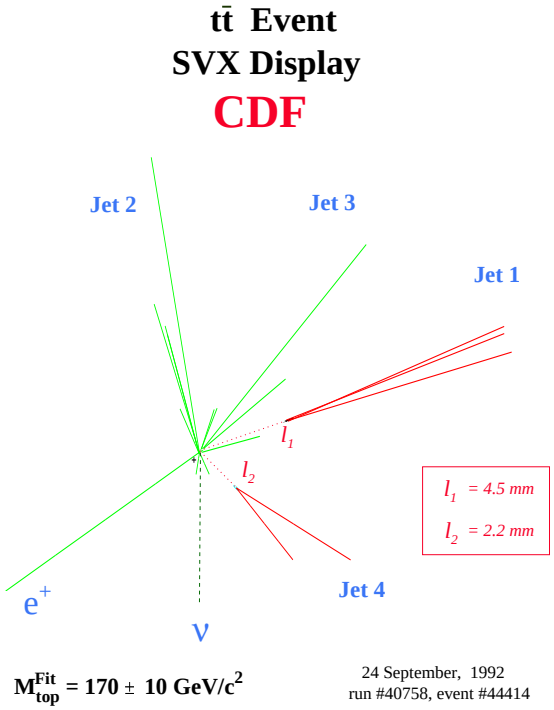
CDF GROUP OVERVIEW and PHYSICS

A. Barbaro-Galtieri
LBNL DOE Review
May 10, 2000

- **The CDF Group at LBNL**
- **LBNL Run II Responsibilities**
  - **Hardware** ⟸ **M. Garcia-Sciveres**
  - **Software and Computing**
- **Physics Analyses: Run I and II**
  - **B Physics**
  - **EWK Physics**
  - **Top and Higgs Physics**
  - **Particle Searches**
- **Summary and Conclusions**



Members of the LBNL-CDF Group

Physicists-Staff

W. Carithers[†]
K. Einsweiler[‡]
R. Ely[§⊕] (returning)
A. Galtieri[•]
C. Haber[‡]
Y. K. Kim[⊕]
J. Lys[§]
M. Shapiro[‡]
J. Siegrist[‡]
W. Yao[&]

Physicists-Term

P. Calafiura[◇‡]
A. Dominguez[○]
M. Garcia-Sciveres[▷]
B. Orejudos[○]
M. Paulini[▷] (going to CMU)
I. Volobouev[○]
F. Zetti (going to ATLAS)

Visitors

J. Wyss(Padova)[*]
A. Sill(TTU)[*]
V. Nagaslaev(TTU)[*]

Grad. Students

D. Reher (Run I)
T. Affolder (Run II-I)
A. Connolly (Run II-I)
G. Veramendi (Run II)
E. Brubaker (Run II)
H-C Fang (Run II)
H. Bachacou (Run II)
T. Gregoire (to Theory)
J. Wacker (to Theory)
L. Sadler (Run II?)
M. Rehn[*]

Undergraduates

L. Chen, J. Thaxton[*],
J. Galyardt[*], K. Rosenberg

Engineers, Designers

O. Milgrome,
B. Holmes, J. Perez

Techs, Physics Grad

J. Taylor, R. Witharm, C. Tran,
H. Chen, J. Wolf, J. Lee,
H. Cheng, P. Gomez(UCD)[*]

[†]Visitor at Penn. (returning)
[‡]Also on ATLAS
[⊕]Presently at FNAL
[•]LBNL/CDF Group Leader
[§]Retired from UC

[&]Half time on PDG
[◇]Half time NERSC
[○]Postdoc
[▷]Staff Scientist
[*]Short term Visitor

LBNL-CDF Group Activities

The CDF group is busy on many fronts.

1. Prepare for Run II

- **Hardware**
  - **Silicon (SVXII,ISL,Layer00)**
  - **COT**
  - **TOF**
  - ⋆ **CDFII Commissioning (NEW)**
- **Computing and Software**
  - **Offline Management**
  - **Monte Carlo**
  - **Mock Data Challenge (Test of Data Handling)**
  - **Silicon system offline software**
- **Physics**
  - **Trigger and Data Set Strategies**
  - **Physics Workshop**
  - **Analysis Strategies**

2. Complete Run I Physics Analyses

- **B Physics (B_s published, 2 Theses in progress)**
- **EWK Physics (M_W:PRD paper V2, Γ_W: PRL sent)**
- **Top (mass PRD V3)**
- **Higgs (being completed, 1 Thesis in prog.)**
- **Particle Searches (CHAMPS: PRL draft V1)**

Run II Software and Computing

LBNL Contributions

- **Project Management**
  - **M. Shapiro** — **Offline Software and Computing Project Manager (since March '98)**
  - **Y.K. Kim** — **Run II Physics Workshop Coordinator (since July '99)**
- **Databases**
  - **Lancaster**[¶] — **Offline Database Manager**
  - **Calafiura**[◇] — **Calibration Database Infrastructure. i.e. Auto generation of DB tables, C++ bindings**
- **Data Handling**
  - **Calafiura**[◇] — **Data Handling Output Module (interface to disk manager and catalog)**
- **Online Detector Monitoring**
  - **Veramendi** — **Work on overall structure+modules**
- **Physics Generators**
  - **Lys** — **HERWIG Monte Carlo code librarian**
- **Physics and Reconstruction Validation**
  - **Yao, Lys** — **Top Datasets**
  - **Yao, Kim** — **WH ($H \rightarrow b\bar{b}$) Dataset**
- **Silicon System Software**
  - **Dominguez, Yao** — **Alignment**
  - **Yao** — **b tagging**

◇ **Joint Physics Division/NERSC Appointment**

¶ **Went to UC London, Fall '99**

Run II Software: Current Status

A. Software Infrastructure

- **Mature Analysis Framework**
  - **Used for Reconstruction, Analysis, Online Monitoring, Calibration**
- **Working Database System**
  - **Oracle for both Online and Offline**
  - **Mechanism for distribution in design phase**
- **Robust code distribution: 115 machines at least 1 with frozen release worldwide**
- **Data Handling software to move data to and from tape.**

B. Reconstruction Software

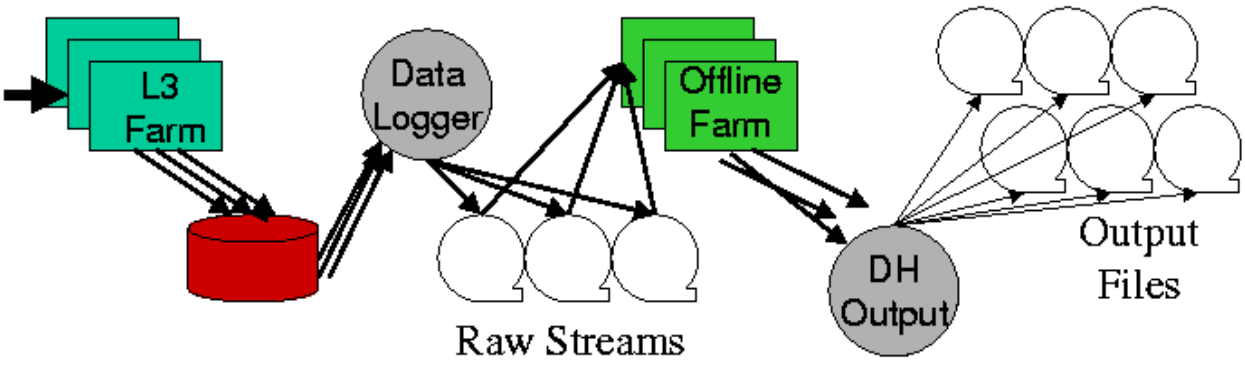
- **Track reconstruction with reasonable efficiency and resolution (COT and SVXII)**
- **Jet and Electron algorithms tested against Run I code**
- **First version of Muon reconstruction exists**
- **Level 3 Trigger Software exists as part of Standard Release.**

C. Offline Hardware

- **Tape Robot working (holds 1 Petabyte)**
- **First large analysis system received: 64 node SGI. Next procurement FY2001**
- **7 Terabyte disk space (next procurement FY2001)**
- **First 50 nodes of production farm operating (50 more expected by Jan 2001).**

Run II Software: Mock Data Challenge II

Rate Test of Complete Data Chain



- **Simulated data sent to Level 3 nodes**
- **Analysis in L3 based on simulated trigger (driven by trigger database)**
- **L3 access to Calibration Database**
- **Output of Level 3 sent to dual-ported disk (multiple streams)**
- **Data logger moves files to tape**
- **Data moved from tape to Farms I/O node**
- **Farms control software ships files to worker nodes and controls flow of production jobs**
- **Production jobs run reconstruction executable and produce output files**
- **Output shipped back to I/O node using farms control software**
- **File splitting and concatenation: write output files split by trigger into robotic tape.**
- **Analysis jobs read these files from tape using the DHInputModule**

Goal: 20 MB/s for several days of running, to match 75Hz L3 rate.

