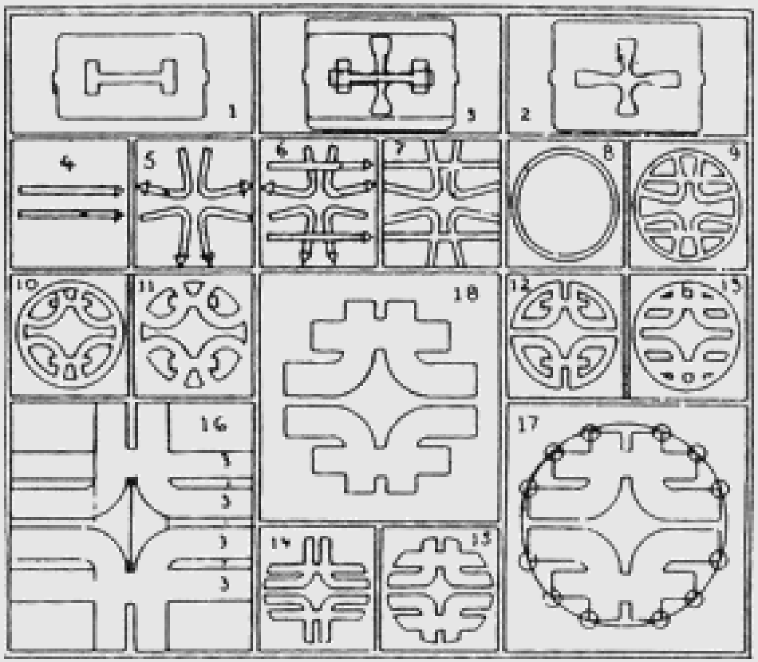
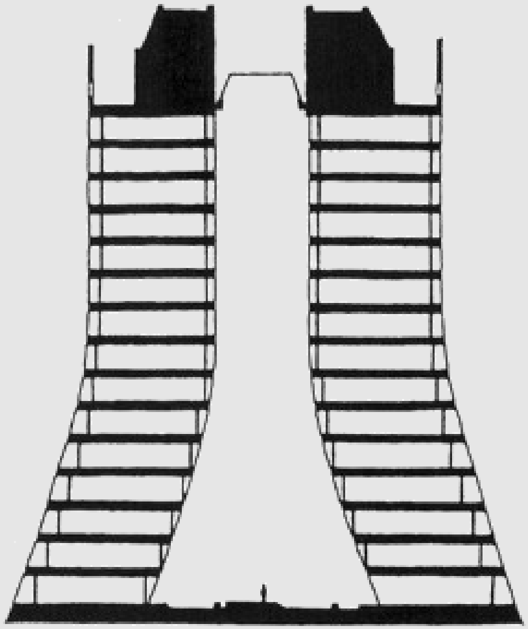
Perspectives on QCD and EW physics from the Tevatron

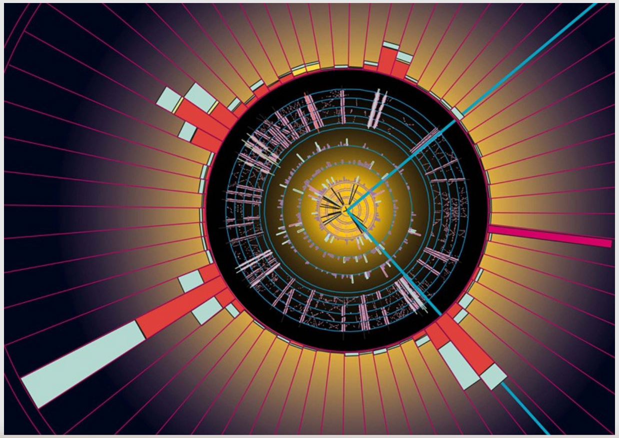


The Evolution of a Logo

DIS2015

SMU



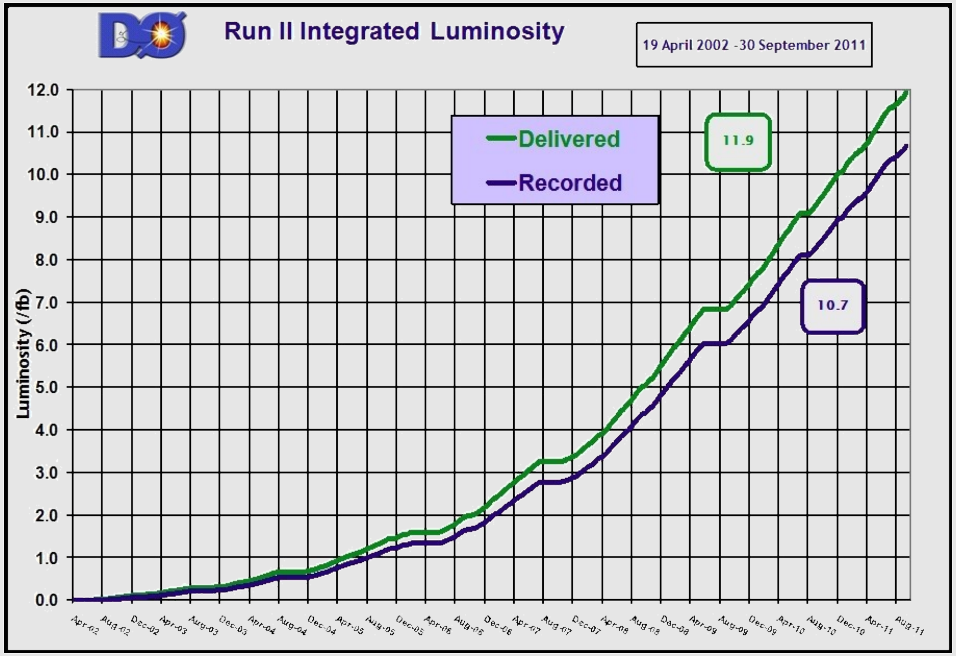


Bob Hirosky
for the CDF and D0 Collaborations

Outline of Tevatron Results

The Tevatron experiments, CDF and D0, continue a rich physics program analyzing ~10fb^{-1} of recorded data from ~2001-2011

- World's highest energy p-$\bar{p}$ data set (2 TeV C.O.M.)
- Unique physics studies
- Complementary/competitive in LHC era



>1100 Tevatron papers and counting

Outline of Tevatron Results

The Tevatron experiments, CDF and D0, continue a rich physics program analyzing ~10fb^{-1} of recorded data from ~2001-2011

Focus today on recent results

Outline of topics

- Heavy flavor states and production/final state asymmetries (incl. CPV)
- Top
- EW production and decay kinematics
- (V)V+jets/HF
- QCD, low-x
- Exotics and non-SM Higgs

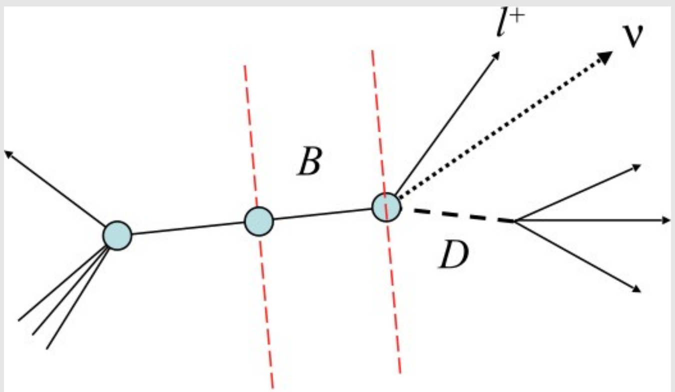
10.4 fb^{-1}

B^0_s lifetime in the flavor-specific decay channel $B^0_s \rightarrow D_s \mu X$ with the D0 detector

Flavor-specific final state

$$B_s^0 \rightarrow D_s^- \mu^+ \nu + \mathrm{C.C.}$$

Determines $B_0, \overline{B}_0$ state at decay

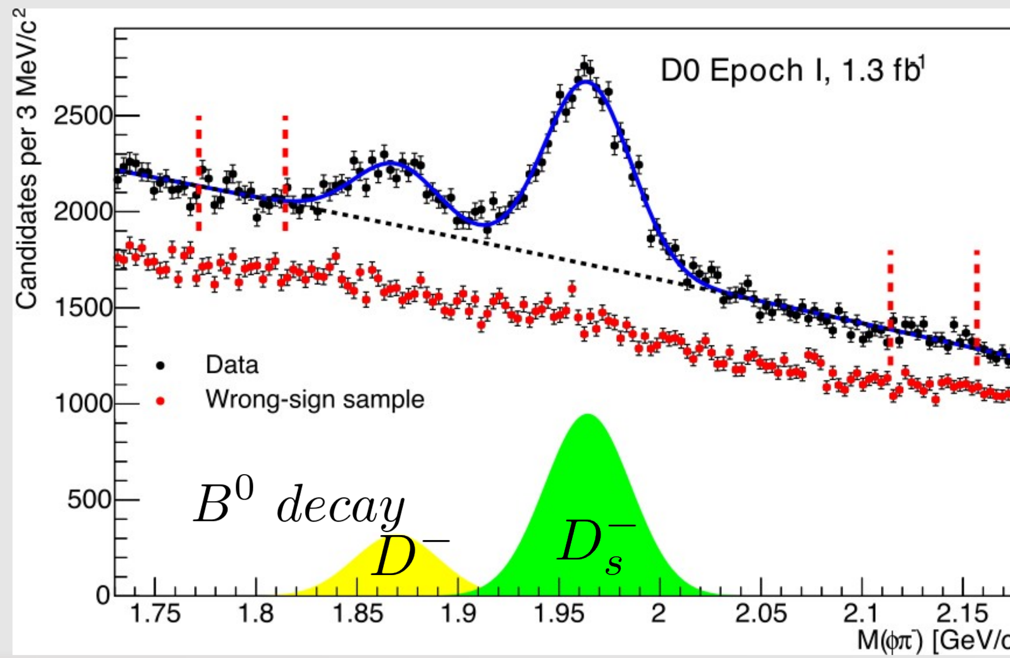


$$c\tau(B_s^0) = L_{xy} \frac{m(B_s^0)}{p_T(D_s^- \mu^+)} \otimes K$$

Lifetime from (pseudo) proper decay length. K-factor for kinematic effects of ν, soft particles from excited states

- Flavor oscillations yield lifetime as linear combo of light+heavy mass eigenstates
- Superposition of states => lifetime distribution:

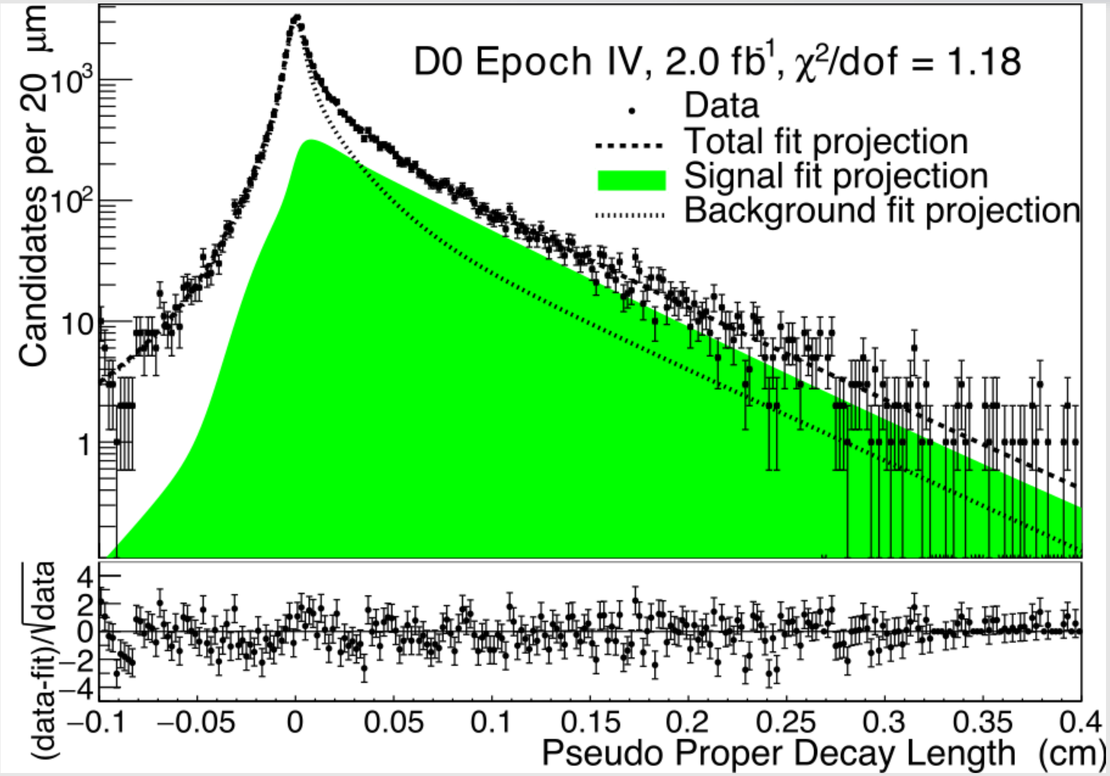
$$\tau_{\mathrm{fs}}(B_s^0) = \frac{1}{\Gamma_s} \cdot \frac{1 + (\Delta\Gamma_s/2\Gamma_s)^2}{1 - (\Delta\Gamma_s/2\Gamma_s)^2}$$



Phys. Rev. Lett. 114, 062001 (2015), arXiv:1410.1568

10.4 fb^{-1}

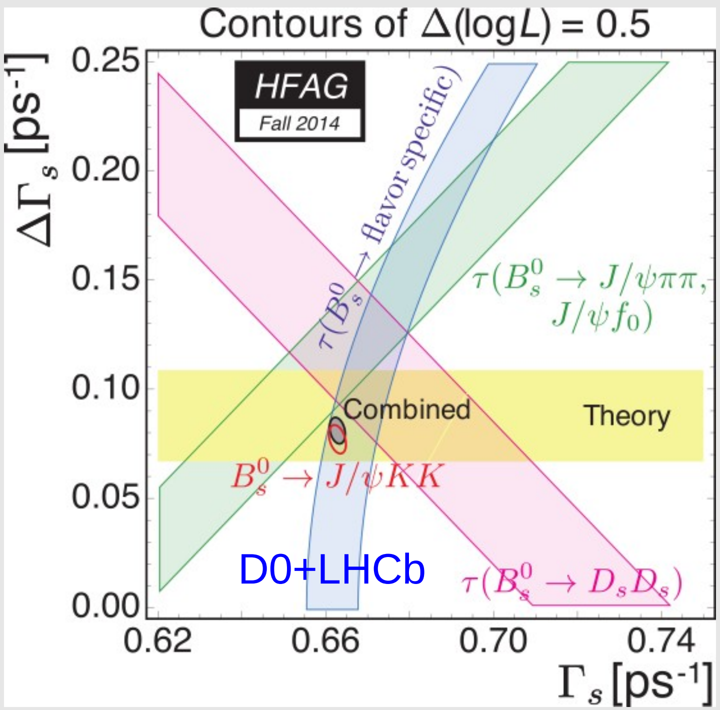
B^0_s lifetime in the flavor-specific decay channel $B^0_s \rightarrow$ Ds μ X with the D0 detector



$$\tau_{fs}(B^0_s) = 1.479 \pm 0.010(\text{stat}) \pm 0.021(\text{syst})\text{ps}$$

$$\tau_{fs}(B^0_s)/\tau(B^0) = 0.964 \pm 0.013(\text{stat}) \pm 0.007(\text{syst})$$

- All contributions in signal region enter in the fit
- τ(B^0) from $B^0 \rightarrow D^-\mu^+\nu X$ decays is also obtained and the ratio τ(B_s^0)/τ(B^0) calculated



- Reduce ΔΓs and Γs => Constraint on CPV
- Precise ratio to τ(B^0) => Constrain NP operators

