The CDF Group at LBNL

LBNL Director Review, November 8-9, 2006

Angela Galtieri

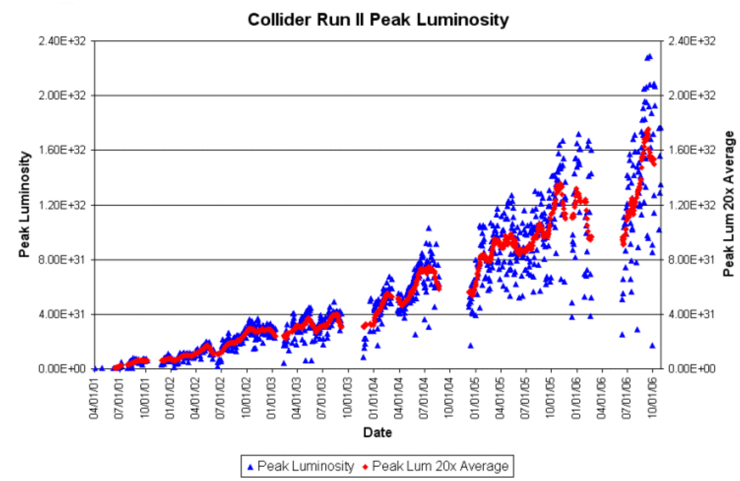
Outline

- Status of the Tevatron
- LBNL Group
- CDFII Detector
- Contributions to CDFII
  - Hardware
  - Operation
- Recent Contributions to Analysis Tools
- Physics Program
  - B physics
  - Top Physics
  - New Phenomena
- Summary and Conclusions

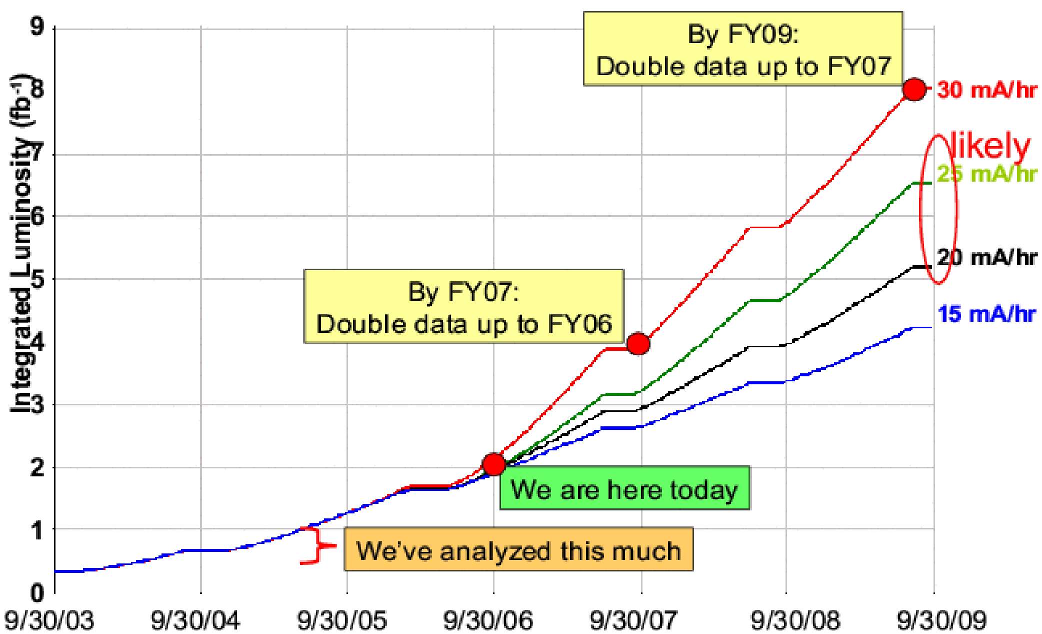
Tevatron Status and Plans

Tevatron has been doing very well.

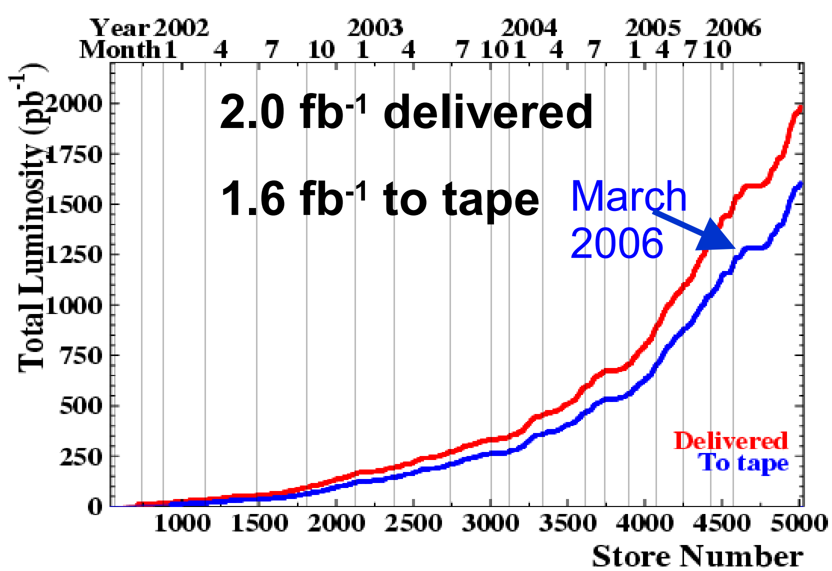
Record luminosity: 2.37×10^{32}



Needs to improve pbar stacking rate to 30 mA/hr to stay on the Design curve



Presently have processed 1.2 fb^{-1} good runs with Silicon



Members of the LBNL Group

Physicists-Staff (2.0FTE)

A. Galtieri
J. Beringer***
C. Haber*
J. Lys *
M. Shapiro* (UC Berkeley)
J. Siegrist* (UC Berkeley)
W. Yao***

Physicists-Term (3 FTE)

A. Cerri (now CERN)
J. Nielsen (UC SantaCruz)
P. M. Fernandez

Grad. Students(5.0FTE)

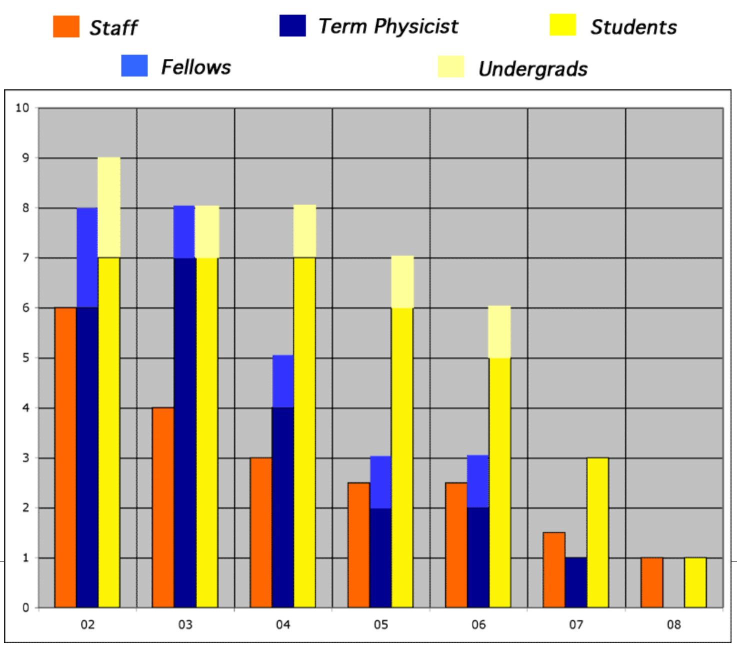
A. Gibson (Toronto)
H-C. Fang
J. Freeman
P. Lujan
A. Deisher
J. Muelmenstaedt

Undergrad. Students (1FTE)

M. McFarlane (now grad. at Wisconsin)

Guest

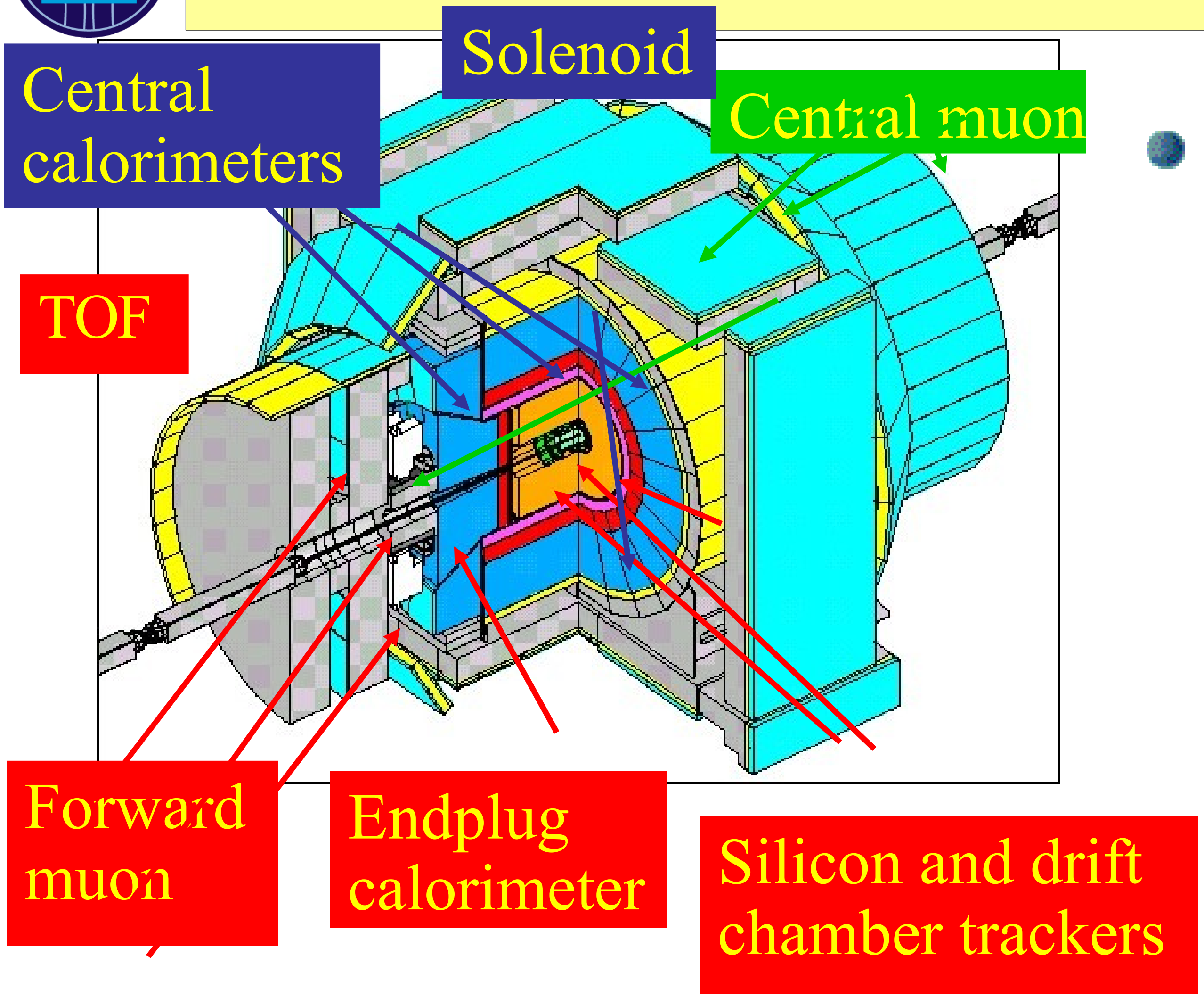
I. Volobouev (Texas Tech)



It is unfortunate that after 25 years of contributions to CDF, LBNL's group is disappearing when the data finally arrives

