HCP2008
19th Hadron Collider Physics Symposium 2008 Summary

Paul Tipton

with great help from all of you

Thanks and Apologies

- Your talks were beautiful, as were (almost all) the results
- Too much to cover in a level of detail that these results deserve
- Many thanks for your help cannibalizing your talks
- Credit goes to you, errors & errors of omission are mine

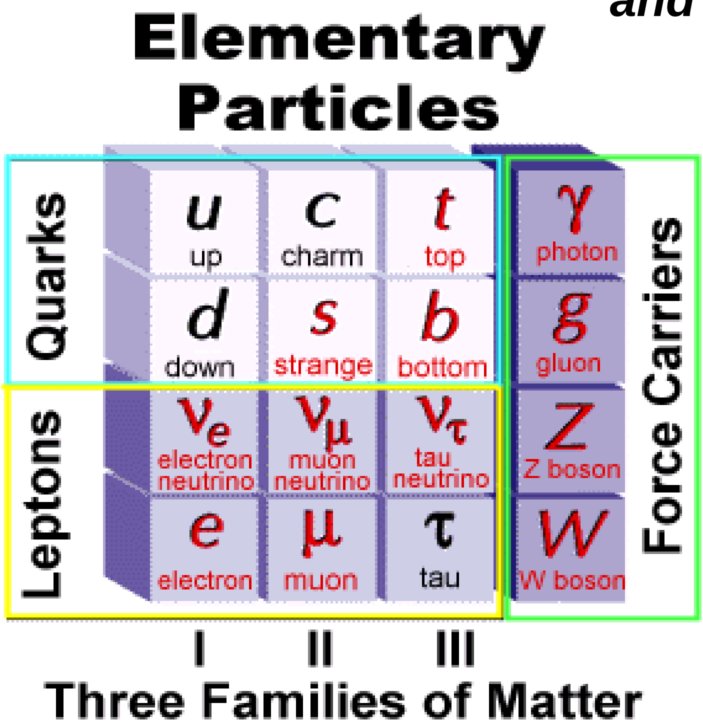
Outline

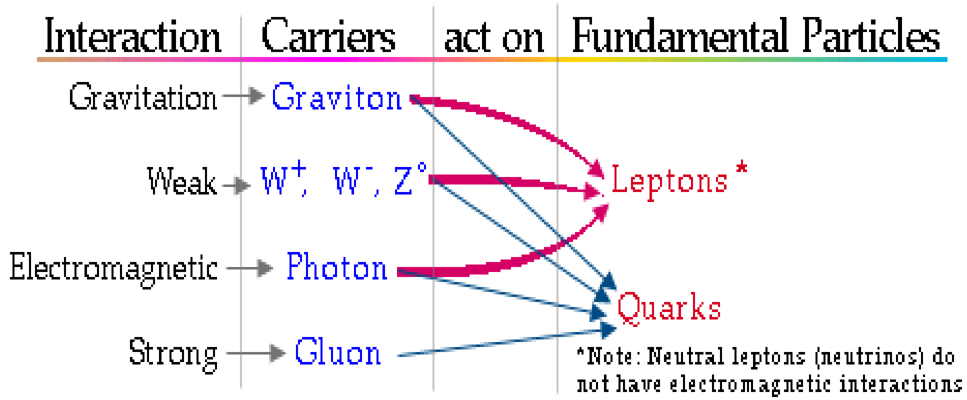
- Standard Model
- SM Problems
- Facilities past, present and future
  - HERA, RHIC, Tevatron, LHC
- Highlights from:
  - QCD
  - Flavor Physics
  - EWK
  - Searches, Higgs, BSM
- Conclusions: Historical Perspective on HCP2008

The Standard Model

Quantitative Gauge Theory based on $SU(3)_c \times SU(2)_L \times U(1)_Y$

Successfully explains hundreds of particles and their interactions

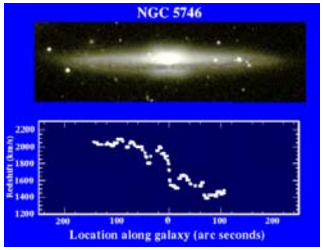




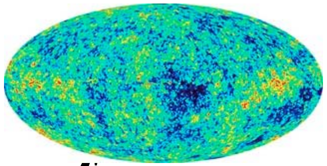
Fundamental particles get masses via interactions with Higgs field, H boson (not yet directly observed)

Flaws in the Standard Model include:

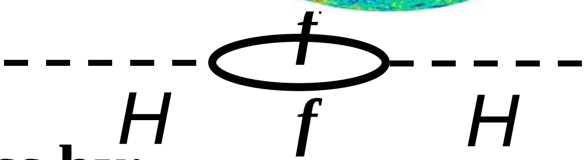
See excellent summary by Maxim Perelstein



- ❖ **Doesn't address what is apparently 95% of the Universe**
  - ❖ **No dark matter candidate (DM)**
  - ❖ **No clue about dark energy**



- ❖ **Hierarchy Problem**
  - ❖**EW radiative corrections to the M_H**
  - ❖ **integrated to scale Λ, shifts bare Mass by:**



$$\delta m_H^2 \cong (115 GeV)^2 [\frac{\Lambda}{400 GeV}]^2$$

Must Conclude that we have a Sub-Standard Model

❖**Need either:**

- ❖ **canceling counter terms (CT)**
- ❖ **some other New Physics by ~ 1-few TeV to maintain fine tuning at $O(10^{-3})$**

Alternatives/Extensions to the Standard Model

- **SUSY** provides cancelling CT and DM candidate
  - However in MSSM, lower limit on M_H pushes SUSY scale to few TeV

$$m_H^2 \leq m_Z^2 + \frac{3 G_F m_t^4}{2\sqrt{2}\pi^2} \log\left(\frac{m_{\tilde{t}}^2}{m_t^2}\right)$$

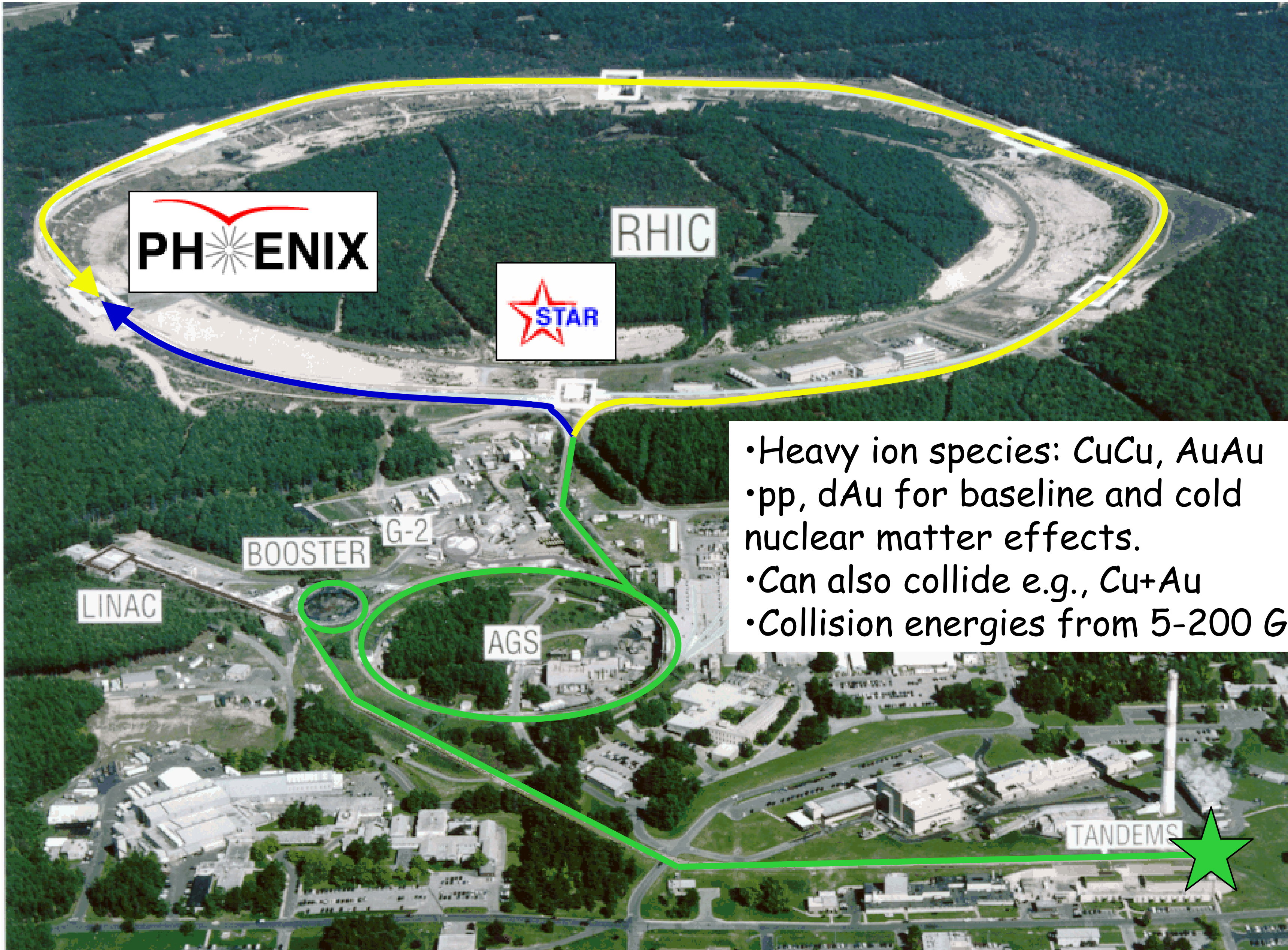
  - Some say MSSM is on the edge of being acceptable as 'natural' solution
- **Technicolor/topcolor/Composite Higgs** models
- **Little higgs models**, using a different symmetry to generate CT
- **Randall-Sundrum Warped Extra Dimensions**, lower Λ to TeV scale
- **Higgsless Models** use warped ED, infinite additional Ws and Zs

Tools

HERA e-p

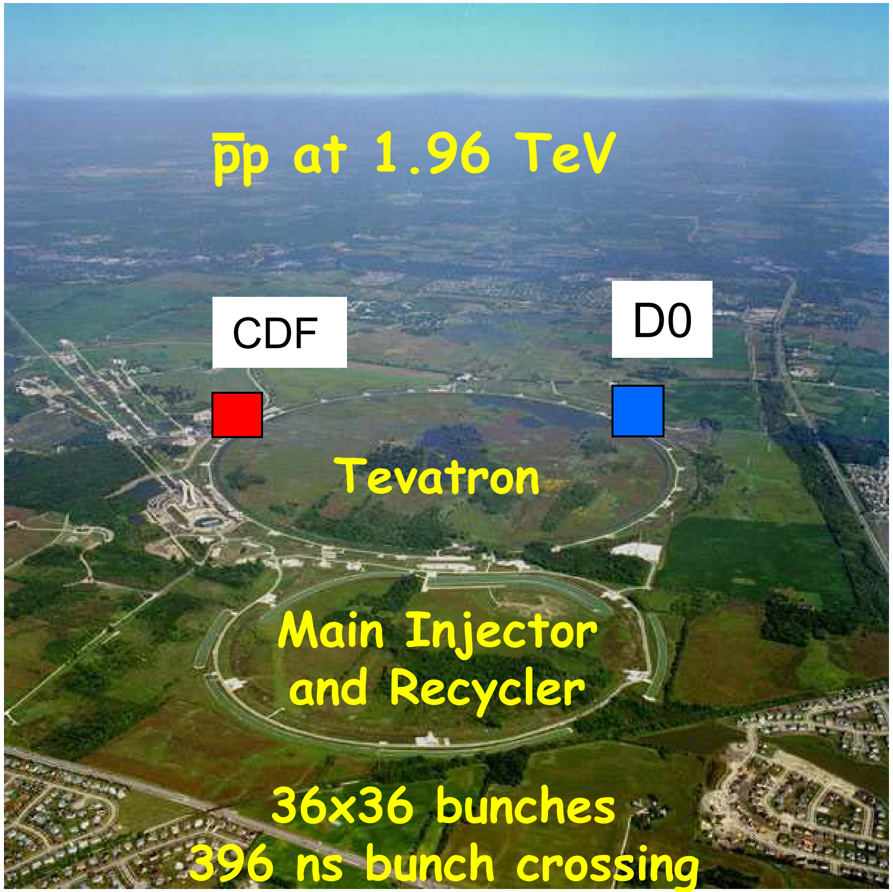
- HERA ended its run in June 2007: ~1 fb^{-1} collected by H1 and ZEUS