Phys. Rev. Lett. 114, 062001 (2015), arXiv:1410.1568

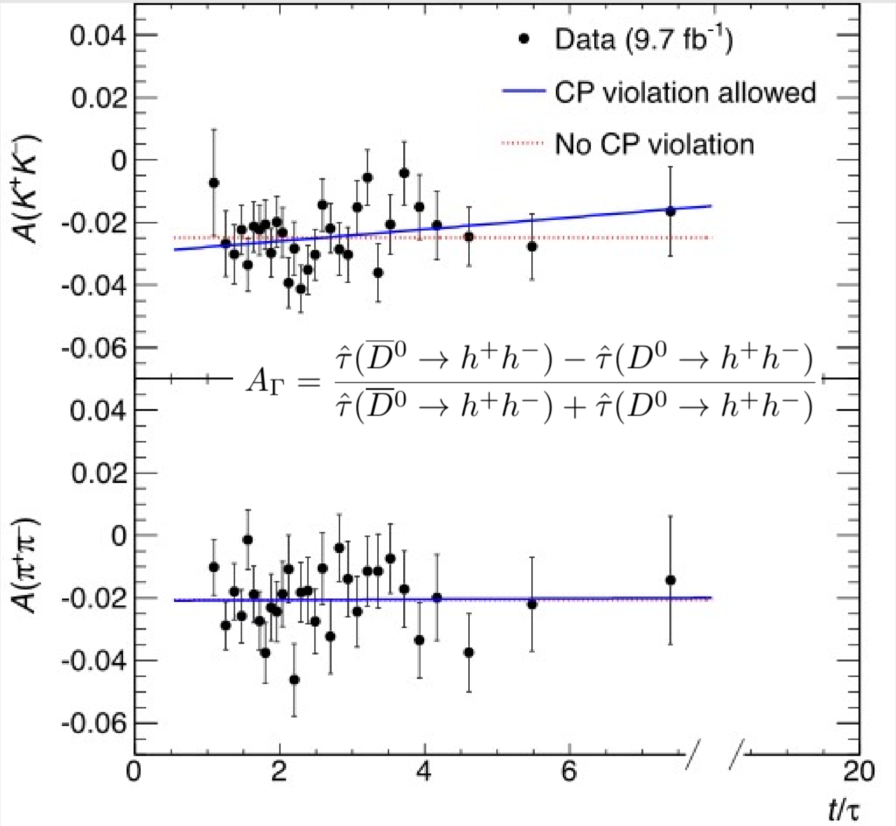
Measurement of indirect CP-violating asymmetries in $D^0 \to K^+K^-$ and $D^0 \to \pi^+\pi^-$ decays

Measure CPV asymmetries A_Γ in charm mesons

- Identify D_0 flavor at production from strong decay $D_0^* \to D_0\pi^+$ (+ CC)
- Measure decay time-rate asymmetries, for slow mixing:

$$\mathcal{A}_{CP}(t) \approx \mathcal{A}_{CP}^{\mathrm{dir}}(h^+h^-) - \frac{t}{\tau}\, A_\Gamma(h^+h^-)$$

(asymmetry in lifetimes of D, $\overline{\mathrm{D}}$)



Sensitive to exchange of virtual non-SM particles, non-SM loops. SM(<1%)

$$A_\Gamma = (-0.12 \pm 0.12)\%$$ (combined)

Consistent with best determinations, improve global constraints on indirect CPV in charm-meson dynamics.

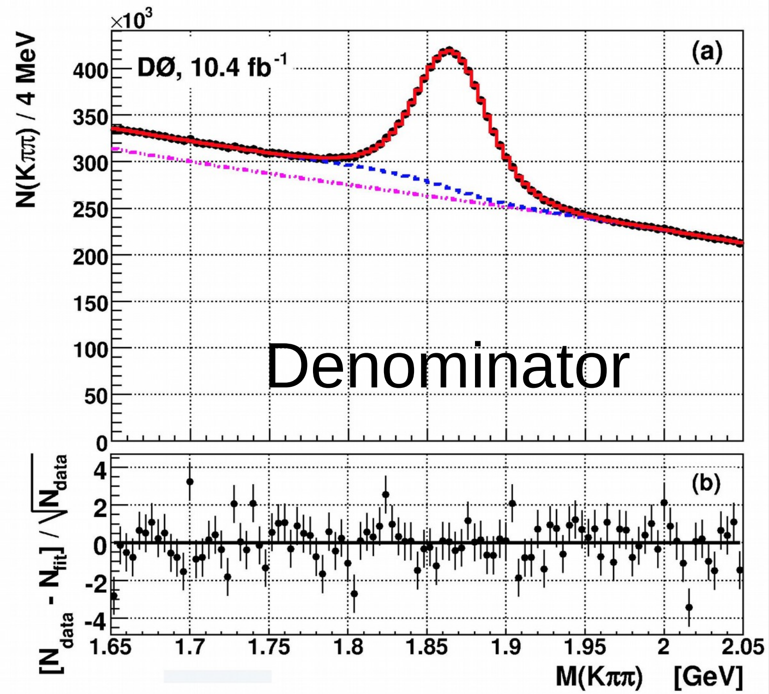
PRD 90 (2014) 111103(R)
arXiv:1410.5435

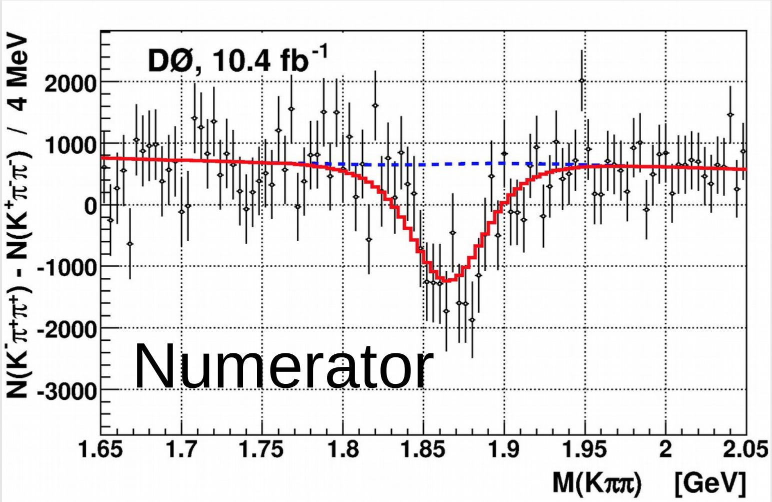
Measurement of the direct CP-violating parameter $A_{CP}(D^+ \rightarrow K^- \pi^+ \pi^+)$

10.4 fb^{-1}

High precision measurement of CPV parameters in Cabibbo favored decays crucial to establish experimental basis for charge symmetric process

$$A_{\rm CP}(D^+ \to K^-\pi^+\pi^+) = \frac{\Gamma(D^+ \to K^-\pi^+\pi^+) - \Gamma(D^- \to K^+\pi^-\pi^-)}{\Gamma(D^+ \to K^-\pi^+\pi^+) + \Gamma(D^- \to K^+\pi^-\pi^-)}$$





- Simultaneous fit
- Consistent with zero (SM)
- **2.5x improvement on measure**

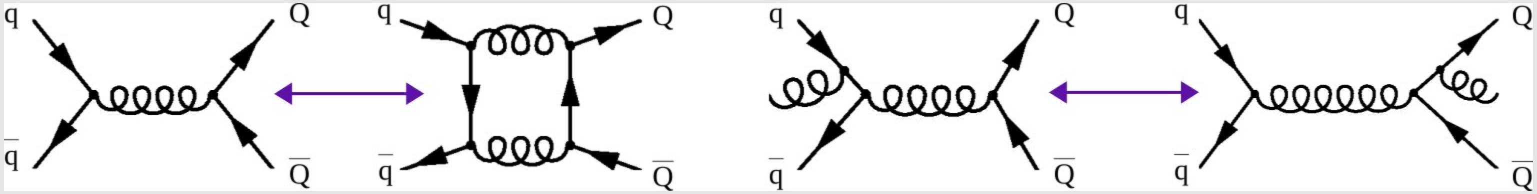
$$A_{\rm CP}(D^+ \to K^-\pi^+\pi^+) = [-0.16 \pm 0.15\,({\rm stat.}) \pm 0.09\,({\rm syst.})]\%$$

Phys. Rev. D 90, 111102(R) (2014)
arXiv:1408.6848

Forward-backward asymmetries

b production

Production mechanism dominated by gluon-gluon fusion → no A FB
A_{FB} receives contribution in $q\bar{q}$ and qg interactions from interference:



• initial and final-state radiative gluon diagrams
• box diagram + Born

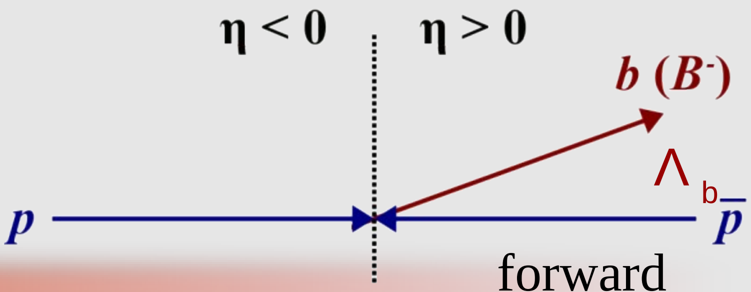
• different amplitudes in flavor excitation
• electro-weak process ($qq \rightarrow Z/\gamma \rightarrow b\bar{b}$)

In $p\bar{p}$ collisions $b(\bar{b})$ quark follows $p(\bar{p})$ direction

$$A_{FB} \simeq \frac{N_F - N_B}{N_F + N_B}$$

A_{FB} depends on $m(b\bar{b})$

D0:
A_{FB} using fully reconstructed B meson and Λ_b
(also Λ)
CDF:
A_{FB} with $b\bar{b}$ jets in low and high mass

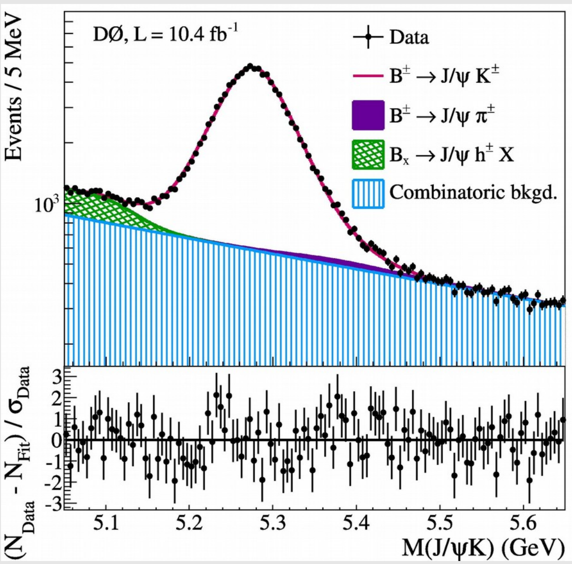


10.4 fb^{-1}

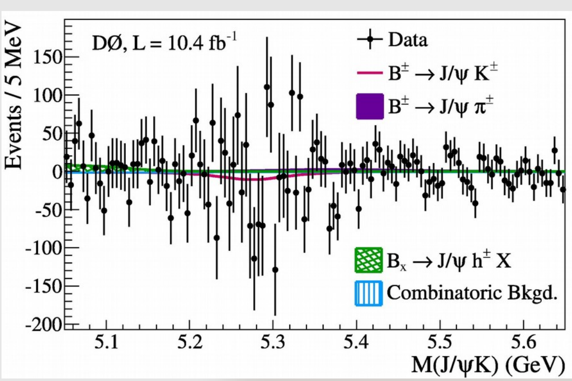
Production asymmetries of B±

(see talk by B. Abbott)

$$A_{FB}(B^{\pm}) = \frac{N(-q_B\eta_B > 0) - N(-q_B\eta_B < 0)}{N(-q_B\eta_B > 0) + N(-q_B\eta_B < 0)}$$

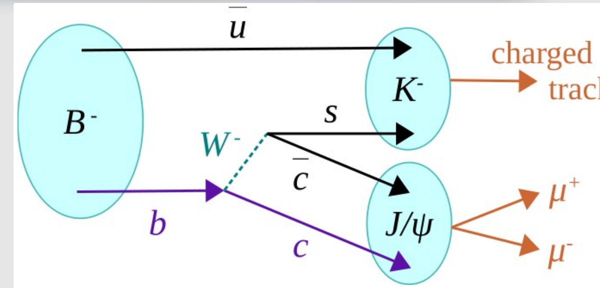


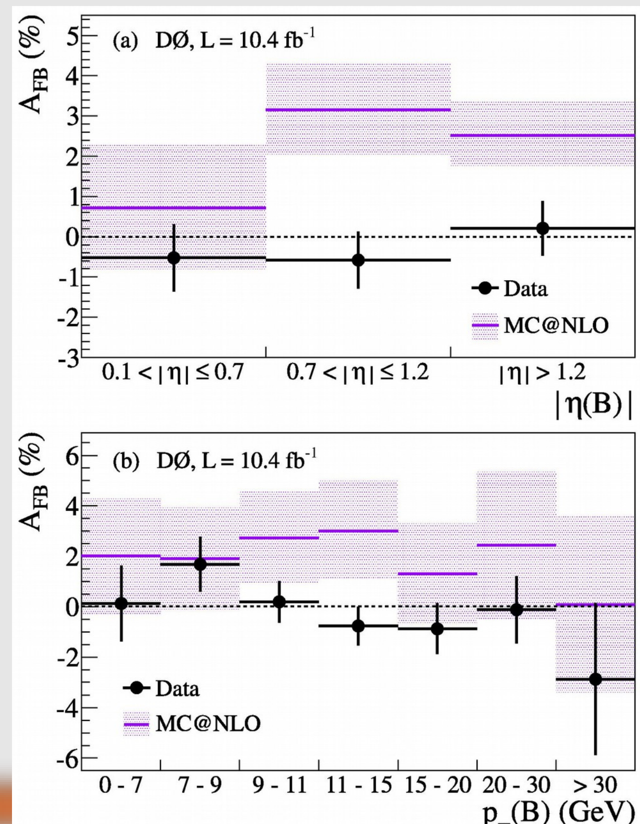
Sum F+B



Difference F-B

Fully reconstructed B meson





$A_{FB}(B^{\pm}) = (-0.24 \pm 0.41 \pm 0.19)\%$

Systematically lower than calculated in MC@NLO

More rigorous determination of the SM predtn. needed to interpret results

Less room for new physics causing anomalous F-B asymmetries (top and bottom)

Phys. Rev. Lett. 114, 051803 (2015)
arXiv:1411.3021

6.9 fb^{-1}

(see talk by J. Wilson)

Forward-backward asymmetries

A_{FB} in bb pairs at low mass

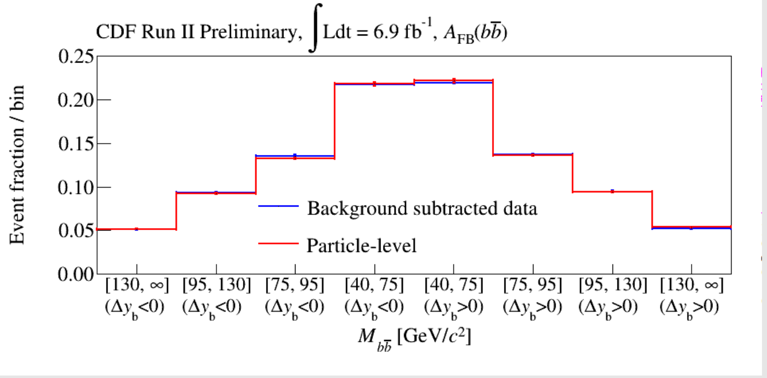
Two b-quark jets using displaced secondary vertices, muon tag

b-quark flavour: charged muon in the jet (muon Jet)
at particle level unfold M and Δy distributions

AFB at particle level → unfold Mbb and Δy_b distributions

$$\Delta y_b = Q(\mu)(y_{AJ} - y_{\mu J})$$

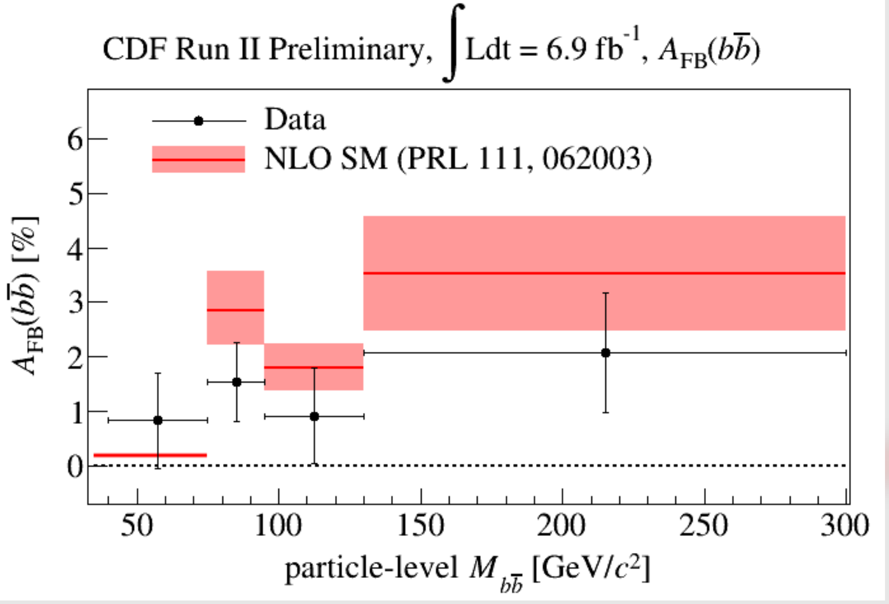
Unfolding effects minimal:



