CDF e Franco Rimondi

Convegno in memoria di

Franco Rimondi

Giorgio Bellettini,

Bologna, 24 maggio 2013

Le tappe di CDF

1980-1981: Detector Design Report (57 americani, 15 giapponesi, 15 Italiani)

1985: rivelate le prime collisions (24 eventi)

1988-1989: raccolti dati con luminosita` ~ 4 pb^{-1} a √s = 1,8 TeV

1992-1996: “Run I”, raccolti dati con ~ 110 pb^{-1} a √s = 1,8 TeV

2001-2011: “Run II” a √s = 1,98 TeV, dati con ~ 10 fb^{-1}

“The CDF detector – an overview”

FERMILAB-PUB-88/25-E,
227 autori, 25 italiani

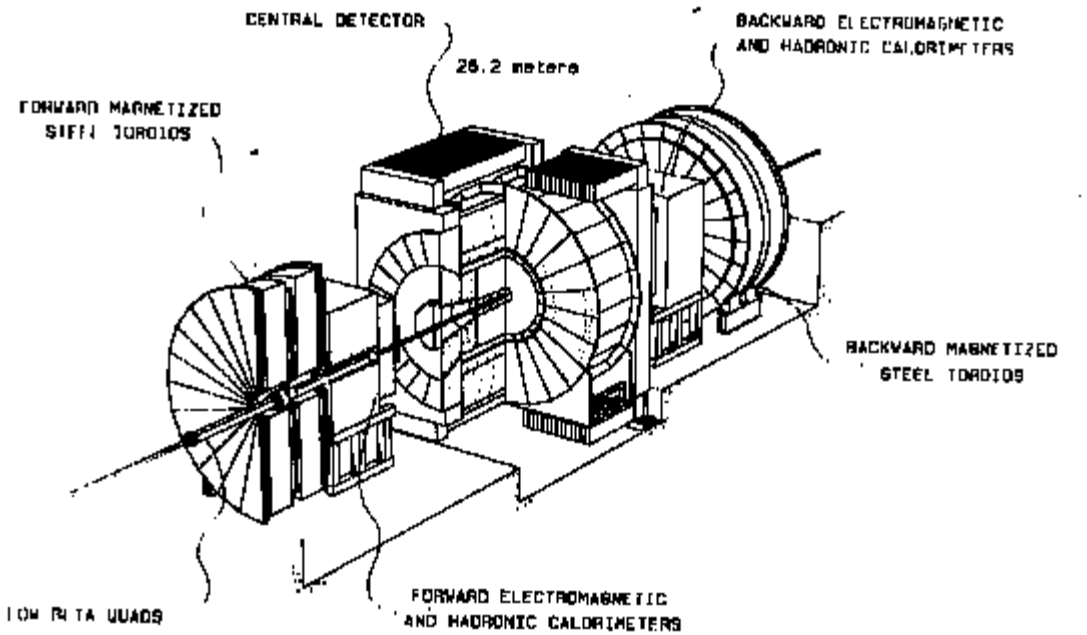


Figure 1

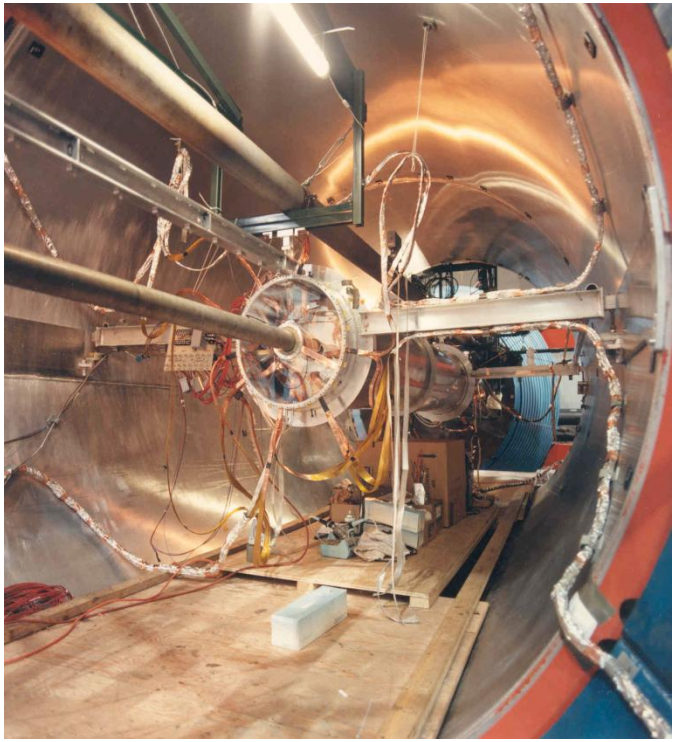
Run dimostrativo a 1.6 TeV nel 1985

VTPC, calorimetri centrali, trigger, d.a.q.

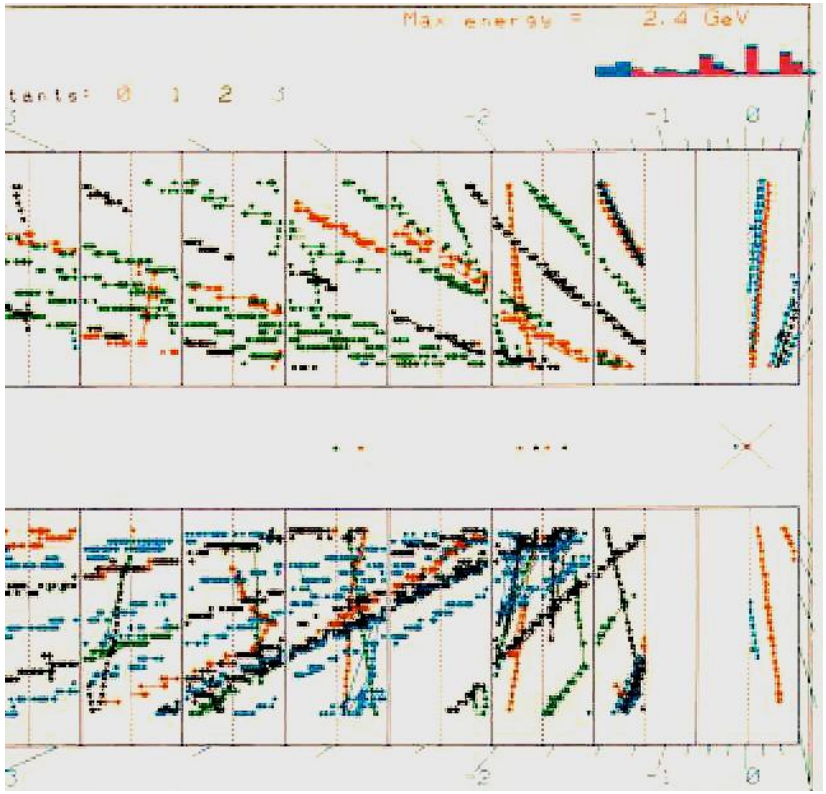
magnete spento

due tubi per i fasci (niente overpass)