RHIC Facility



- Heavy ion species: CuCu, AuAu
- pp, dAu for baseline and cold nuclear matter effects.
- Can also collide e.g., Cu+Au
- Collision energies from 5-200 GeV

Fermilab Tevatron Run II

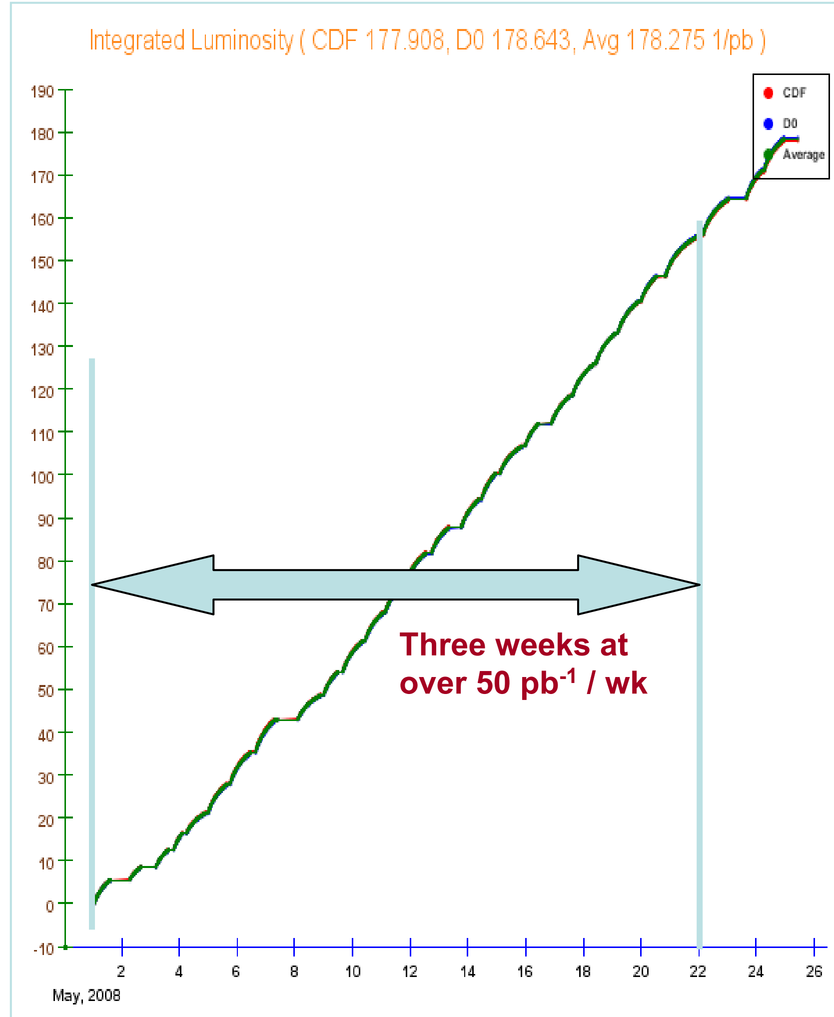


- Run II started in March 2001
- Peak Luminosity: 2.85 x 10^{32} $cm^{-2}s^{-1}$
- Delivered: 4.2 fb^{-1} (3.8 collected)
  (Run I: 0.14 fb^{-1})

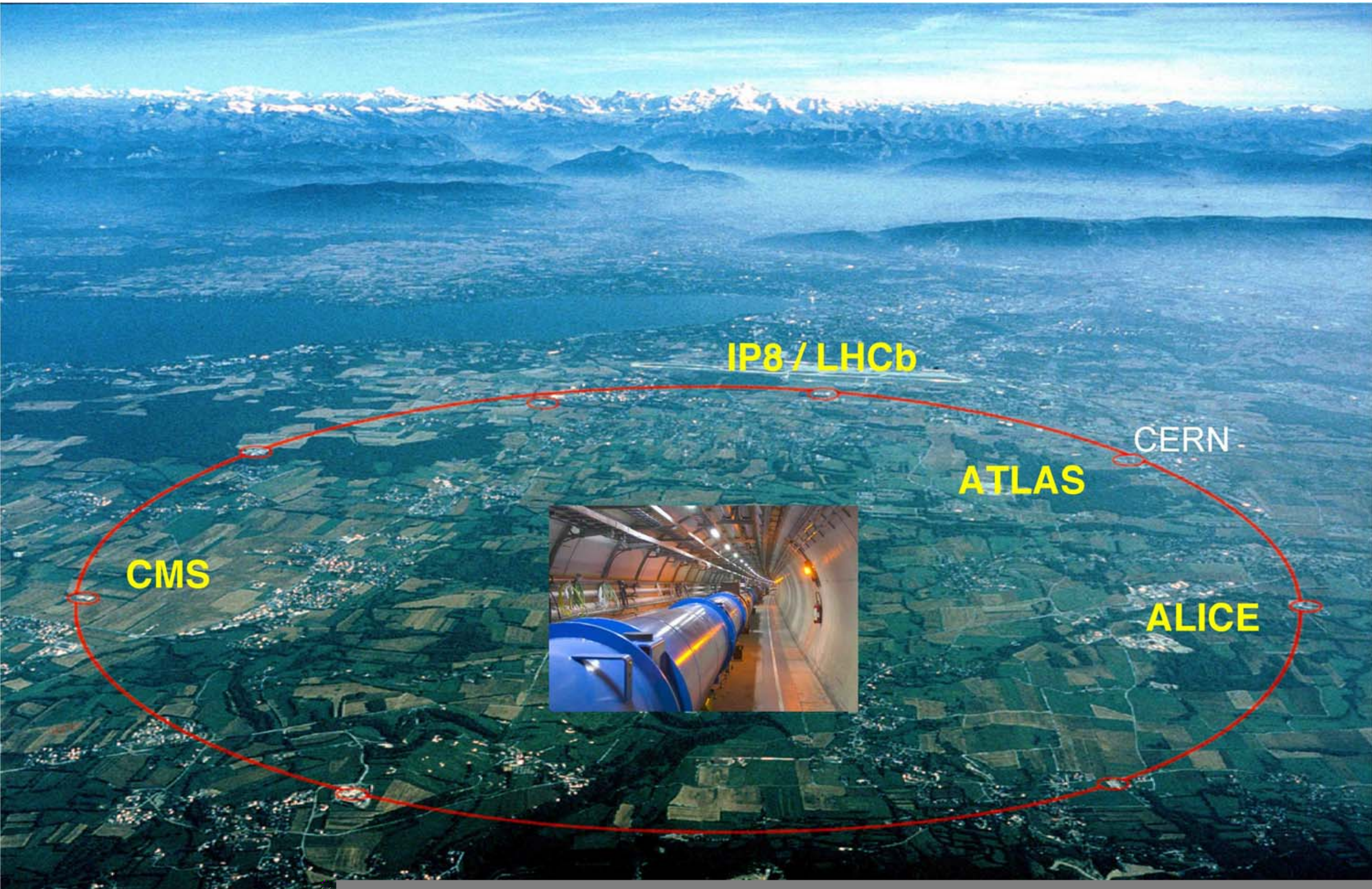
6 fb^{-1} expected by April 2009
8 fb^{-1} by end of FY2010

Tevatron Performance Pier Oddone

- 3 weeks in May at over $50 pb^{-1}$ /week
- "Without major breakdowns and with achieved performance, could have close to 6 fb-1 delivered by April 2009 and 8 fb-1 by the end of FY2010"
- Pier channeling Hillary: "We should run the Tevatron until the LHC has clearly overtaken it."



LHC



QCD

QCD is Cool, especially at LHC

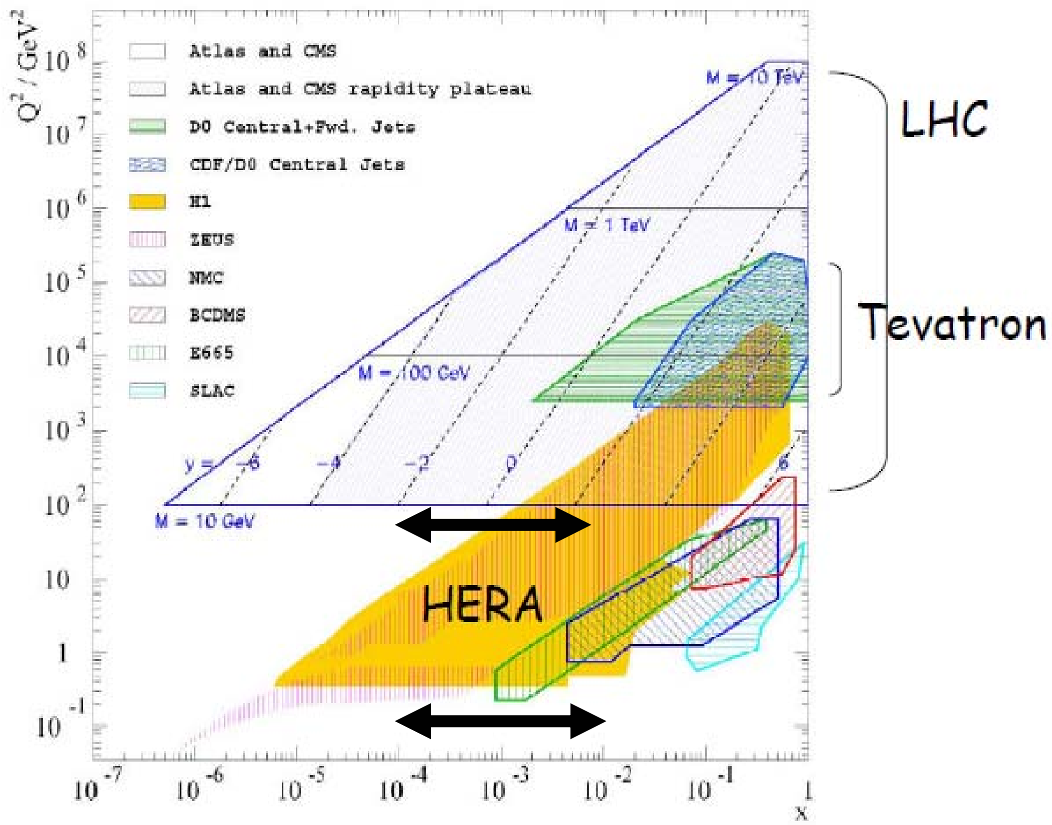
- Fabio Maltoni –
  - have code that writes code to do trees, now loops
  - have cute graphical representations of processes with equally cute names like ‘bubbles’ and ‘tadpoles’
  - quote Madonna
- “…just need to lock yourself in a room, sit down and start calculating…”
- All agree QCD essential to mine the LHC, recent progress is noteworthy

