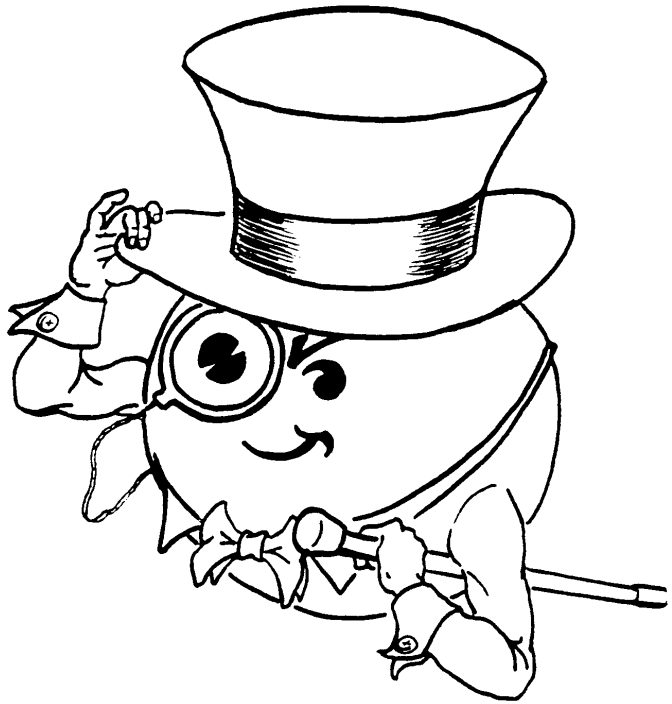
Top Turns Ten Symposium



The DØ Graduate Student Perspective

Jim Cochran
Iowa State University
(formerly SUNY Stony Brook & UC Riverside)

Who am I representing ?

my fellow 133 students of the last millennium!

Detector, Testbeam, Instrumentation

Richard Astur ,Jeffrey Bantley, Ties Behnke, John Borders, Sarah Durston, Fabrice Feinstein, Terry Geld, Terry Heuring, Robert Hirosky, Jonathan Kotcher, Bo Pi, Domenic Pizzuto, Alain Pluguet, Srini Rajagopalan

Bottom physics (μ id, b-tagging)

Gene Alvarez, Wagner Carvalho, Kevin Davis, Regina Demina, David Fein, Tong Hu, Thorsten Huehn, Eric James, Guilherme Lima, Thomas McKibben, Christopher Murphy, Vitor Oquri, Alex Smith, Andre Snajder, David Vititoe

New Phenomenon (similar analyses)

Rich Genik, Mark Goforth, Ambreesh Gupta, Dan Karmgard, Bryan Lauer, Adam Lyon, Doug Norman, Nirmalya Parua, Marc Paterno, H. C. Shankar, Prajakta Singh, Mark Sosebee, Guoliang Wang, Djoko Wirjawan

QCD (jet id, jet energy scale, QCD backgrounds)

Braden K. Abbott, Levan Babukhadia, John Balderston, Mrinmoy Bhattacharjee, Wei Chen, David Cullen-Vidal, Daniel Elvira, Sal Fahey, Kathy Fatyga, Ki Suk Hahn, James Jaques, Steve Jerger, Tacy Joffe-Minor, Soon Yung Jun, Chang Lyong Kim, John Krane, Yi Cheng Liu, Gian Di Loreto, Robert Madden, Kristal Mauritz, Brent May, Andrew Milder, Freedy Nang, Jill Perkins, Paul Rubinov, Christopher Shaffer, Robert Snihur, Tracy Taylor Thomas, Yeonsik Yu

WZ physics (W/Z PT, e/μ id, Z(μμ) fitting, similar analyses (WW))

Ian Adam, Paul Bloom, Dylan Casey, Geary Eppley, Tom Fahland, Eric Flattum, Patrick Gartung, Cecilia Gerber, Steven Glenn, Azriel Goldschmidt, Gervasio Gomez, Jose Luis Gonzalez-Solis, Peter Grudberg, A. Raul Hernandez-Montoya, Ting Hu, John Jiang, Hossain Johari, Michael Kelly, Gregory Landsberg, Hailin Li, Leonel Magana-Mendoza, Manuel Martin, James McKinley, Ajay Narayanan, Alberto Sanchez-Hernandex, Georg Steinbruek, Jamal Tarazi, Jie Yang, John Yetter, Jaehoon Yu, Qiang Zhu

top

Erfan Amidi, V. Balamurali, Alexander Belyaev, Vipin Bhatnager, Dhiman Chakraborty, Su-Min Chang, Suyong Choi, Sailesh Chopra, Cathy Crestinger, Ray Hall,Frank Hseih, Robert Kehoe, Jean Francois Lebrat, Martin Mason, Jeff McDonald, Myungyun Pang, Harpreet Singh, Eric Smith, Scott Snyder, Peter Tamburello, Joey Thompson, Erich Varnes, Eunil Won, Haowei Xu, Cary Yoshikawa

How did DØ Organize Itself ?

