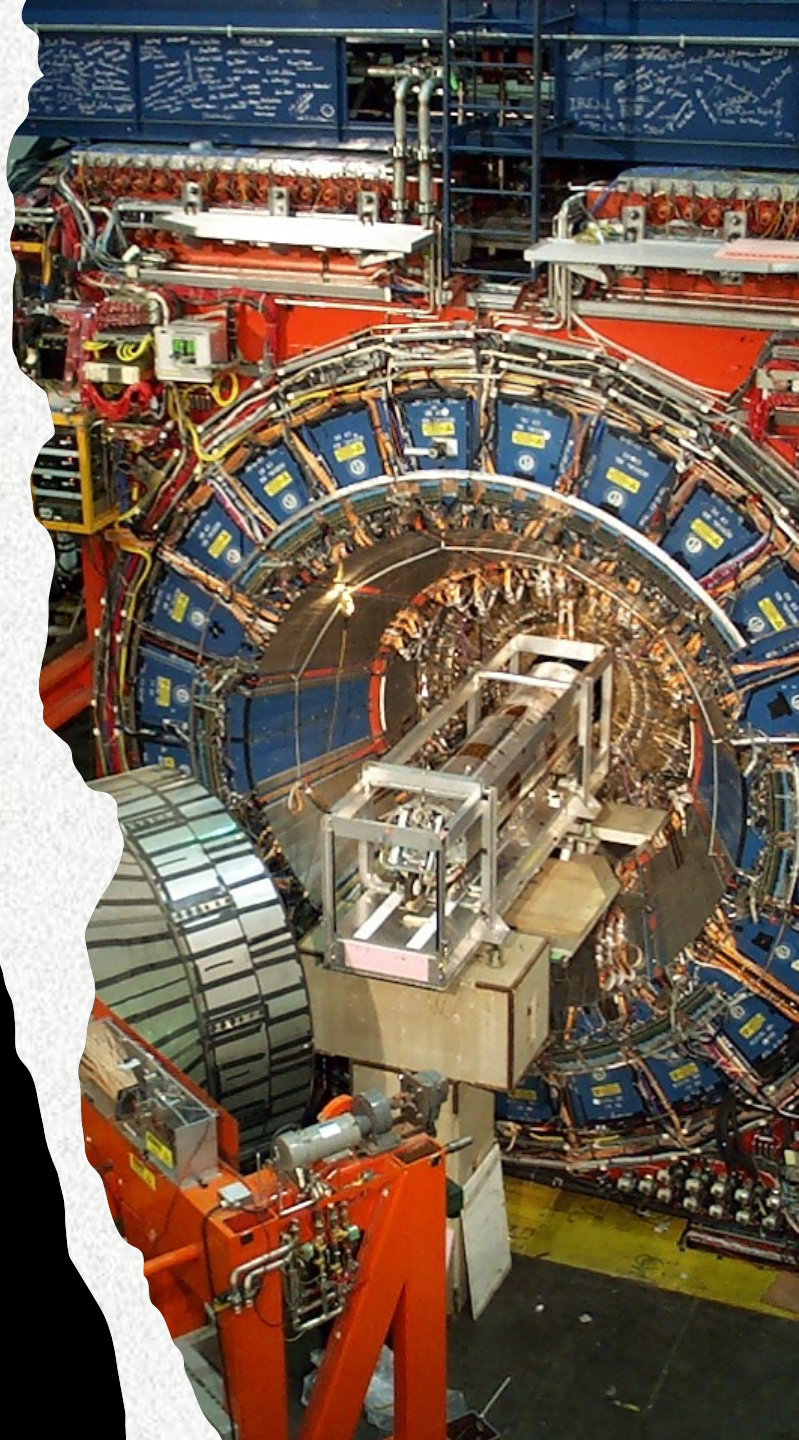
Giorgio at Fermilab

Pisa Symposium

June 4, 2024

Al Goshaw



Giorgio's move to the US and his contributions to CDF and Fermilab.

- It is my great pleasure to speak at this celebration of Giorgio's 90th birthday.
- When asked by Giorgio Chiarelli I was honored but also concerned since I did not overlap with Giorgio during most of the time when he was playing leadership roles at CDF and Fermilab. In fact, I joined only in late 1993, and was working below the CDF control room testing LeCroy TDC when all the excitement about the top discovery was going on with Girogio and others "upstairs".
- So I have done some research based on talks given by Giorgio himself and others, and some photos from this era. These will form the bulk of what I am about to show. Some of you here today are more familiar with these early days and should add and correct what I say!

The plan ..

First review the “big picture” of events leading to the creation of Fermilab and the CDF experiment. This sets the time frame into which Giorgio came to the US in 1980.

Review Giorgio’s role the planning and construction of CDF

Then his leadership during the operation of CDF, in physics and as Co-spokesperson

And finaly a few words about his contributions to the Fermilab community in general

How it all started

In the late 1965 there was a call for proposals from the Atomic Energy Commission and the National Academy of Sciences to build a 200 GeV proton accelerator in the US. They received 126 proposals !

The NAS narrowed the list of sites down to seven in March 1966: Sierra Nevada, California; Denver, Colorado; South Barrington, Illinois; Weston, Illinois; Ann Arbor, Michigan; Brookhaven, New York; and Madison, Wisconsin.

The Weston site had some challenges

- Local opposition: Residents feared that the influx of physicists would bring traffic and "disturb the moral fiber of the community."
- Legal problems: the site selection was hampered due to the lack of fair-housing laws in Illinois
- It was a green-field site (compared to Berkeley, BNL, Argonne ..,)

But the Weston site was chosen!

- The Weston site had many strengths: including accessibility to users from all areas of the US and indeed the world given its Midwestern location and proximity to O'Hare airport. Also some political connections in Congress!