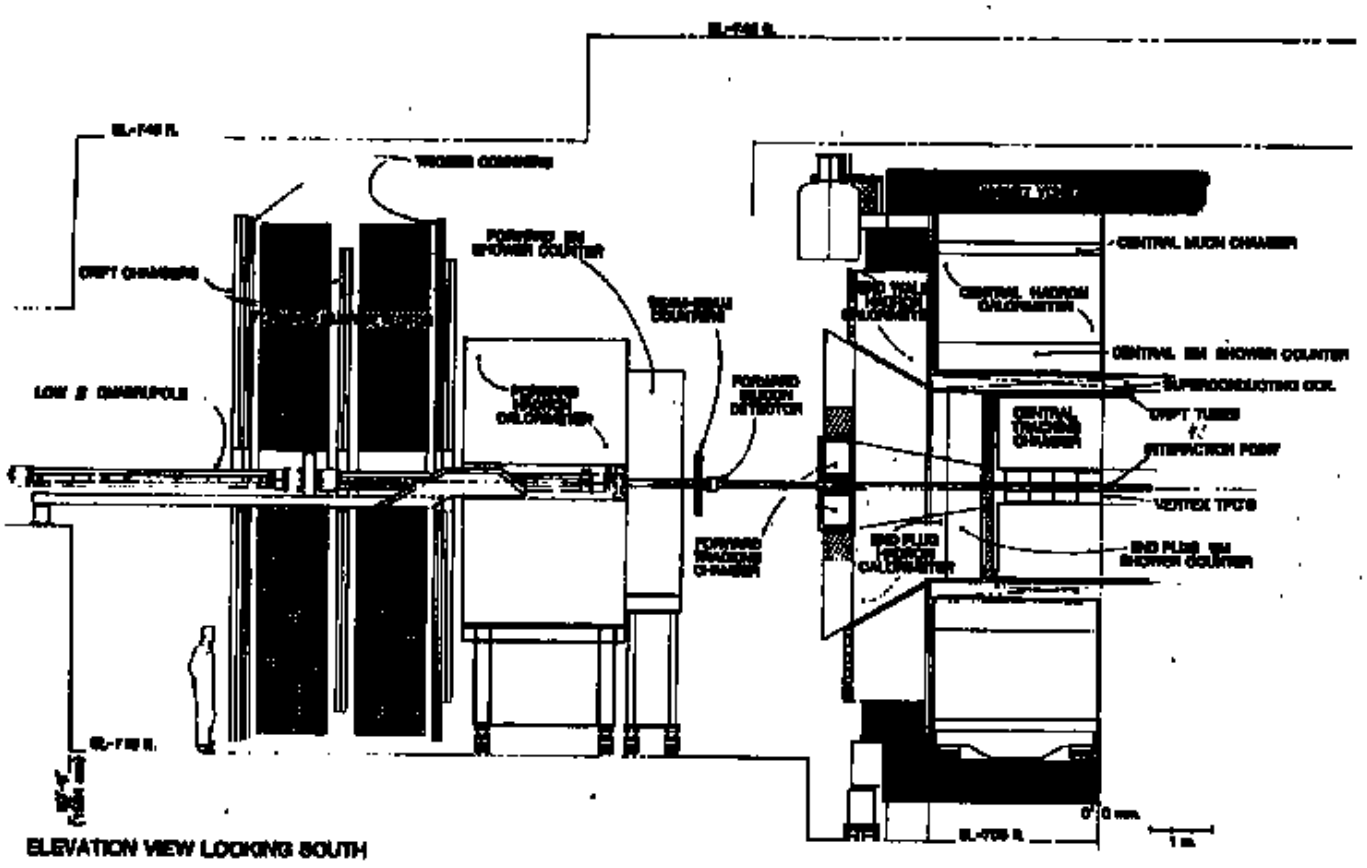
Installazione della VTPC e degli archi



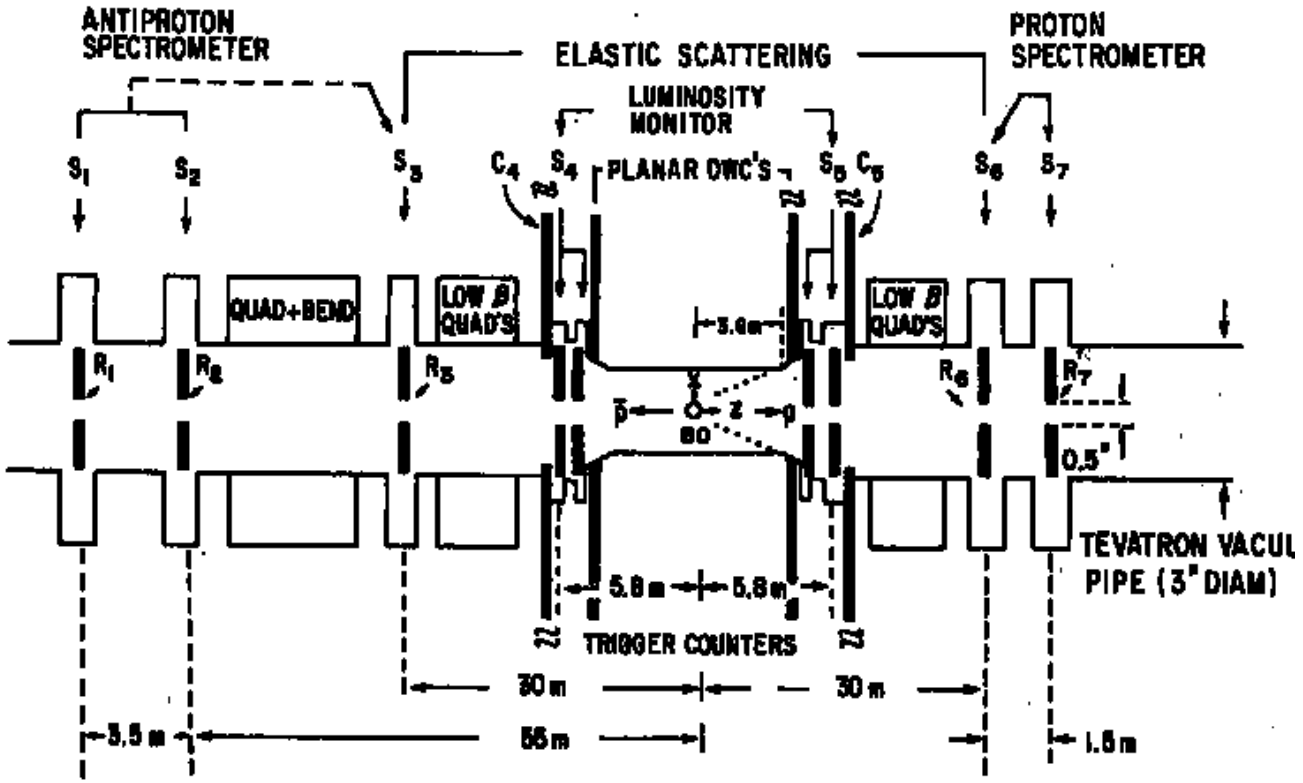
24 eventi e la tesi di Stefano Miscetti



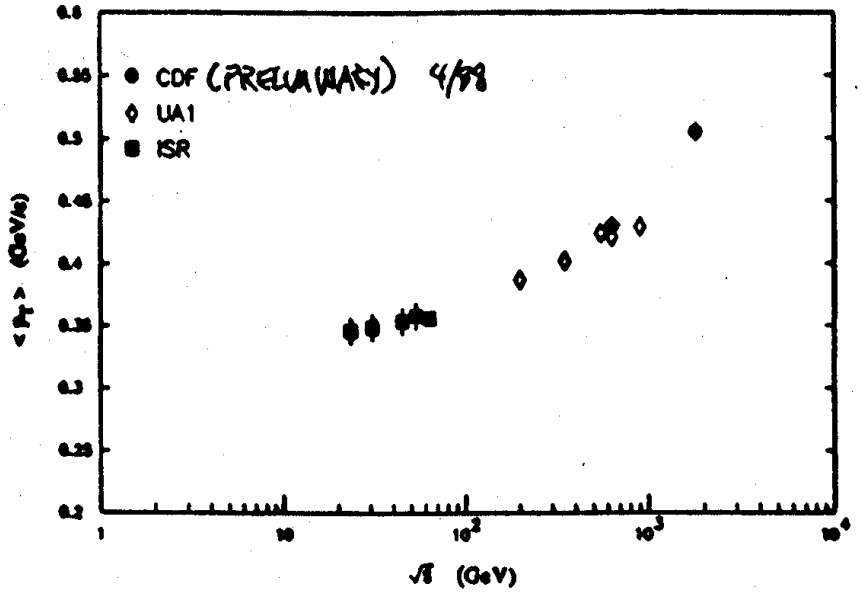
CDF nel 1988

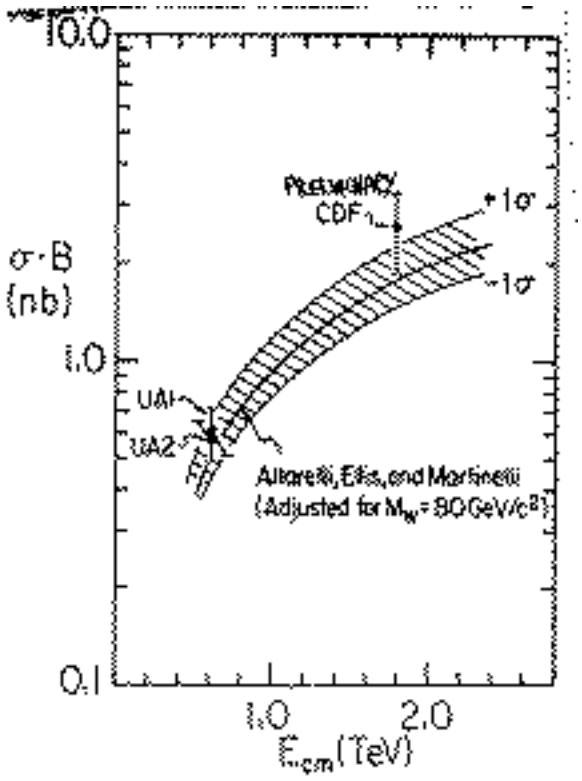

CENTRAL MUON CHAMBER
CENTRAL HADRON CALORIMETER
CENTRAL EM SHOWER COUNTER
DRIFT TUBES
INTERACTION POINT
VERTEX TPC'S
PLUG EM SHOWER COUNTER
ELEVATION VIEW LOOKING SOUTH