Groups, subgroups, subsubgroups, … (like all HEP experiments)

Physics Groups

bottom
New Phenomenon
QCD
Top
WZ

→ Lepton + jets
→ **Dilepton**
→ All jets
→ Mass → lepton + jets / **dilepton**

Dilepton → ee / **eμ** / μμ / eν


Dilepton Group led by Steve Wimpenny & Meenakshi Narain

Detector Groups

Vertex
Transition-Radiation
Drift Chamber (**Central** & Forward)
Calorimeter (EM & Hadronic, **Central** & Forward)
Muons (Central, Forward, & SAMUS)
Trigger

Service Groups

General Computing
Calibration & Alignment
Production (data & **MC**)
Simulation
Resource Management

Particle id

electrons
muons
jets
E_T^{miss}

So many topics and so many stories … it was a very fun time

(despite the large sleep deficit)

Guided by my old logbooks – old email is much more elusive!

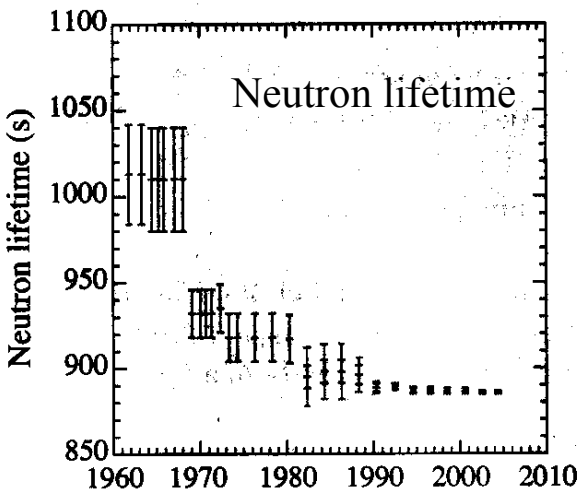
A few dominant themes:

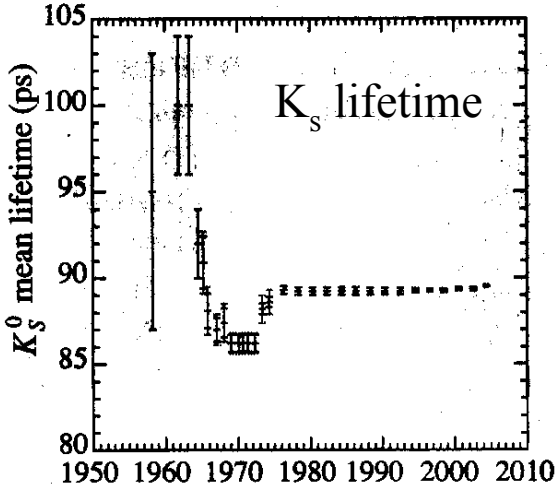
- worries!
- trying to do the right thing
- the saga of event 417
- victory over the forces of darkness

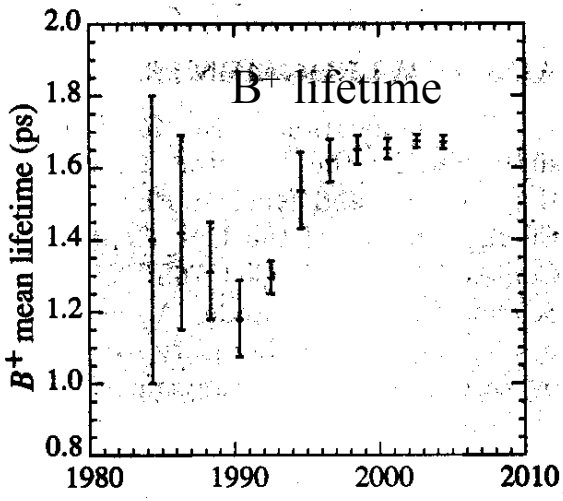
I worked on the eμ analysis so will give the perspective from this channel

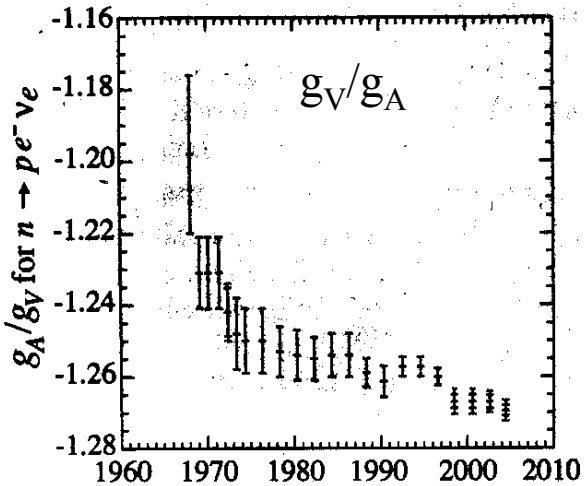
The Big Worry …

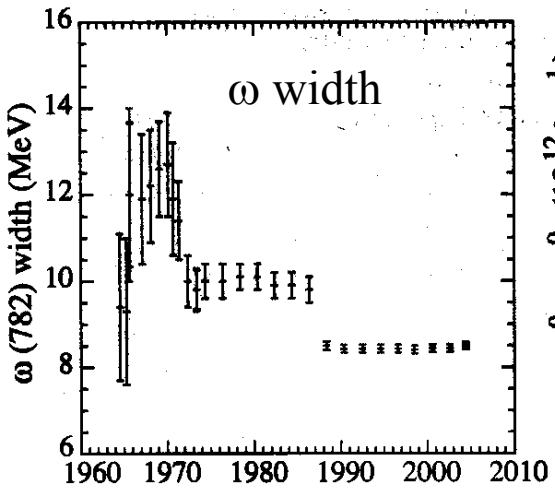
Historical evolution of published measurements from the PDG