HERA

Kuni Nagano

- Still work to do understanding PDFs for gluon, HF
- Are DGLAP assumptions correct in detail?
- LHC main body of phase space i.e. ~1 TeV @ central rapidity corresponds to HERA's x region of $10^{-4} < x < 10^{-1}$
- At LHC most of the cross sections are due gluons, whose PDFs are mainly determined by HERA

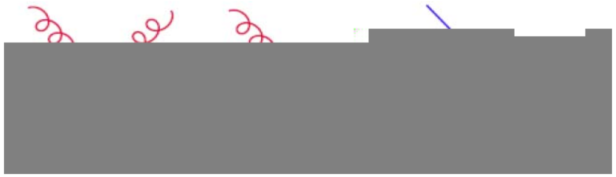
HERA provides essential input to LHC



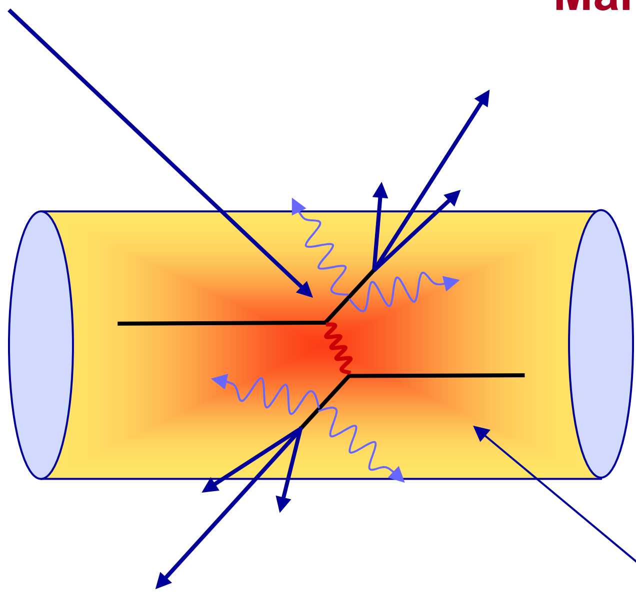
RHI: Hard probes of QCD matter

Use ‘quasi-free’ partons from hard scatterings

Marco van Leeuwen



Calculable with pQCD



to probe ‘quasi-thermal’ QCD matter

Interactions between parton and medium:
- -Radiative energy loss
- -Collisional energy loss
- -Hadronisation: fragmentation and coalescence

Quasi-thermal matter: dominated by soft (few 100 MeV) partons

Use the strength of pQCD to explore QCD matter

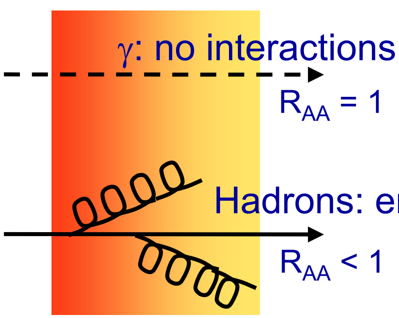
Sensitive to medium density, transport properties

Energy loss in QCD matter

Compare Au+Au spectra to properly scaled p+p spectra:

$$R_{AA} = \frac{dN/dp_T\big|_{Au+Au}}{N_{bin}\; dN/dp_T\big|_{p+p}}$$

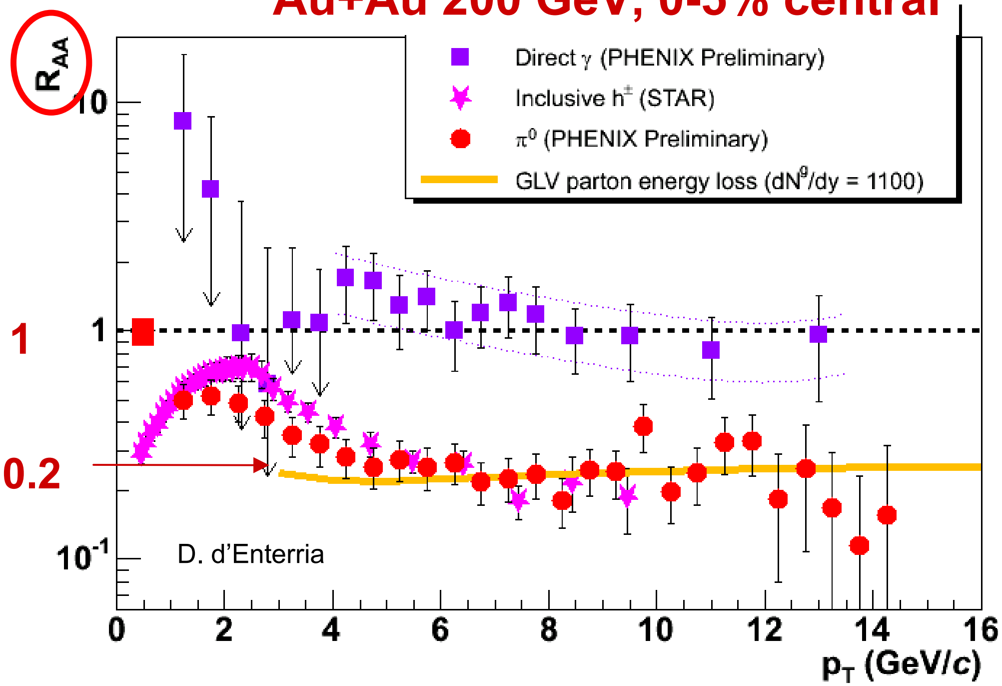
'nuclear modification factor'



Au+Au 200 GeV, 0-5% central

γ: R_{AA} = 1

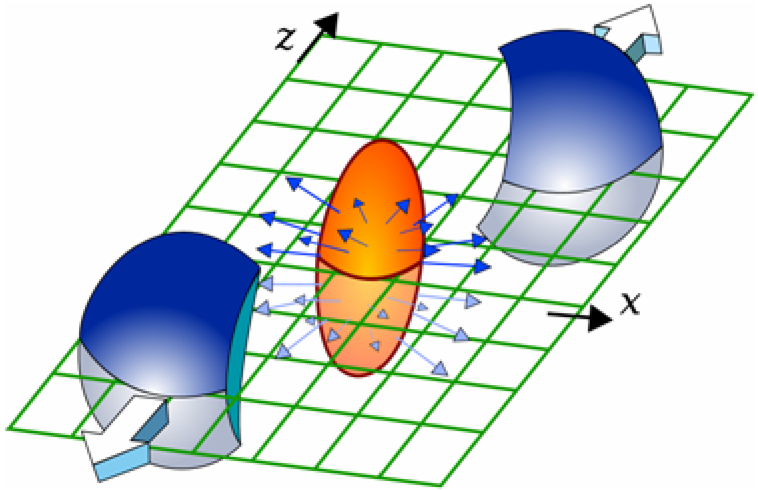
π^0, $h^{\pm}$: $R_{AA} \approx 0.2$

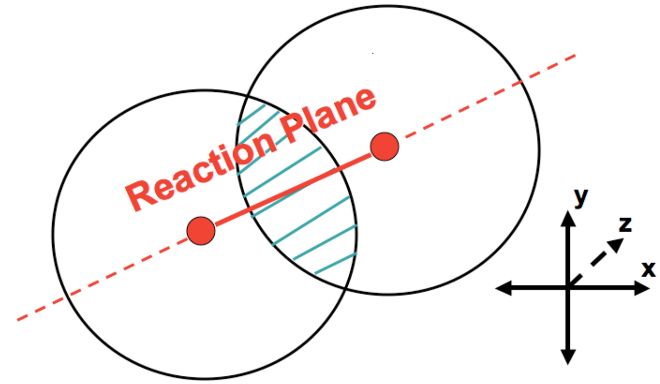


Hadron suppression ~ independent of p_T for p_T > 4 GeV

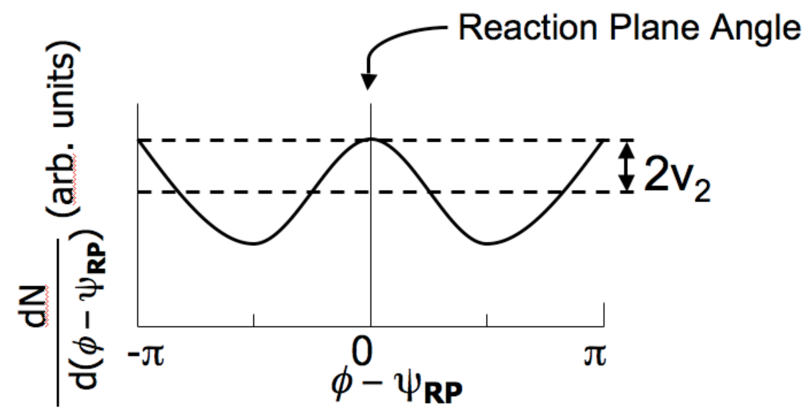
Hard partons lose energy in the hot matter

The Reaction Plane (and Flow)



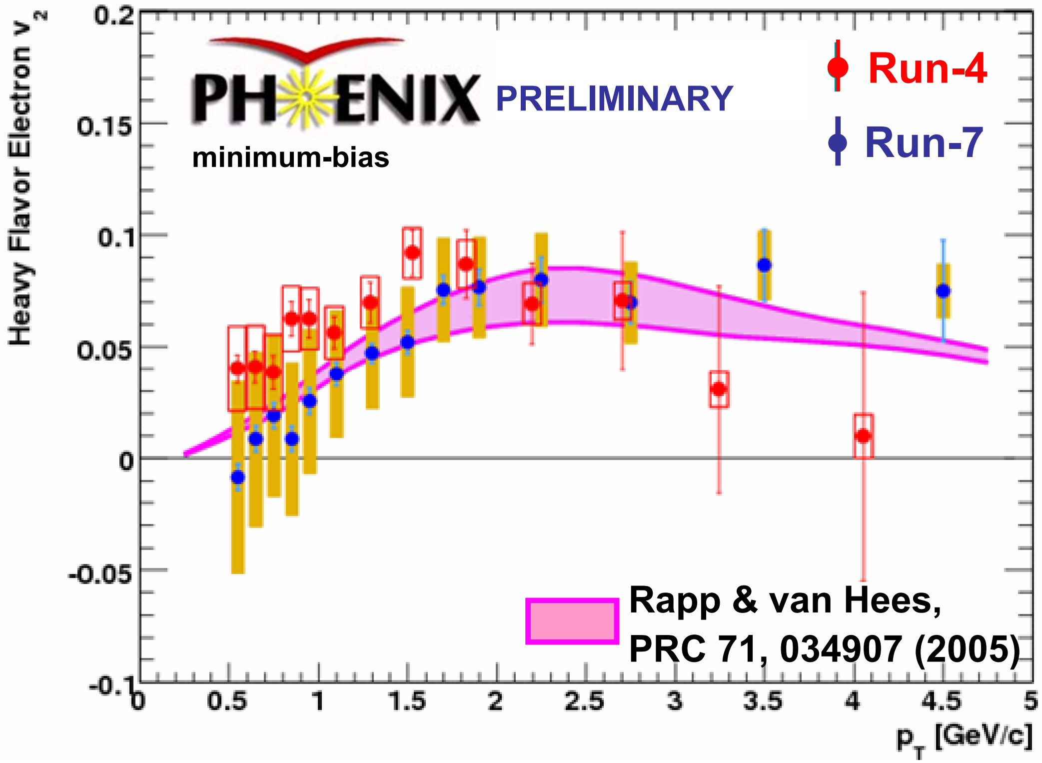


$$\frac{dN}{d\Delta\varphi} = \frac{1}{2\pi}\sum_n (1 + 2v_n \cos n\Delta\varphi)$$



- Spatial anisotropy in colliding zone leads to pressure gradients and anisotropy in momentum space

Heavy Quarks Even Flow!