*ATLAS, ** PDG
FTE refer to FY06

CDFII Detector



- CDF recent upgrades
  - Improved photon detection
    - EM calorimeter: timing readout added
    - Central preshower: wire chambers replaced with scintillation tiles
  - DAQ upgrade
    - To match the trigger: 20MB/sec -> 60 MB/sec
  - Trigger Upgrade
    - 30KHz(L1), 1KHz(L2) 100Hz(L3)
    - XFT: fast tracking trigger added 3 stereo layers

LBNL Contributions to: Silicon detectors, COT, TOF

Commissioning, Operation, Software

Silicon Detectors:LBNL Contributions

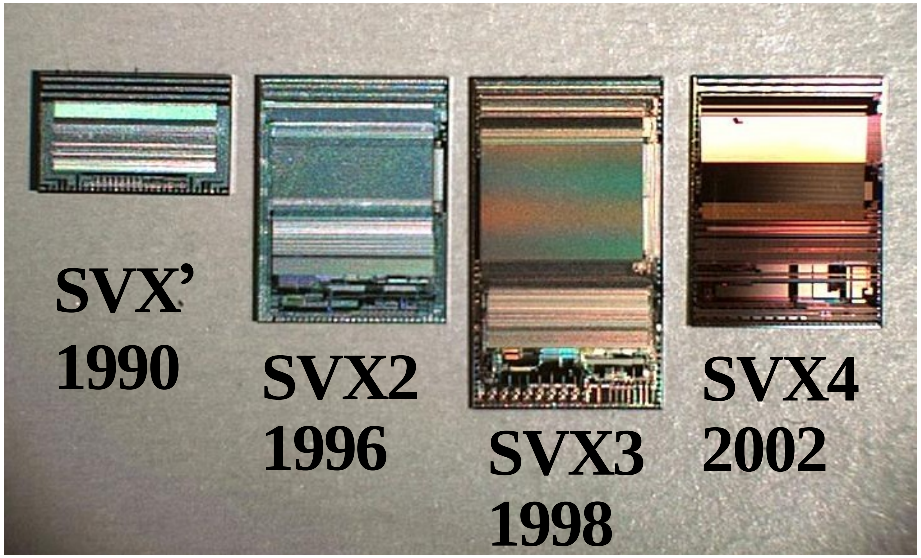
Silicon detectors transformed physics capabilities of CDF since early '90. LBNL is a major player in Vertex Detector technology. Long standing tradition, now extended to LHC.

- LBNL designed SVX, SVX'.
- Joint designs with FNAL since.
- SVX3 used in CDFII

RUN 2b R&D and prototyping

- SVX4: developed for Run 2b
  Project canceled due to budget cut. Chip used by D0, Phenix at BNL
- Conversion to .25 micron CMOS technology proposed by LBNL.
  Also used by ATLAS' pixel chip
- Hybrids and "stave" (new detector concept : integrated electrical, mechanical and cooling unit) being evaluated by ATLAS

Rad hard chips for Silicon Detectors



SVT, displaced vertex trigger
Extended B physics capability

LBNL Contributions to CDF II

I. Construction

- Silicon detectors
  - SVX3 chip (co-design with FNAL), test, probe
  - hybrids for L00, SVXII, ISL
  - associated electronics
- Drift Chamber (COT)
  - inner cylinder, field sheets
  - Conceptual design of alignment
  - Time calibration system
- TOF
  - Study laser calibration system
  - Install fibers, online monitoring

II. Commissioning

- COT Associate Project Manager
- COT Commissioning
- Silicon commissioning

III. Operation

- CDF II Operation Manager
- SVT operation
- Silicon Operation

IV. Computing and software

- Project manager
- Codegen for relational data bases
- Data handling software for early tests
- Silicon Code librarians

LBNL Contributions to CDF II

Detector Operation (MOU)

- Silicon good run list (P. Lujan)
- SCI-Co or CO shifts (everybody)

moved to other groups

- Online silicon monitoring (to John's Hopkins)
- Silicon calibration (Nielsen)
- Online data monitoring (YMON) (to Rochester))
- COT calibration (to FNAL)
- SVT data taking: pager (to Pisa)
- SVT online monitoring checks, SVT hardware support, upgrade code consultant (A. Cerri)
- DAQ shifts (3 months service)

Software Responsibilities (MOU)

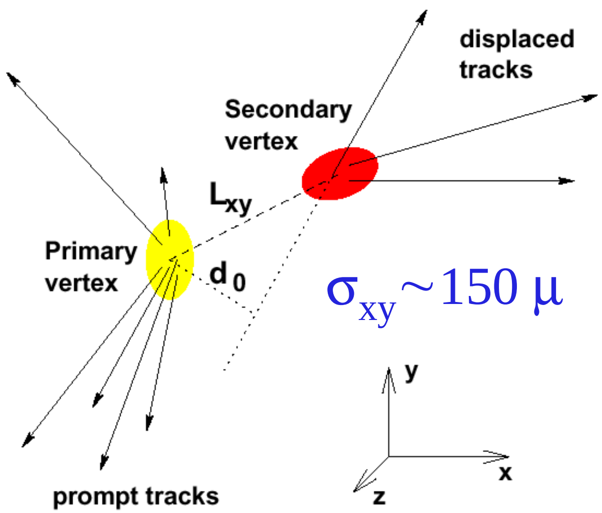
- GFLASH tuning (P. Fernandez)

moved to other groups

- MC generators : ISAJET (Galtieri), HERWIG, Wbbgen (Lys), ZGRAD (Gibson)
- Silicon geometry (A. Dominguez)
- Passive material (L. Vacavant)
- Silicon Tracking (W. Yao)
- Secondary vertices code (W. Yao, A. Dominguez)
- SVT simulation (A. Cerri)
- MC: EVTGEN, B decays generator (J. Beringer)

Displaced vertex b-tagging (SECVTX)

M. McFarlane, J. Nielsen, W-M Yao + others



Displaced vertex algorithm allows detection of b quarks, important for B physics, top, and Higgs

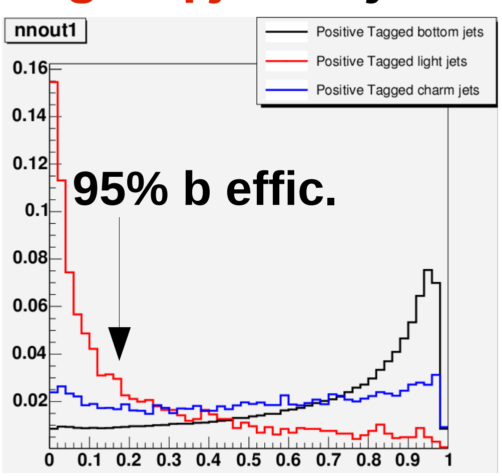
- tt event efficiency = **(60±3)%**
- Efficiency for second tag in top events **(25±2)%**
- Efficiency ratio between data and MC **(91± 6)%**

NN improved tagging efficiency.

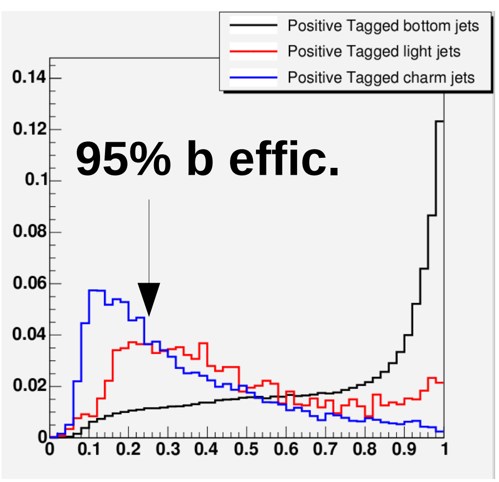
Combine SECVTX (reconstructed secondary vertices) with JetProb (single displaced tracks).

- Improved efficiency by ~25% adding jets that were not tagged
- Reduced backgrounds from c and light quark jets by ~fac. 2
- Retain 90% of b-tags

light q jets-b jets



charm jets-b jets

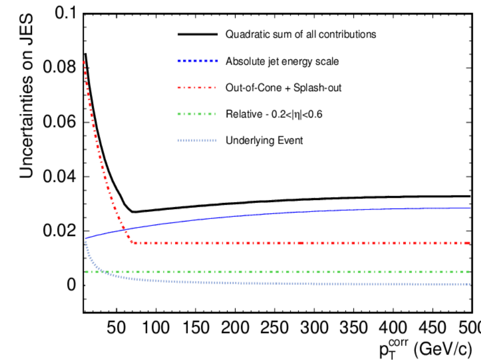


Jet Corrections and systematics

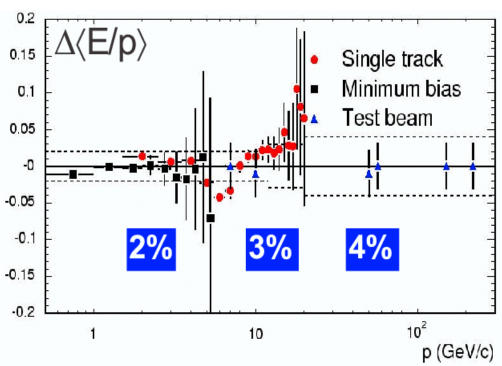
Pedro Fernandez, L. Galtieri + others

NIM **A566**, 375 (2006)

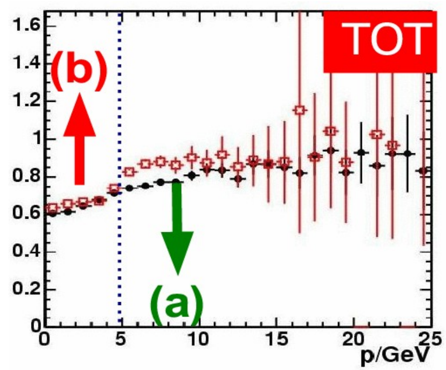
- Long standing expertise on jets in LBNL group
- Run2 systematic uncertainties (published in NIM) are now smaller than Run1.
- Recent calorimeter simulation tuning (P. Fernandez)

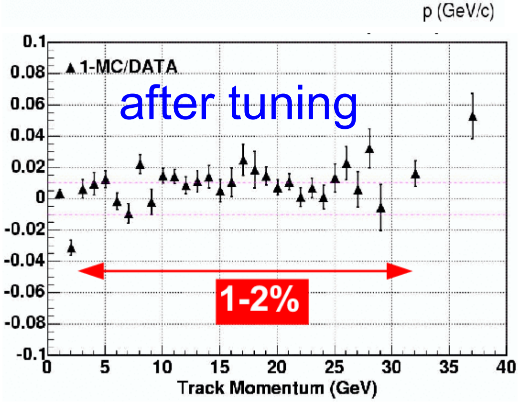


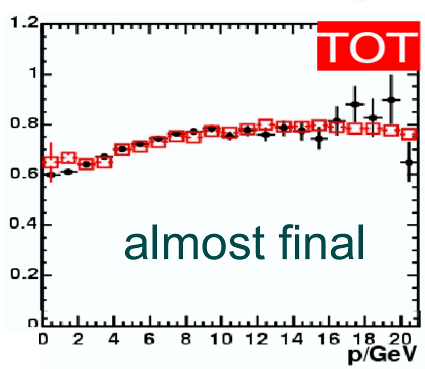
Central , before tuning



Plug , before tuning



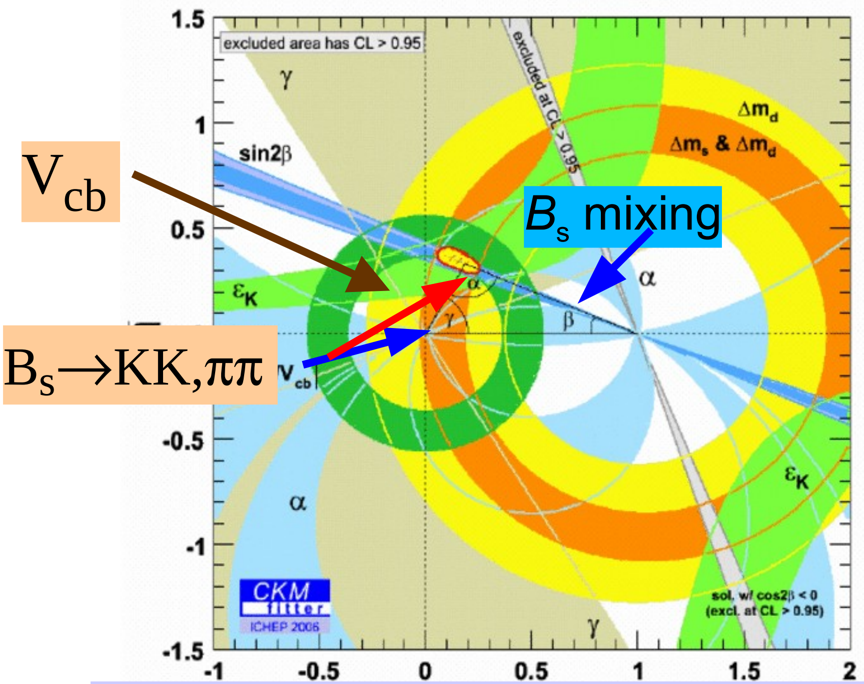




- Special trigger provided large samples of isolated tracks to 40 GeV/c (from 5 GeV/c)
- Lateral and longitudinal tuning of central and plug calorimeters almost finished
- Plug tuning helped reduce W mass systematic uncertainty
- Expect to reduce jet energy systematics by at least 30%

B Physics: where are we?