LBNL Role in Mock Data Challenge

- **Overall Management and Oversight (Shapiro)**
- **Major Effort on Database Access Software (Calafiura)**
- **Work on Data Handling I/O modules (Calafiura)**
- **All data for MDC-I was generated and simulated at LBNL using NERSC-PDSF facility**
  - **Sample Size: $\sim$500,000 events**
  - **List of data sets generated:**
    - $W/Z \rightarrow leptons$ **(**e**,** μ**)**
    - $t\bar{t}$ **(**$t \rightarrow b\ell\nu$**,** $\bar{t} \rightarrow all$**)**
    - $b\bar{b}$ **(**$B \rightarrow \psi X$**,** $\overline{B} \rightarrow anything$**)**
    - **Inclusive jets (3** p_t **thresholds)**
    - $W/Z + H, H \rightarrow b\bar{b}$
- **Significant LBNL involvement in validation of generators and simulation (Kim, Lys, Yao)**
- **Expect large LBNL involvement in analysis of MDC-II output. Use the PDSF facility for analysis.**

MDC-II should insure all critical software ready before August Commissioning Run.

- **CDF Run II Data Collection**

$\sim$ 1.8 Billion Events $\sim$ 1 Petabyte (inc. raw data)

Trigger/Data Sets for RUN II

Coordination Physics and Trigger/Datasets groups.
Each of the five physics groups has a representative.

EWK group: M. Lancaster
TOP group: W-M. Yao
Exotics group: H. Frisch

Lancaster, Frisch left in FY99.

- **This group provides input to the trigger group. There is a 75 Hz limit to the L3 output. Need to optimize the physics output of the experiment.**
  L1=40KHZ L2=300HZ L3=75HZ
- **Many aspects of data handling are being studied.**
  1. **size of data sets.**
  2. **data access requirements.**
  3. **number of data streams.**
- **Specification of High-level Physics Objects**
  - **Optimize work for the needs of different groups**
  - **Define e, μ, τ, ν, jets, t, b, c, tracks**
- **CDF Run II Data Collection**

$\sim$ 1.8 Billion Events $\sim$ 1 Petabyte (inc. raw data)

Physics Analyses at LBNL

Preparation for Run II

- **Participate to Run II Physics Workshops at FNAL**
  - **Thinktop Workshop (Galtieri, Lys, Yao went)**
  - **SUSY and Higgs workshop (Yao, Connolly, Galtieri, Y.K. Kim went)**
  - **B Physics workshop (Paulini is an organizer)**

1. **Physics Workshop at LBNL (Apr. 25-27)**
   - **Five sessions on physics of interest to LBNL-CDF group**
   - **Overview of the field given by a local theorist**
   - **CDF physicist summarized expectation for Run II**
   - **Final session on Detector and Software for Run II.**

- **Established tight connection between physicists, graduate students and our theoretical collegues.**

Physics Topics discussed at the Workshop:

- **B physics: Bob Cahn**
- **EWK Precision Measurements (W and Top): M. Chanowitz**
- **EWK Symmetry Breaking (SM Higgs, non SM Higgs): Hitoshi Murayama**
- **SUSY: Frank Paige from BNL (I. Hinchliffe out of town).**
- **Extra Dimensions: Nima Arkani-Hamed**

Status of Run I Physics Analyses

- **Bottom Physics**
  - **People: Affolder$^{\triangle}$, Paulini, Shapiro, Reher$^{\triangle}$**
  - **b hadron lifetimes (B_u, B_d, B_s). (Completed)**
  - **Time-dependent mixing studies. (Completed)**
  - **Look for B_c in new channel. (Reher's PHD thesis)**
  - **$b\bar{b}$ production correlation (Affolder's PHD thesis)**
- **EWK Physics**
  - **People: Kim, Lancaster(just left), Carithers, Sadler$^{\triangledown}$**
  - **Measurement of the W mass (PRD V2 to collab.)**
  - **Direct measurement of the W width. (Sub. to PRL)**
  - **$ZZ\gamma$ and $Z\gamma\gamma$ trilinear couplings (ongoing).**
- **Top and Higgs Physics**
  - **People: Galtieri, Lys, Yao, Gregoire$^{\triangledown}$, Garcia-Sciveres**
  - **New people for Higgs in Run II: Kim, Siegrist, Bachacou$^{\triangle}$.**
  - **Measurement of the top mass (PRD V3, ready to send)**
  - **Search for Higgs in W/Z+H ($H \rightarrow b\bar{b}$) (almost done).**
  - **SUSY Higgs ($A \rightarrow \tau\bar{\tau}$) (Connolly's PHD thesis).**
- **Particle Searches**
  - **People: Connolly$^{\triangle}$, Kim, Orejudos, Yao.**
  - **Search for charged long-lived particles (PRL V1 out)**

$^{\triangle}$ **PhD student**

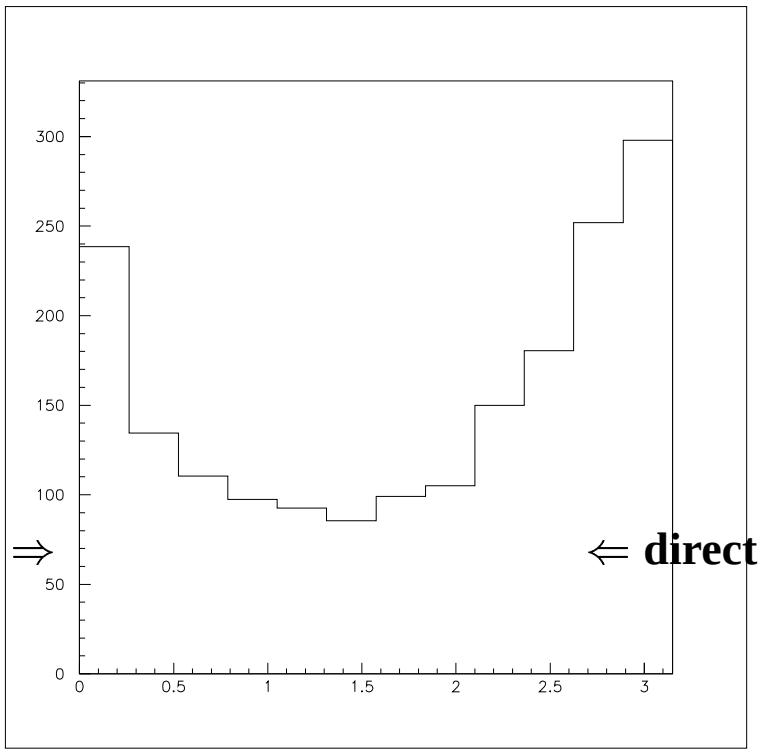
$^{\triangledown}$ **Grad. Student**

Ongoing B Physics Analyses at LBNL

* **Measurement of $b\bar{b}$ correlation (Tony Affolder)**

- **Potential to resolve gluon splitting contribution**
- **Use displaced $J/\psi \to \mu\mu$ to tag one B hadron**
- **Identify add. lepton to get 2nd b quark in event**
- **Plot $\Delta\phi$ between J/ψ & lepton**

gluon splitting $\Rightarrow$



$\Leftarrow$ direct production

* **Search for hadronic B_c decays (Doug Reher)**

- **CDF discovered $B_c \to J/\psi \ell X$ in 1998.**
- **Improve limit on $B_c \to J/\psi\pi$ due to knowledge of τ_{B_c}**
- **Add. search for $B_c \to J/\psi 3\pi$, improves published limit.**