- The AEC issued a press release announcing the selection of the Weston Illinois site on December 16, 1966.

WEATHER
Cloudy Saturday and warmer, with high in lower 40s. See Page 54.

CHICAGO SUN-TIMES

FINAL TURF EDITION

Vol. 19, No. 274 Phone 321-3000 SATURDAY, DECEMBER 17, 1966 80 Pages, 2 Sections—10 Cent

How Weston Won A-Site

SPECIAL SECTION IN CENTER FOLD

By Tom Littlewood
Sun-Times Bureau

WASHINGTON—The Atomic Energy Commission chose Weston in the Chicago metropolitan area Friday as the location of the world's largest scientific instrument, a circular atom smasher three miles around.

The Illinois entry in DuPage County won a national competition for the site of the AEC's new high-energy physics laboratory.

At the heart of the laboratory is planned a 200-billion electron volt accelerator that will take eight years to build at a cost of possibly $375,000,000. The instrument will be designed to hurl tiny particles of matter at high speeds so that physicists can study the fundamental structure of the atom, the building blocks of the universe.

When completed, the laboratory will employ 2,300 scientists, technicians and others. It will cost an estimated $60,000,000 a year to run and is expected to stimulate the economy of the entire west suburban region.

All but four of the 50 states submitted more than 200 proposed sites. The AEC reduced the field drastically in September, 1965, and asked the National Academy of Sciences for further advice. Last March the academy screened out all but six finalists.

Glenn T. Seaborg, the AEC

Other stories and pictures on Pages 3, 4, 6 and 7.

Turn to Page 5

Weston, selected as nation's atom-smasher capital, is easily accessible to O'Hare Airport, tollways, Argonne National Laboratory and major universities. (Sun-Times Map)

Holding a press conference in Weston, picked as site for the world's largest atom smasher, are (l. to r.) Matthew Molitor and Eugene Jones, village trustees; Arthur Therfault, village president, and State Rep. Lewis V. Morgan, chairman of Illinois Commission on Atomic Energy. (Sun-Times Photo)

THE WESTON FACTS

Here, at a glance, are the salient facts concerning Weston's 200-billion electron volt proton accelerator:

WHERE—Western Du Page County, near developing Du Page and Kane County communities.

COST—Up to $375,000,000, probably in more than one stage.

COMPLETION TIME—About a decade, with up to two years of planning and preliminary work and eight years of construction.

JOBS—The construction phase is expected to employ some 1,200 persons year around. The accelerator, when completed, is to have a staff of more than 2,000, with an affiliated visiting staff of up to 1,000. An unknown number of jobs would be created through spin-off industry that results from the presence of research installations.

IMPACT ON ECONOMY—Unlimited, but the accelerator is to have an annual operating budget of $60,000,000 and one official says 3,000 new workers means $17,000,000 more in bank deposits annually, $9,000,000 more in retail sales and 90 more retail establishments.

IMPACT ON COMMUNITIES—The same official estimates that 3,000 new workers means 9,000 more people, and 2,700 more schoolchildren.

Victory On The Lakefront

See Editorial On Page 25; McCormick Place Story On Page 2

The National Accelerator Lab → Fermilab

- The driving force behind the construction of the new laboratory in Weston Illinois was Robert Wilson, who was appointed the Director in February 1967.
- The lab was called the National Accelerator Lab (renamed as Fermlab in 1974).
- Remarkably the NAL's Main Ring accelerator quickly achieved its design energy of 200 GeV in March 1972. And then rapidly surpassed this going to 500 GeV by May 1976

Bob Wilson: "The main application of the work here is spiritual, if you will. It's because, in a philosophical sense, in the tradition of Democritus, we feel we have to understand in simplest terms, what matter is, in order to understand who we are."

Very rapid progress to use of super-conducting magnets and the Tevatron pbar-p collider

Installation of final magnet in Energy-saver-doubler in March 1983

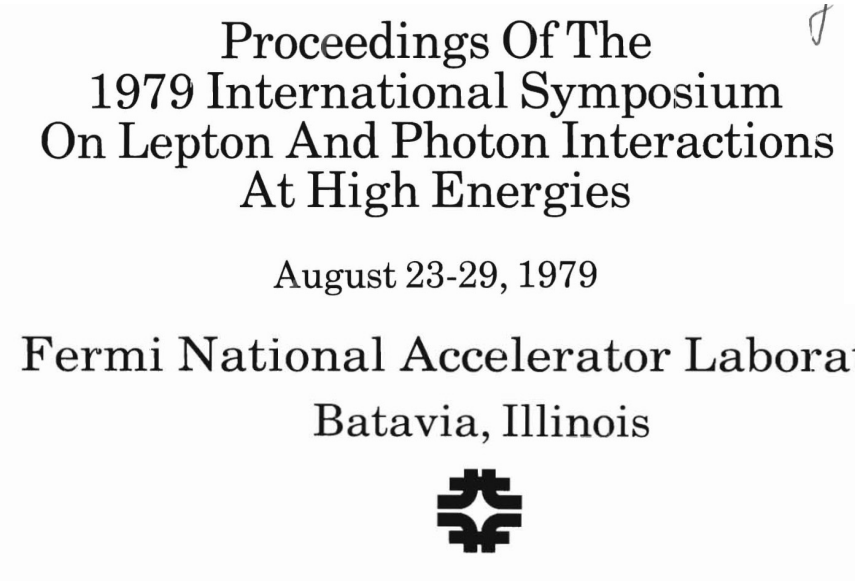
- 1972-1983 Tevatron design and construction
- 1983: first beams at 512 GeV proton beams
- 1984: then 800 GeV proton beams
- 1981-1985 Anti-proton source design and construction
- Oct.16 1985 pbar – p first collisions at 1.6 TeV

Accelerator Control room when first 512 GeV proton beam July 1983

Gorgio’s contributions to the CDF experiment

Giorgio's entrance into research at Fermilab

- In September 1979 Giorgio learned about the Fermilab Tevatron Collider at the Lepton-Photon conference that was held at Fermilab that year.