Integrated asymmetry: (1.2 ± 0.7)%

AFB :

- agreement with SM, including feature around Z pole mass



CDF Note 11156

(see talk by J. Wilson)

Forward-backward asymmetries

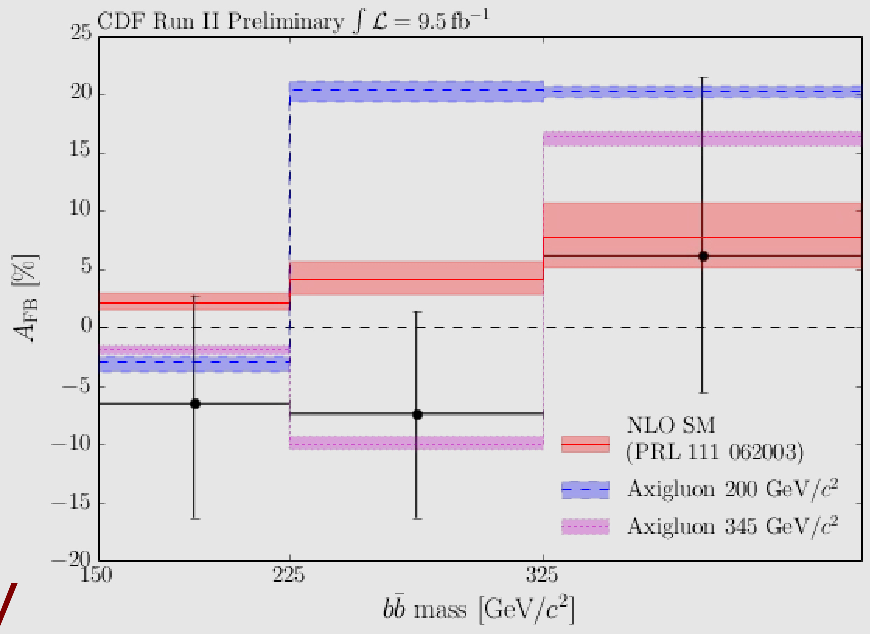
A_{FB} in bb pairs at high mass

Sample with at least two b-quark jets, m(bb)>150 GeV/c^2

- b-quark identified requiring displaced secondary vertex
- vertex mass used to determine sample composition (b,c,LF)
- b-quark charge via jet charge

Poisson Likelihood defined for: background, systematics, purity, smearing and signal asymmetry

Use Bayesian technique to extract the hadron-jet level A_{FB} posterior probability distribution in each bin



Results consistent with zero & SM

Exclude wide axigluon model m~200 GeV
Reduction of parameter space for $t\bar{t}$ asymmetry

CDF Note 11092

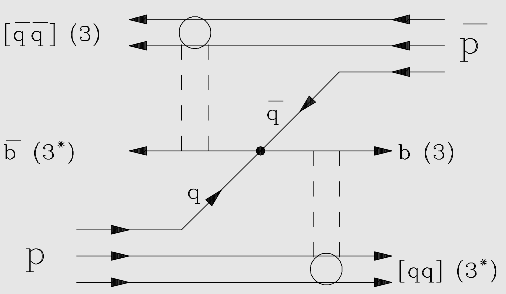
Forward-backward asymmetries

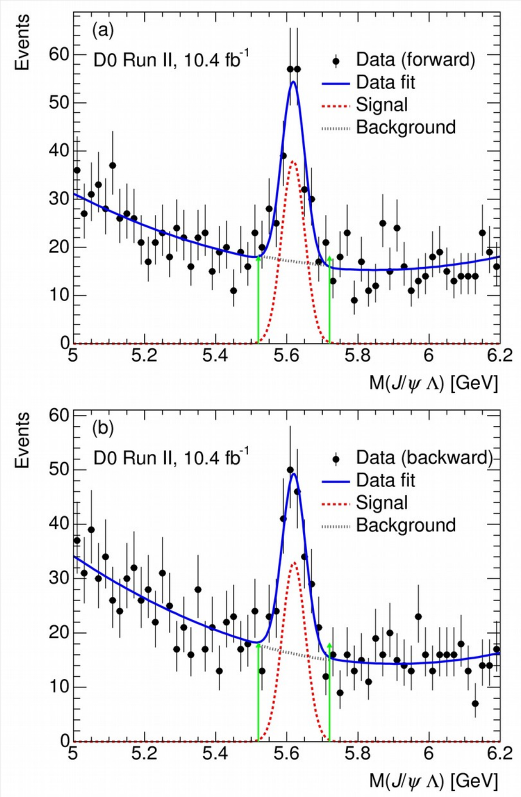
Λ^0_b and $\overline{\Lambda}^0_b$ baryon production

(see talk by B. Abbott)

Production through $q\bar{q}$, gg has small asymmetry (~1%) from NLO corrections

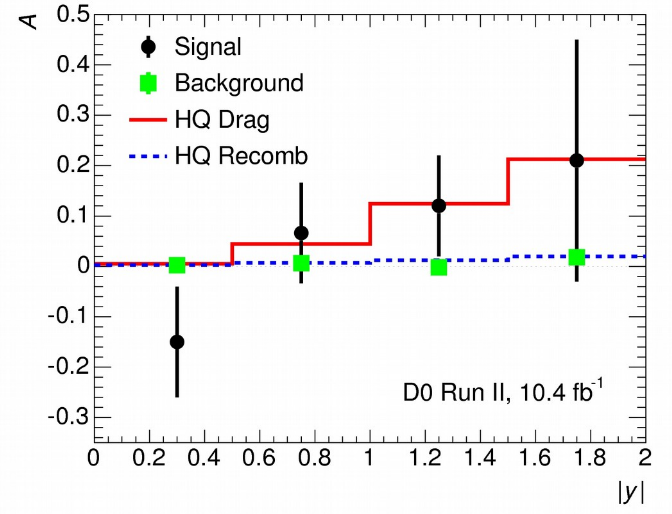
=> Study hadronization effects, eg "string drag" model (Rosner) favor production of $(\overline{\Lambda}_b)\Lambda_b$ in (anti)proton beam direction





Clean signals
Forward/backward events shown

General agreement with heavy quark drag model =>



(More details and "rapidity loss" analysis in parallel talk)

arXiv:1503.03917

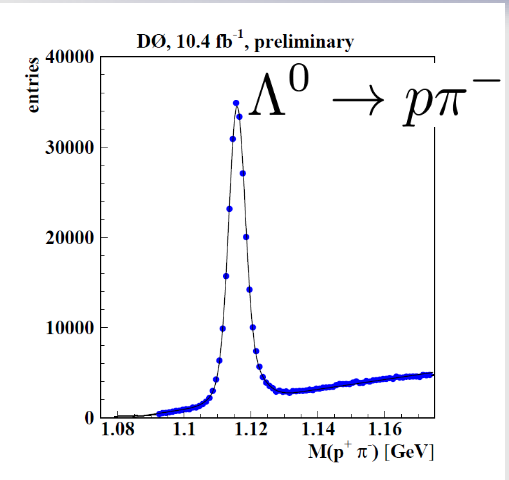
Forward-backward asymmetries

Λ^0 and $\bar{\Lambda}^0$ baryon production

NEW

10.4 fb^{-1}

(see talk by B. Abbott)

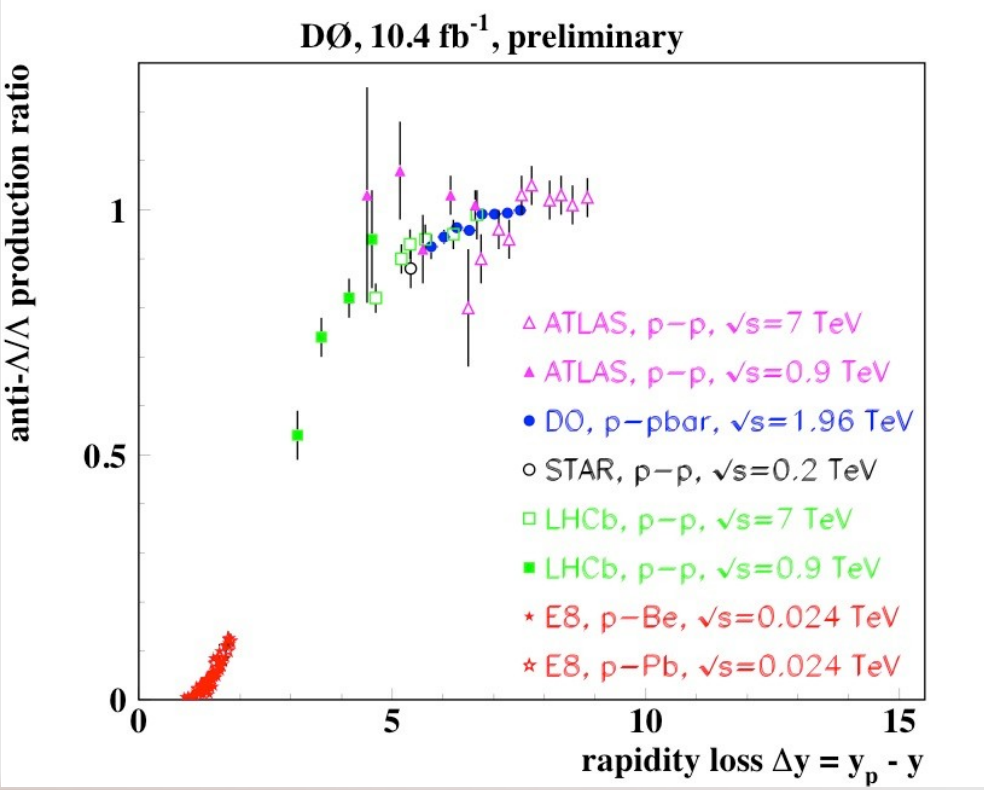


A_{FB} measured in 3 separate samples: $\Lambda(\bar{\Lambda})X$, $\mu^{\pm}\Lambda(\bar{\Lambda})X$, $J/\Psi\Lambda(\bar{\Lambda})X$

A_{FB} consistent with strong connection to quark flavor of incoming hadron

$\bar{\Lambda}/\Lambda$ production ratio is approximately a universal function of the proton "rapidity loss" $y_p - y$

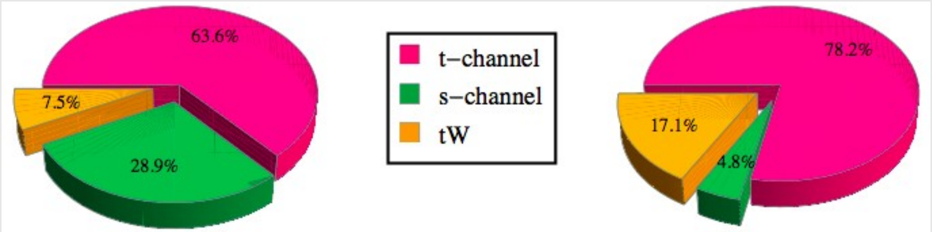
Little dependence on $\sqrt{s}$, target, or kinematic factors



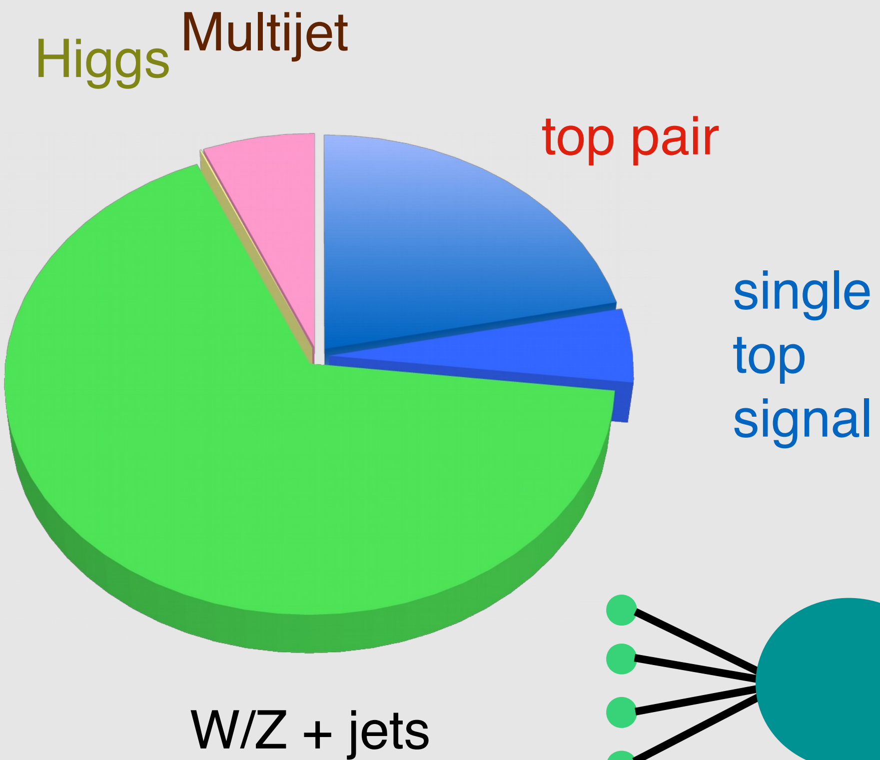
D0conf 6464

Single top (s+t)-channel Tevatron XS combo and Vtb extraction

Tevatron: **strong advantage of $p\bar{p}$ initial state for s-channel production**

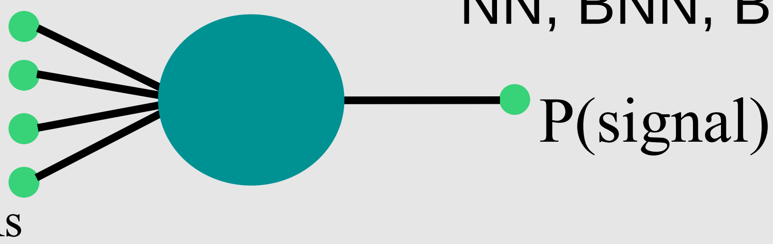


Tevatron: σ_{tot} = 3 pb **LHC: σ_{tot} = 114 pb @ 8 TeV**



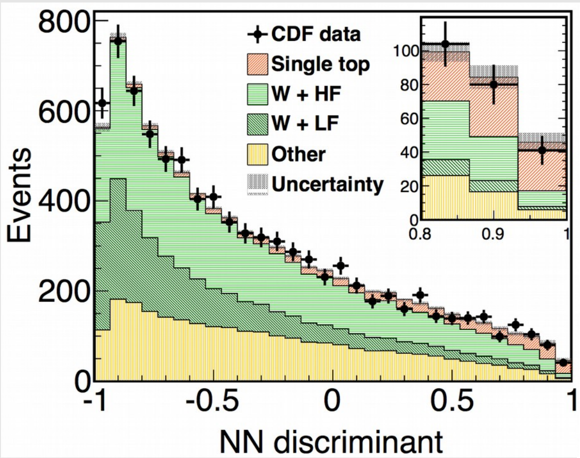
Complex background environment, small signal component