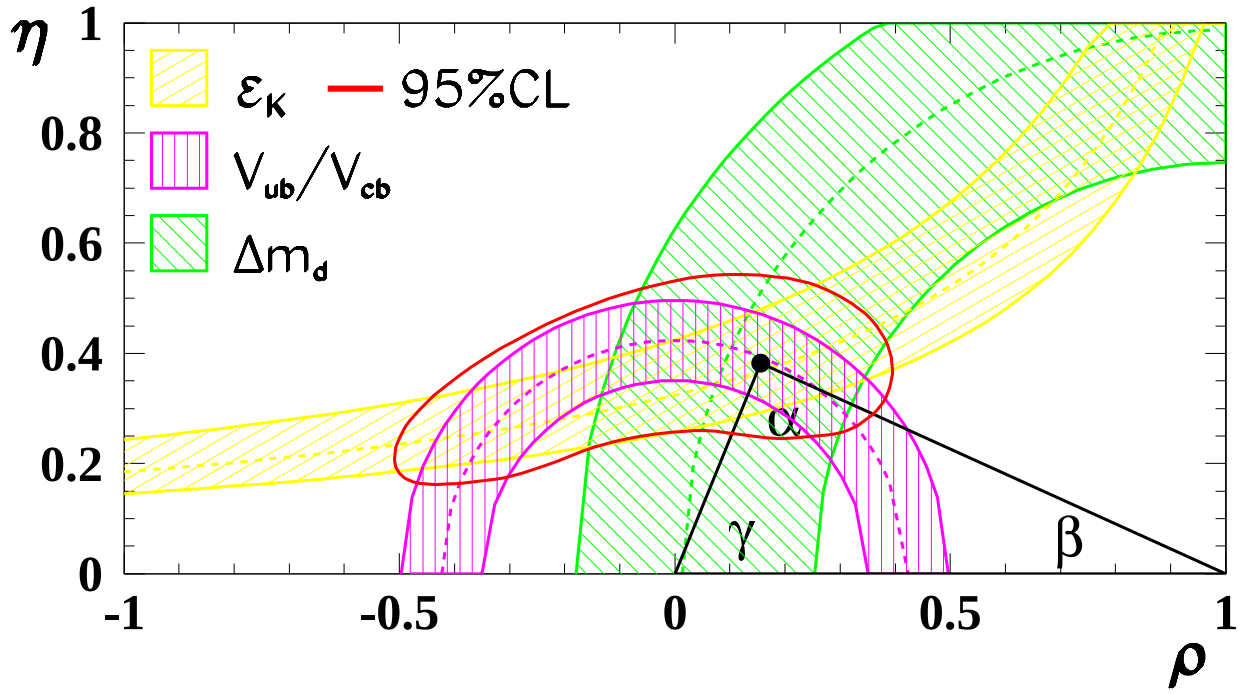
B Physics at CDF and LBNL

⋆ **LBNL major contributor to increase B physics capabilities at CDF:**

- **COT, SVX (SVX II, ISL, L00), ToF**

- **Turn hardware improvements into precision CKM measurements**

- **Current knowledge of CKM matrix still poor**



∗ **CDF will improve knowledge of:**

- $\sin 2\beta$ **from** $B^0 \to J/\psi K_S^0$
- $B_S^0 \bar{B}_S^0$ **oscillations from** $B_S^0 \to D_S^- \pi^+$ **(**Δm_S**)**
- $\sin 2(\beta+\gamma)$ **from** $B^0 \to \pi\pi$ **&** $B_S^0 \to KK$
- $\sin\gamma$ **from** $B_S^0 \to D_S^- K^+$ **(Run IIb)**

Measurement of $\sin 2\beta$ at CDF

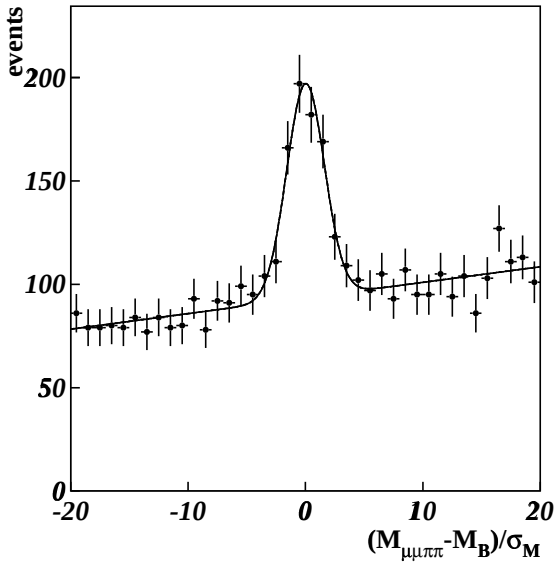
⋆ CDF: Initial measurement of $\sin 2\beta$:

$B^0 \to J/\psi K_S^0$ **yield:**

395 ± 31 **events**

$S/B = 0.7$

Currently world's largest sample of $J/\psi K_S^0$



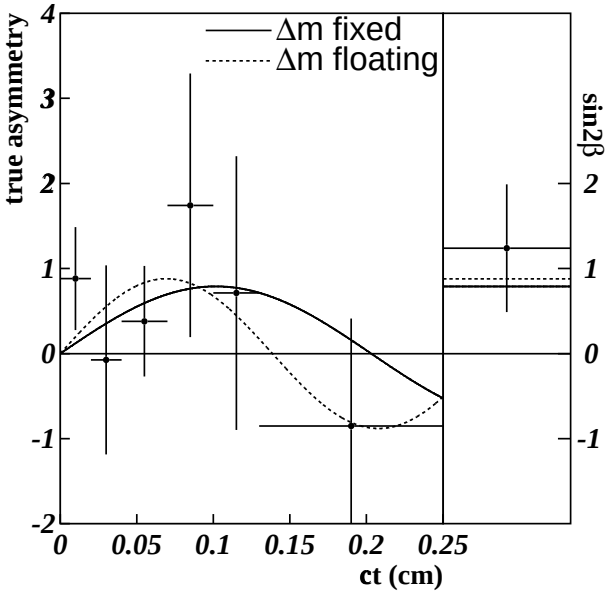
⋆ Best direct measurement of CP violation in B system

$\sin 2\beta =$

$0.79 \pm 0.39 \pm 0.16$

Limit:

$0 < \sin 2\beta < 1$ **at 93% C.L.**



CDF demonstrated that CP **violation measurement is feasible at Tevatron in Run II !**