Proceedings Of The
1979 International Symposium
On Lepton And Photon Interactions
At High Energies

August 23-29, 1979

Fermi National Accelerator Laboratory

Batavia, Illinois

DR. GIORGIO BELLETINI
LAB. NAZIONALI DEL INFN
C.P. 70
I-00044 FRASCATI
ITALY

when Giorgio was 45 years old …

DR. PAOLO GIROMINI
LABORATORI NAZIONALE DI FRASCATI
CASELLA POSTALE 13
I-00044 FRASCATI (ROMA)
ITALY

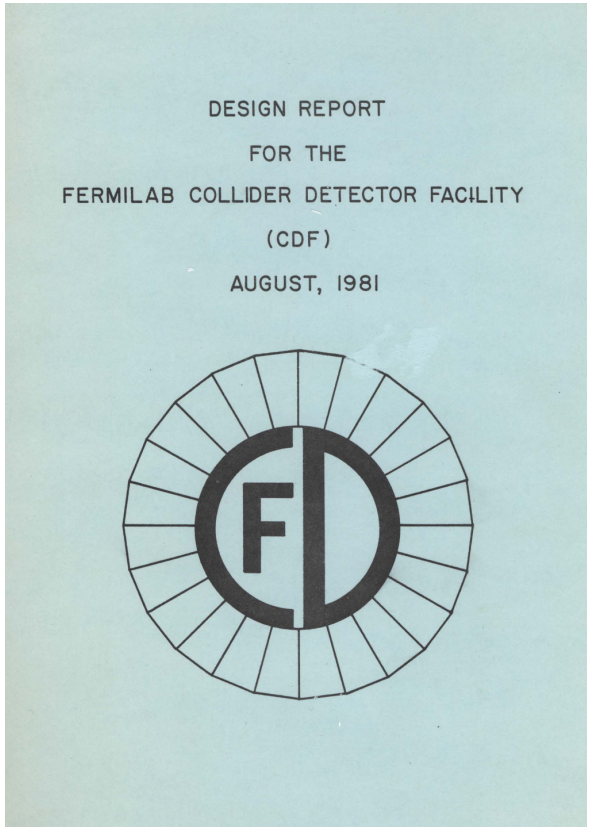
Formation of the CDF collaboration

- Latter in 1979 Giorgio met Alvin Tollestrup and Robert Diebold at CERN. The discussion centered on the goal of designing a magnetic detector to operate at the Tevatron B0 collision point.

- This led to the formation of a strong Frascati-Pisa group that spearheaded the Italian contribution to CDF.

- Kunitaka Kondo was the leader of the Japan group at this time.

CDF was born as a US-Japan-Italy Collaboration of 13 institutions and 87 physicists



For the Fermilab Collider Detector Facility (CDF)

Argonne National Laboratory - D. Ayres, R. Diebold, E. May, B. Musgrave, L. Nodulman, J. Sauer, R. Wagner, A.B. Wicklund

University of Chicago - H. Frisch, C. Grosso-Pilcher, M. Shochet

Fermi National Accelerator Laboratory - M. Atac, F. Bedeschi, A. Brenner, T. Collins, T. Droege, J. Elias, J. Freeman, I. Gaines, J. Grimson, D. Gross, D. Hanssen, H. Jensen, R. Kadel, H. Kautzky, R. Kephart, M. Ono, R. Thatcher, D. Theriot, A. Tollestrup, R. Yamada, J. Yoh

Laboratori Nazionali dell' INFN - Frascati - S. Bertolucci, M. Cordelli, P. Giromini, P. Sermoneta

Harvard University - G. Brandenburg, R. Schwitters

University of Illinois - G. Ascoli, B. Eisenstein, L. Holloway, U. Kruse

KEK - S. Inaba, M. Mishina, K. Ogawa, F. Takasaki, Y. Watase

Lawrence Berkeley Laboratory - W. Carithers, W. Chinowsky, R. Kelly, K. Shinsky

University of Pisa - G. Bellettini, R. Bertani, L. Bosisio, C. Bradaschia, R. Del[illegible]abbro, [illegible]. Focardi, M.A. Giorgi, A. Menzione, L. Ristori, A. Scribano, G. Tonelli

Purdue University - V. Barnes, R.S. Christian, C. Davis, A.F. Garfinkel, A. Laasanen

Texas A & M - P. McIntyre, T. Meyer, R. Webb

Tsukuba University - Y. Asano, S. Kim, K. Kondo, S. Miyashita, H. Miyata, S. Mori, I. Nakano, Y. Takaiwa, K. Takikawa, Y. Yasu

University of Wisconsin - D. Cline, R. Loveless, R. Morse, L. Pondrom, D. Reeder, J. Rhoades, M. Sheaff