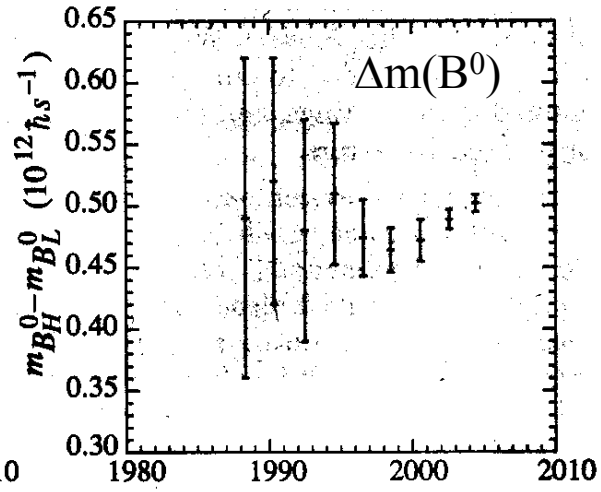












… that we would screw up !

What screw-ups did we worry about most ?

- overlooking something (lack of thoroughness)
- unintentional bias !

> "It's OK to be stupid, but it's not OK to be biased."
>
> Ed Thorndike, Panofsky Prize winner, 1999

Strangely comforting – and bias was something we can work to avoid

For $t\bar{t} \rightarrow e\mu$, we expected only a few events !

actually true for all $t\bar{t}$

Dilepton group agreed that we would not look in the signal region before deciding on our selection

We were blind before blind was cool !

With that constraint we proceeded naively (& optimistically) on

but it wasn't so easy …

We seemed to be thwarted at every turn

It was as if our beloved quark were being held hostage …

… and the ransom ?

our blood, sweat, frustration, and sanity seemed not to be enough!

We had thought we would be greeted as liberators …

So, in the face of adversity, we trudged on and tried to

Do the right thing(s)

