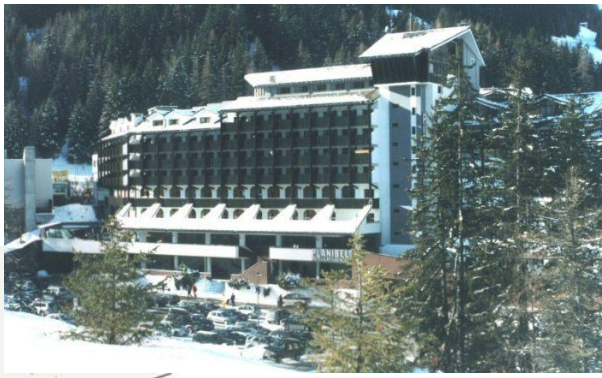
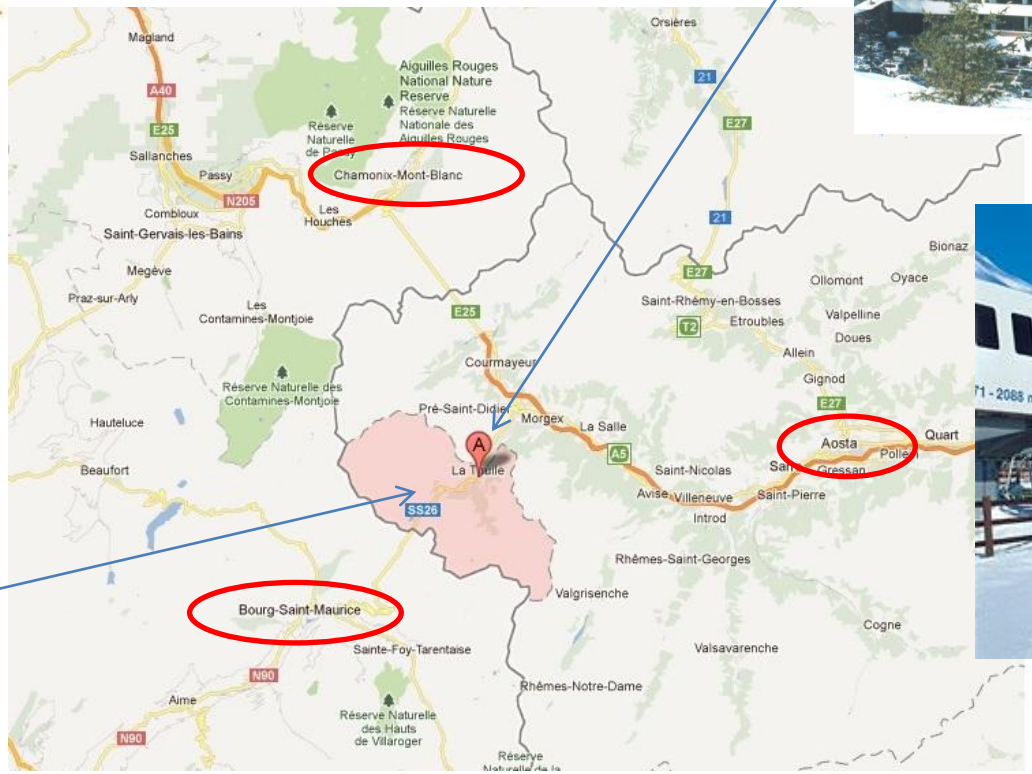
Julie Kirk

http://agenda.infn.it/conferenceOtherViews.py?view=standard&confId=4116




Magland
A40
E25
Sallanches
Passy
N205
Combloux
Saint-Gervais-les-Bains
Megève
Praz-sur-Arly
Les Contamines-Montjoie
Réserve Naturelle des Contamines-Montjoie
Hauteluce
Beaufort
Aiguilles Rouges National Nature Reserve
Réserve Naturelle Nationale des Aiguilles Rouges
Chamonix-Mont-Blanc
Les Houches
Orsières
21
E27
Bionaz
Ollomont
Oyace
Saint-Rhémy-en-Bosses
T2
Etroubles
Valpelline
Doues
Allein
Gignod
Aosta
Quart
Pollein
Gressan
Saint-Nicolas
Avise
Villeneuve
Saint-Pierre
Introd
Courmayeur
Pré-Saint-Didier
Morgex
La Salle
A5
La Thuile
SS26
Rhêmes-Saint-Georges
Valgrisenche
Bourg-Saint-Maurice
Sainte-Foy-Tarentaise
Cogne
Valsavarenche
N90
Aime
Rhêmes-Notre-Dame
Réserve Naturelle des Hauts de Villaroger


Col du Petit St Bernard
Altitude 2188m


ITALIA

Last at La Thuile in 1994 much is still the same:

What can I do from 11.30 'til 4.30??

About 120 participants
2 sessions a day (8.30-11.30 and 4.30-7.30) covering:

- Cosmology and Astrophysics
- Neutrino Physics and Lepton Flavour Violation
- QCD Physics/Hadronic Interactions
- Flavour Physics/CP Violation and Rare Decays
- Electroweak and Top Physics
- Higgs Searches
- Searching for New Physics
- Perspectives

Each session about 7-8 20 minute talks with questions
→ selected highlights here

- Physics and Society
- Young Scientist Forum

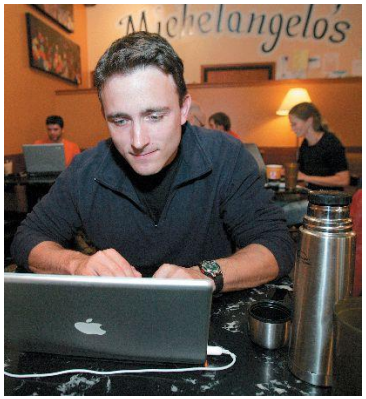
Thorium reactors
Physics in Latin America

New this year:
Experiments asked to nominate good, young scientists to talk about their research.

To Wi-Fi or NOT to Wi-Fi ??

No Wi-fi in conference room (7th floor). Good as people pay attention to the talks....

..BUT attendance not great at some sessions. Not everyone was out skiing

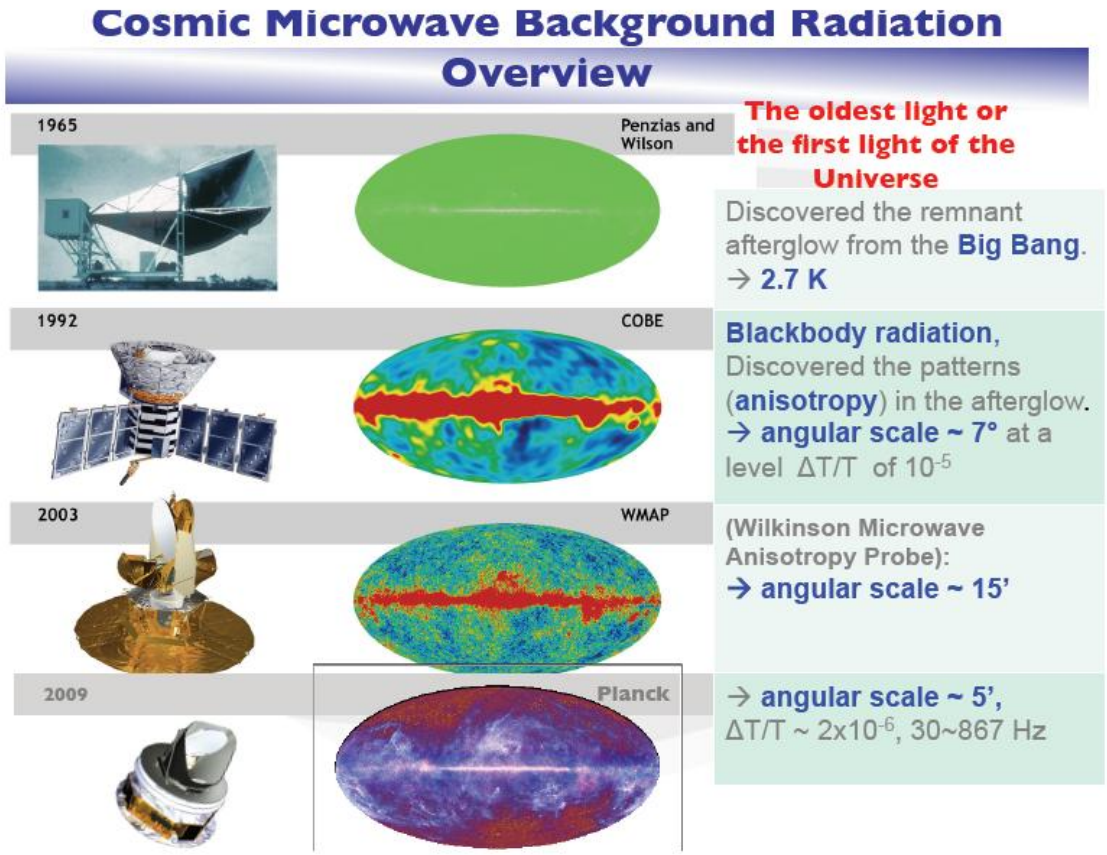


Summary (sadly)

“Come back next week”

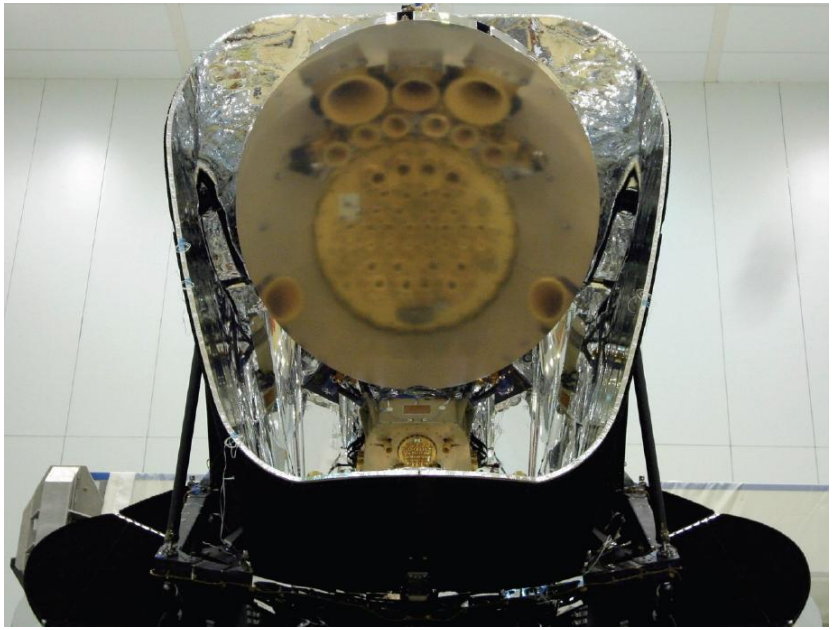
i.e. for Moriond!

Planck – Cosmic Microwave Background



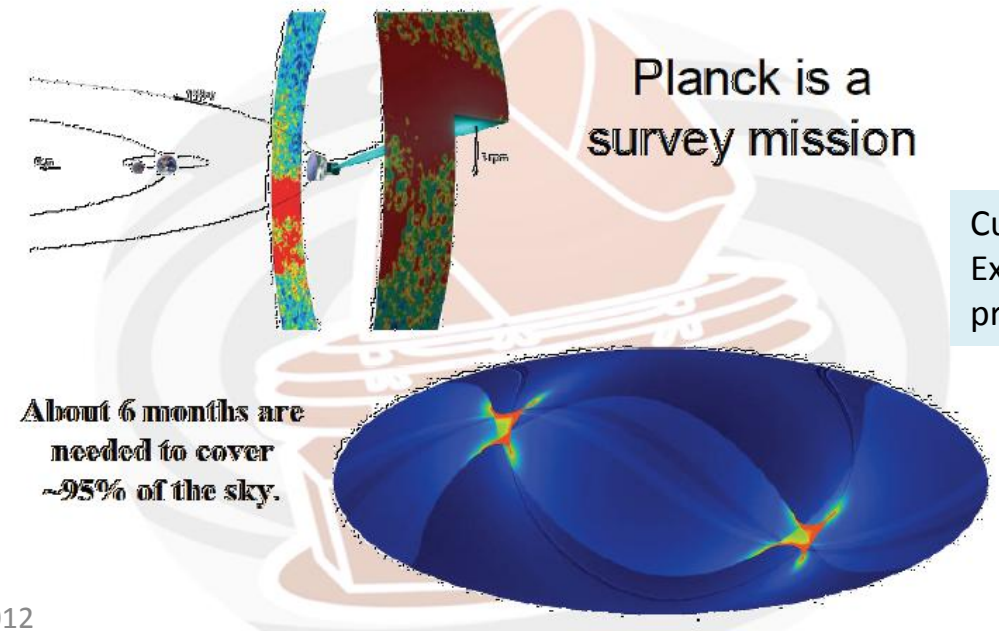
3rd generation of CMB experiment:

- Better angular resolution
- Larger frequency range



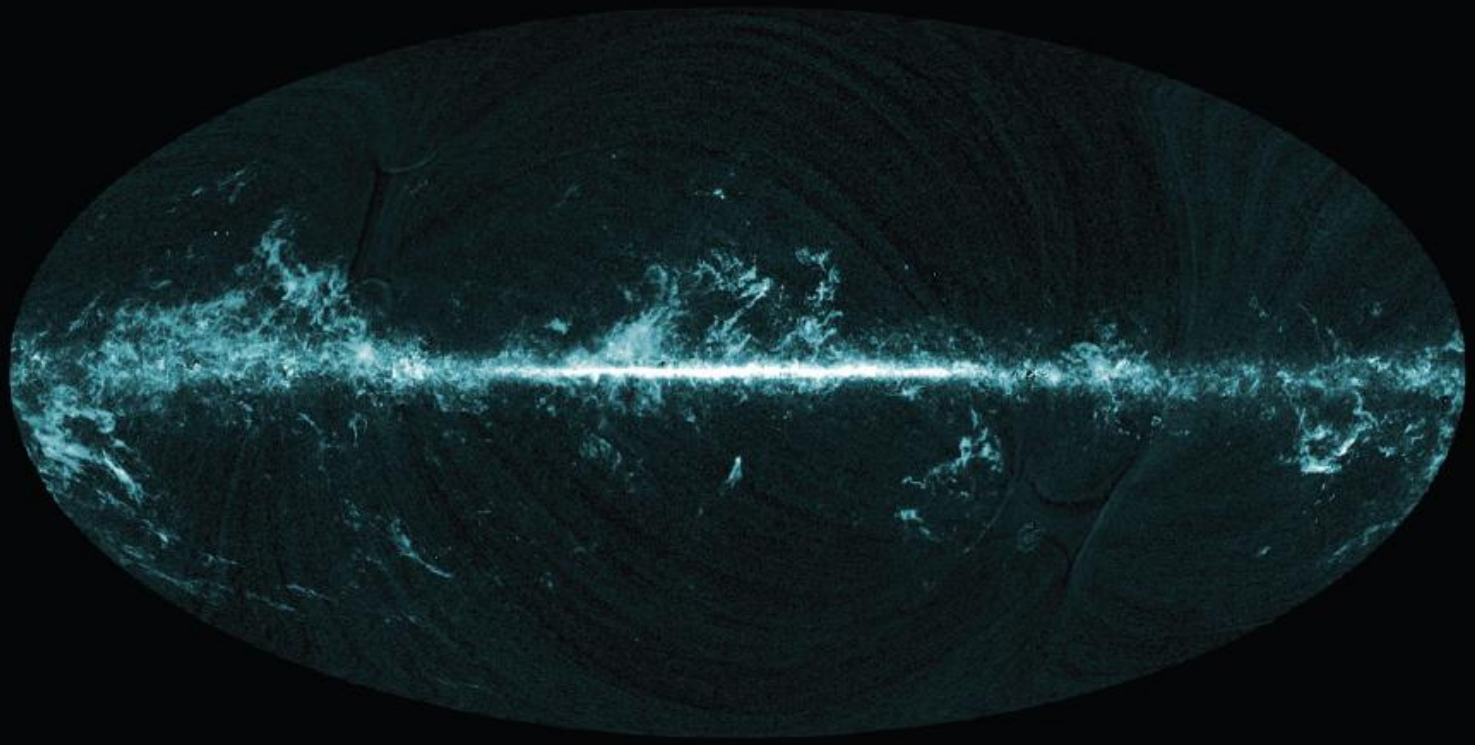
Current Status

- 1019 days since launch.
- Satellite and instruments have been working nominally and continuously since start of sky surveys (mid August 2009)
  - HFI ran out of He on 14 Jan 2012 and stopped taking scientifically useful data
  - LFI still data gathering (several months)
- All the sky has been surveyed about five times with both instruments. LFI is already into its sixth sky survey.

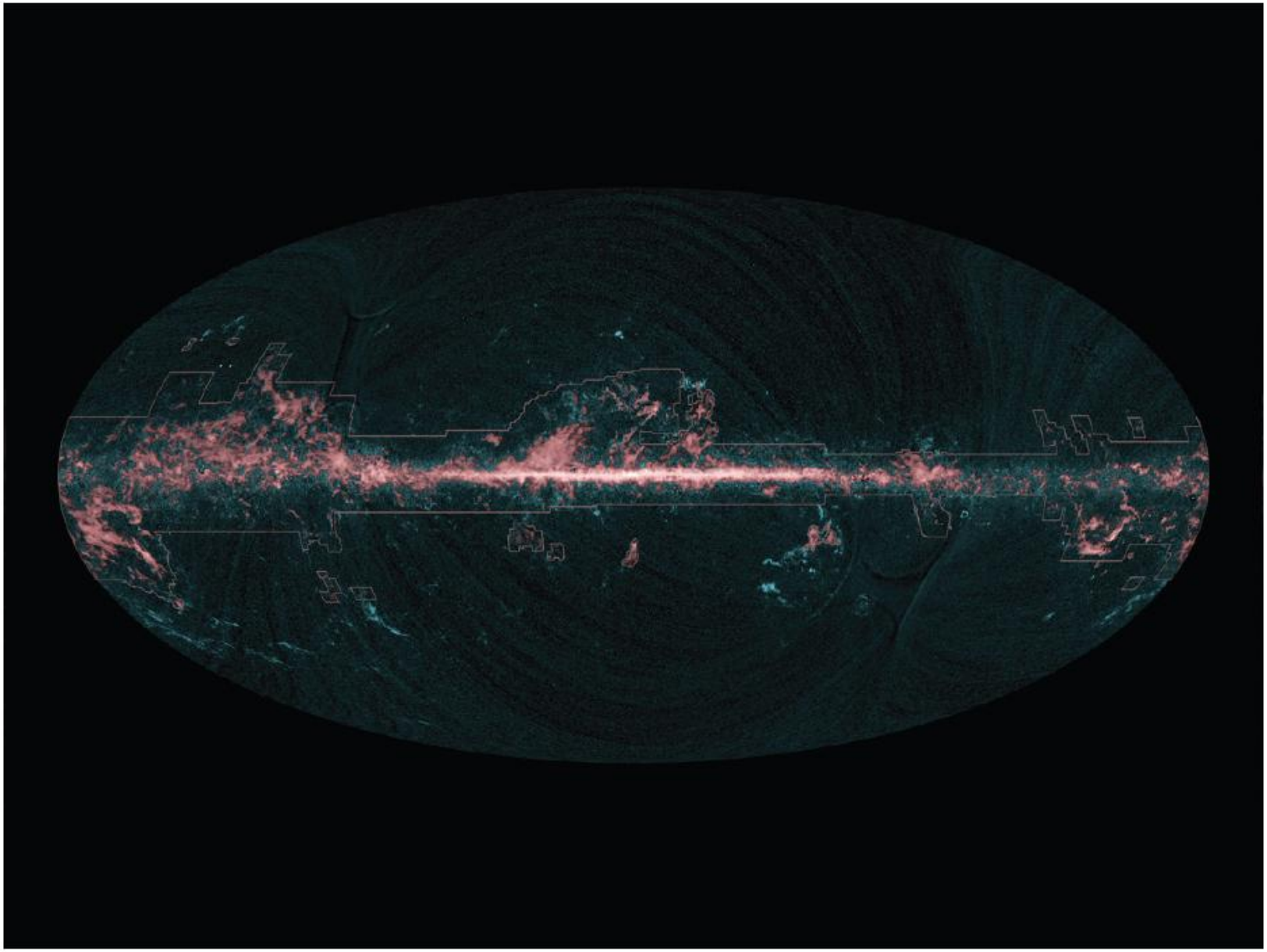


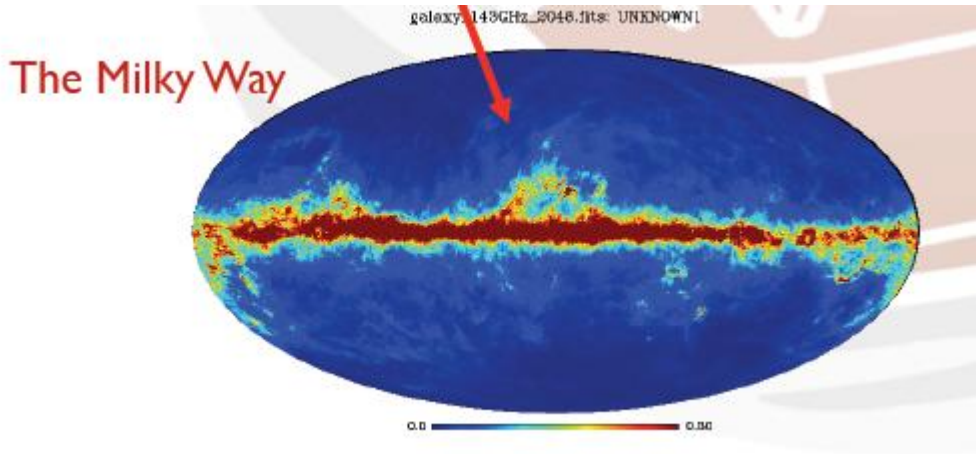
Current results of interest to astrophysics
Expect results from cosmological programme in 2013