- Difficult to reproduce R_{AA} and v_2.
- Can be used to provide a measure of the medium viscosity near to a conjectured lower bound.
- Inspired string theory comparisons to experiment.
- Important to know bottom contributions.

LHC vs RHIC heavy flavours

From RHIC to LHC

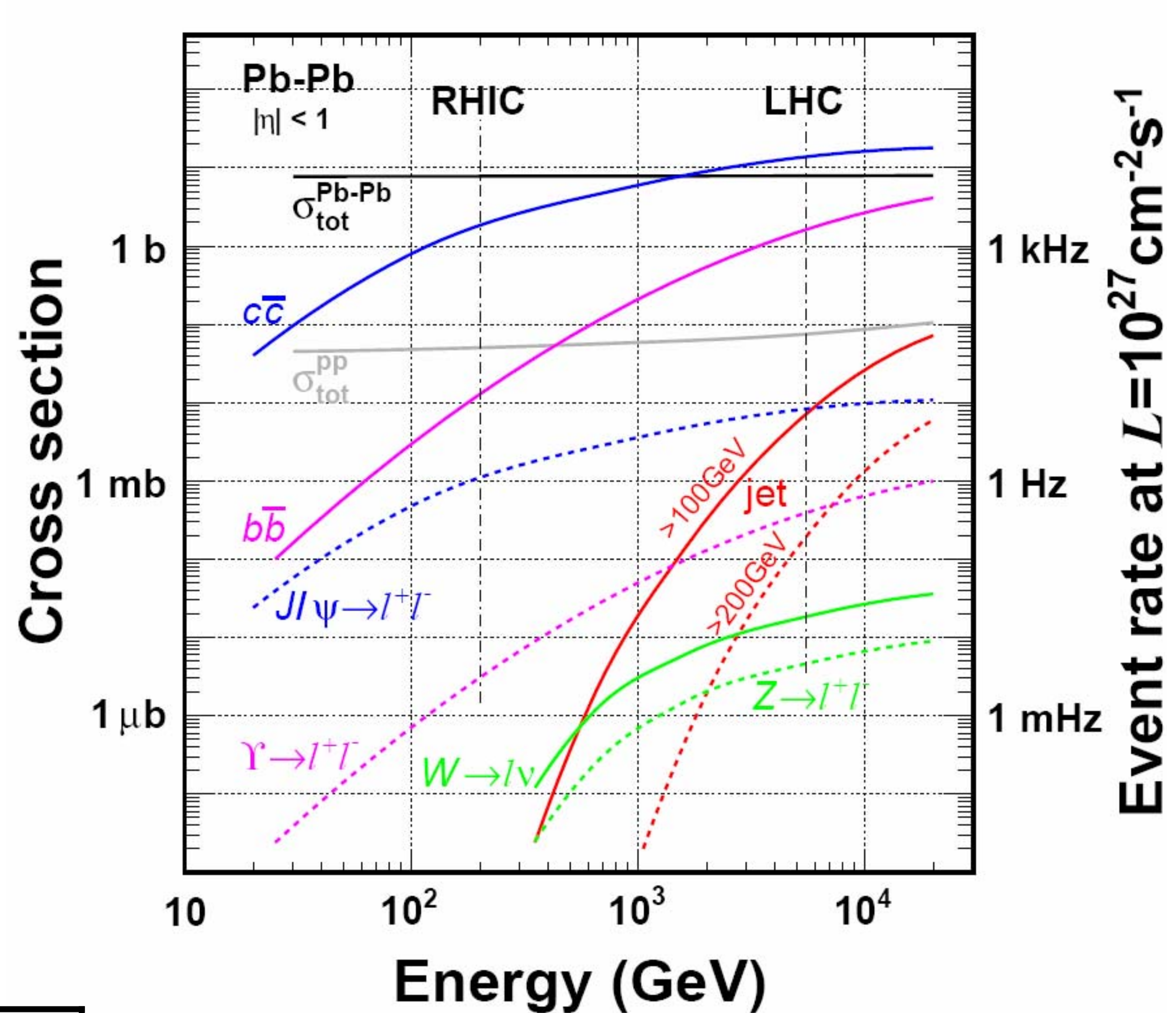
- Cross section for heavy flavours and jets grows by:

  $\sigma_{c\bar{c}} \rightarrow \sim 10$

  $\sigma_{b\bar{b}} \rightarrow \sim 100$

  $\sigma_{jet>100GeV} \rightarrow \sim \infty$

$\sigma_{RHIC}(\Upsilon \rightarrow ll) \sim \sigma_{LHC}(Z \rightarrow ll)$



N(qq) per central PbPb collision

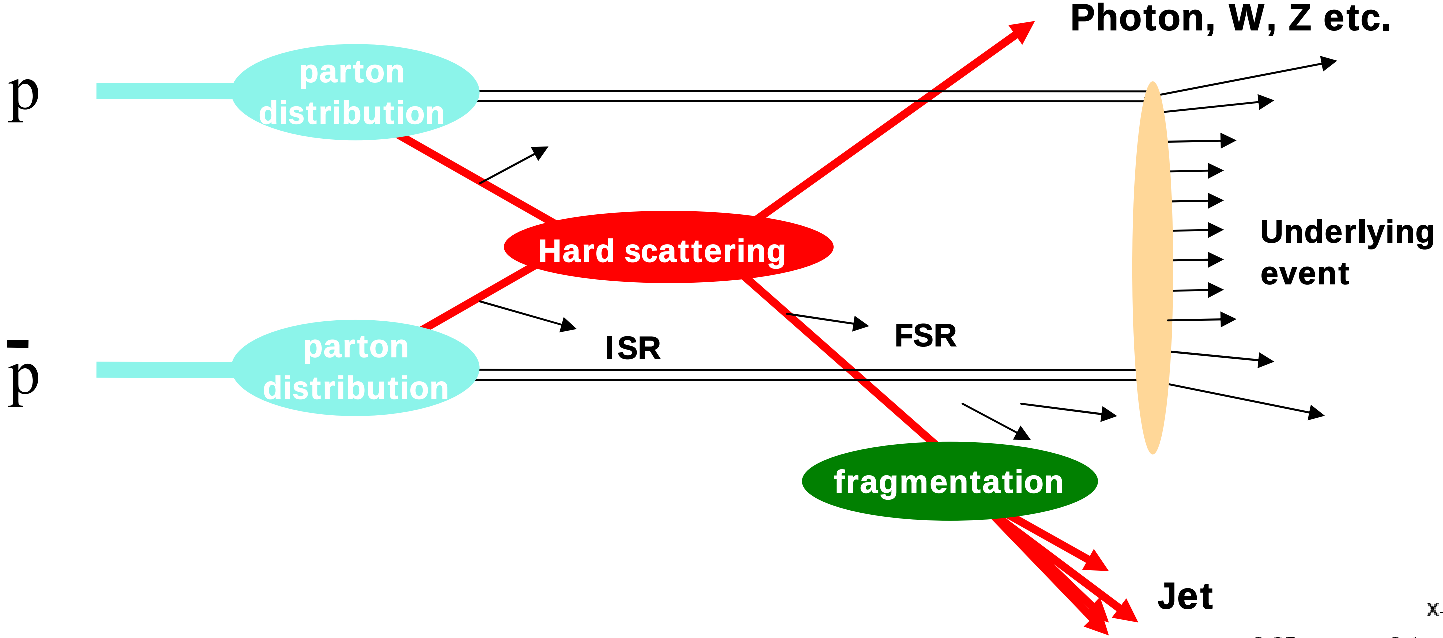
	SPS	RHIC	LHC
charm	0.2	10	200
bottom	-	0.05	6

LHC is a Heavy Flavour Machine!

QCD at Tevatron

Jet Production in pQCD

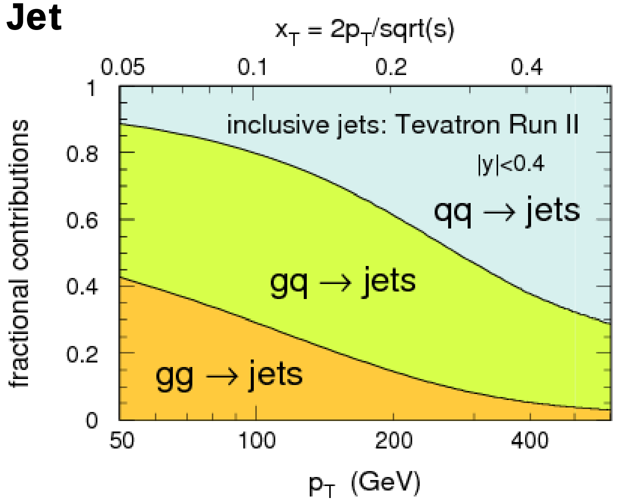
Jets of particles originate from hard collisions between quark and gluons



Quark and gluon density is described by PDFs.

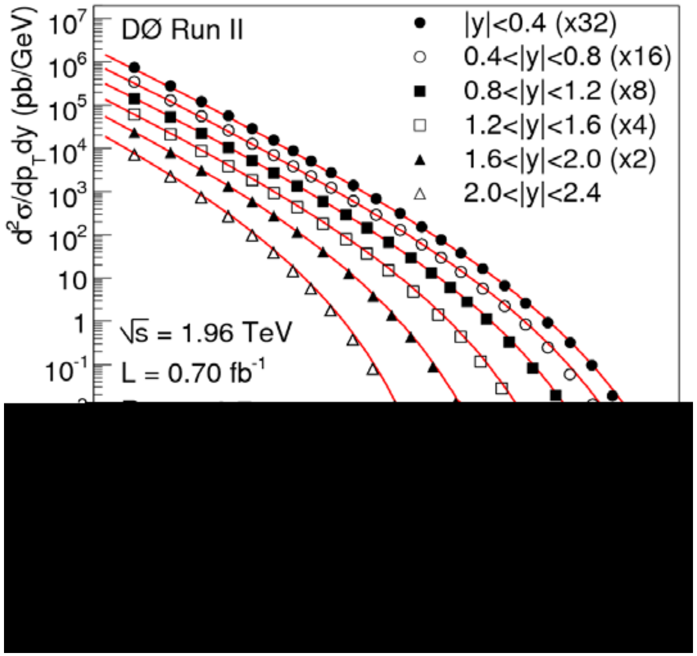
Proton remnants form the Underlying Event (U.E.)