(1) As the run started, the muon id was not well defined

scanned thousands of single μ events attempting to converge on a reasonable μ-id

We started with the loosest μ provided by the reconstruction

- but, we didn't appreciate the subtleties of the muon reconstruction

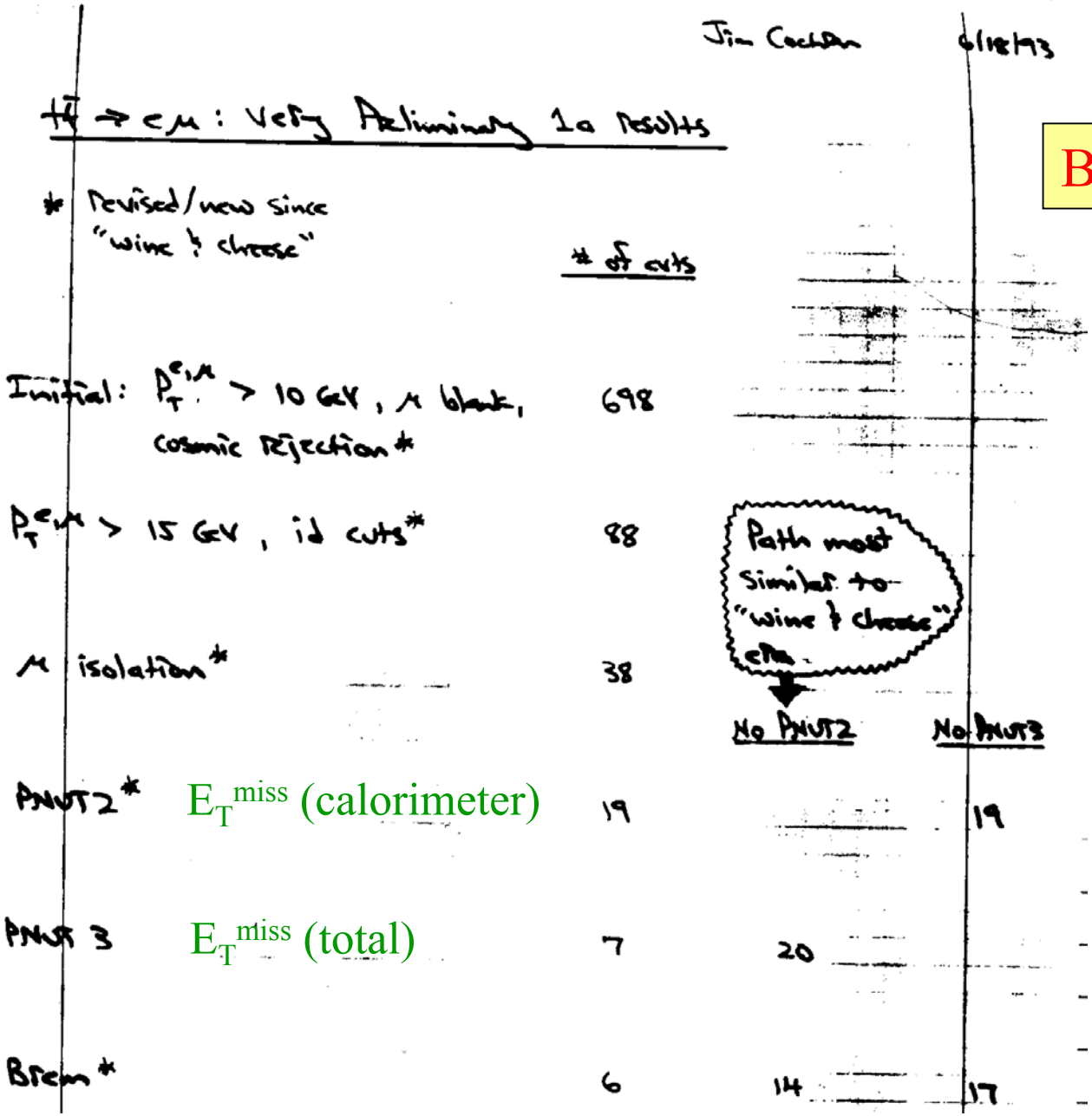
valuable lesson

(2) Initial background estimation

Background estimates < 1 event can make one rather uncomfortable

Some comfort can be gained from backing off on the cuts and comparing background estimate with data …

And after we had finalized our selection, we did just this



But they didn't agree!

unless we cut on both

E_T^{miss} (total) &

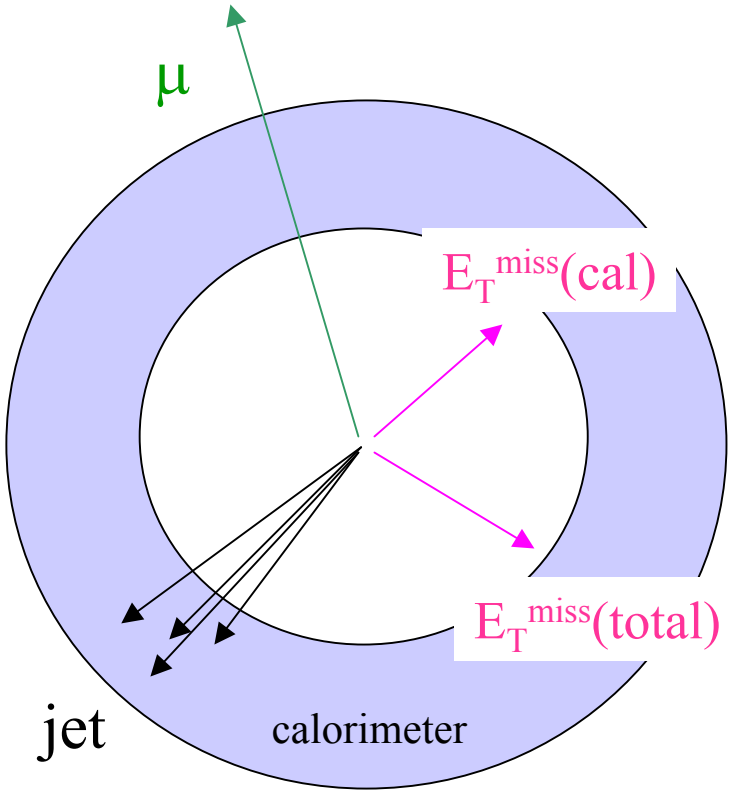
E_T^{miss} (calorimeter)

?

What had we missed ?

We had not yet estimated the background from W(μν)+jets(*e*)

had assumed it to be negligible

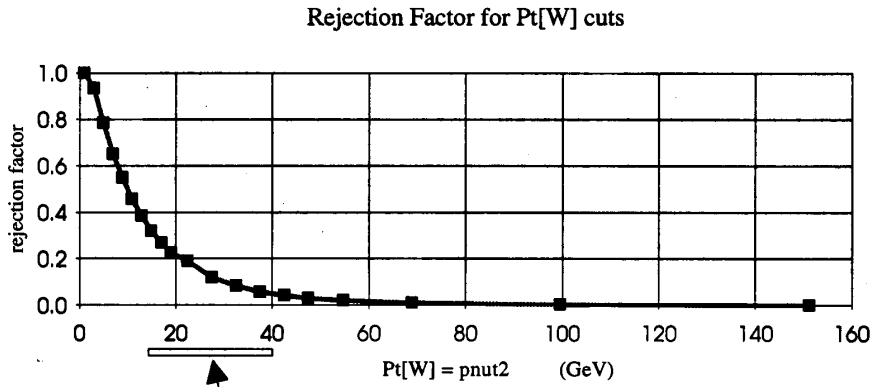


And since our cut on E_T^{miss}(total) was low (10 GeV), many passed our selection

But for W(μν)+jet events,

E_T^{miss}(calorimeter) = P_T[W]

and has little effect on $t\bar{t} \rightarrow e\mu$!