First full sky CO Map



Shows star forming regions



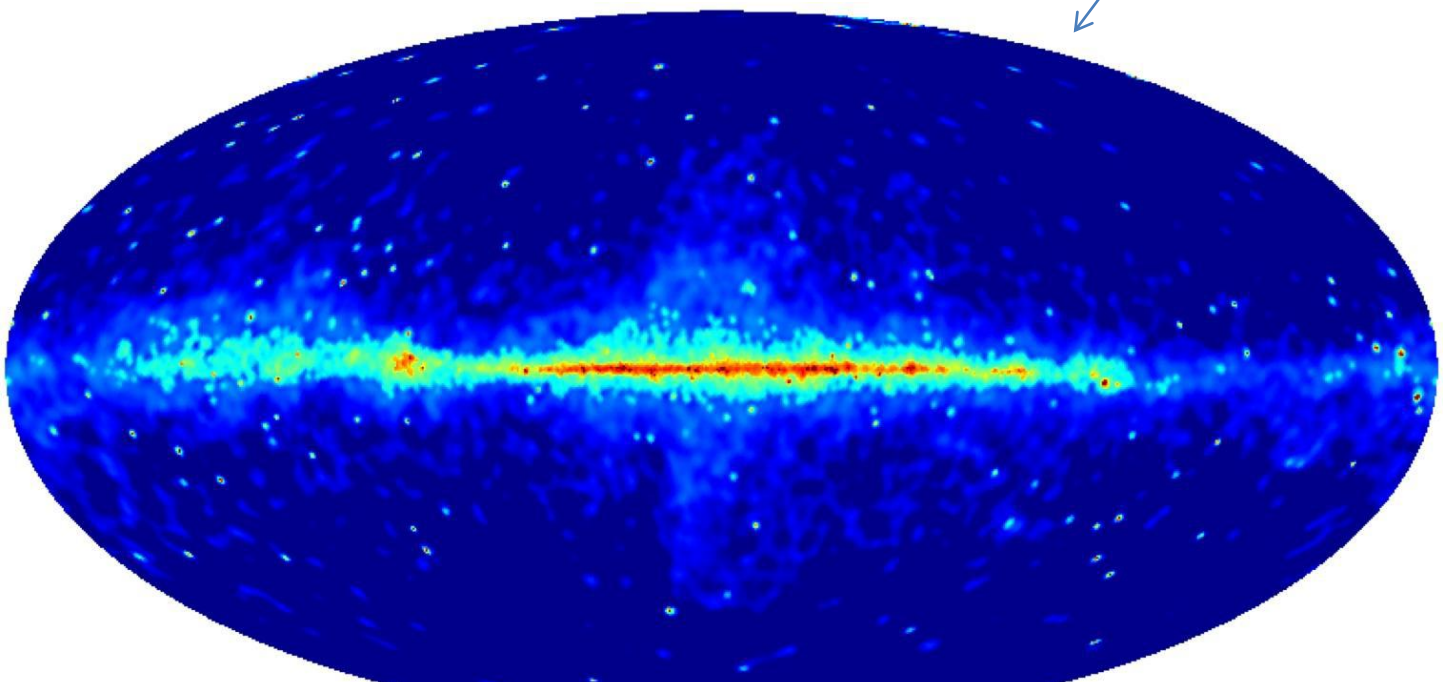


Cosmic Haze:

Synchrotron emission from centre of galaxy – not consistent with expectations.

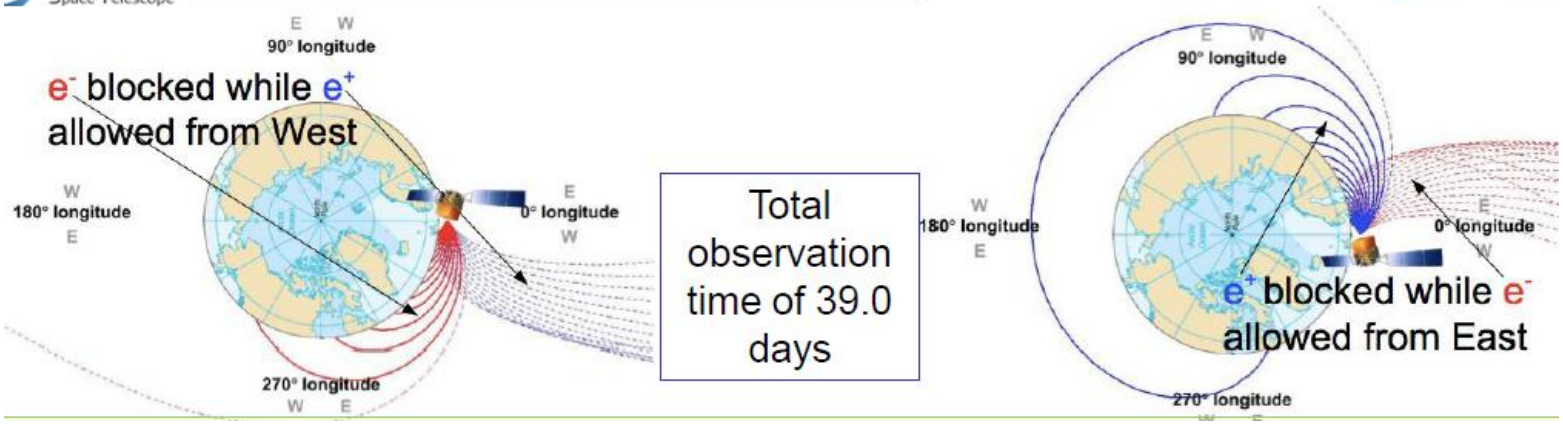
SN/ new CR component/ DM??

Also seen by Fermi

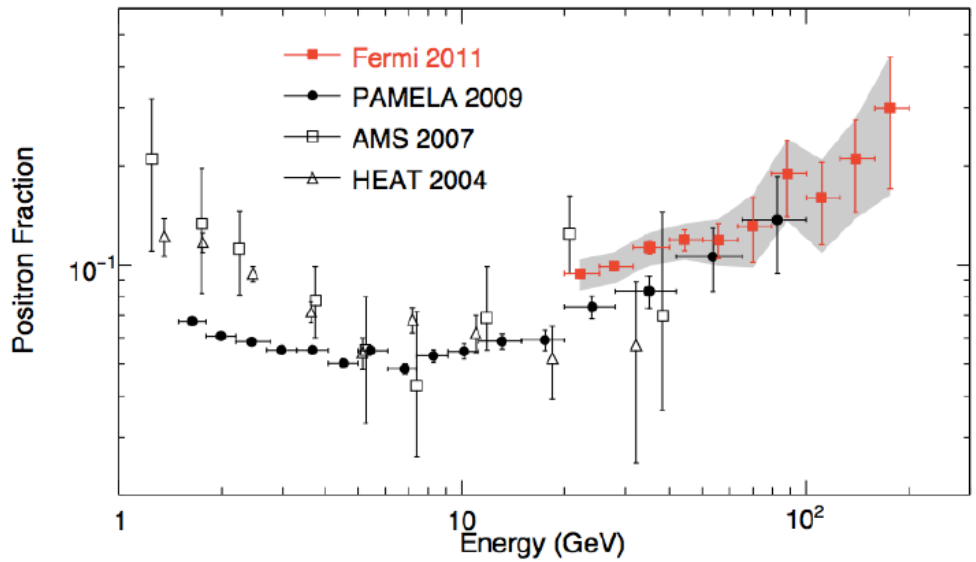


3 years smoothed count map above 10 GeV

Electron-positron distinction with Fermi



Positron fraction rises with energy. Confirms PAMELA result



Dark forces – Kloe.....

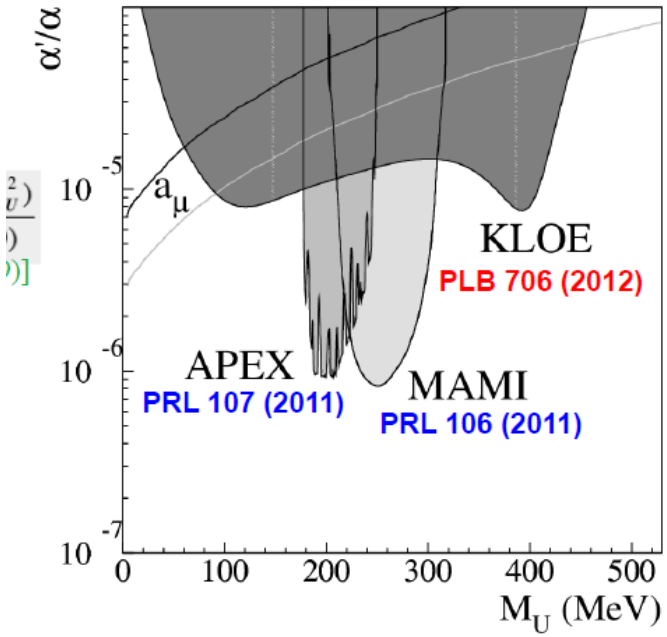
Low energy dark forces

Several unexpected astrophysical observations (PAMELA, ATIC, INTEGRAL, DAMA/LIBRA, CoGent…) could be explained with the existence of a hidden gauge sector weakly coupled with SM through a mixing mechanism of a new **gauge boson (U, A', V…)** with the photon:

[Arkani-Hamed et al. PRD79 015014 (2009)]
[Essig et al., PRD80 015003 (2009)]

- ✓ U mass range: **1 MeV – few GeV**
- ✓ Coupling constant of electric charge to U: $\varepsilon \leq 10^{-3}$
- ✓ U production/decay through photon mixing

S. Giovannella – La Thuile 2012 – KLOE searches on Dark Forces 2



✘ The most advanced search is through the $\phi \to \eta U$, $\eta \to \pi^+\pi^-\pi^0$, decay, which allow to set a limit of:

$\alpha'/\alpha \leq 2 \times 10^{-5}$ **@ 90% C.L. for 50<M_U<420 MeV**

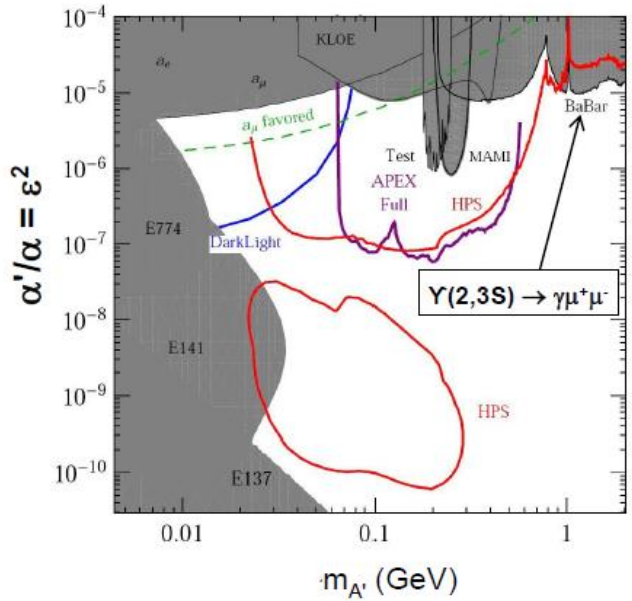
..... And BaBar

⇨ A dark photon can be readily produced in

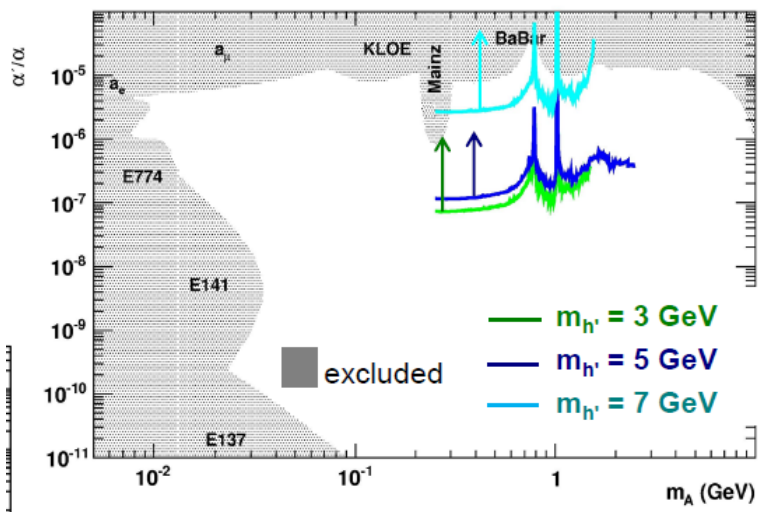
$$e^+e^- \to \gamma A', A' \to f\bar{f}$$

The limits on $e^+e^- \to \Upsilon(2S,3S) \to \gamma\mu^+\mu^-$ can be reinterpreted as limits on dark photon production.

Constraints on $\alpha'/\alpha = \varepsilon^2$



Limit on $\varepsilon^2 = \alpha'/\alpha$ for various Higgs mass (assuming $\alpha_D = \alpha_{em}$)



Substantial improvement over existing limits for $m_{h'}$ < 5 - 7 GeV if light dark Higgs boson exists

⇨ The **Higgs'-strahlung process**

$$e^+e^- \to A'^* \to h' A', h' \to A' A'$$

is very interesting, as it is **only suppressed by ε^2** and is expected to have a **very small background.**

Neutrino Physics

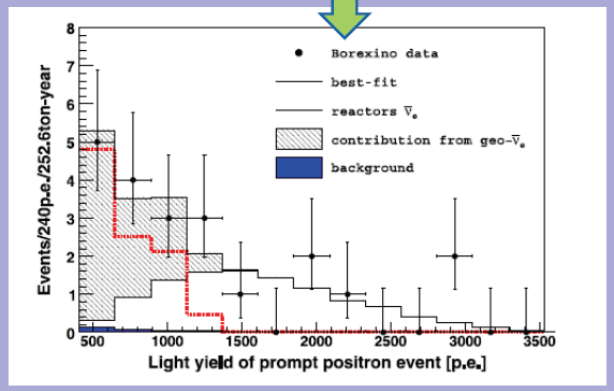
BOREXINO

Search for delayed coincidences in the Borexino detector
Main background sources:
• Li-9, He-8, untagged muons, accidentals……

$$3.9\,^{+1.6}_{-1.3}\left(^{+5.8}_{-3.2}\right)\,ev/(100\,tons\cdot yr)$$

68.3 %CL

99.73 %CL



La Thuile - 27 Feb 2012 15

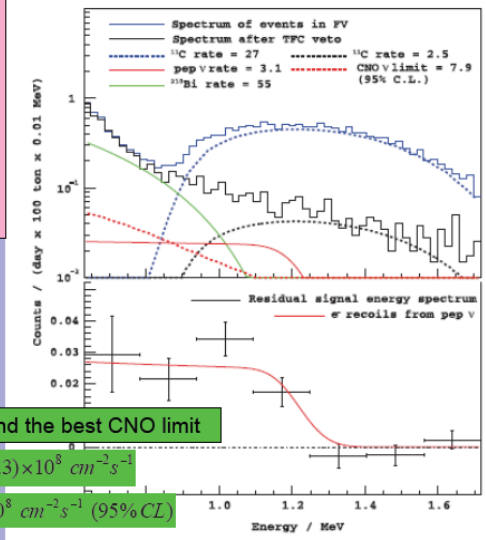
Geo-neutrinos

AntiNeutrinos emitted in beta decays of naturally occurreing radioactive isotopes in the Earth's crust and mantle

C-11 reduction strategy:

• Threefold coincidence (muon,neutron,C11)

• Pulse shape discrimination electron/ gamma/positron (Ps formation)

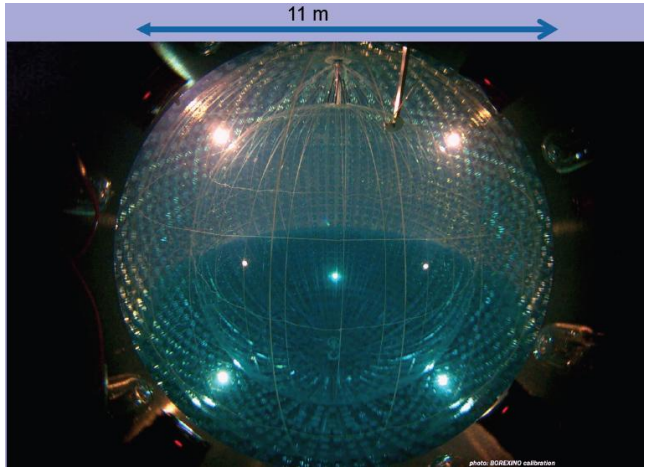


First pep measurement and the best CNO limit

$$\Phi_{pep}\,(MSW-LMA)=(1.6\pm0.3)\times10^{8}\ cm^{-2}s^{-1}$$

$$\Phi_{CNO}\,(MSW-LMA)<7.7\times10^{8}\ cm^{-2}s^{-1}\ (95\%\,CL)$$

La Thuile - 27 Feb 2012 20



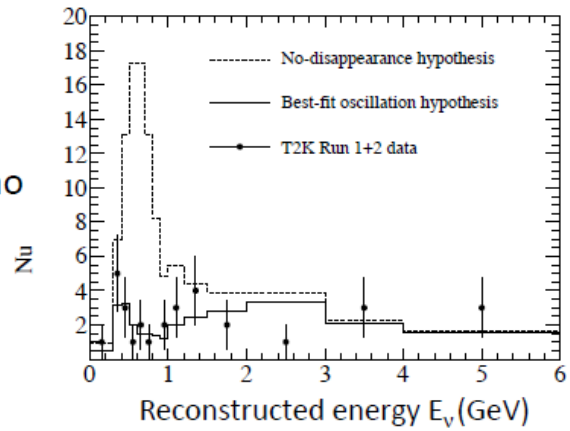
P-e-p

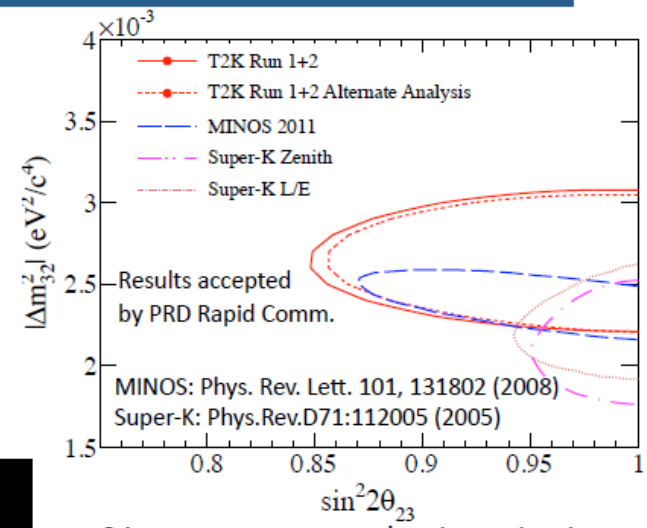
T2K

Open questions:

- Is θ_{23} exactly 45 degrees, or not?
- Is θ_{13} zero, or just small?
- Is there CP violation in the neutrino sector?