CP violation in the B system constrains the unitary triangle.
SM requires $\alpha+\beta+\gamma=\pi$, Sin2β well measured at the B factories.

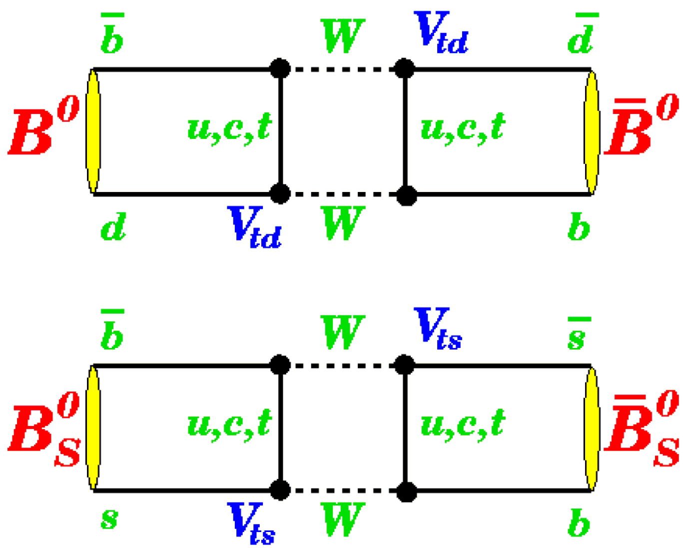


CP violation in $B_s \rightarrow J/\psi\phi$ is new physics

- B_s physics can only be done at the Tevatron
- SVT (Silicon Vertex trigger) allows study of the hadronic decays
  $B \rightarrow hh$, $B_s \rightarrow D_s \pi$ etc.
- It opened a whole new window that can lead to new physics

- B_s mixing is best measured with fully reconstructed decays to reach high values of x_s. Partially reconstructed decays modes are also used.
- Initially B_s semileptonic decays, high statistics, were used
- **CDF has measured B_s mixing in 2006.**

B_s Mixing at CDF



$$\frac{|V_{td}|}{|V_{ts}|} = 1.01\xi\sqrt{\frac{\Delta m_d}{\Delta m_s}}$$

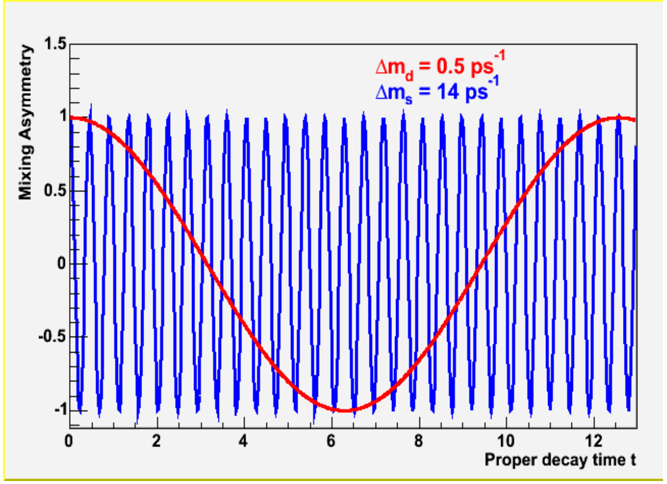
from LATTICE

$\xi = 1.21^{+0.047}_{-0.035}$ Okamoto-05

$\Delta m_d = 0.507 \pm 0.005$ PDG-06

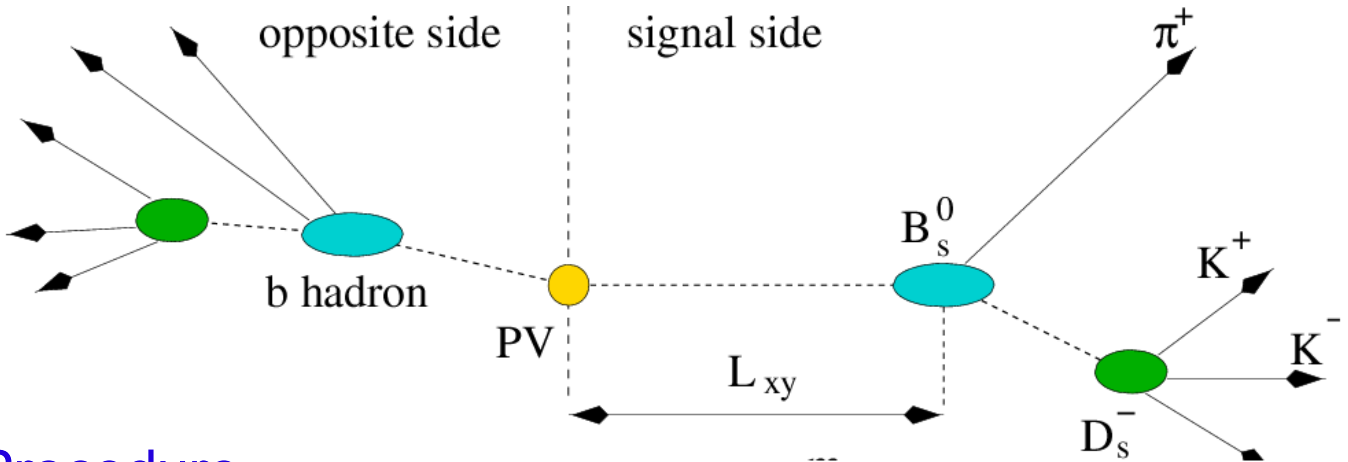
SM Fit: $\Delta m_s = 18.3^{+6.5}_{-1.5}$ ps^{-1}

- To measure CPV in the B_s system we need to measure Δm_s from B_s-$\bar{B}_s$ oscillations.
  $A_{mix} \sim D\cos(\Delta m_s t)$
- Δm_s expected to be large due to coupling to top quark
- B_s fully mixes in < 0.15 lifetimes !!



- B mixing measurements :
  $\Delta m_s \geq 14.5$ ps^{-1}, LEP and SLD data
- $17 < \Delta m_s < 21$ ps^{-1} 2006 D0 PRL 97,021802
- $\Delta m_s = 17.31^{+0.33}_{-0.07} \pm 0.07$ ps^{-1} CDF PRL 97,062003

B_s mixing Analysis (I)



$$ct = \frac{L_{xy}\, m_B}{p_T} K$$

K factor for partially reconstructed B_s

Procedure

- B Reconstruction

  hadronic: good p_T resolution, small statistics

  semileptonic : bad p_T resolution, large statistics
- Tag flavor at production (calibrate with B_d)
- Measure time dependent asymmetry

significance:

$$1/\sigma_A = \sqrt{\frac{n_S \epsilon D^2}{2}} \sqrt{\frac{n_S}{n_S + n_B}} \exp\left(-\frac{(\Delta m_s \sigma_{ct})^2}{2}\right)$$

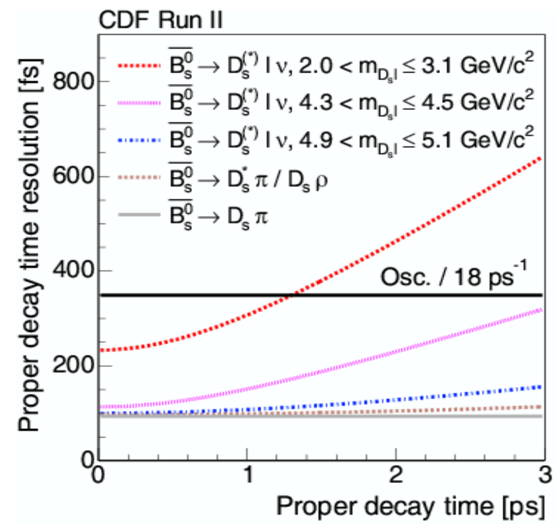
$$\sigma_{ct} = \sqrt{(\sigma_{ct}^0)^2 + \left(ct\,\frac{\sigma_p}{p}\right)^2}$$

$$A(t) = \frac{N(t)_{\mathbf{mixed}} - N(t)_{\mathbf{unmixed}}}{N(t)_{\mathbf{mixed}} + N(t)_{\mathbf{unmixed}}} = D\cos(\Delta m_s t)$$ where $D = 1 - 2P_{mistag}$ (dilution)

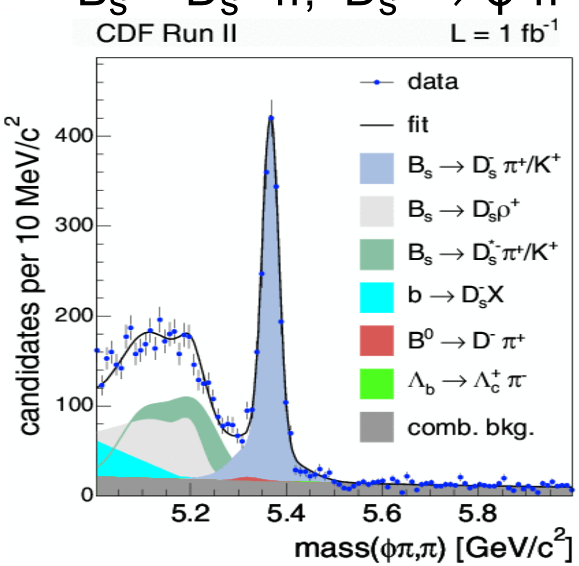
- εD^2 : crucial for high significance (ε : fraction of events with flavor tag).