Gli spettrometri in avanti



Prima fisica nel 1988





Contributi italiani al rivelatore CDF1

Scintillatori, guide di luce, fototubi, alimentatori, calibratore laser del calorimetro adronico centrale

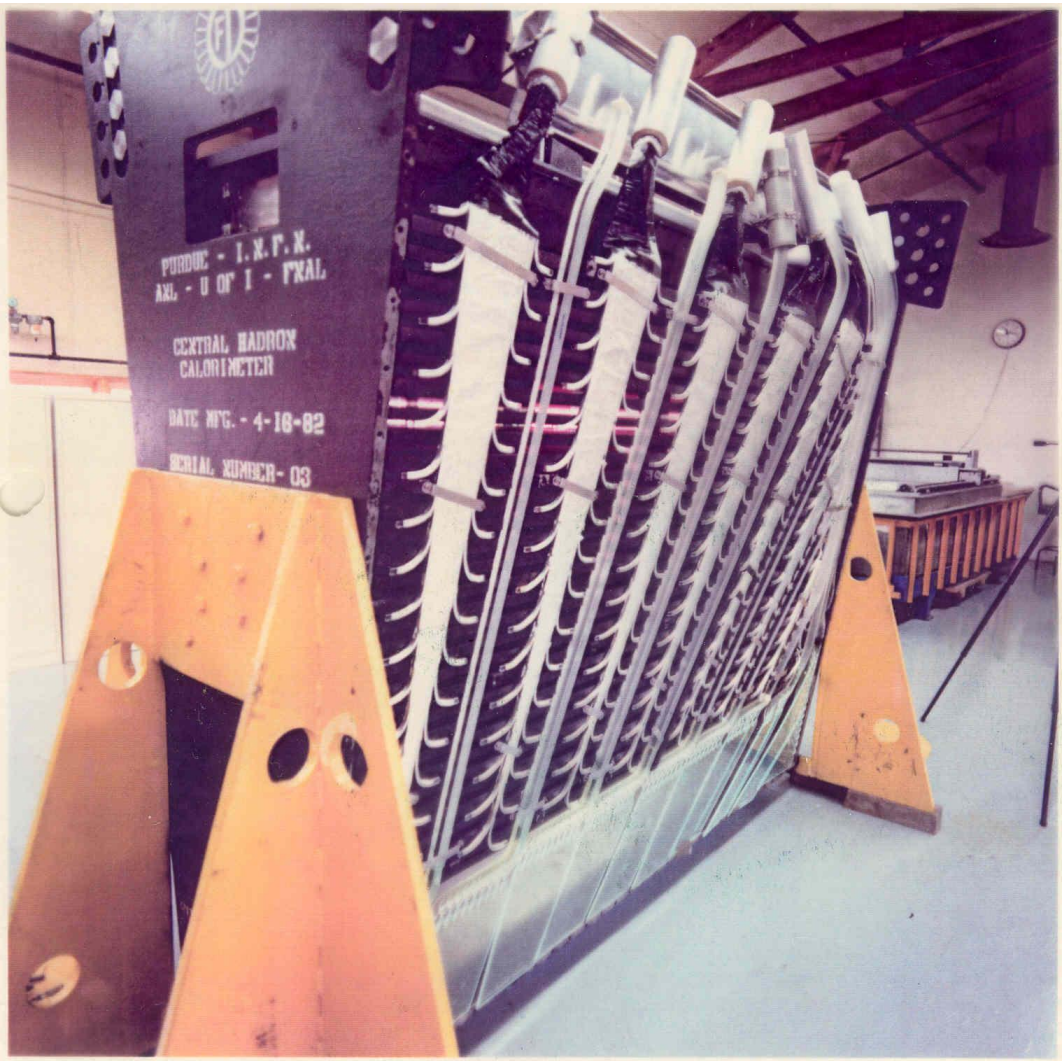
Rivelatore di vertice Silicon Vertex Detector (costruito ed installato nel 1992 in collaborazione con Fermilab e LBL)

Parte della elettronica di trigger

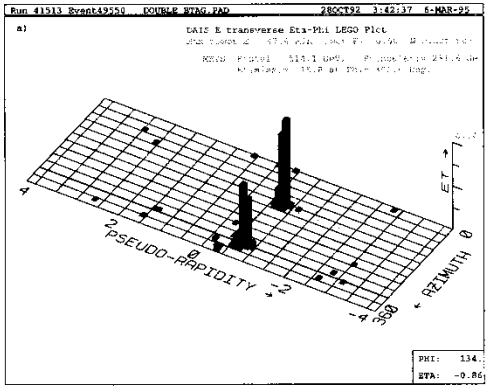
Spettrometri per lo scattering elastico in avanti (costruiti in collaborazione con Rockefeller e Tsukuba)

Contatori a scintillazione per il trigger dei μ

Uno spicchio del calorimetro centrale



Central Calorimeter
module with Light
Guide 9/28/82



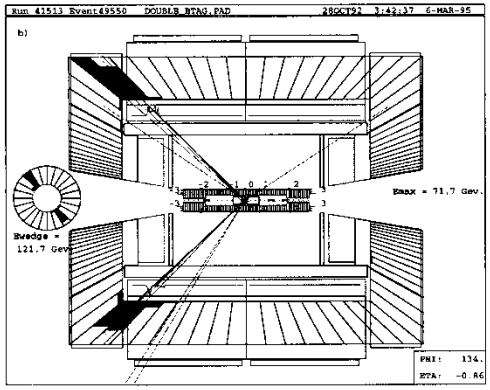


Figure 3.1: A typical dijet event at CDF. a) Lego plot of the energy deposited in the calorimeter. b) Side view of the same event.

La proposta di SVX nel 1985

February 15, 1986
INFN PI/AE 86-4

A SILICON VERTEX DETECTOR FOR CDF

F.Bedeschi[a], S.Belforte[b], G.Bellettini, L.Bosisio, F.Cervelli, G.Chiarelli[c], R.Del Fabbro, M.Dell'Orso[a], A.Di Virgilio, E.Focardi, P.Giannetti, M.Giorgi, A.Menzione, L.Ristori, A.Scribano, P.Sestini[a], A.Stefanini, G.Tonelli, F.Zetti

Istituto Nazionale di Fisica Nucleare
Pisa, Italy

Presented by F.Bedeschi

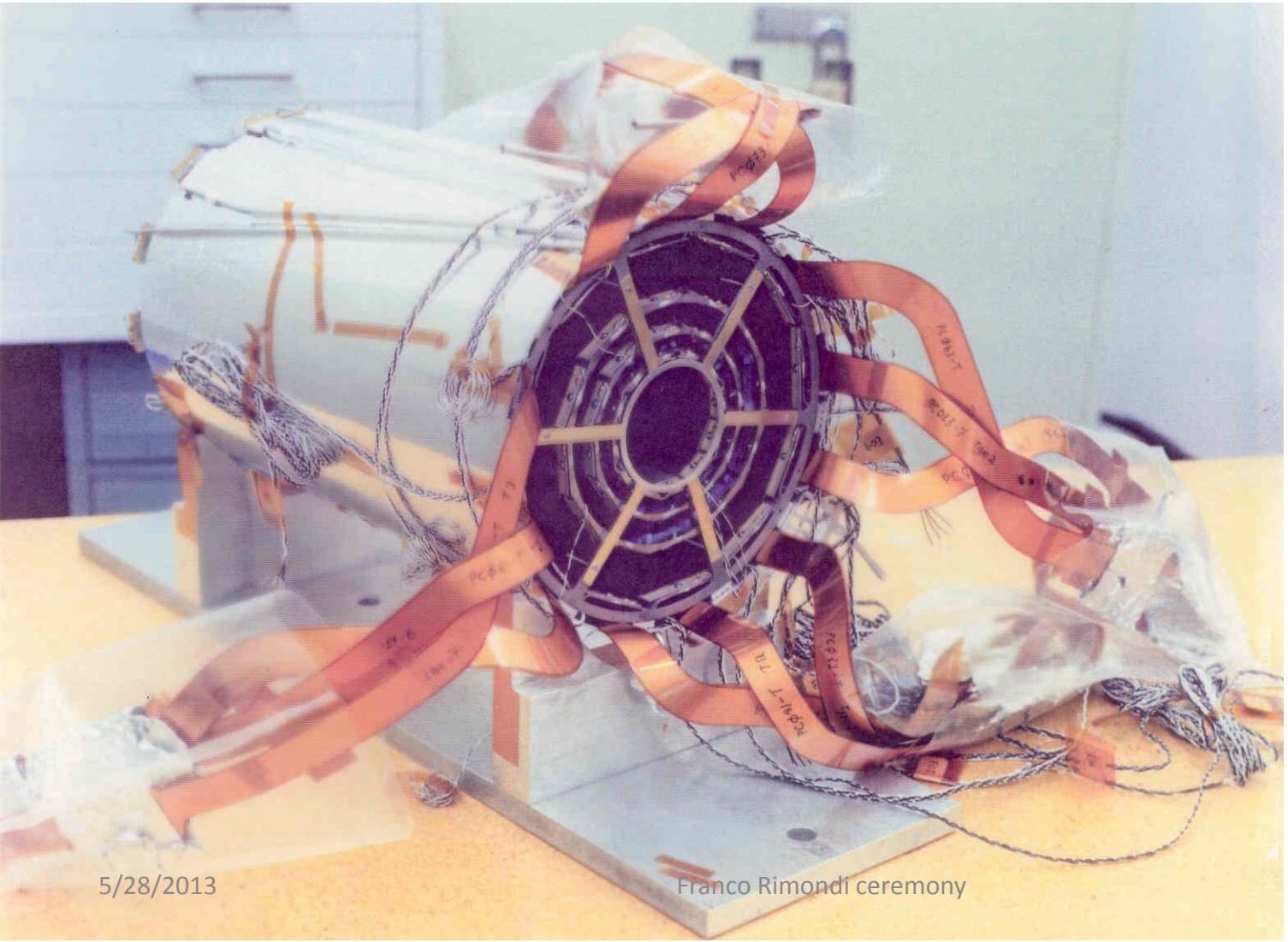
at the IEEE Nuclear Science Symposium
San Francisco, October 1985