The Institutions in the 1981 CDF design report

US

Argonne,
Chicago,
Fermilab,
Harvard,
Illinois,
LBL,
Purdue,
Texas A&M,
Wisconsin

Japan

KEK
Tsukuba

Italy

Frascati,
Pisa

13 Institutions

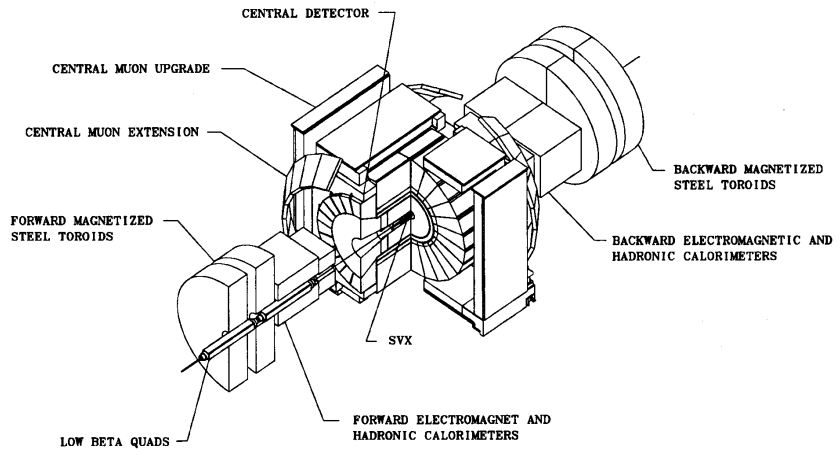
87 physicists

56 Americans, 15 Japanese , 16 Italians

First CDF Co-spokespersons

- In 1980 the Co-spokespersons were Alvin and Roy Schwitters.

- The CDF Conceptual Design Report was completed in 1981



Major Italian contributions to CDF1

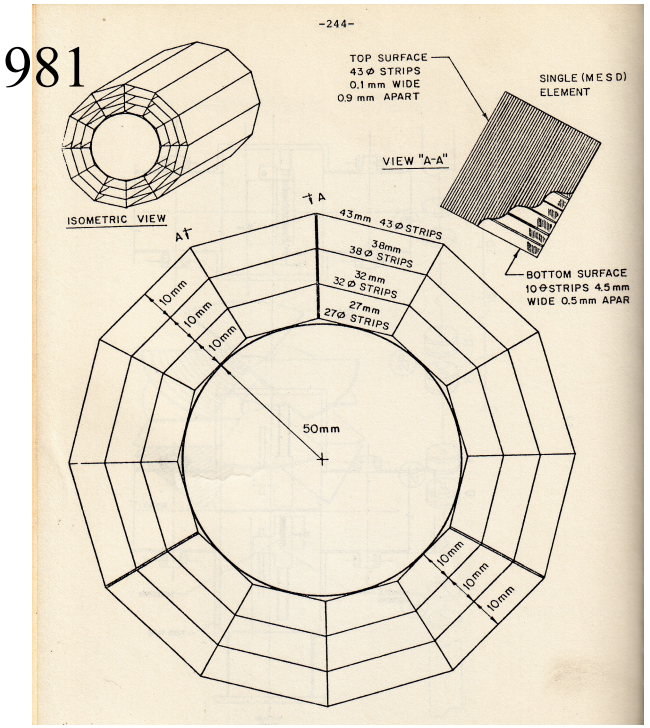
1. A small-angle spectrometer to measure the total pbar-p cross section.

2. A central hadronic calorimeter with projective towers using plastic scintillators.

3. An innovative silicon vertex detector to be positioned around the beam pipe.

Here is slide from a talk given by Giorgio in June 2012

1981



After 7 years of debates and 4 years of construction SVX started operating in 1992.
A Fermilab-Italy-LBL endevor
Project Leader: **Aldo Menzione**

February 15, 1986
INFN PI/AE 86-4

A SILICON VERTEX DETECTOR FOR CDF

F.Bedeschi[a], S.Belforte[b], G.Bellettini, [illegible].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

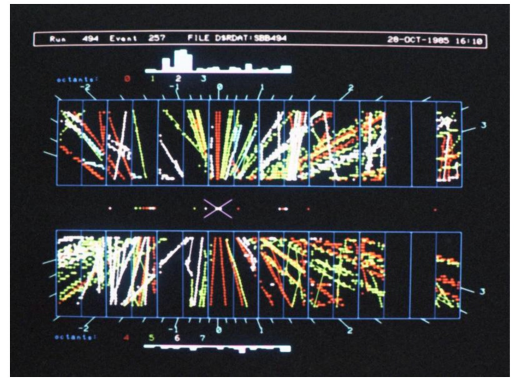
at the IEEE Nuclear Science Symposium
San Francisco, October 1985

Others who played a major role in developing that new technology
Franco Bedeschi
Carl Haber
Stuart Kleinfelder

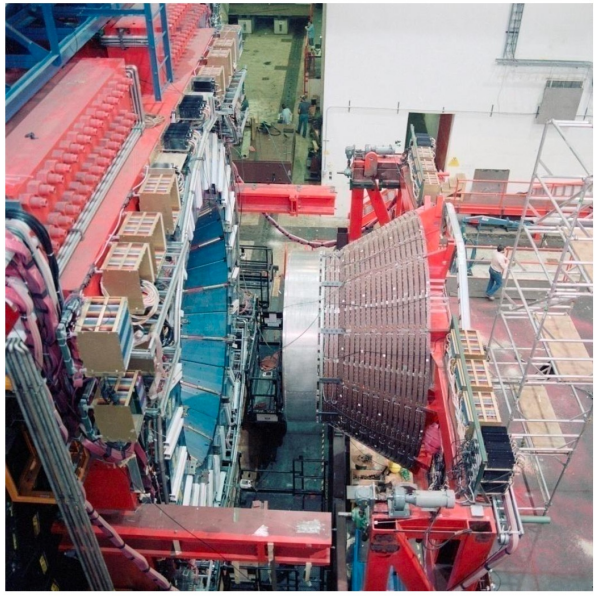
Some early CDF1 milestones

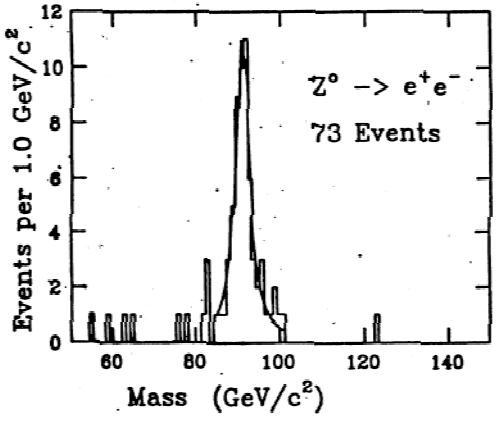
- Rapid CDF construction following 1981 Design report
- First collisions observed in 1985 at √s = 1.6 TeV
- 1988-1989: ~ 4 pb^{-1} with pbar-p collisions at

