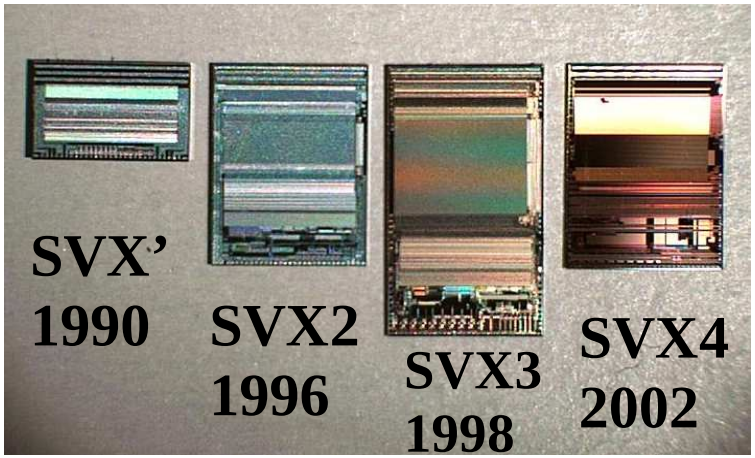
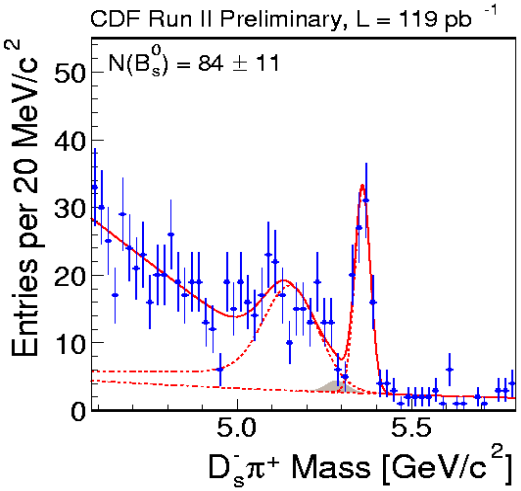
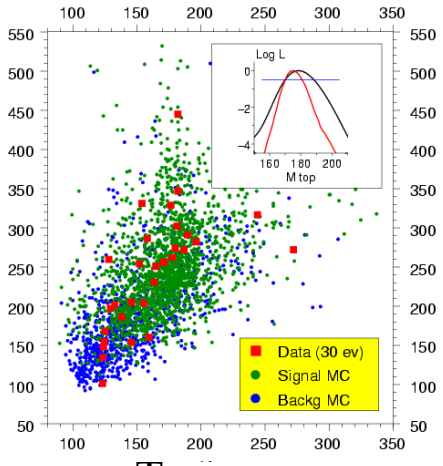
LBNL-CDF Group Program at the Tevatron

Angela Galtieri

LBNL DOE Review, February 18-19, 2004





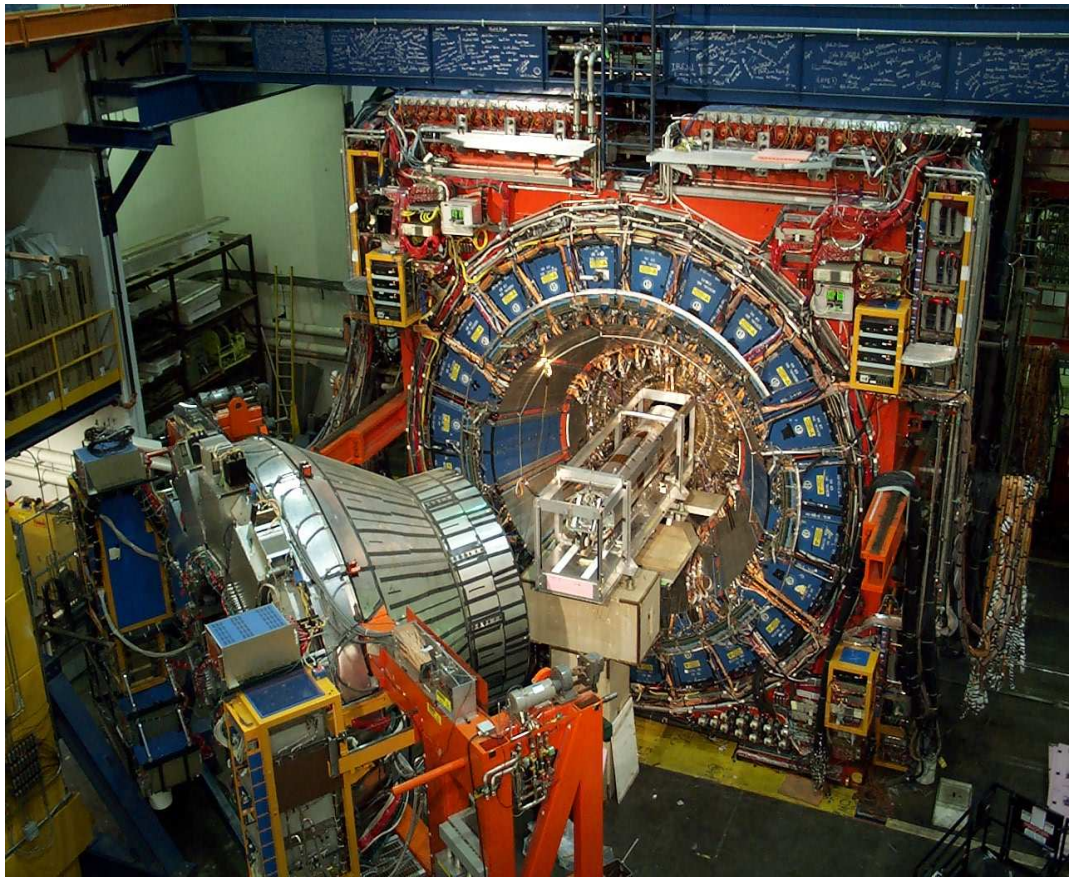


Top mass

Outline

- Accelerator Status
- LBNL Group
  - Responsilities
- Silicon Detectors
  - Run IIa
  - Run IIb
- Analysis Tools
  - b-tagging
  - Jet corrections
  - Realistic Monte Carlo
- Physics Program
  - B Physics
  - EWK (W/Z/Top)
  - Higgs
- New Physics
- Prospects for the future
- Summary and
  - Conclusions

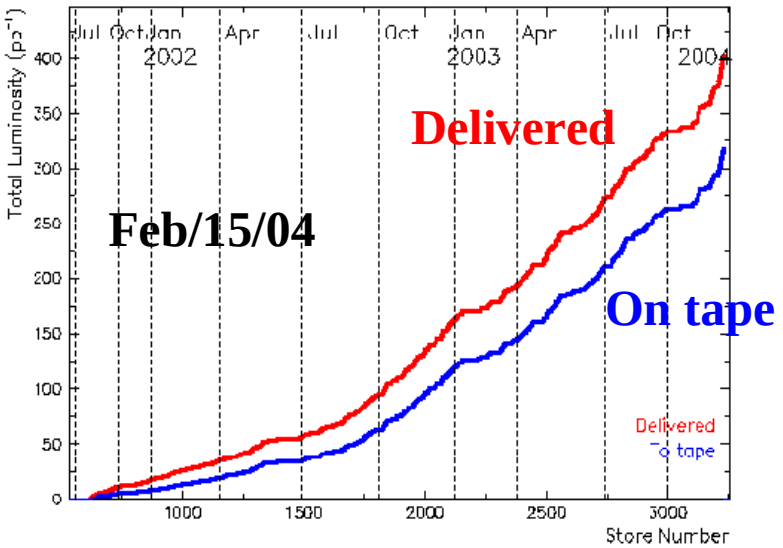
CDF Detector



Installing silicon tracker, March 2001

Tevatron Status

- Run II Upgrades: $2.5 \times 10^{32}\ cm^{-2}\ s^{-1}$
- Main Injector (2001)
  - Recycler (2003):
    recover antiprotons
  - Bunches
    baseline 36x36 at 396 ns
  - $\sqrt{s} = 1.96$ TeV



- Current performance
  $5.9 \times 10^{31} cm^{-2}\ s^{-1}$ (record)
  Consistently $> 5.0 \times 10^{31} cm^{-2}\ s^{-1}$
- Integrated luminosity
  405 pb^{-1} delivered
- CDF: 320 pb^{-1} on tape
- Plan for the future

Integrated Luminosity (fb^{-1})				
	Design Projection		Base Projection	
	per year	Accum-ulated	per year	Accum-ulated
FY03	0.22	0.30	0.20	0.28
FY04	0.38	0.68	0.31	0.59
FY05	0.67	1.36	0.39	0.98
FY06	0.89	2.24	0.50	1.48
FY07	1.53	3.78	0.63	2.11
FY08	2.37	6.15	1.14	3.25
FY09	2.42	8.57	1.16	4.41

Members of the LBNL Group

Physicists-Staff (3.2 FTE)

A. Galtieri (Group leader)
R. Ely*(retired)
M. Garcia-Sciveres*
C. Haber*
Y.K. Kim (now UC Chicago)
J. Lys *(retired)
R. Miquel**
M. Shapiro* (UC Berkeley)
J. Siegrist* (UC Berkeley)
W. Yao**

Physicists-Term (4.3 FTE)

A. Cerri
A. Dominguez
J. Nielsen
B. Orejudos
L. Vacavant*
I. Volobouev***

Fellows (1 FTE)

C. Currat (now gone)
M. Weber (moving to ATLAS)
P. M. Fernandez (July '03)

Grad. Students(7.0 FTE)

T. Affolder++ ('96 Run II/I)
A. Connolly++ ('96 Run II/I)
G. Veramendi++ ('98)
H.C. Fang ('98)
E. Brubaker ('99)
H. Bachacou ('99)
A. Gibson ('00)
J. Freeman ('00) from ATLAS
J. Muelmenstaedt ('02)+
A. Deisher ('02)+
P. Lujan ('03)

Undergrad. Students

L. Tompkins
E. Feng (to ATLAS)

Visitors

F. Zetti (Pisa) (to ATLAS)
M. Tavi (Finland)

Engineers, Designers

B. Krieger
H. von-der-Lippe
J.P. Walder
E. Mandelli
B. Holmes

---

*ATLAS, ** PDG
*** Supported by UC Chicago in FY04

+ Start on CDF on '04
++ Thesis completetd

FTE refer to FY04

Leadership roles at CDF (last 3 years)

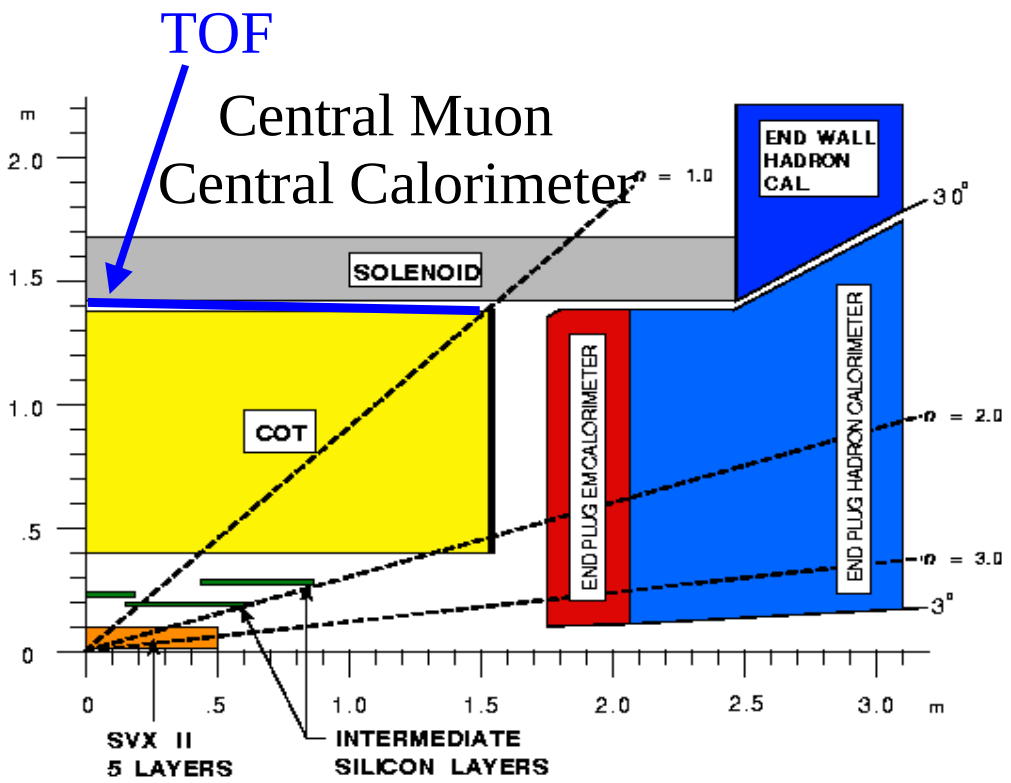
- Marjorie Shapiro
  - **Offline Project Manager (March 98-October 2001)**
  - **Co-coordinator: CDF simulation group (October 2001-October 2003)**
  - **Co-coordinator: B physics group (since January 2002)**
- Young-Kee Kim (left Jan. '03)
  - **Associate Head of CDF Operations Department (to Dec. 2001)**
    - **in charge of commissioning**
    - **setting milestones, schedule and priorities**
  - **L3 group co-leader (end '02)**
- Bill Orejudos
  - **Co-coordinator of the COT group**
  - **CDFII Operation Manager (to June 02)**
- Alex Cerri
  - **Co-convener of the Semileptonic B Physics group**
- Weiming Yao
  - **Co-convener : Higgs group (to 9/2003)**
- Aaron Dominguez
  - **Co-convener : b-tagging (to 9/03)**
  - **Co-convener: silicon studies (to 5/03)**
  - **Co-convener: Higgs Physics group**
- Lina Galtieri
  - **Co-convener: Jet corrections (to 5/03)**
- Greg Veramendi
  - **Co-convener: High Pt Electrons (to 2/03)**