U.S.A.
a) Now at Fermi National Accelerator Laboratory.
b) INFN and Rockefeller University.
c) Now at Rockfeller University.

A Silicon Vertex Detector was included in the 1981 Design Report because of the insistence of the Pisa group.

After 7 years of debates and 4 years of construction SVX started operating for Run1 in 1992.

½ of SVX1



½ of SVX1 is displyed in the Pisa museum.

La crescita dei gruppi dell`INFN

1980, gruppi di Frascati e Pisa

1990, gruppo di Padova

1992, gruppo di Bologna

Scoperta del quark top (1995)

1997, gruppo di Trieste-Udine

1999, gruppo di Roma

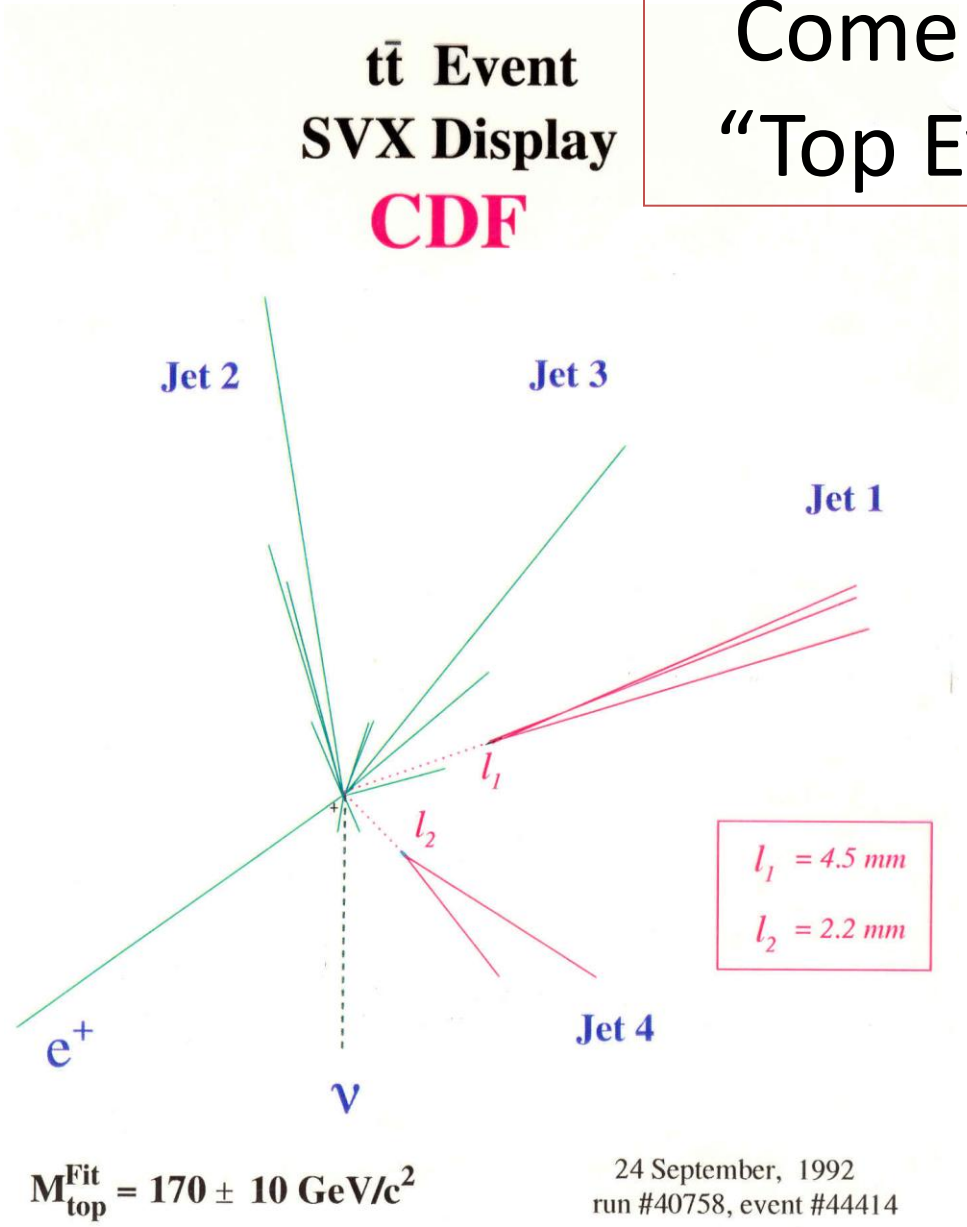
Inizio del Run 2 nel 2001

Il numero massimo degli italiani (2003)

53 gruppi per un totale di circa 650 fisici
6 gruppi italiani con111 physicists

Bologna:	**10 fisici**
Frascati:	7
Padova:	22
Pisa:	37
Rome:	21
Trieste/Udine:	14

Come si misurava con SVX: "Top Evidence Paper", 1994



Esempio di un evento di tipo top-leptonico singolo in CDF

Efficienza di "tagging" delle coppie top-antitop ~ 42%

Probabilita` di segnalare getti di quark leggeri ~ 0,5% per getto.

Massa del quark top nella “Evidence Paper” (1994)

7 single lepton events could be reconstructed to find the mass. A peak was found at m_t = 174 17 GeV/c^2.

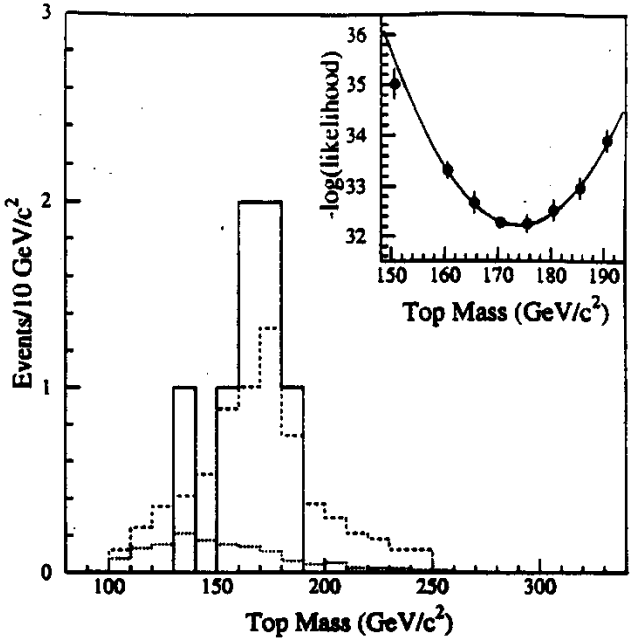


Figure 35: CDF top mass distribution (solid histogram) compared with the W + jets background prediction (dots) and the predicted signal+background distribution normalized to the data for m_t = 175 GeV (dashed). The inset shows the likelihood fit results.

Analisi italiane nella scoperta del top

Developed the first “d-ϕ” b-tagging algorithm (F. Bedeschi)

Contributed to the search in the dilepton channel

“Relative Likelyhood” analysis of the single lepton events (Hans Grassmann)

Contributed to the measurement of the mass in the single lepton sample.