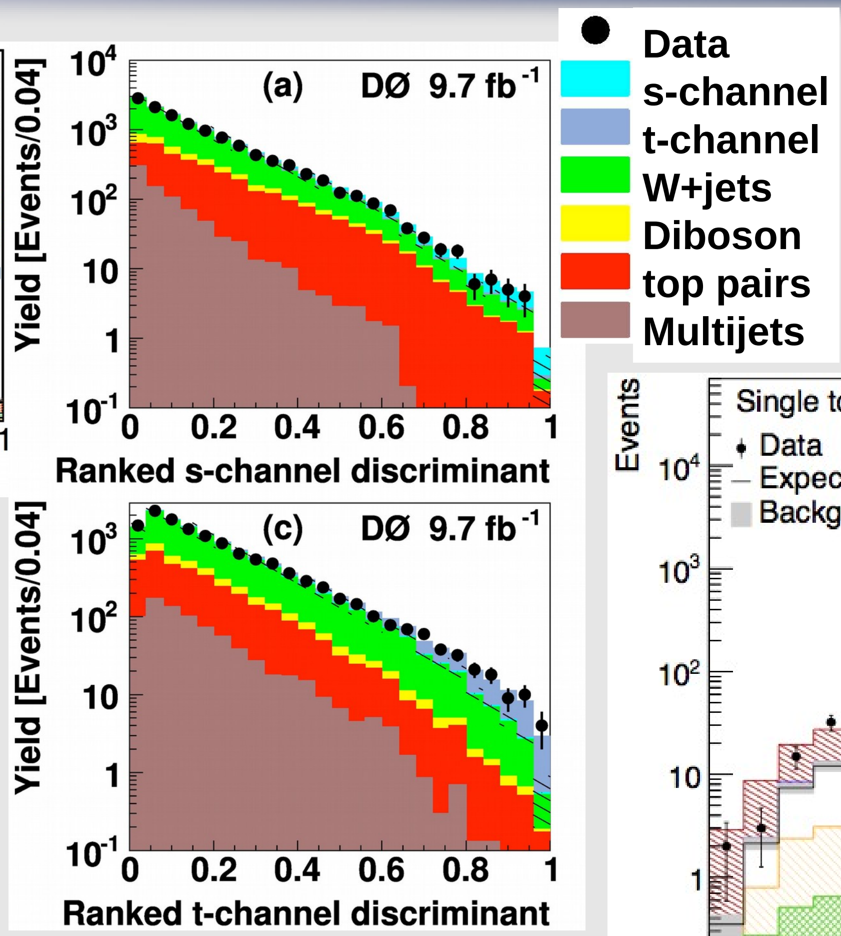
- Extensive studies: event selection, discriminating variables
- Exploit MVA and analytic methods: NN, BNN, BDT, ME

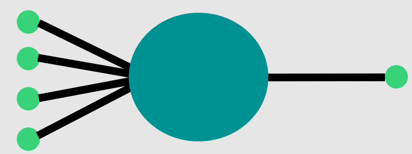


Combination: arXiv:1503.05027
CDF: arXiv:1410.4909
arXiv:1407.4031
D0: Phys. Rev. Lett. 112, 231803,
arXiv:1402.5126

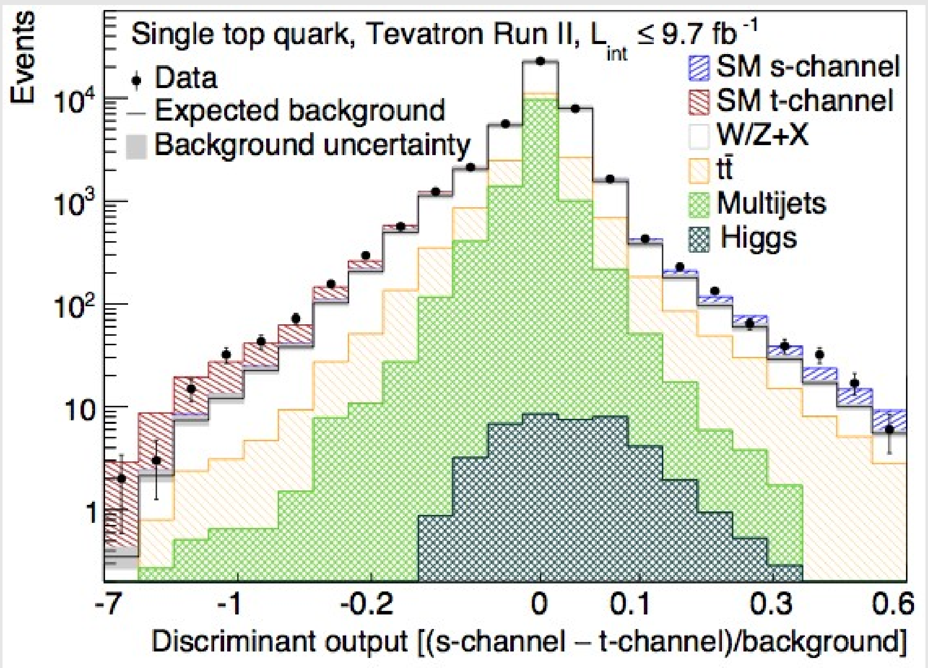
Top
Single top (s+t)-channel Tevatron XS combo and Vtb extraction







combined discriminant



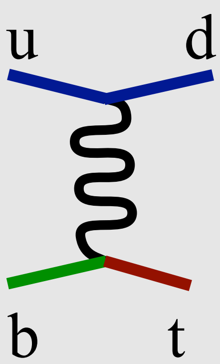
↑ CDF: lepton+jets s+t discriminant

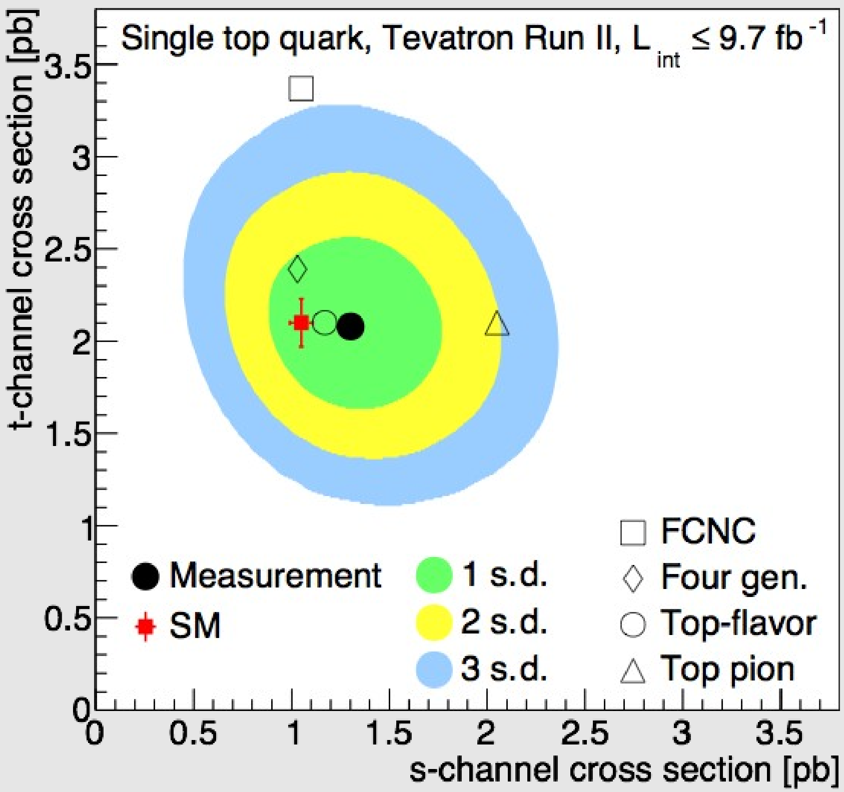
D0: s-channel, t-chan →

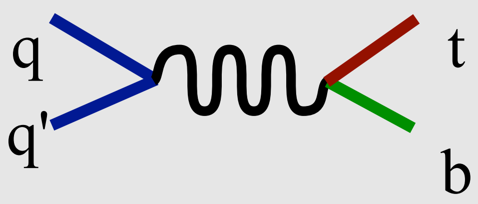
X-axis units:

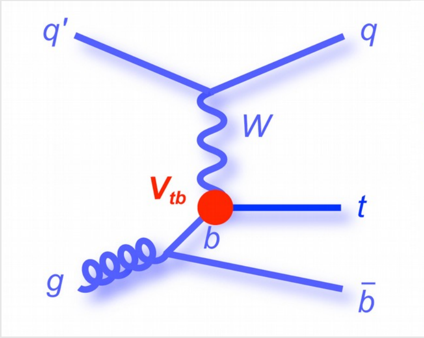
t-channel s/b | s-channel s/b

Single top (s+t)-channel Tevatron XS combo and Vtb extraction



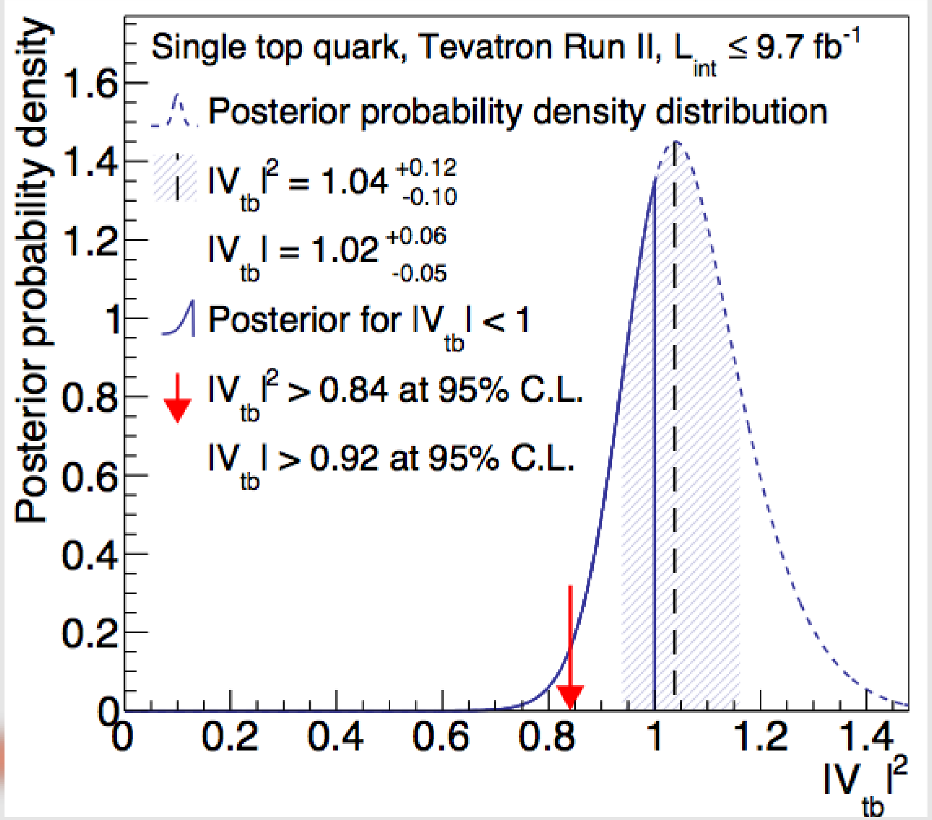






$$V_{CKM} = \begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix}$$

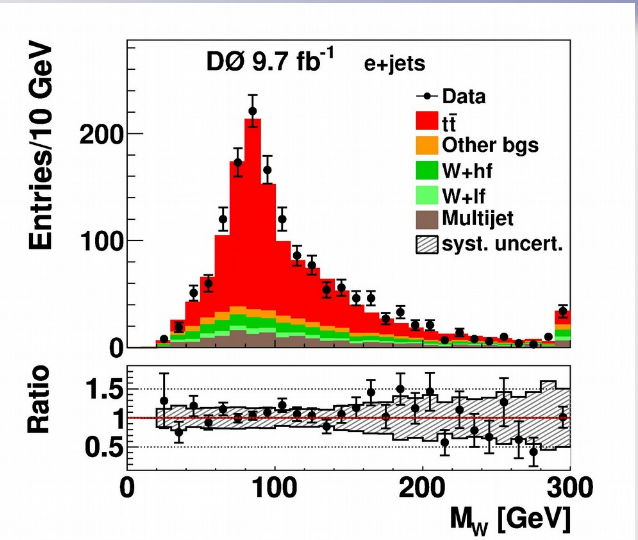
$$\sigma_{s+t} \propto |V_{tb}|^2$$



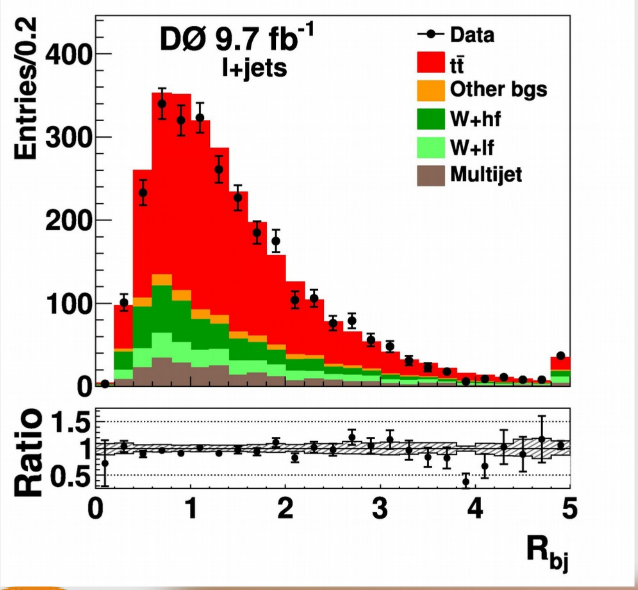
Precision measurement of the top-quark mass in lepton+jets final states

9.7 fb^{-1}

Mw → dijets



Light-to-b-jet scale

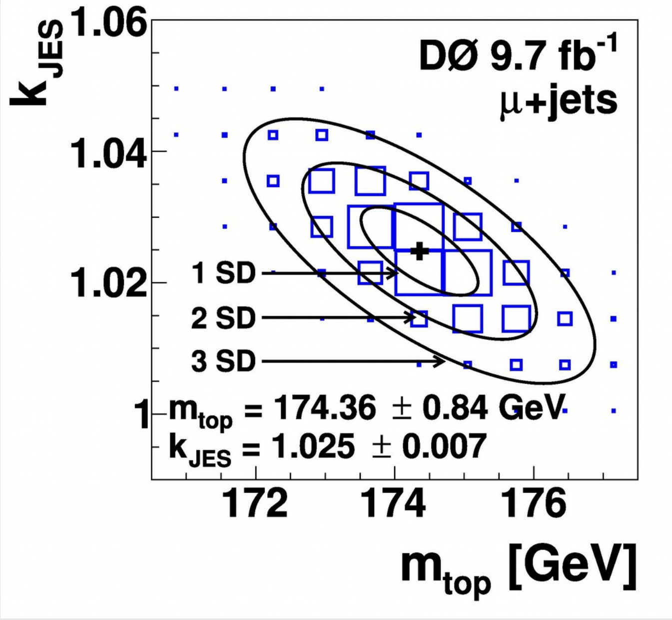


Matrix element method

- Innovations in ME calculation via arXiv:/1410.6319

- **Single-most precise measurement!**

- Detailed PRD, e.g. cross-check of b-quark jet energy scale:



R_{bl} = 1.008 ± 0.0195 (stat.) ± 0.037 (syst.)

l+jets channel

$\delta m_t / m_t$ = 0.43% (D0)

$\delta m_t / m_t$ = 0.45% (CMS)

$\delta m_t / m_t$ = 0.65% (CDF)

Phys. Rev. Lett. 113, 032002 (2014)

&Submitted to PRD arXiv:1501.07912

Precision Measurement of the Top Quark Mass in Dilepton Events

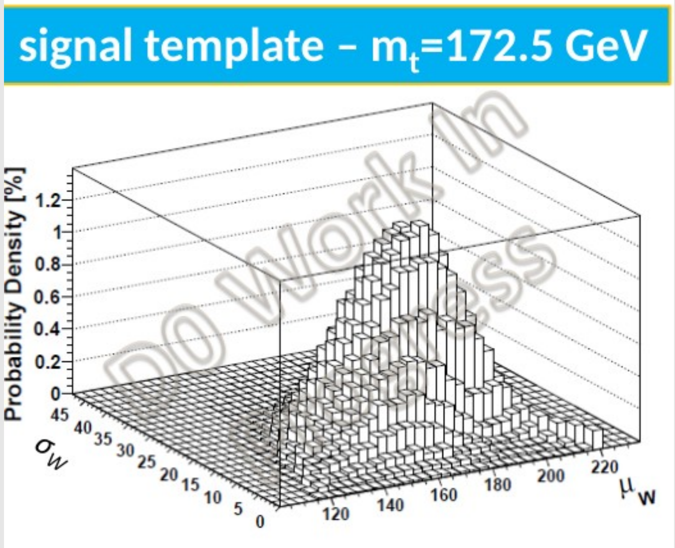
9.7 fb^{-1}

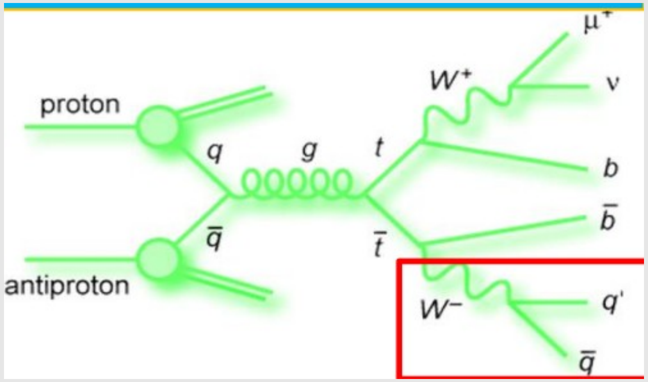
NEW

Measure of top quark mass in dilepton channel with full D0 data set

(see talk by Huanzhao Liu for 1st public result)