B_s mixing Analysis in 1 fb^{-1}

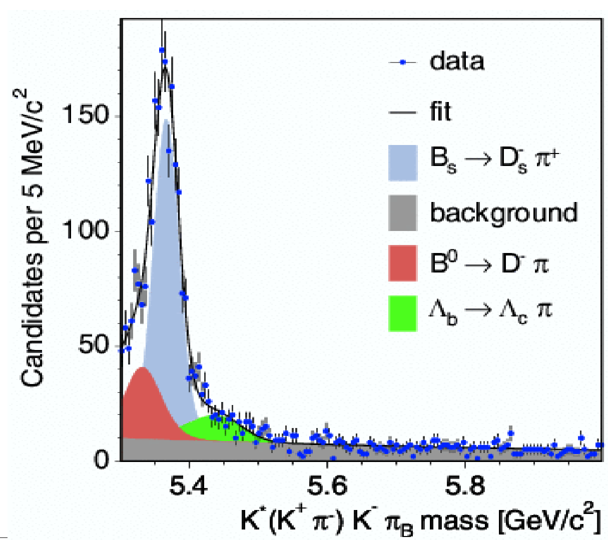
- Use NN for event selection, including TOF and dE/dx (reduce background, improve efficiency)
- Many tagging techniques: opposite side tagging (including kaons), same side tagging (also NN)
- Include partially reconstructed B's (K factors). Optimize proper time resolution.
- Obtain: εD^2 = 4.8% semileptonic (61500 ev.)
  εD^2 = 3.7% hadronic (8700 events)



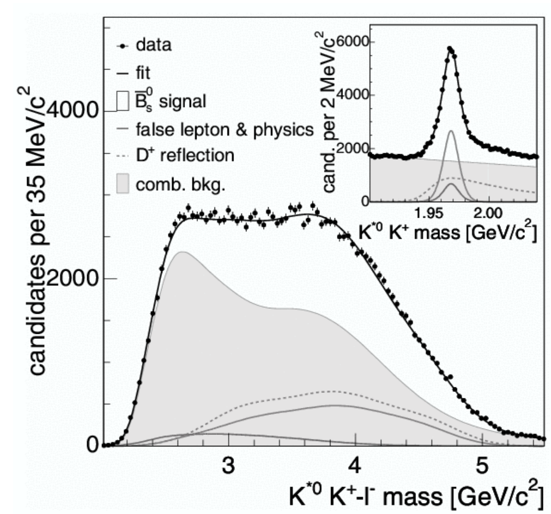
$B_s \to D_s^- \pi$, $D_s^- \to \phi \pi^-$



$B_s \to D_s \pi$, $D_s \to K^*K$

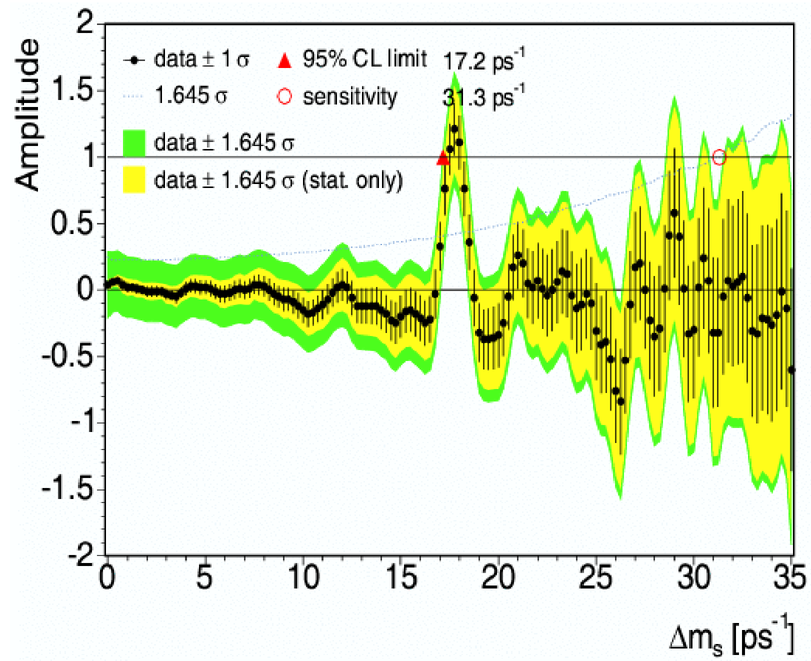


$B_s \to D_s$lep., $D_s \to K^{*0} K^+$



B_s mixing results (1 fb-1)

Perform an Amplitude Analysis $\mathscr{L} \sim [1 \pm AD\cos(\Delta m_s t)]/2$

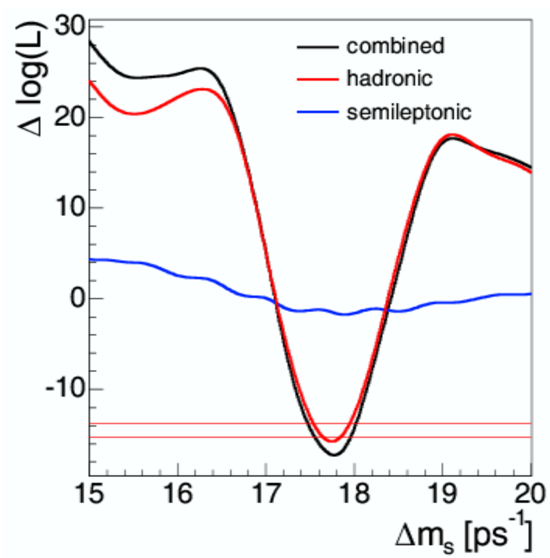


B_s mixing is observed!

A= 1.21 ± 0.20 (stat) consistent with 1.
Probability of random tags to produce this result is $p = 8 \times 10^{-8}$ → 5.4 σ

Δm_s= 17.77±0.10(stat) ± 0.07(syst) ps^{-1}

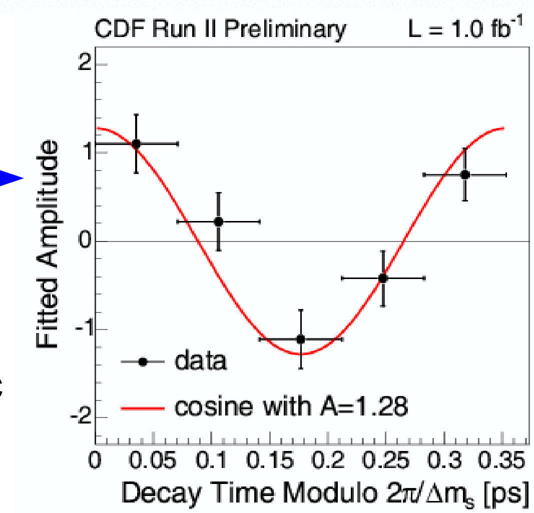
agrees with SM prediction: no New Physics



Likelihood for Δm_s
(all modes)

Oscillations Period
(hadronic modes only)

B_s switches between matter and antimatter 3 trillion times/sec

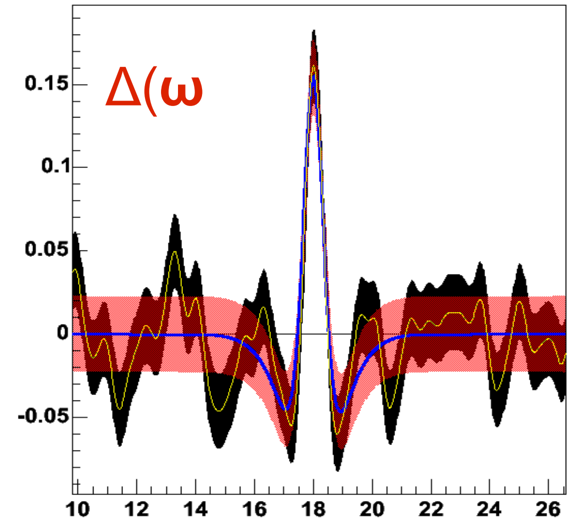


Several contributions from the LBNL group

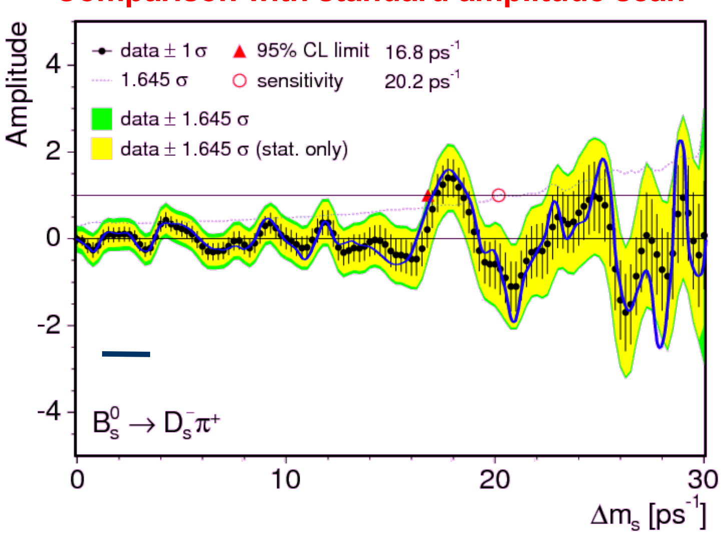
B_s mixing with Fourier Transform

A. Cerri, M. Shapiro, A. Deisher, H-C Fang, J. Muelmenstaedt +others

- B_s oscillations are a periodic signal: Fourier space is the natural tool
  - Fourier transform of data: $g(\omega)=\Sigma_k \cos(\omega t_k)$
    (t_k = proper time event k)
  - Difference of $g(\omega)$ for unmixed and mixed events: $\Delta(\omega)$
    - Peaks for $\omega=\Delta m_s$ and is 0 everywhere else
- Same sensitivity as fit based Amplitude scan
- Can relate $\Delta(\omega)$ to fit based Amplitude
- Very fast computationally (no fit!)
- Analysis tool has been developed and validated against standard method (1/10 of data)
- Largely systematics free approach opens novel route towards search of CP violation signals in B_s oscillations (e.g. in $B_s \to \psi\phi$)



Comparison with standard amplitude scan

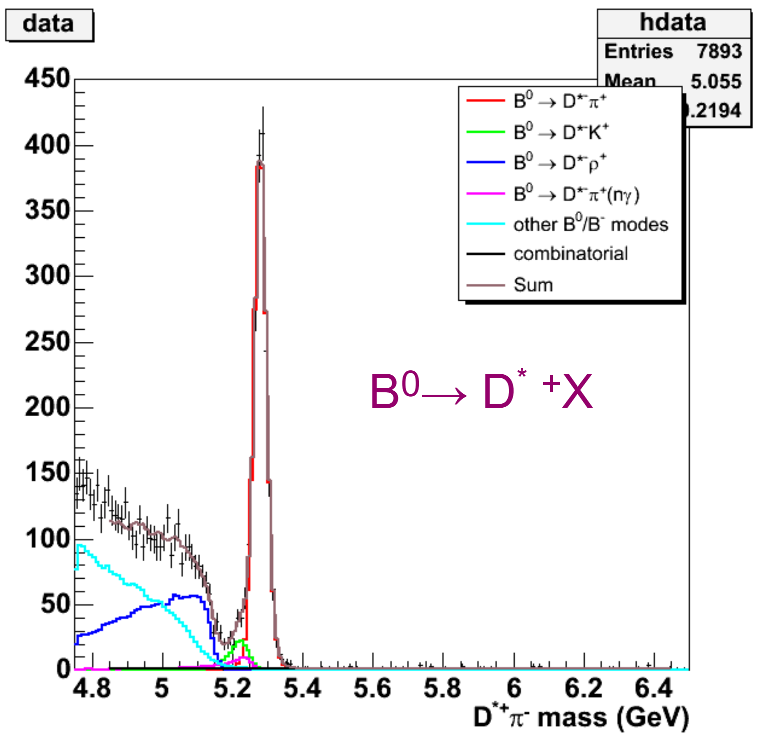


LBNL Present Program

A. Deisher, H-C. Fang, J. Muelmenstaedt, M. Shapiro

- 3 PHD thesis :
  - B_s lifetime
  - $BR(B^+ \to D^0K)/(B^+ \to D^0\pi)$
  - $BR(B_s \to D_sK)/(B_s \to D_s\,\pi)$
- Common code, common Monte Carlo etc.
- Control samples:
  - $B^0 \to D^* X$
  - $B^0 \to D^+ X$
- Understand common inputs:
  - Event selection cut optimization
  - Particle ID : dE/dx
  - Background model studies
  - Systematics studies
- Mass fit results used in lifetime measurement