LBNL Contributions to CDF II

I. Construction

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

Schematics of CDFII Detector



II. Commissioning

- Associated Project Manager (YK Kim)
- COT Commissioning (Orejudos)
- Silicon commissioning (Affolder, Dominguez, Nielsen, Volobouev)

III. Operation

- CDF II Operation Manager (Orejudos)
- SVT operation (Cerri, pager, ongoing)

LBNL Contributions to CDFII

IV. Computing and software

- Project manager (M. Shapiro)
- Codgen for relational data bases
- Data handling software for early tests
- Silicon Code librarian (A.Dominguez)

V. Detector Operation (MOU)

- Online silicon monitoring
  (H. Bachacou, I. Volobouev)
- Offline Silicon calibration
  (Nielsen (pager), Volobouev)
- Online data monitoring (YMON)
  (Gibson, Veramendi)
- COT calibration (Orejudos, pager)

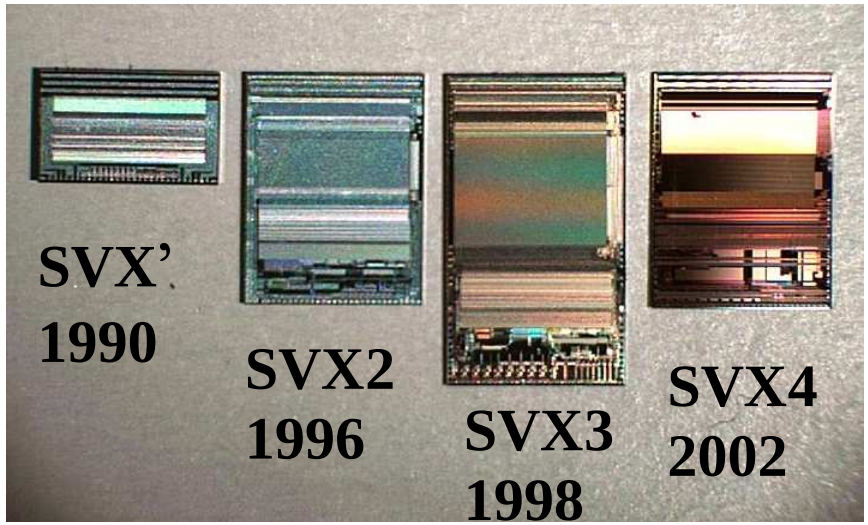
– Ongoing responsibilities

- MC generators : ISAJET (L. Galtieri), HERWIG, Wbbgen (J. Lys) **MOU** ZGRAD (A. Gibson).
- Silicon geometry (A. Dominguez)
- Silicon Tracking (W. Yao)
- Secondary vertices code (W. Yao, A. Dominguez)
- Passive material (L. Vacavant)

In FY04 we have to hand out most of our responsibilities (MOU and others) to other groups because of lack of manpower in FY05 in the LBNL group

Silicon Detectors: LBNL contributions

Rad hard chips for Silicon Detectors



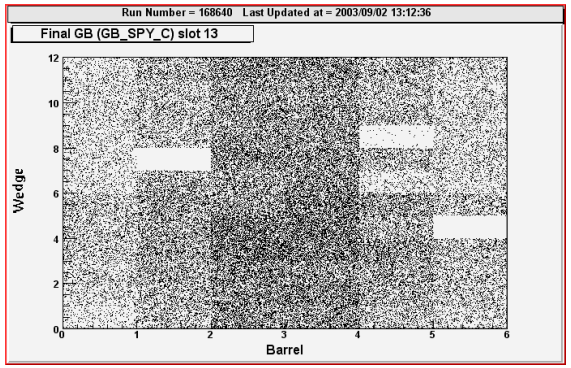
- LBNL designed SVX, SVX'.
- Joint designs with FNAL since.
- SVX4: technology transfer of SVX3 plus enhancements
- Conversion to quarter micron CMOS technology proposed by LBNL
- LBNL/FNAL/Padova design
  LBNL: integration and simulation

Run IIa Silicon detector Status

- 4% dead strips
- 3% have readout problems
- 92% of ladders integrated
- Tracking efficiency 90%
- Expected lifetime: 4-6 fb^{-1}

SVT, displaced vertex trigger

Tracks reconstructed 4/5 layers
TT trigger efficiency ~78%



Contributions to Run 2b silicon

M. Garcia-Sciveres, C. Haber, M. Weber, W. Yao, L. Galtieri, (physicists)
A. Gibson, J. Freeman, P. Lujan, E. Feng, (students)

The present Silicon detector may not survive for integrated luminosity > 6 pb^{-1}.

CDF had plans to replace L00 and the 5 layers SVXII detector in 2006.

Plans have been canceled because of low Tevatron luminosity

LBNL group participation:

- **LBNL-IC group lead SVX4 chip design (with FNAL and Padova). To** be used by both CDF and D0. Testing and irradiation responsibility (6000 chips on hand).
- **Design and pre-prod. of hybrids** (120 pre-production hybrids done)
- **Proposed 'stave' concept.** Also, bus cable: design, prototype and testing
  Highly integrated electrical, mechanical & cooling unit (66 cm long).
- Systematic studies of electrical performance of the stave. **15 staves being built.**

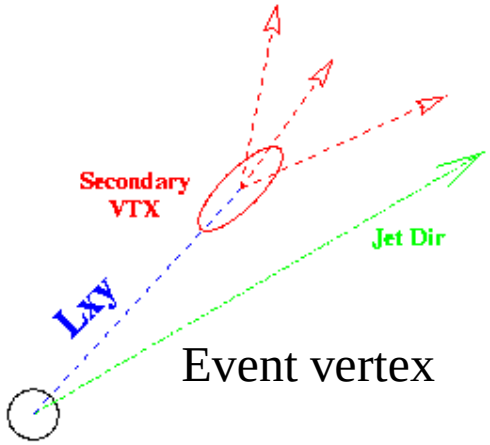
Very successful project: SVX4, Hybrids, " Staves" working as expected.

The PHENIX experiment at BNL buying some hybrids from us: want to use the SVX4 chip

Analysis contributions: b-tagging (SVX)

A. Dominguez (co-coordinator), W-M Yao, H. Bachacou

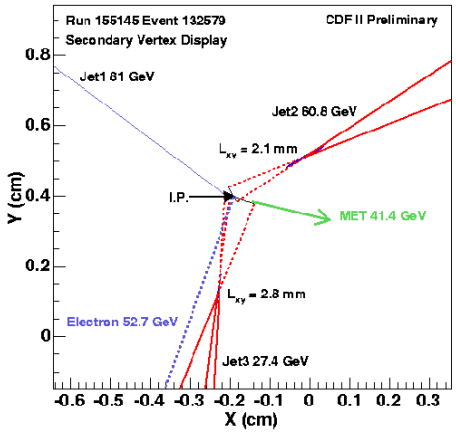
Displaced vertex algorithm allows detection of b quarks, important for B physics, top, and Higgs

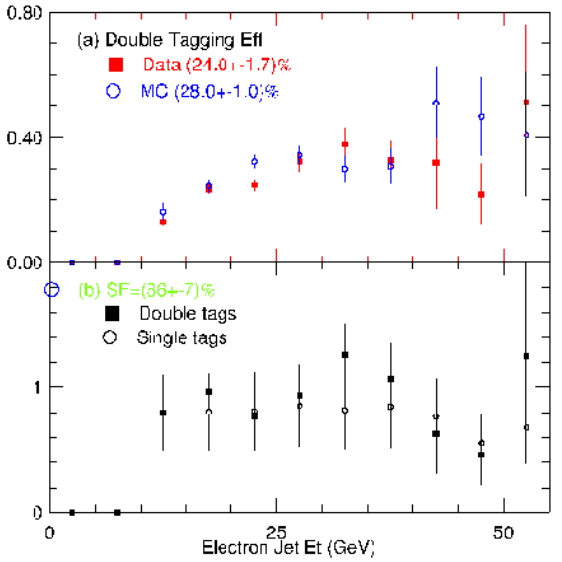


- Reconstruct secondary vertex with ≥ 2 tracks
- Require $L_{xy}/\sigma_{xy} > 3$

  $\sigma_{xy} \sim 150\ \mu$
- Performance, alignment of Si detector crucial

Double tagged top event



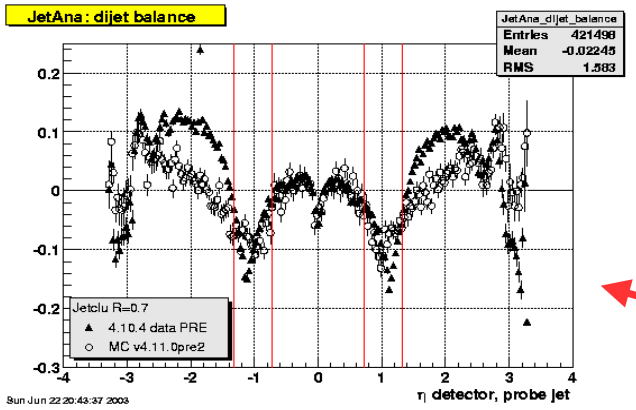


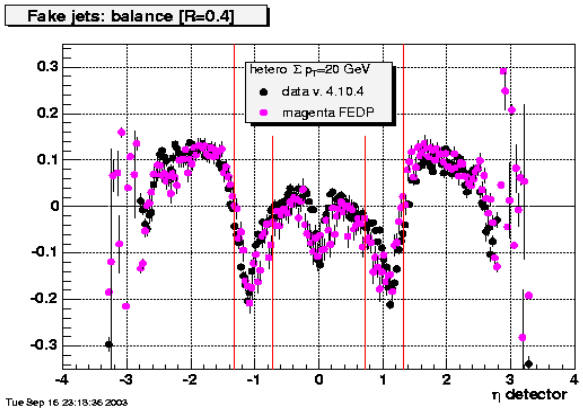
- Efficiency for at least one tag in *l* +jets events (24.0±1.7)%
- Efficiency to tag a $t\bar{t}$ event =(55±1±5)%
- Relative difference between data and MC = (86 ± 7)%

Contributions: Jet Energy cor. + sys

Galtieri (Co-convener jet corrections), Currat, Gibson, Lys

- Many studies done since 2001 to provide jet corrections to CDF.
- LBNL contributions: Plug calorimeters studies, simulation tuning, Energy scale in Central using γ–jet balance.



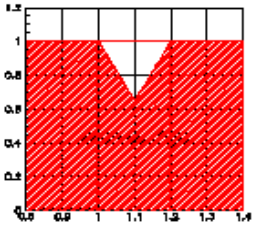


- Plug E-scale determined from jet-jet balance
- Scale checked in Central Calorimeter using γ-jet balance .

