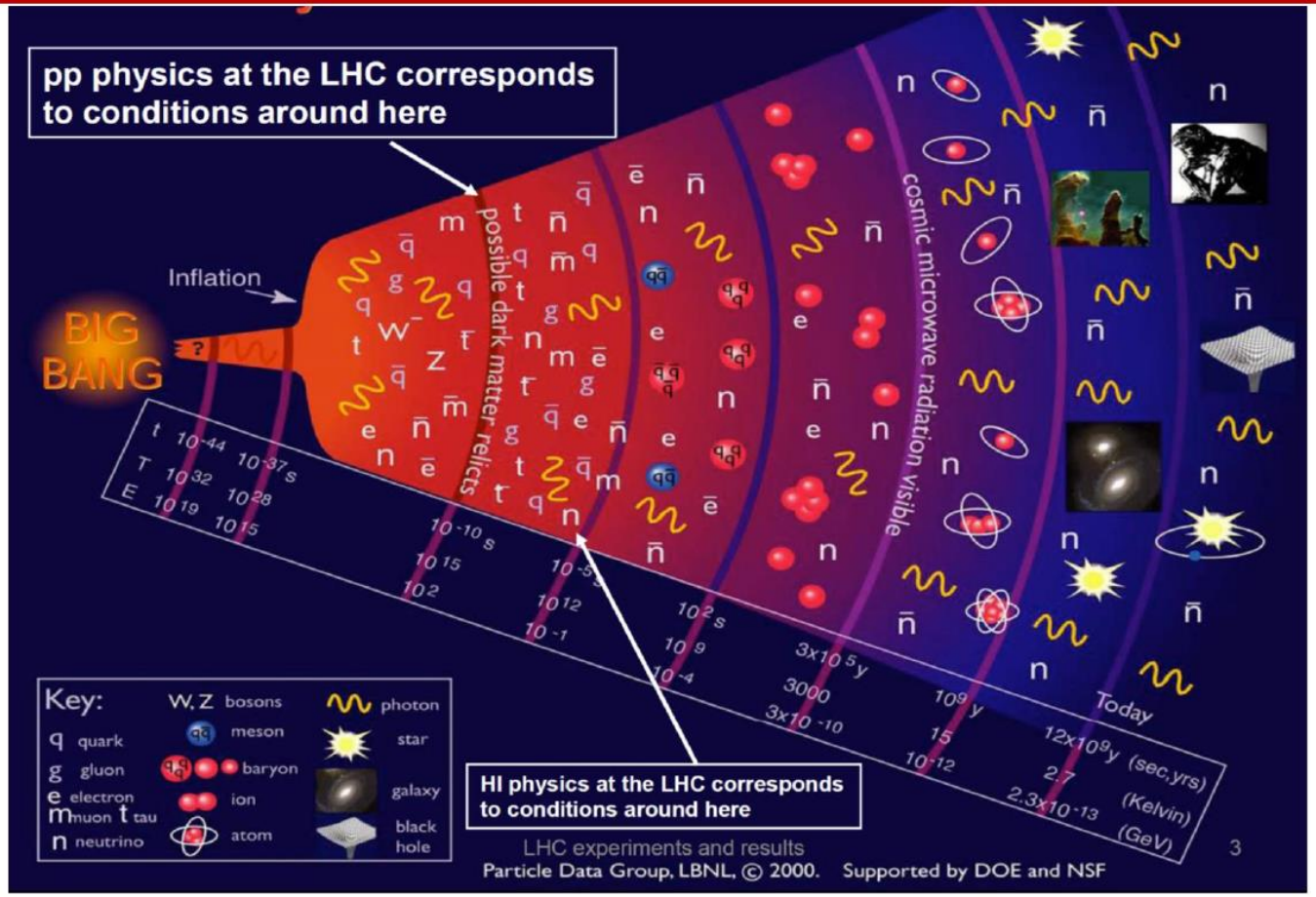
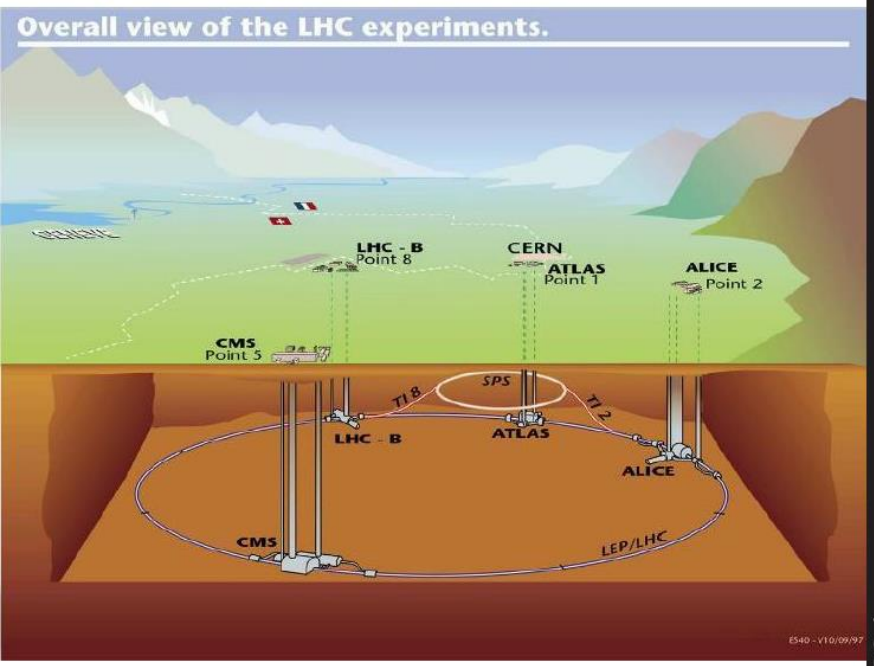