Il run 2 nel 1992

Dopo un arresto di oltre tre anni, la presa dati riprese nel marzo del 1991 per il “run 2”

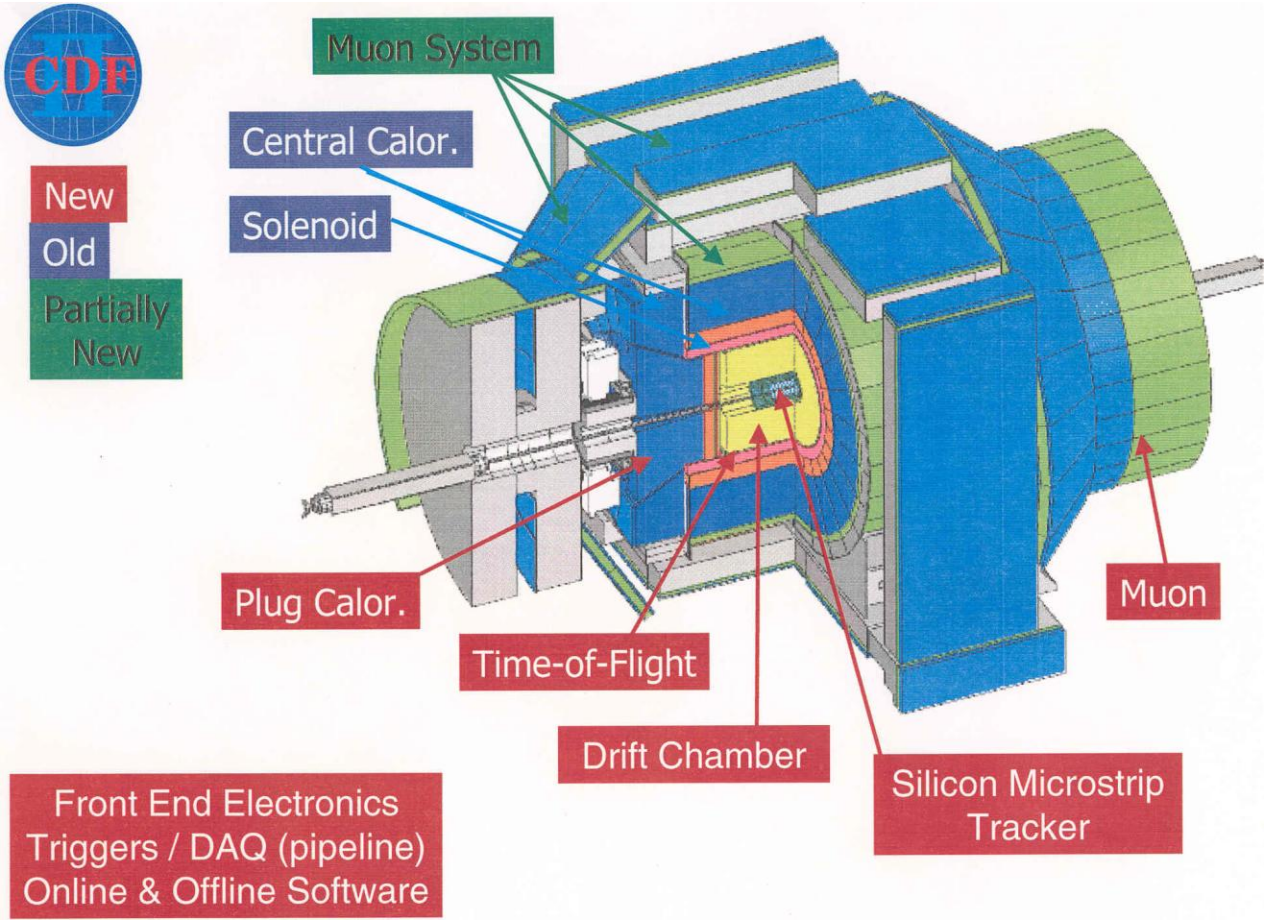
Gli scopi di CDF2

Precision measurements
W and top quark mass
b physics, e.g.B_s oscillation frequency

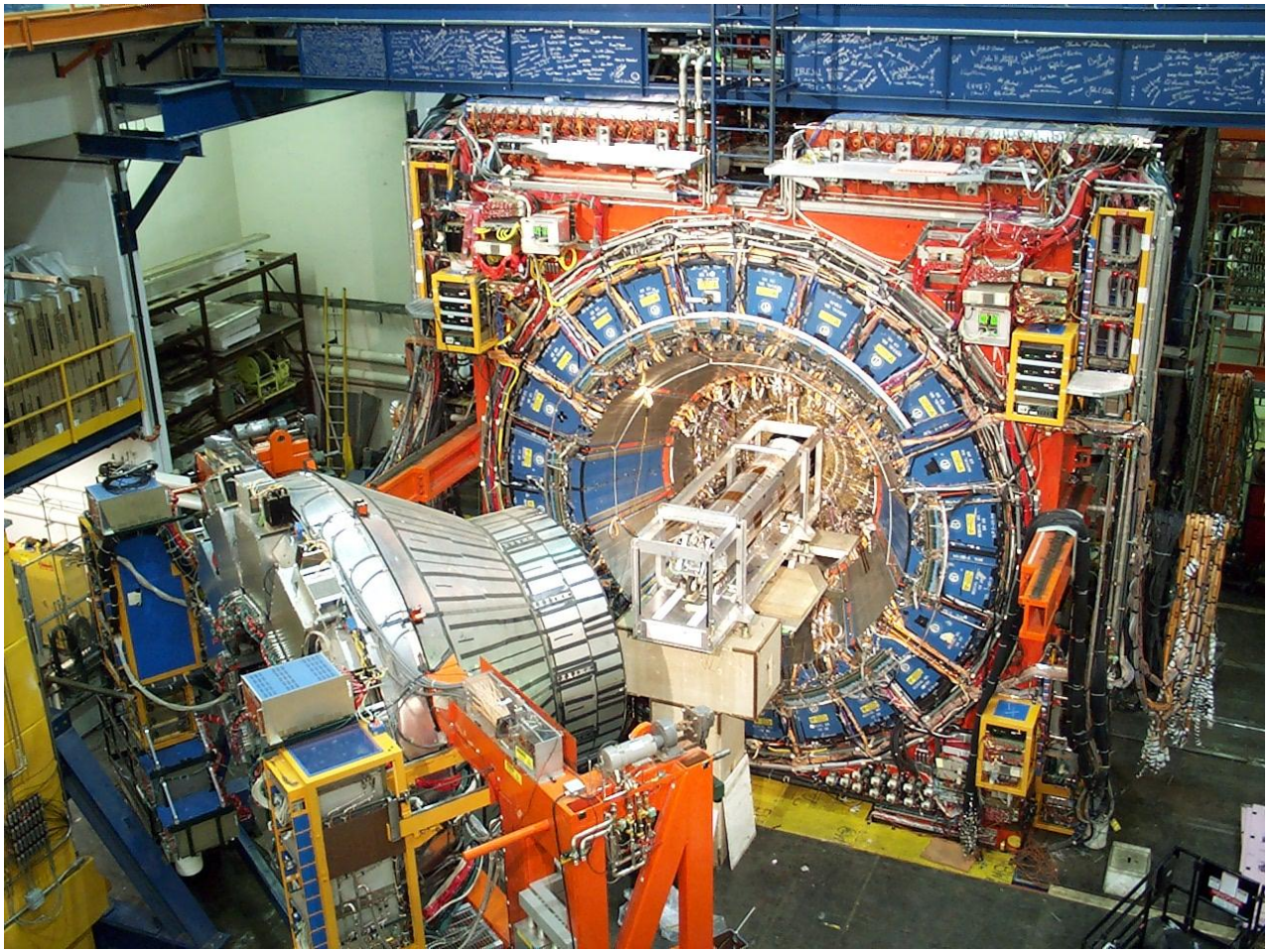
Exploring the Standard Model
Top quark properties
Boson pair cross sections (WW, WZ, ZZ)

Hunt for discoveries
b-flavored barions
Light Higgs boson
More?