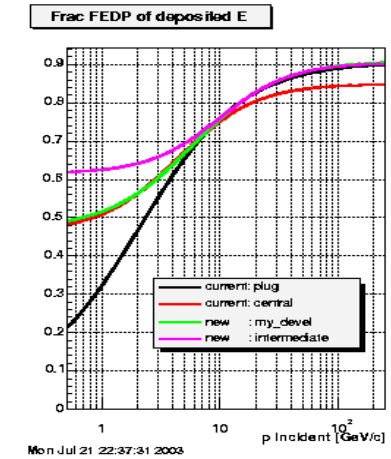
6/03 Bad agreement above η=1

9/03: much better

New extrapolation at the low particle P_T (magenta curve)



Notch in crack region



Due to lack of funds, we could not retain C. Currat. Plug studies end here.

Contributions: Realistic Monte Carlo

A. Dominguez, A. Cerri, H-C Fang, R. Miquel, M. Shapiro , L. Vacavant

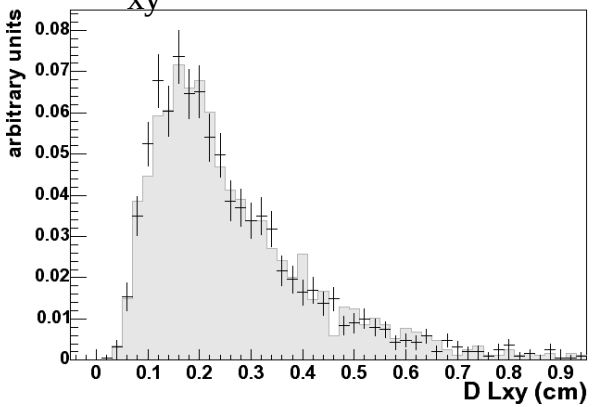
Detailed simulations of detector performance are needed to evaluate efficiencies and acceptance for most physics processes.

Detector conditions vary during a long data taking period. Need to evaluate average conditions during the data interval used. Include:

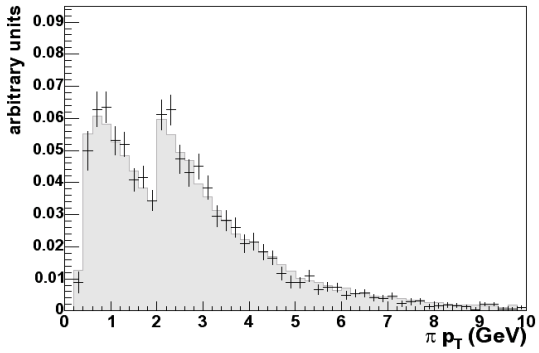
- Silicon dead channels, misalignment
- Trigger L1 and L2 emulations
- SVT trigger turn on and efficiency

Some examples from the lepton+SVT trigger data used by the B group

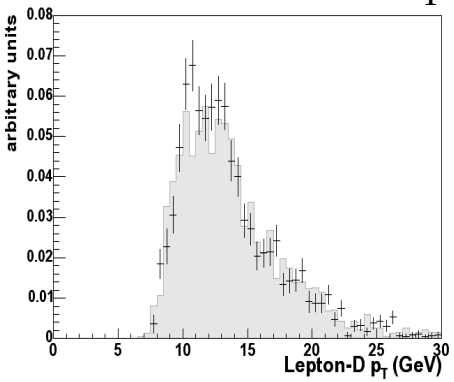
L_{xy} for D mesons



Pion P_T



Lepton+D meson P_T



LBNL Group Physics Program

EWK/Top/Higgs Physics

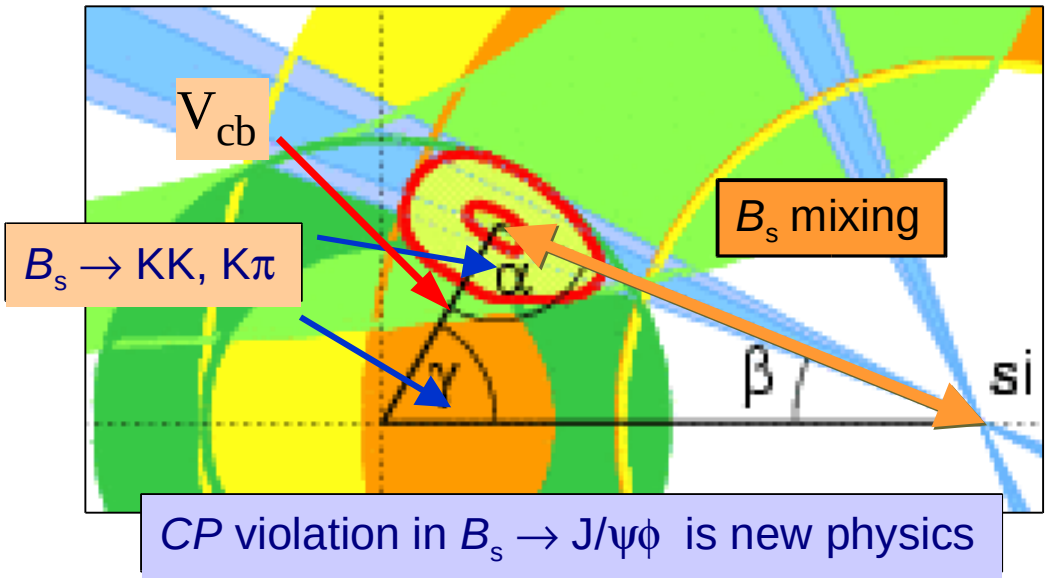
- People : Bachacou, Brubaker, Currat, Dominguez, Fernandez, Freeman, Garcia-Sciveres, Galtieri, Gibson, Lujan, Lys, Nielsen, Orejudos, Siegrist, Veramendi, Volobouev, Yao
- Physics Interest :
  - $\sigma(W), (Z)$: A_{FB} at $s > M_Z^2$
  - Top : cross section and ratio of cross sections.
  - Top Mass
  - Higgs Searches: SM and SUSY
  - New particle Searches

B Physics

- People : Cerri, Deisher,Fang, Miquel, Muelmenstaedt, Shapiro, Vacavant
- Physics Interest :
- V_{cb} and Semileptonic decays
  - Major LBL goal for Winter 2004 Addresses CKM matrix issues.
- B_s mixing
  - Optimize B_s reconstruction and measure B_s branching ratio.

B Physics: where are we?

CP violation in the B system being tested via the unitary triangle.
Sin2β measured with high precision at the B factories.



- B_s physics can only be done at the Tevatron
- **It opens whole new chapter that can lead to new physics**
- SVT (Silicon Vertex trigger) allows study of the hadronic decays

$B \rightarrow hh$ and $B_s \rightarrow D_s \pi$

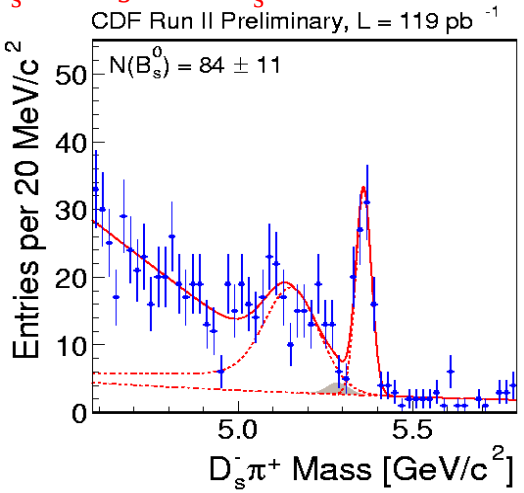
- **B_s mixing requires fully reconstructed decays to reach high values of x_s**
- **Fully reconstructed B_s decays will lead to measurements of the angle γ**
- **LBNL Group working on two sides of the triangle: B_s mixing and V_{cb}**
- **CDF , BaBar and theory group: powerful team for B physics at LBNL**

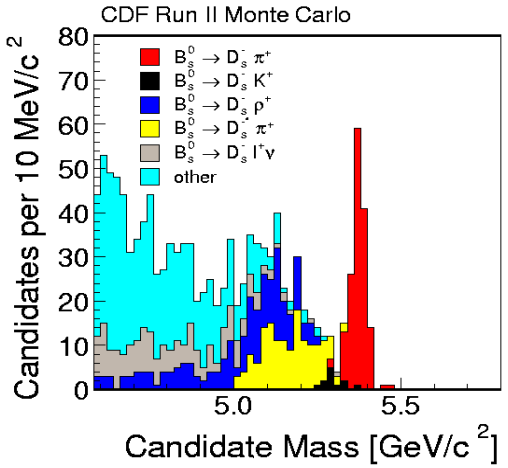
First observation of $B_s \to D_s \pi$

Alessandro Cerri (with MIT and Padova groups)

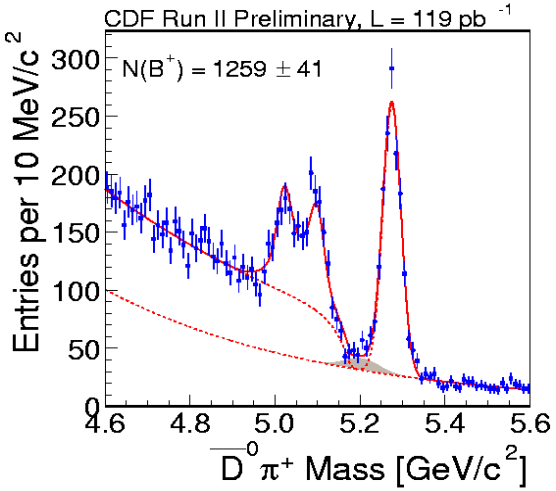
$f_s.BR(B_s \to D_s \pi^+) / f_d.BR(B^0 \to D \pi^+) = 0.35 \pm 0.05(stat) \pm 0.04(sys) \pm 0.09(BR)$

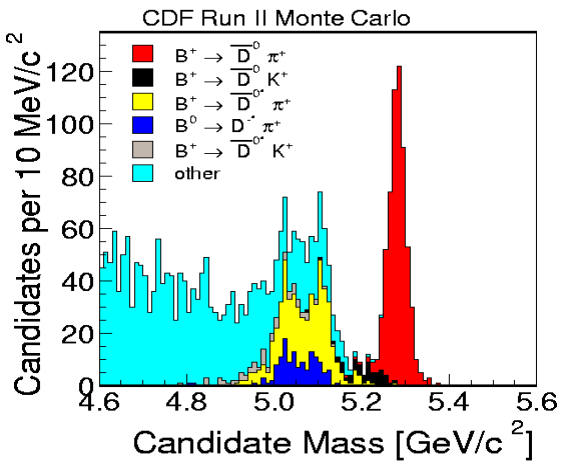
$B_s \to D_s \pi^+$, $D_s \to \phi\pi^+$, $\phi \to KK$





$B^+ \to D^0 \pi^+$





Use f_s/f_d from PDG

Future plans for LBNL group:

- Other D_s decay modes
- More statistics
- B tagger optimization
- PHD thesis (H-C Fang)
  - Cabibbo suppressed mode $B^+ \to D K^+$ info on angle γ
  - **Also search for $B_s \to D_s K$**

B Physics: Moments Analysis

M. Shapiro, A. Cerri, H-C Fang, R. Miquel, L. Vacavant

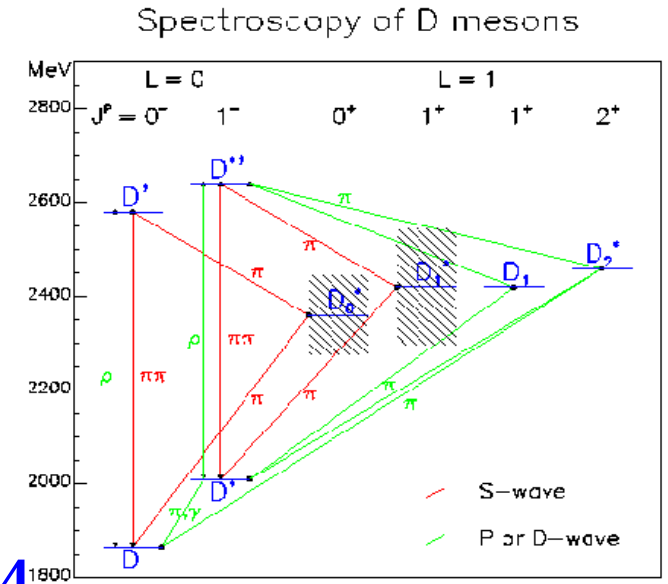
- Measurement of V_{cb} from inclusive semileptonic rate:

  OPE provides expansion in terms of α_s, Λ_{QCD}/m_b , ...
- Need comparison of theory and experiments for many quantities: build confidence in predictions by testing them
- Theory does not provide detailed knowledge of hadronic states, but makes prediction for inclusive quantities, e.g.