CP Violation with 2 fb^{-1}

For Run II prospects, take advantage of Run I experience

- **Measurement of $\sin 2\beta$ with 2 fb^{-1}:**

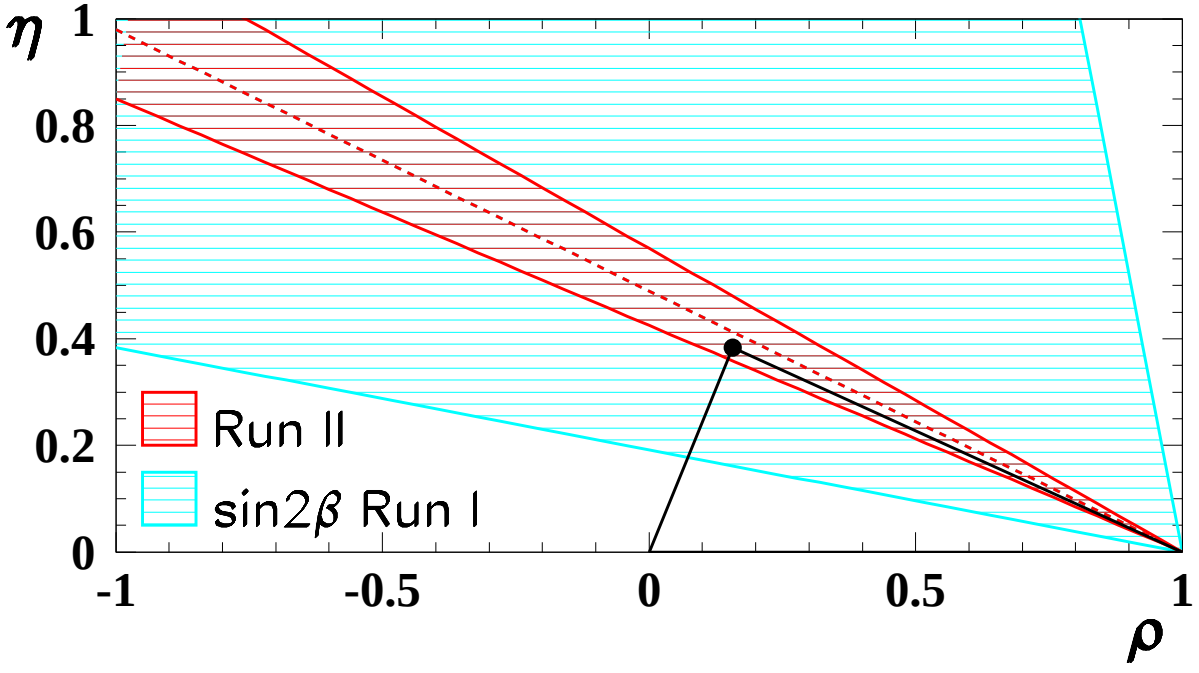
  $\sim 10\,000\ J/\psi K_S^0$ **events with** $J/\psi \to \mu^+\mu^-$

- **Improved B flavour tagging:**

Flavour tag	$\varepsilon\mathcal{D}^2$ Run I	$\varepsilon\mathcal{D}^2$ Run II
Same side tag	$(1.8 \pm 0.4 \pm 0.3)\%$	2.0%
Jet charge tag	$(0.78 \pm 0.12 \pm 0.08)\%$	3.0%
Lepton tag	$(0.91 \pm 0.10 \pm 0.11)\%$	1.7%
Kaon tag	–	2.4%

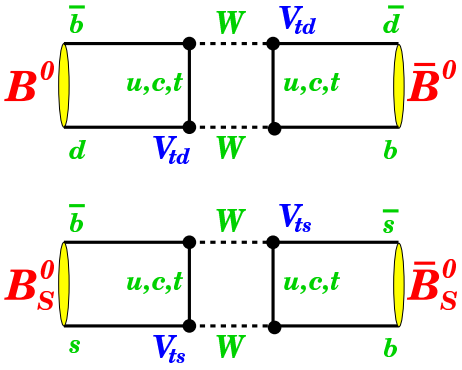
- **Total** $\varepsilon\mathcal{D}^2 \approx 9.1\%$ **(from 3.1% in Run I)**

- **Expect** $\Delta \sin 2\beta \sim 1/\sqrt{\varepsilon D^2 N} \sim 0.07$ **(2 fb^{-1})**



$B_S^0\bar{B}_S^0$ Mixing with 2 fb^{-1}

Measure $|V_{td}|/|V_{ts}|$



∗ **L00 in Si improves proper time resolution, σ_t:**

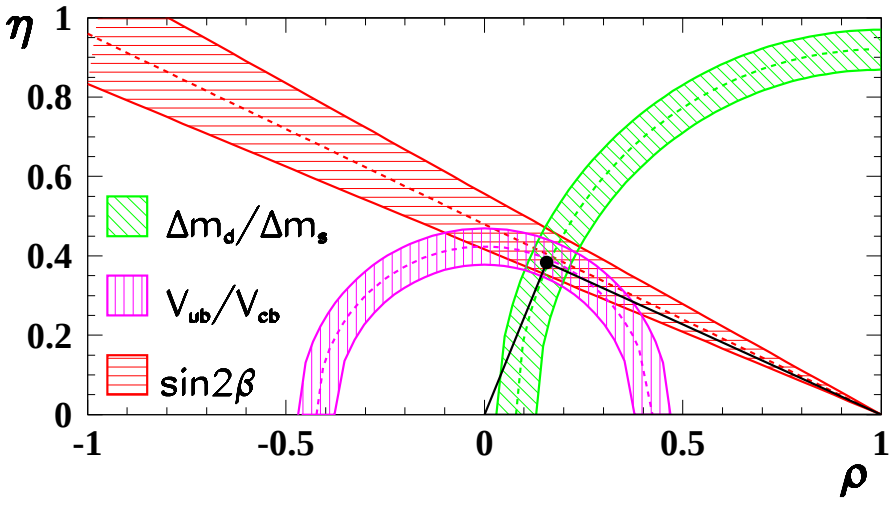
- $\sigma_t = 150$ fs $\rightarrow$ 60 fs $\rightarrow$ 45 fs **(important if Δm_S large)**

ToF enhances effectiveness of flavour tagging

- $\varepsilon\mathcal{D}^2 = 2.7\% \rightarrow 5.7\% \rightarrow 11.3\%$ **(with SST on kaons)**

- **Signal: 15,000 - 23,000 $B_S^0 \rightarrow D_S^-\pi^+$, $D_S^-3\pi$ events from two-track hadronic trigger (2 fb^{-1})**
- **For 20k events: 5σ measurement for $\Delta m_S < 40$ ps^{-1}**

  current limit: $\Delta m_S > 14.3$ ps^{-1} (95% C.L.)
- **Physics with B_S^0 mesons unique to Tevatron**
- **CDF will overconstrain CKM triangle**

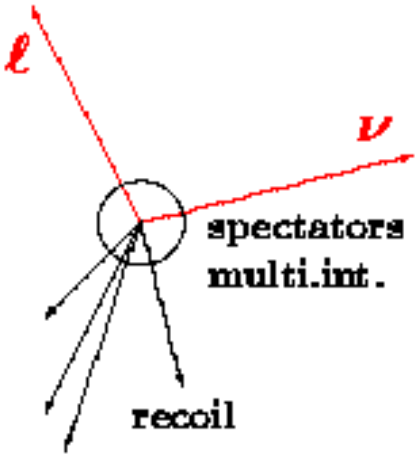


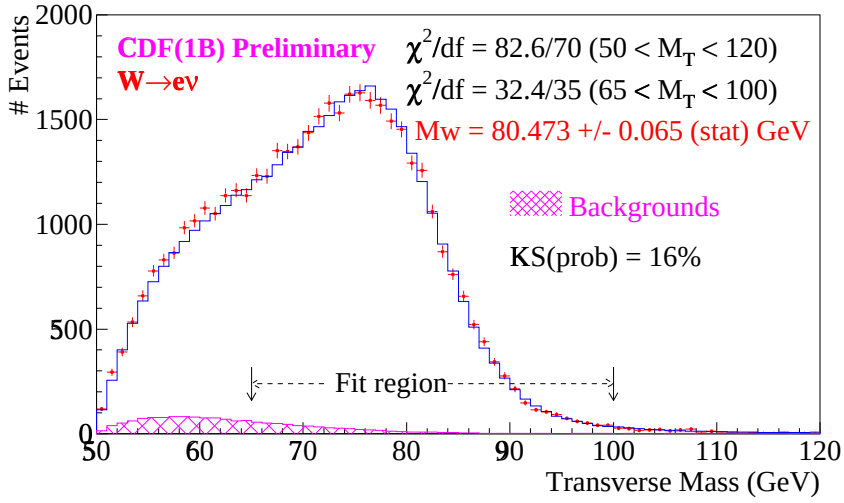
W Mass Measurement in Run I

- **Use $W \rightarrow \ell\nu$ decays (ℓ = e, μ)**

- **Mass measured through transverse quantities :**

$$M_T = \sqrt{2P_T^{\ell}P_T^{\nu}(1-cos\phi_{\ell\nu})}$$





- **Using 30115 events in the W $\rightarrow e\nu$ channel and 14740 events in the W $\rightarrow \mu\nu$ channel, we obtain for Run IB**

$$M_W = 80.473 \pm 0.065(stat) \pm 0.092(syst)\ \text{GeV} \quad W \rightarrow e\nu$$
$$M_W = 80.465 \pm 0.100(stat) \pm 0.102(syst)\ \text{GeV} \quad W \rightarrow \mu\nu$$

