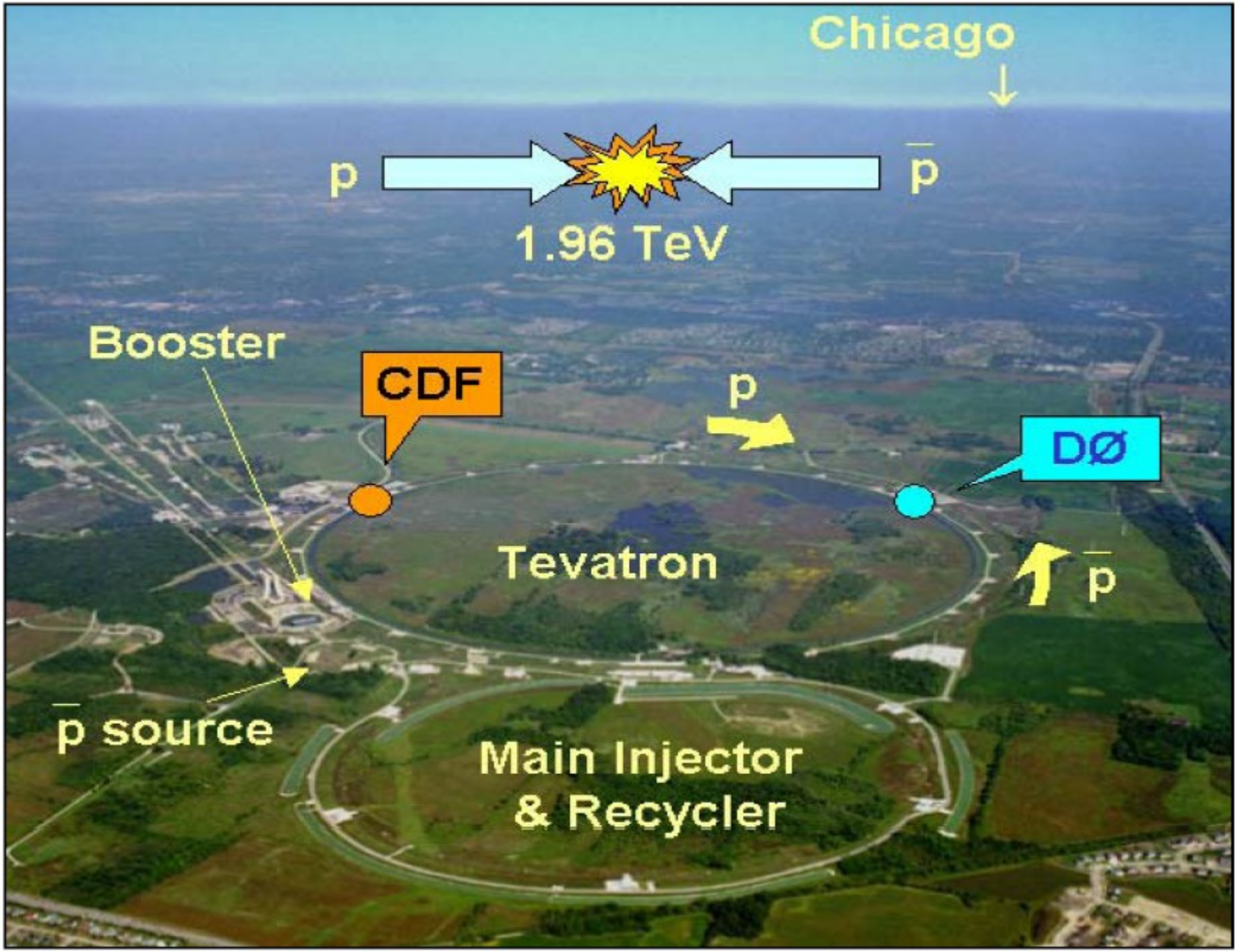
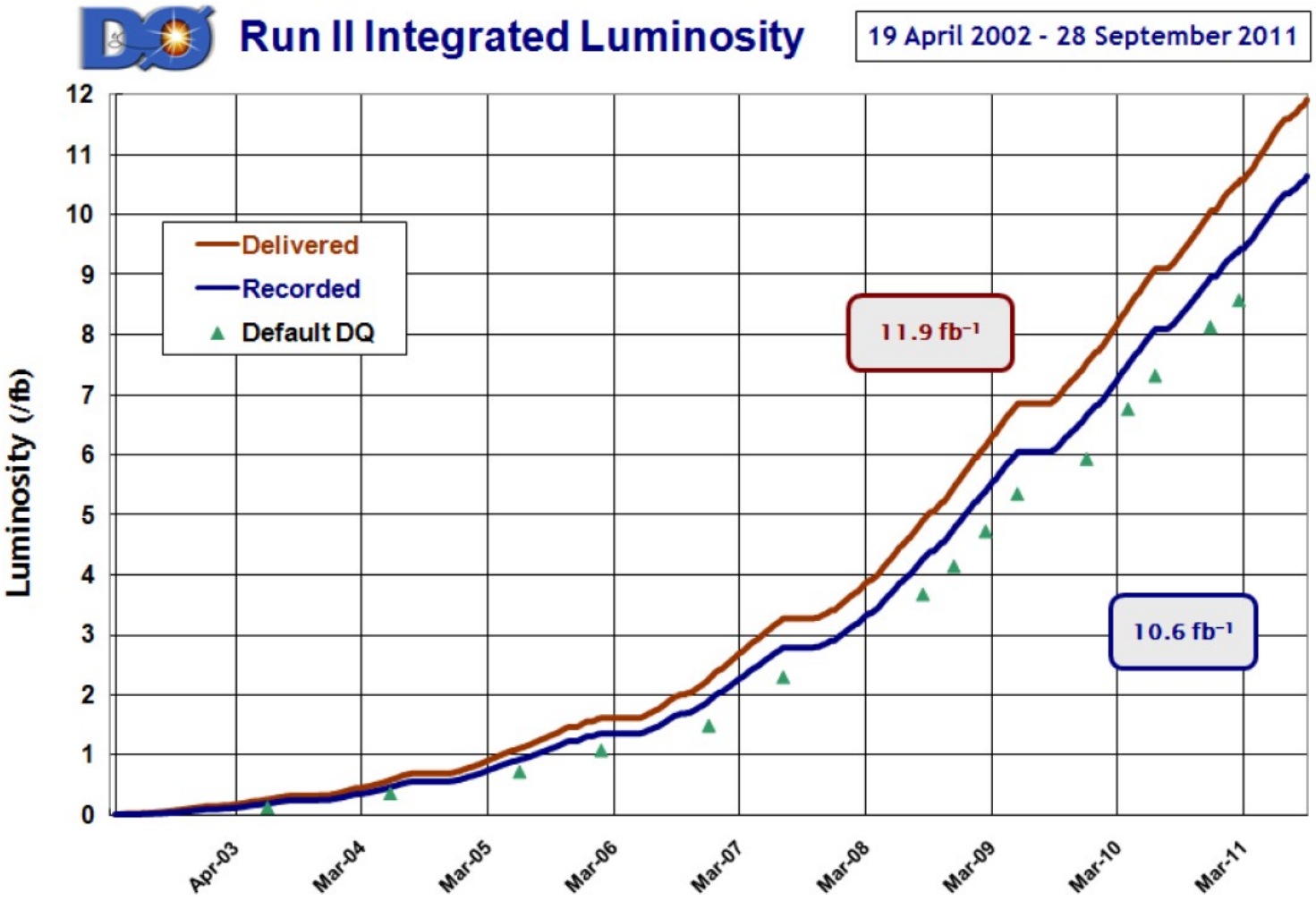
DZero experiment in 2011