  $<M_{hadronic}>$, $<M^2_{hadronic}>$,.....

  these are the "hadronic mass" moments

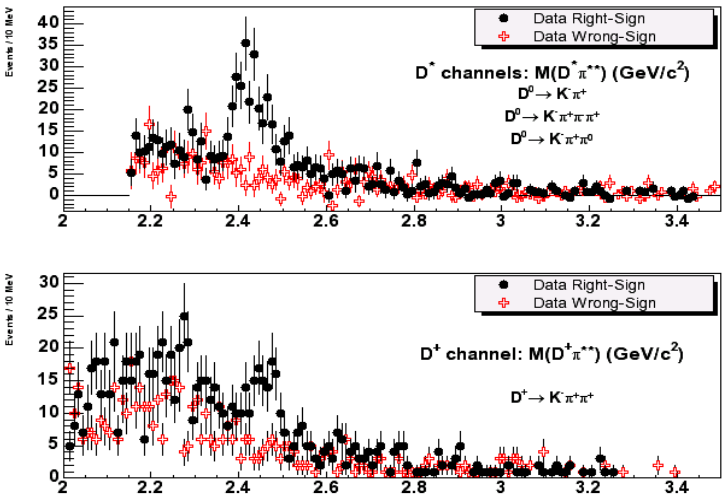
  $B \rightarrow X_c\, l\, \nu_l$



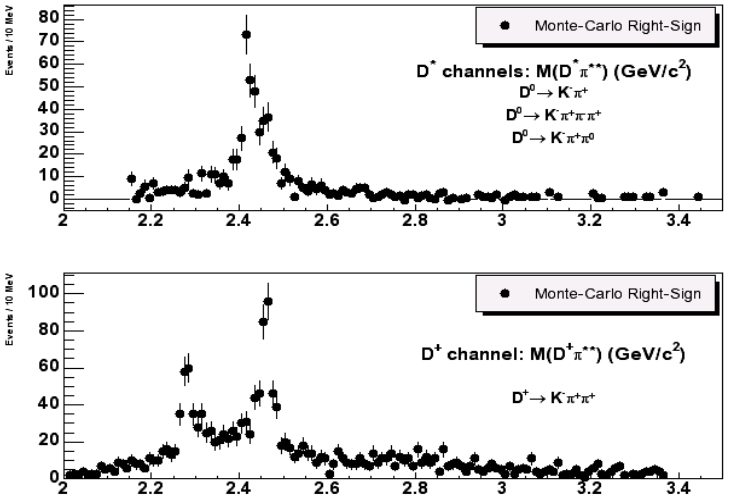
- X_c is D, D*, D** , where D** is any charm state, resonant or not with $M_{D^{**}} > M_{D^*}$
- BR($B \rightarrow l\nu D,D^*$) and M for D and D* known .
- **Goal: first CDF measurements by Winter '04**

Moments analysis

Lepton+$D^{**+}\pi$ and lepton+$D^{+}\pi$ data

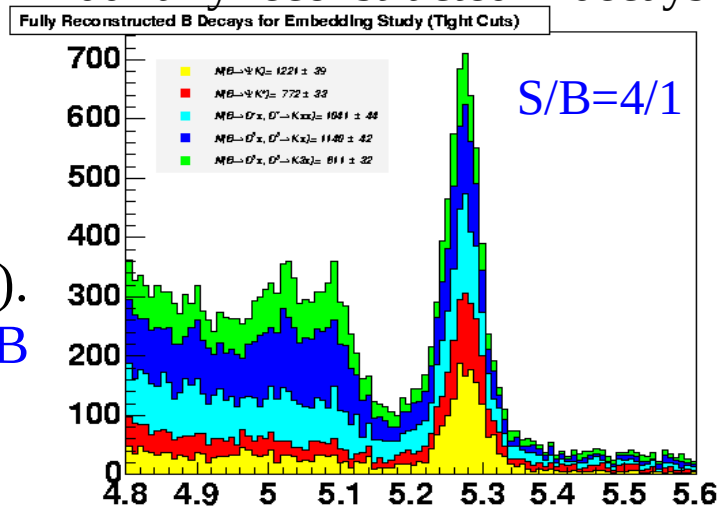


Evtgen+Sim prediction for lepton+ D**



- Raw M** distribution shows resonant D**.
- To extract correct M** distribution, must model background shape.
- Wrong Sign combinations cannot be used (possible contributions from radial excitations).
- Use Fully reconstructed B decays and replace B with MC semileptonic events to determine : fragmentation, underlying event backgrounds

4700 fully reconstructed B decays



High P_T Physics Activities

Bachacou, Brubaker, Currat, Dominguez, Fernandez, Freeman, Garcia-Sciveres, Galtieri, Gibson, Lujan, Lys, Nielsen, Orejudos, Siegrist, Veramendi, Volobouev, Yao

Group Activities:

- Z asymmetry (1 PHD Thesis)
- Top cross section (1 PHD thesis)
- Several top mass analyses (3 PHD theses)
- SM Higgs Search
- MSSM Higgs search
- Heavy long lived particles (CHAMP) search

Results presented at Conferences:

- **Z asymmetry** (Veramendi's PHD thesis)
  ready for publication, second draft to Collaboration soon
- **Top cross section** using b-tagged events (Bachacou's PHD thesis)
- Conventional **top mass** measurement (Brubaker's PHD thesis)
- **CHAMP search**

$Z \rightarrow e^+ e^-$ Asymmetry

Y. K. Kim, Veramendi, Brubaker, Gibson, Tompkins

Asymmetry of $Z \rightarrow e^+ e^-$ at the Tevatron is expected to agree with LEP measurement. The Standard Model predicts A_{FB} at all M(e+e-) .

- High mass reach unique to Tevatron
- Probe Z-γ interference
- Complements direct Z' search

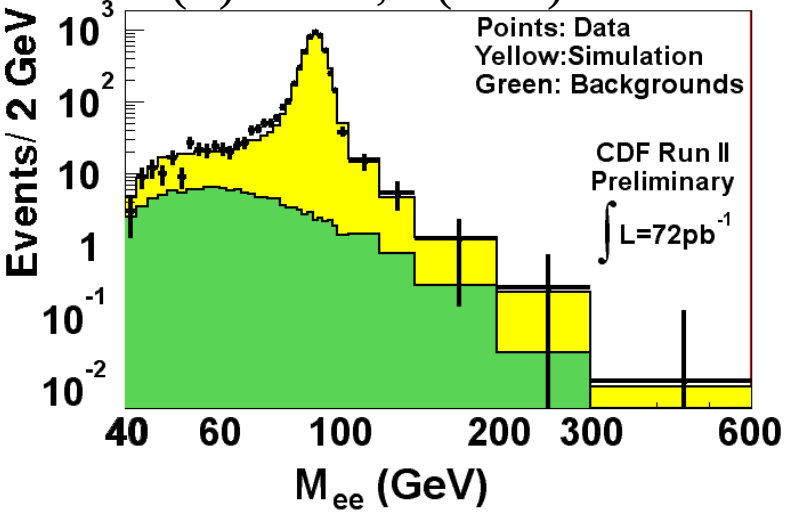
Results agree with the SM

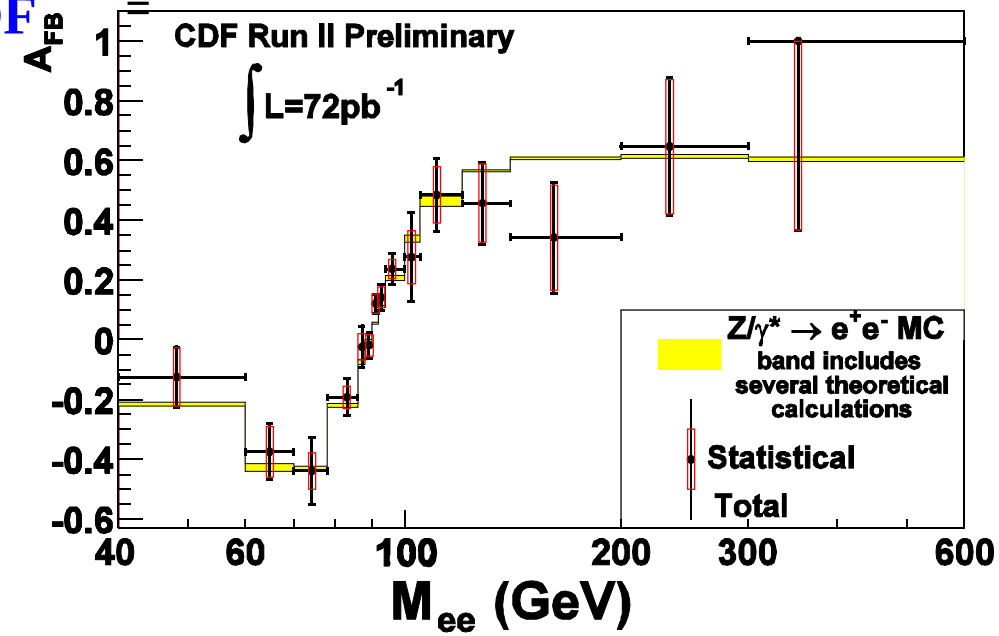
Publication being reviewed by CDF

Electrons up to η=3 used

$$A_{FB} = \frac{d\sigma(\cos\theta>0)-d\sigma(\cos\theta<0)}{d\sigma(\cos\theta>0)+d\sigma(\cos\theta<0)}$$

N(Z)=5200 , N(back)=186



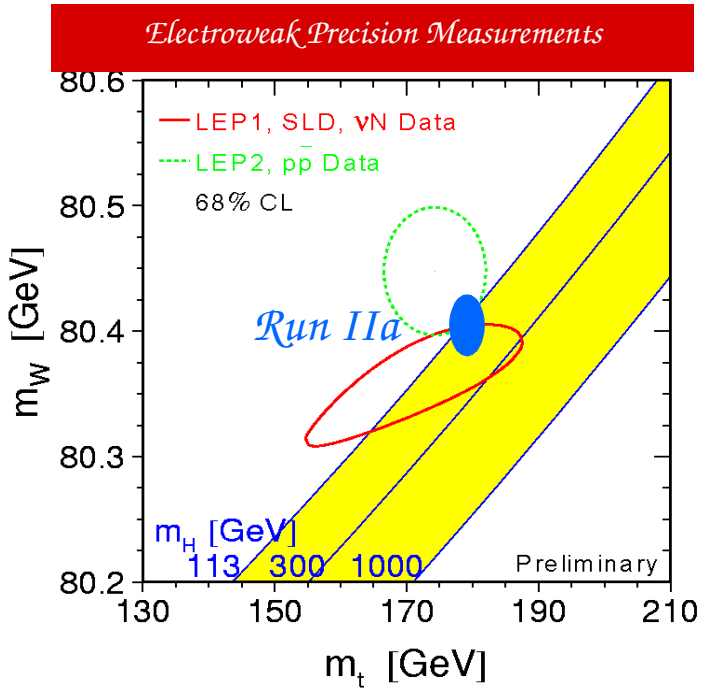


Top Quark property Measurements

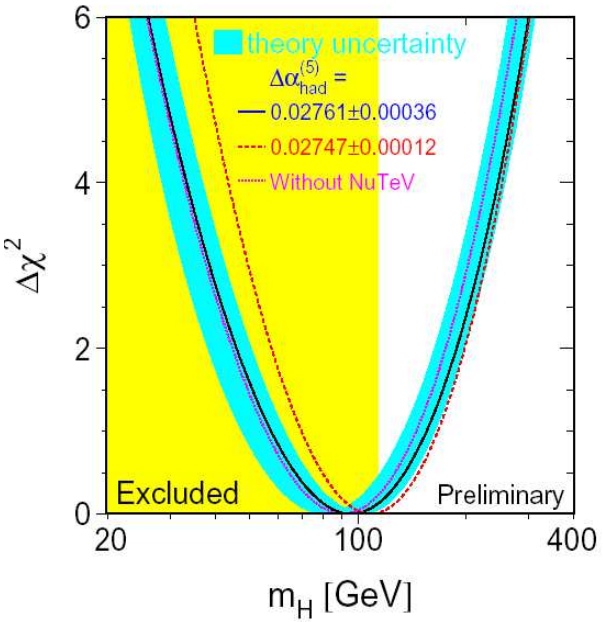
Bachacou, Brubaker, Fernandez, Freeman, Galtieri, Gibson, Lys, Nielsen, Volobouev, Yao

Short term goal:

- Top cross section and mass measurement.
- The Standard Model predicts the Higgs mass once the W and Top mass are measured with high precision.
- In Run II we need to improve the systematic error on the top mass. Working on this aggressively (jets, methodology, etc.)