Combining Run IB and Run IA values we obtain:

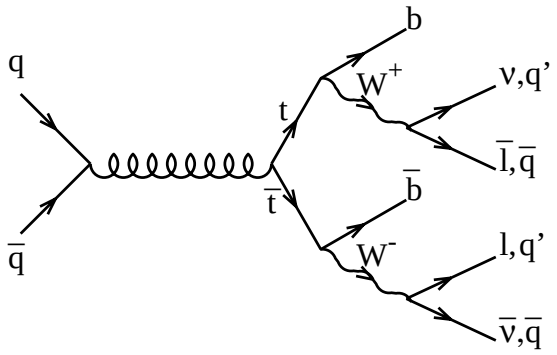
$$M_W = 80.433 \pm 0.079\ \text{GeV} \quad \text{CDF}$$

★ **PRD ready to submit for publication**

∗ **Run IIA : expect to reduce systematic error to 30 MeV.**

Top Physics at LBNL

Top Quark Decay Signatures:



- **Dilepton Channel:** $t\bar{t} \rightarrow W^+bW^-\bar{b} \rightarrow \ell^+\ell^-\nu\bar{\nu}b\bar{b}$
- **Lepton + Jets Channel:** $t\bar{t} \rightarrow W^+bW^-\bar{b} \rightarrow \ell^\pm\nu q\bar{q}'b\bar{b}$
- **Hadronic Channel:** $t\bar{t} \rightarrow W^+bW^-\bar{b} \rightarrow q_1\overline{q_1}'q_2\overline{q_2}'b\bar{b}$

LBNL Major Contributions in Run I

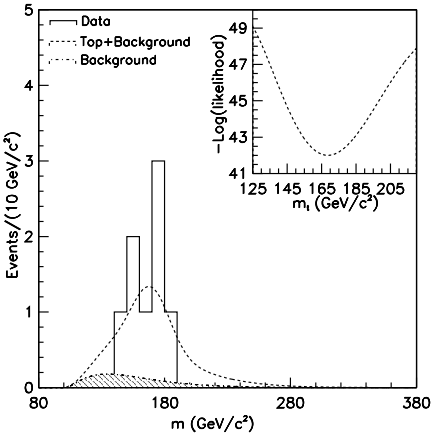
- **SVX b-tagging Algorithm.**
- **Measurement of $\sigma_{t\bar{t}}$ using b-tagging.**
- **Measurement of M_t (ℓ + jets and dilepton channels). (Major LBNL contributions since 1993).**

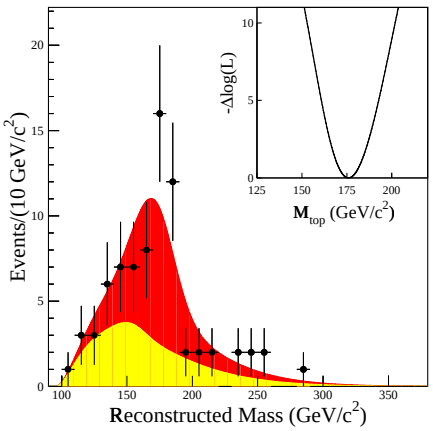
$\star$ **Final publication of M_t measurement in the ℓ + jets channel and combined results, ready for submission to PRD.**

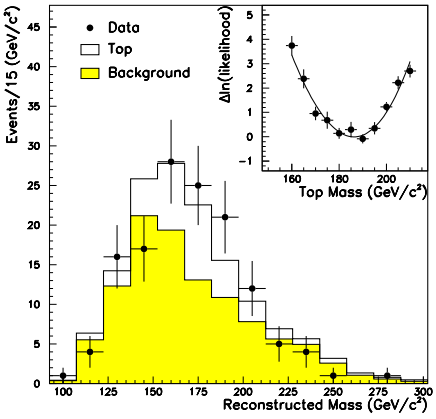
Top Mass Measurement Summary

M =	$167.4 \pm 10.3 \pm 4.8$	GeV	dileptons	PRL Publ.
M =	$175.9 \pm 4.8 \pm 5.3$	GeV	lepton+jets	Rev. Sys.
M =	$186.0 \pm 10.0 \pm 5.7$	GeV	all hadronic	Rev. Sys.
M =	$176.0 \pm 4.0 \pm 5.1$	GeV	Combined	

Final CDF result : M = 176.0 ± 6.5 GeV







Largest systematic error is from jet energy uncertainty.

- **Run II challenges:**
  - **reduce jet E_T systematics**
  - **reduce uncertainty on gluon radiation**

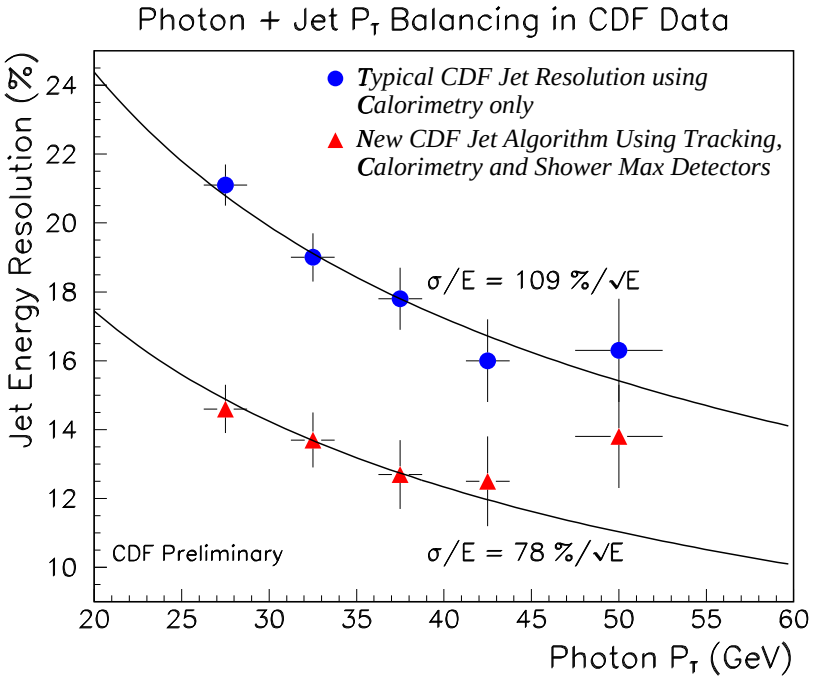
Improving the jet resolution for Run II

People: Bachacou, Galtieri, Garcia-Sciveres, Lys, Siegrist,Yao

An effort to improve jet resolution for top and Higgs studies in Run II has started at FNAL about a year ago. The idea is to use more than just the calorimeter to measure jet energies. The detectors used so far are:

Central tracking Chambers, e.m. Calorimeter,
Strip Chambers (in e.m. calorimeter) hadronic Calorimeter.

Resolution improved by 30%.



We have two aims:

- **Study *b* jets, i.e., if a jet is tagged as *b*, can the information be used to improve its energy measurement?**
- **Can we improve on what was done so far?**

Studies have started, no final results as yet.