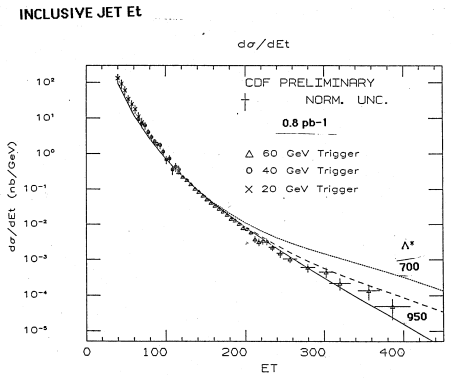
√s = 1.8 TeV. First look at Z mass, jets, σ_{Tot}



Detector complete as described in 1981 Design Report.







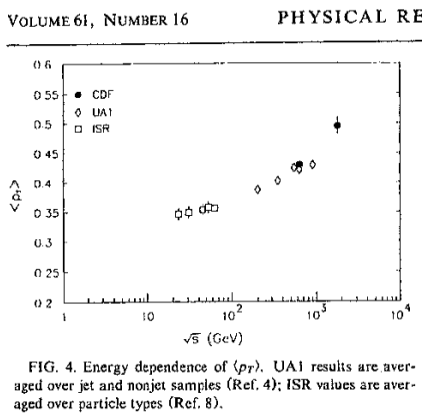


FIG. 4. Energy dependence of $\langle p_T \rangle$. UA1 results are averaged over jet and nonjet samples (Ref. 4); ISR values are averaged over particle types (Ref. 8).

Best Z mass for 3 weeks before MARK II turned on …
Confirmed rise in σ_{Total} with cm energy

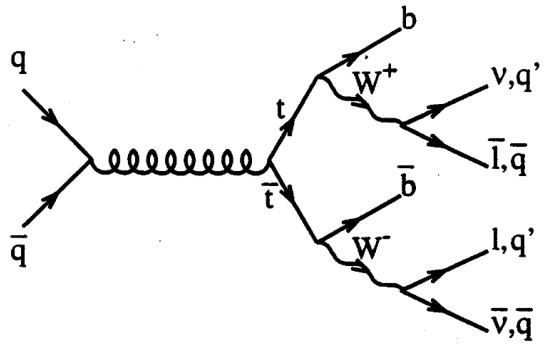
And then a search for the top quark begins

A decade of futile searches for the top quark

PETRA/PEP	> 22 GeV/c^2 in 1984
TRISTAN	> 26 GeV/c^2 in 1988
SLC	> 41 GeV/c^2 in 1989
LEP	> 45 GeV/c^2 in 1989
UA1	> 50 GeV/c^2 in 1990
UA2	> 69 GeV/c^2 in 1990
CDF	> 70 GeV/c^2 in 1990
UA2 and CDF	> 77 GeV/c^2 in 1991

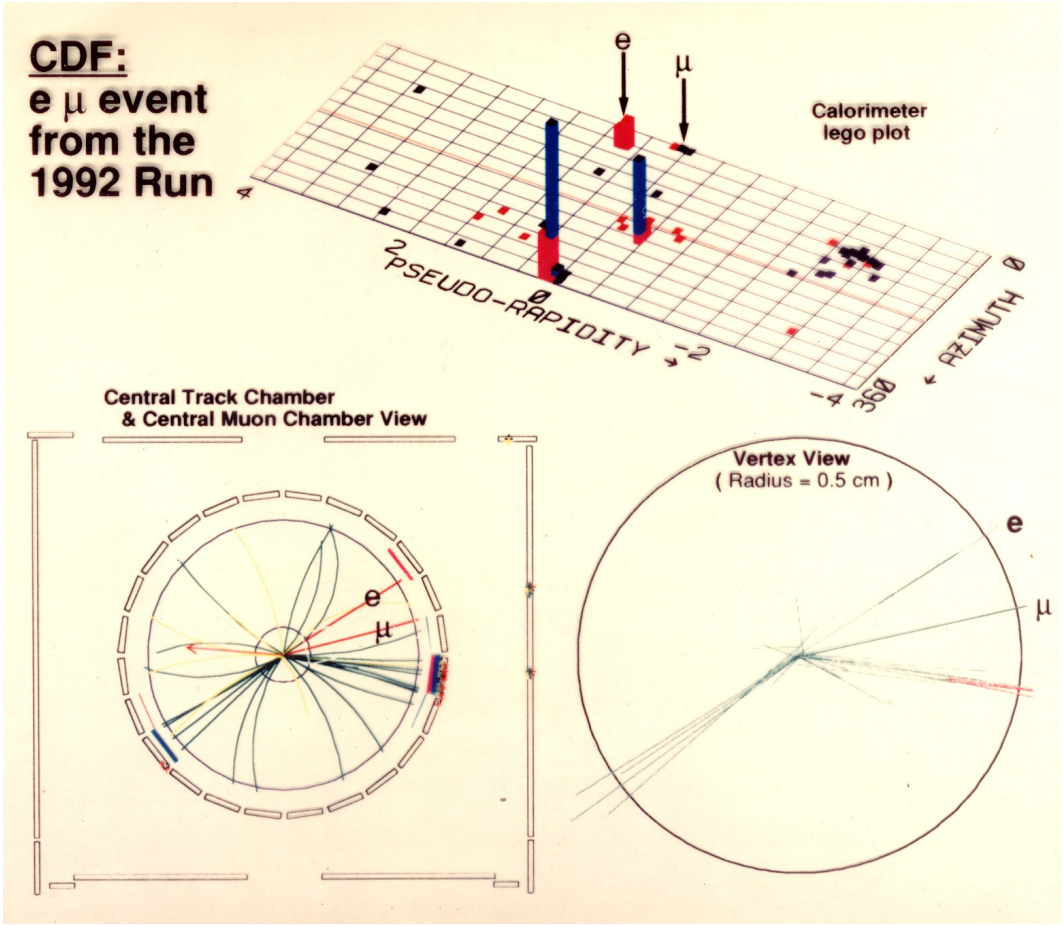
- In 1991 it was realized that if the top quark exists, the W boson does not decay to the top, but the top must decay to a W boson!