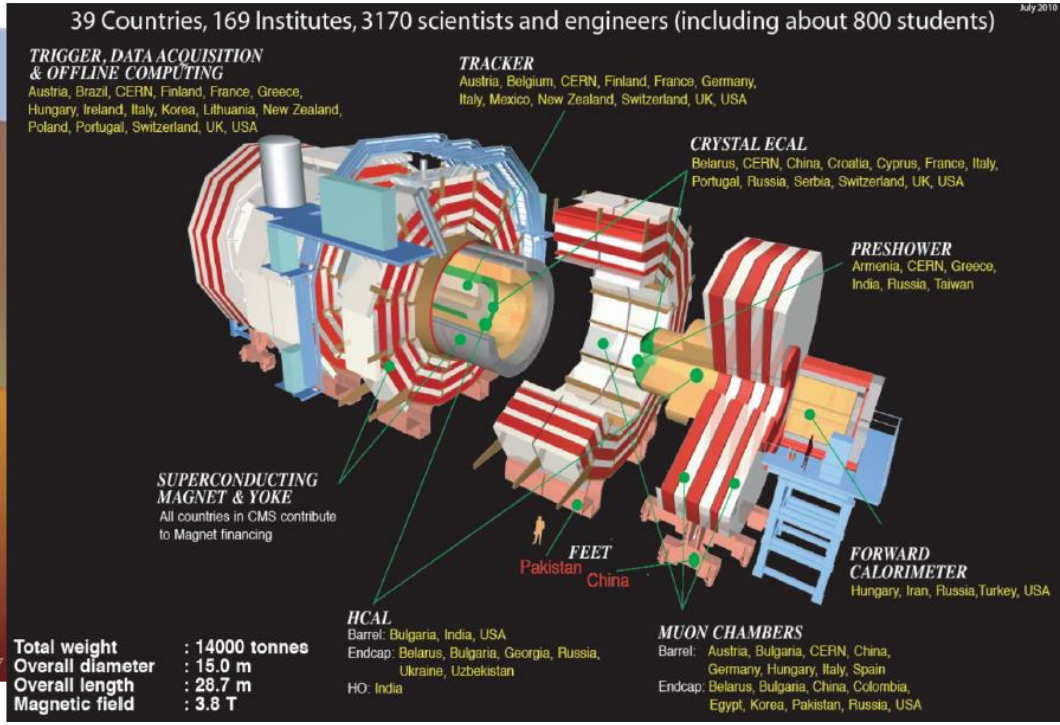
3η ΗΜΕΡΙΔΑ ΕΝΗΜΕΡΩΣΗΣ ΦΟΙΤΗΤΩΝ ΤΟΥ ΔΠΜΣ
‘ΦΥΣΙΚΗ ΚΑΙ ΤΕΧΝΟΛΟΓΙΚΕΣ ΕΦΑΡΜΟΓΕΣ’