$M_H^{fit} = 96\ ^{+60}_{-38}$ GeV, probab. 4.5%



M_H<219 GeV

Without NuTev

χ^2/dof =16.8/14

probab. 26.5%.

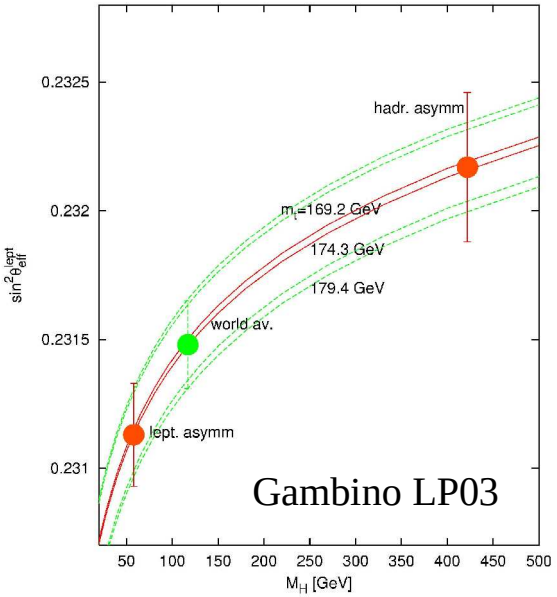
M_H=91 GeV

M_H < 202 GeV

Consistency of EWK data

The Chanowitz argument (PRL 87,2001)

- Discrepancy between $\sin^2\theta_{eff}$ measured from leptonic (A_{LR} ,SLD) and hadronic (A^b_{FB}, LEP) asymmetries: they predict different M_H.
- Is this discrepancy due to new physics? Or is it a statistical fluctuation, or a systematic effect not taken into account?

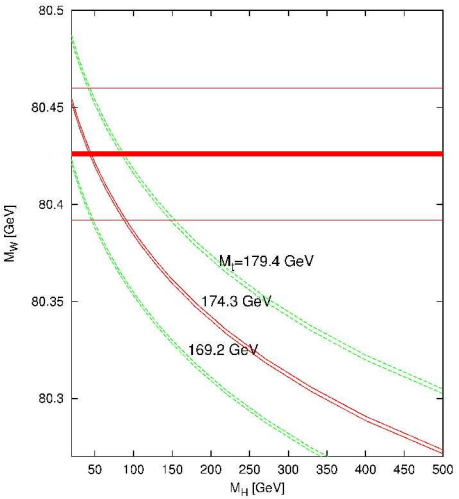


Without $A_{FB}(b)$ the SM fit is very good, but

M_H=42 GeV, M_H<120 GeV at 95%CL

somewhat in conflict with direct lower bound M_H>114.4 GeV , 95%CL

M_H has a strong dependence on M_{top}

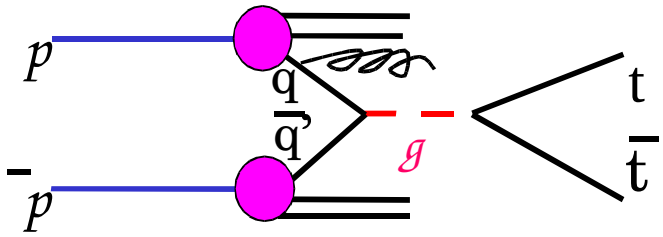


Need to improve δM_{top} by a factor 2

- Does this conflict indicate new physics?
- Altarelli et al. can fix this with SUSY (a light slepton).

Top Physics Studies

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



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

Top quark is heavy: decays very fast!

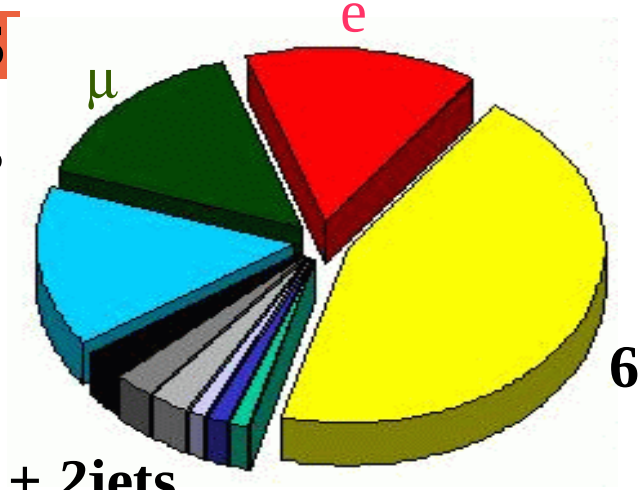
$\Gamma(t \rightarrow Wb) \sim 1.5$ GeV, $t = 4\times10^{-25}$ sec

$\Lambda_{QCD} \approx 100$ Mev, $\Lambda^{-1} \approx 10^{-23}$ sec

No hadronization: no top mesons or baryons

W + JETS

***l* + 4jets**

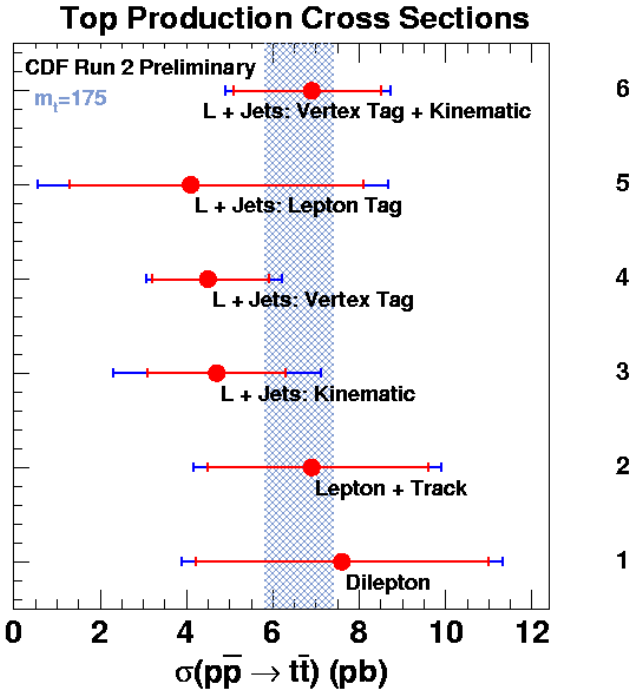


6 jets

***2l* + *2*jets**

Top events are preferentially in W+≥3 jets

CDF σ measurements in Run II



Top Cross section

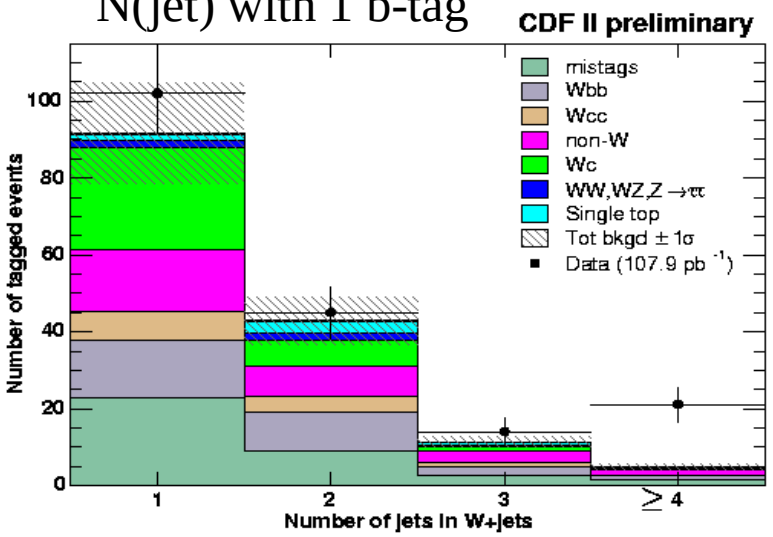
H. Bachacou, J. Nielsen, W-M Yao +UM

- **High P_T lepton, high MET, ≥3 jets**
- **1 b-tag by the SVX algorithm**

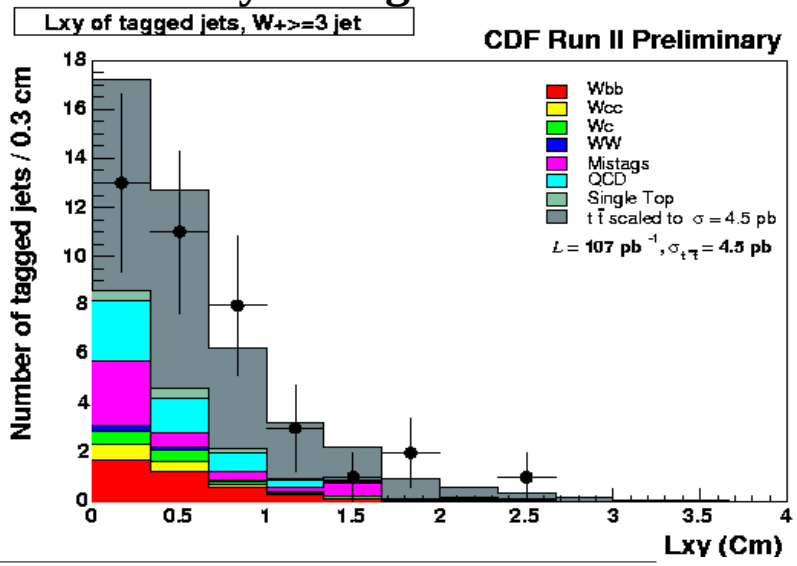
  $L_{xy} > 3\,\sigma_{Lxy}$
- **Nev (≥3 jets) = 35 events (108pb^{-1})**
- **Expect (back.) = 15.1 ± 2.0 events**

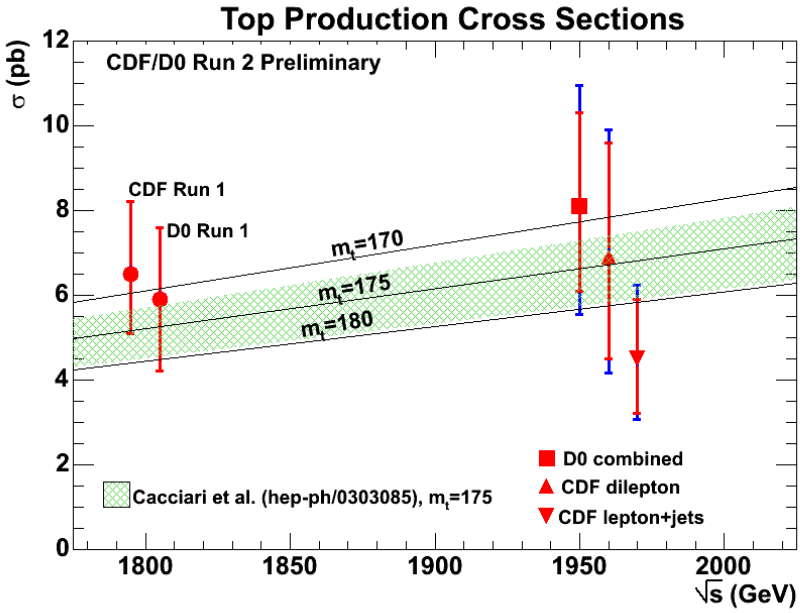
$\sigma(tt) = (4.5 \pm 1.4 \pm 0.8)$ pb

N(jet) with 1 b-tag



L_{xy} for signal and back.