Top Physics with 2 fb^{-1}

- **For $p\overline{p}$ at 2 GeV σ increases by 40%**
- **Background increases only by 12%**
- **Improvements due to new Silicon detectors:**
  - **Improved tagging efficiency for top events: 50% $\Longrightarrow$ 80%.**
  - **Improved Double b tag efficiency: 8% $\Longrightarrow$ 27%.**

Sample	Run I	Run IIA
Dilepton events	6.6	155
ℓ + jets ($\geq$ 1SVX tag)	24.8	990
Mass sample ($\geq$ 1SVX tag)	17.4	790
Mass sample ($\geq$ 2SVX tag)	4.8	240

(above estimated do not include L00)

LBNL plans for Run II

- **Improve top mass measurement: δM_t = 2-3 GeV.**
- **Test Standard Model prediction for:**
  - **Branching ratios into dileptons, ℓ + jets, hadronic decays.**
  - **Top weak decays couplings, by studying W helicity states and lepton decay correlations.**

Standard Model Implications

Measurement tests SM beyond tree level

Ultimately → constrain Higgs Mass

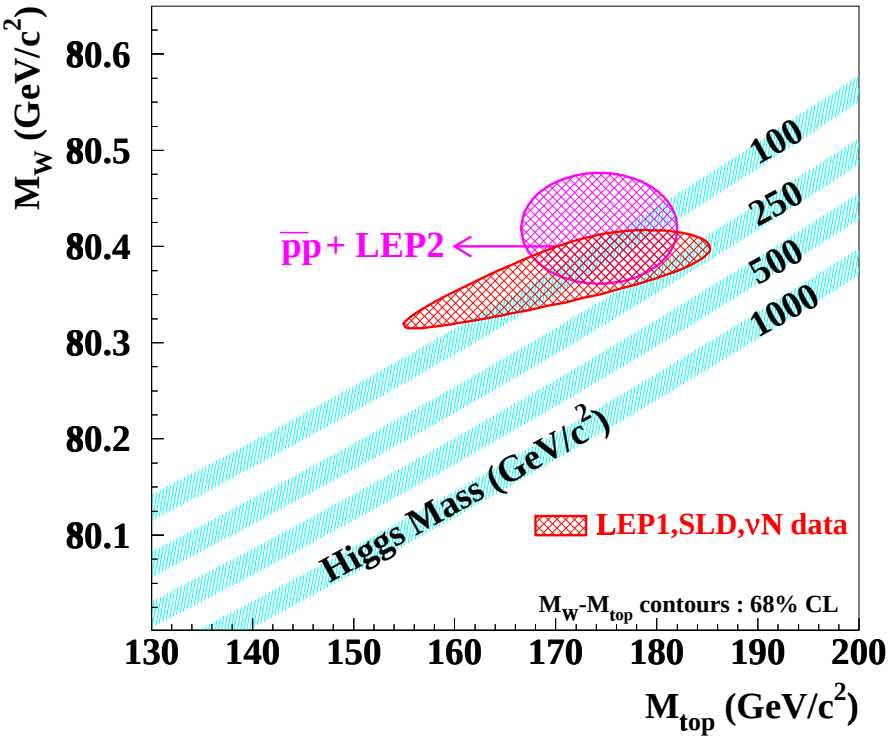
→ indicate physics beyond SM

Tevatron $M_W = 80.450 \pm 0.063$ GeV/c^2

LEP $M_W = 80.401 \pm 0.048$ GeV/c^2

World average $M_W = 80.419 \pm 0.038$ GeV/c^2

CDF-D0 average $M_t = 174.3 \pm 5.1$ GeV



- **Standard Model testing and Higgs mass constraint depend on:**
  $\sin^2\theta_W^\ell$, $\alpha(M_Z)$, M_W, M_t
- **Tevatron Run II can measure M_W and M_t to higher precision, thus constrain the Higgs mass further.**

Search for Standard Model Higgs at CDF

Run I search: study strategies, understand backgrounds.

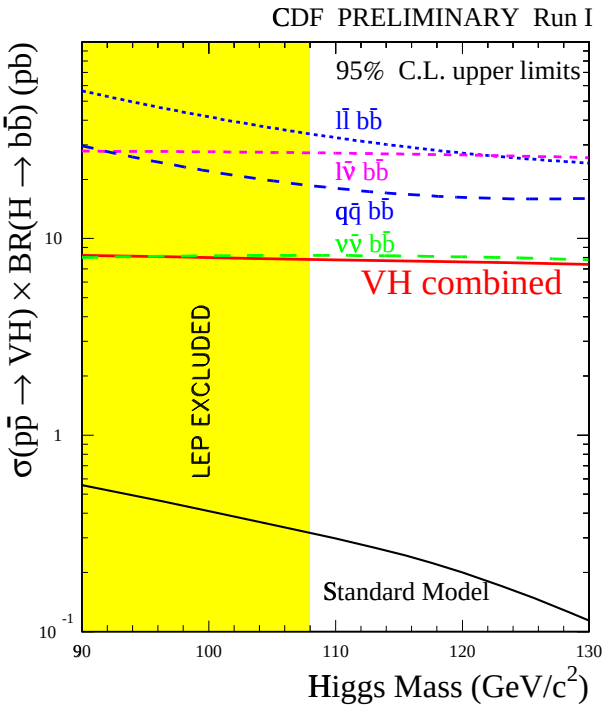
$V(W/Z)\,H \rightarrow (l^{+}\nu, l^{+}l^{-}, \nu\nu)\,b\bar{b}$

- **Isolated charged lepton and/or $\not\!\!E_T$**
- **One or two b tagged jets**
- **Small BR, but relatively clean.**

$V(W/Z)\,H \rightarrow j\,j\,b\bar{b}$

- **4 or more jets ($\geq$ 2 tagged b)**
- **High BR, but large QCD background.**

★ Combined CDF VH limit in Run1



Run2 SUSY/HIGGS Workshop

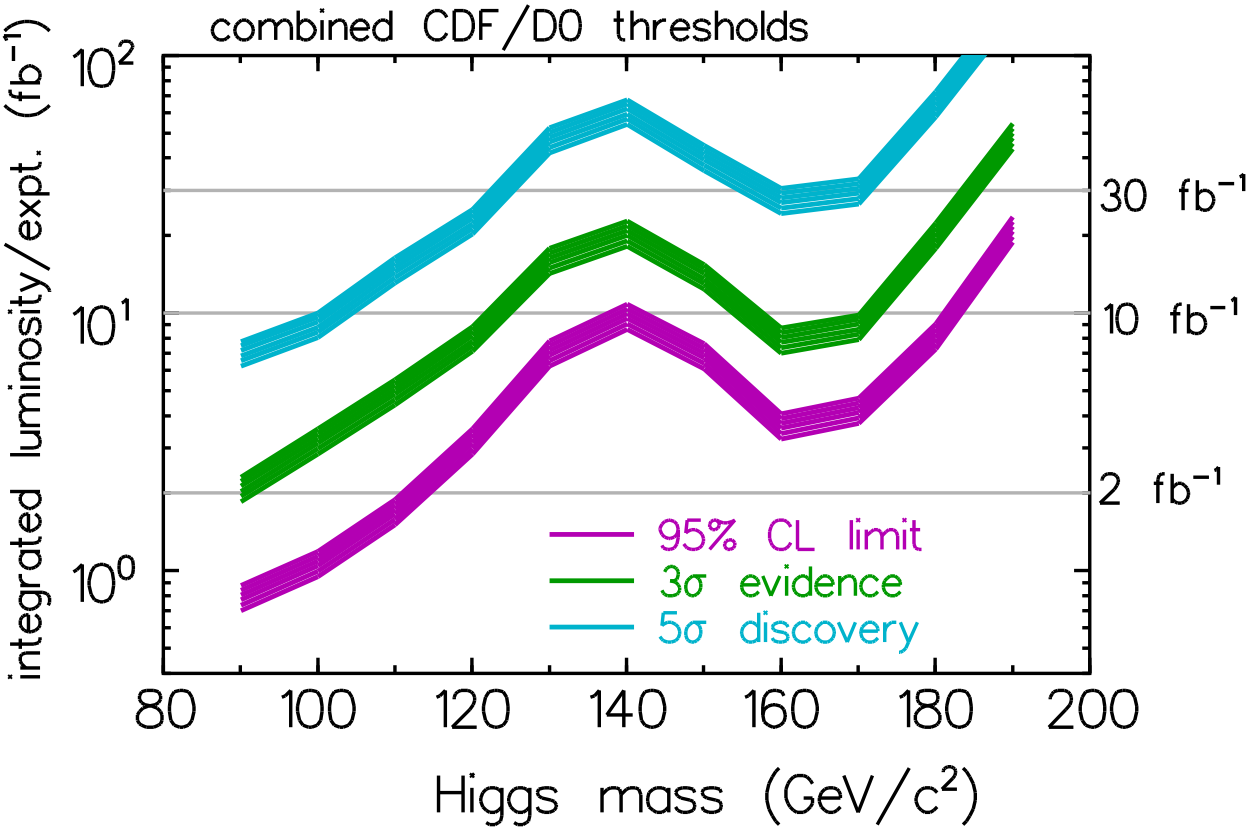
- **Can CDF observe Standard Model Higgs in Run 2?**
- **Continue to study possible observation of**

$$V(W/Z)H \rightarrow (l\nu, l^+l^-, \nu\bar{\nu})\, b\bar{b}$$

using a more realistic CDF II detector simulation.