Neutrino weighting method:
- Kinematic reconstruction with weights for multiple solutions based on calculated and observed MET (ω)
- Integrate solutions, η(ν) range + jet-lepton assignments, over m(top) hypotheses
- Characterize events by moments of the distribution: μ(ω) and σ(ω)





Correction factor derived from l+jets analysis (kJES) reduces JES uncertainty ~4x

Multiply likelihoods from all events to get a combined $L(m_{top}^{MC})$

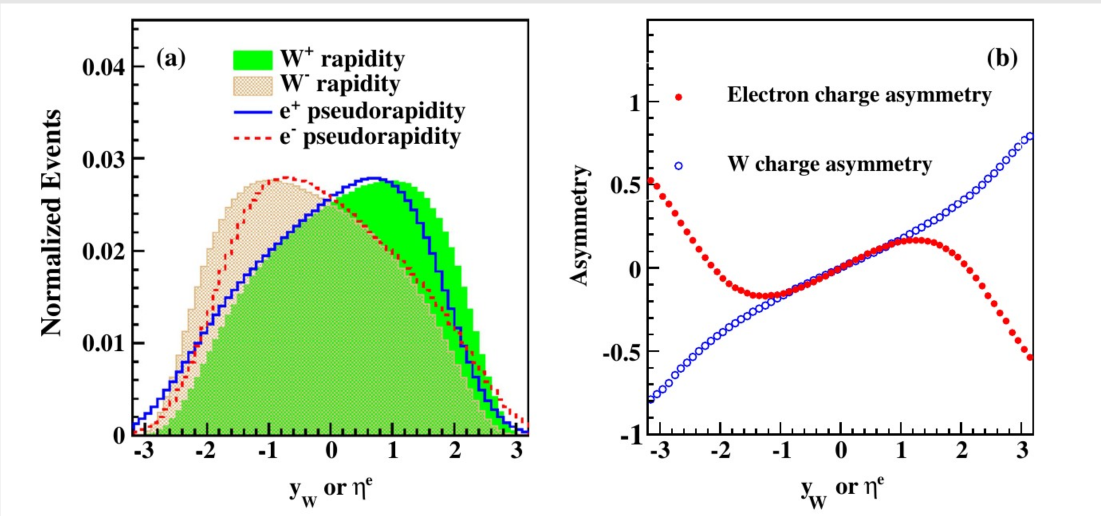
D0conf 6463

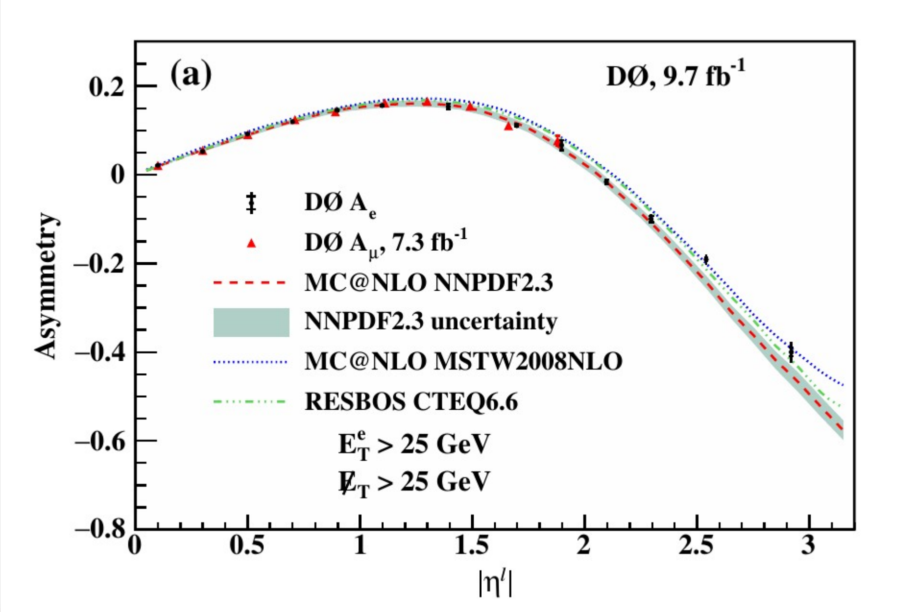
9.7 fb^{-1}

Electron charge asymmetry in $p\bar{p} \rightarrow W + X \rightarrow e\nu + X$ events

W charge asymmetry is sensitive to Parton Distribution Functions (PDFs)

- Tevatron measurements => stringent constraints on valence *u,d* distributions
- Straightforward observable. Convolution of the W production asymmetry and V-A decay (important to measure both)





CP-folded electron asymmetry compared to MC@NLO(NNPDF2.3), RESBOS(CTEQ6.6)

Phys. Rev. D. 91, 032007 (2015)
arXiv:1412.2862

EW production and decay

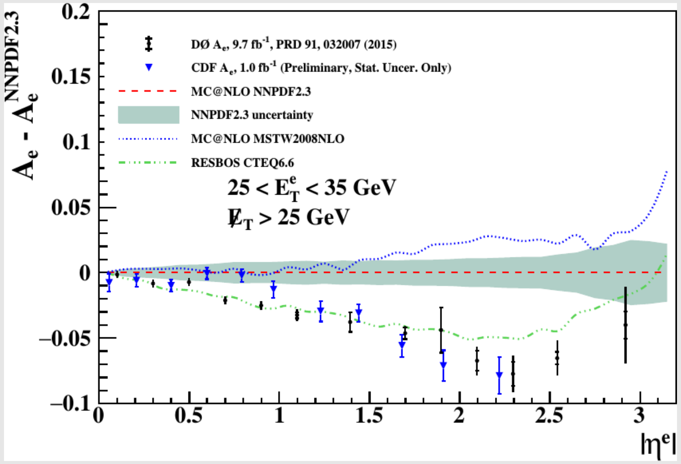
Electron charge asymmetry in $p\bar{p} \rightarrow W + X \rightarrow e\nu + X$ events

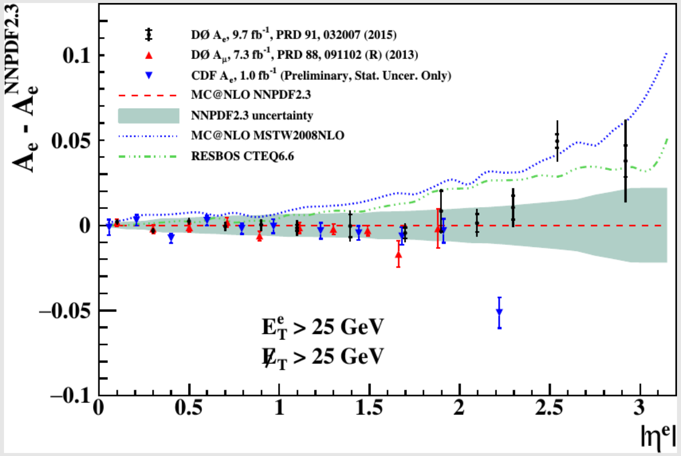
9.7 fb^{-1}

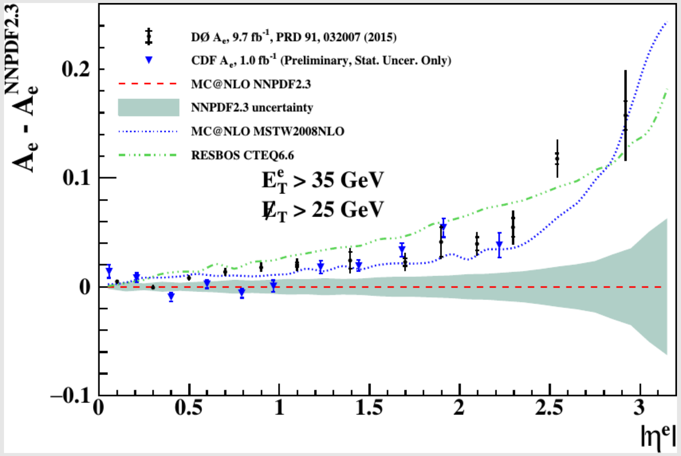
Most precise measurements of electron charge (+previous W production) asymmetry in electron channel.

Benefit to all hadronic physics analyses

- Extended η coverage to 3.2
- Improvement of PDF models in the $x - Q^2$ region of interest for W production at the Tevatron (Estimated to reduce the PDF uncertainty in the DØ M_W measurement by approximately 30% (2-3 MeV))







Various comparisons vs kinematic range:

e/μ channel, experiments, generators

Phys. Rev. D. 91, 032007 (2015)
arXiv:1412.2862

Measurement of the φ*η distribution of muon pairs with masses between 30 and 500 GeV

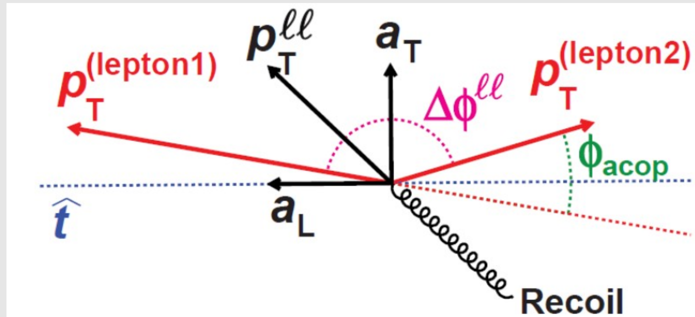
$10.4\ fb^{-1}$

$\varphi^* = \tan(\varphi_{acop}/2)\sin\theta^*$

$\varphi_{acop} = \pi - \Delta\varphi^{ll}$

$\cos\theta^* = \tanh[(\eta_- - \eta_+)/2]$

Collins-Soper angle



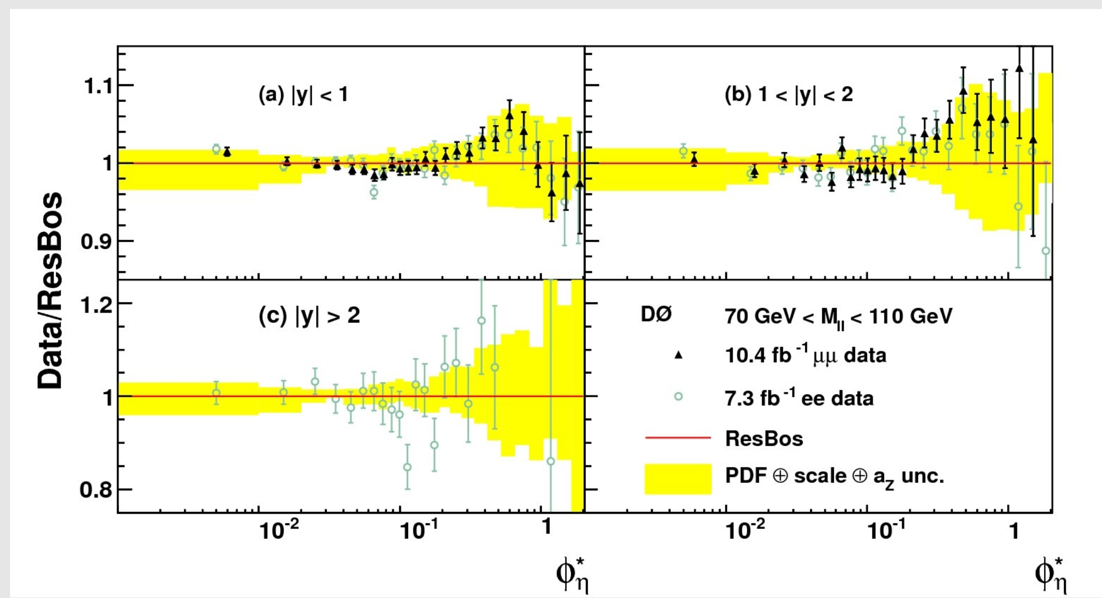
Probes same physics as p_T^{ll}, $\varphi^* \sim a_T/M_{ll}$

Less sensitive to detector resolution and efficiency (Uses angles only)

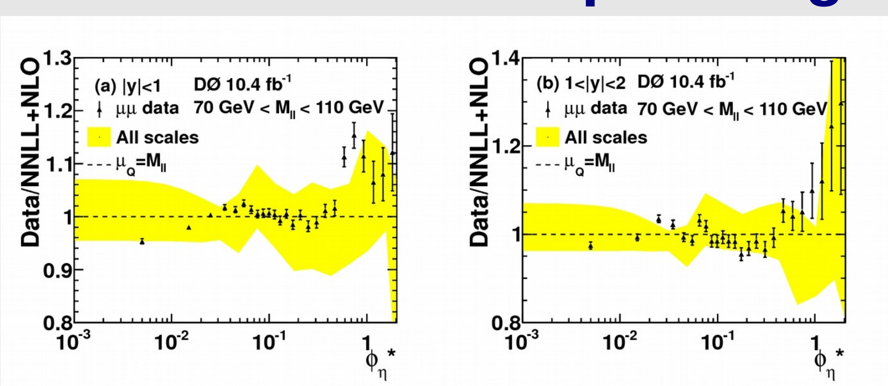
First measured in Z peak region by D0 (7.3 fb-1) PRL 106, 122001 (2011)

Data used to improve ResBos and make predictions for LHC

ATLAS: PLB 720, 32(2013)
LHCb: JHEP 1302, 106(2013)



Z peak region

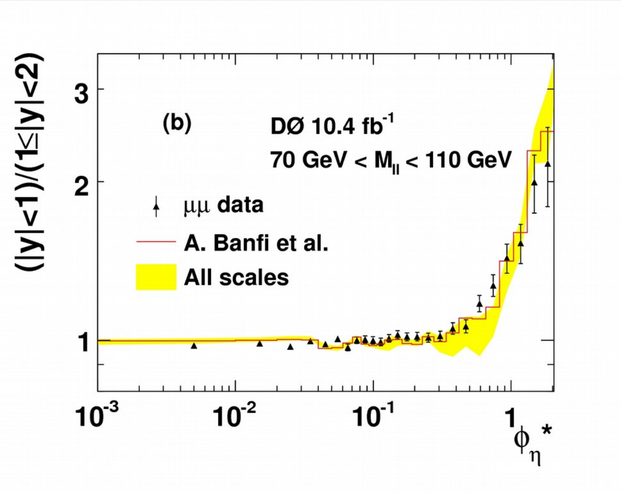


Phys. Rev. D 91, 072002
arXiv:1410.8052

10.4 fb^{-1}

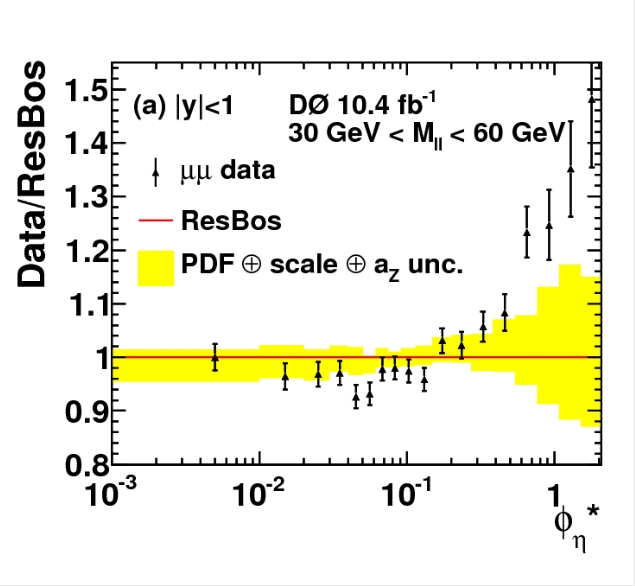
Measurement of the φ*η distribution of muon pairs with masses between 30 and 500 GeV