Chicago
p
$\bar{p}$
1.96 TeV
Booster
CDF
p
DØ
Tevatron
$\bar{p}$
$\bar{p}$ source
Main Injector
& Recycler

Теватрон последние три года работал на проектной светимости, и за 1 месяц работы набирал интегральную светимость больше чем во всём Run I.

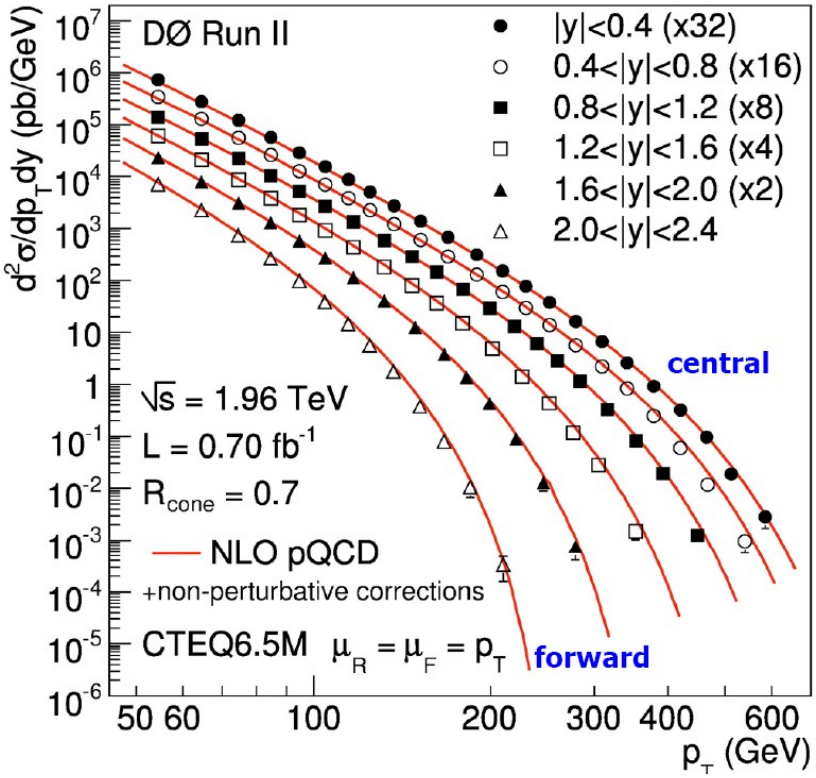


Tevatron achievements (1985 – 2011)

Run I: 1992 – 1996, Run II: 2001 – 2011

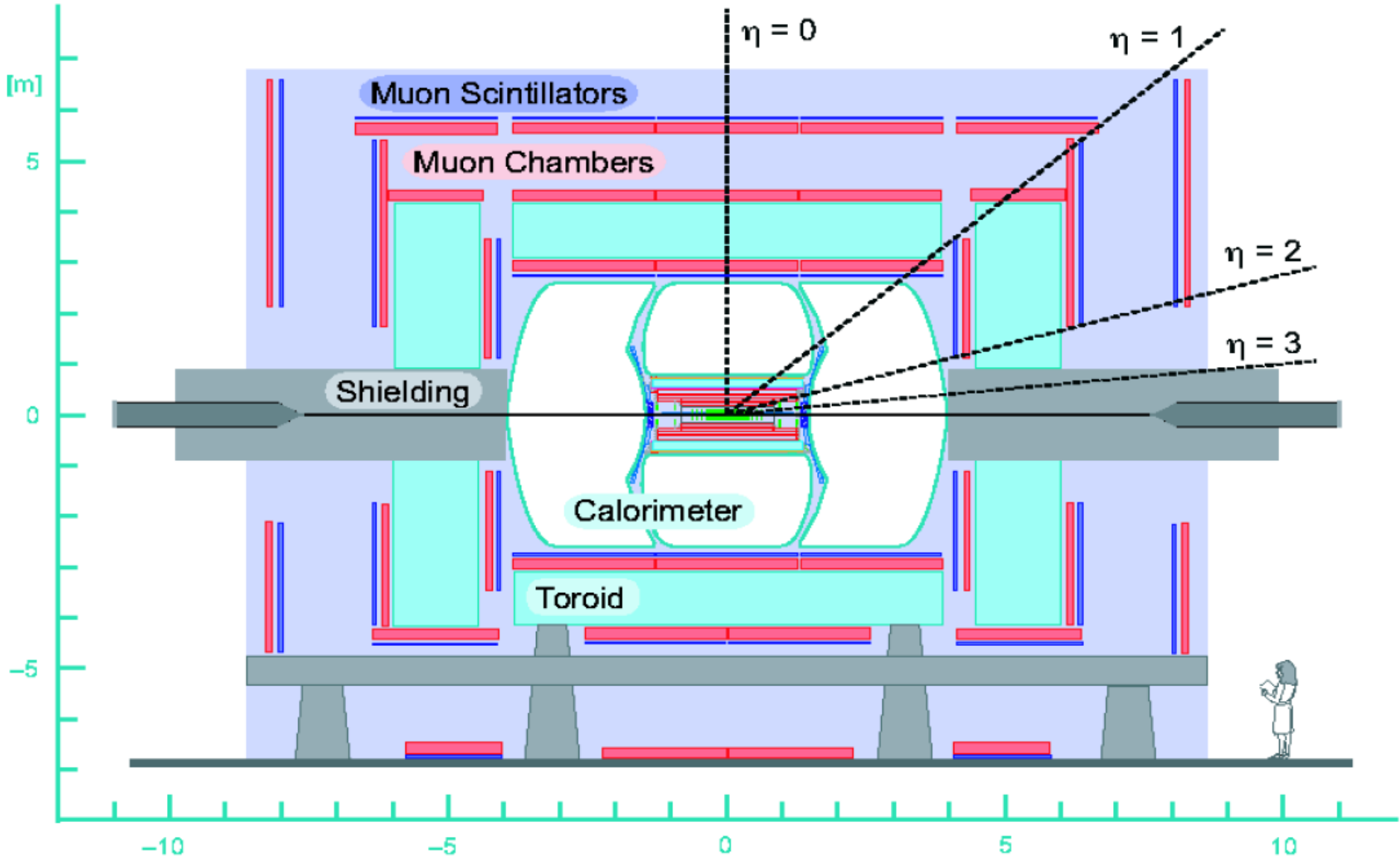
- Discovery of elementary particles: B^{+}_{c}, Σ^{-}_{b}, Ξ^{-}_{b}, Ω^{-}_{b}, Ξ^{0}_{b}
- Creation of hydrogen antiatoms
- Confirmation of a direct CP-violation in 2-pion decay of neutral kaons
- **Discovery of top quark (1995),** discovery of single top quark production
- First direct registration of tau-neutrino
- Precision measurements of masses of top quark and W boson
- Discovery of B_{s}^{0} oscillations and determination of the oscillation frequency (2006)
- Exclusion of a mass interval of the Higgs boson
- Measurement of jet cross sections over 8 orders of magnitude