So, we changed our selection and added a cut on E_T^{miss}(calorimeter)

The eμ Visits

As Run 1a progressed, I was occasionally visited by senior members of the collaboration (often with minions in tow) who had "discovered" $t\bar{t} \rightarrow e\mu$ events which I had apparently missed

Each time we dutifully staged the event(s) and looked it over with great care …

… and each time the muon was obvious junk

(and the other aspects of the events were unimpressive)

a byproduct of the very loose default μ-id in reco

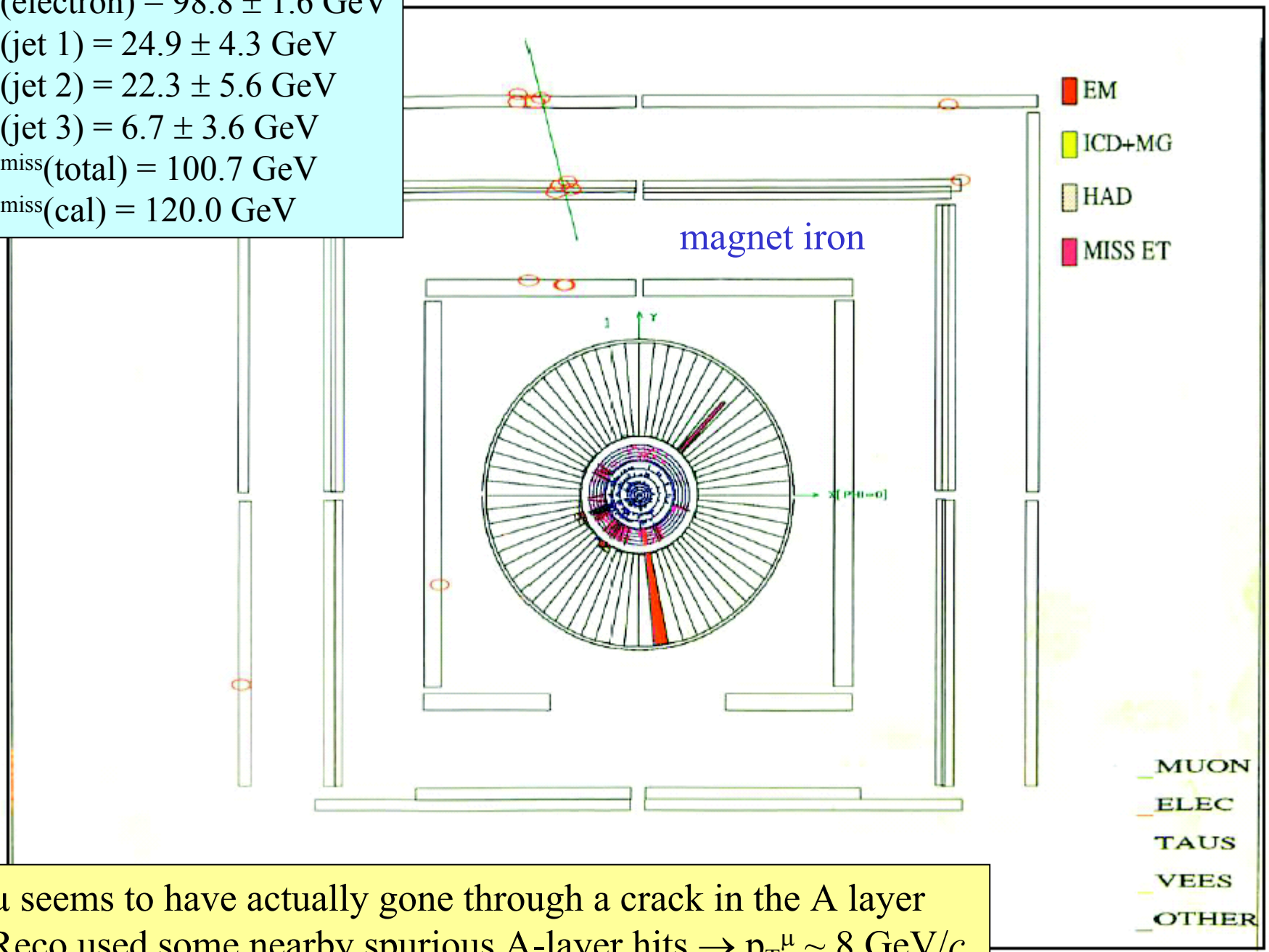
That is, until Boaz passed along the eμ event which he found (Jan 93)

The "muon" was not obvious junk!

(although it did have some problems – reco gave $p_T^{\mu} \sim 8$ GeV/c & no CD track !)

And the other aspects of the event were truly spectacular!