CDF2 (2001-2011)



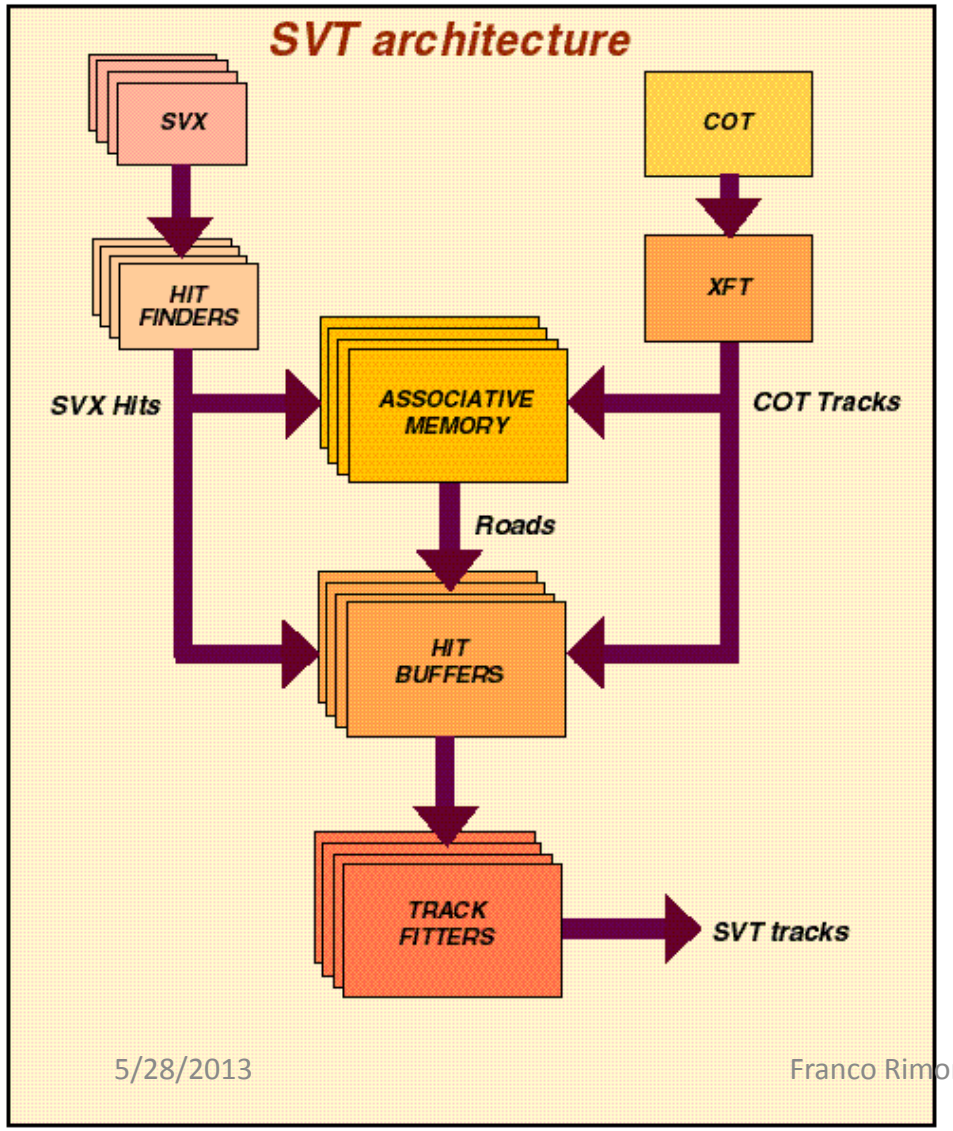
Installazione di ISL e del calorimetro “plug”



Italiani nel “CDF 2 Design Report” (1993)

40 Istituzioni di cui 4 italiane
(**Bologna**, Frascati, Padova, Pisa)
63 autori italiani su 389

Secondary Vertex Tracker SVT



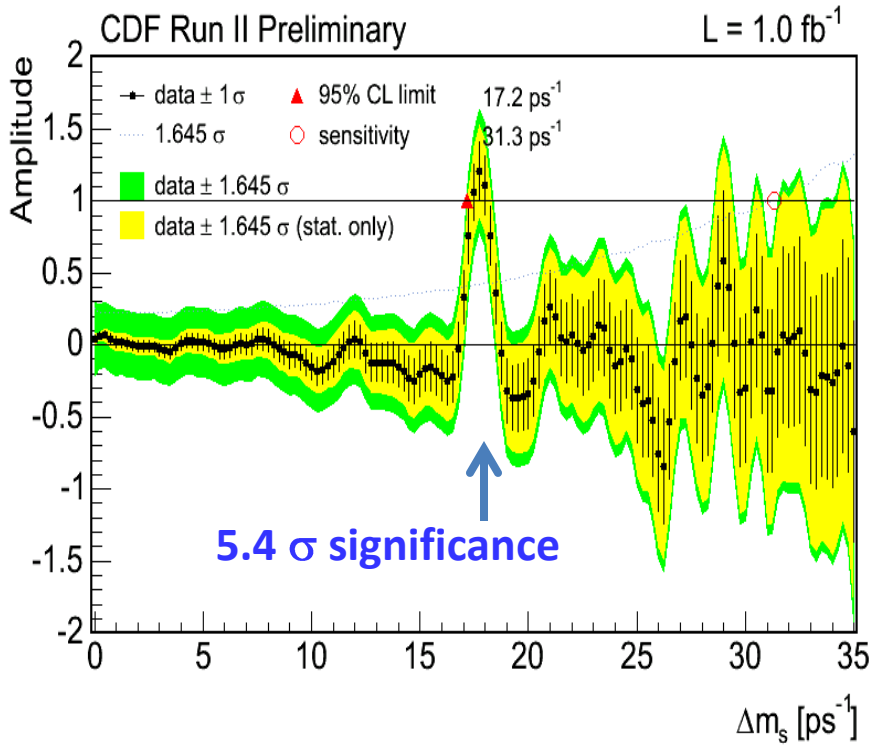
- Fast electronics (XFT) feeds COT track segments to SVT
- Associative memory combines them with hits in the SVX and signals tracks which are not likely to come from the primary vertex
- Tracks are found in ~20 μs. Triggering at level 2 is possible on hadronic Charm and Beauty decays.

SVT Hardware

$B_s^0 - \overline{B}_s^0$ mixing

(PRL 97, 242003 2006)

87 fs (< 30 μm, 0.4%) resolution for fully reconstructed states



$$|V_{td}/V_{ts}| = 0.2060 \ \pm 0.0007 \ (\text{exp}) \ ^{+0.0081}_{-0.0060} \ (\text{theor})$$

$$\Delta m_s = 17.77 \ \pm 0.10 \ (\text{stat}) \ \pm 0.07 \ (\text{syst}) \ \text{ps}^{-1}$$