Run II Top mass measurement: lepton+jets

E. Brubaker, A. Gibson, Y.K.Kim

1 high P_T lepton, high MET, 1 b-tag

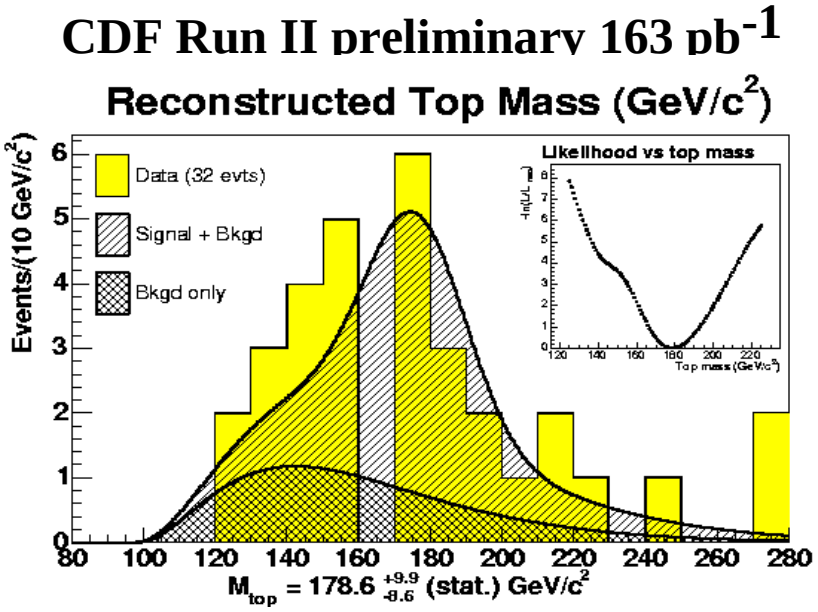
Jets (1-3) E_T>15 GeV, Jet (4) E_T>8 GeV,

Find: 32 candidate events

Expect 8.9± 1.2 background

Analysis follows run I methodology

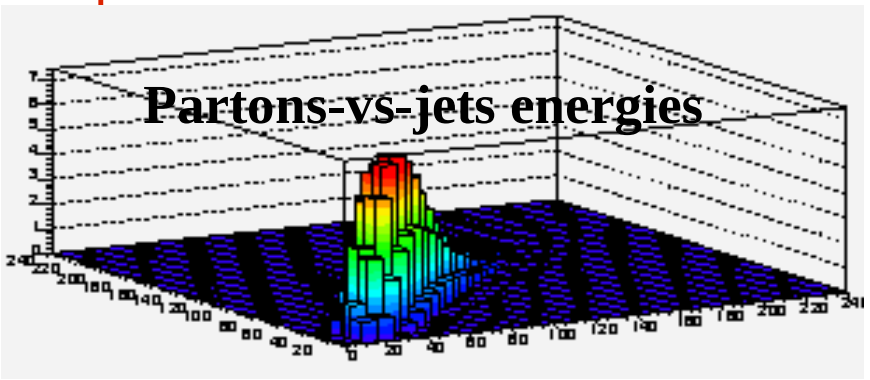
$M = 178.6^{+9.9}_{-8.6}$(stat)±7.1(syst) GeV



A. Gibson(PHD thesis), and others

Try the new D0 method:

- Use matrix elements in the likelihood for top production and decay.
- Improve calorimeter modeling by using jet E_T transfer functions.
- Expect smaller statistical errors



No results yet.

Run I mass results:

M(top) = 174.3± 5.1 GeV CDF+D0 comb.

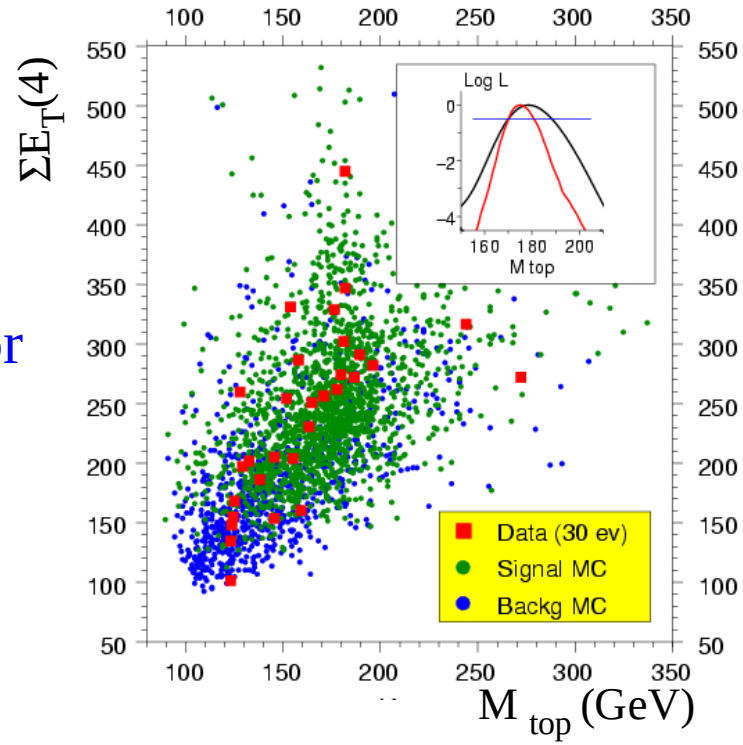
Top mass: new LBNL method

I. Volobouev, P. Fernandez, J. Freeman (PHD thesis), L. Galtieri, J. Lys

Fits events to $t\bar{t} \rightarrow W^+ b\, W^- b$

- Jet E-scale allowed to vary within a gaussian shape in W mass fit
- W Breit-Wigner is integrated correctly
- Multivariate templates for mass fitting likelihood, using kernel density estimator
- Separate templates for correct and incorrect permutations.
- Probability of correct choice determined from χ^2 value of all permutations.
- Multi dimensional templates used to increase discrimination between signal and background.
- Optimal choice of variables being studied

Very preliminary



$M = 175.1^{+5.7}_{-5.1}$ (stat) GeV

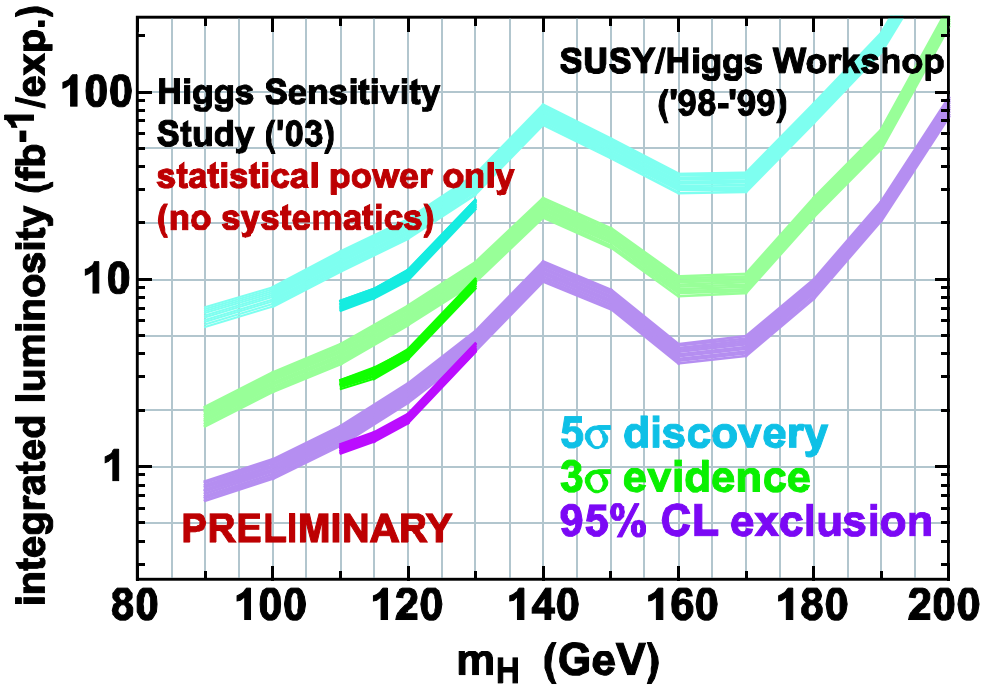
Factor 1.7 smaller error than run I method

Higgs search

Yao (co-convener Higgs group), Dominguez (new conv.), Tompkins

Standard Model Higgs needs large integrated luminosity

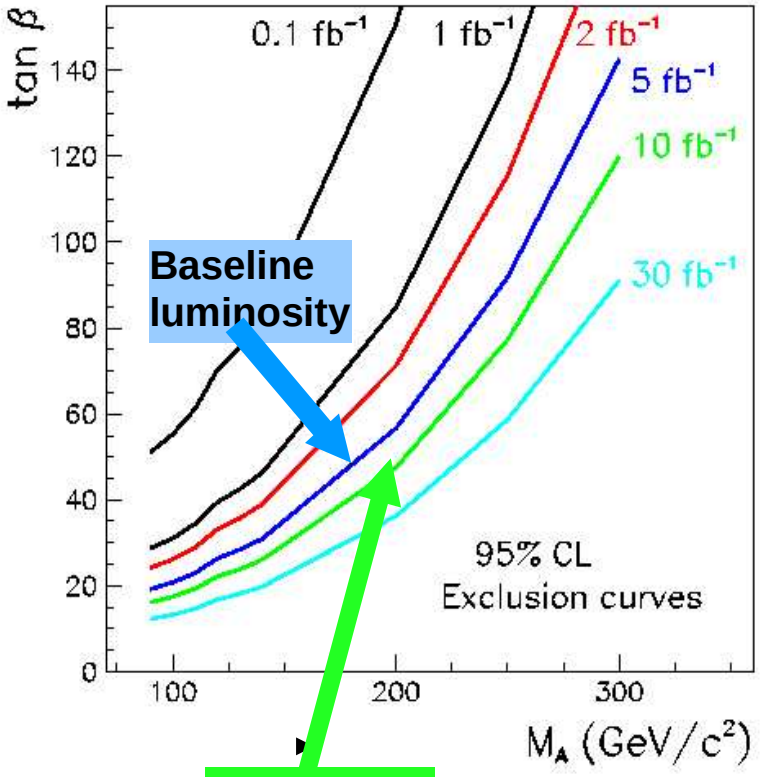
2003 sensitivity estimates are lower. Need better understanding of background



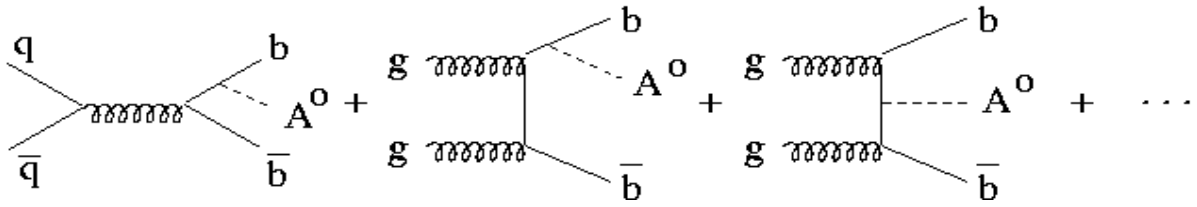
LEP m_H>114.4 GeV @95% CL

SUSY Higgs can have a large cross section for large values of tanβ.

Study the A/H → ττ, bb channels



SUSY Higgs A/H in ττ, bb



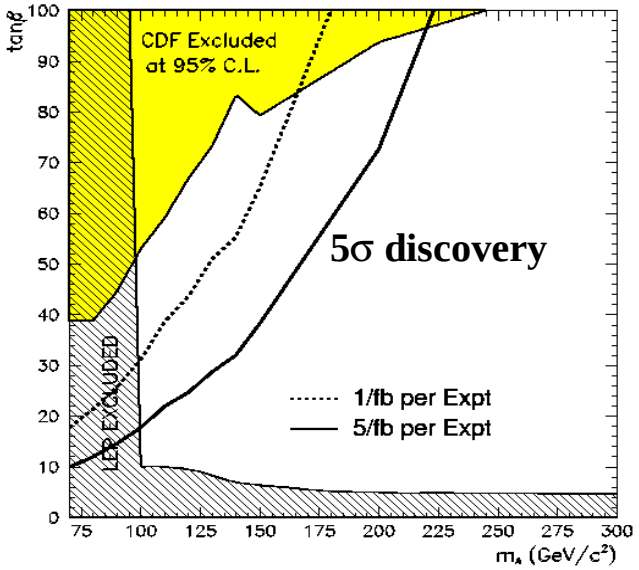
$b\bar{b}$(h/H/A) enhanced at large tan β

A → $b\bar{b}$, so 4 b's in final state

Run Ib Amy Connolly's PhD Thesis

A → ττ,

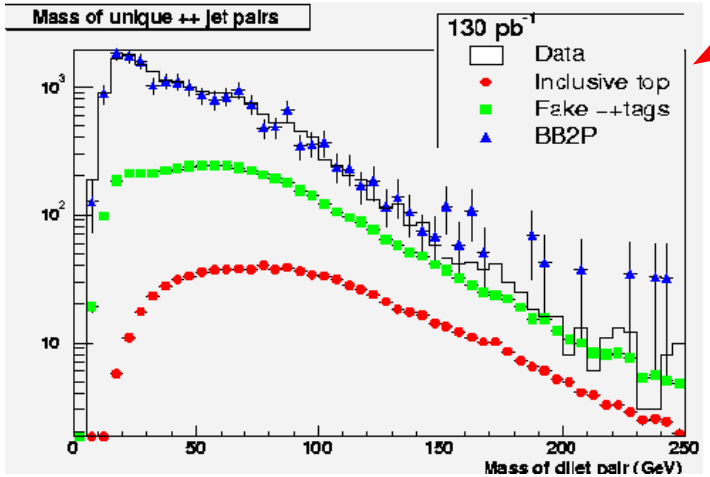
Run I analysis: 4 jets, 3 b tags



Run II 5σ discovery: M=175 GeV for **tanβ=50 with 5 fb^{-1}**

Work in progress:

- Higgs multijet trigger studies
- 4 jets QCD background
- B-mistag background studies



Control sample requires two b-tags.