ν_μ disappearance results



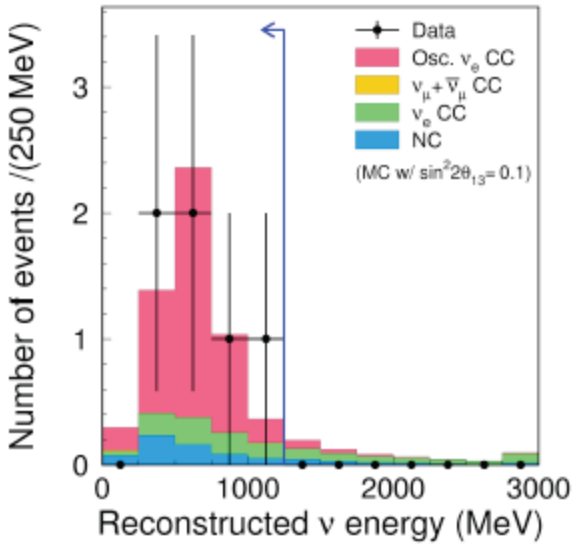


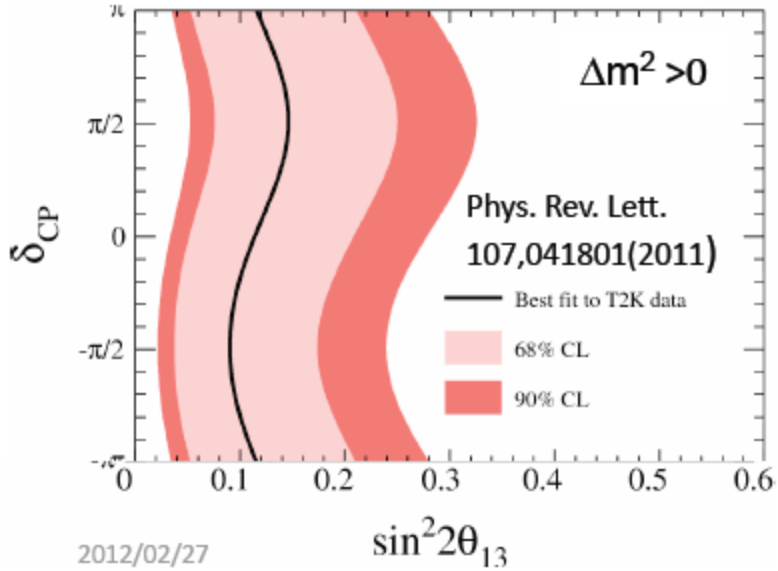
Summary of uncertainties	ν_μ signal Δm^2_{23} =2.4 x 10^{-3} eV² $\sin^2 2\theta_{23}$=1.0
ν flux	±4.8%
ν interactions	+8.3 -8.1%
Near detector	+6.2 -5.9%
Far detector	±10.3%
Total	+15.4 -15.1%

- 31 events pass ν_μ selection criterion
- $103.6^{+13.8}_{-13.4}$ expected for no osc, excluded at 4.5σ
- Fit E_ν distribution for 2 flavor osc. parameters (binned χ^2 fit)
- Best fit: $|\Delta m^2_{32}|$=2.65 x 10^{-3} eV² $\sin^2 2\theta_{23}$ = 0.98

2012/02/27 K Mahn, Les Rencontres de Physique de la Vallée d'Aosta 19

ν_e appearance results

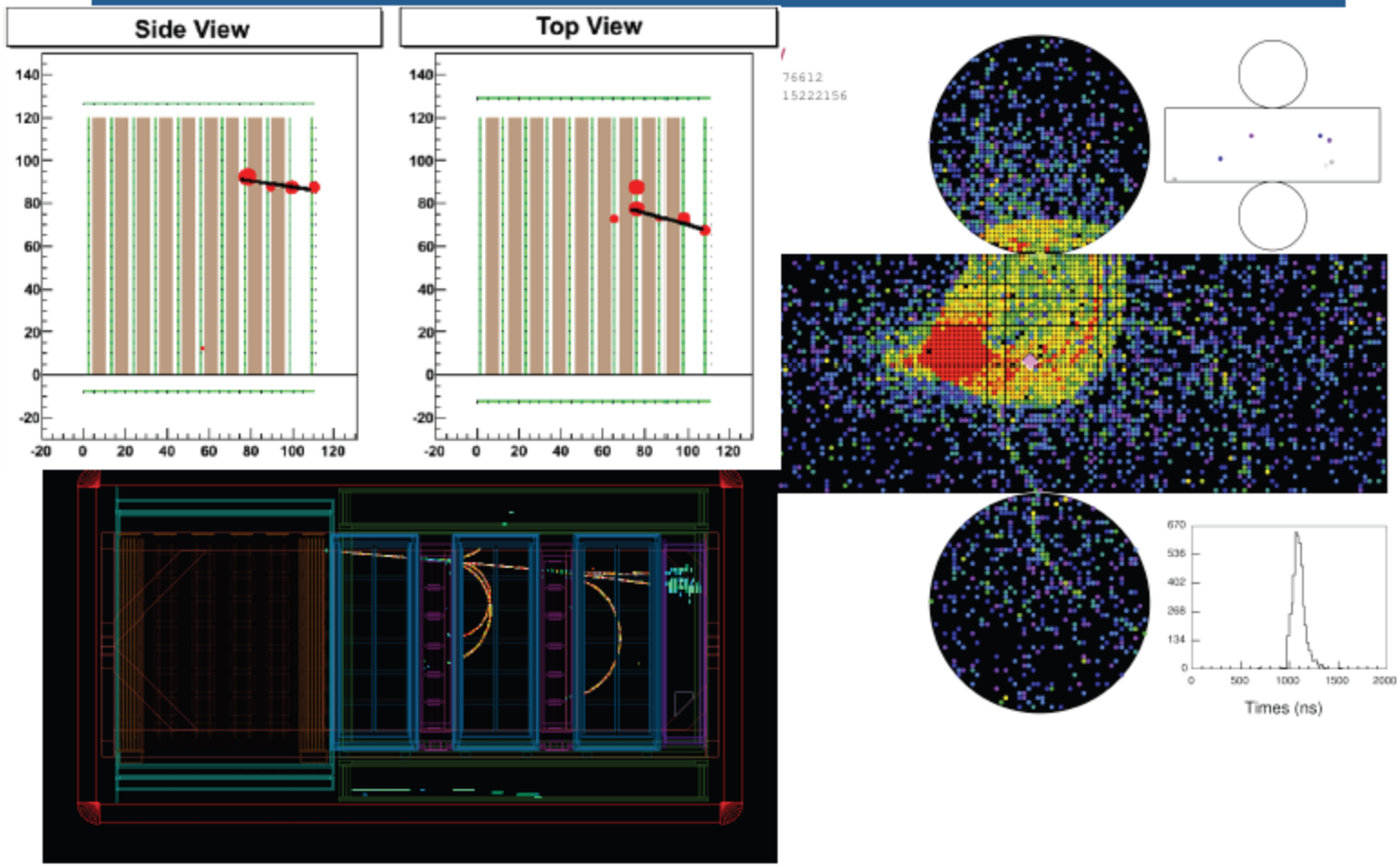




- 6 candidate events observed for background of 1.49 ± 0.34
- Probability to see 6 events or more for $\sin^2 2\theta_{13}=0$ is 0.007 (2.5σ equivalent)
- For $|\Delta m^2_{32}|=2.4 \times 10^{-3}$ eV^2; $\sin^2 2\theta_{23} = 1$
  Best fit: $\sin^2 2\theta_{13} = 0.11$
  $0.03 < \sin^2 2\theta_{13} < 0.28$ at 90% C.L.
- Recent results are consistent with T2K:
  MINOS: $\sin^2 2\theta_{13} < 0.12$ at 90% C.L.
  Double Chooz: $0.017 < \sin^2 2\theta_{13} < 0.16$
- Combined fit to all three experiments: $\sin^2 2\theta_{13} > 0$ at ~3σ

References:
MINOS: Phys. Rev. Lett. 107, 181802 (2011)
Double Chooz: hep-ex/1112.6353
Global fit: hep-ph/1111.3330

First neutrinos post-earthquake!



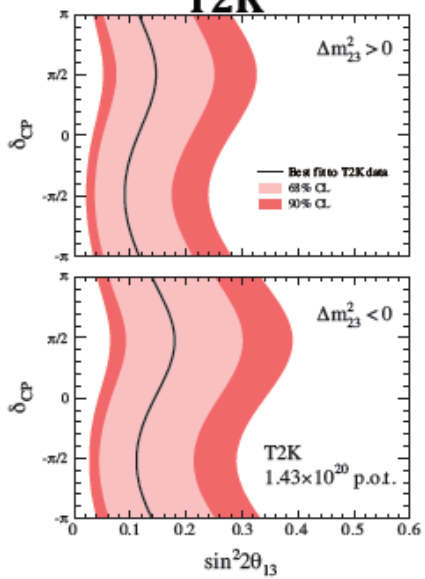
Enormous amount of work by collaborators, labs (KEK, J-PARC) and funding agencies) to make this happen, to which we are very grateful

DAYA BAY

Recent Experimental Results (2011): θ_{13} may be large

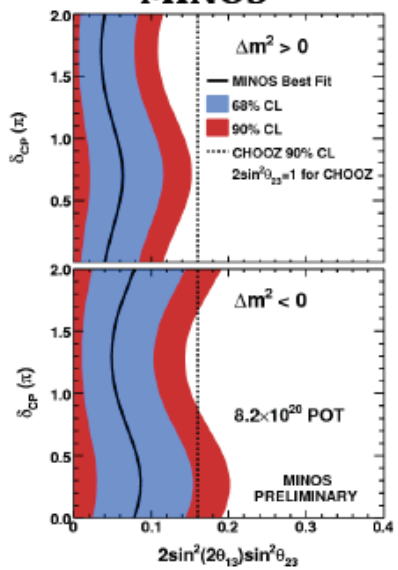
Accelerator based appearance expts

T2K



PRL 107, 041801 (2011)

MINOS

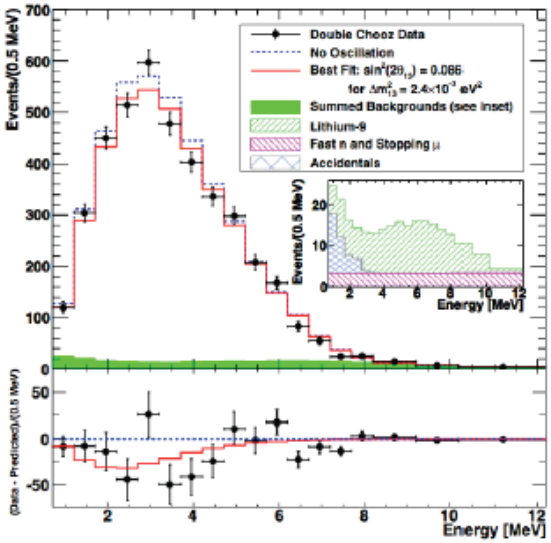


PRL107, 181802 (2011)

0.03(0.04)<$\sin^2 2\theta_{13}$<0.28(0.34) at 90% CL

Reactor based disappearance expt

Double Chooz



arXiv:1112.6353v2

$\sin^2 2\theta_{13}$=0.086±0.041(stat)±0.030(sys)

(0.015<$\sin^2 2\theta_{13}$<0.16 at 90% CL)

VirginiaTech
Invent the Future

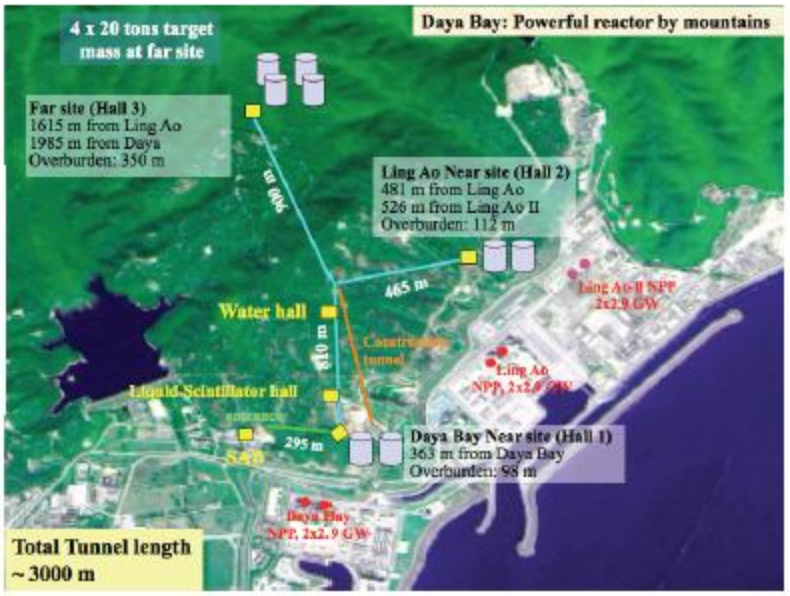
4

Daya Bay Design Principle

- Identical near and far detectors cancel many systematic errors
- Multiple modules boost statistics while reducing systematic errors with multiple independent measurements
- Three zone detector design eliminates the need for spatial cuts which can introduce systematic uncertainties
- Shielding from cosmic rays and natural radioactivity reduces background rates
- Movable detectors allow possible cross calibration between near and far detectors to further reduce systematic errors.

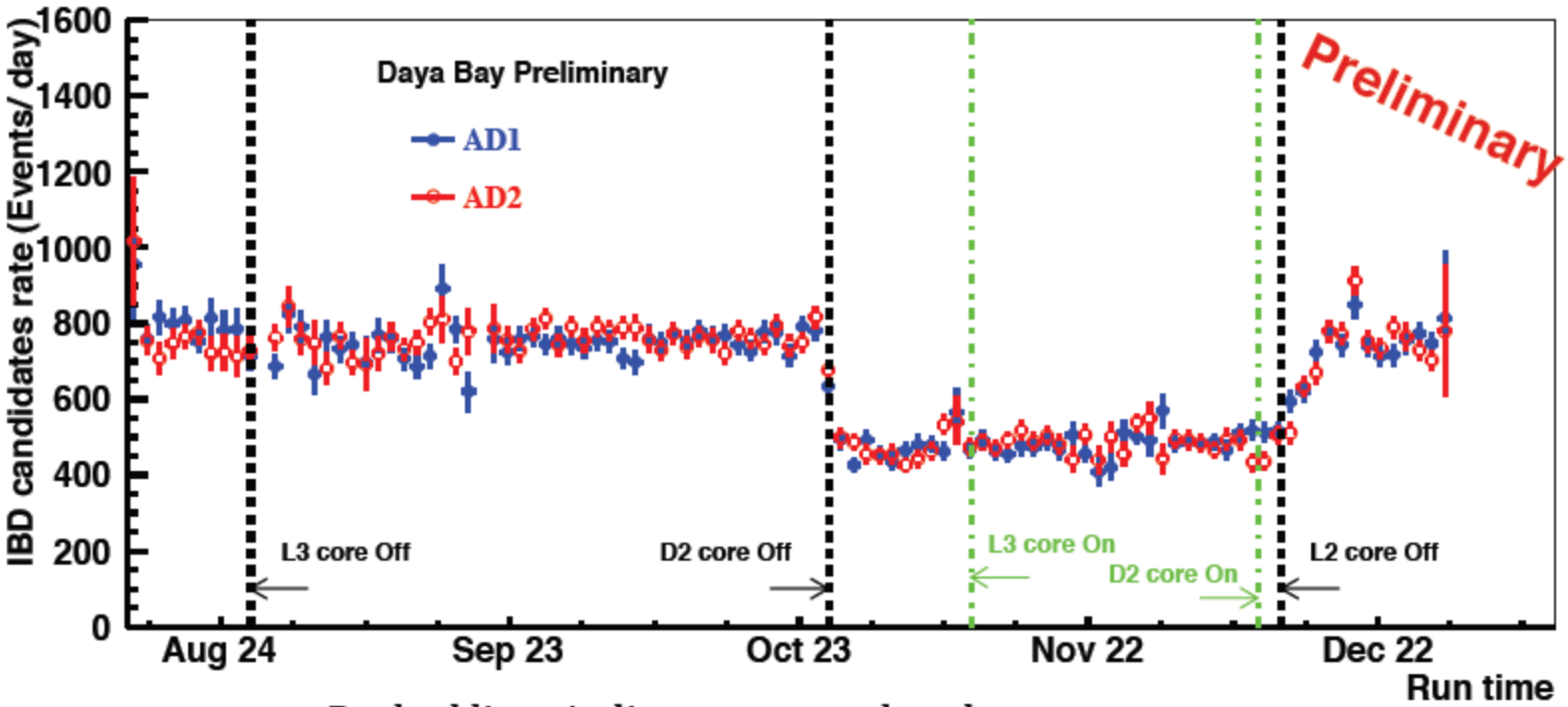
Experimental Layout

	Overburden	D. B.	L. A.	L. A. II
EH1	280	360	860	1310
EH2	300	1350	480	530
EH3	880	1910	1540	1550
	mwe	m	m	m



VirginiaTech
Invent the Future

IBD Candidate Rate



Dashed lines indicate reactor shut down or turn on.

Expected events (/day/detector)

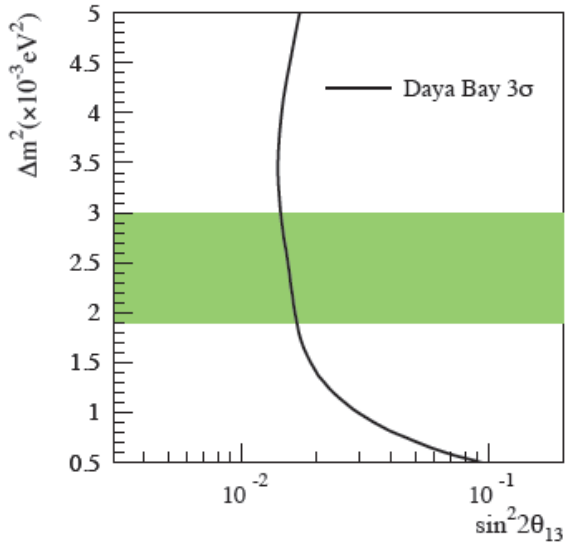
	DYB Site	LA Site	Far Site
IBD Evts	840	760	90
BKG Evts	<0.6%	<0.5%	<0.4%

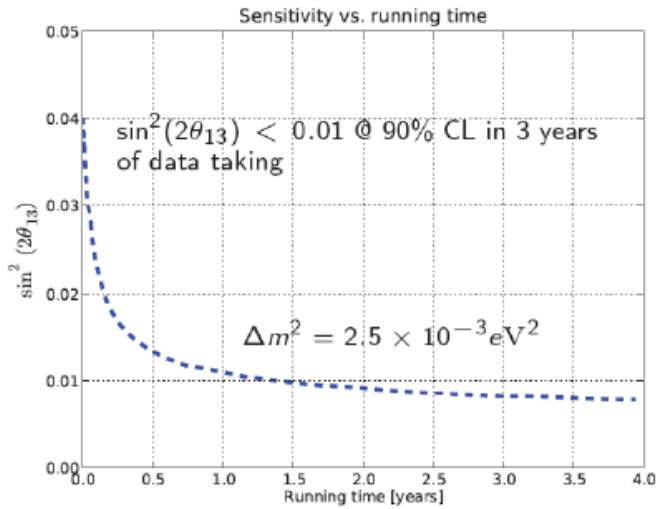
Expected events with all cores ON

VirginiaTech
Invent the Future

“2 months of runnning to measure theta_13 as non-zero”

Summary





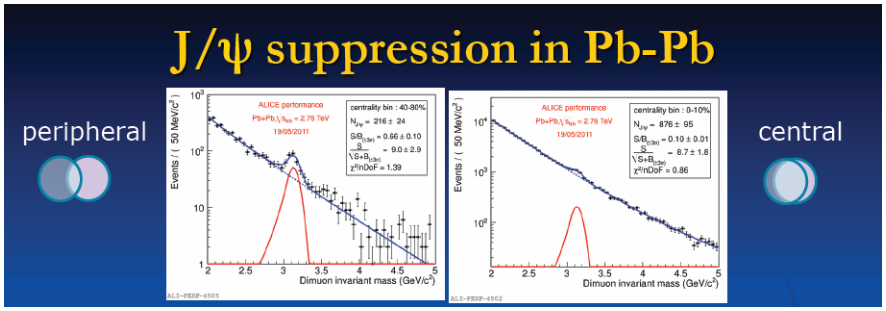
- We have demonstrated the identicalness of the first two detectors at Daya Bay near site
- With all 8 detectors running by summer 2012, Daya Bay is going to provide the most precise measurement of θ_{13}.