We compare to pQCD calculations to NLO (α_s^3)



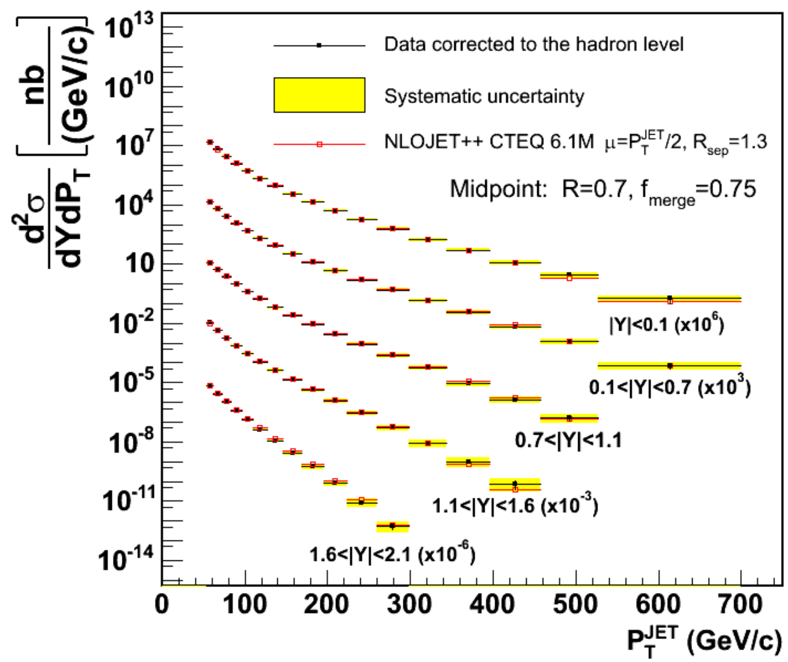
Inclusive Jet Production

D0 Run II (L=0.7 fb-1)



[redacted]

CDF Run II Preliminary (L=1.13 fb^{-1})

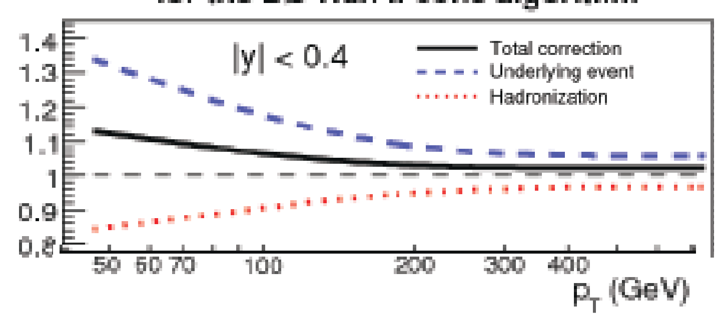


1% error in JES ⟶ 5—10% (10—25%) central (forward) x-section

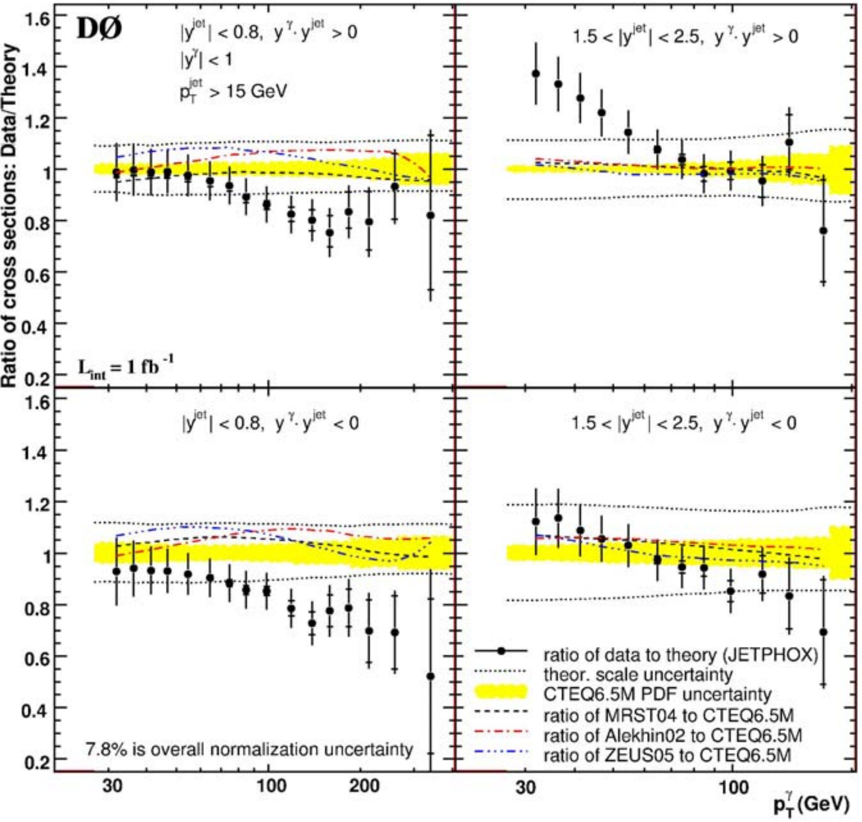
Up to 10 times more data than in Run I

NLO pQCD + non-perturbative corrections from Pythia

Non-perturbative corrections for the inclusive jet cross section for the DØ Run II cone algorithm



Inclusive Photon + jets Production



- Similar p_T dependence than inclusive photons in UA2, CDF, and D0
- Shapes very similar for all PDFs
- Measurements cannot be simultaneously accommodated by the theory

- Most errors cancel in ratios between regions (3-9% across most p_T^γ range)
- Data & Theory agree qualitatively
- A quantitative difference is observed in the central/forward ratios

Need improved and consistent theoretical description for γ+jet

W/Z + Jet Physics

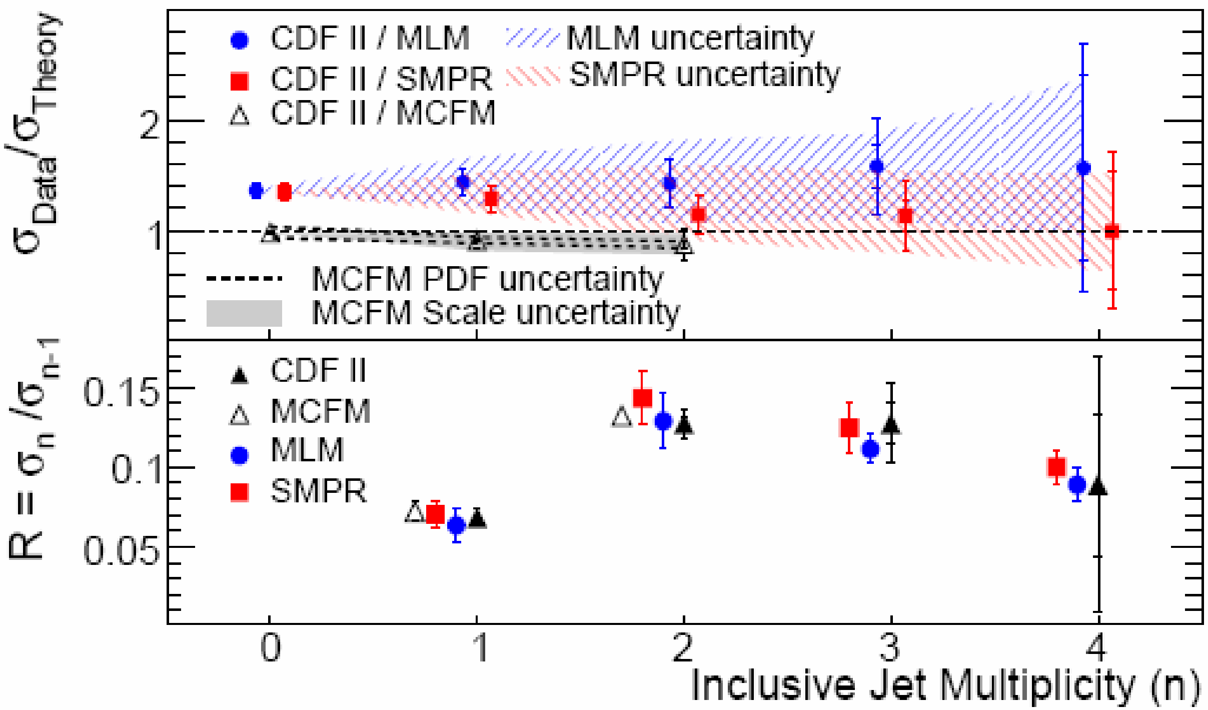
J.Campbell/C.Neu

Why study W/Z +jet production?

- Important tests of Quantum Chromodynamics (QCD)
- Recent LO and NLO simulations need experimental verification
- Signature shared with top production, Higgs, other searches at Tevatron, LHC

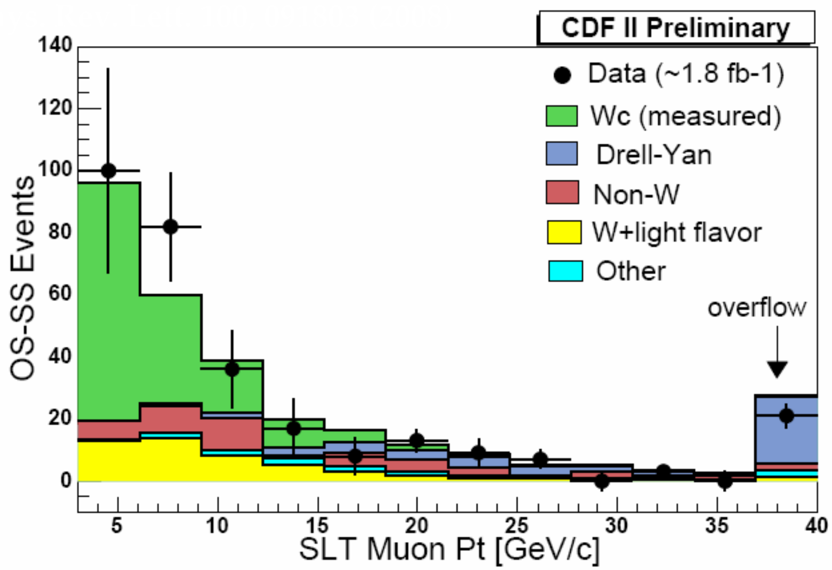
- **CDF: NLO MCFM tracks data more accurately than LO Herwig, madgraph, pythia**
- **NLO not yet available for 3 or more jets**

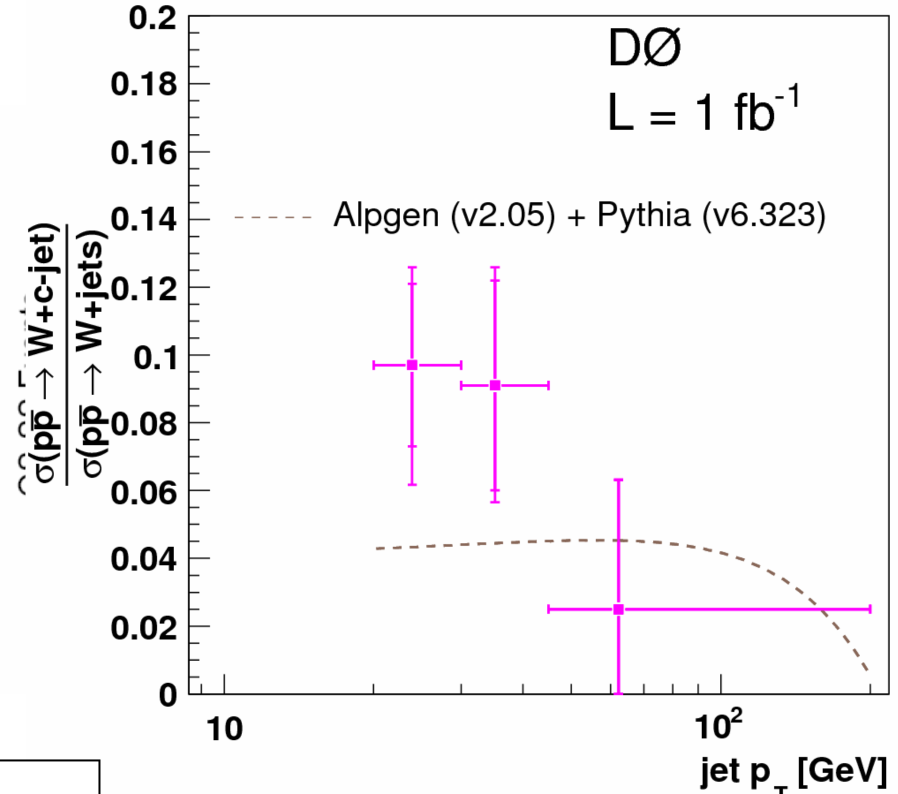
W+N jets data/MC vs. N



New W + Single *c* Production

- **CDF Result:** for $p_T^c > 20$, $|\eta^c|<1.5$
  $\sigma x BR = 9.8 \pm 2.8$ (stat) $^{+1.4}_{-1.6}$(syst) $\pm$ 0.6 (lum) pb
- **Prediction: NLO from MCFM**
  $\sigma x BR = 11.0\ ^{+1.4}_{-3.0}$ pb