- The CDF detector with the SVX was ideally suited to observe these top decays.



A top-antitop candidate observed in CDF in 1992

Very early hints of the top quark



Top quark mass in the CDF "Evidence"

Evidence for top quark production in $p^{-}p$ collisions at $\sqrt{s}$ =1.8 TeV

F. Abe *et al.*
Phys. Rev. Lett. **73**, 225 – Published 11 July 1994

With ~ 20 pb^{-1} in May 1994, seven single lepton events could be reconstructed and the mass computed. A peak was found at $m_t = 174 \pm 17$ GeV/c^2.

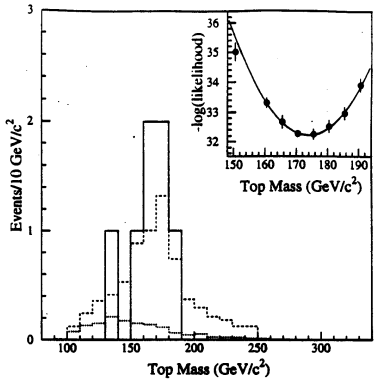
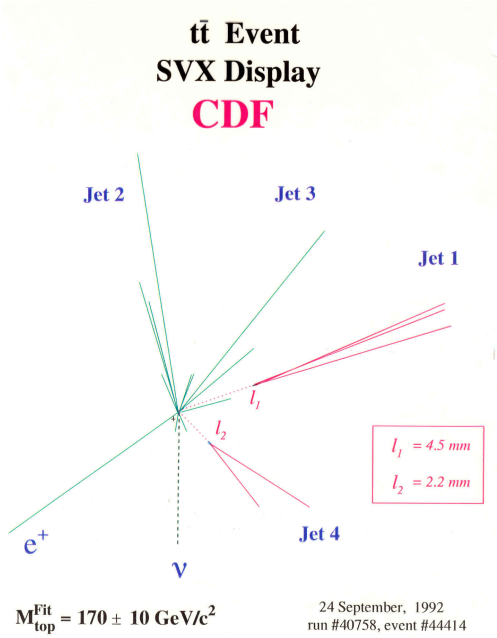


Figure 35: CDF top mass distribution (solid histogram) compared with the W + jets background prediction (dots) and the predicted signal+background distribution normalized to the data for m_t = 175 GeV (dashed). The inset shows the likelihood fit results.

Making use of the SVX



"Though the statistics are too limited to establish firmly the existence of the top quark, a natural interpretation of the excess is that it is due to tt production.
Under this assumption, constrained fits to individual events yield a top quark mass of 174+ - 17 GeV/c . The tt production cross section is measured to be 13.9 pb."

Giorgio as CDF Co-spokesperson

- During the period of the top quark discovery Giorgio was elected CDF Co-spokesperson in 1994, serving with Bill Carithers,

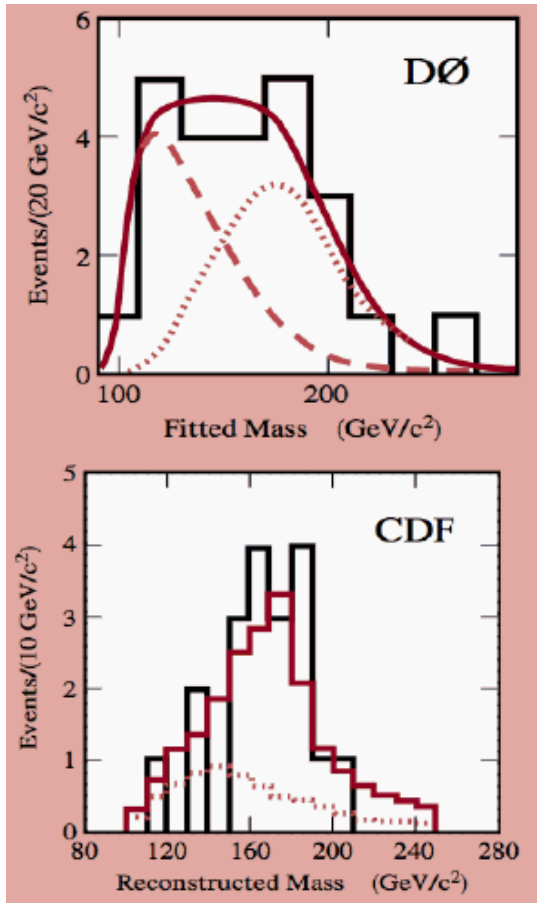
Top quark news conference in 1995

- And re-elected Co-spokesperson in 2015

Discovery of the quark top in 1995

Observation of Top Quark Production in $\bar{p}p$ Collisions with the Collider Detector at Fermilab