- Ratio 1/σ dσ/dφ* in the central to forward rapidity regions can reduce the uncertainty band from QCD scales => suggests the possibility of a new variable that is less sensitive to theoretical uncertainty



scale uncertainty

- **First low mass measurement**
  - More sensitive to small-x effects

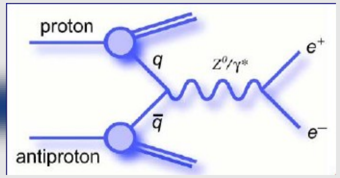


- **Also first ever high mass measurement**
  - For constraining QCD ISR in high mass final states

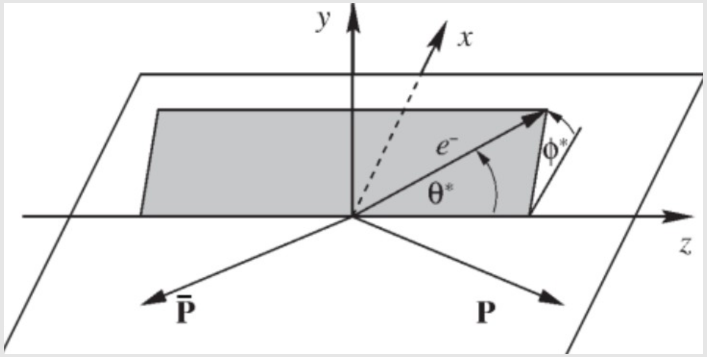
Phys. Rev. D 91, 072002
arXiv:1410.8052

10.4 fb^{-1}

Measurement of the effective weak mixing angle in pp → Z/γ* → e+e- events



Drell-Yan pairs produced via $q\bar{q}$ anhilation at Tevatron

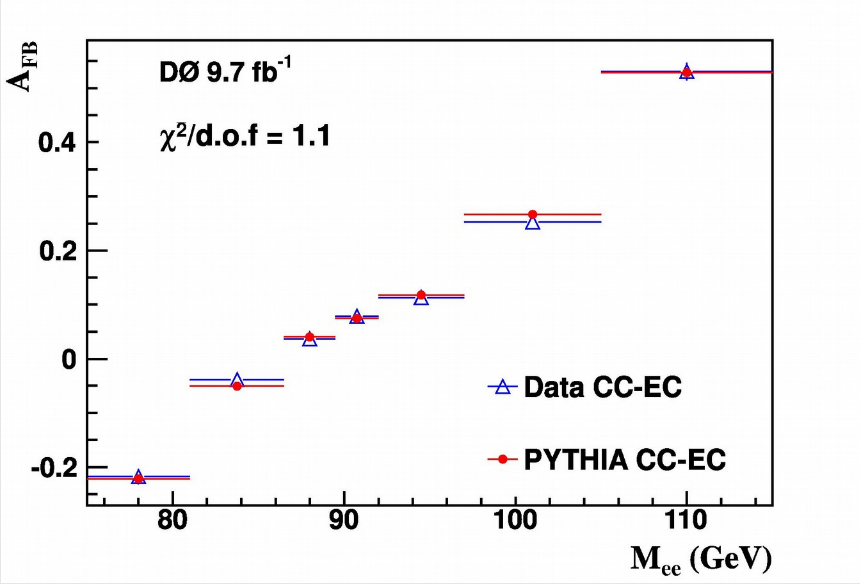


Weak mixing angle measured from forward-backward asymmetry of lepton polar angle distribution:

$$A_{FB} = \frac{\sigma^+ - \sigma^-}{\sigma^+ + \sigma^-}$$

Sensitive to $\sin^2\theta_W$ through interference of vector and axial vector couplings of Z boson

- Measure A_{FB} vs dilepton pair invariant mass
- Compare to MC $A_{FB}(M_{ee}, \sin^2\theta_W)$ templates
- Analysis for CC-CC, CC-EC, EC-EC cases and running periods



arXiv:1408.5016

10.4 fb^{-1}

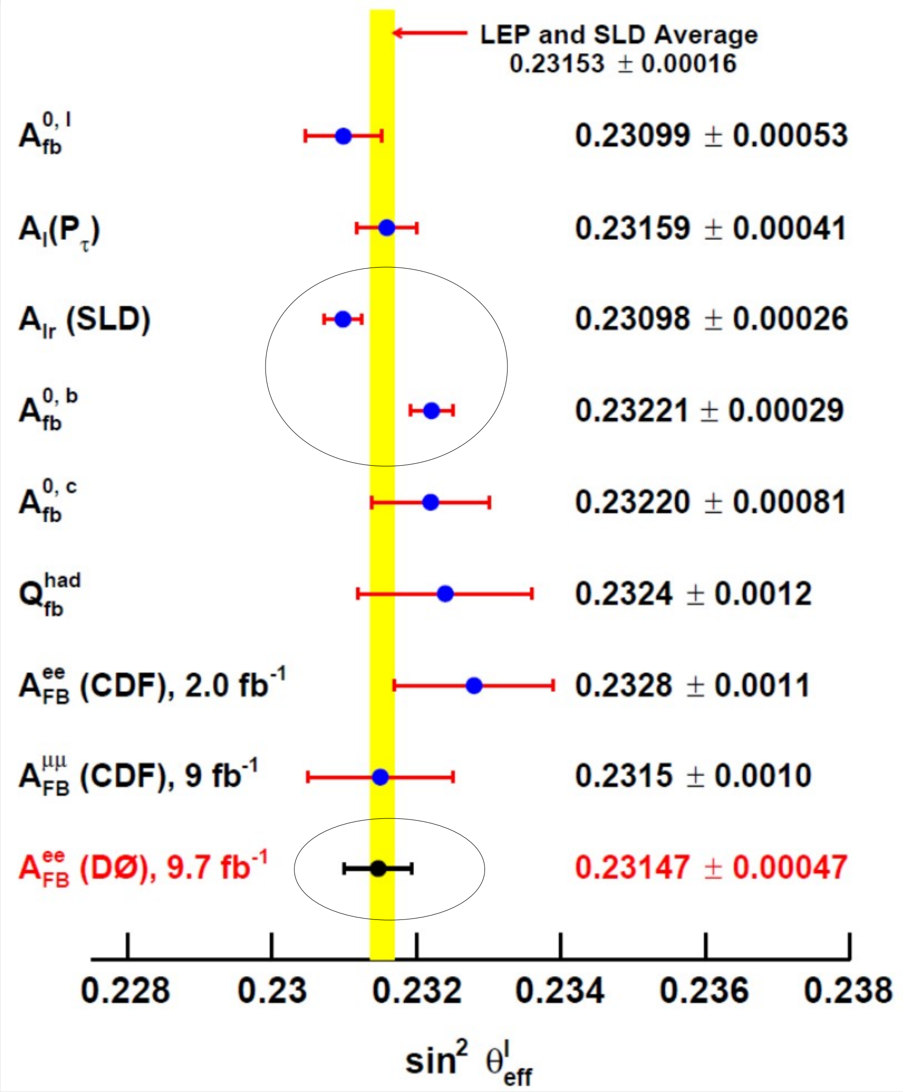
Measurement of the effective weak mixing angle in $p\bar{p} \rightarrow Z/\gamma^* \rightarrow e^+e^-$ events

	CC-CC	CC-EC	EC-EC	Combined
$\sin^2\theta_W$	0.23142	0.23143	0.22977	0.23139
Statistical	0.00116	0.00047	0.00276	0.00043
Systematic	0.00009	0.00009	0.00019	0.00008
Energy Calibration	0.00003	0.00001	0.00004	0.00001
Energy Smearing	0.00001	0.00002	0.00013	0.00002
Background	0.00002	0.00001	0.00002	0.00001
Charge Misidentification	0.00002	0.00004	0.00012	0.00003
Electron Identification	0.00008	0.00008	0.00005	0.00007
Fiducial Asymmetry	0.00002	0.00001	0.00001	0.00001
Total	0.00116	0.00048	0.00277	0.00044

$\sin^2\theta^l_{eff} = 0.23147 \pm 0.00047$

World's best from hadron collider

Relates to observed tension involving most precise quark and lepton couplings



arXiv:1408.5016

9.4 fb^{-1}

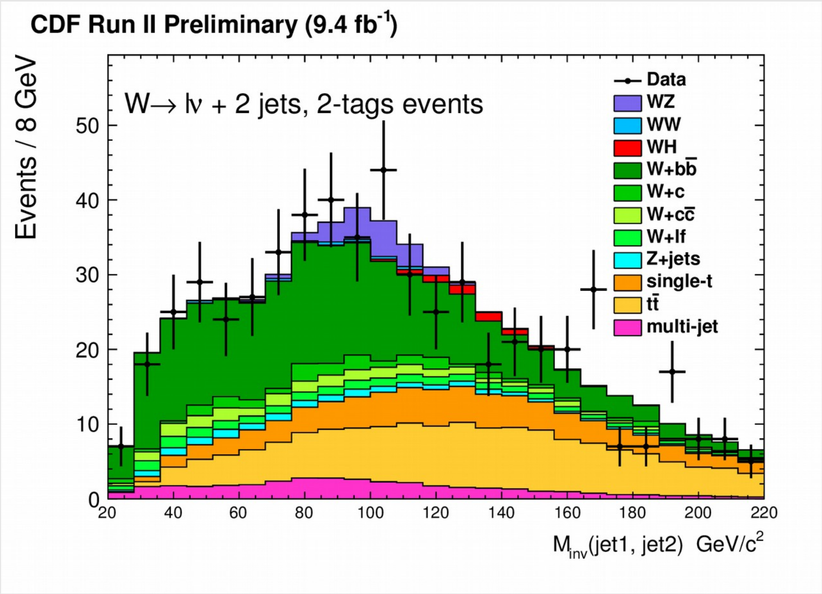
NEW

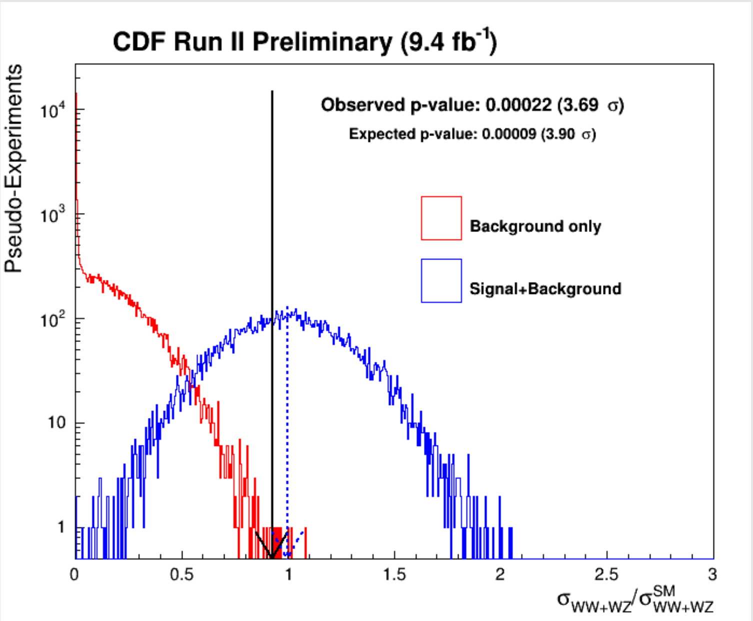
Diboson cross sections

WW and WZ production in the lepton+Heavy Flavor jets channel

Diboson WW and WZ production in final state consistent with semileptonic W decay plus heavy flavor quarks

$W \to cs$, $Z \to b\bar{b}$, $c\bar{c}$





Analysis of the di-jet invariant mass spectrum

3.69 s.d. evidence of WW+WZ w/ HF final states

Cross section measurement

σ_{WW+WZ} = 13.7 +/- 3.9 pb

$$\mu^{Obs}_{WW+WZ} = 0.92$$

CDF Note 11157

9.4 fb^{-1}

NEW

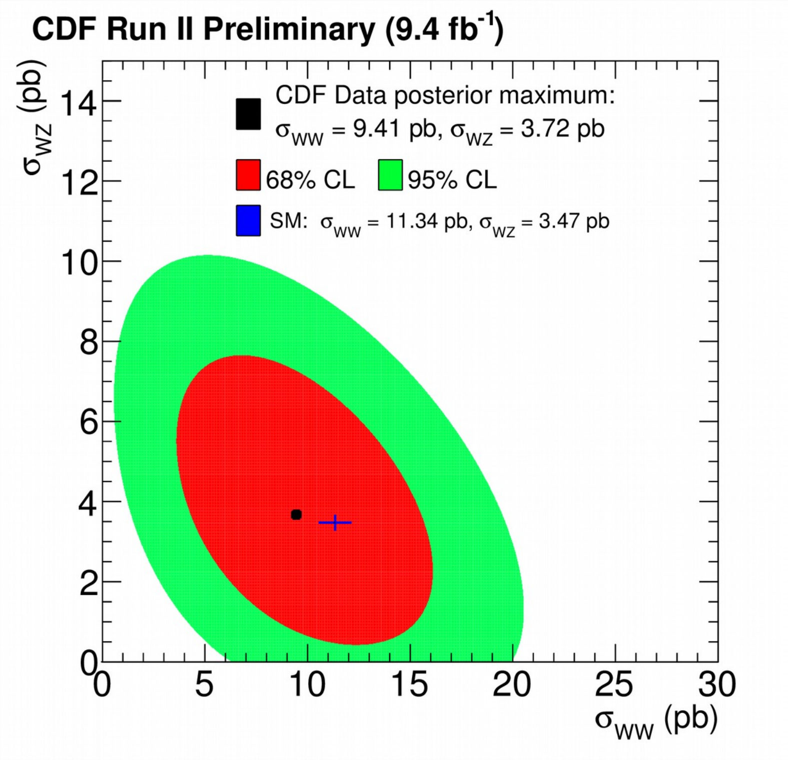
Diboson cross sections

WW and WZ production in the lepton+Heavy Flavor jets channel

Diboson WW and WZ production in final state consistent with semileptonic W decay plus heavy flavor quarks

$W \rightarrow cs$, $Z \rightarrow b\bar{b}, c\bar{c}$

- Use different HF decay pattern of the W and Z and the analysis of the secondary-decay vertex properties
- Independently measure the WW and WZ production cross section in a hadronic final state, **for the first time at hadron colliders**



Measured cross sections:

σ_{WW}= 9.4 +/- 4.2 pb

σ_{WZ}=3.7+2.5-2.2 pb

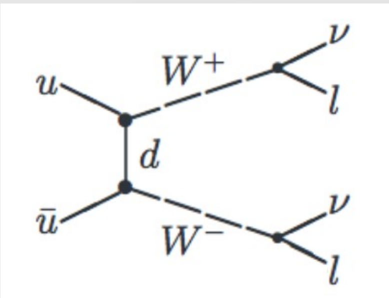
Consistent with the SM predictions, correspond to signal significance of 2.87 s.d. and 2.12 s.d. for WW and WZ respectively

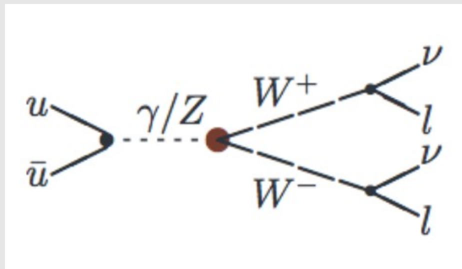
CDF Note 11157

9.7 fb^{-1}

Diboson cross sections

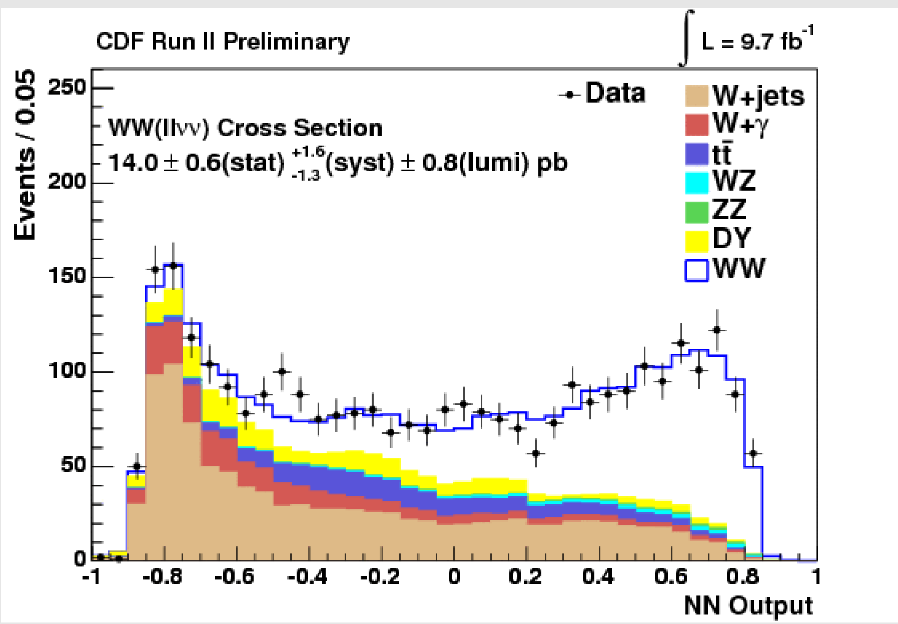
W+W− Production Cross Section and Differential Cross Sections