- **The decay $H \rightarrow WW^*$ is allowed for $M_H > 140$ GeV/c^2**

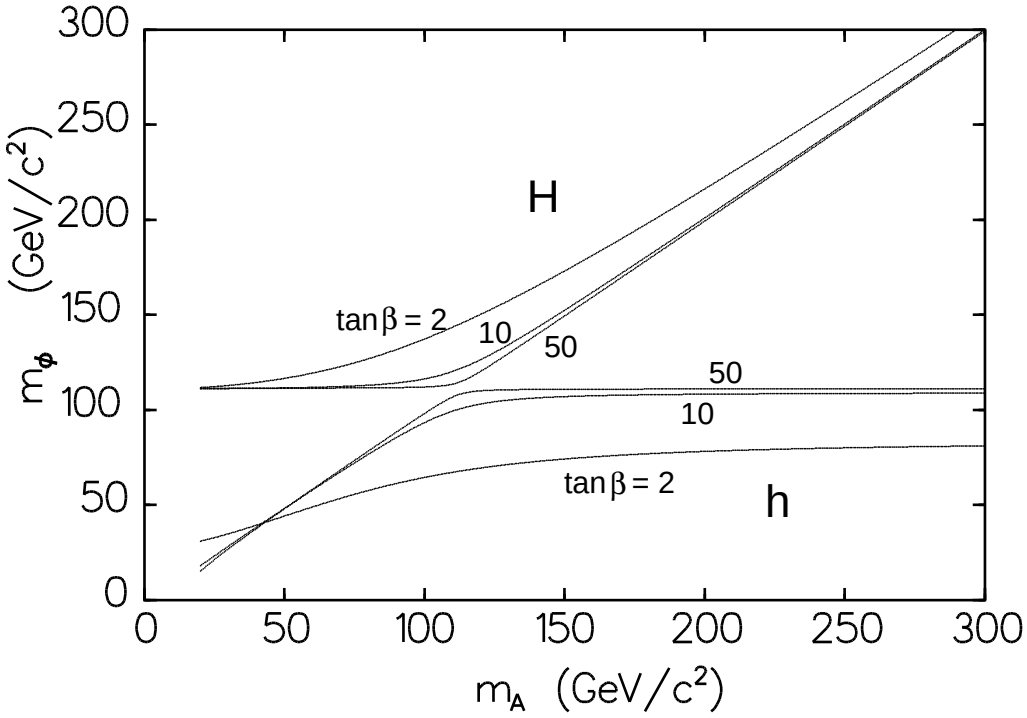
∗ **CDF/D0 should be able to discover (3 σ) the standard model higgs up to 180 GeV/c^2 using 30 fb^{-1} by combining all the channels.**



Search for $gg \to A/H \to \tau^+\tau^-$

A. Connolly PHD thesis

- **MSSM predicts five Higgs Bosons:** $h, A, H, H^{\pm}$
- **Masses governed by two parameters:** m_A, $tan\beta$

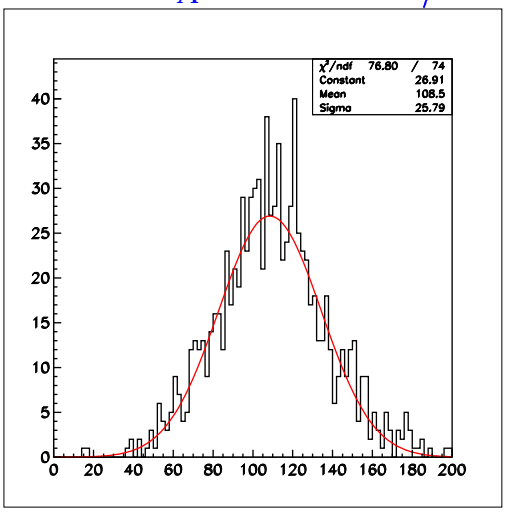


SUSY Higgs Production at large $\tan\beta$

- $\sigma(gg \to A/H)$ **enhanced at large** $\tan\beta$ **by** $\tan\beta^2$**.**
- $Br(A/H \to \tau^+\tau^-) \approx 10\%$ **stay sizable at large mass, especially for large** $\tan\beta$**.**
- M_A **can be reconstructed from** $\not{E}_T$ **and** τ **jets by assuming the neutrinos are along the** τ **direction.**

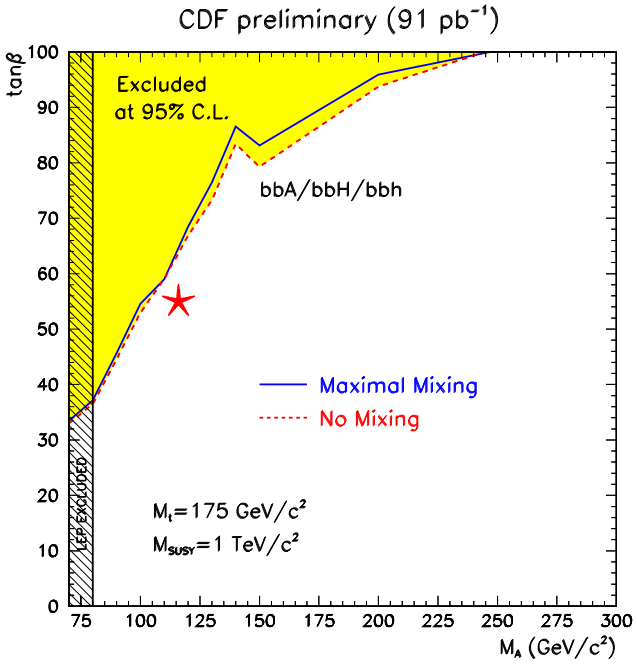
Search for $gg \to A/H \to \tau^+\tau^-$

- **Mass reconstruction for $m_A = 110\ GeV/c^2$**



- **This gives some discriminating power against $Z \to \tau^+\tau^-$ background, especially at higher masses.**

- **Existing CDF limits in $\tan\beta$ vs m_A space from $A/H \to b\bar{b}$ can improve for $\tan\beta$=45-65 and $M_A \sim$ 120 GeV.**



- **In Run II this could be best search channel for high mass Higgs. Studies in progress.**

New Particle Searches

- **Searching for new physics beyond the Standard Model, to answer some/all of the questions left by SM.**
- **Variety of models are being pursued, no hints as yet!!**

Search for Charged Massive Particles (CHAMPS)

Amy Connolly

Using Run I data, develop techniques and set limits for CHAMPS production. PRL V1 written.