Control sample (410 pb^{-1})



Simultaneous fit of $D^{*+}\pi^-$ mass and dE/dx for each track

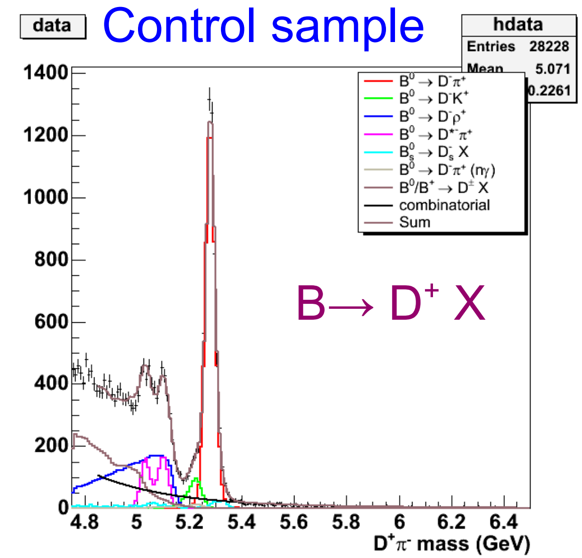
B_s Lifetime measurement ($1 fb^{-1}$)

Amanda Deisher (PHD thesis), M. Shapiro, H-C Fong, J. Muelmenstaedt

Motivation:	theory	experiment
$\tau(B_s)/\tau(B^0)$	1.00 ± 0.01	0.914 ± 0.030

$\tau(B_s) = 1.466 \pm 0.059$ ps (PDG)

$\tau(B_s) = 1.60 \pm 0.10 \pm 0.02$ ps (CDF 360 pb^{-1})

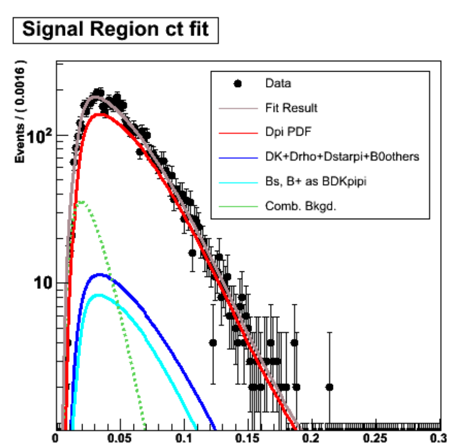


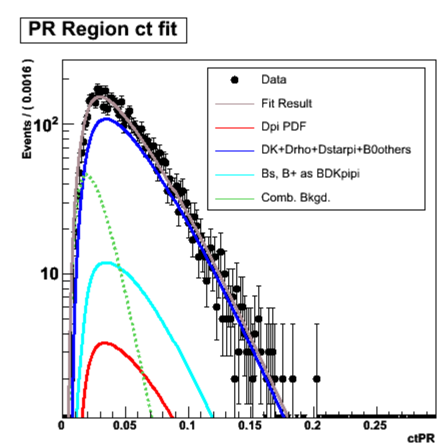
- Use all hadronic decay modes
- Add new hadronic modes, Partially Reconstructed (PR) modes , more data
- Developing method on B^0 control sample:
  get good mass fit (sample composition)
  get K factors for PR samples
- Results on control sample:
  $c\tau = 461.4^{+9.7}_{-9.4}$ μm (signal region)

  $c\tau = 464.8^{+12}_{-11}$ μm (PR region)
- Going to B_s sample after control sample measurement is completed.

$c\tau(B^0) = 458.7 \pm 2.7$ μm

World Average, PDG





Cabibbo suppressed $B^- \to D^o K^-$

H-C. Fang (PHD thesis), M. Shapiro, A. Deisher, J. Muelmenstaedt

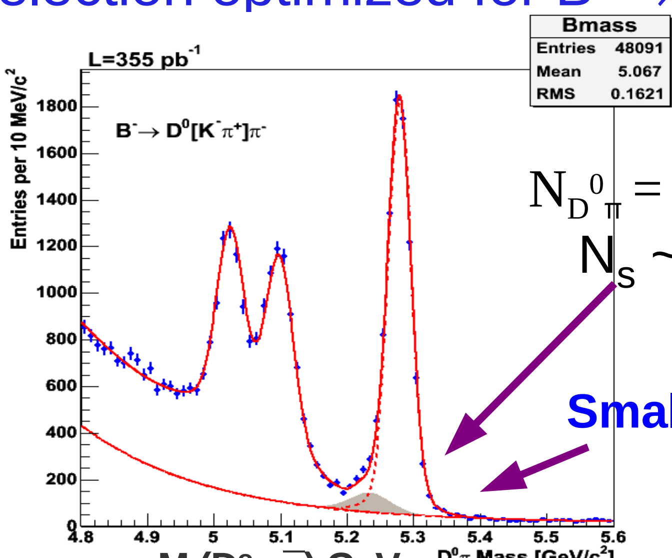
Motivations: measure the angle γ , via three branching ratios:

$BR(B^- \to D^o K^-)/BR(B^- \to D^o \pi^-)$ and

$BR(B^- \to D^o_{CP\pm} K^-)$ / $BR(B^- \to D^o_{CP\pm} \pi^-)$ $D^o_{CP+} \to K^+K^-, \pi^+\pi^-$

Direct CP-violation in $B \to D_{CP\pm} K$ (M. Gronau, PRD 58, 037301) predicts $B^- \to D^o_{CP\pm} K \neq B^+ \to D^o_{CP\pm} K$). Model allows extraction of the angle γ

Selection optimized for $B^- \to D^o K^-$



$N_{D^0\pi} = 8054 \pm 101$

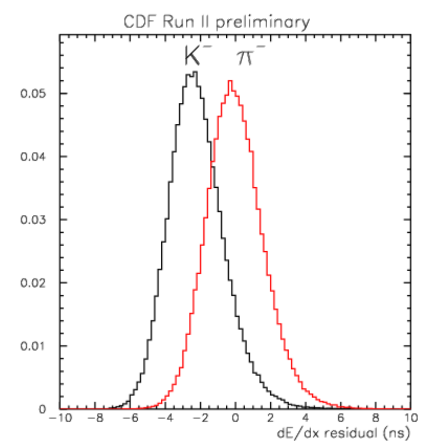
$N_S \sim 670$

Small background

M ($D^o \pi^-$) GeV

Use dE/dx for π-K separation

1.4 σ at P ~ 2 GeV



Obtain templates from known processes

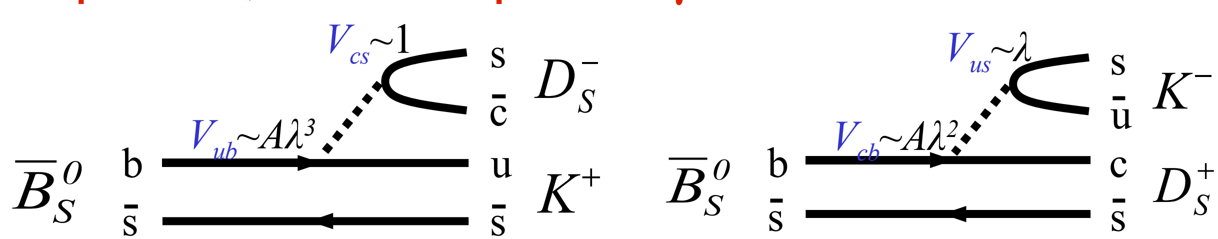
$$ID = \frac{dE/dx_{\text{meas}} - dE/dx_{\text{exp}}(\pi)}{dE/dx_{\text{exp}}(K) - dE/dx_{\text{exp}}(\pi)}$$

Extend analysis to 1 fb^{-1}, after fits to control samples are satisfactory.

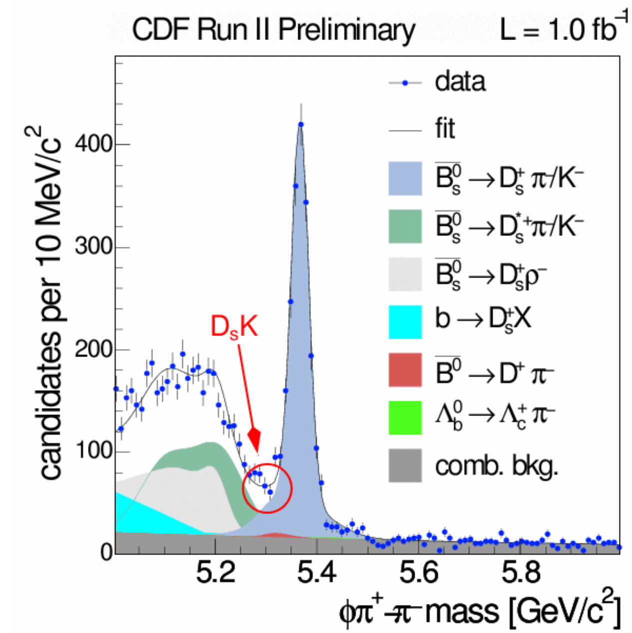
Measurement of BR($B_s \rightarrow D_s K$)

Johannes Muelmenstaedt (PHD thesis), M. Shapiro, A. Deisher, H-C Fang

- Measure BR($B_s \rightarrow D_s K$)/BR($B_s \rightarrow D_s \pi$)
  $D_s K$ sample is already available
- *Need to understand control fit of dE/dx + mass*
- There are two processes. They have comparable amplitude, relative phase γ.

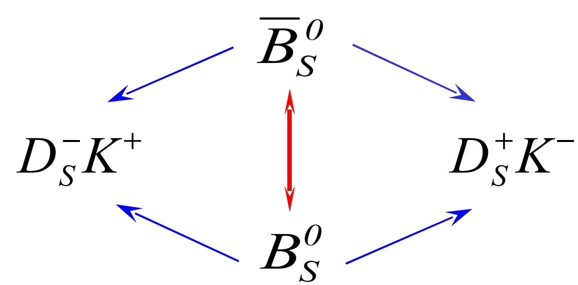


B_s-> $D_s^-\pi$, $D_s^- \rightarrow \varphi\pi^-$



- B_s oscillations can cause interference between the two amplitudes

$$B_S^0 \rightarrow D_S^{\pm} K^{\mp}$$
$$\overline{B}_S^0 \rightarrow D_S^{\mp} K^{\pm}$$



- Time dependent CP asymmetry measurement needed to measure γ

Prospects for High P_T physics at CDF

Measure top quark properties

Mass to 2 GeV, Top cross section to 10%
Verify SM decay properties
Any non SM processes hide in top events?