Do Result:

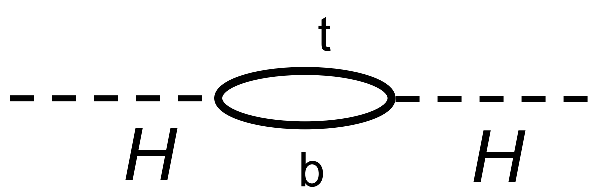
$$\frac{\sigma\,[W + c\text{-jet}]}{\sigma\,[W + \text{jets}]} = 0.074 \pm 0.019(\text{stat.})^{+0.012}_{-0.014}(\text{syst.})$$

Compared to LO: 0.040 ± 0.003

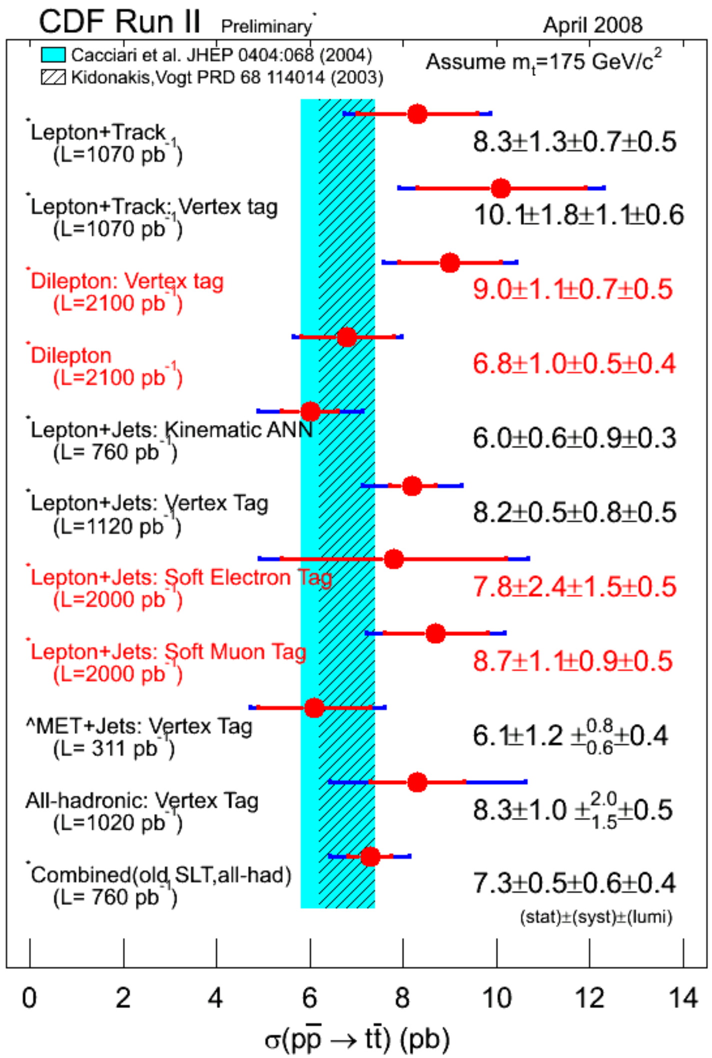
Heavy Flavor

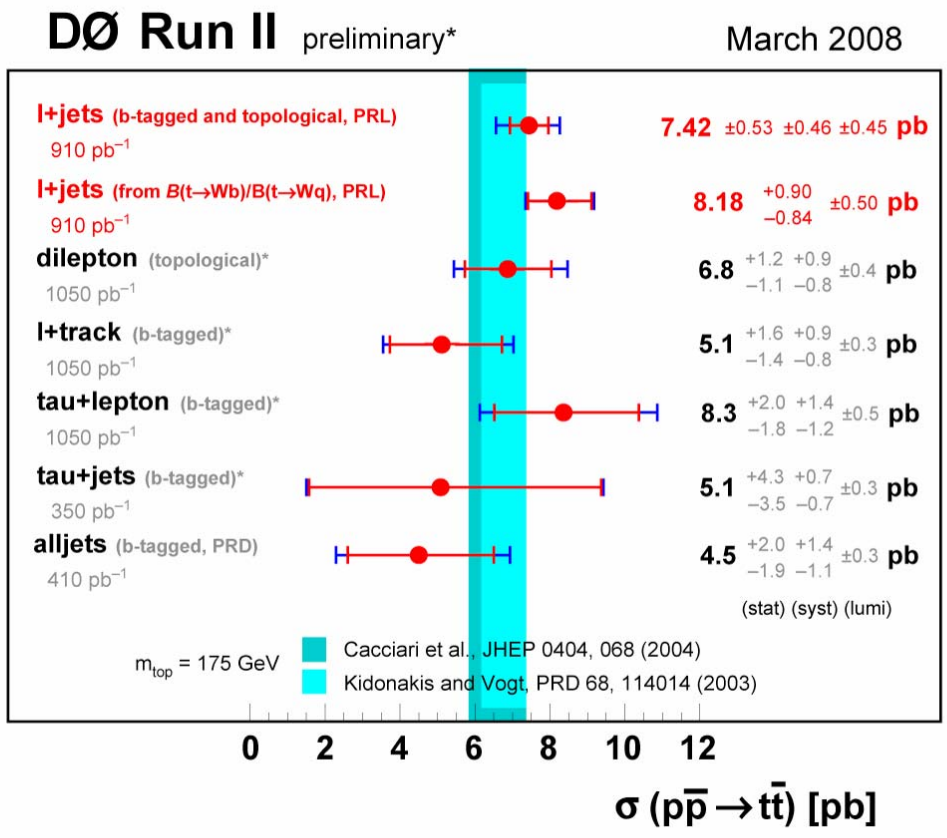
Top as Problem and Opportunity

- Eric Laenen reminded us of why top is important:
- **Large top mass** gives:
  - strong coupling to EWSB mechanism
  - good for pQCD, no hadronization
  - spin information preserved due to rapid decay
- Top is also still the **main trouble-maker**:
  - the main source of quadratic divergences in Higgs self-energy corrections



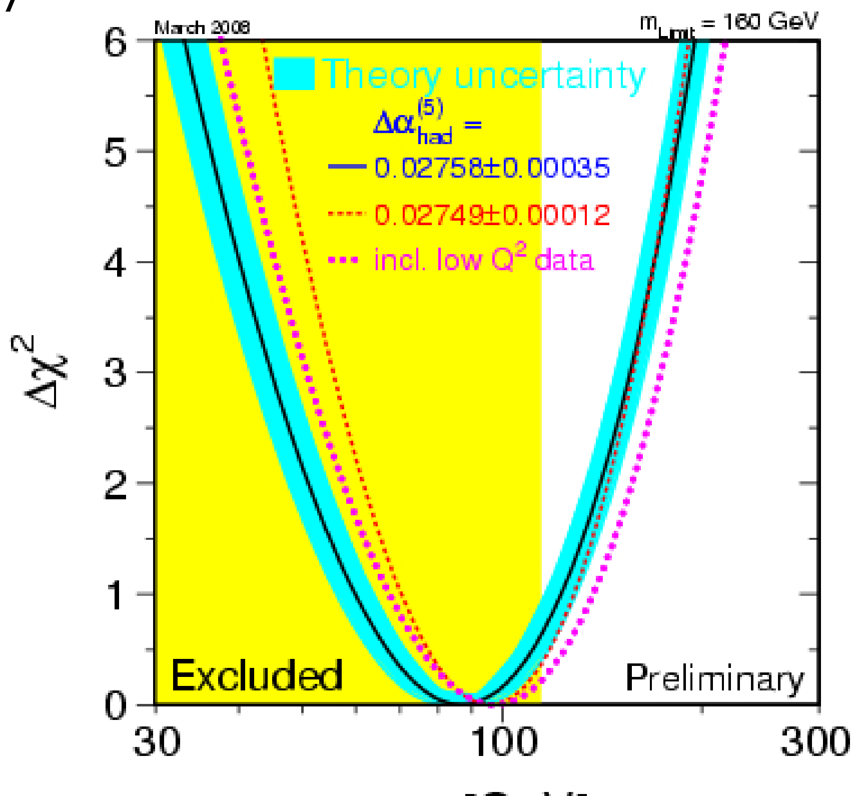
Top Cross Section Ford Garberson

- 

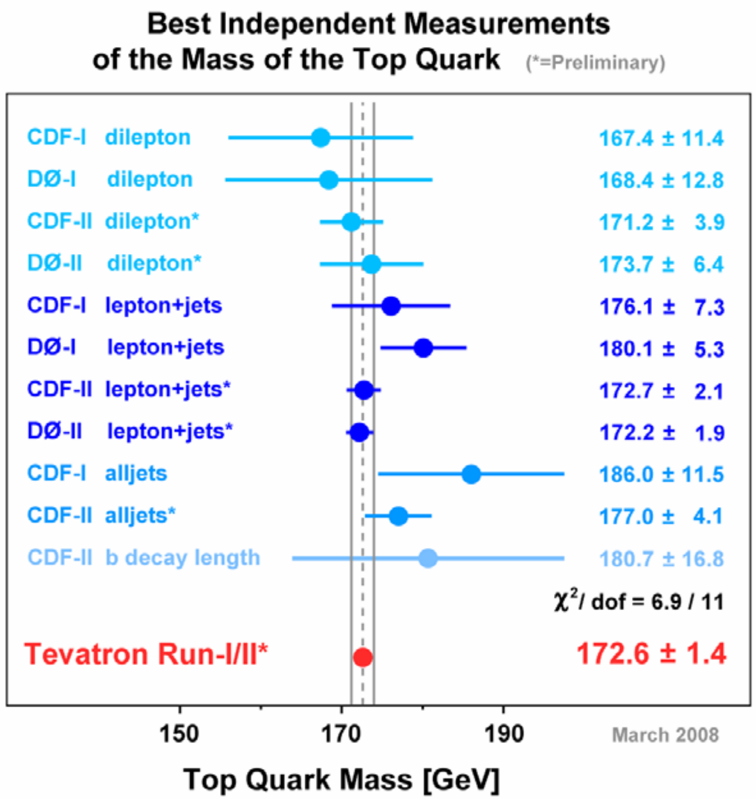


Top Mass Ford Garberson

- Electroweak fits: SM Higgs mass now < 160 GeV/c^2 at 95% c.l.
- With LEP lower limit of M_H>114 GeV/c^2: upper limit rises to 190 GeV/c^2