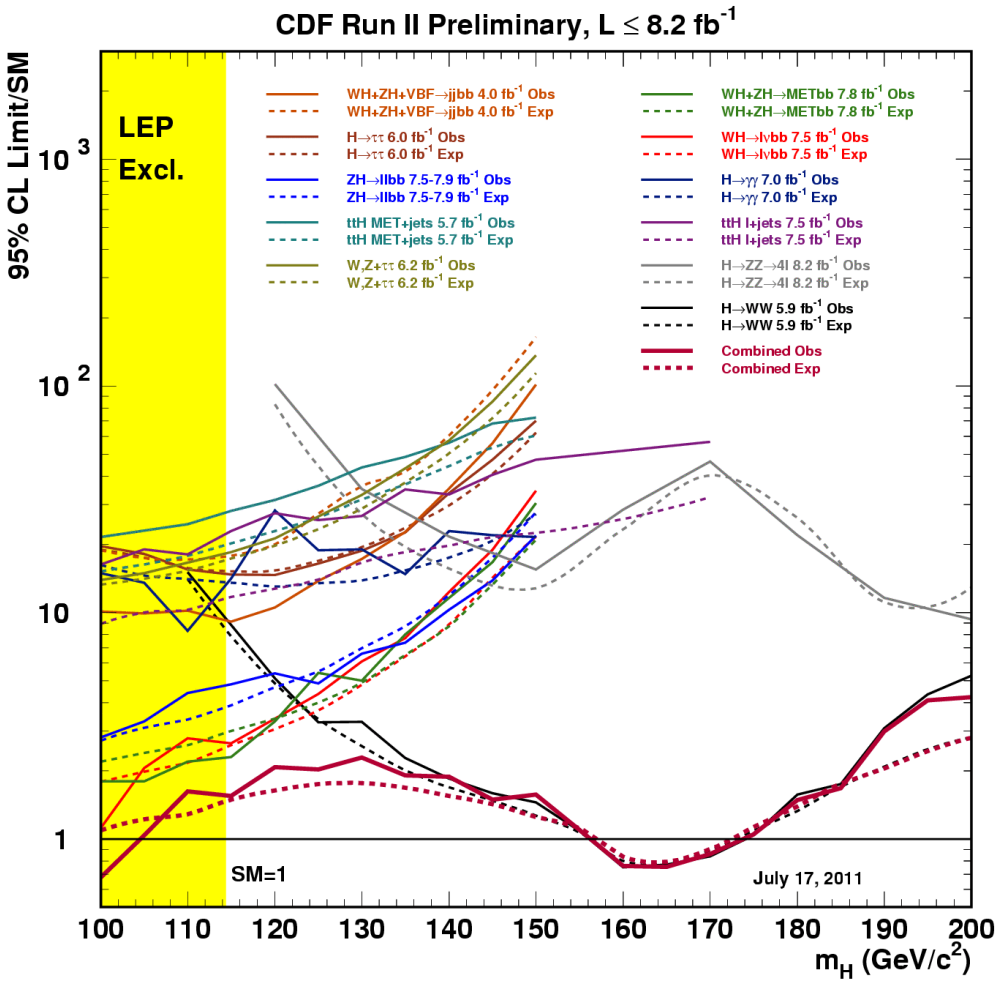
Talks by Hildreth, Tollefeson

CDF light Higgs Search

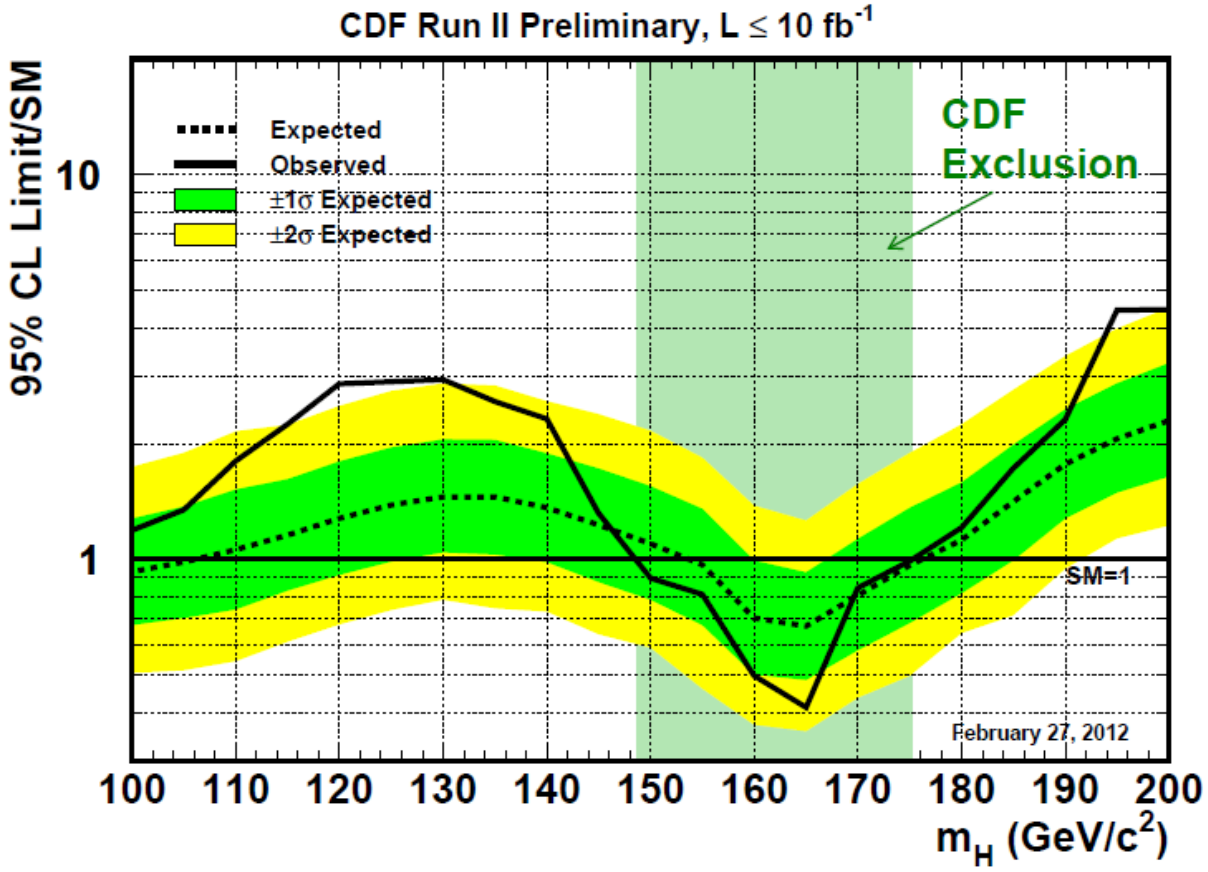
Almost equal contributions by:

- $ZH \rightarrow llbb$
- $WH \rightarrow l\nu bb$
- $ZH \rightarrow \nu\nu bb$
- $H \rightarrow WW \rightarrow l\nu l\nu$

Remaining channels have a combined weight of ~10%

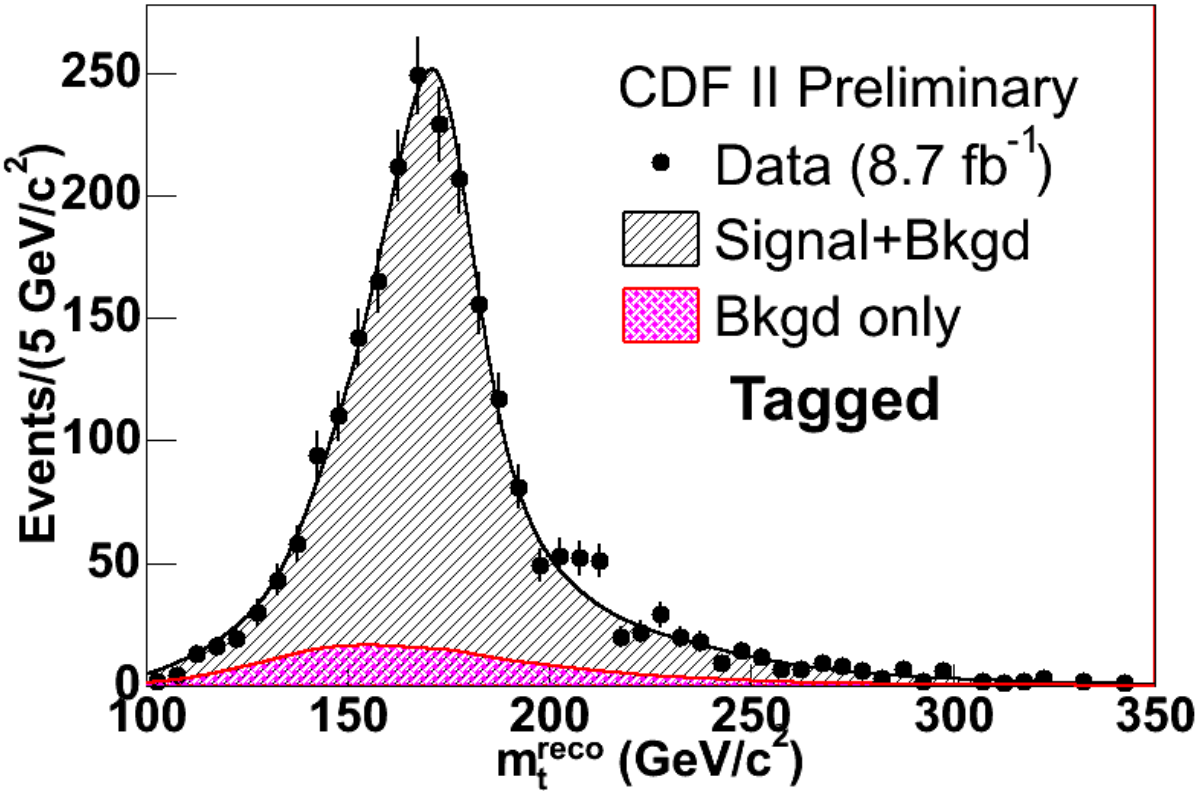


CDF Higgs combination limits



Final CDF lepton+jets top mass with full dataset (December 2011)

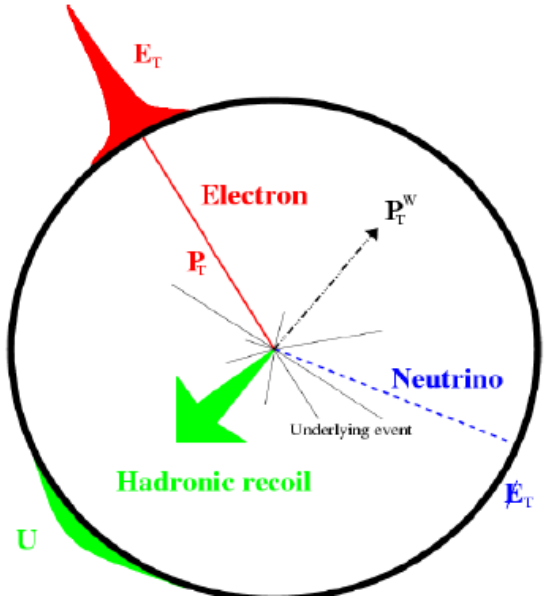
Mtop = 172.85 ±1.11 GeV/c2



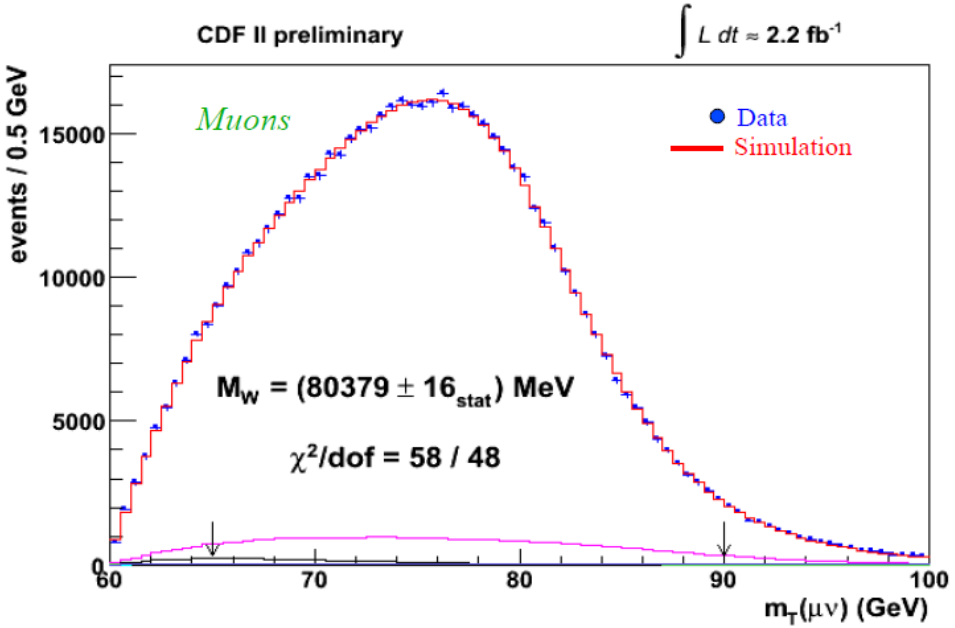
W mass

(February 2012)