E_T(electron) = 98.8 ± 1.6 GeV
E_T(jet 1) = 24.9 ± 4.3 GeV
E_T(jet 2) = 22.3 ± 5.6 GeV
E_T(jet 3) = 6.7 ± 3.6 GeV
E_T^{miss}(total) = 100.7 GeV
E_T^{miss}(cal) = 120.0 GeV

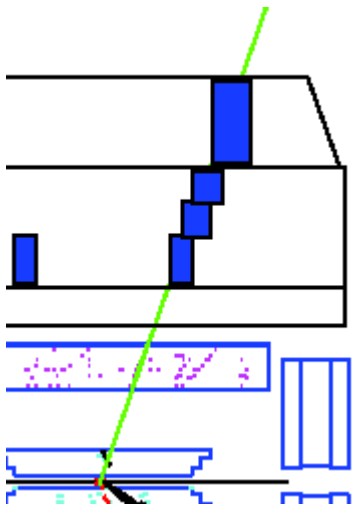


μ seems to have actually gone through a crack in the A layer
Reco used some nearby spurious A-layer hits → $p_T^{\mu} \sim 8$ GeV/*c*

To clarify our understanding of the muon, it was necessary to

Call in the experts

Qizhong quicky found that there were FADC hits corresponding to the muon track – χ^2 had simply been set slightly too tight



Vertex track & TRD info also confirmed

The CDC track and the μ trace in the hadronic calorimeter pointed to a crack in the muon A layer

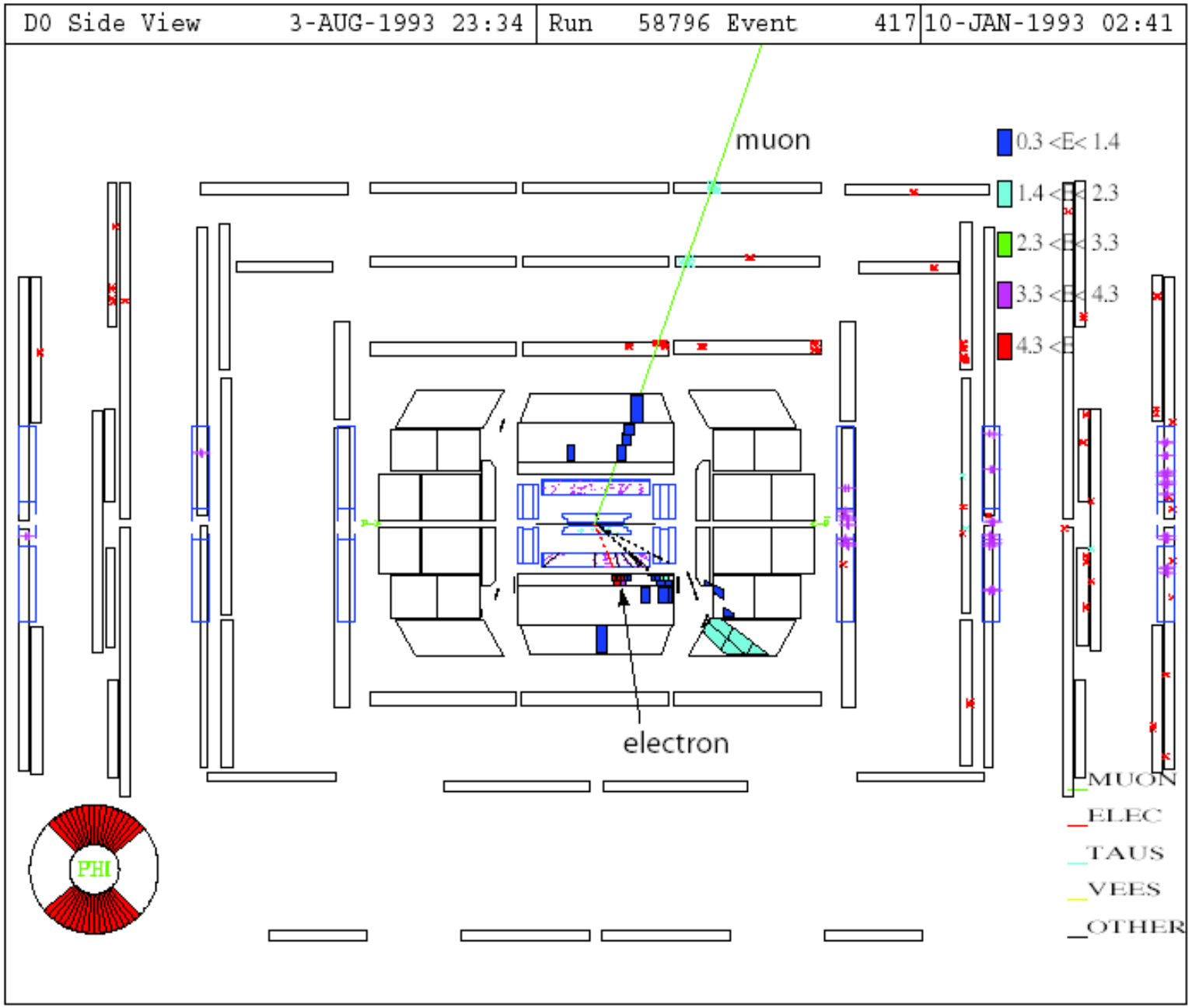
. . .