- **First superconducting high-energy accelerator**



Jet cross sections vs p_T

DZero detector

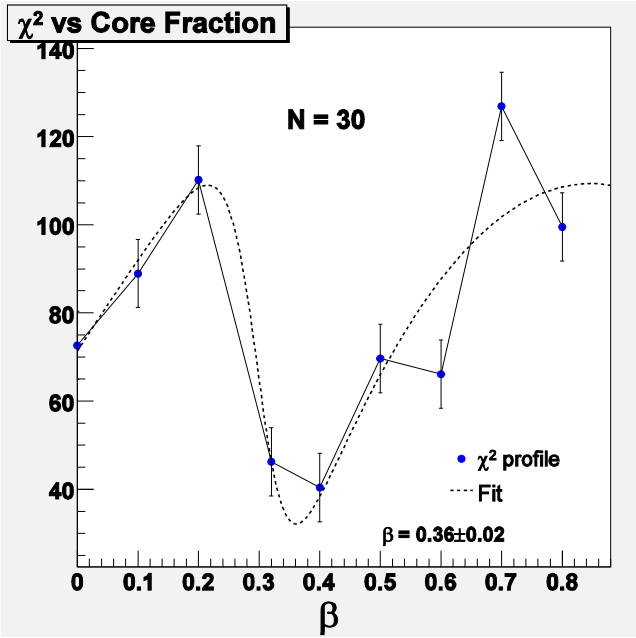


1.9 T superconducting solenoidal magnet; 1.8 T iron toroids

PNPI

Readout electronics for 50 000 mini drift tubes
Software for the data acquisition by our electronics
Software for the electronics interface
Repairing of electronic blocks
Reprogramming of the electronics
Calibration of the D0 Calorimeter
Participation in shifts
Participation in data analyses

G.Z. Obrant …



Профиль χ2 как функция доли кора β в плотности партонов. χ2 имеет минимум при β = 0.36.

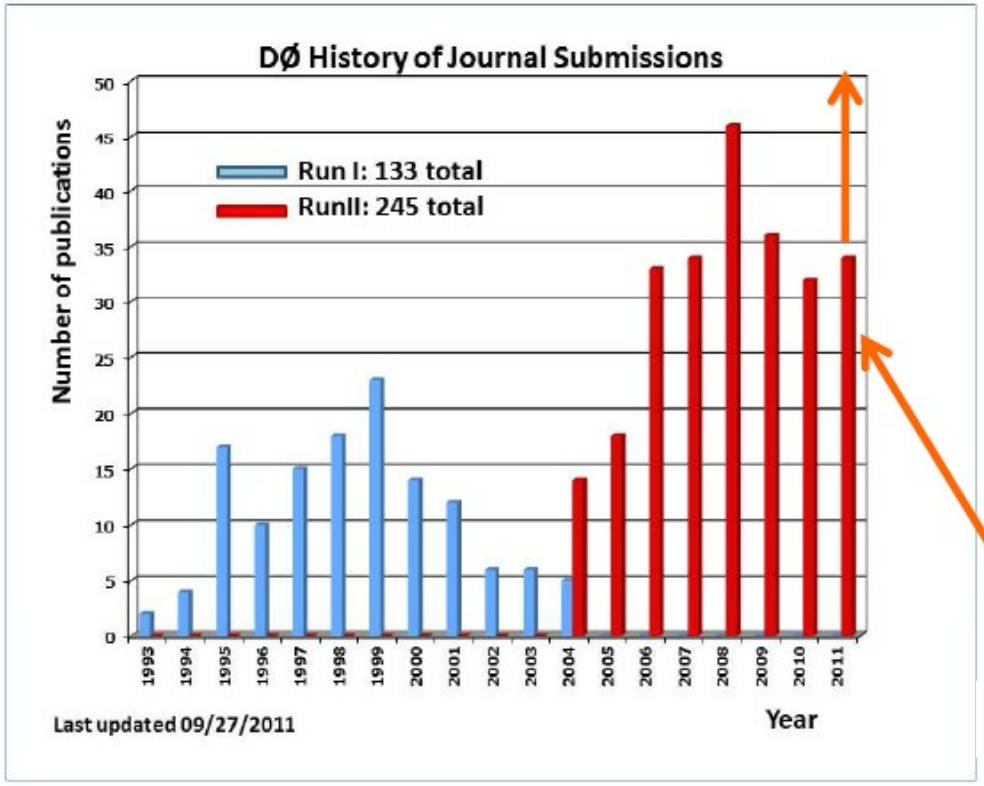
Physics program

- **Search for SM Higgs boson**
- **Limit on the B_s^0 to μμ branching ratio**
- **CP violation studies in B_s^0 system**
  - **— Mass difference Δm_s**
  - **— Lifetime Γ_s and lifetime difference $\Delta\Gamma_s$**
  - **— CP-violating phase Φ_s**
- **High precision measurement of W boson mass**
- **High precision measurement of top quark mass**
- **Precision measurements of the top quark production cross section**
- **Studies of the top quark properties**
- **QCD jets studies**
- **Di-boson production**
- **Search for non-SM Higgs boson(s)**
- **Search for SUSY in many modes**
- **Search for high mass resonances (Z' etc.)**
- **Search for extra dimensions**

Publications

32 publications in 2010
Very good first part of 2011, already 34 publications,
Aiming at breaking the year record of 46!