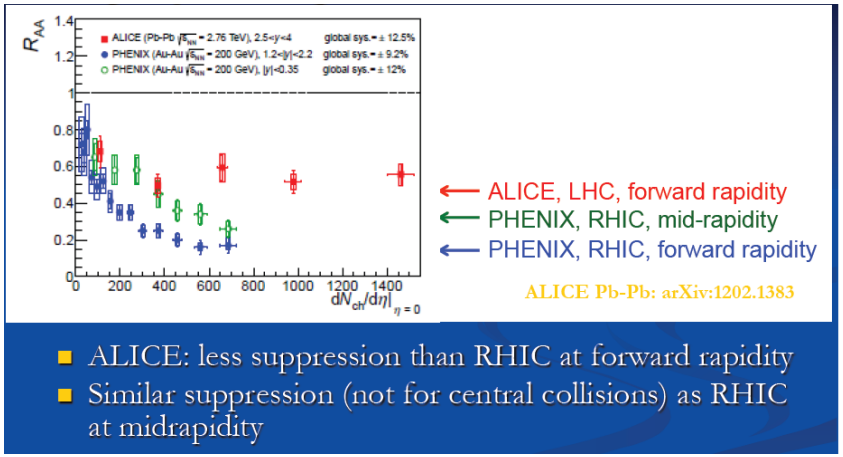
VirginiaTech
Invent the Future

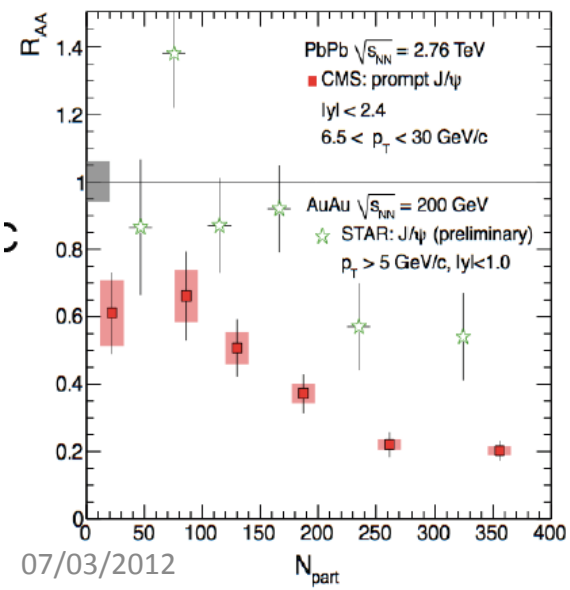
27

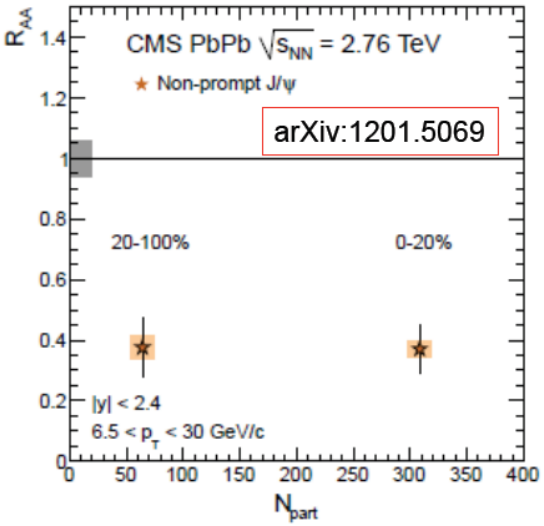
(about 30 people in audience and no chairperson!)

Heavy Ions





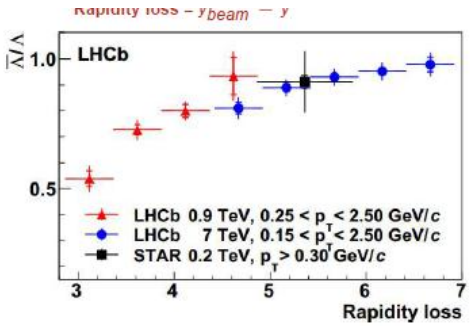




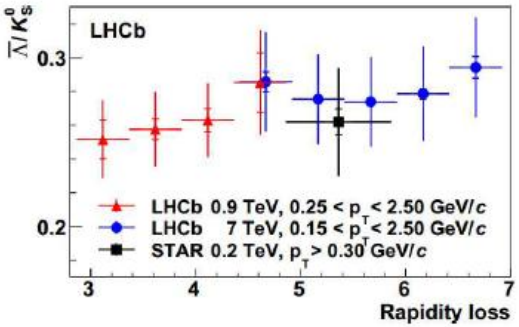
- First measurement in heavy-ion collisions
- J/ψ coming from B decay are strongly suppressed

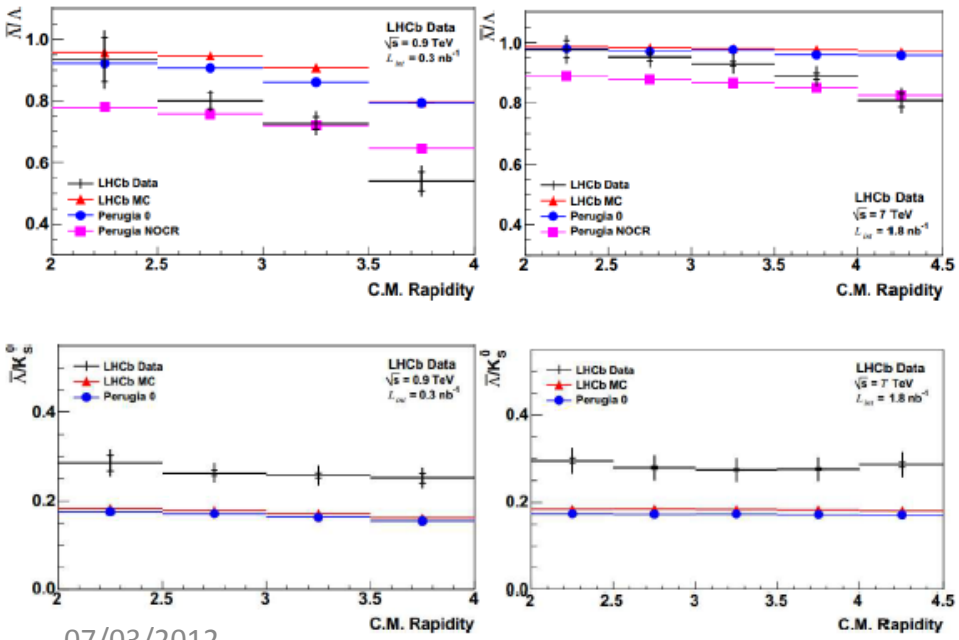
Production ratio: $\bar{\Lambda}/\Lambda$, $\bar{\Lambda}/K_S^0$

- $\bar{\Lambda}/\Lambda = \frac{\sigma(pp \to \Lambda X)}{\sigma(pp \to \Lambda X)}$ probes the baryon number transport.
- $\bar{\Lambda}/K_S^0 = \frac{\sigma(pp \to \bar{\Lambda} X)}{\sigma(pp \to K_S^0 X)}$ probes the strange baryon suppression.



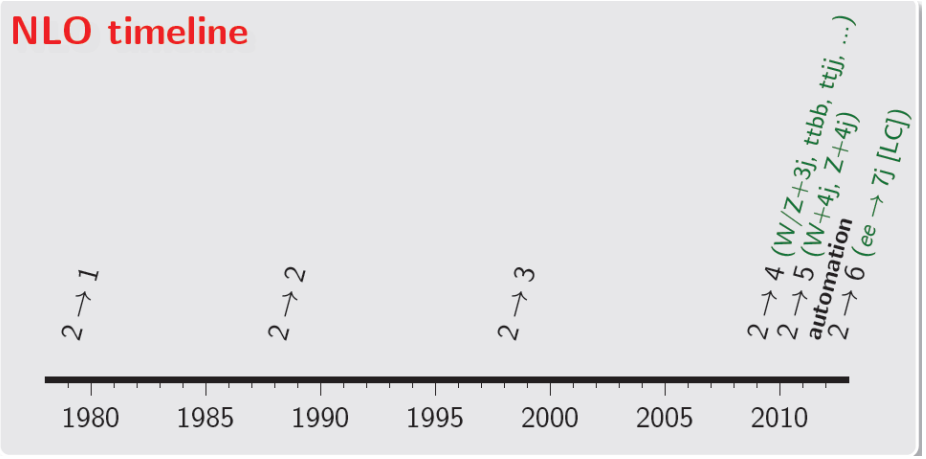
- Consistency between the two measurements ($\sqrt{s} = 900$ GeV and 7 TeV) and the previous results.

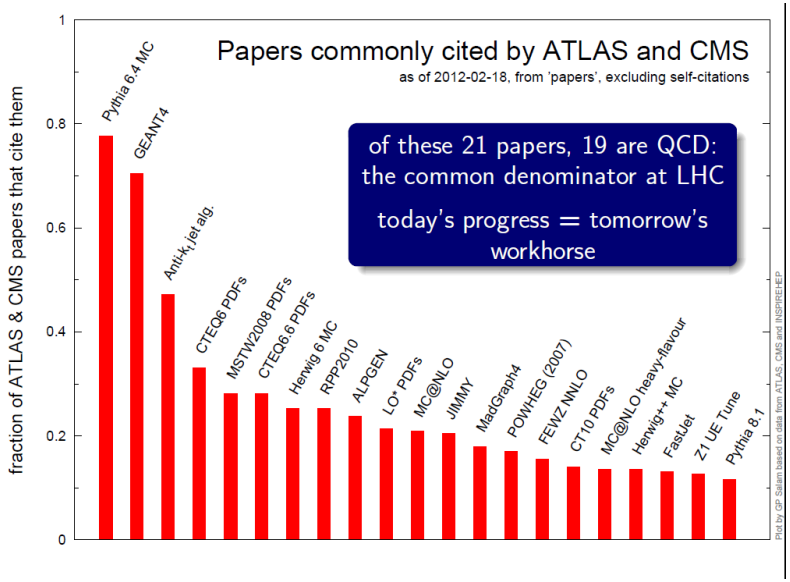




- $\bar{\Lambda}/\Lambda$: good agreement with Perugia0 at low rapidity while at high rapidity Perugia NOCR looks to be favoured.
- $\bar{\Lambda}/K_S^0$ measured ratio is significantly larger than predicted by the generators, i.e. more baryons are produced in strange hadronization than expected.

QCD



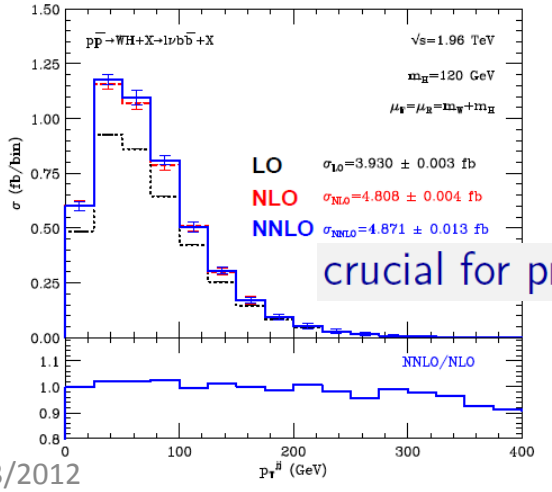


High precision — NNLO — is crucial for key processes, but not yet always available:

✓ W, Z, Higgs, $\gamma\gamma$, VBF, VH

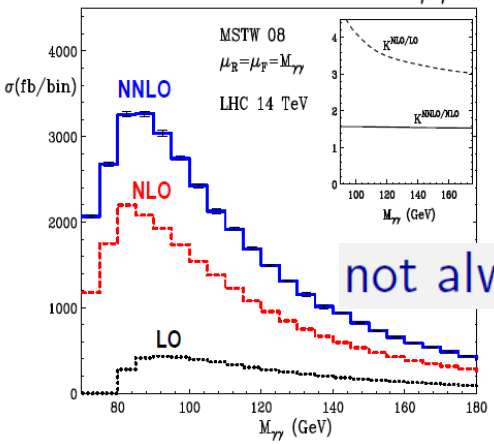
× VV, $t\bar{t}$, inclusive jets, etc.

New in 2011: **NNLO WH (differential)**



crucial for precision

New in 2011: **NNLO $\gamma\gamma$**



not always reassuring

Important also to develop methods so that we're less sensitive to limits on our precision.

Generally by finding ways to distinguish signals from the background more efficiently, i.e. increasing S/B.

BBC Mobile | News | Sport | Weather | Travel | TV | Radio | More | Search BBC News

NEWS SCIENCE & ENVIRONMENT

Home | UK | Africa | Asia | Europe | Latin America | Mid-East | US & Canada | Business | Health | Sci/Environment | Tech | Entertainment | Video

29 February 2012 Last updated at 17:40 GMT

690 Share

New twist in antimatter mystery

By Paul Rincon
Science editor, BBC News website

Physicists have taken a step forward in their efforts to understand why the Universe is dominated by matter, and not its shadowy opposite antimatter.

A US experiment has confirmed previous findings that hinted at phenomena outside our understanding of physics.

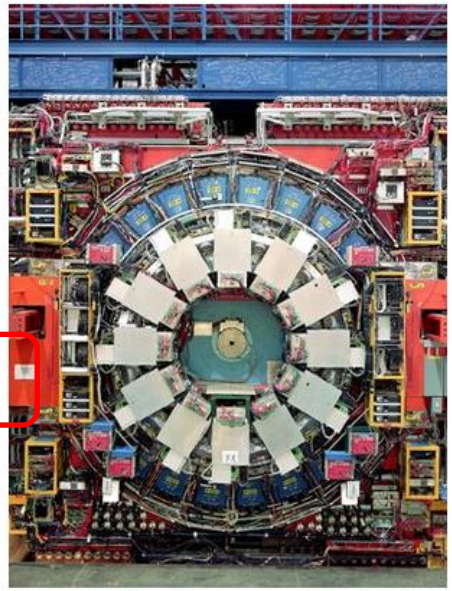
The results show that certain matter particles decay differently from their antimatter counterparts.

Such differences could potentially help explain why there is so much more matter in the cosmos than antimatter.

The findings from scientists working on the CDF experiment have been presented at a particle physics meeting in La Thuile, Italy.

CDF was one of two multi-purpose experiments at the now-defunct Tevatron particle smasher in Illinois.

Physicists think the intense heat of the Big Bang should have forged equal amounts of matter and its "mirror image" antimatter. Yet today we live in a Universe composed overwhelmingly of matter.



CDF was one of two multi-purpose experiments at the US Tevatron accelerator near Chicago

Top Stories

New Homs delay for Red Cross aid

US clears up after tornado havoc

Brazil to boycott Fifa official

BP reaches $7.8bn oil spill deal

Capsized Costa ship hearing opens

Features & Analysis

Trees or SUVs
Five interpretations of Dr Seuss's The Lorax

Tough times
Power cuts and candle shortages blight daily life in Syria

52 mouths to feed
How many orphans could you take into your home?

Year of change
John Simpson on new leadership among key powers

http://www.bbc.co.uk/news/world-middle-east-17243779 | Local intranet | Protected Mode: Off | 100%

CP violation

CDF updated ΔA_{CP} using full runII dataset
(LHCb result shown in PPD seminar last week)

- New CDF result confirms LHCb result: same resolution, <1σ difference in central value

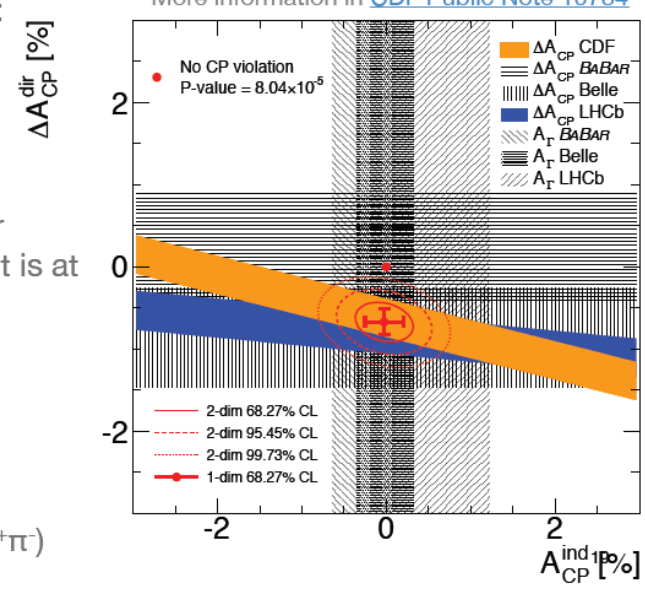
  $\Delta A_{CP}(LHCb) = [-0.62 \pm 0.21 \pm 0.10]\%$

- When combining à la HFAG with other available measurements, no CPV point is at ~3.8σ and

$$\Delta A_{CP}^{dir} = (-0.67 \pm 0.16)\%$$
$$A_{CP}^{ind} = (-0.02 \pm 0.22)\%$$

- CDF will also produce separate measurements of $A_{CP}(K^+K^-)$ and $A_{CP}(\pi^+\pi^-)$

More information in CDF Public Note 10784



Results $B_s^0 \to J/\psi\phi$

Most precise measurements:

$\Gamma_s = 0.656 \pm 0.009$ (stat)± 0.008 (syst) ps^{-1}

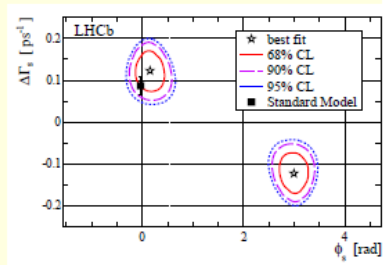
$\phi_s = 0.15 \pm 0.18$ (stat)± 0.07 (syst) rad

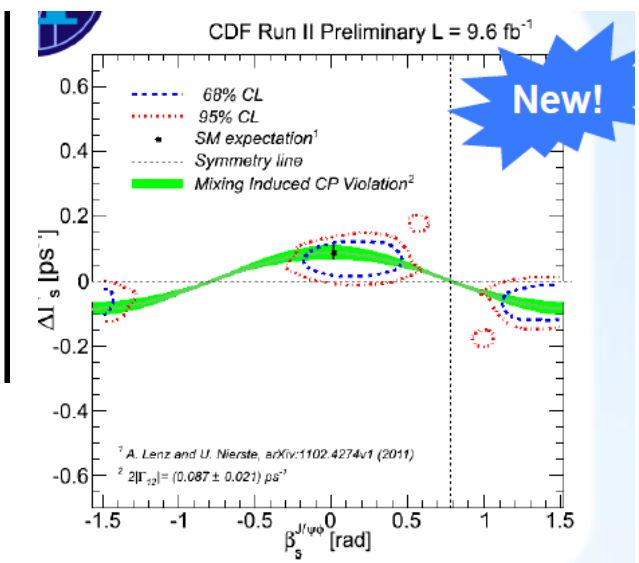
$\Delta\Gamma_s = 0.123 \pm 0.029$ (stat)± 0.011 (syst) ps^{-1}

First direct evidence of non-zero $\Delta\Gamma_s$

2 solutions, 1 in agreement with SM prediction

→ Current uncertainties still leave room for New Physics





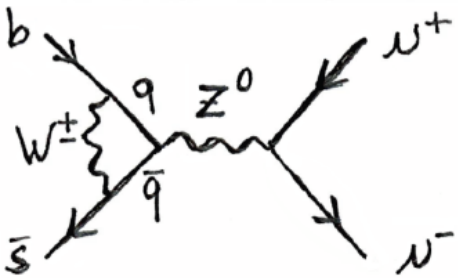
COMBINATION OF $B_s^0 \to J/\psi\phi$ AND $B_s^0 \to J/\psi f_0$

$$\phi_s = 0.03 \pm 0.16(\text{stat}) \pm 0.07(\text{syst}) \text{ rad}$$

Rare Decays

sensitive to NP

- Z-penguin suppressed diagram
  doubly suppressed : FCNC & helicity



- SM-expected Branching Ratio :

$$B_{SM}(B_s \to \mu^+\mu^-) = (3.64^{+0.17}_{-0.31}) \times 10^{-9}$$

$$B_{SM}(B_d \to \mu^+\mu^-) = (1.13^{+0.06}_{-0.11}) \times 10^{-10}$$

[The CKMFitter group - hep-ph 1106.4041]

Previously..

Experimental status

- CDF $Br(B_s \to \mu\mu) = 1.8^{+1.1}_{-0.9} \times 10^{-8}$ PRL107, 191801 (2011)
- DØ $Br(B_s \to \mu\mu) < 5.1 \times 10^{-8}$ @95% C.L. PLB693, 539 (2010)
- LHCb $Br(B_s \to \mu\mu) < 1.4 \times 10^{-8}$ @95% C.L. PLB 708, 55 (2012)
- CMS $Br(B_s \to \mu\mu) < 1.9 \times 10^{-8}$ @95% C.L. PRL107, 191802 (2011)

7→10 fb^{-1}

NEW at La Thuile

$BR(B_s \to \mu^+\mu^-) = (1.3^{+0.9}_{-0.7}) \times 10^{-8}$

$0.8 \times 10^{-9} < BR(B_s \to \mu^+\mu^-) < 3.4 \times 10^{-8}$ 95% C.L.