$M_W = 80387 \pm 19$ MeV/c^2 (→ ± 12 (stat.) ± 15 (syst.))



pp→WX→eγX



MOU di Bologna per CDFII

CDF-II Memorandum of Understanding
among the
Fermi National Accelerator Laboratory,
the CDF-II Collaboration
and The University of Bologna

Firmato nel 1990

MOU/2

II. Personnel and Coordination of Responsibilities

A. The following members of the University of Bologna, Italy and Istituto Nazionale di Fisica Nucleare, are presently participants in the collaboration. This level of commitment is expected to remain approximately constant for three years.

Name	Title	Usual Location	Total CDF Fraction	Other Commitments
F. Rimondi	Physicist	Bologna	50%*	Teach, LHC
A. Castro	Physicist	Bologna	70%	Teach, LHC
M. Deninno	Physicist	Bologna	100%	Teach
L. Malferrari	Physicist	Bologna	100%	
P. Mazzanti	Physicist	Bologna	50%	LHC, Computing
F. Semeria	Physicist	Bologna	30%	LHC, Computing
S. Zucchelli	Physicist	Bologna	100%	Teach
N. Moggi	Post-doc	Bologna	100%	

*F. Rimondi is the University of Bologna CDF-II coordinator.

B. The coordinator for the University of Bologna is F. Rimondi and the representative on the CDF-II Executive Board is F. Rimondi. The alternative members for the Executive Board are S. Zucchelli and M. Deninno. Each participating CDF-II institution has one member on the CDF-II Executive Board.

MOU/3

V. Responsibilities of The University of Bologna

A. Project: Maintenance of the HV System of the End Plug Calorimeter.

1. Responsible for continued maintenance of the End Plug Calorimeter HV hardware (CAEN SY527 HV system), A person in charge will be present at Fermilab at all times or as needed. Approximately 0.25 (FTE) Post-doc time and 0.75 (FTE) Faculty time will be provided.

MOU/4

2. Responsible for continued maintenance of the code for the operation, remote control and monitoring of the above system.

B. Online Activities

1. Bologna will participate in the implementation and maintenance of the high multiplicity and multijet triggers. Whenever needed, c/o Bologna the appropriate trigger table will be modified.

C. Offline Activities

D. Offline Representative

1. F. Semeria

E. Deliverables

F. Operational Activities

1. Post-docs will act as Ace

G. Supervision

1. The End Plug Calorimeter HV hardware system activities are coordinated by S. Zucchelli.
2. The End Plug HV system control and monitoring code activities are coordinated by L. Malferrari.

H. Schedule

1. The End Plug Calorimeter HV hardware and software systems are installedand working and have successfully performed during the commissioning run of year 2000.

Bologna con Pisa e Dubna

November 12, 2003

Protocol of Agreement

An Agreement of Joint Scientific Research
between
THE ISTITUTO NAZIONALE DI FISICA NUCLEARE
Sezione di Bologna (Italy)
and
THE ISTITUTO NAZIONALE DI FISICA NUCLEARE
Sezione di Pisa (Italy)
and
THE JOINT INSTITUTE FOR NUCLEAR RESEARCH
(Dubna, Russia)

- Study of *Very High Multiplicity* and Minimum-Bias proton-antiproton processes selected in the CDF experimental data at the 2 TeV Fermilab Tevatron Collider.

28 Note di CDF di F. Rimondi et al./1

1878 11/5/1992: Particle Production and Energy Flow in W and Z Underlying Events, F. Rimondi, The CDF Collaboration

1775 6/24/1992: Description of a Micro-DST for CDF Minimum Bias Data, F. Rimondi, A. Sgolacchia

1633 11/29/199: Intermittency Studies in pbar-p Collisions at sqrt(s) = 1800 GeV, F.Rimondi, The CDF Collaboration

1551 8/23/1991: Intermittency Studies in pbar-p Collisions at sqrt(s) = 1800 GeV F.Rimondi

1283 8/20/1990: Multifractal Structures in Multiparticle Production in pbar-p Interactions at sqrt(s) = 1800 Gev, F. Rimondi, The CDF Collaboration

1200 5/11/1990: Study of the Multifractal Structures in the Multiparticle Production in Minimum Bias Events, F. Rimondi

1104 9/1/1989: Particle Correlations in ppbar Interactions at sqrt(s) = 1800 and 630 GeV, F. Rimondi, The CDF Collaboration

Note di CDF di F. Rimondi et al./2

5288 4/14/2000: Soft and Hard Interactions in ppbar Collisions at sqrt(s)=1800 and 630 GeV, M. Deninno, N. Moggi, F. Rimondi, S. Zucchelli

4922 3/22/1999: W -> tau nu and Gamma(W) Studies at the Tevatron Collider, F.Rimondi, The CDF and D0 Collaboration

4763 3/24/1999: What Can We Learn from Minimum Bias? Part I, N.Moggi, F. Rimondi

3251 7/10/1995: New Structure of Minimum Bias Micro-DST V. Bolognesi, F. Rimondi

2879 11/7/1994: Study of the Structure of the Events Produced in Soft pbar-p Interactions at sqrt(s) = 1800 GeV, F. Rimondi, The CDF Collaboration

2324 11/8/1993: Multiciplicity Distributions in pbar-p Interactions at sqrt(s) = 1800 GeV F. Rimondi, The CDF Collaboration

2198 8/24/1993: Multiplicity Distributions in pbar-p Interactions at sqrt(s) = 1800 GeV M. Deninno, F. Rimondi, A. Sgolacchia

Note di CDF di F. Rimondi et al./3

6682 9/13/2003: A First Look to High-Multiplcity Trigger Data, N. Moggi, F. Rimondi

6043 2/4/2004: A Study of Corrections for k0s and L0 Distributions in Minimum-Bias Events N. Moggi, F. Rimondi

5603 3/30/2001: A Simple Study for a TOF High-Multiplicity Trigger, N. Moggi, F. Rimondi

5575 4/12/2001: Minimum Bias Correction, N. Moggi, F. Rimondi

5542 4/2/2001: Soft and Hard Interactions in ppbar Collisions at sqrt(s)=1800 and 630 GeV, F. Rimondi, The CDF Collaboration

5461 5/8/2001: A High Multiplicity Trigger for RunII, N. Moggi, F. Rimondi

5415 9/6/2000: Soft and Hard Interactions in ppbar Collisions at sqrt(s)=1800 and 630 GeV, F.Rimondi, The CDF Collaboration

Note di CDF di F. Rimondi et al./4

10911 8/23/2012: On the excess of high pt tracks in the Minimum Bias sample, N. Moggi, M. Mussini, F. Rimondi

10300 9/27/2010: Study of D0→kpi decays recunstructed in the Minimum Bias sample, Niccolo' Moggi, Michael Joseph Morello, Manuel Mussini, Giovanni Punzi, Franco Rimondi, Diego Tonelli

9936 9/18/2009: Multiplicity Distribution of Charged Particles in Inelastic pp Interactions, N. Moggi, M. Mussini, F. Rimondi
8594 11/9/2006: MB Trigger Acceptance to MB Data, N. Moggi, F. Rimondi

8593, 11/9/2006: Track Selection and Counting Efficiency in MinBas
N.Moggi, M. Mussini, F. Rimondi

7838 9/15/2005: Primary Vertex Studies for Minimum Bias Data, N. Moggi, M. Mussini, F. Rimondi

Franco ha mostrato:

La importanza delle misure
La modestia nel rappresentarle
La serieta` nel lavoro
La franchezza nelle amicizie

non lo dimenticheremo