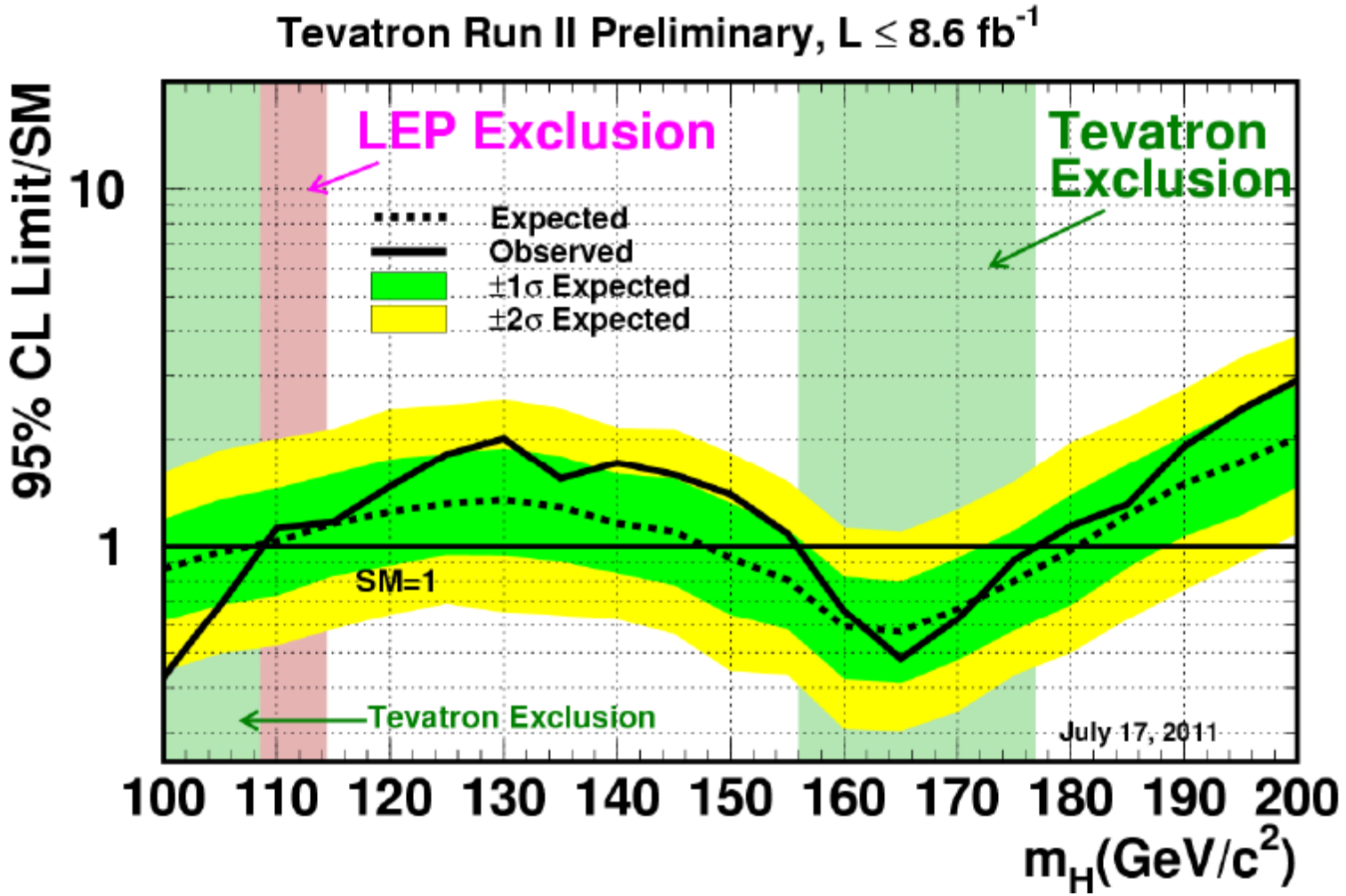
247 total



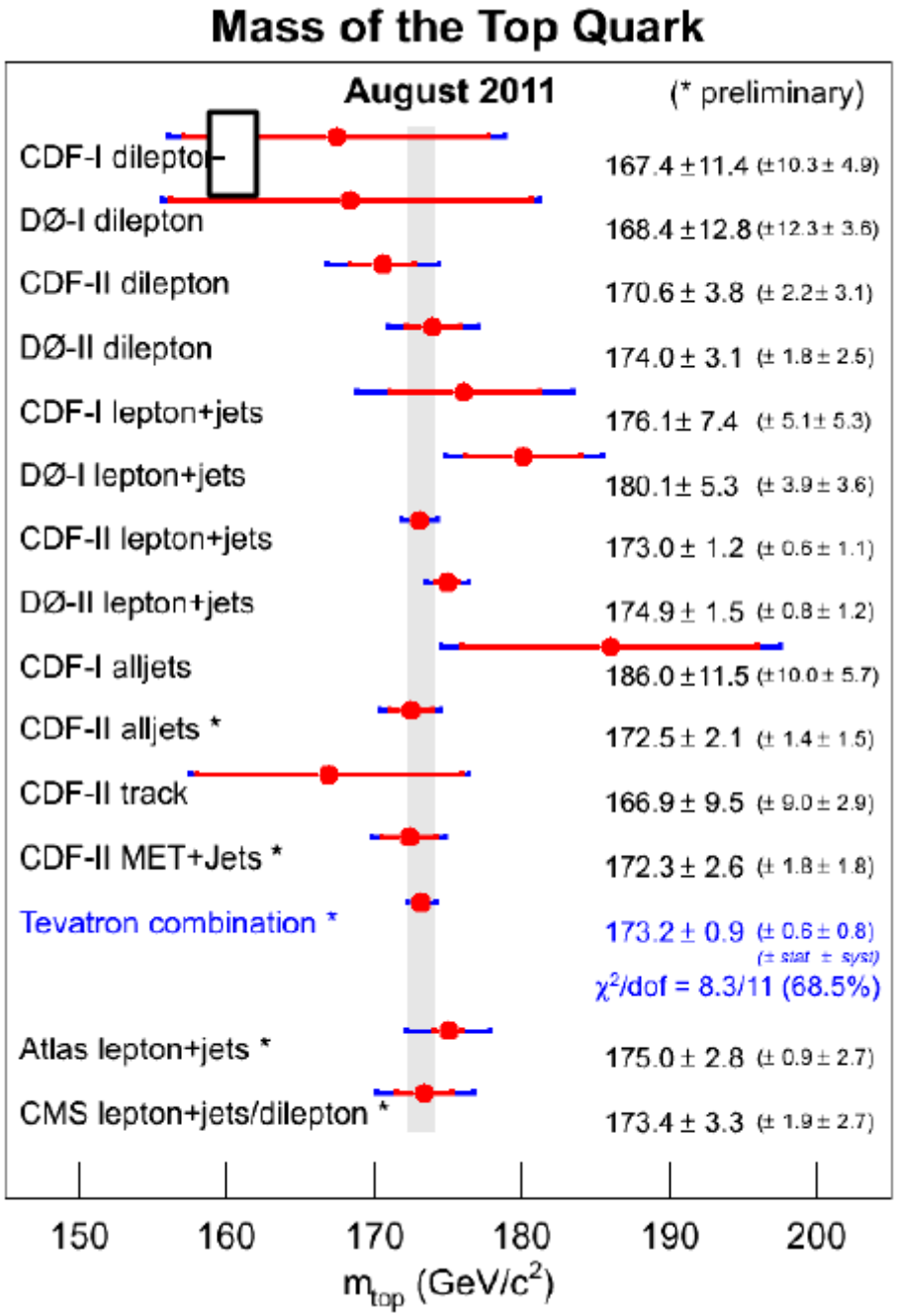
26 papers in the first six months of 2011, Best ever # of papers/6 months.