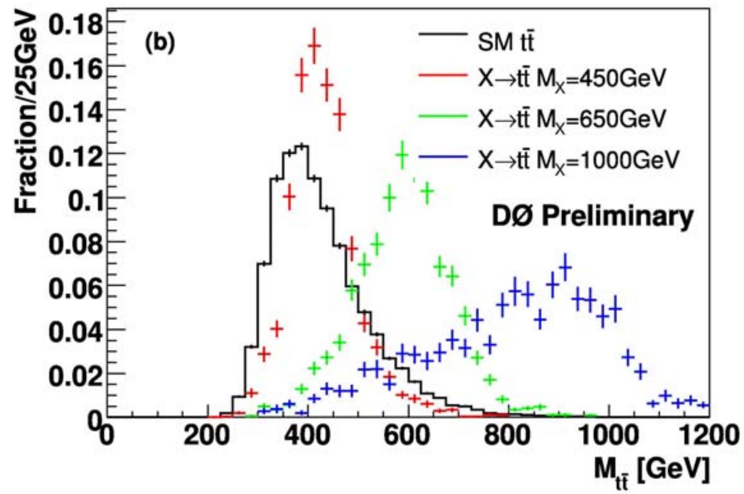


M_{top}=172.6+/-1.4GeV/c^2



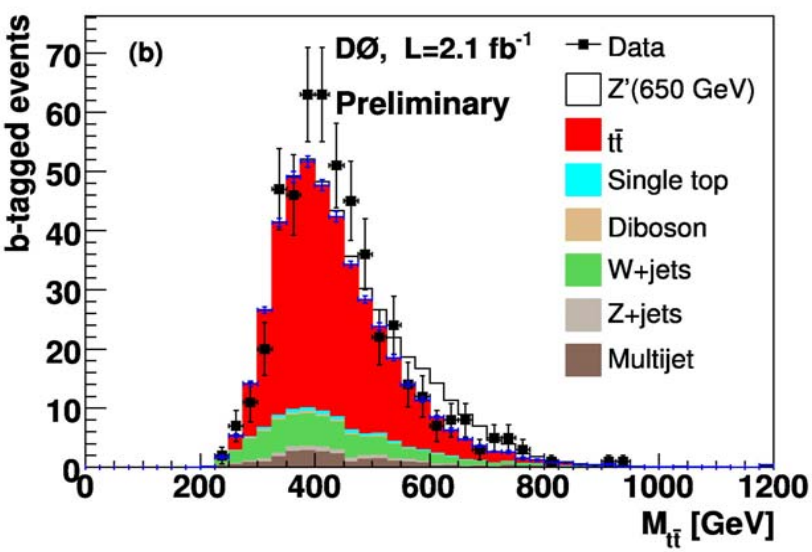
tt Resonance Searches at D0

- New heavy particles could couple strongly with 3rd generation fermions
  - A narrow-width leptophobic Z′ is such a case
  - technicolor model (Hill and Parke, Phys. Rev. D 49)



$M_{Z'}$<760 GeV for $\Gamma_{Z'}/M_{Z'}$ =1.2%

-



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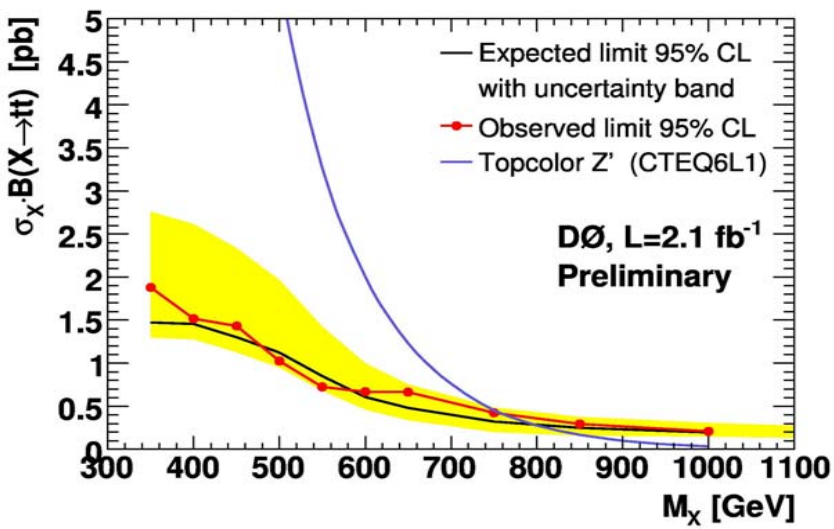
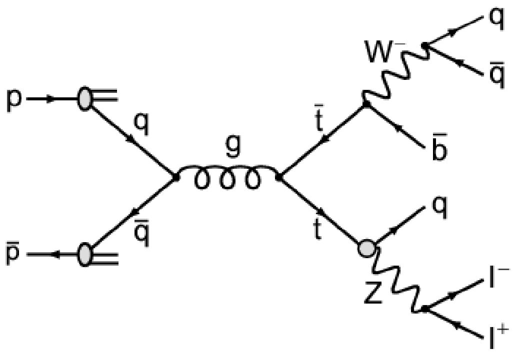
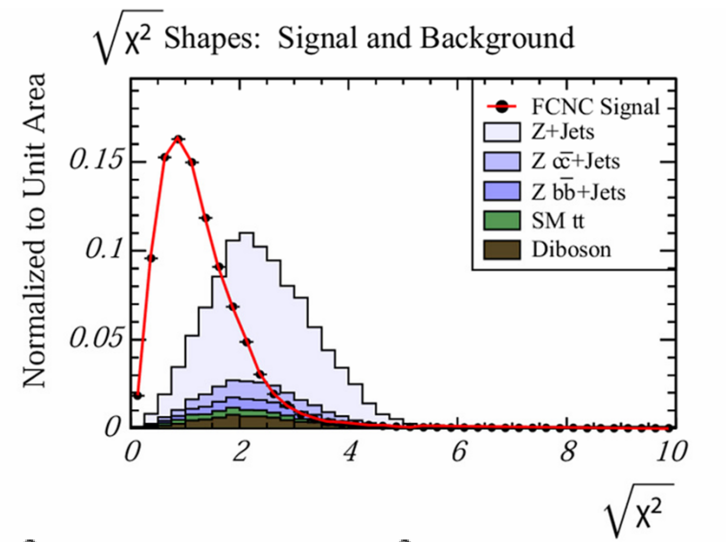


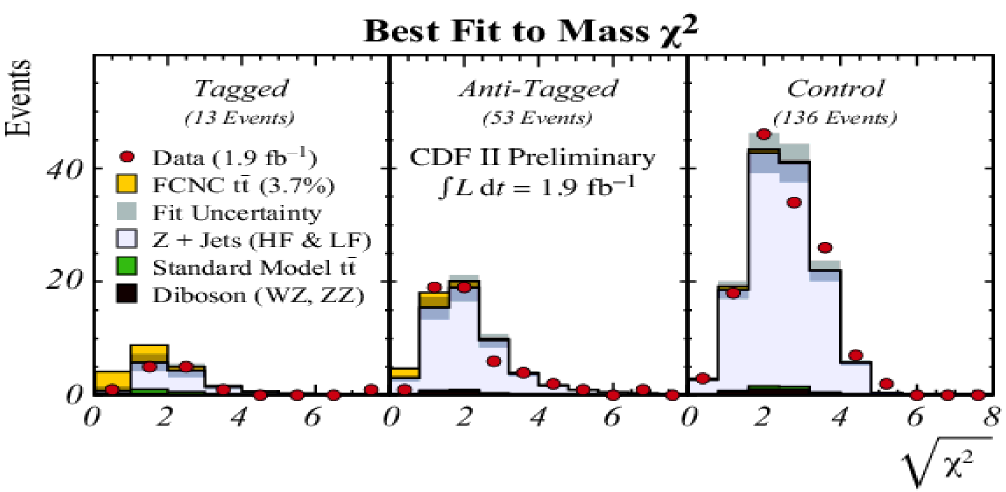
FCNC search

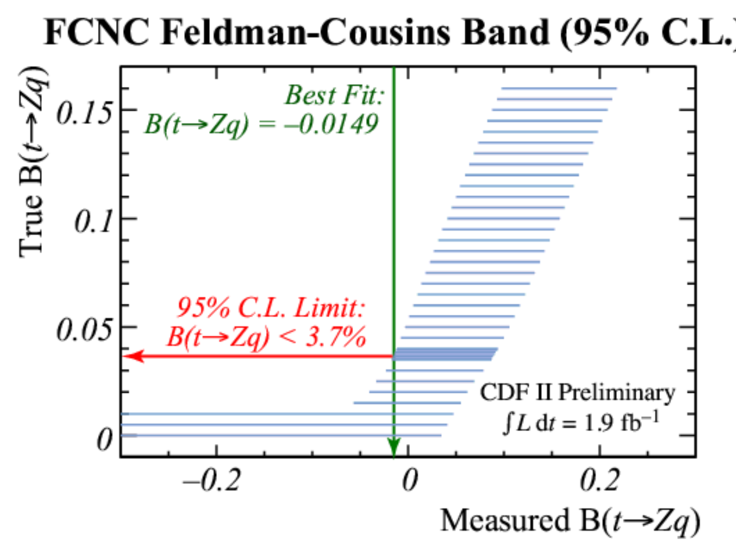
- Flavor changing Neutral Currents
  - Highly suppressed in SM
  - Fit to a mass χ^2
  - Tag and anti-tag(zero-tag)





$$\chi^2 = \left(\frac{m_{W,\mathrm{rec}} - m_W}{\sigma_W}\right)^2 + \left(\frac{m_{t\to Wb,\mathrm{rec}} - m_t}{\sigma_{t\to Wb}}\right)^2 + \left(\frac{m_{t\to Zq,\mathrm{rec}} - m_t}{\sigma_{t\to Zq}}\right)^2$$



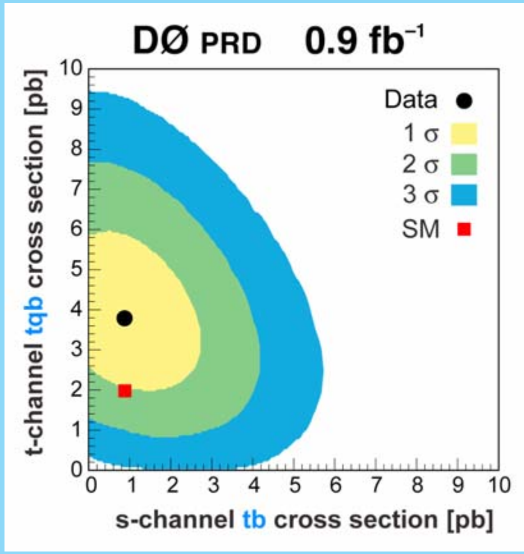


Single top Measurements of *tb* and *tqb*

Ann Heinson

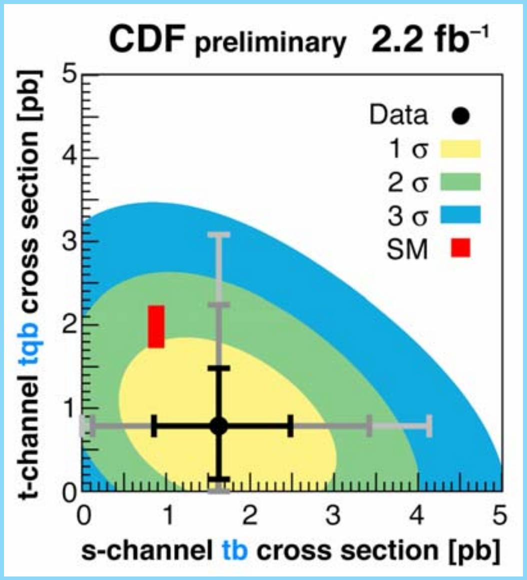
- **DØ *tb*+*tqb* decision trees 2-d fit**
  - Allow *tb* and *tqb* cross sections to float
  - Fit cross sections simultaneously