0.37→1 fb^{-1}

MORIOND 13 th March

$BR(B_s \to \mu\mu) < 4.5 \times 10^{-9}$ @ 95% C.L.

1.14→4.9 fb^{-1}

CERN seminar 6th March

$BR(B_s \to \mu\mu) < 7.7 \times 10^{-9}$ @ 95% C.L.

ATLAS:

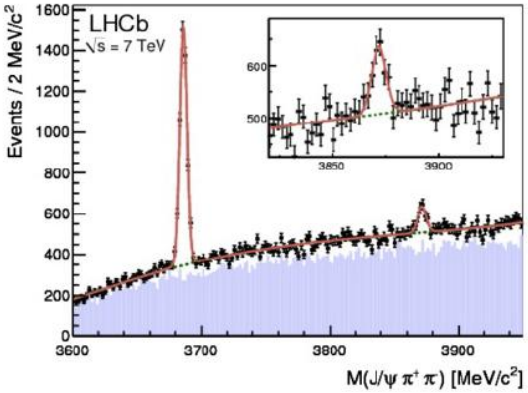
2.4 fb^{-1}

CERN seminar13th March

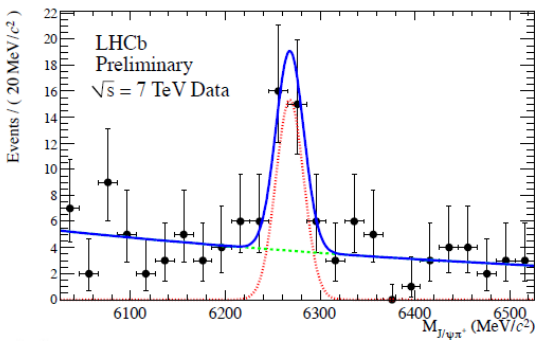
$BR(B_s \to \mu\mu) < 2.2 \times 10^{-8}$ @ 95% C.L.

Lots of other B physics

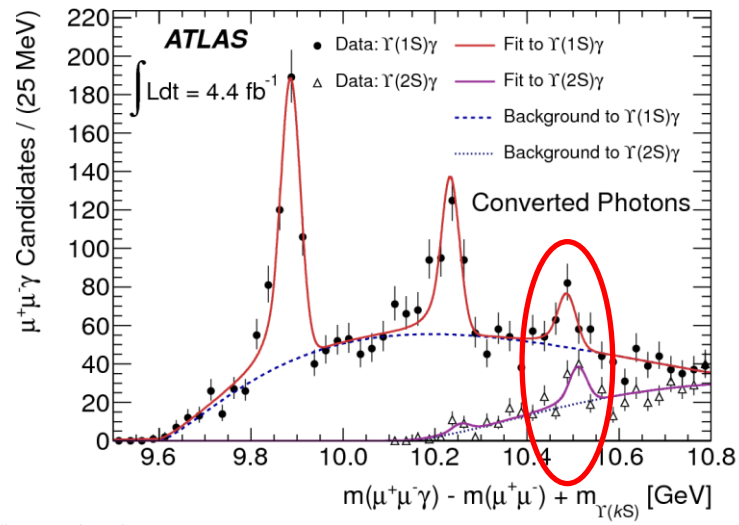
$M_{X(3872)}$ = 3871.95 ± 0.48 (stat) ± 0.12 (syst) MeV



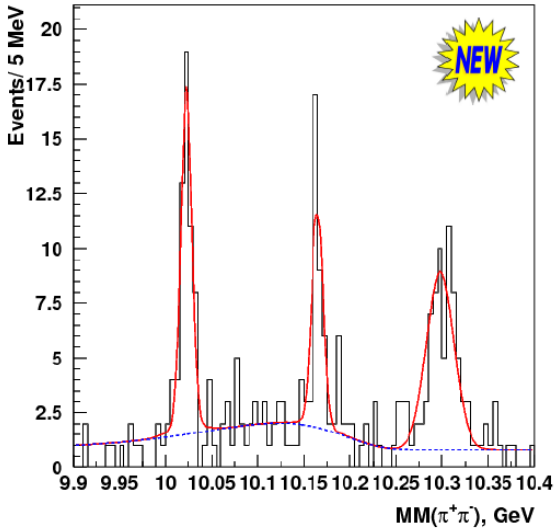
$M(B_c^+)$ = 6268.0±4.0(stat)±0.6(syst) MeV



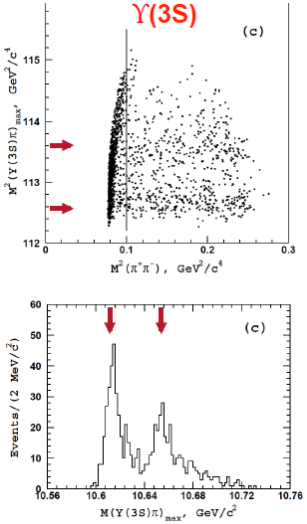
Mass (χ_b(3P)) = 10.530 ± 0.005 (stat.) ± 0.009 (syst) GeV



Observation of Y(5S)→Y(1D)$\pi^+\pi^-$



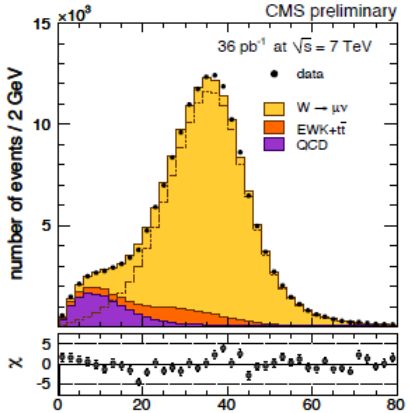
Discovery of Z_b

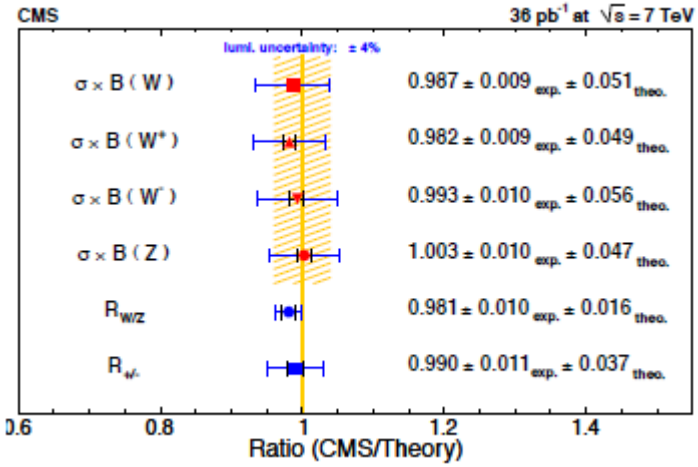


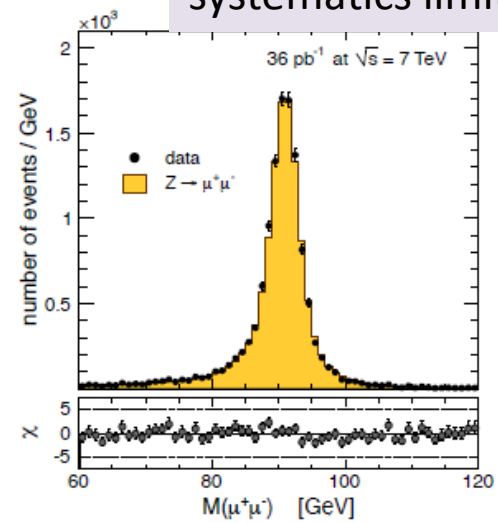
Electroweak

W/Z @ LHC

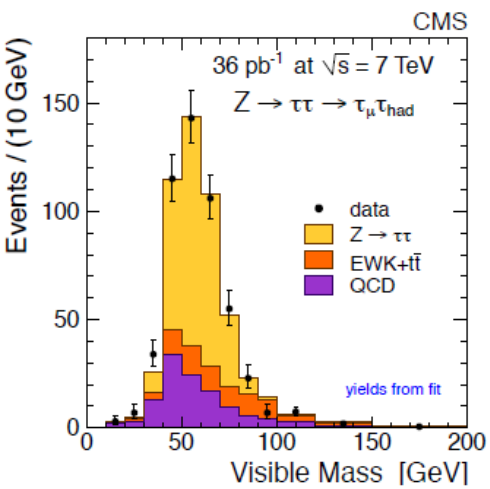
systematics limited

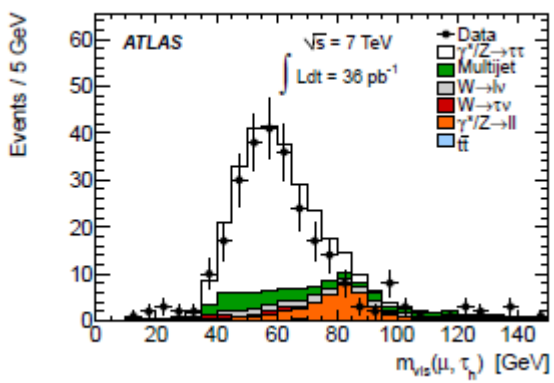


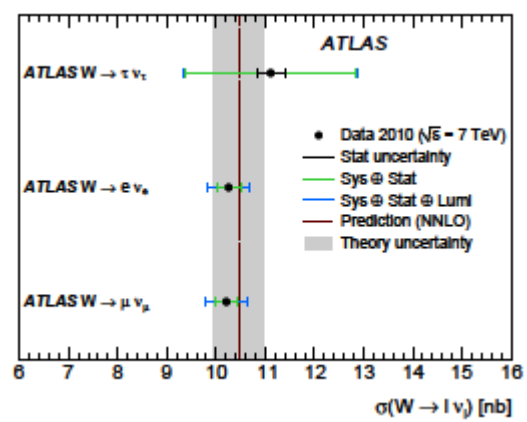




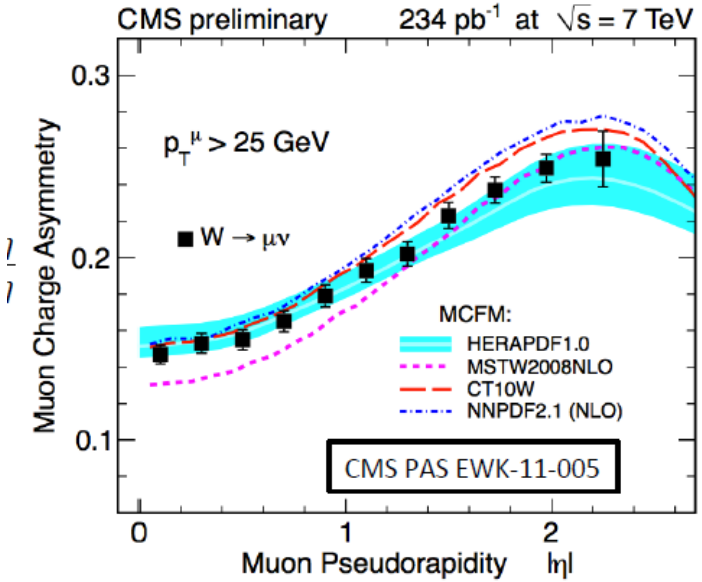
τ channels still statistics limited

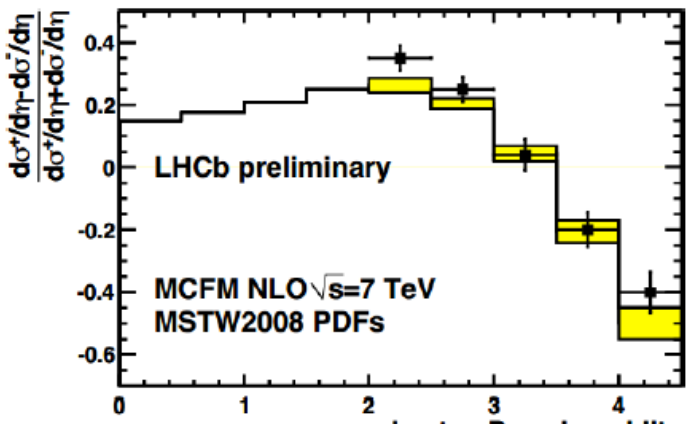






W charge asymmetry



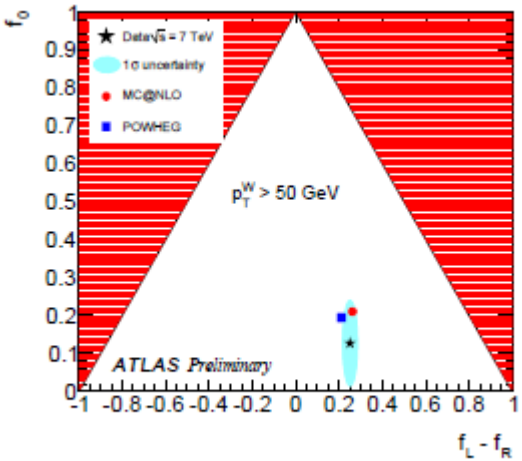


- Asymmetry changes sign in the forward region.
- In this region, PDF uncertainty on A_W is of the order of 2 - 8% (MSTW2008NLO, 68%C.L.)
- LHCb measurements already constrain PDFs with present analysis (analysis of the 2011 data ongoing).

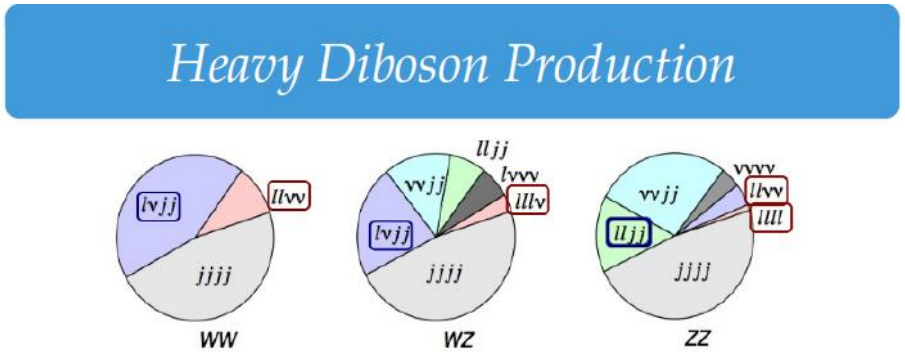
Good agreement with HERAPDF
More flat than MSTW (χ^2=5.3), CT10 (χ^2=2.1), NNPDF (χ^2=4.1)
Provides significant constraints to the PDF global fits

W polarisation measurements

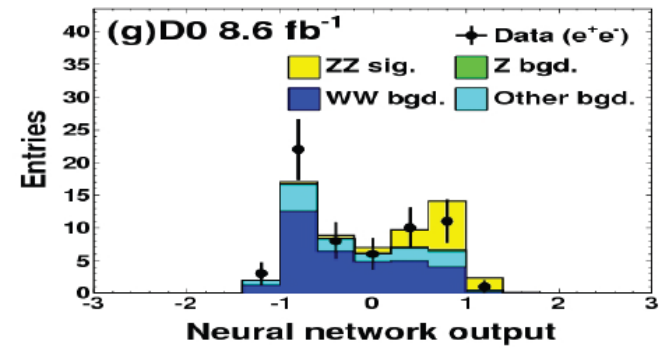
$$f_L + f_R + f_0 = 1.$$



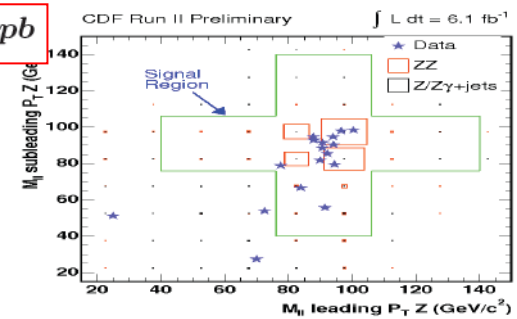
Di-bosons @ Tevatron



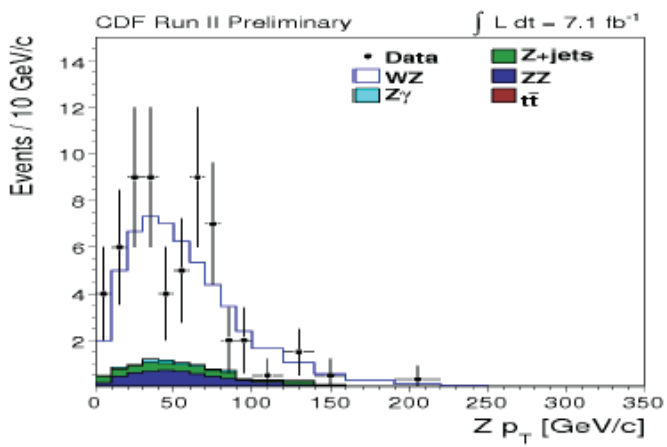
$\sigma(ZZ) = 1.64 \pm 0.44(stat.)^{+0.13}_{-0.15}(syst.)\ pb\ (SM = 1.30 \pm 0.10\ pb)$



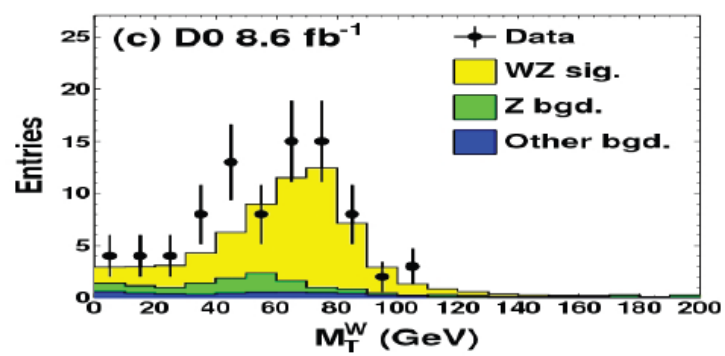
$\sigma(ZZ) = 1.64^{+0.44}_{-0.38}\ pb$



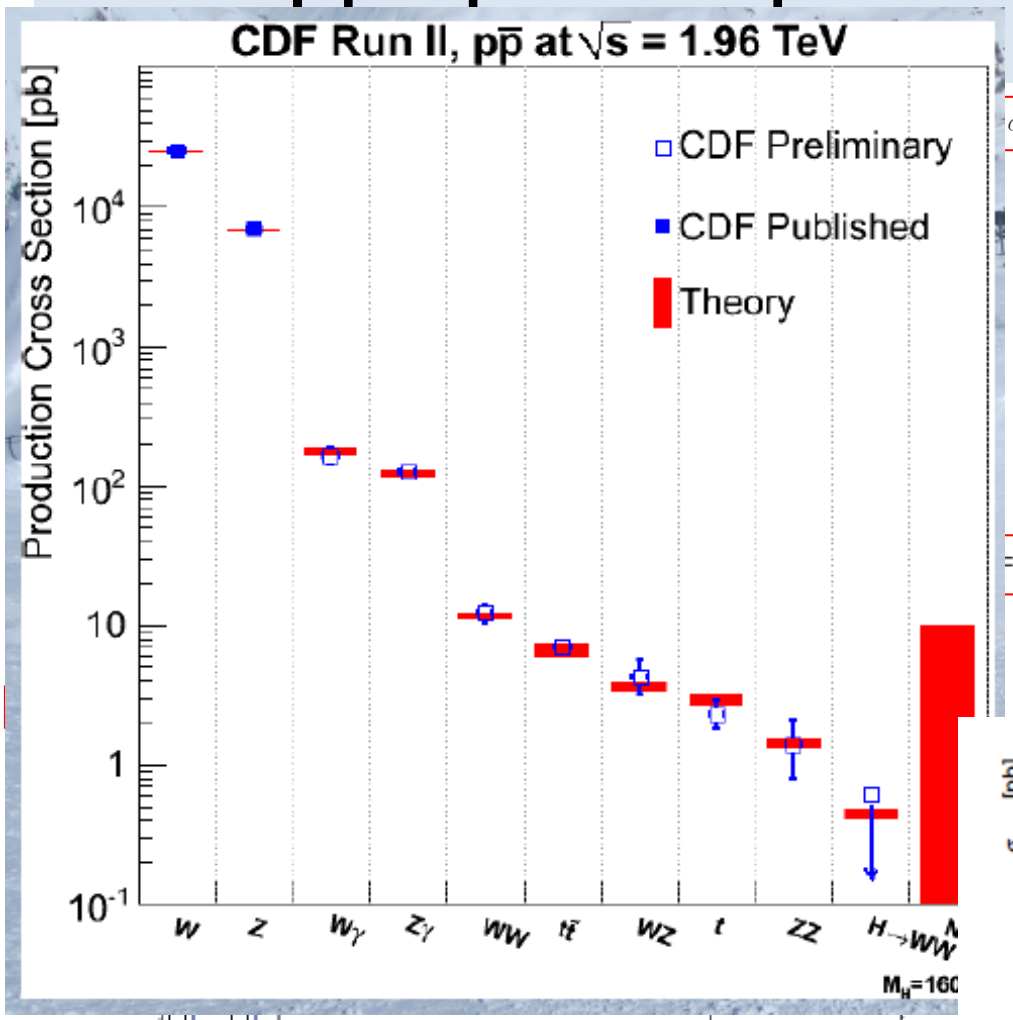
$\sigma(WZ) = 3.9^{+0.6}_{-0.5}(stat.)^{+0.6}_{-0.4}(syst)pb\ (SM\ = 3.46 \pm 0.21pb)$