2010: D0+CDF excluded a Higgs boson with a mass of ~ 158 - 175 GeV

2011



Observed Exclusion : 100-109 and 156-177 GeV



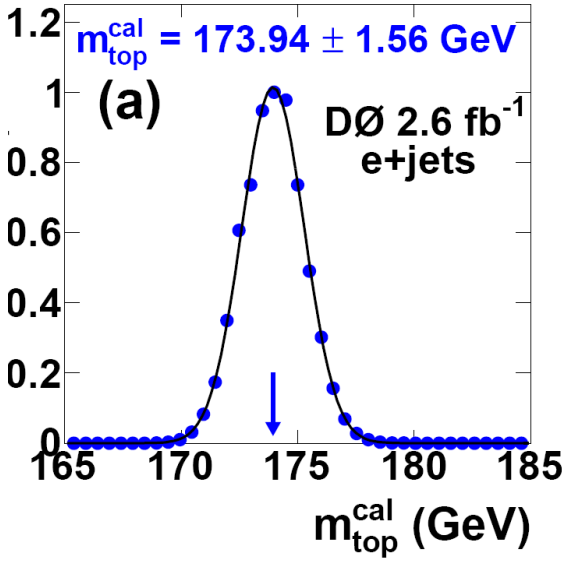
2010: M_t=173.3 +/- 1.1 GeV/c^2

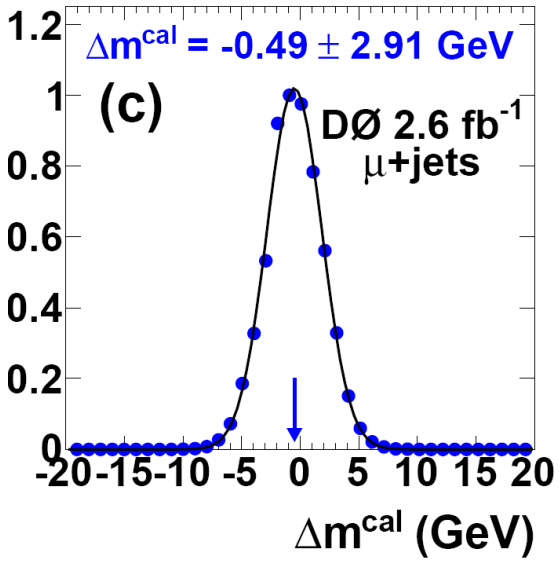
2011: M_t=173.2 +/- 0.9 GeV/c^2

For the first time $\Delta M_t < 1$ GeV/c^2

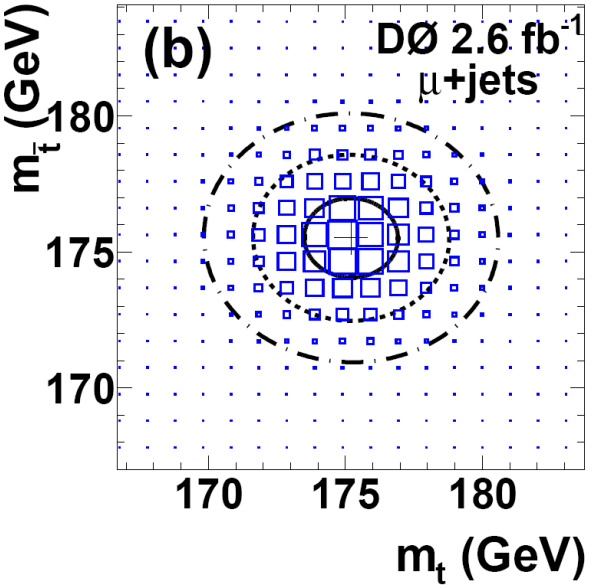
Direct measurement of the mass difference between top and antitop quarks

CPT: the mass of a particle = the mass of its antiparticle





$\Delta m = m_{top} - m_{untitop}$



$\Delta m = 0.8 +/- 1.8$ (stat)
$+/- 0.5$ (syst) GeV

Top pair spin correlations

In the SM, the spin of the top and the spin of the antitop are produced correlated

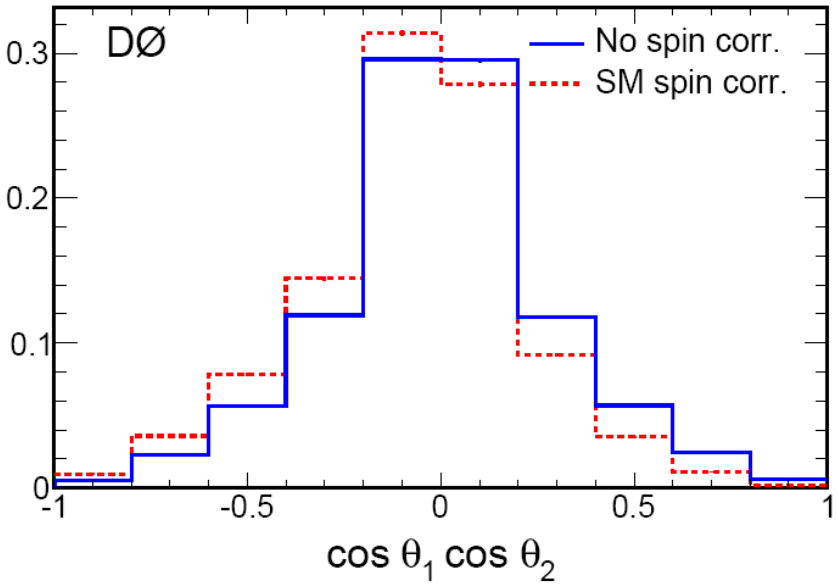
$C = (N_{\uparrow\uparrow} - N_{\uparrow\downarrow})/(N_{\uparrow\uparrow} + N_{\uparrow\downarrow})$ $\quad -1 \le C \le +1$ $\quad C_{SM}$ (NLO) = 0.78 +0.03/–0.04 for qq

$$d\sigma/d\cos\theta_1 \cdot d\cos\theta_2 = \sigma(1 - C \cdot \cos\theta_1 \cdot \cos\theta_2)/4$$