Production via quark radiation, multi-gauge-boson coupling

- Background for H->WW
- XS measure similar to H→WW search
  - Extend to 1, 2-or-more jets regions
  - 1-jet measure differential in jet pT



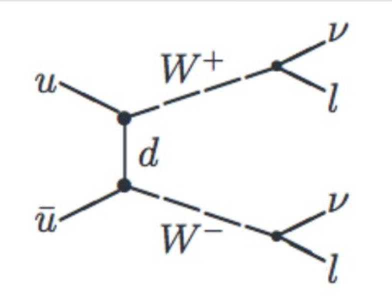
<== combined NN for inclusive measurement

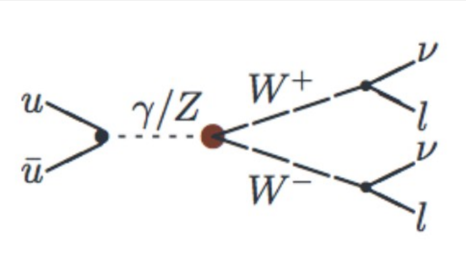
Good modeling of input variables for Signal and Background regions

CDF Note 11098

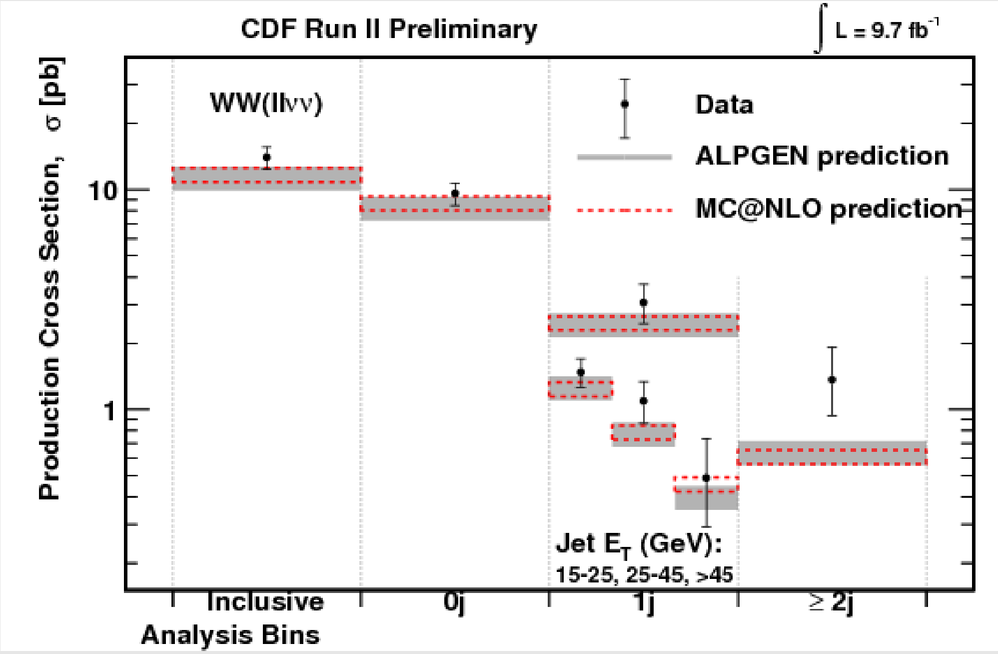
Diboson cross sections

W+W− Production Cross Section and Differential Cross Sections





Production via quark radiation, multi-gauge-boson coupling



- Results unfolded for bin migration and acceptance differences
- Uniformly higher than, but consistent with predictions

First differential σ in a massive diboson state

Very challenging at LHC due to $t\bar{t}$ background

CDF Note 11098

V+HF

Search for production of an Upsilon(1S) meson in association with a W or Z boson

Probe of QCD, NRQCD, and long distance matrix elements (LDME)

Search for excursions from SM production

- Charged Higgs may decay into ΥW with high BR
- SM Higgs can decay into ΥZ, as can other light scalars

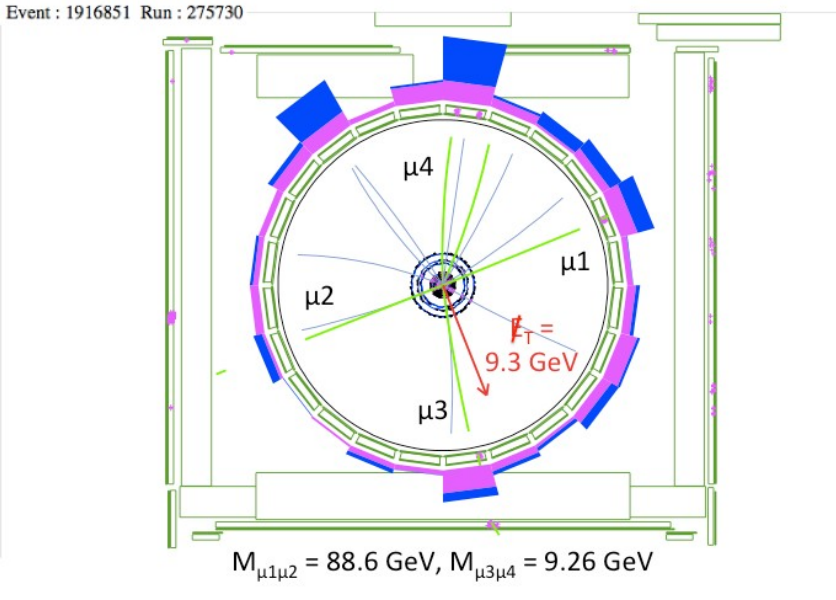
Observe

- 1 Υ(→μ+μ-)+W(→lν) candidate
  - Expected bkg: 1.2±0.5 events
- 1 Υ(→μ+μ-)+Z(→l+l-) events
  - Expected bkg: 0.1±0.1 events

Event selection:

Υ(1S) candidate + W or Z selections

4-muon event



95% CL limits σ(ΥW) < 5.6 pb
σ(ΥZ) < 21 pb

Phys. Rev. D 91, 052011
arXiv:1412.4827

Measurement of the W+b-jet and W+c-jet differential production

8.7 fb^{-1}

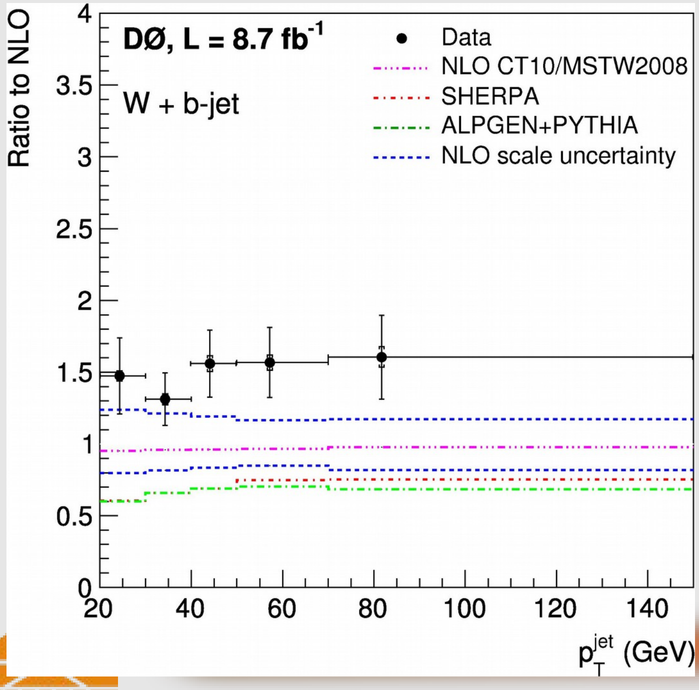
(See talk by A. Kumar)

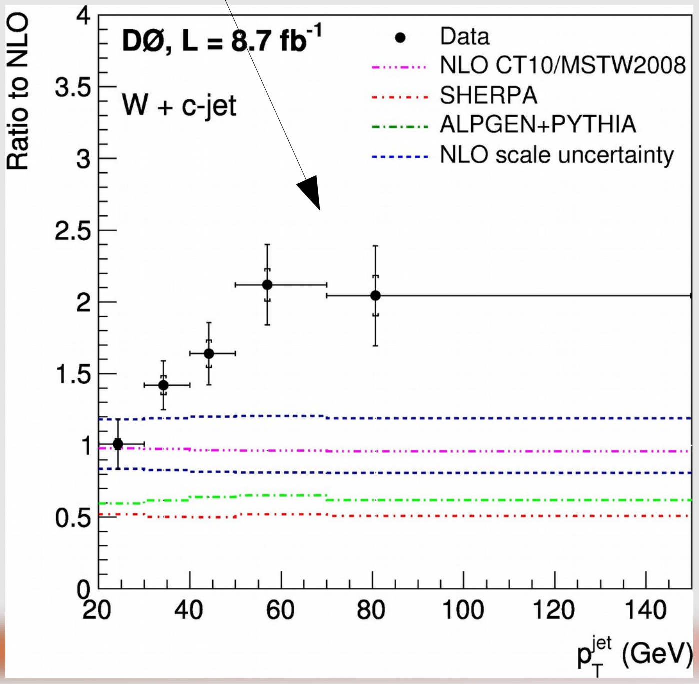
W+c is a probe of s-quark PDF

Tevatron W+c 85% s-quark initial state, $Q^2 < 10^4$ GeV^2

W+c and W+b are backgrounds to WH(→bb), ttH or beyond the SM

New selections => Enhance contribution from qq→W+g(g→cc)
(almost half gluon splitting at high p_T)





First measures differential in pT
and
Sensitive to gluon splitting process

Missing higher order corrections, enhanced cc splitting, strange sea?

Phys. Lett. B 743, 6 (2015)
arXiv:1412.5315

V+jets
Ratio of inclusive cross sections $\sigma(p\bar{p} \to Z+2b\ jets)/\sigma(p\bar{p} \to Z+2\ jets)$

(See talk by A. Kumar)

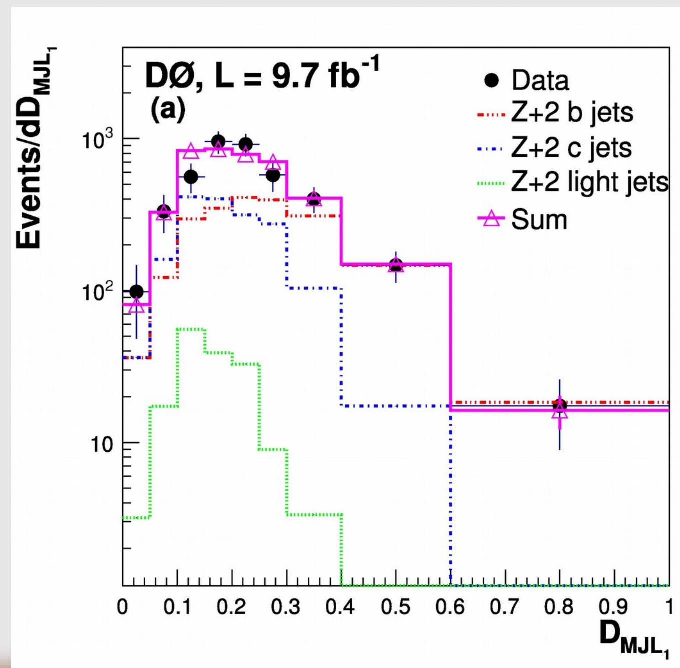
Z+2b is significant background to ZH(H→bb) and searches for sbottom

Important test of pQCD and non-pQCD (gluon splitting)

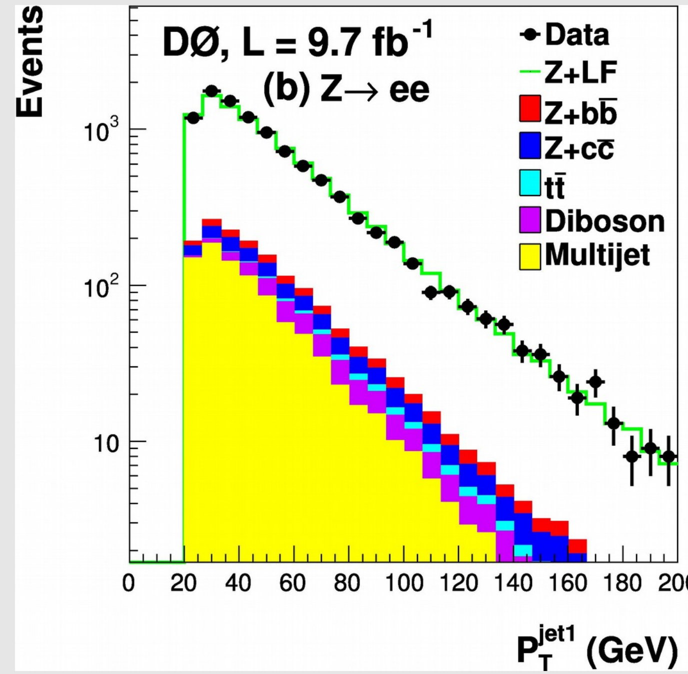
At Tevatron
- qq→Zbb 76%
- gg→Zbb 24%

Discriminate between Z+2b, Z+2c after SM bkg subtraction

Fit 2D templates of b-jet discriminant using both jets



Measure in ee and mumu channels



$$R = 0.0236 \pm 0.0032 \pm 0.0035$$

In agreement w/ NLO pred w/in exp & theory uncertainties

Phys. Lett. B 743, 6 (2015)
arXiv:1412.5315

Measured at √s=0.9, 1.96 TeV
(see talk by M. Albrow)

QCD low-x

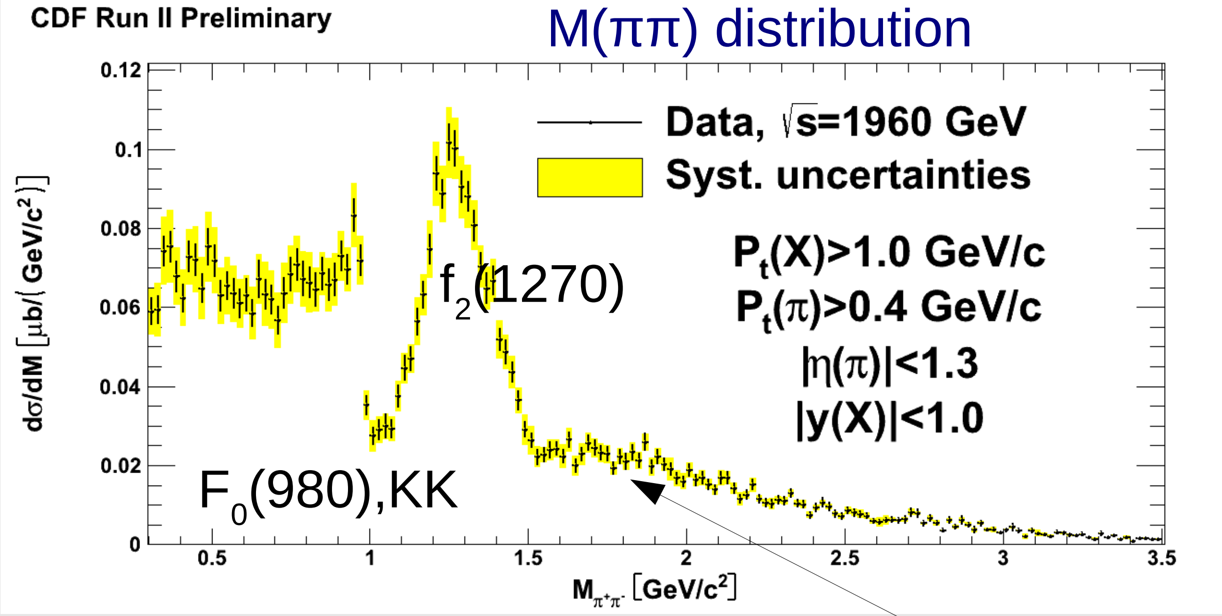
Exclusive pi-pi production

(double pomeron exchange)