Higgs production

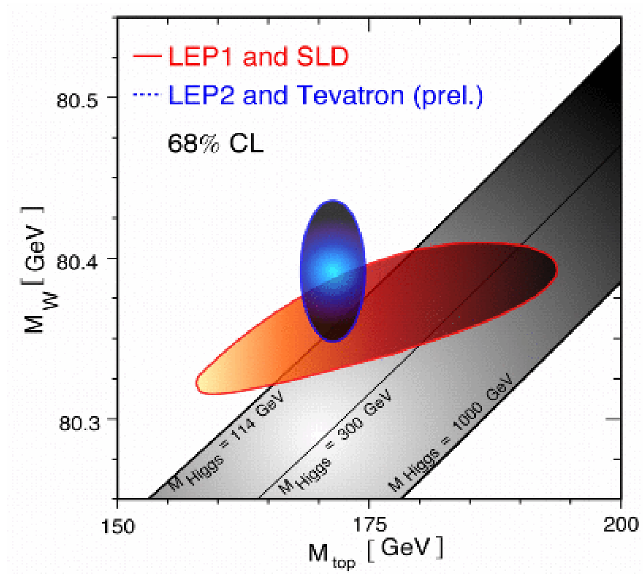
SM Higgs: it is a big challenge, but try
SUSY: tanβ=50 5σ discovery possible of H/A with M=175 GeV ($8\ fb^{-1}$)

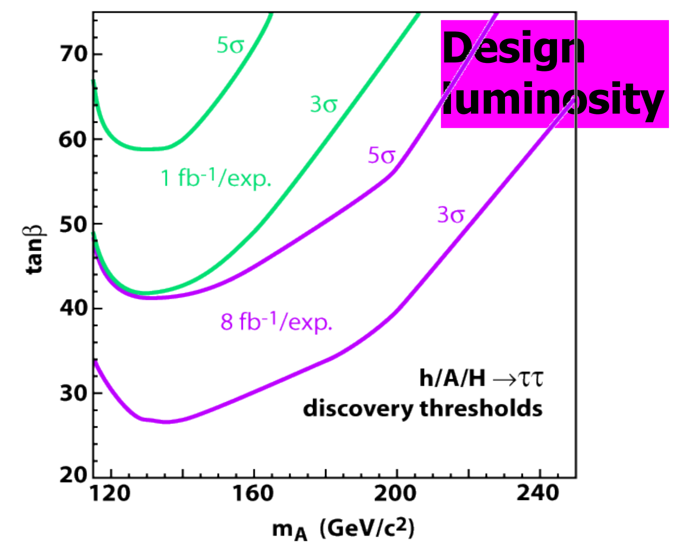
SUSY:

Some of the parameter space for squarks and gluinos are being explored.
Long lived stable particles , trileptons, etc.
Many ways to search

Many other searches: W'. Z', leptoquarks , technicolor, extra dimensions etc.

Electroweak Precision Measurements

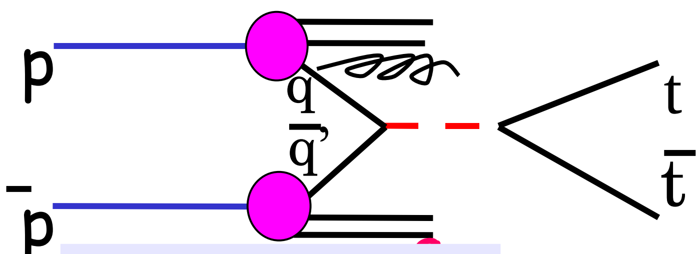




Top Quark Property Measurements

Fernandez, Freeman, Galtieri, Lujan, Lys, McFarlane, Nielsen, Yao

$t\bar{t}$ Production at the TeV:



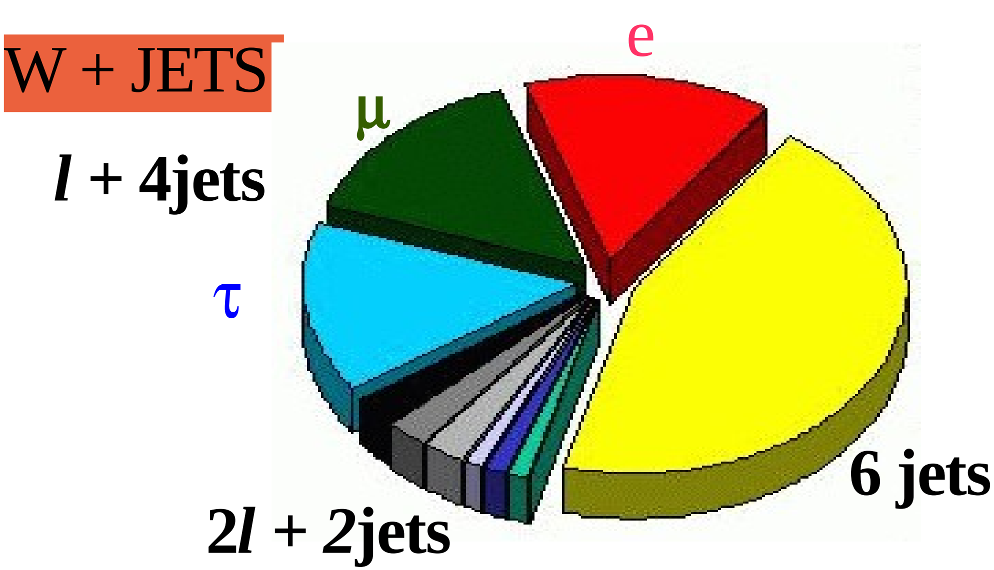
$t\bar{t} \rightarrow W^+ b W^- \bar{b}$

Top quark is heavy: decays very fast!

Γ(t -> Wb) ~ 1.5 GeV, t=4x10^{-25}sec

Λ_{QCD} = 100 Mev, Λ^{-1} = 10^{-23} sec

No hadronization: no top mesons or baryons



Top events preferentially in W+ ≥ 3 jets

Strategy:

- Understand the top candidate sample: b-tagging, backgrounds, agreement between data and Monte Carlo etc.
- Optimize tools for σ, mass, W helicity etc. measurements.
- Look for deviations from SM

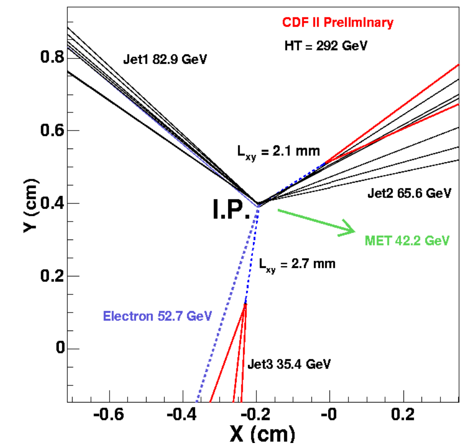
Top Cross Section Measurement

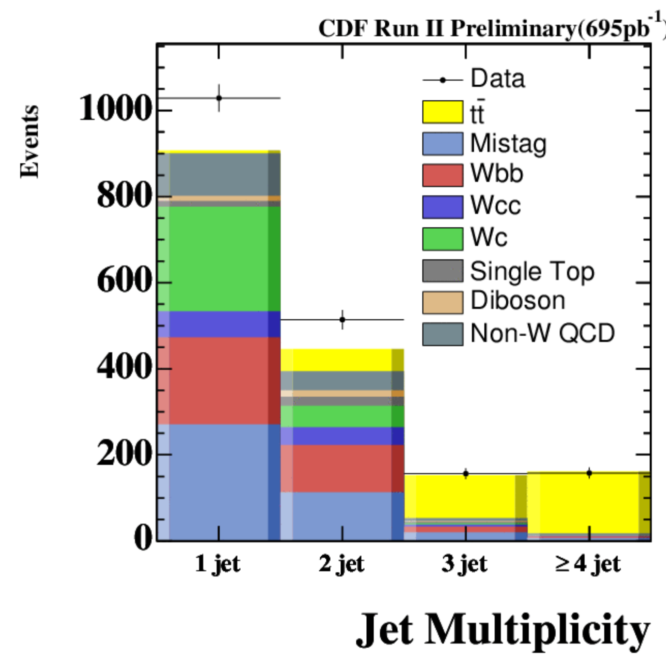
McFarlane, Nielsen, Yao, Kusakabe(Tsukuba) + others

- Understanding top candidates sample, to be used for all other top studies
- LBNL: use lepton+jets channel, b-tagging to reduce background.
- Sample selection:
  - Isolated lepton, $P_T > 20$ GeV
  - MET > 20 GeV (neutrino)
  - N (jets) ≥ 3 jets
  - ≥1 b-tag by the SVX algorithm

- Background : use N(jet) = 1,2 to check background calculations
  - Mistag
  - non-W QCD
  - Physics background: $Wb\bar{b}$, Wcc
  - Single top, WW, WZ etc.

Double tagged top event



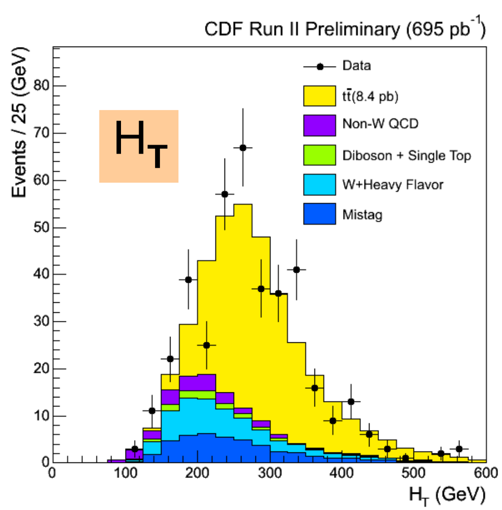


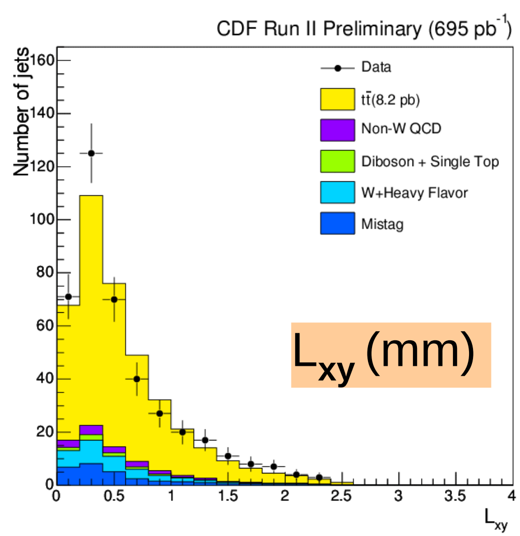
Top Cross Section (cont.)

$$\sigma_{t\bar{t}} = \frac{N_{\rm obs} - N_{\rm bkg}}{\epsilon_{t\bar{t}} \times \mathcal{L}}$$

314 tagged events, 79 with 2-tags
(70 ± 8 back.)

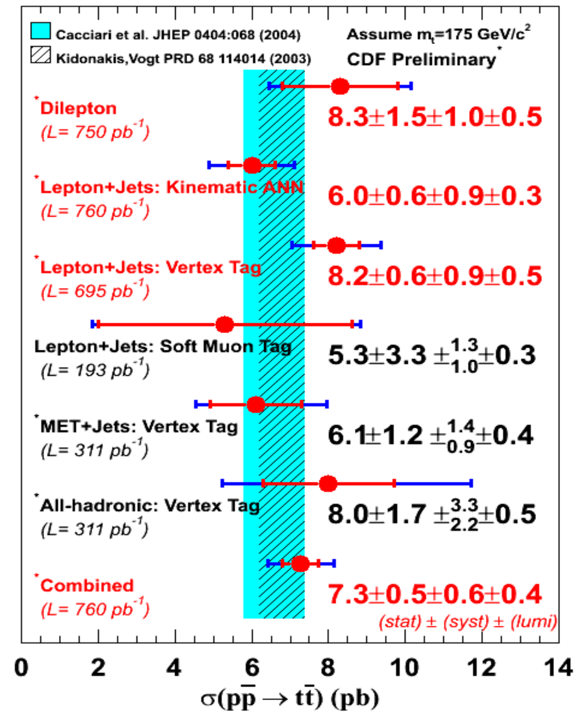
Require, H_T (total transverse energy) > 200 GeV to reduce background