$t\bar{t} \rightarrow W^+ b\, W^- \bar{b} \rightarrow \ell \nu b + \ell \nu \bar{b}$

5.3 fb^{-1} $\ell\ell$ + 2 jets; ℓ + 4 jets

C_{meas} = 0.66 +/– 0.23

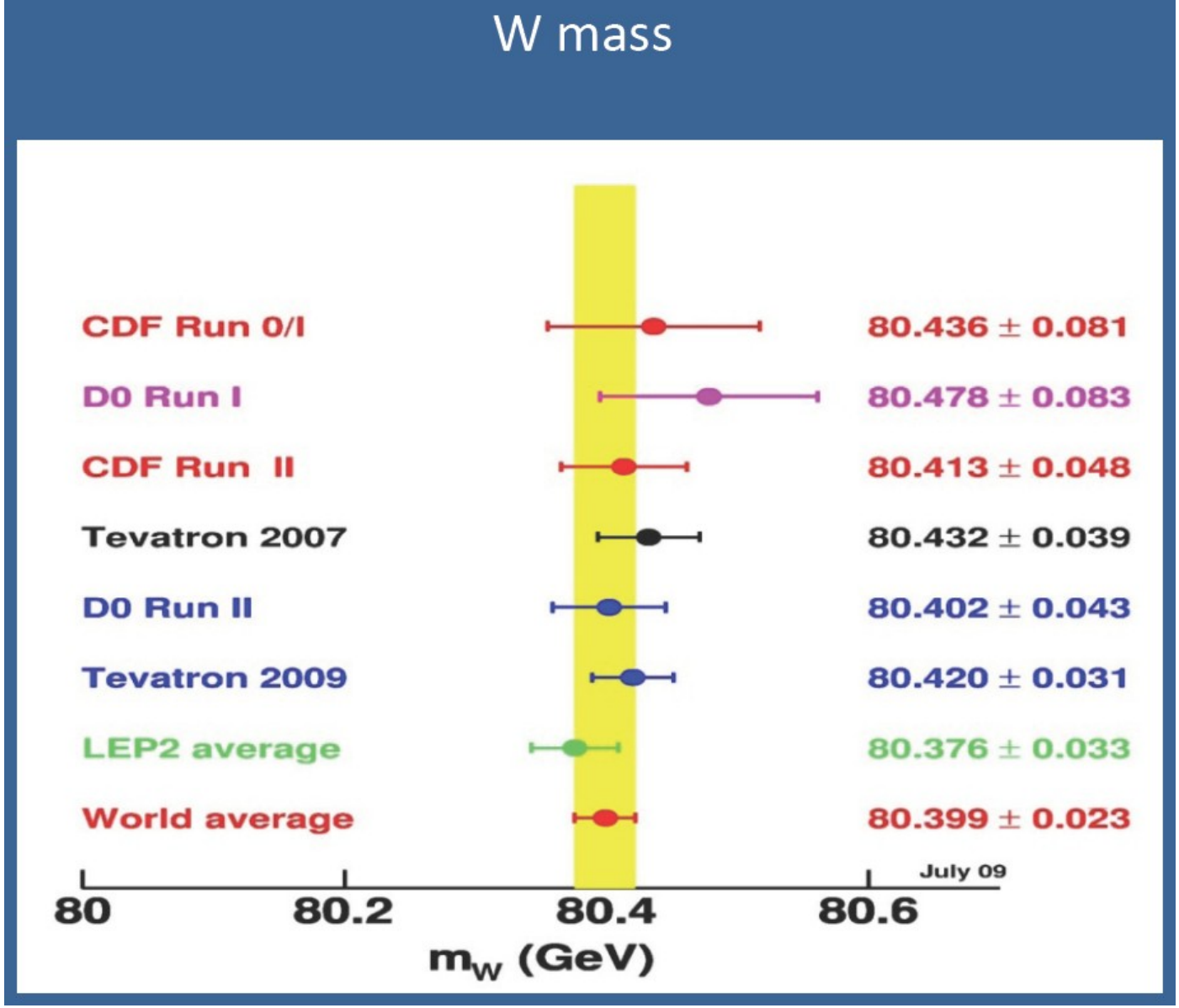


Evidence of SM spin correlation

at 3 standard deviations

ATLAS: C_{meas} = 0.34 +0.15 -0.11

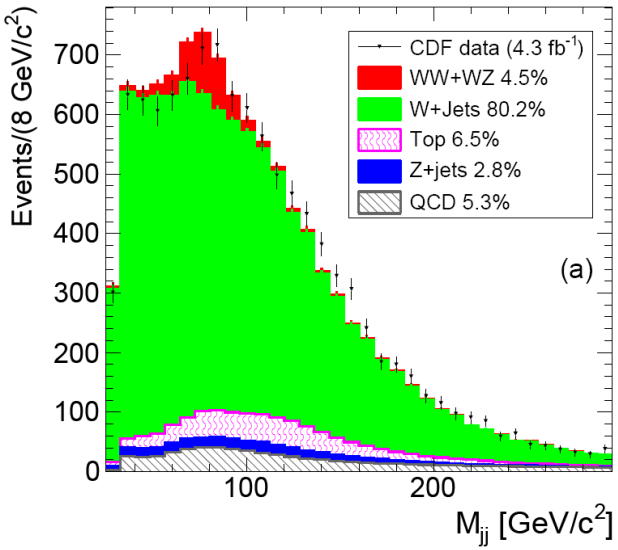
C_{SM} = 0.32



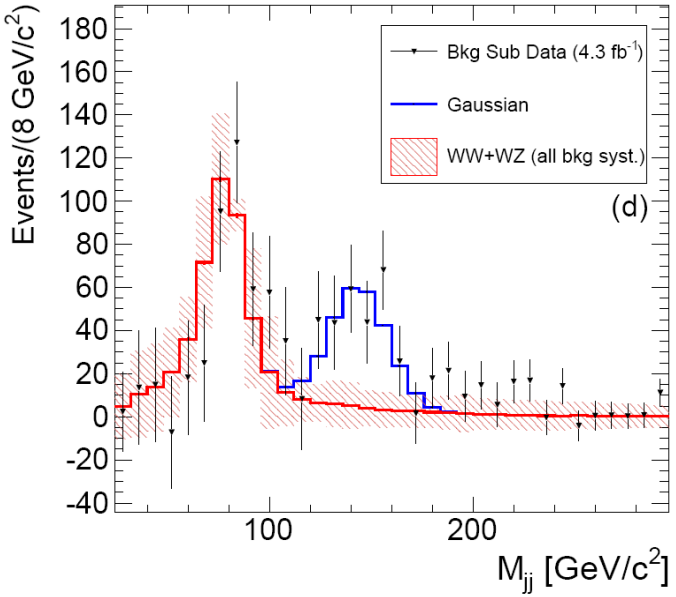
Tevatron expected final uncertainty in Δm_W – 0.015 GeV

$m_H \approx 95$ +/- 27 GeV

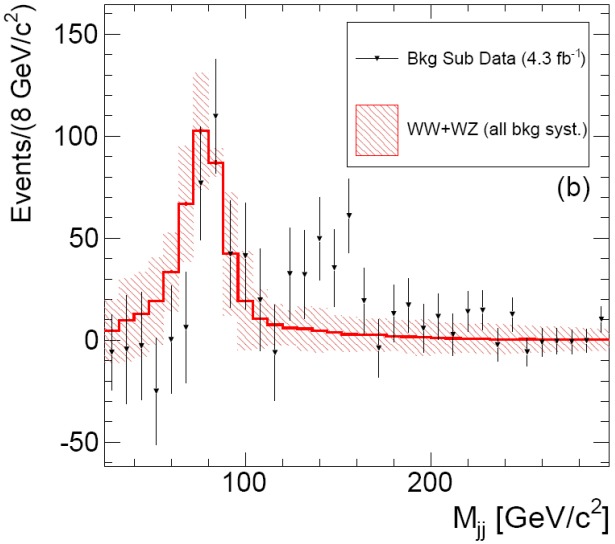
Wjj: CDF vs. DZero

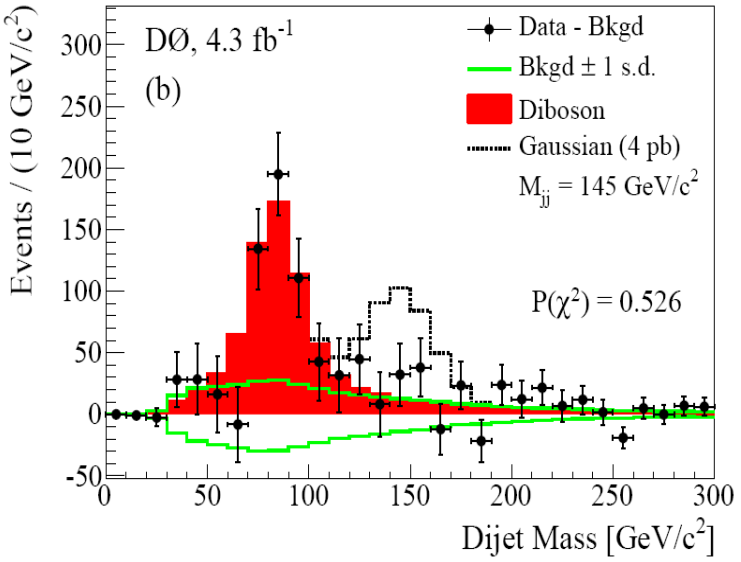


CDF