CHAMPS can be produced in many models:

- $g \rightarrow Q\overline{Q}$ **"strong" production of stable color triplets quarks.**
- **"Weak" production of sleptons in Gauge Mediated SUSY Breaking (GMSB) models.**
  - **Drell-Yan** $\rightarrow \tilde{\tau}\tilde{\tau}$
  - **Cascade decays of SUSY particles,** $\chi \rightarrow \tilde{\tau}$
    The $\tilde{\tau}$ **would be NLSP and can be charged and long lived. Also, the CHAMP would be isolated.**
- **Data samples based on following triggers:**
  lepton (e**,** μ**) with** $P_T >$ **(20,12) GeV**
  $\not\!\!E_T >$ **35 GeV trigger**
- **Search for highly ionizing tracks (** $P_T >$ **35 GeV/c) due to heavy particles, using the dE/dx measurement in SVX and COT (two independent measurements). Evaluate** $M_{dE/dx}$ **for the candidate tracks in each event.**

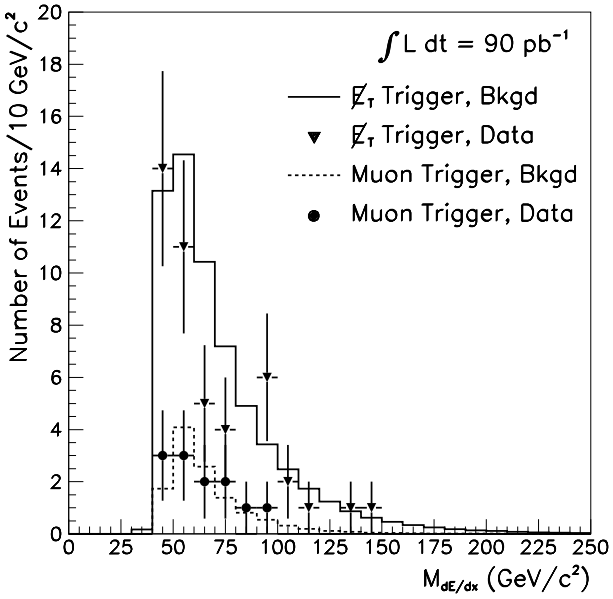
Search for CHAMPS (cont.)

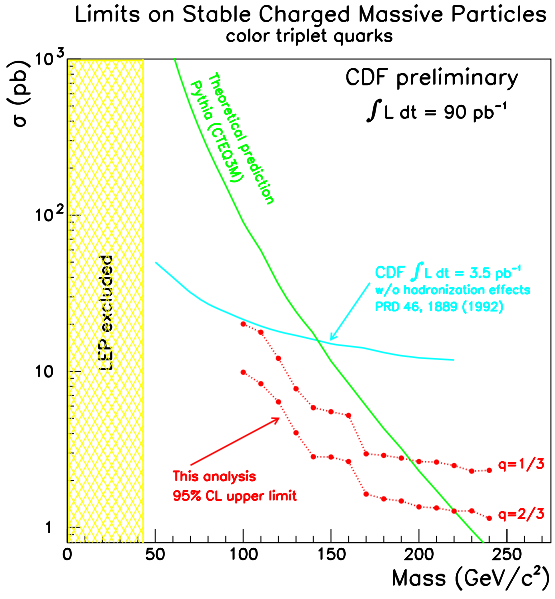
- **Background due to:**
  - **overlapping tracks**
  - **tracks for which dE/dx fluctuates high.**

⋆ Results

- **"Strong" production.**

  Expect: 62.7 ± 8.9 back. tracks ($\beta\gamma < 0.85$), Find 45





Limits:

M ≥190 GeV (q=1/3), M≥220 GeV (q=2/3) 95% CL.

- **"Weak" production. Add isolation cut on each track.**

  Expect: 5.6 ± 2.9 back. tracks, Find 1

  - **For sleptons, at one point in GMSB parameter space:**

    $\sigma < 1$ pb for M=80-120 GeV mass range

  - **Taking into account cascade decays:**

    Get: $\sigma < 550$ fb at 90% CL. Expect $\sigma \sim 80$ fb

Run II discovery reach in MSSM

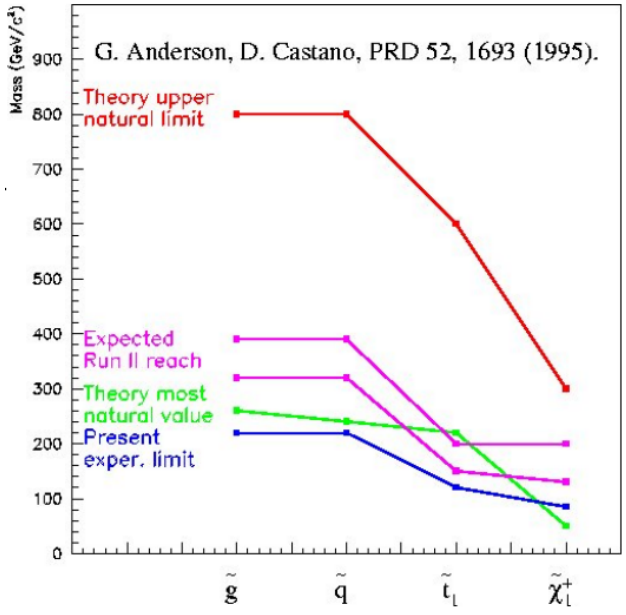
- **Expected Run II reach estimated with some assumptions within the minimal Super Gravity Model (mSUGRA). (Report of SUGRA working Group of Run II Workshop).**

- **Parameter space that can be explored at the Tevatron is considerably extended with increased luminosity:**

  Run IA $2\ \text{fb}^{-1}$ $M_{\tilde{g}} < 300$ **GeV**

  Run IIA $30\ \text{fb}^{-1}$ $M_{\tilde{g}} < 400$ **GeV**

- **With different assumption the gluino mass reachable in Run IIA can be as large as 600 GeV.**



- **Theory "upper natural limit" calculated with 10% fine tuning**

Conclusion:LBNL Responsibilities

Upgrades Responsibilities

LBNL/CDF group playing an important role in preparation for Run II.

- **COT : Young Kee Kim et al.**
  Production of field sheets (complete).
  Cabling and Electronics calibration.
- **SVXII : Maurice Garcia-Sciveres et al.**
  SVX3 chip co-design, testing and probing
  Hybrid Design, production and testing
  Port Card Design and manufacturing
- **ISL : Carl Haber et al.**
  Hybrids design and production
- **Layer00: Carl Haber et al.**
  Hybrids design and production
- **TOF : Y. K. Kim et al**
  Laser calibration system

★ **SVXII Ladders system test: Bob Ely (Sept '99-now)**

★ **CDFII Commissioning Manager:Y. K. Kim (May '00-)**

★ **Offline Manager : Marjorie Shapiro (March '98-)**

- **MOU's for Hardware and Software mantainance to come**

Summary and Conclusion

Present Physics Leadership roles:

- ⋆ **Physics for RUN II Workshop Coordinator: Y. K. Kim.**
- **B Physics**
  - **M. Paulini, B physics co-convener (’99-).**
- **Electroweak Physics**
  - **B. Carithers, EWK co-convener (’99-).**
- **Top Physics**
  - **W.M. Yao, Trigger and data set Co-convener(’98-)**
- **Particle Searches**
  - **W.M. Yao, Higgs and EWKSB co-convener (’98-)**

Run I analyses completed.

- ⋆ **Improved W mass measurement.**
- ⋆ **B mixing and B_s lifetime**
- ⋆ **Top Mass measurement**
- ⋆ **Particle Searches**

PHD Theses on Run I Data

- ∗ **B_c hadronic Decays**
- ∗ **Study of $b - \bar{b}$ production processes**
- ∗ **Search for MSSM Higgs Production**

Summary and Conclusion

Preparation for Run II Physics underway.

- **Measurements of CP asymmetries, ($\Delta \sin 2\beta$ = 0.07), exploit B_s physics.**
- **Increased statistics for better EWK parameter measurements, W mass in particular.**
- **Improved M_t measurements**
- **Testing of the Standard Model in Top decays.**
- **Search for Higgs and origin of EWKSB.**
- **Good opportunity for new physics.**

What Next?

- **Detector components for CDFII almost finished**
- **Start thinking about Run IIB Silicon upgrade participation (funds, manpower)**
- **Expect 2 fb^{-1} by year 2004, 20 fb^{-1} by 2006. Clearly Higgs and EWKSB studies will need Run IIB data.**
- **Members of the CDF group are working on ATLAS as well as CDF. ATLAS is the next step in Hadron Collider Physics. CDF provides the training ground for that type of physics.**
- **We want to continue physics analysis after 2004. We have to think about the transition period.**