Data and MC agree very well

Search for Long Lived Heavy Particles

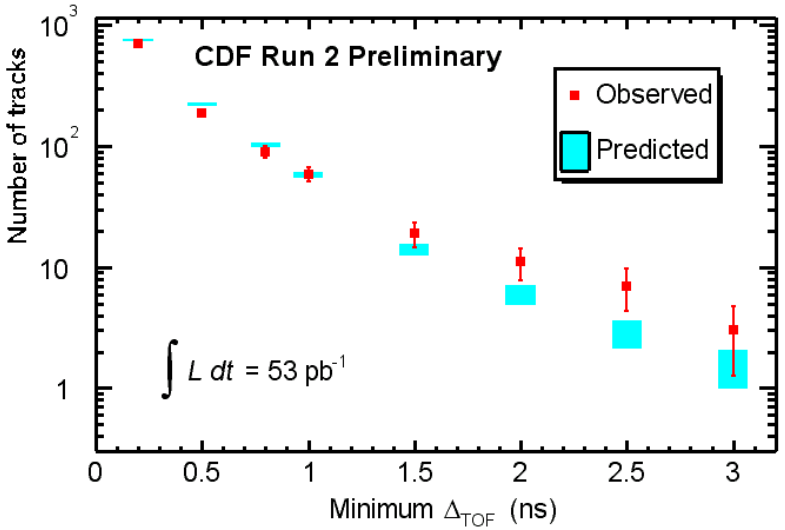
Bill Orejudos and FNAL physicist

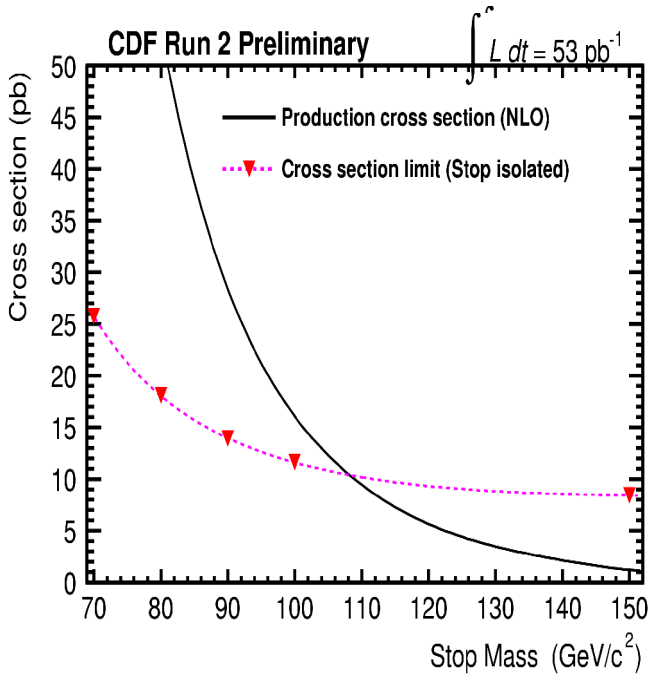
what can such particles be?

SUSY: stable stau, stop

Long-lived massive charged particles:

- **Move slowly: measure time-of-flight!**
- **ΔTOF=TOF candidate – TOF expect.**
- **Events from μ trigger used here**





Tracks with P_T>40 GeV ΔTOF>2.5 ns

Observe 7 events in 53pb^{-1}

Expect 2.9 ± 0.7(stat) ± 3.1(syst)

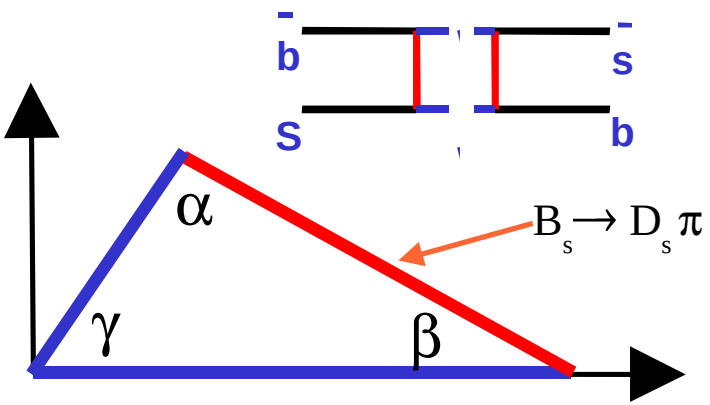
Consistent with no signal
m(stop)> 107 GeV @95% C.L.
LEP limit is 95 GeV

New trigger added, more data, expect limit
m(stop) close to 140 GeV

Postdoc not replaced, no money! SUSY search at LBNL ends here

Prospects for B_s Physics at CDF

By end of FY07 the accumulated luminosity will be 2 or 4 fb^{-1}.



unitary triangle

- **B_s mixing World Average @95% C.L.**

  $\Delta m_s \geqslant 14.4\ ps^{-1}$

- Will need good proper time resolution, 50fs
  Minimize error on P_T with fully reconstructed $B_s \rightarrow D_s \pi$

- Needs improved flavor tagging: **εD^2**

- **B_S meson properties**
  - **Mass**
  - **Lifetime, $\Delta\Gamma_S$**
- **New physics search**
  - **Δm_S frequency**
  - **CP violation**
    CKM angle γ

- Present performance: **$\varepsilon D^2 \sim 4\%$, $\sigma_t = 67fs$**

  Upper limit for $\Delta m_S = 15ps^{-1}$ with $0.5fb^{-1}$ data

- Modest improvements: **$\varepsilon D^2 \sim 5\%$, $\sigma_t = 50fs$**

  5σ sensitivity for $\Delta m_S = 18ps^{-1}$ with $1.7fb^{-1}$ data

  5σ sensitivity for $\Delta m_S = 24ps^{-1}$ with $3.2fb^{-1}$ data

Prospects for High P_T physics at CDF

Measure top quark properties

Mass to 3 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 (5 fb^{-1})

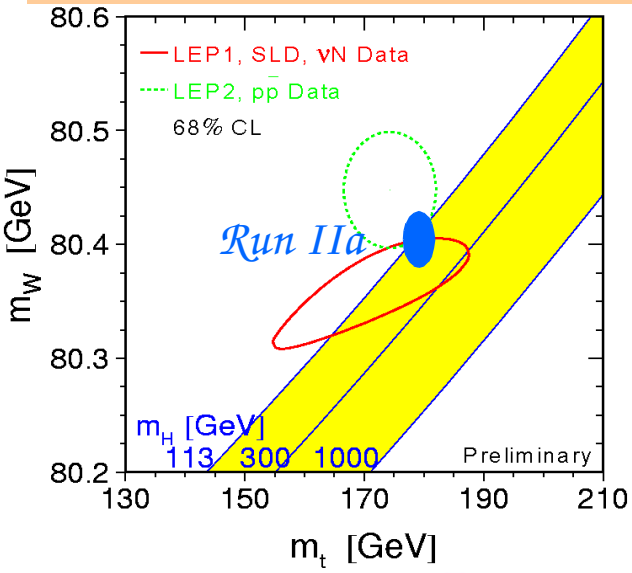
SUSY:

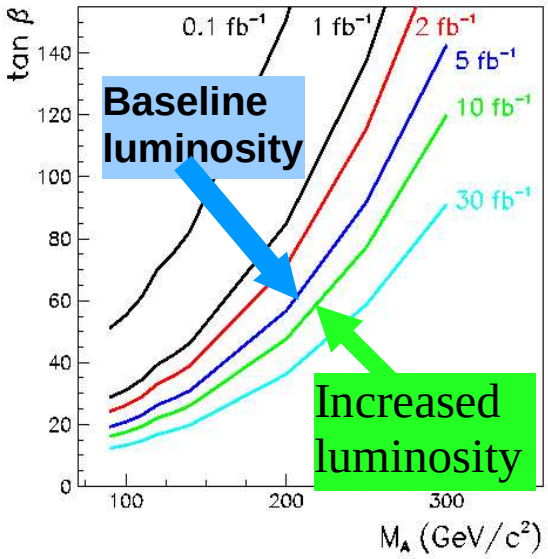
Some of the parameter space for squarks and gluinos can be explored.

Long lived stable particles , trileptons, etc. offer many ways to search

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

Electroweak Precision Measurements





Summary and Conclusions

LBNL contributing heavily to Run II CDF physics analysis.

Large contributions to hardware and physics over the last 22 years
Contributed 10 PHD thesis, 12 postdocs.
15 of these have faculty or lab staff positions.

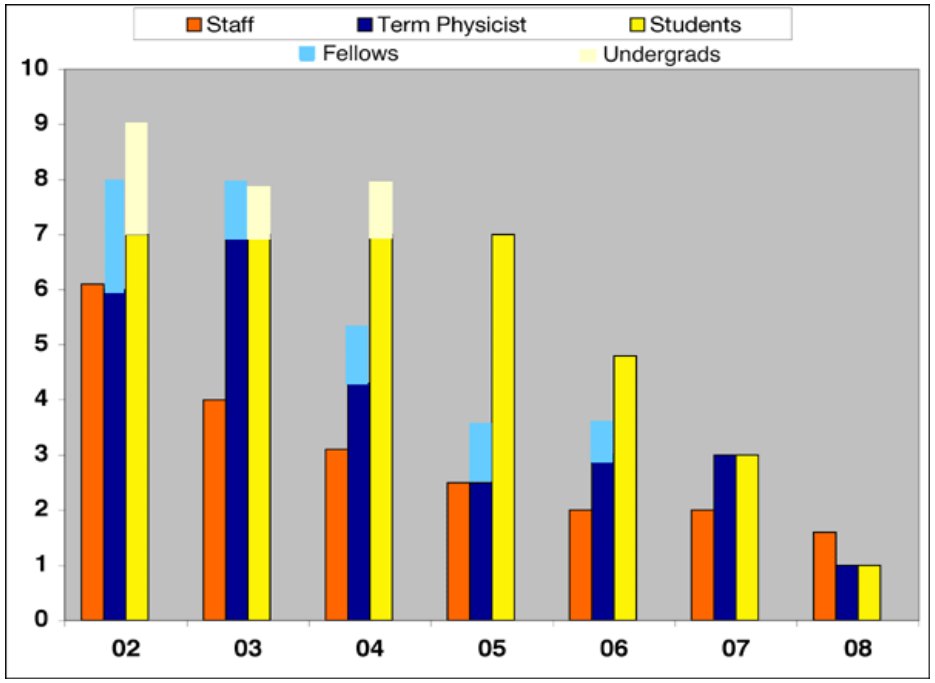
Contributed to top discovery, precision top and W mass measurements, properties of B mesons, Higgs studies etc.