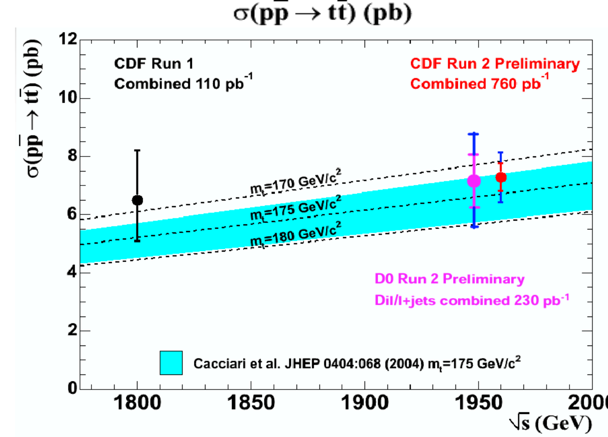




$$\sigma_{t\bar{t}} = 8.2\ \pm 0.6(stat)\ \pm 1.0(syst)\ pb$$

CDF winter '06 averages use 750 pb-1

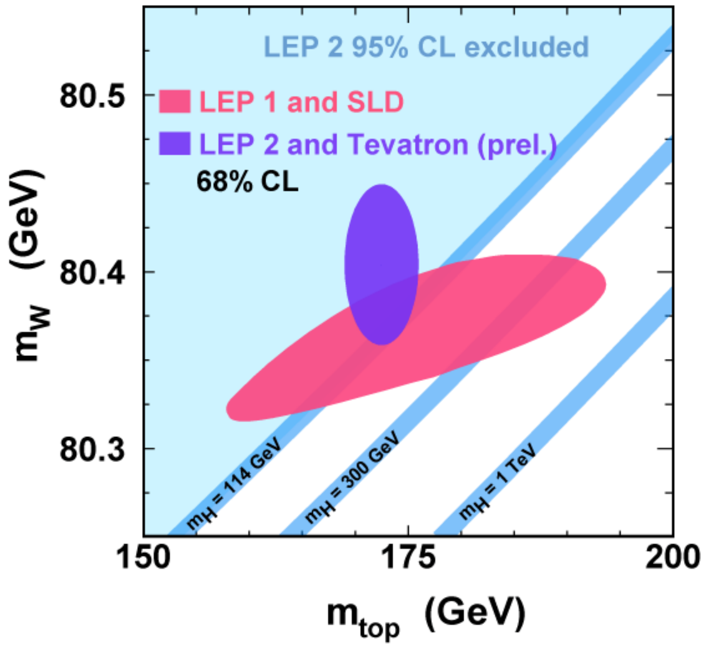


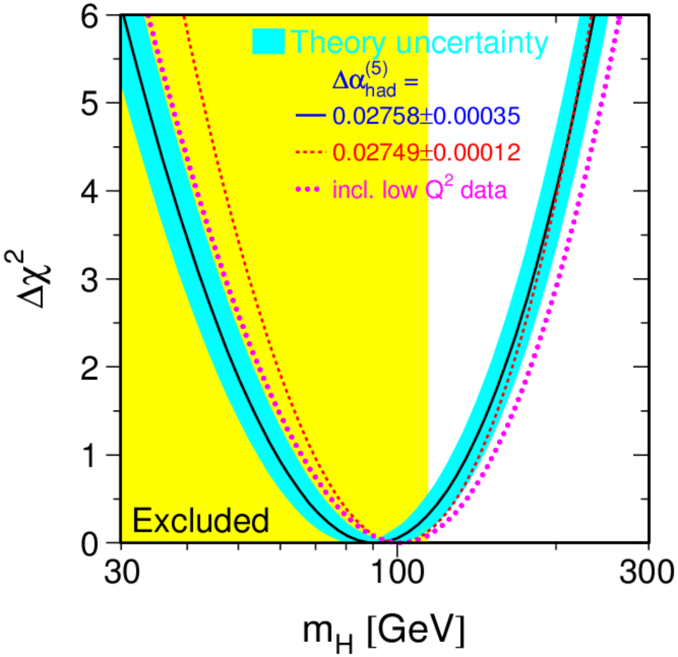


Top Quark in the Standard Model

- The Standard Model predicts the Higgs mass, once the W and Top mass are measured with high precision.
- Loop corrections to M_W proportional to M_t^2 or *ln*(M_H)
- Summer 2006 World average:

M(top) = 171.4 ± 2.1 GeV (CDF+D0 Run I+II)





July 2006 best Fit

$M_H = 85^{+39}_{-28}$ GeV

old:

$M_H = 91^{+45}_{-32}$ GeV

now

M_H< 166 GeV at 95% CL

Direct limit:

M_H > 114 GeV at 95% CL

Top Mass: new LBNL analysis

Fernandez, Freeman (thesis), Galtieri, Lujan, Lys, Nielsen, Volobouev

For each event evaluate a likelihood as a function of the top mass and JES . Integrate over phase space (d Φ) and Matrix Element for top prod. and dec.

- **See Kondo (JPhys. Soc. 57,1988), Dalitz&Goldstein(Proc. R. Soc. Lond., A445,1999).**

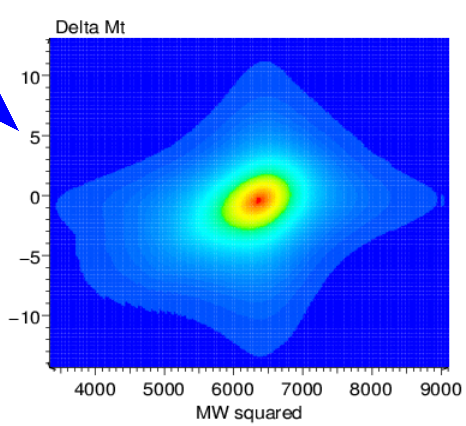
$$L(\vec{y}|m_t,\mathrm{JES}) = \frac{1}{N(m_t)A(m_t,\mathrm{JES})}\sum_{\mathrm{perms}}\int f(z_1)f(z_2)w(\vec{y}\cdot\mathrm{JES}|\vec{x})|M(m_t,\vec{x})|^2 d\Phi(\vec{x})$$

measured quantities **Incoming partons** **parton level quantities.**

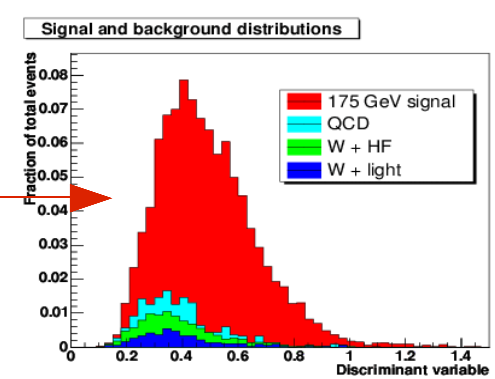
- JES (Jet Energy Scale): to transfer systematic to statistical uncertainties.
- ***w*(y,JES| x):** Jet transfer functions to improve resolution

Unique Features

Introduce effective propagators to take into account jet masses and angular smearing, on event-by-event basis

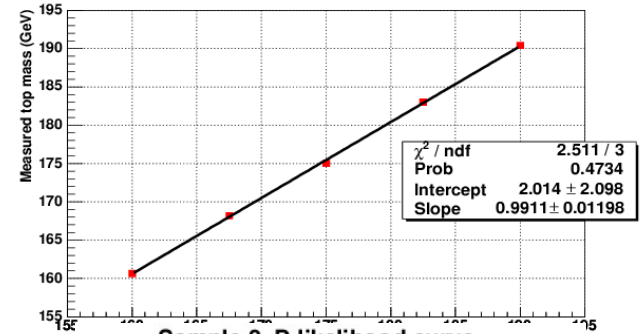


Introduce a back./signal discriminant to reduce back. effects

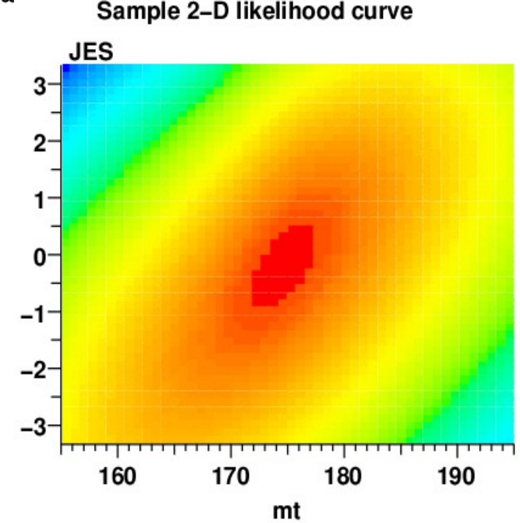


LBNL Mass analysis (cont.)

- Integration done over 7 variables. All jet permutations used.
- Reconstructed-vs-true mass has slope = 0.99±0.01 and bias=0.4 GeV for signal only

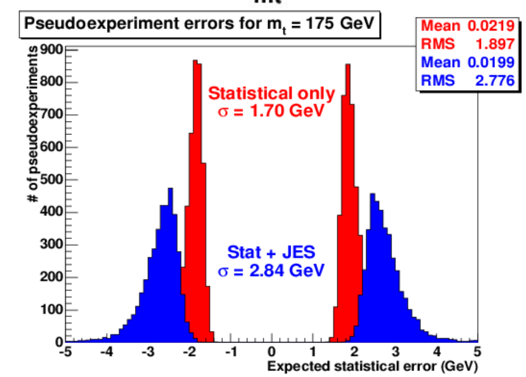


- Present data (955pb^{-1}):116 events with 4 Jets (P_T>15 GeV), ≥ 1 b-tagged jet.
- Expected background = 18 ± 4 events



- 2-D likelihood: mass -vs -JES allows reduced JES systematics

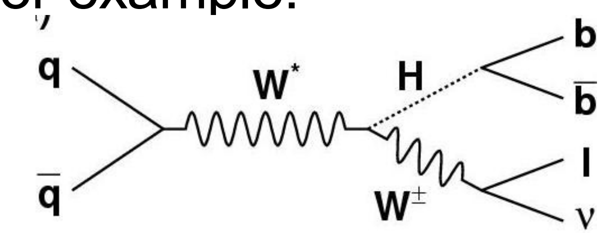
- Present results based on MC : cannot look at data until our model is optimized.
- Pseudo-experiments (MC) predict mass uncertainties larger than expected (pulls ~ 1.3) Working on improving the model.
- Method being reviewed by the collaboration

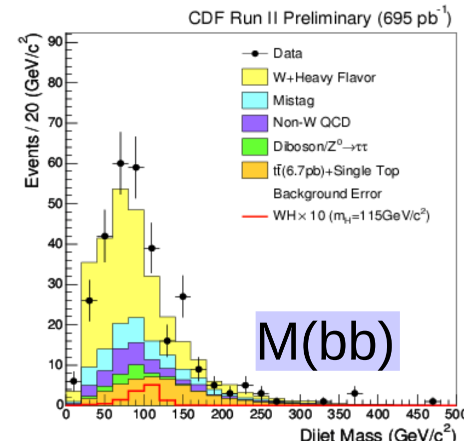


Search for new signals in W $b\bar{b}$ events

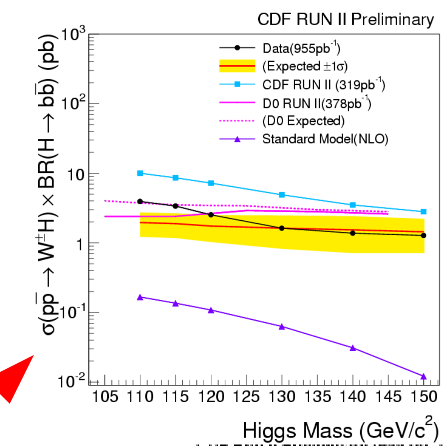
J. Nielsen, W-M Yao, + Tsukuba U. + Waseda U.

Techniques developed in Top analyses can be used for other searches, for example:
$\bar{p}p \rightarrow W X$ with $X \rightarrow \bar{b}b$





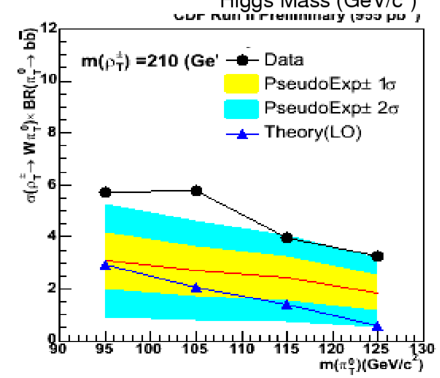
- Higgs bb, $\bar{S}$M cross section too small for observation in current data
- Understand backgrounds, develop better tools, increase acceptance etc.
- Use top sample events with a W and 2 jets (at least one tagged jet). In 955 pb^{-1}, observe 421 events, expect 394±67 background events
- Calculate limit for Higgs production-vs-mass.