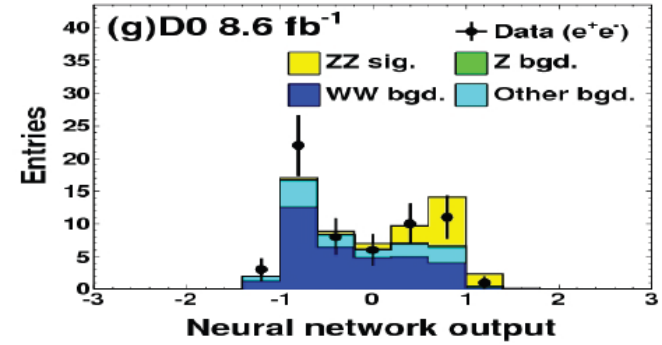
$\sigma(WZ) = 4.50 \pm 0.61(stat.)^{+0.16}_{-0.25}(syst.)\ pb$



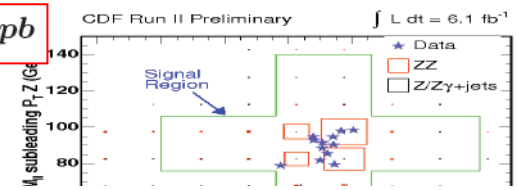
Di-bosons @ Tevatron

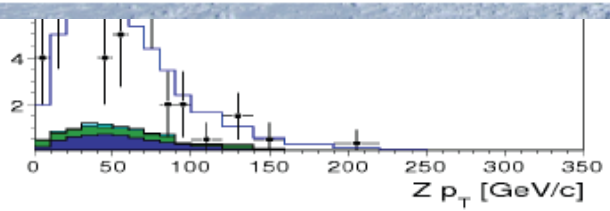


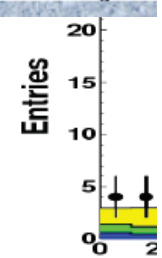
$\sigma(ZZ) = 1.64 \pm 0.44(stat.)^{+0.13}_{-0.15}(syst.)\ pb\ (SM = 1.30 \pm 0.10\ pb)$

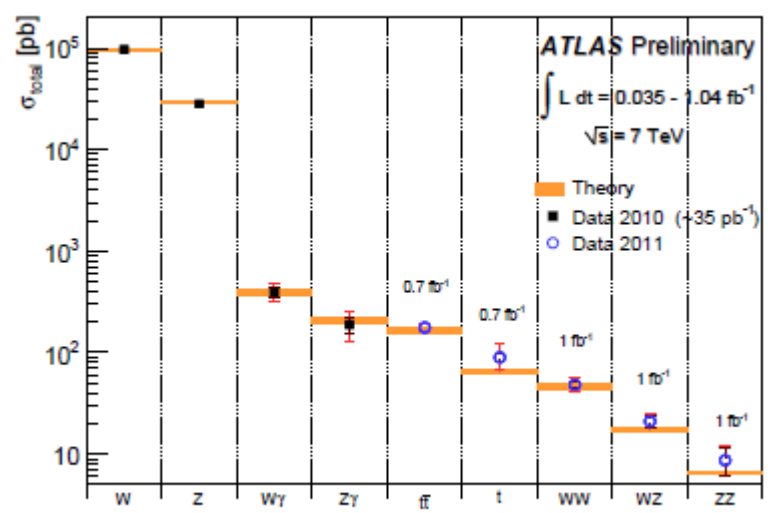


$= 1.64^{+0.44}_{-0.38}\ pb$

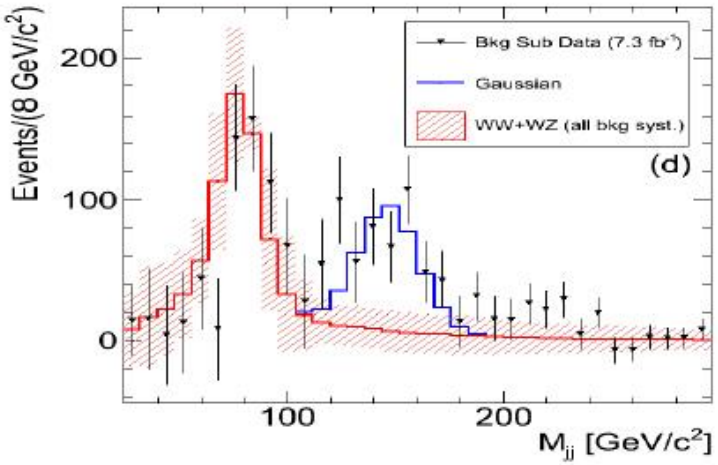






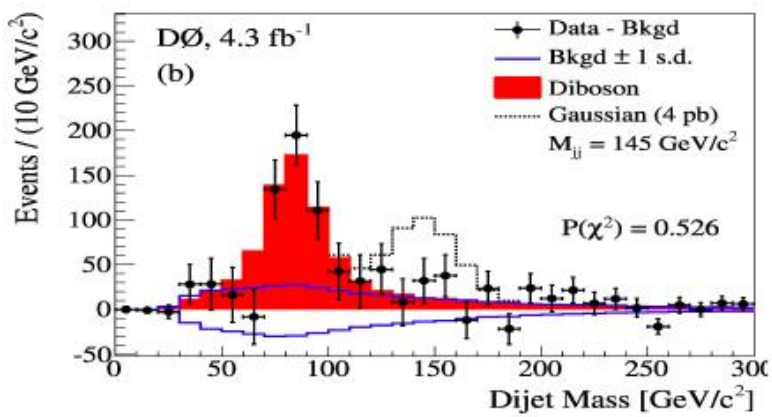


Wjj anomalous production



- **4.1σ excess seen in dijet mass spectrum of W+2jet sample**
  - Binned χ^2 fit to Mjj distribution consistent with $\sigma = 3.0pb \pm 0.7$
  - Many cross checks performed: various bkg control regions, W+jets modelling etc
- PHYS. REV. LETT. 106, 171801 (2011), and Public Webpage

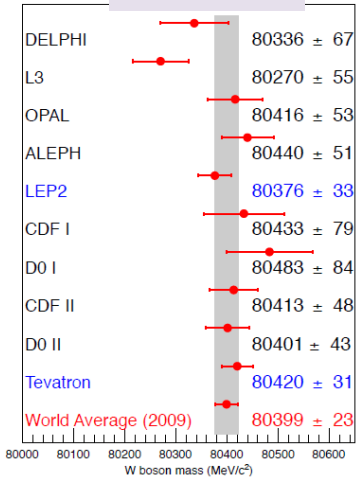
- DØ repeated CDF analysis → with some minor differences
- **No significant discrepancy w.r.t. background model**
- Results are 2.5 σ apart
- Phys.Rev.Lett. 107 (2011) 011804



- **S/B 10x worse at LHC**
- **Hard to understand $W+$ jets at that level**

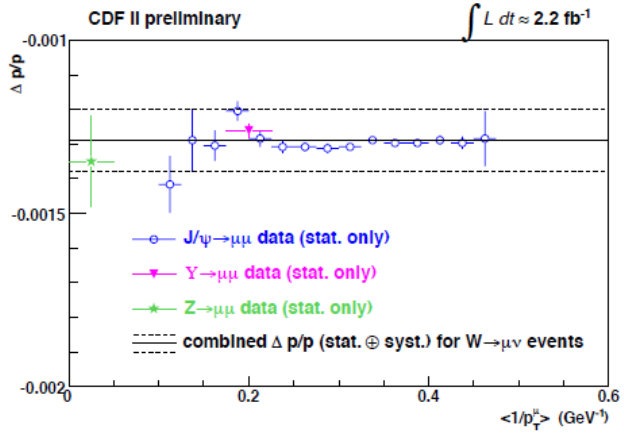
New W mass from CDF

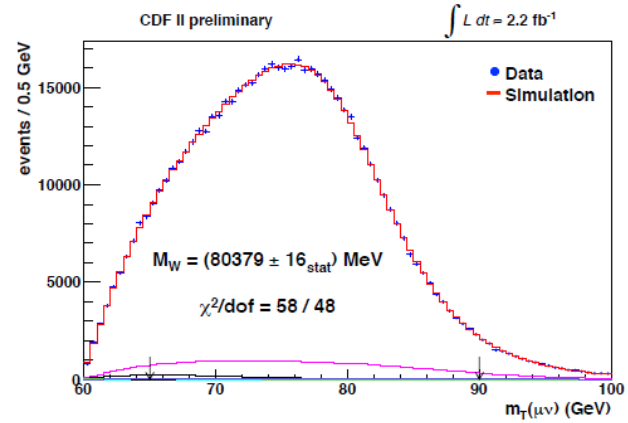
Previously



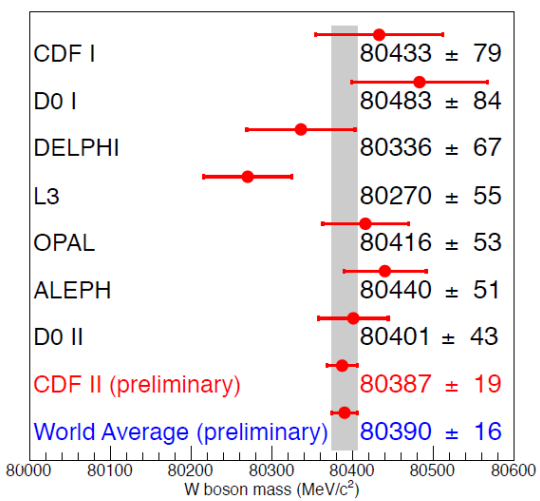
SM Fit $M_H = 92^{+34}_{-26}$ GeV

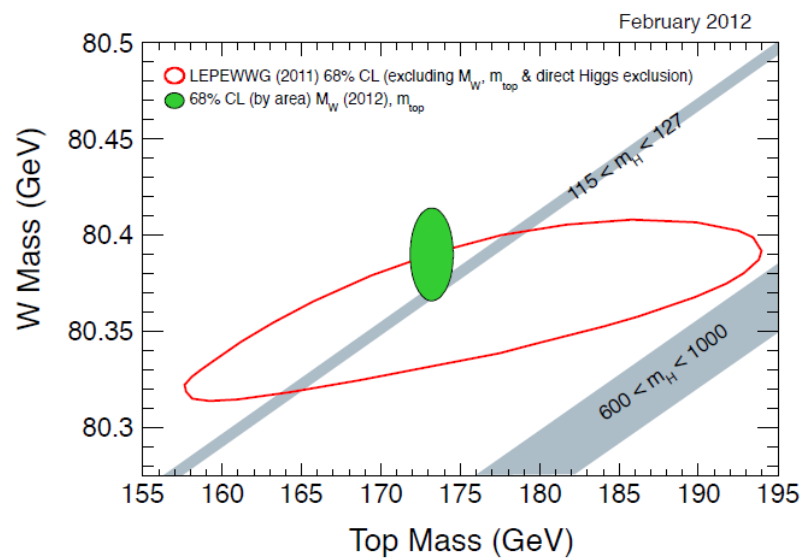
$M_H < 161$ GeV @95% CL





$$M_W = 80387 \pm 12_{stat} \pm 15_{syst}\ \mathrm{MeV}/c^2$$





$M_H = 90^{+29}_{-23}$ GeV

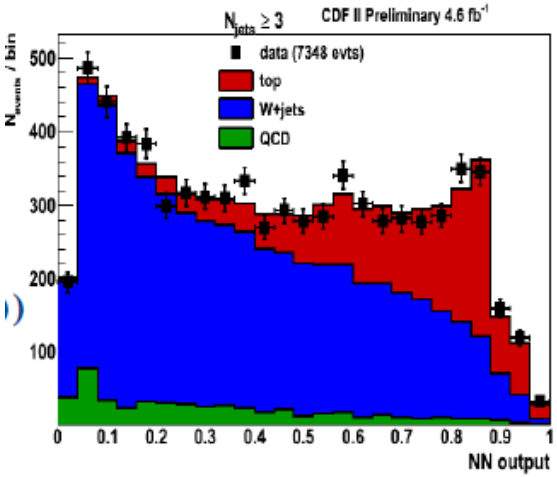
$M_H < 145$ GeV @95% CL

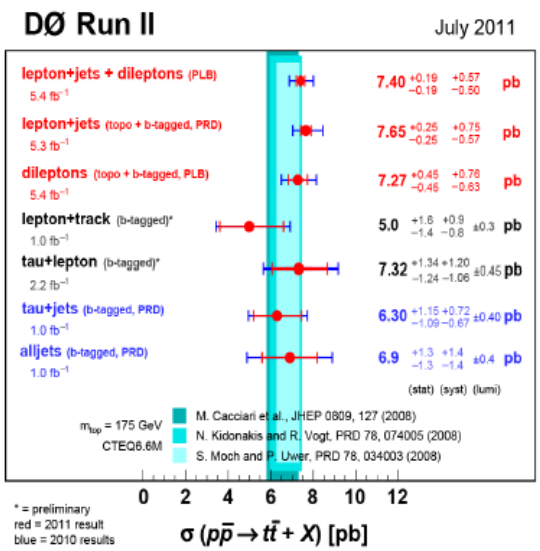
Top physics

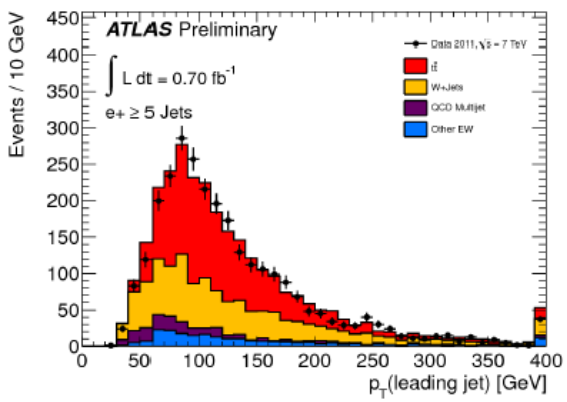
- **D0 l+jets 5.3fb^{-1}:**
  $\sigma_{t\bar{t}} = 7.78\ ^{+0.77}_{-0.64}$ (stat+sys) pb
- **CDF l+jets 4.6 fb^{-1}:**
  $\sigma_{t\bar{t}} = 7.82 \pm 0.55$ (stat+sys) pb

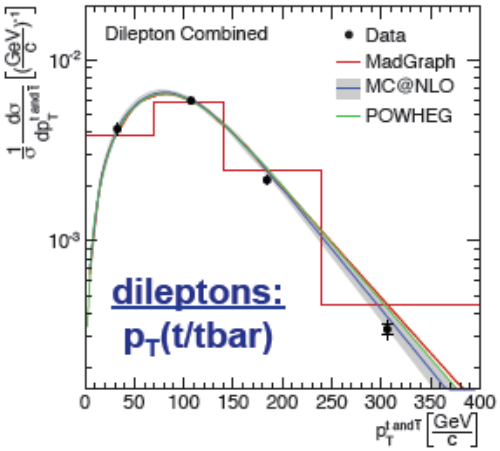
with a theoretical NNLO$_{approx}$ cross section of

- $_{top}$ •• •7.46 pb @ m_{top} = 172.5 GeV (PRD 78, 034003 (2008))









$\sigma_{t\bar{t}} = 179.0 \pm 9.8(\text{stat.} + \text{syst.}) \pm 6.6(\text{lumi.})$ pb

CMS combined 2011:

CMS Preliminary

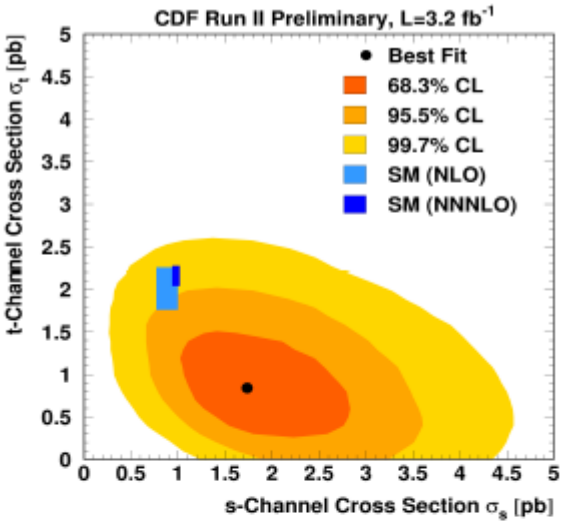
$\sigma_{t\bar{t}} = 165.8 \pm 2.2(\text{stat.}) \pm 10.6(\text{syst.}) \pm 7.8(\text{lumi.})$ pb

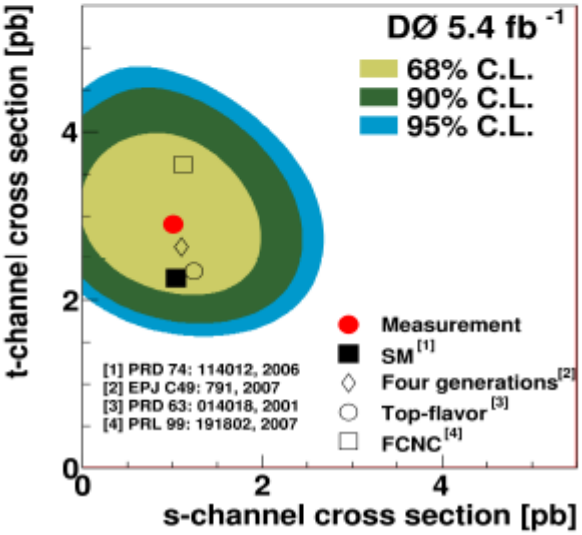
Single top @ tevatron

Separate t- and s- Channel Production

- 2-dimensional measurement of s- and t-channel
  - t-channel sensitive to anomalous couplings
  - s-channel sensitive to resonances
- strategy: train separately for s- and t-chanel
- CDF 3.2 fb^{-1}:
  - σ (t) = 0.8 ± 0.4 pb (PRD 82, 112005 (2009))
  - σ (s) = $1.8^{+0.7}_{-0.5}$ pb
- D0 5.4 fb^{-1}:
  - σ (t) = 2.90 ± 0.59 pb (PLB 705, 313 (2011))
  - σ (s) = 0.98 ± 0.63 pb
- t-channel observation with 5.5 σ at D0
  - main systematics from background

LHC also starting to show results

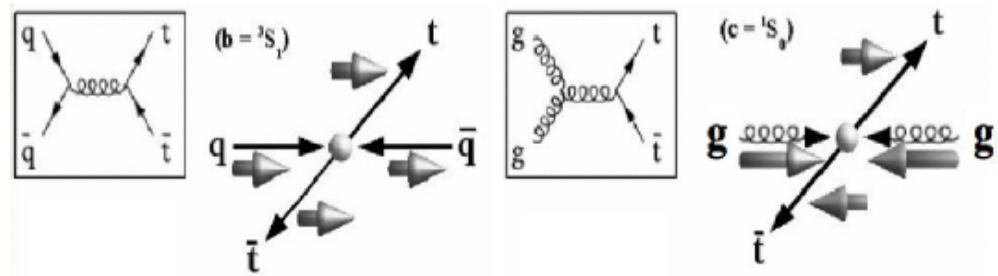




Spin Correlation

- even tops are not produced in polarized state, the spins are correlated
- the correlation strength A

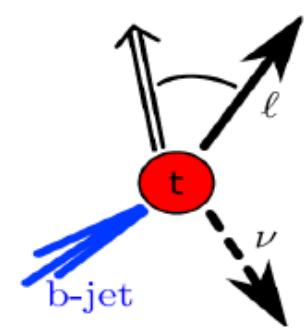
$$A = \frac{N_{\uparrow\uparrow} + N_{\downarrow\downarrow} - N_{\uparrow\downarrow} - N_{\downarrow\uparrow}}{N_{\uparrow\uparrow} + N_{\downarrow\downarrow} + N_{\uparrow\downarrow} + N_{\downarrow\uparrow}}$$



  - depends on the production mode → different for Tevatron and LHC
  - choice of spin basis (here beam basis)
- due to the short top lifetime the spin does not flip and is reflected in the angular distributions of the decay products

$$\frac{1}{\sigma}\frac{d\sigma}{d\cos\theta_i} = \frac{1}{2}(1 + \alpha_i \cos\theta_i)$$

with $\alpha = 1$ for charged leptons and down-type quarks



- thus spin correlation can be measured by studying e.g.

$$\frac{1}{\sigma}\frac{d^2\sigma}{d\cos\theta_1\, d\cos\theta_2} = \frac{1}{4}(1 - C\cos\theta_1\cos\theta_2)$$

$$\text{where } C = A\,\alpha_1\alpha_2$$

Spin Correlation

- even tops are not produced in polarized state, the spins are correlated
- the correlation strength A

- D0 5.4 fb^{-1} dilepton :

  C_{beam} = 0.57 ± 0.31 (stat+syst)

- D0 5.3 fb^{-1} l+jets :

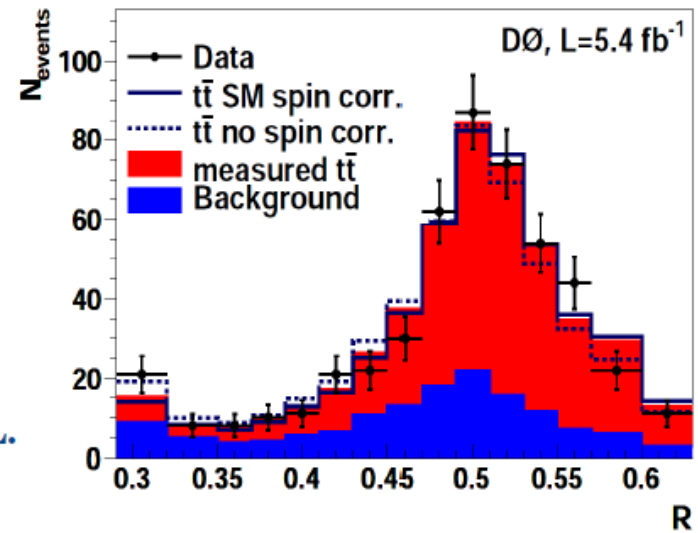
  C_{beam} = 0.89 ± 0.33 (stat+syst)

- 30% increased sensitivity
- excellent agreement with SM
- combining statistically independent results:

  C_{beam} = 0.66 ± 0.23 (stat+syst)

  - C < 0.26 @ 95% C.L. and C < 0.04 @ 99.7% C.L.
  - C= 0 @ 3.1 σ SD (PRL 108, 032004 (2012))

=> first evidence for non-vanishing spin correlation !