From there the muon experts (Dave, Daria, Steve, Brajesh, Asher, + many others) took over – after many studies and lengthy discussions, the muon was declared ok (see poster)

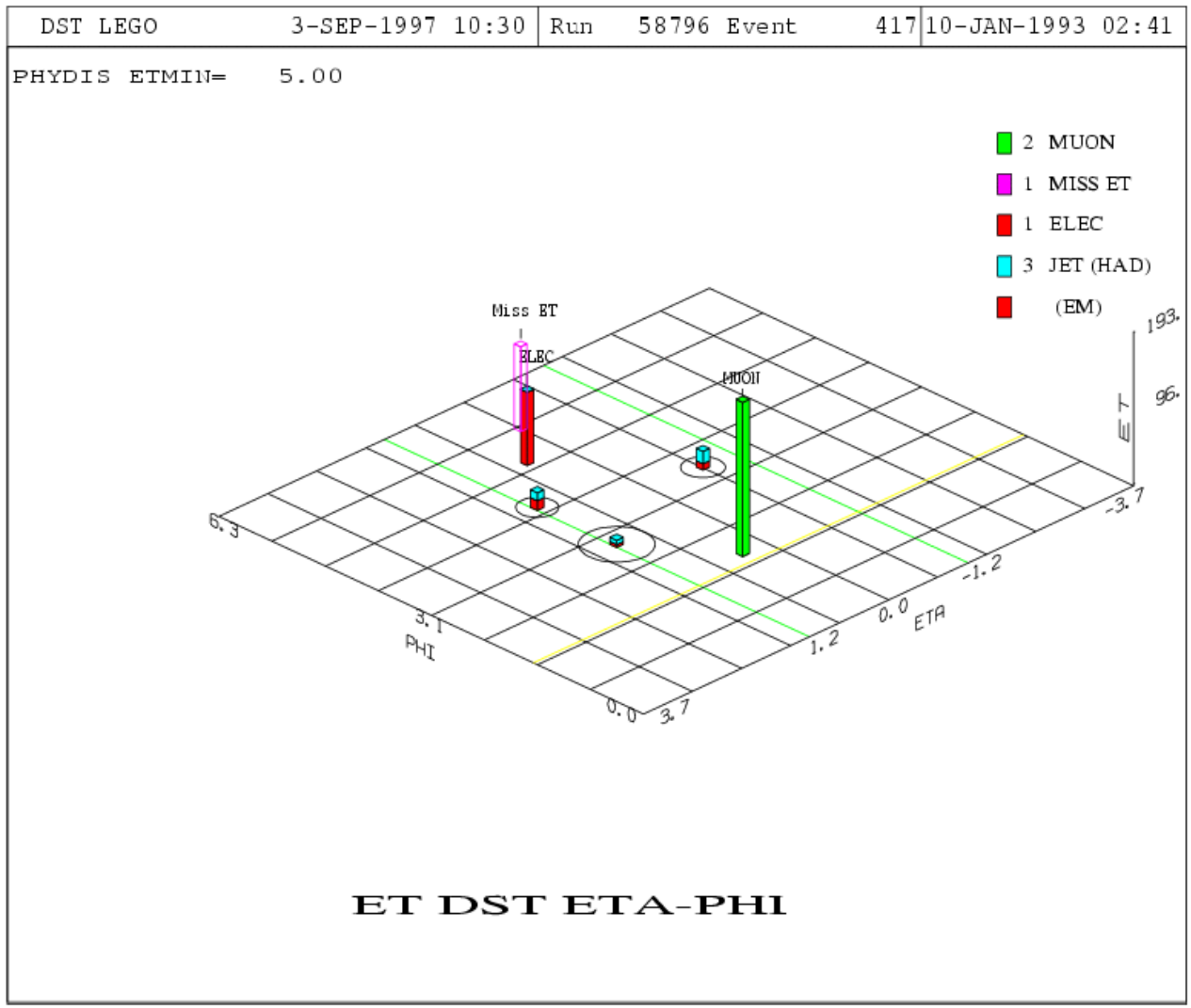
and with $P_T > \sim 100$ GeV/c !

cementing 417 as a truly spectacular event!

Side view of Event 417



Lego view of Event 417



The fallout from the various 417 studies led to permanent improvements in the reconstruction (but no change in our analysis)

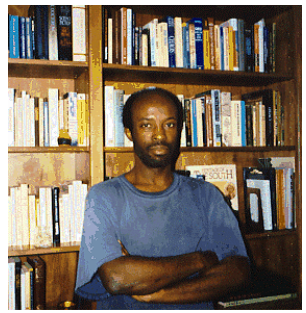
There was much effort to determine the likelihood that 417 is top *vs* background – was the birth of DØ's multivariate methods effort

And a cottage industry in dilepton mass analysis quickly sprang up

Uli Heintz

Mark Strovink

Rajendran Raja



Harrison Prosper

see poster

Giving an estimated mass of 145 – 200 GeV/c^2 for this event

And as you'll hear from Meena, many wanted to claim discovery on this one event

Once the excitement on event 417 eventually died down

it took months!

We focused on collecting and studying more events

And I discovered the "power of top"

as the top group representative to the OCPB

Offline
Computing
Policy
Board

"We" decided how to allocate DØ's limited offline computing resources

Each group had its own preferred direction – conflict was common

but it was easy for me: I needed only to say

"well, that may affect the top results for conference X"

to get my way

And on the rare occaisions when that didn't work …

I was forced to use the power of the "cc"

we've all done it

(You know, cc'ing someone important to intimidate your opponent)

But unlike many of my colleagues, I never cc'd the spokespeople or the top group convenors

seemed to meet with only limited success

Instead I would cc certain "sometimes volatile" members of the top group

The recipients of such emails were typically in my office within 5 minutes!