CDF





D0

No bump at 145 GeV/c^2

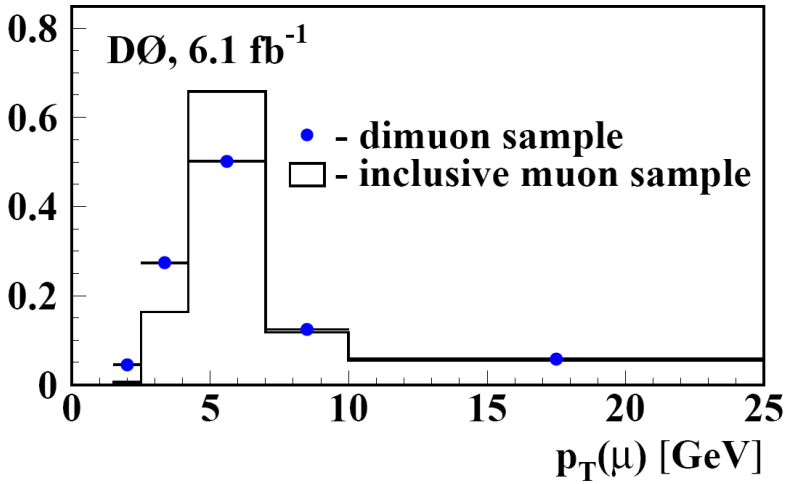
Evidence for an anomalous like-sign dimuon asymmetry

$A=(N^{++} - N^{--})/(N^{++} + N^{--})$ $a=(N^{+} - N^{-})/(N^{+} + N^{-})$

$B \rightarrow \mu^{-} X$ $B \rightarrow \mu^{+} X$

SM → $A=a= -2.3(0.6) \cdot 10^{-4}$

Mesons $p_T > 1.5$ GeV and $p_z > 6.4$ GeV,
or $p_T > 4.2$ GeV, but $p_T < 25$ GeV
$\Delta s < 5$ mm
reversal of the magnetic field



Main background - from K-mesons
Fraction of muons from K-mesons - ~16%
Asymmetry of muons from K-mesons - ~ 6%
Contribution to A (a) from K-mesons - ~ 1%