F. Abe *et al.* (CDF Collaboration)
Phys. Rev. Lett. **74**, 2626 – Published 3 April 1995



Mass values at discovery:

D0 (50 pb^{-1}):
m_t=199±30 GeV, σ=6.4±2.2 pb

CDF(67 pb^{-1}) :
m_t=176±13 GeV, $\sigma = 6.8^{+3.6}_{-2.4}$ pb

CDF and D0 spokespersons in 1995

Italians involved with the top quark discovery

Italians in the top discovery

BOLOGNA	8
FRASCATI	5
PADOVA	11
PISA	36

60 Italian authors, ~13% of the CDF Collaboration.

Italian contributions to the CDF2 detector

The secondary vertex tracker (Pisa-Chicago-LBL)

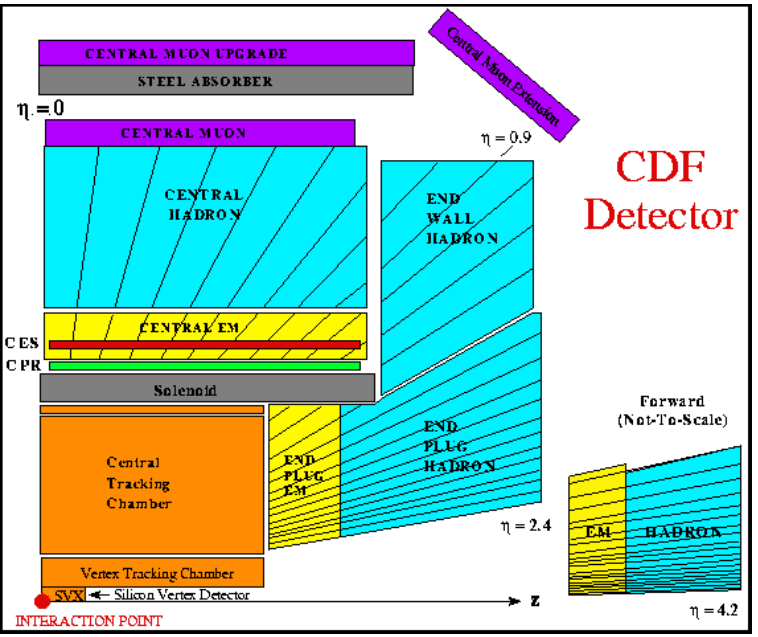
The Intermediate Silicon Layers (Pisa-Tsukuba-Fermilab)

The laser flasher of the scintillator plug calorimeter (Udine)

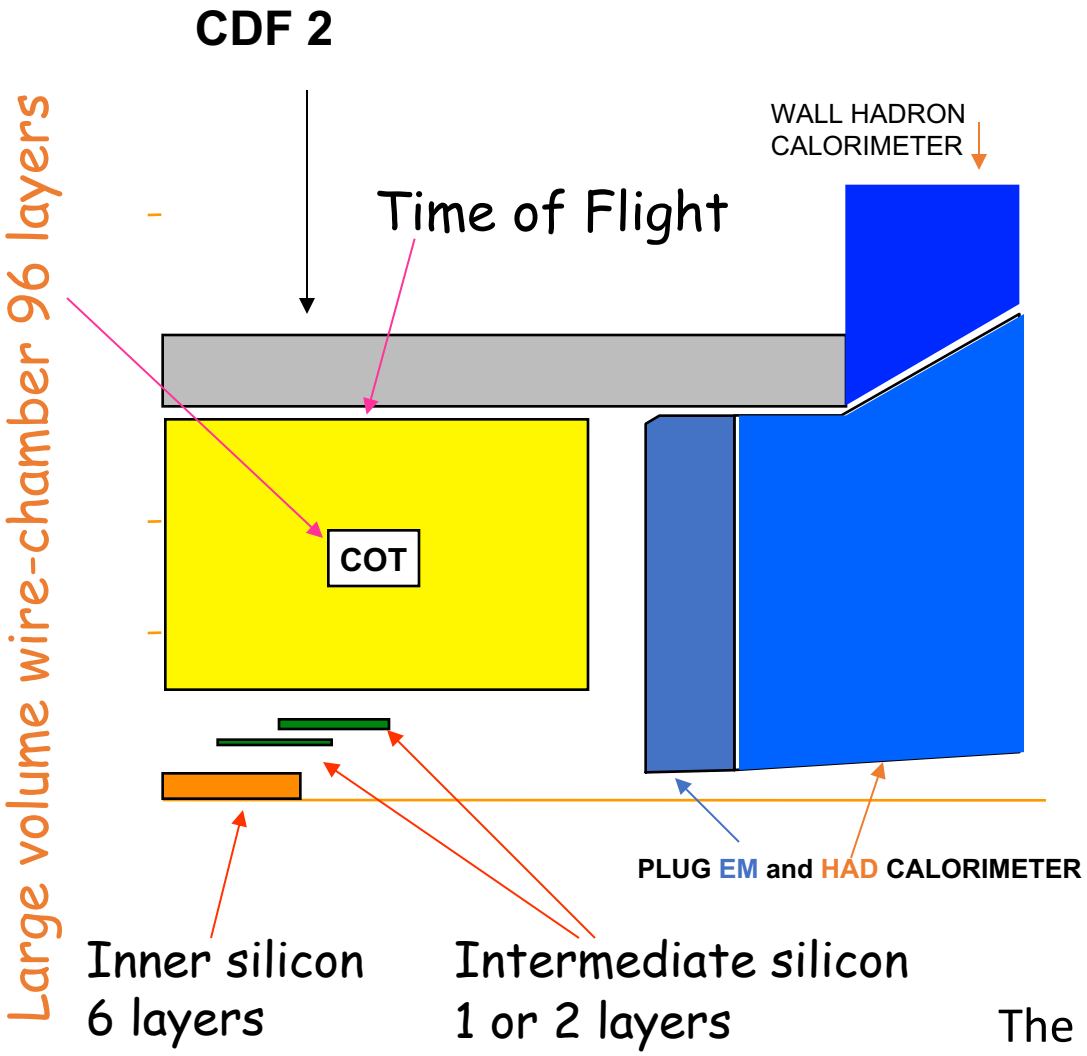
The upgraded muon scintillation detectors (Pisa-JINR)