- **We expect a large increase in data collected**
  20-40 times what we had in Run I by end FY07
- We are now on the verge of measuring B_s mixing.
- Great high P_T physics potential before the LHC!!
- **Great opportunity to prepare for the challenges of LHC physics.**

However, support for the CDF group is drastically being reduced

CDF Group members

Our plan for CDF ⇒ ATLAS transition



Even this drastic reduction is not supported by current funding

CDF-LBL postdocs and students now with permanent positions:

- M. Franklin (Harvard)
- R. Harris (FNAL)
- C. Haber (LBNL)
- W. Wester (FNAL)
- P. Tipton (Rochester)
- M. Gold (New Mexico)
- B. Winer (Ohio State)
- O. Schneider (Lausanne)
- W-M Yao (LBNL)
- M. Lancaster (U. College, London)
- M. Paulini (Carnegie Mellon)
- M. Garcia-Sciverez (LBNL)
- H. Wenzel (FNAL)
- Y.K. Kim (Chicago)
- B. Ashmanskas (Ass. Prof. at Cornell)

Back up slides

Back up slides

Run2b

B physics: charm states

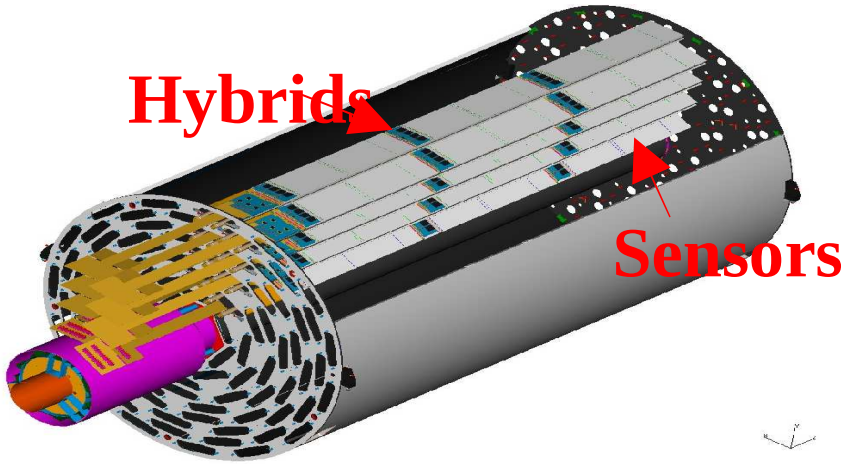
Run II b Silicon Tracker Upgrade

M. Garcia-Sciveres, C. Haber, M. Weber, W. Yao, L. Galtieri (physicists), A. Gibson, J. Freeman, P. Lujan, E. Feng (students)

- For high luminosity run much of silicon tracking will not survive.
- CDF had plans replace L00 and the 5 layers SVXII detector in 2006.
- Plans now canceled due to low Lum.
- Simplified construction and assembly. Single sided detectors.

A new chip (SVX4) and a new concept "the stave" have been developed. They work.

We reached pre-production stage. The project continues to 3/ 2004



LBNL group participation:

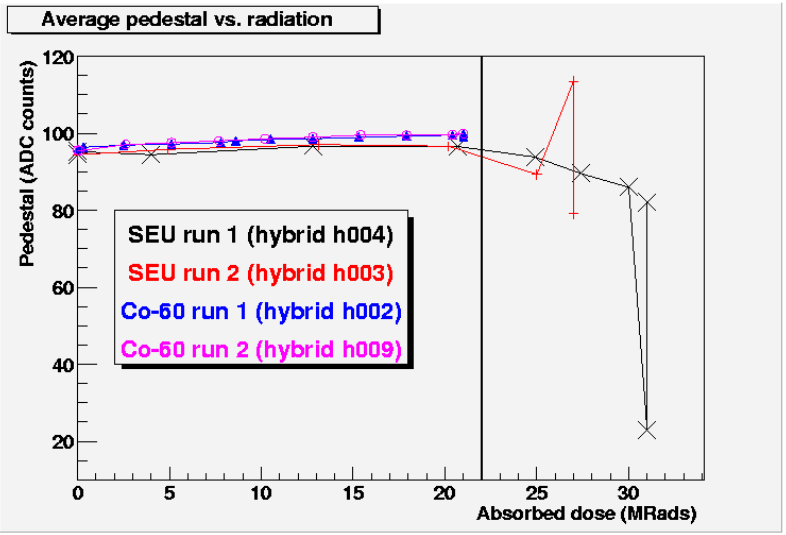
- **LBNL-IC group lead SVX4 chip design (with FNAL and Padova).** Chip to be used by both CDF and D0. Testing and irradiation responsibility.
- Design and pre-prod. of hybrids
- **Proposed ' stave 'concept: bus cable: design, prototype and testing**
- Systematic studies of electrical performance of "stave" concept.

SVX4 and Hybrid Work at LBNL

SVX4 chip

- 7000 pre-production chips in hand
- No changes needed for production
- D0 physicist participated at LBNL
- Extensive radiation studies done

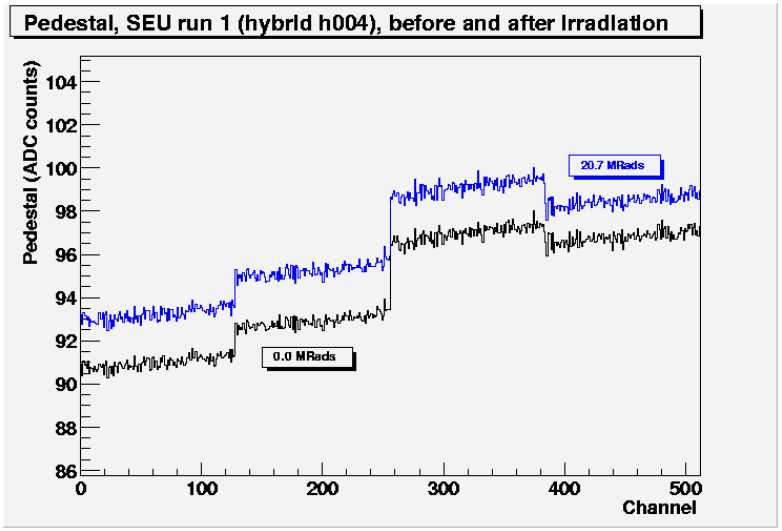
Radiation tests of chips done with CO source and Davis cyclotron (SEU). Breakdown at 25 Mrad.



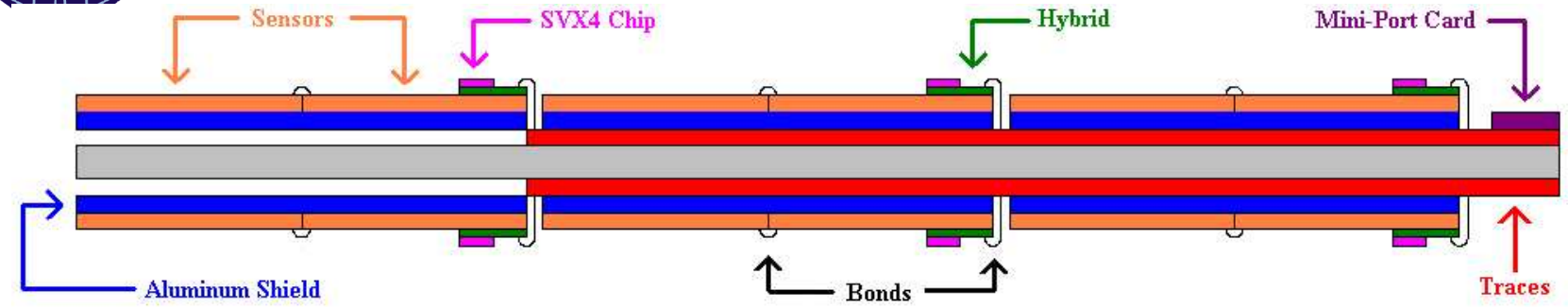
Hybrids Pre-production

- Only two types of Hybrids (13 types in Run IIa)
- LBL responsibility, augmented by visitors from Italy and Finland
- 90 hybrids produced: 90% perfect, others can be fixed

Radiation test on the 4 chips:
OK up to 20.6 Mrad

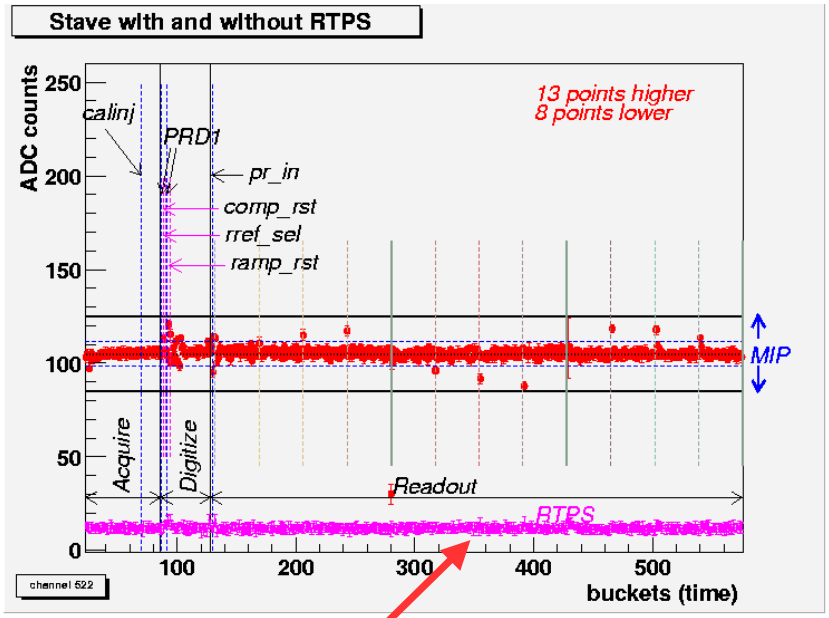


The 'Stave'



Highly integrated electrical, mechanical & cooling unit (66 cm long).

Current Stave Performance



Real Time Pedestal Subtraction

Stave Bus

Stave contains integrated data/power bus, serving all hybrids/sides.

57 cables fabricated and tested at LBNL. Delivered to FNAL.

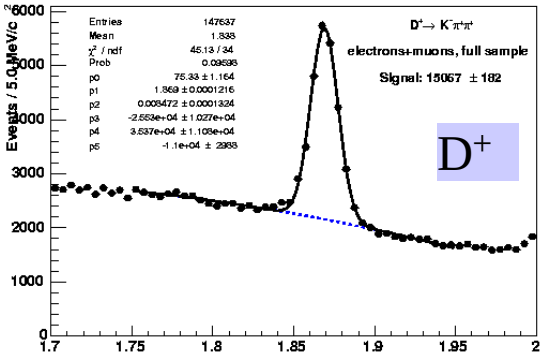
- **Status and plans:**
  - FNAL to build 15 staves
  - Study of stave performance is continuing at LBNL (through March 2004).
  - NIM papers being written

Moments Analysis: D and D* states

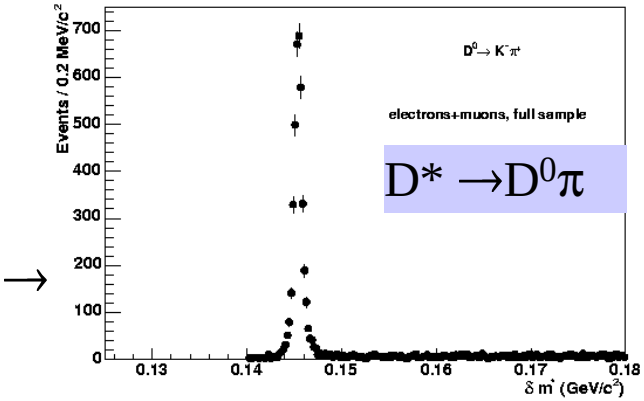
Sample mass plots for the lower states. (CDF Preliminary)

120 pb^{-1} Lepton (μ or e) + SVT trigger

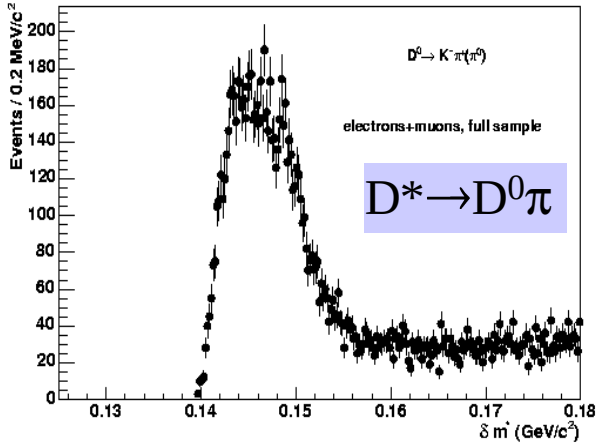
$D^+ \rightarrow K\pi\pi^+$ (15067 ±182 ev)



$D^0 \rightarrow K\,\pi$ 3890±63 events



$D^0 \rightarrow K\pi\pi^0$ (6638±98 ev)



$D^0 \rightarrow K\pi\pi\pi$ (2994±57)