- Cross sections for technirho production

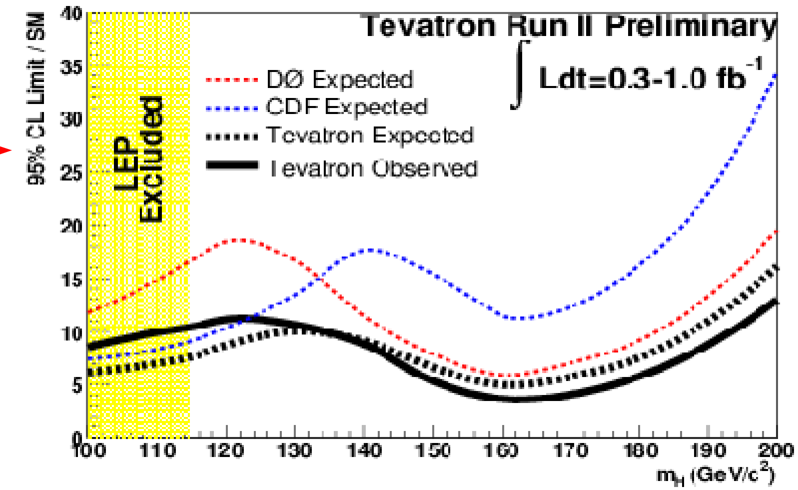
  $\rho_T \rightarrow W\pi_T$, $\pi_T \rightarrow bb$

are an order of magnitude larger. 95% CL limit



Higgs Search at the Tevatron

- CDF and DO limits (Yao et al.), ICHEP06.
- Combination of 11 measurements:
  4 use ~1 fb^{-1}, 7 use ~ .3 fb^{-1}

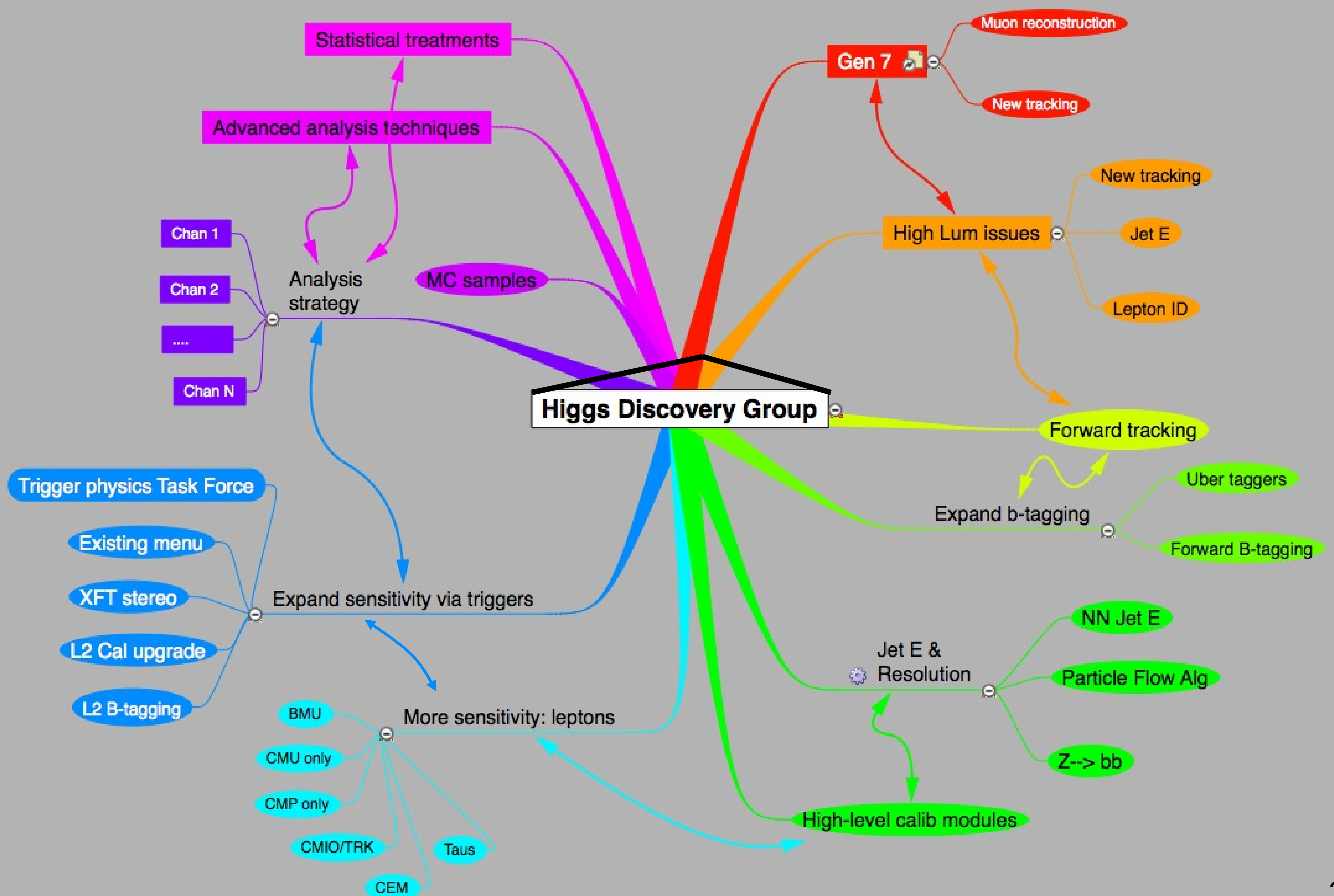


- Factor 10 off for M<140 GeV/c^2
  " 5 " M ~ 160 GeV/c^2
  By end of 2008, expect ~10 times the data.
- Working on increasing the sample
  Trigger task force: increase triggers used
- Analysis improvements list (October 05)
  - Many tools available, have to be included in the analysis of the different channels
  - LBNL b-tagging separate 1 and 2 b-tag, + NN: ~ 30% sensitivity improvement.
  - Forward tracking being improved
  - NN Event Selection being investigated

Improvement	$WH \to l\nu bb$	$ZH \to \nu\nu bb$	$ZH \to llbb$
Mass resolution	**1.7**	**1.7**	**1.7**
Continuous b-tag (NN)	1.5	1.5	1.5
Forward b-tag	1.1	1.1	1.1
Forward leptons	1.3	1.0	1.6
Track-only leptons	1.4	1.0	1.6
NN Selection	**1.75**	**1.75**	**1.0**
WH signal in ZH	**1.0**	**2.7**	**1.0**
Product of above	8.9	13.3	7.2
CDF+DØ combination	2.0	2.0	2.0
All combined	17.8	26.6	14.4

- CDF is moving towards a strong effort on the Higgs search

The Road to the Higgs



Summary and Conclusions

- Large contributions to hardware and physics over the last 25 years
  Trained 15 PHD thesis, 21 postdocs.
  21 of these have faculty or lab staff positions.

- Contributed to top discovery, precision top and W mass measurements, particle searches, properties of B mesons, B_s mixing

- LBNL still contributing to Run II CDF physics results:
  - CKM Parameters, B_s Mixing
  - Top Physics
  - New particle searches

- Data sample expected to be ~ 40 times the Run I data by end FY07.
- Better statistics, improved analysis tools.
- Window of opportunity for high P_T physics before the LHC.

- Unfortunately, the LBNL group is dwindling in size!

Backup Slides

Contributions to Analysis Tools 2005-6

Exploit group expertise to optimize data taking and detector performance.
Develop reliable tools to perform physics analysis.
Essential for precision measurements.

- EVTGEN: improved B decays simulation (Beringer)

- Trigger efficiency for electrons (for all High P_T physics groups)
- Improved offline code, Gen5, and validation for top group analysis.
- Validate Gen6 using W cross section data (Freeman,Nielsen)
- Improved Scale Factor (data/MC) for electron ID (McFarlane, Yao)

- Trigger studies for B physics (improve B_s mixing measurement)
- Improved impact parameter resolution (better B_s mixing sensitivity)

- Silicon b tagging high P_T (efficiency, scale factor, NN)

- Jet corrections and systematics (smaller systematics on top mass)

Top Mass results: July '06

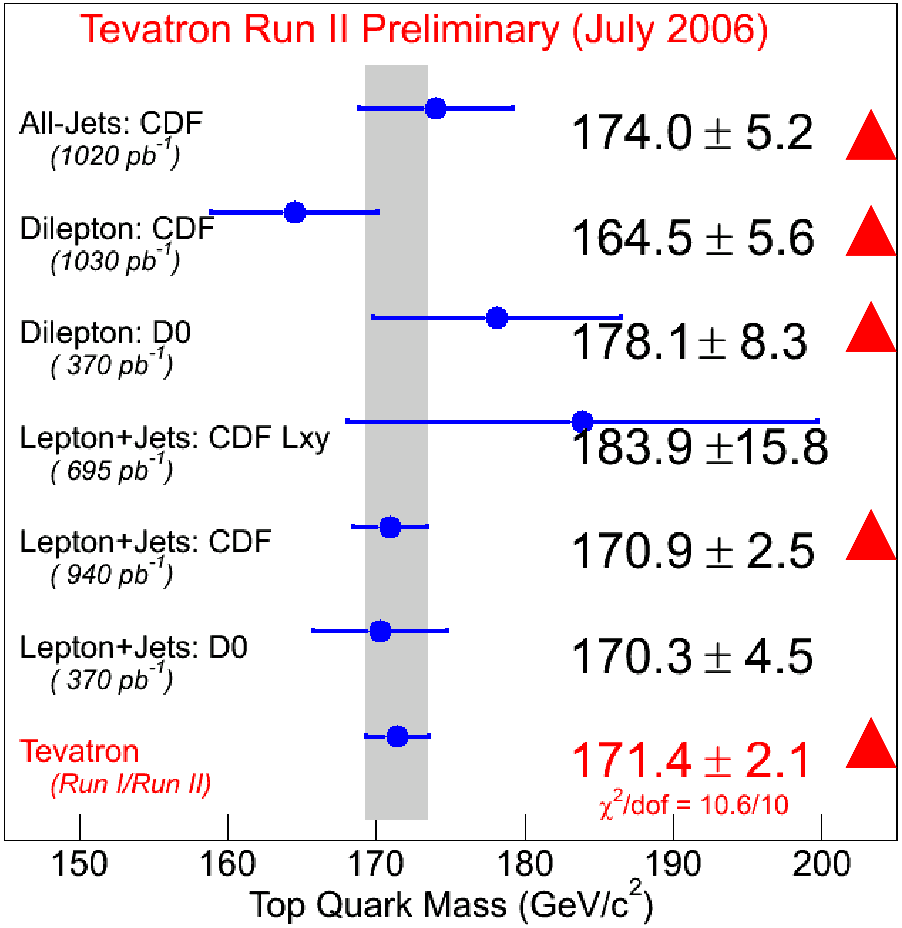
- Top mass average of best results of CDF and D0.
- All correlations taken into account.

M_{top}= 171.4 ± 2.1 GeV/c^2

dM_{top}= 1.2% M_{top}

δM(stat) = ± 1.2 GeV/c^2
δM(JES) = ± 1.4 GeV/c^2
δM(sys) = ± 1.0 GeV/c^2

- Values obtained from 3 different channels agree at the 15% level



▲ New results

(Glenzinski, ICHEP06)