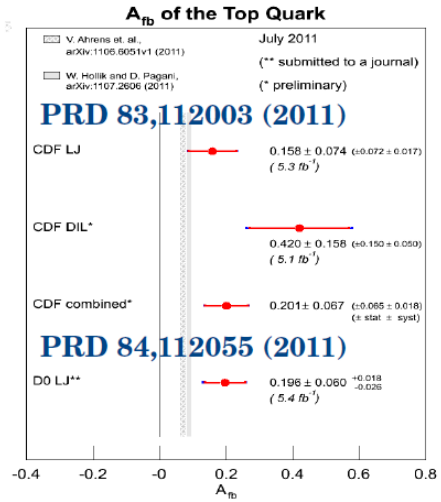


- thus spin correlation can be measured by studying e.g.

$$\frac{1}{\sigma}\frac{d^2\sigma}{d\cos\theta_1\, d\cos\theta_2} = \frac{1}{4}\left(1 - C\cos\theta_1\cos\theta_2\right)$$

$$\text{where } C = A\,\alpha_1\alpha_2$$

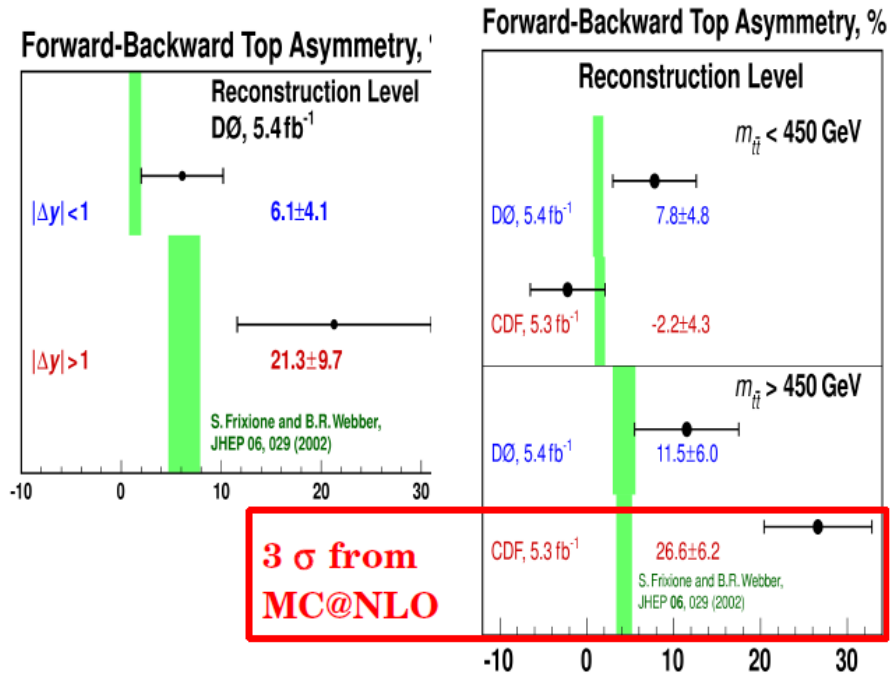
Top Asymmetry A_{fb}



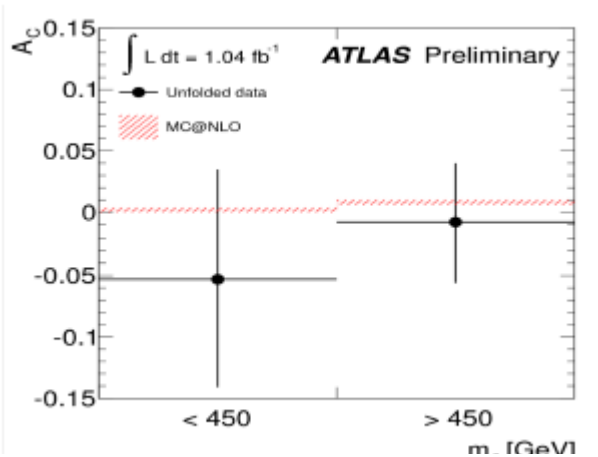
- measurements higher than prediction
- even larger difference for A_{fb}^{l}:
  - D0 l+jets: $A_{fb}^{l} = 14.2 \pm 3.8\ \%$ where MC@NLO : $A_{fb}^{l} = 0.8 \pm 0.6\ \%$
  - CDF dilepton: $A_{fb}^{\Delta\eta(l)} = 21 \pm 7\ \%$

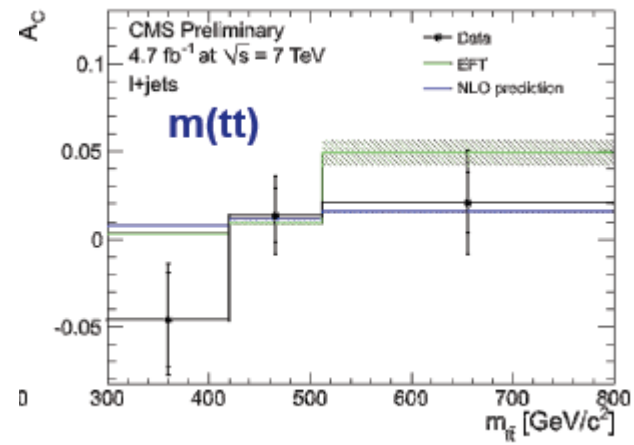
asymmetry depends on several variables like $m_{t\bar{t}}$, $|y|$

- e.g. new physics could lead to a different mass dependency



.... And at LHC





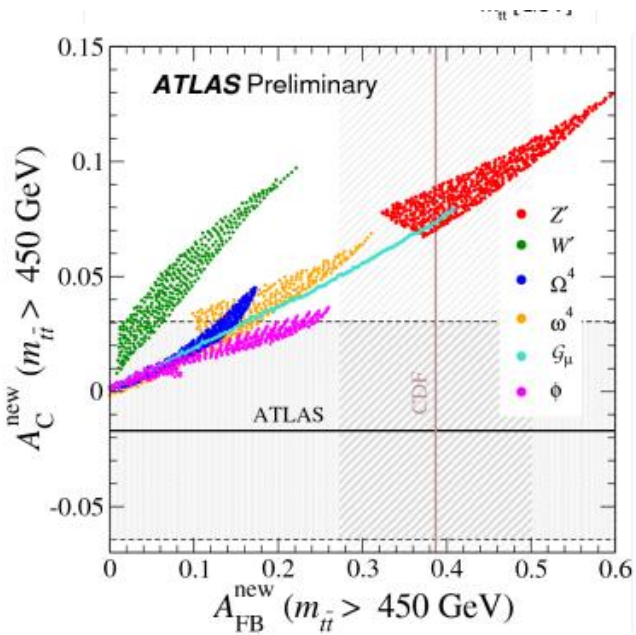
Final corrected	0.004 ± 0.010 (stat.) ± 0.012 (syst.)
Theory prediction (SM)	0.0115 ± 0.0006

Result:

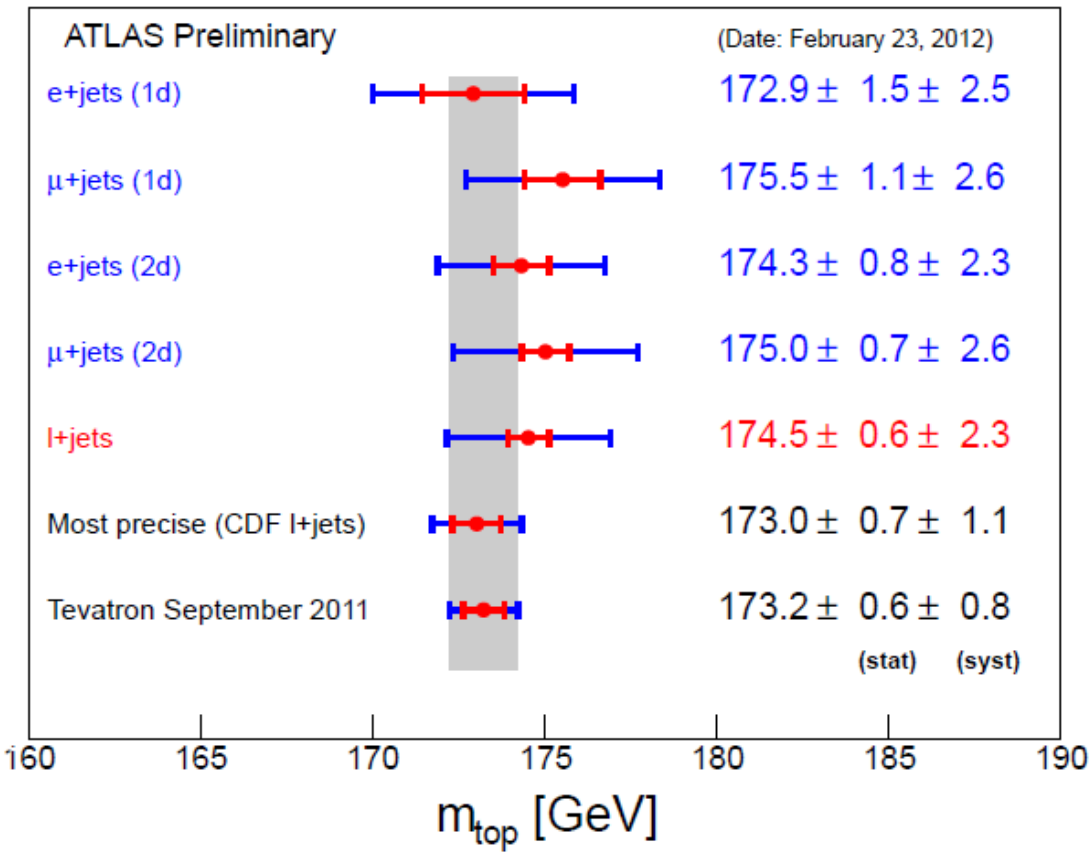
$$A_C = -0.018 \pm 0.028\ (\text{stat}).\ \pm 0.023\ (\text{syst.})$$ [a]

- **consistent with the SM value** of $A_C^{pp} = 0.006 \pm 0.002$

- **limits on allowed A_C(LHC) and A_{FB}(Tevatron) regions** can constrain some models proposed to explain the Tevatron A_{FB}



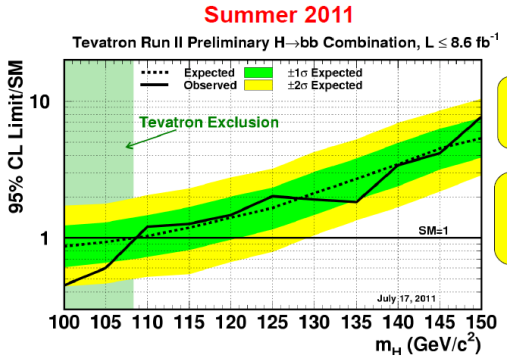
Top Mass



- reduction of the systematics uncertainty needed to reach Tevatron measurement uncertainty.
- Challenging, but there is a lot of space for improvement wrt. currently published measurement, incl. reducing JES, MC modelling uncertainties, reducing MC stats. effects by generating huge samples . . .

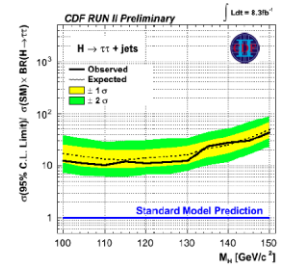
HIGGS - Tevatron

Limits for $H \rightarrow b\bar{b}$



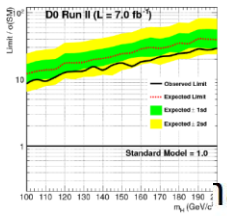
New results coming very soon

Searches with Taus



Limits at M_H = 115 GeV:
Exp: 13 × σ_{SM}
Obs: 12 × σ_{SM}

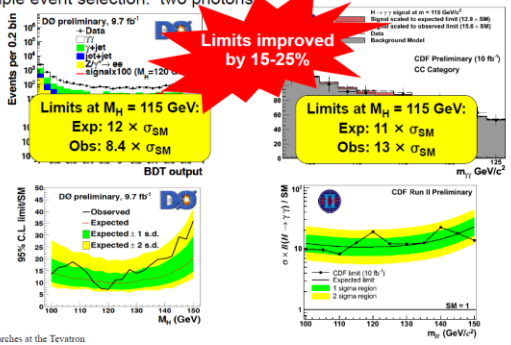
15% improvement In limits

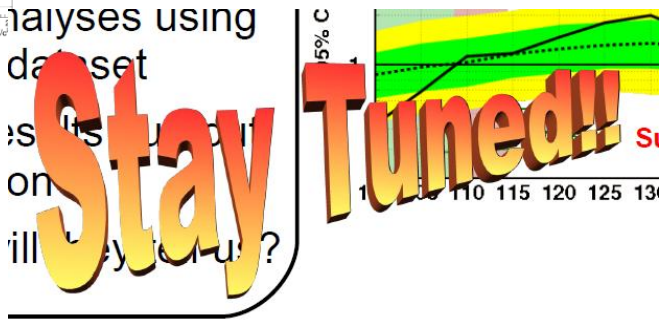


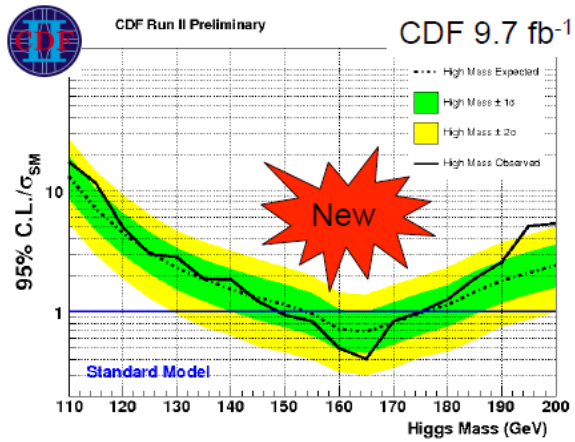
Limits at M_H = 115 GeV:
Exp: 14 × σ_{SM}
Obs: 11 × σ_{SM}

Diphoton final states

Simple event selection: two photons







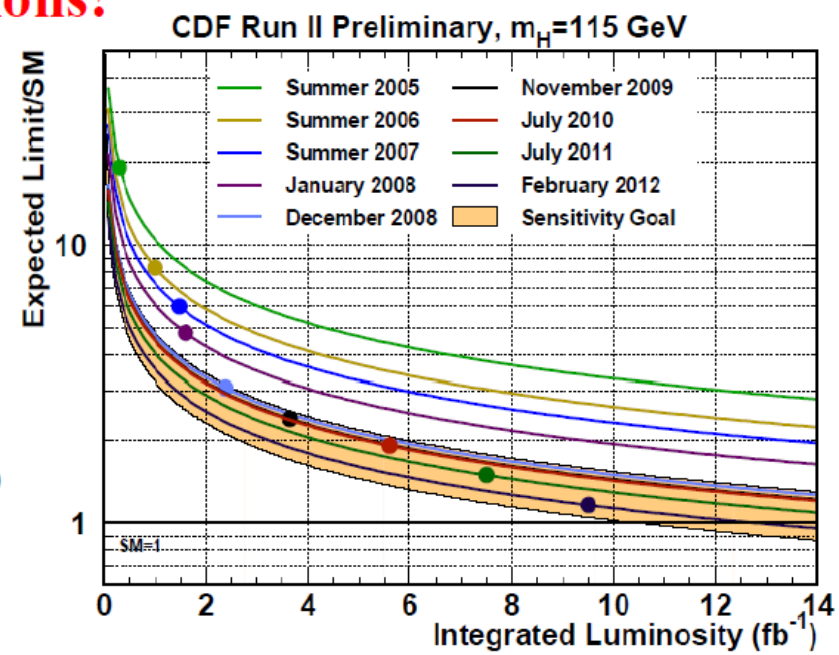
High mass search updated: 12% better at 165 GeV

CDF Sensitivity close to TeV sensitivity in July2011.

CDF gave us a taste of what is to come??

Conclusions

- The CDF Collaboration has produced Higgs searches with expected sensitivities
  a factor of 2 better than 2007
  beyond luminosity additions!
- CDF is sensitive to <√2xSM Everywhere
  - 2XCDF would have >25% chance of 3-sigma!
- Tevatron Leads in H→bb
- The Tevatron full dataset combined Higgs search will be exciting!

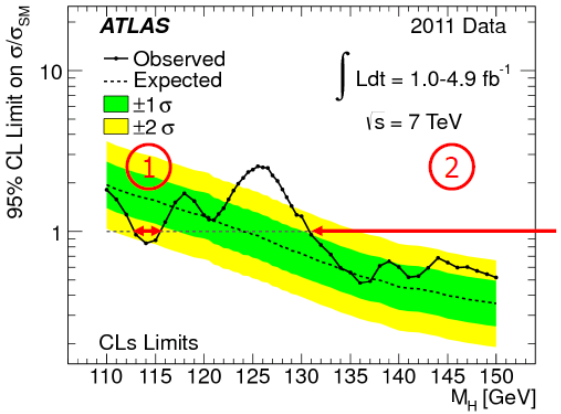


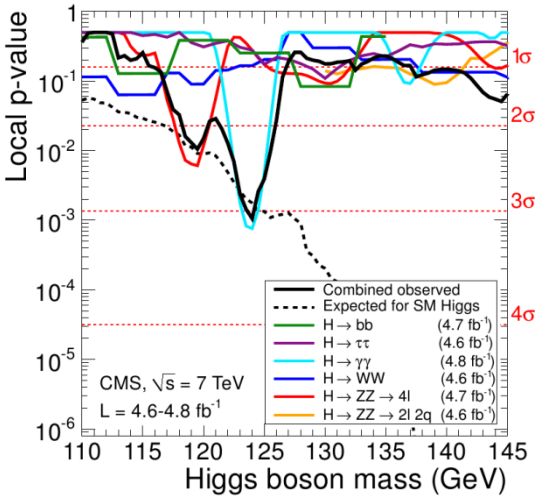
- Release observed limits next Weds at Moriond!
- Tevatron Combination talk at Moriond EWK by Wade Fisher!