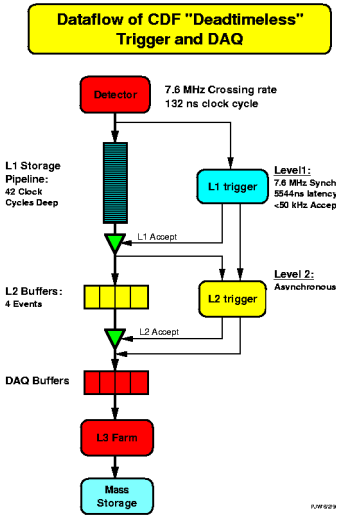
New elements of the CDF2 detector

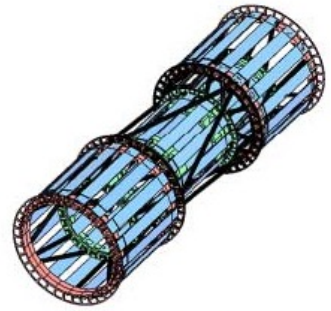
CDF 1



CDF 2



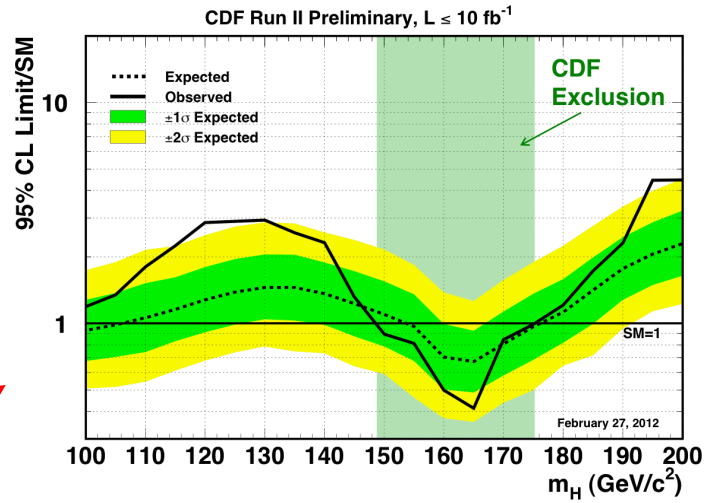


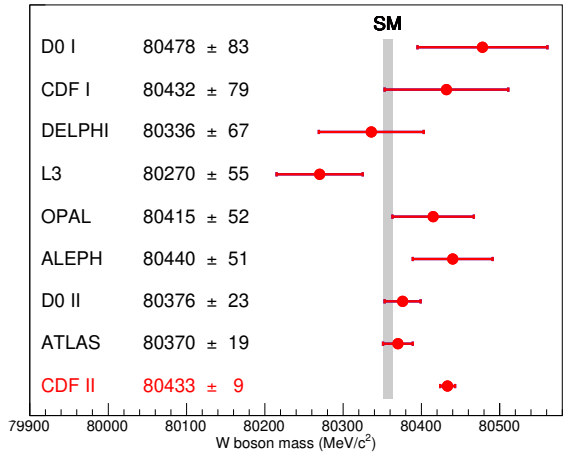


The ISL construction in Pisa was led by Giorgio Chiarelli

The rich physics program from CDF2

- Study of top quark production and decay properties
- W and Z boson production compared the SM predictions
- Study of charm and beauty hadron production and decays
- QCD studies with multi-jets
- Limits on SUSY particles
- First information about Higgs bosons
- And most recently the final CDF W mass measurement





Gorgio’s contributions to the Fermilab community

Bringing Italian students to Fermilab

- In 1983 Giorgio started an Italian summer student program by hosting three students at Fermilab to help with the CDF detector construction.
- In 2003 a formal US-Italian student exchange program was funded by INFN and DOE.
- By 2016 this had grown to 36 physics and engineering students working at many groups at Fermilab.

Adding to the cultural life at Fermilab

- Reaching beyond science, Giorgio led initiatives to bring Italian cultural activities to Fermilab.

Cultural Association of Italians at Fermilab

He established the Cultural Association of Italians at Fermilab

"The purpose of CAIF is to preserve and spread the Italian culture within the resident Italians in the USA, and within the American community. In addition, Italian students and visitors will be helped to get acquainted with the American style of living and working."

Adding to the enjoyment of life at Fermilab

Girogio initiated the Festa Italiana to bring a true taste of Italy to the lab

Concluding remarks

- Giorgio's involvement with research at Fermilab started in 1980 and continues to this day, a period spanning ½ of his incredibly productive life.

- The participation of Italy in CDF was his initiative and has been a remarkable success both scientifically and for the health of Fermiab.

- A quote from Giorgio in an interview in 2023 captures his beautiful view of life:

" My mania is collaboration …with earth as my home … and students as my children"

- Thank you, Giorgio, for letting me participate in this symposium recognizing your amazing career.

Acknowledgments

Talks given by Giorgio B. and Alvin Tollestrup.

Interviews of Giorgio by Paul Grannis and Barbara Rosario of ISSNAF.

Photos and other background material provided by the Valerie Higgins (Fermilab archivist).