The LHC purpose

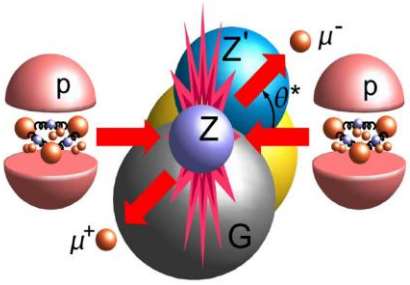


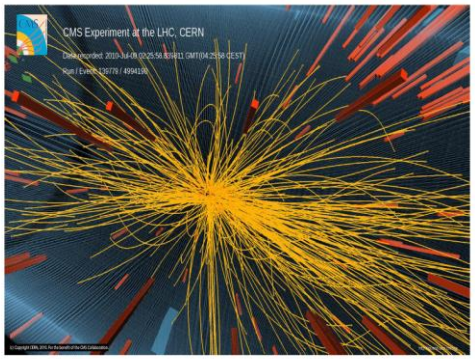
CERN Accelerator & Experiments





$$E = mc^2$$



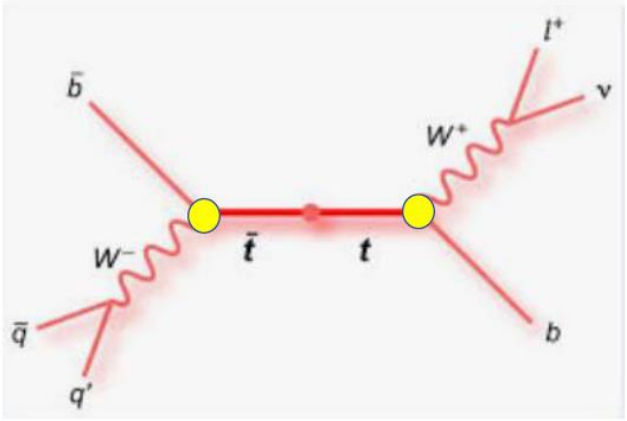


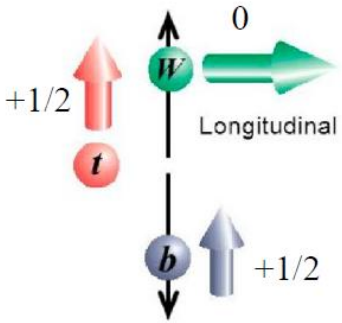
TOP : W helicities from ttbar events

Motivation:

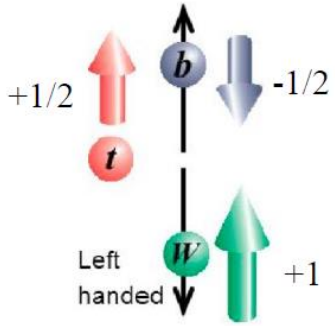
The measurement is sensitive to the Wtb vertex structure;

new physics from anomalous Wtb couplings

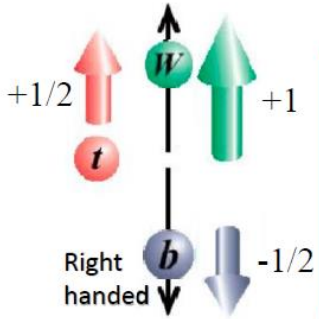




F_0



F_L



F_R

V-A suppressed

CMS (8 TeV)

Phys. Lett. B 762 (2016) 512

F_0 = 0.681 ± 0.012 (stat) ± 0.023 (syst),
F_L = 0.323 ± 0.008 (stat) ± 0.014 (syst), and
F_R = -0.004 ± 0.005 (stat) ± 0.014 (syst)

ATLAS (8 TeV)

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F_0 = 0.709 ± 0.019 (stat+syst),
F_L = 0.299 ± 0.015 (stat+syst), and
F_R = -0.008 ± 0.014 (stat+syst)

TOP : W helicities from ttbar events

$$\frac{1}{\Gamma}\frac{d\Gamma}{d\cos\theta} = \frac{3}{8}(1-\cos\theta)^2 F_L + \frac{3}{8}(1+\cos\theta)^2 F_R + \frac{3}{4}\sin^2\theta F_0 \ , \quad \theta \equiv \theta^*$$

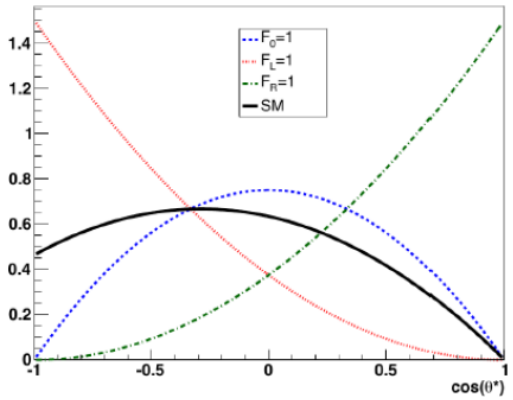
F_0 = 0.687±0.005, F_L = 0.311±0.005, F_R = 0.0017±0.0001
(Phys. Rev. D **81** (2010) 111503) , mt = 172.8 1.3 GeV

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 $\cos(\theta^*)$ → 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
  - $\cos(\Theta^*)$
  - $\Delta\varphi$ (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**