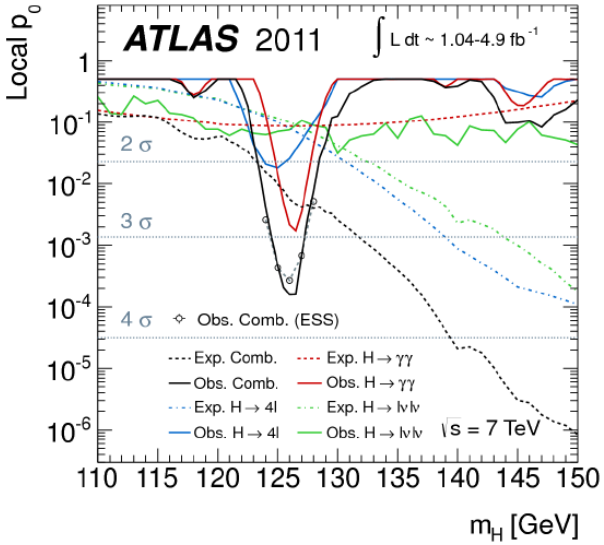
2xCDF Preliminar

HIGGS - LHC

- **Higgs search at LHC/ATLAS is very exciting now!**
  - ATLAS still have several channels (WW/ττ/bb etc) to be updated.
  - -> Wait for new results until Morinod conf.
- In the low mass region, we have a small un-excluded mass window of **115.5-131GeV.**
- Small excess around 126GeV is real? -> **No conclusion at the moment**
  - -> Still ~2-3 sigma level with the look elsewhere effect.
  - -> We need more data in this year.



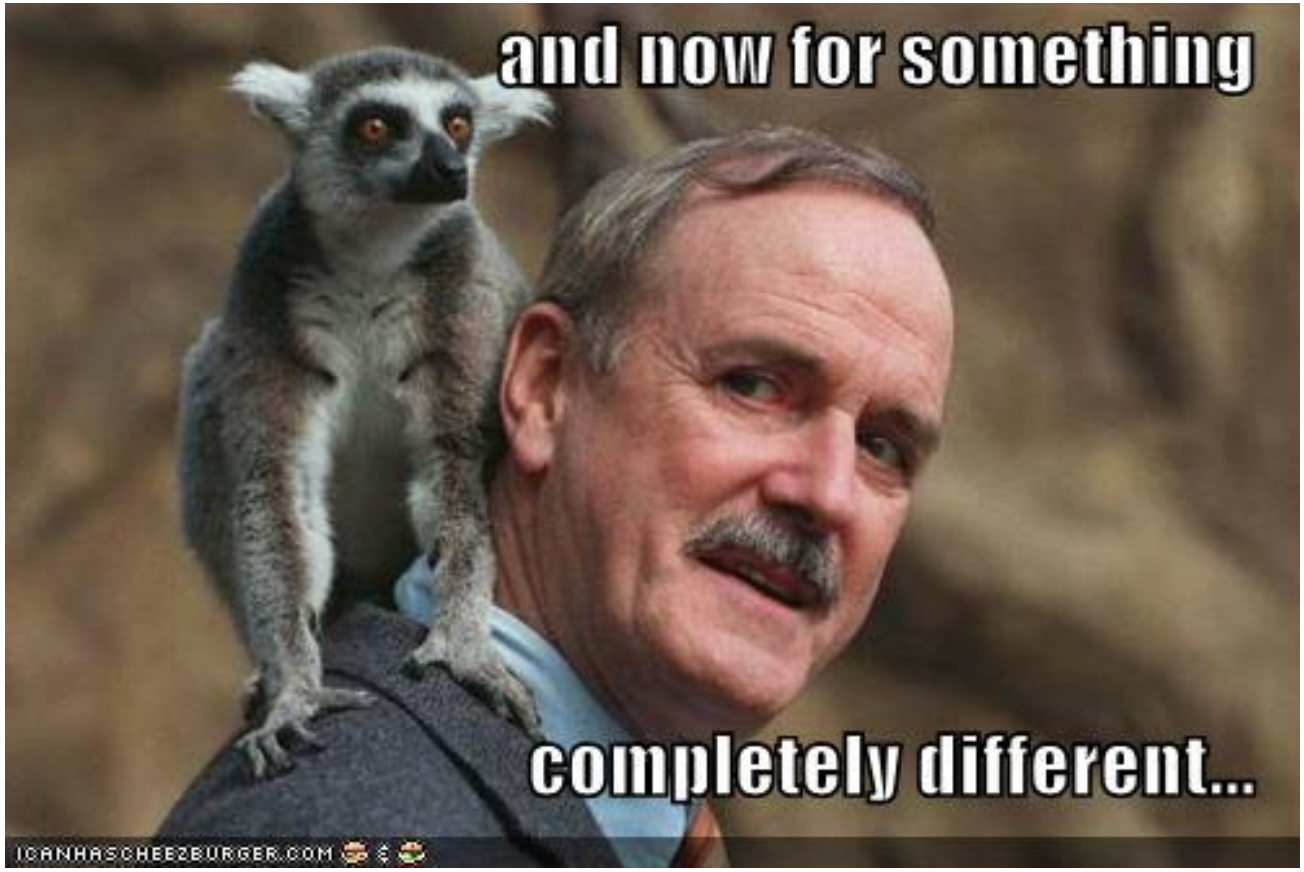




"More data are required to ascertain the origin of the observed excess."

Beyond Standard Model

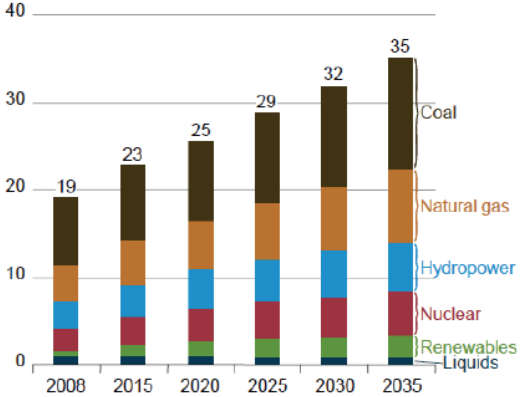
Lots of searches
No signals


and now for something
completely different...
ICANHASCHEEZBURGER.COM

Thorium Energy and Accelerator-Driven Reactors

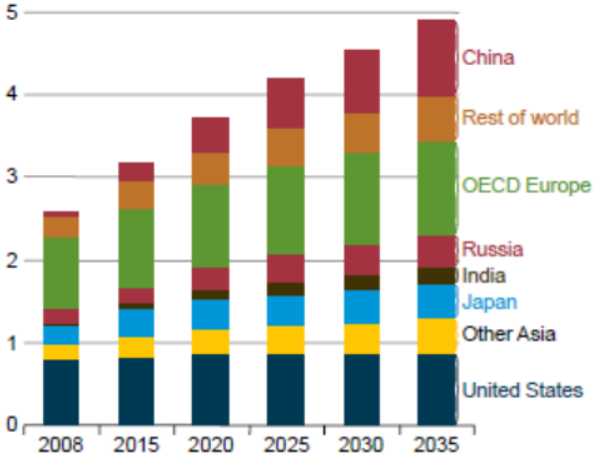
The Challenge

Figure 17. World net electricity generation by fuel type, 2008-2035 (trillion kilowatthours)



- World net electricity consumption increases by 84%
- World coal consumption increases by 50%
- World Nuclear power generation increases by ~90%, but remains flat at ~14% of total electricity generation

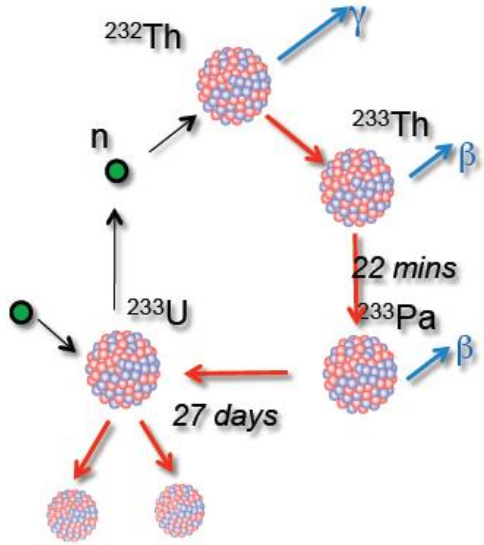
Figure 76. World net electricity generation from nuclear power by region, 2008-2035 (trillion kilowatthours)



Problems for nuclear power:

- Public acceptance
- Real accidents
- Radioactive waste
- Proliferation concerns
- Not competitive in terms of cost

Thorium/Uranium Fuel Cycle

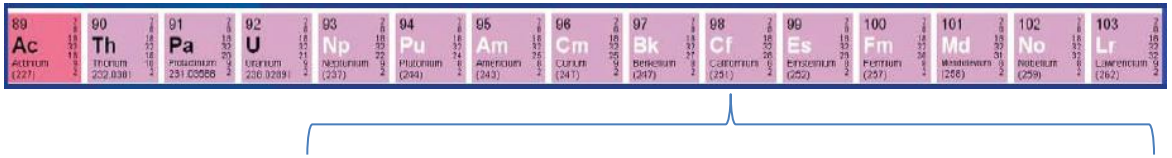


- U-235 is the only naturally occurring fissile material
- U-233 is also fissile but does not exist in nature
- U-233 can be produced from Th-232 via neutron capture
- Reactors that generate fissile U-233 from Th-232 are Breeder Reactors

"Previous work on Thorium reactors dropped because they didn't produce enough Plutonium!"

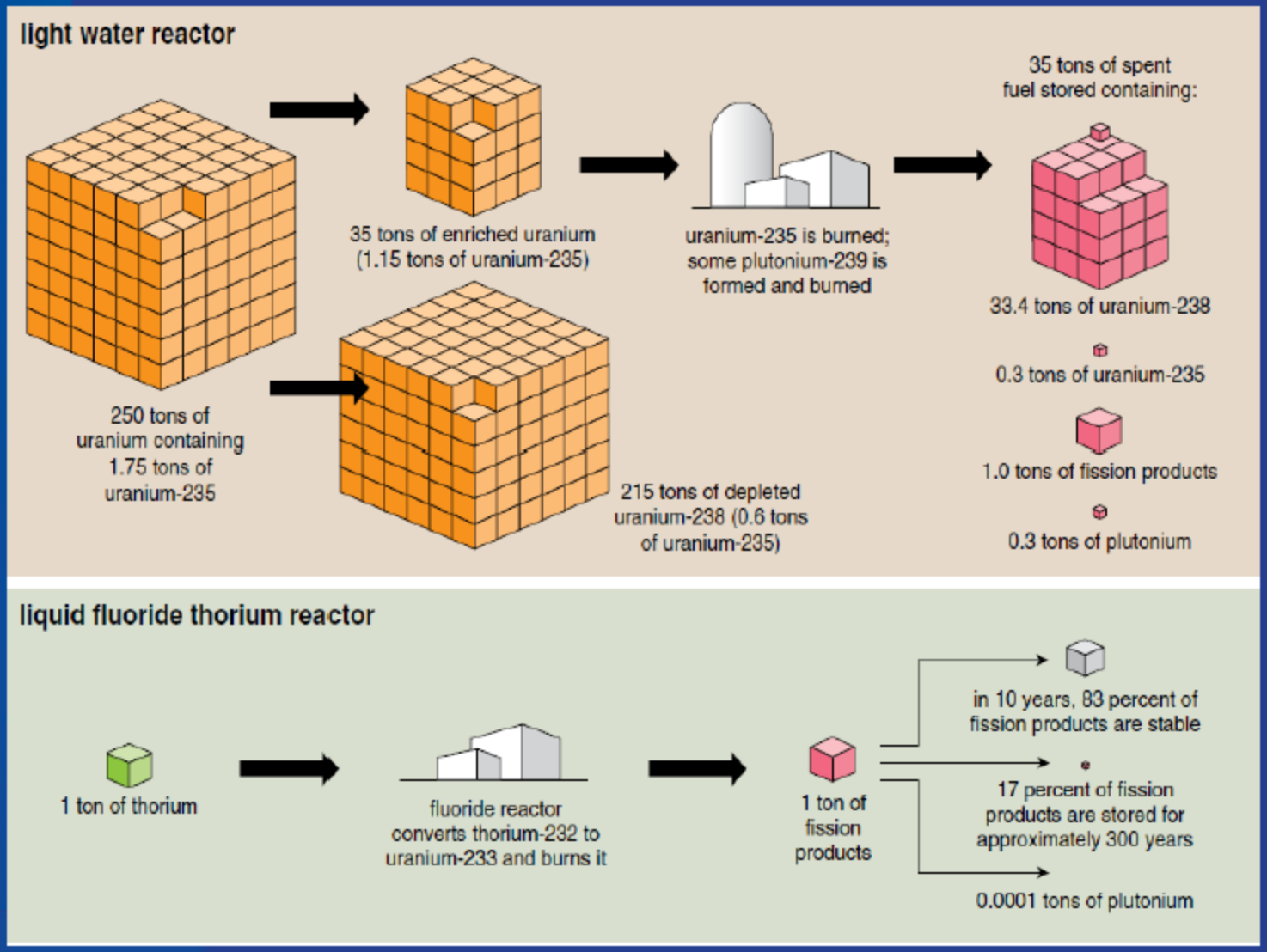
~4 times more abundant than U-238, 400 times more abundant than U-235
As abundant as lead

Thorium currently costs only US$30/kg, while the price of Uranium has risen above $100/kg, not including costs for enrichment and fuel fabrication.

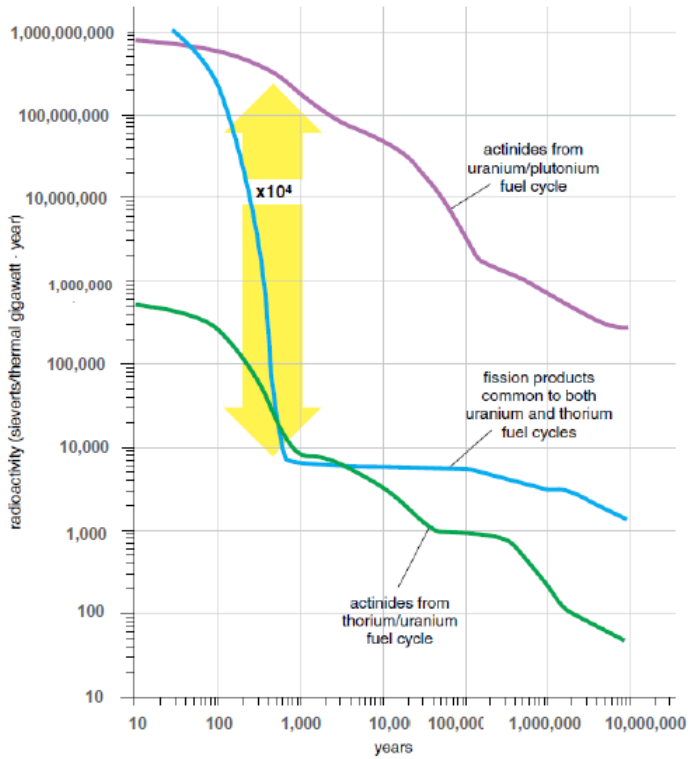


Minor actinides -> long lived radioactive waste

Advantages of Thorium: Raw Material and Resource Utilization for 1GW-year



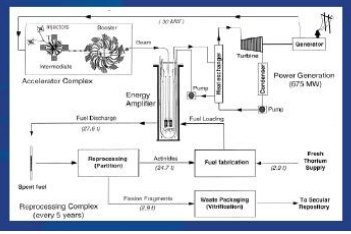
Waste Storage



Deploying Thorium Energy: Three Approaches

Thorium fuel in solid form in conventional reactors

Thorium as fuel in molten-salt reactors



Accelerator-driven Subcritical Reactors using Thorium fuel

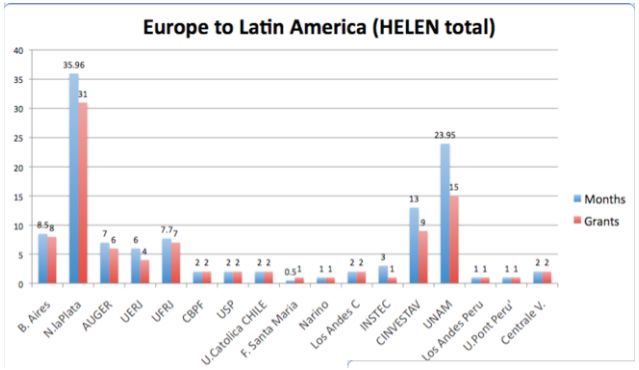
C. Rubbia, Energy Amplifier

- **Europe**: Belgium has committed to build MYRRHA, the first ADS demonstration reactor
- **India**: National nuclear power strategy is based on Thorium; ADS is needed to breed U-233
- **China**: Announced development program to build 1 GW ADS by 2032

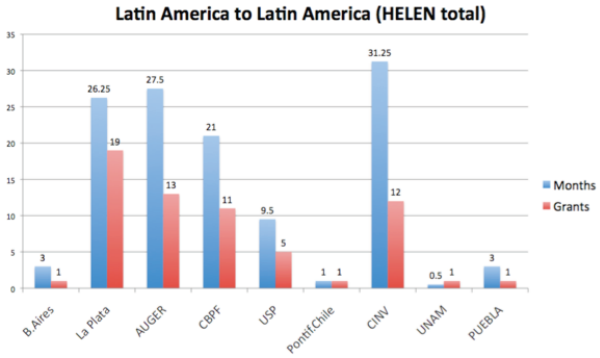
HELEN

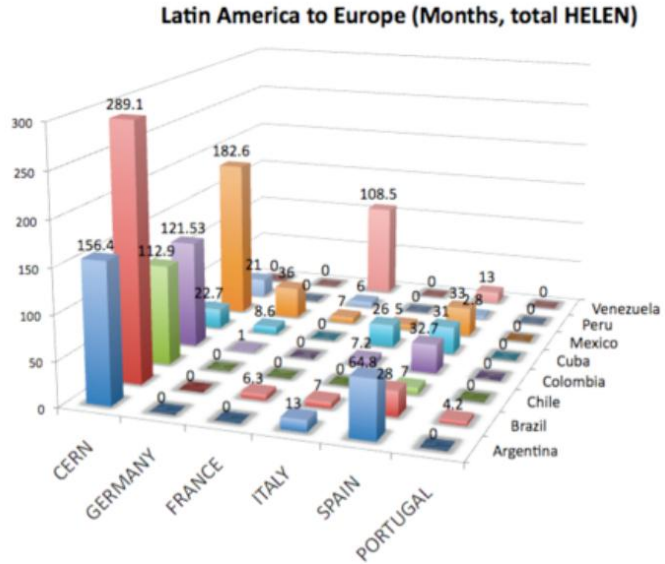
High Energy Physics LatinAmerican-European Network

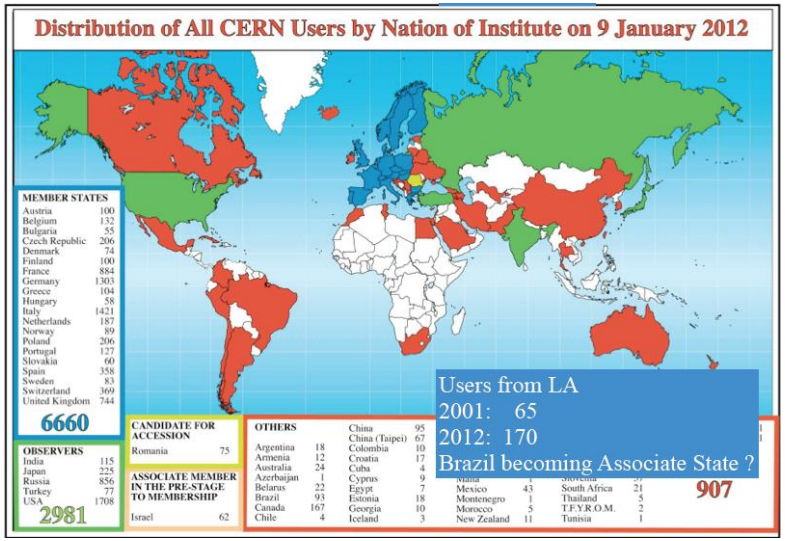
Trainees at CERN (Jan. 2006)



HELEN has operated from July 2005 to April 2009







- 4 years, budget 3.245 ME, 1803 months;
- started 1feb 2011(about 2 years gap from HELEN).

Thankyou for listening!

http://agenda.infn.it/conferenceOtherViews.py?view=standard&confId=4116