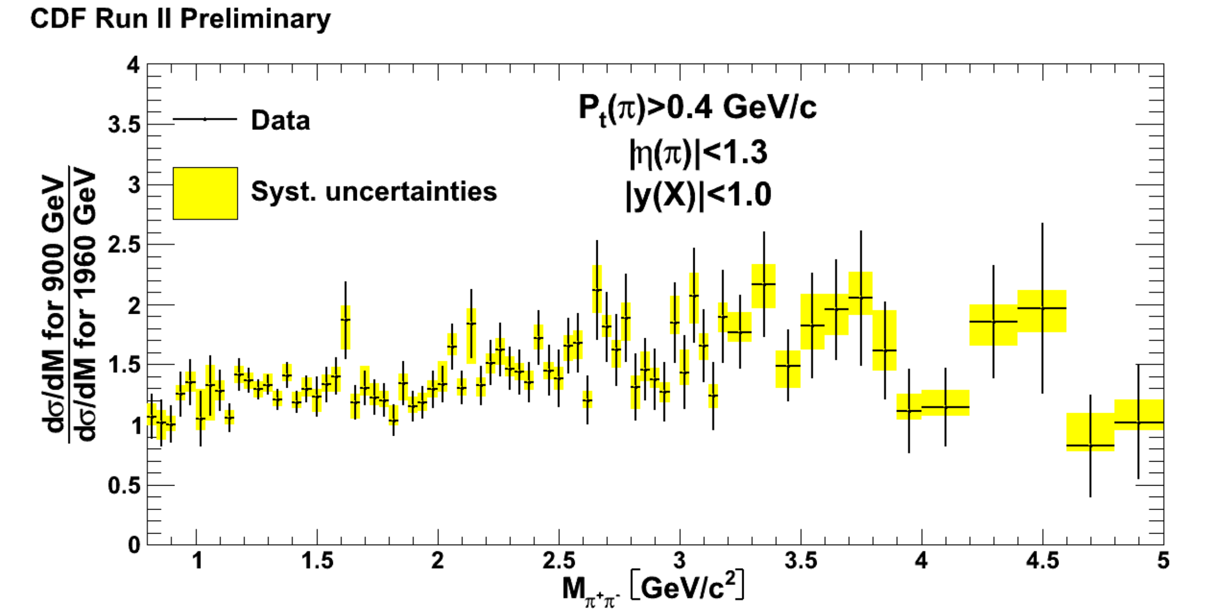
- 2 charged particles (π+π-) in |η|<1.3
- No particles in 1.3<|η|<5.9

Expect dominance of DPE production

σ(p+(π+π-)+p)~1/ln(s) consistent with Regge theory



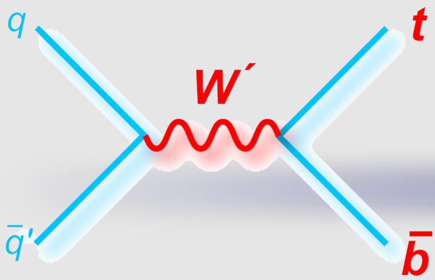
$f_0(1500)$, $f_0(1710)$ glueball candidates, no significance



Possible information for:
- isoscalar meson spectroscopy
- pomeron in transition to pQCD

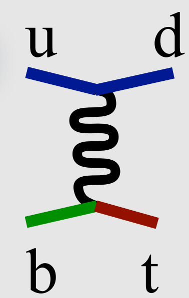
arXiv:1502.01391

9.5 fb^{-1}

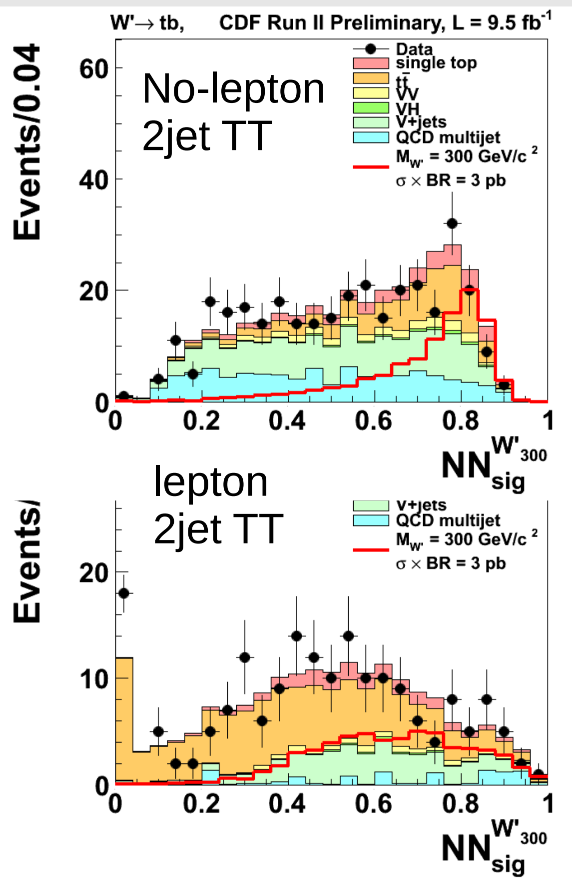


Search for W' decaying to a t+b quark pair

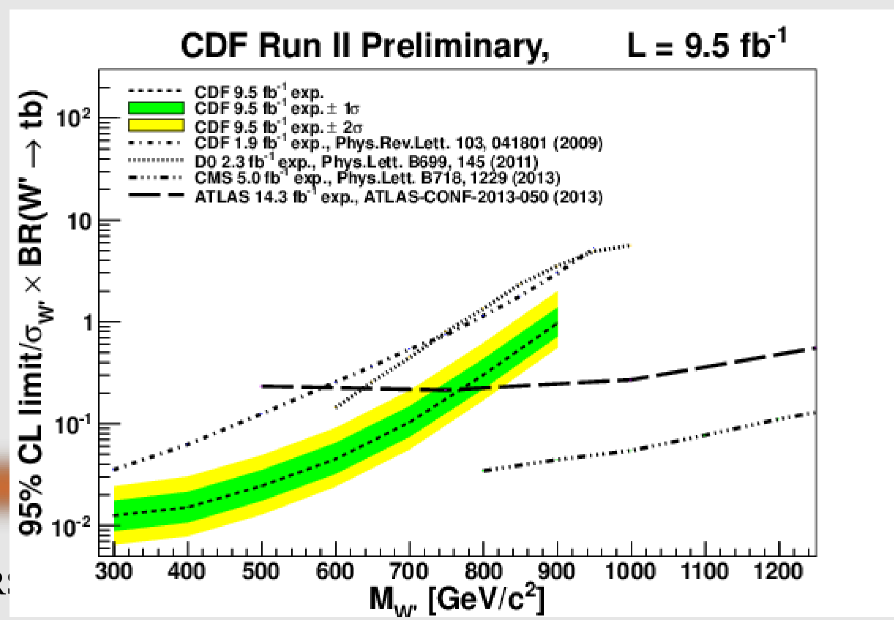
Tevatron is sensitive to observed single top production through a time-like virtual W boson



- Same topology can be used to search for heavier W-boson
- Use MET-based trigger, optimize for channels w/ and w/o charged lepton
- Examine a benchmark left-right symmetric NLO model. Assume SM couplings of W', allowed or forbidden leptonic decay modes



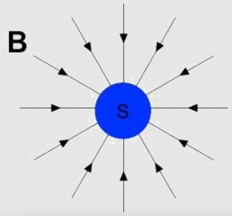
W' excluded up to 860(880) GeV/c^2, assuming allowed(forbidden) leptonic decay modes



Best exclusion limit below 700 GeV/c^2

CDF Note 11110

1.2 fb^{-1}



Exotics

Search for Dirac monopoles

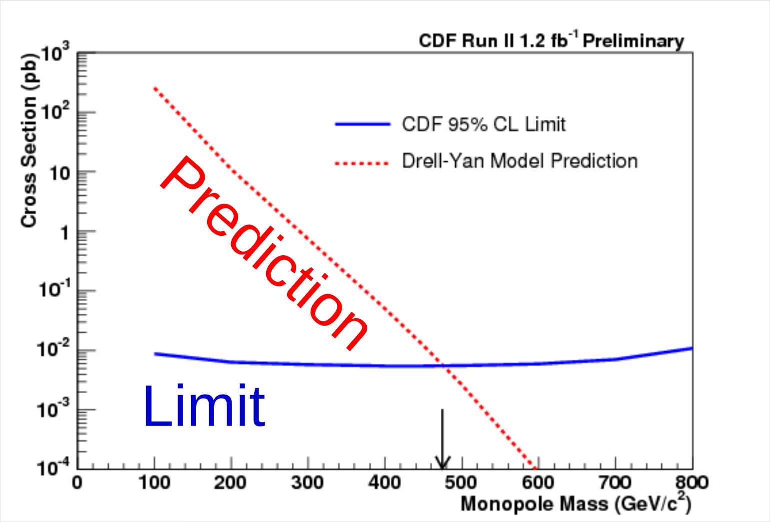
Unique signature => low background + high efficiency

Dedicated trigger

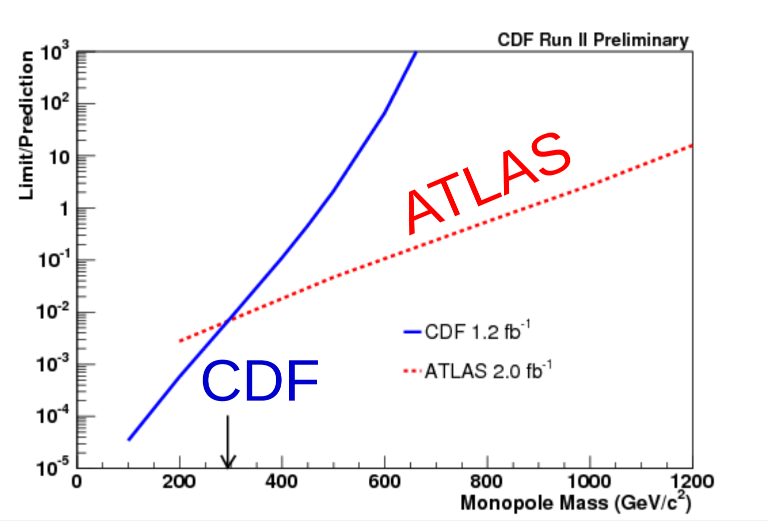
- Heavy ionization (LIGHT!) in TOF scint
- Track: heavy ioniziation, no φ curvature (parabolic arc along B)

Correcting for acceptance, trigger effs, & pileup inefficiency

- 30-40% overall acceptance
- Expected fake rate ~ 3.4×10^{-9}!



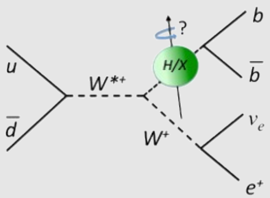
Exclude monopole up to mass of 476 GeV/c^2 at 95% CL



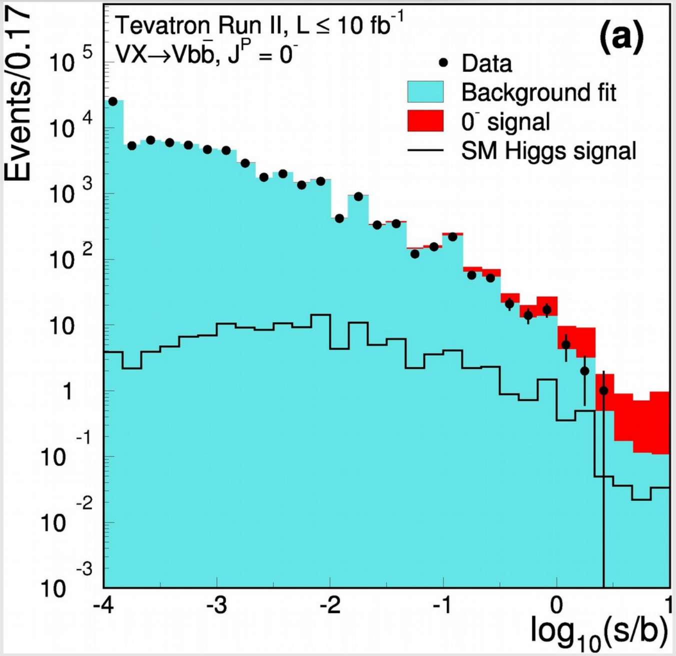
Best limit up to 300 GeV/c^2

CDF Webpage

Constraints on Models of the H Boson with Exotic J^P Using Decays to Bottom-Antibottom Quark Pairs

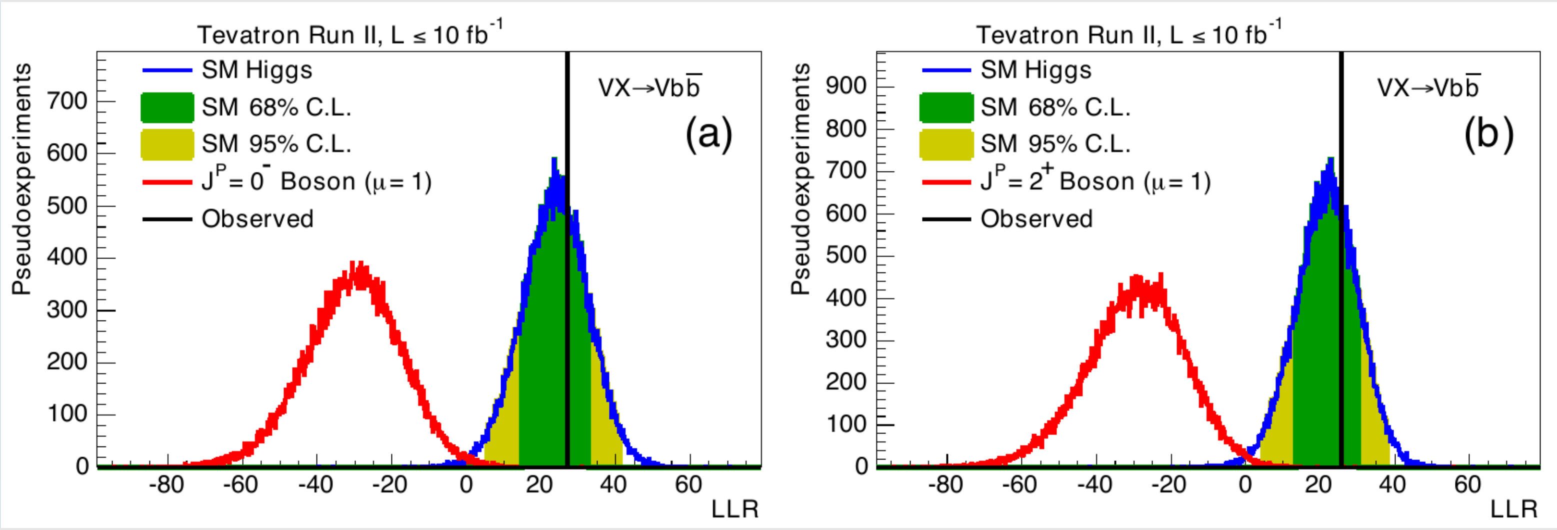


Exploit sensitivities of $Vb\bar{b}$ mass distributions to spin-parity of exotic H boson in decay: VX, $X \to b\bar{b}$



0− excluded at 4.9σ and 2+ at 5σ, in the absence of 0+, assuming SM production and decay rates

95% CL limits of production rates at 36% of SM rate set for both 0− and 2+, in the absence of 0+



Unique study in $b\bar{b}$ final states, compliments outstanding LHC work in VV

Phys. Rev. Lett. 114, 151802, arXiv:1502.00967

Summary

Tevatron experiments continue a rich physics legacy

Exploiting advantages: better S/B, $q\bar{q}$ initial states, triggering capabilities, … for competitive and complimentary physics program

- Precision EW results including fundamental parameters of standard model (Wmass, $\sin^2\theta_W$) and W,Z production and PDF inputs
- World leading top mass, unique and complimentary measures (A_{FB}, cross sections, properties, single top, ...)
- Rich b-physics program (CPV studies, hadron properties, new work in production and hadronization asymmetries)
- Closing the gaps between earlier results and LHC for moderately high mass new physics. Limit exotic higgs to fermions
- Unique and complimentary work in QCD (V(V)+jets/HF, low-x, extensive DPI studies, …)

Visit the parallels for more details and watch for significant updates to come!