This is not to say the top group had free reign over the DØ's computing resources

To get around the constraints imposed on us we had to be inventive

i.e. mis-labeling top files to make use of another group's disk space

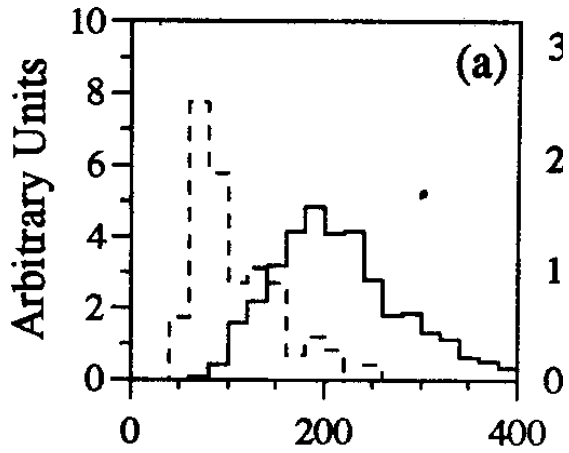
Or, when they limited the #jobs/user, we simply recruited more users

- this one ultimately landed us in Stu's office

Resource contentions aside,

the "post-417" years saw a reoptimization for high-mass top

Leading to the introduction of H_T for the dilepton channels



These new cuts took us on into the discovery period, and beyond

And in the more quiet post-discovery period,

our focus shifted to beating back the systematics

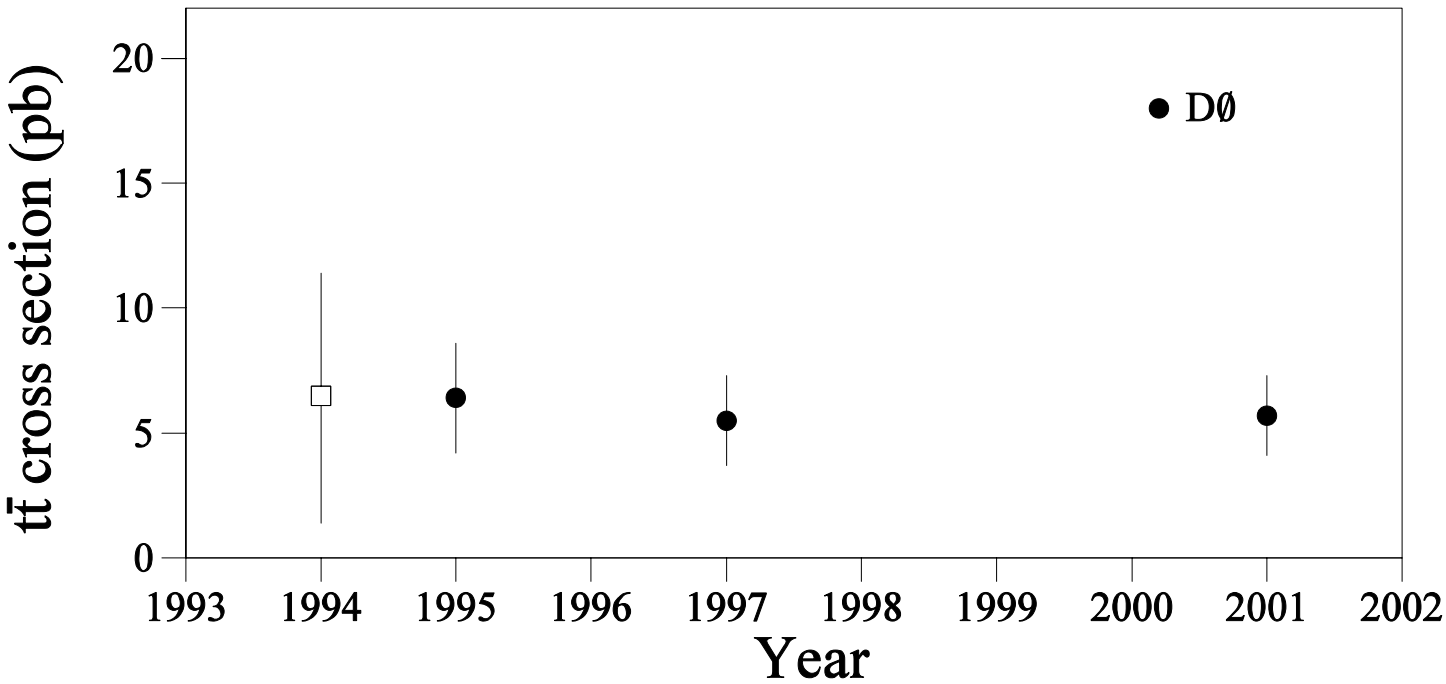
(was somewhat anti-climactic)

And at LHC, many regard top as a calibration or background - sniff

Event 417 was only the first of many top quarks to be liberated …

Showing that we could indeed overcome our demons

And time has allayed our worries to some degree …



… but the story is never really over