6 fb^{-1}
1.5 10^9 inclusive muons
3.7 10^6 dimuons

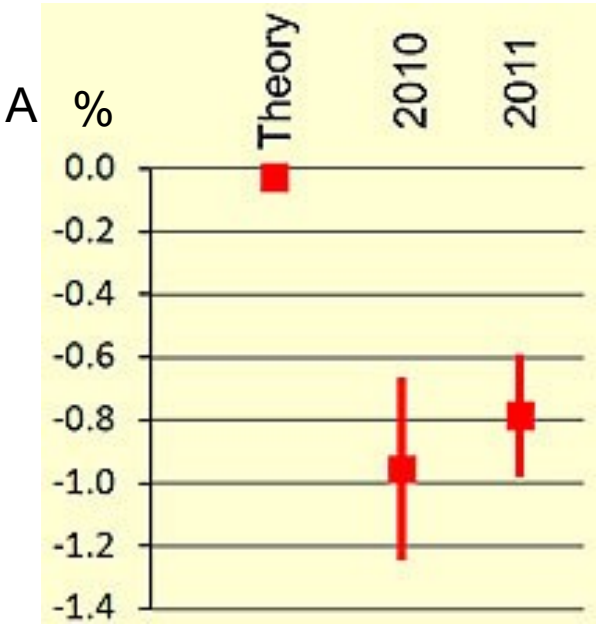
A(a) = 0.9% +/-1.1% (stat) +/- 2.1% (syst)
A = - 0.7% +/-0.3% (stat) +/-0.3%(syst)

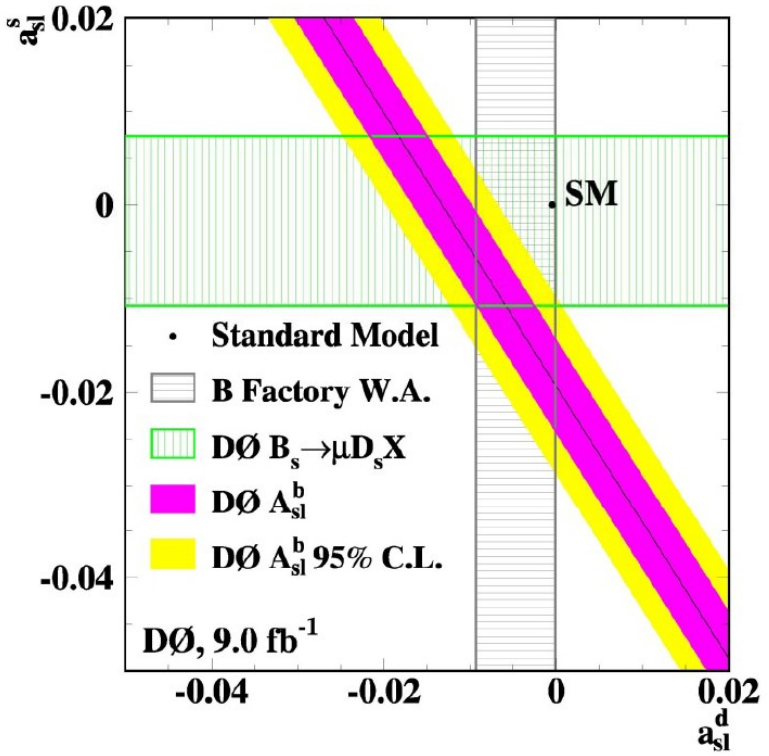
A(SM) = - 0.02%

2010: A_{fin}= -0.9% +/-0.3%(stat) +/- 0.1%(syst)

Evidence for an anomalous like-sign dimuon asymmetry

2011: A_{fin}= -0.8% +/-0.2%(stat) +/- 0.1%(syst) 9 fb^{-1}





Forward-backward asymmetry in top quark pair production

At first order QCD, **tt** production in **pp** collisions is charge symmetric
NLO QCD – forward-backward asymmetries ~ 5-10%

$A_{fb} = (N_f - N_b)/(N_f + N_b)$ N_f: $\Delta y = y_t - y_t > 0$ $y = \ln[(1+\beta\cos\theta)/(1-\beta\cos\theta)]/2$

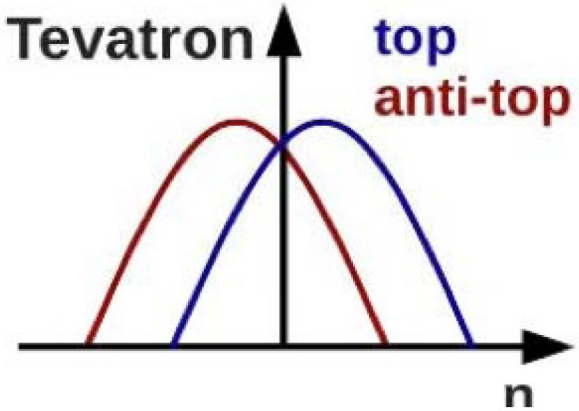
First measurements – **D0, 2007** 0.9 fb^{-1}: agreement with the SM within the error bar.

2010-11, CDF: 5.3 fb^{-1}, ℓ + 4 jets, $t \to \ell\nu b$, $t \to qqb$
The main background is from W + jets

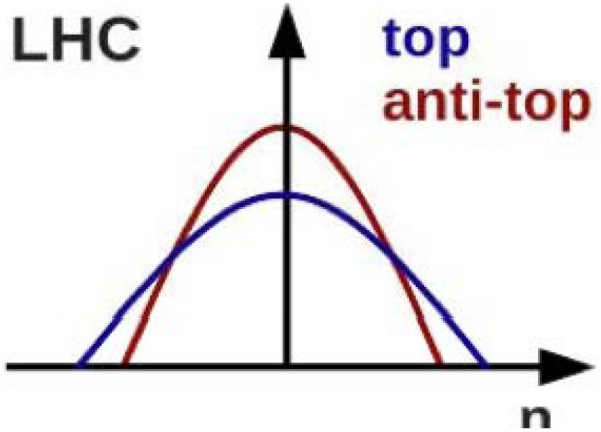
A_{fb} = (48 +/- 11)% for $M_{tt} > 450$ GeV/c^2, to be compared with
A_{fb} = (9 +/- 1)% NLO QCD prediction

2011, D0: 5.4 fb^{-1}, ℓ + 4 jets, $t \to \ell\nu b$, $t \to qqb$
A_{fb} = (20 +/- 7)%, averaged over all M_{tt} masses, to be compared with
A_{fb} = (5.0 +/- 0.1)% NLO QCD prediction

$A^{\ell}_{fb} = (N^{\ell}_f - N^{\ell}_b)/(N^{\ell}_f + N^{\ell}_b)$
A^{ℓ}_{fb} = (15 +/- 4)%, to be compared with
A^{ℓ}_{fb} = (2.1 +/- 0.1)% NLO QCD prediction



forward-backward asymmetry



central-forward asymmetry

CMS ?

D0 in 2012-14 – data analysis

FNAL G-2

David Hertzog:

Dear g-2 Collaborators and Friends,
2011 has been a wonderful year for us!

We are approved
We have received funding
We have developed the official "Project" with great, energetic leaders
We have become a priority at Fermilab
We are central to the US Intensity Frontier
And, we are doing great science whose motivation continues unabated.