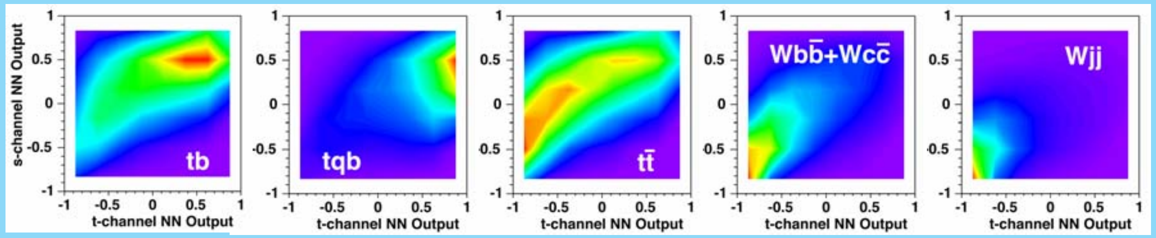
s-channel σ(*tb*) = 0.9 pb
t-channel σ(*tqb*) = 3.8 pb



- **CDF neural networks 2-d fit – *NEW***
  - Search 2.2 fb^{-1} of data in the 2-, 3-jets 1-, 2-tag channels
  - Fit to *tb* and *tqb* templates

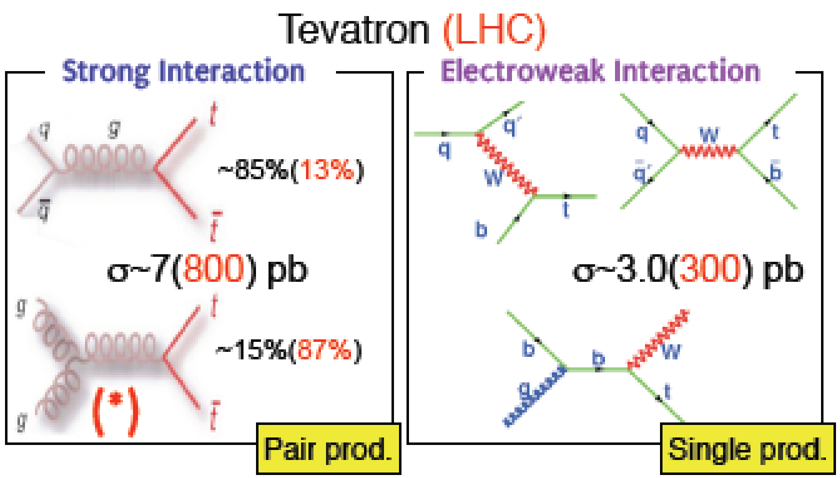
s-channel σ(*tb*) = 1.6 $^{+0.9}_{-0.8}$ pb
t-channel σ(*tqb*) = 0.8 $^{+0.7}_{-0.8}$ pb





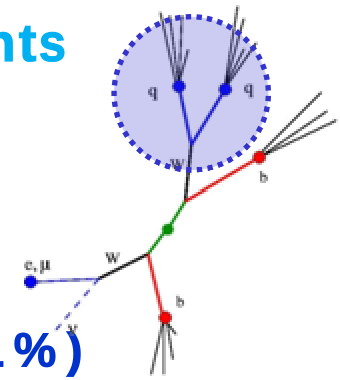
Top Production at LHC

Stephanie Beauceron

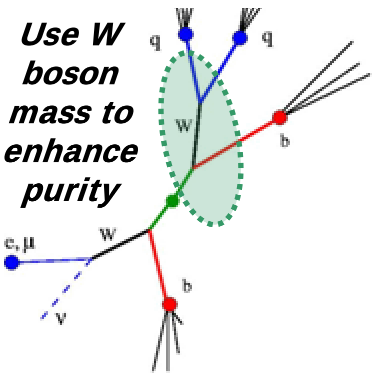


LHC is a real top "factory":
$8 \cdot 10^6$ tt / experiment with $L=10^{33}$

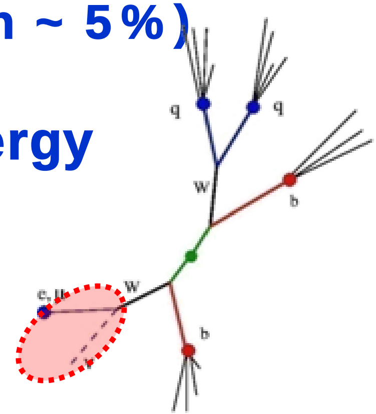
➔ **Use high statistics of complex events**



Use W boson mass to enhance purity



- **Calibrate light jet energy scale**
  - impose PDG value of the W mass (precision < 1%)
- **Estimate b-tagging efficiency**
  - Study b-tag (performance) in complex events
  - From data (precision ~ 5%)
- **Calibrate missing transverse energy**
  - use W mass constraint in the event
  - range 50 GeV < p_T < 200 GeV



Missing E_T (GeV)

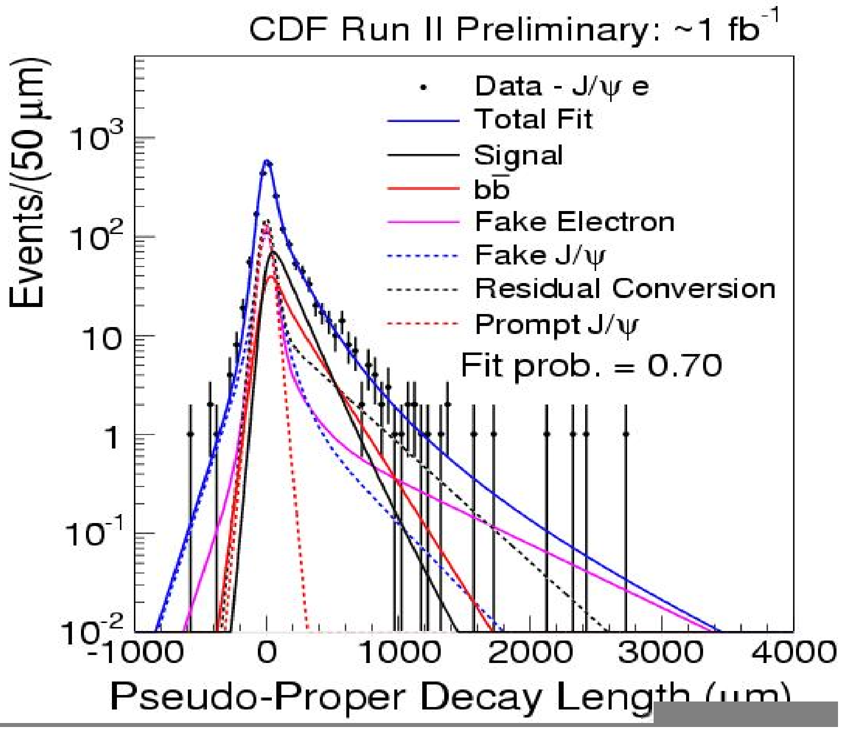
Top at LHC

Akira Shibata

- FCNC limit should decrease by 10-100 in $10fb^{-1}$
- Single top give ~5% determination of V_{tb} $10fb^{-1}$
- Mtt studies looking for resonances
- Aim for top mass measurement to < $1GeV/c^2$

B_c Lifetime Results

Mark Hartz



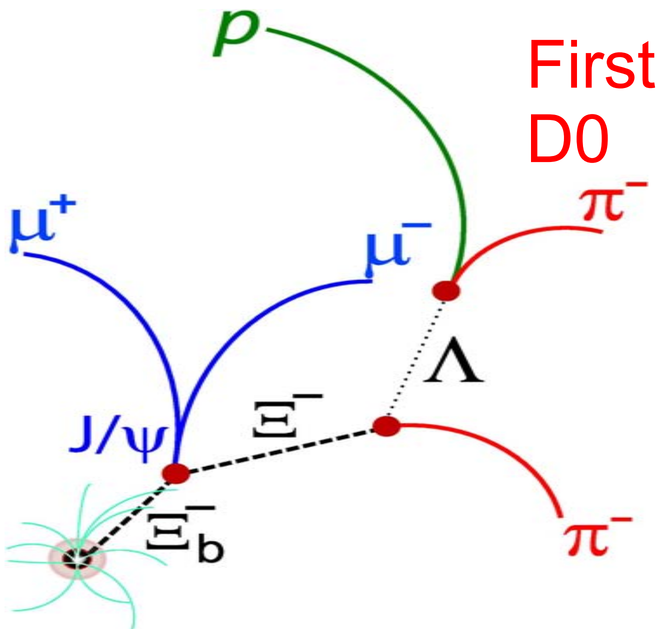
Combined Result: lifetime=0.476+/-0.05+/-0.018ps

http://www-cdf.fnal.gov/physics/new/bottom/080327.blessed-BC_LT_SemiLeptonic/

Cascade-b Observation and Mass (D0)

Mark Hartz

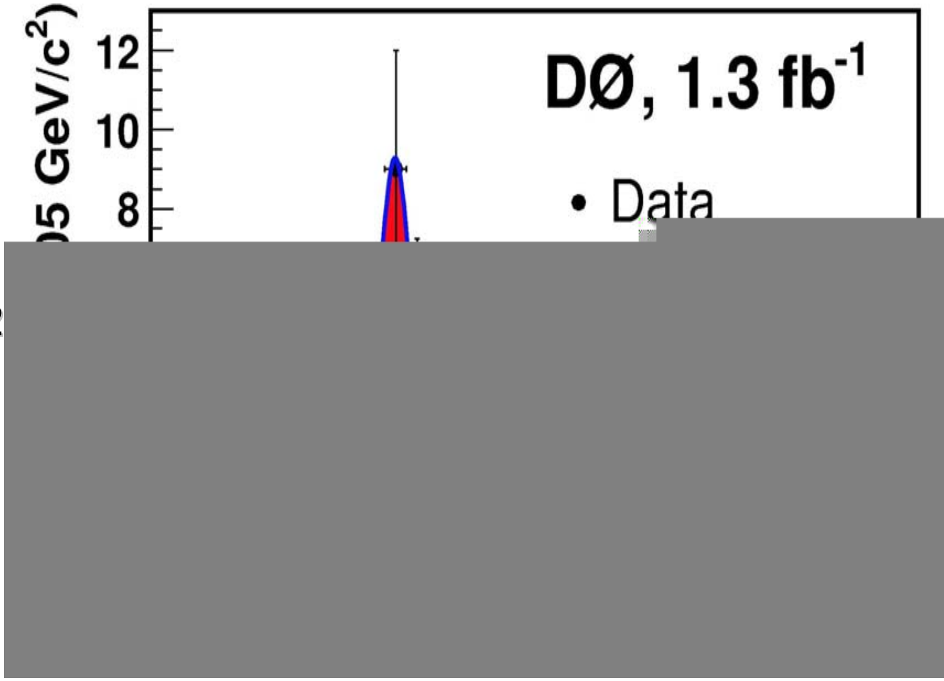
First direct observation of (dsb) baryon by D0



- 1.3 fb^{-1} of integrated lumi.

15.2+/-4.4 Events

M=5.774+/-0.011+/- 0.015 GeV/c^2

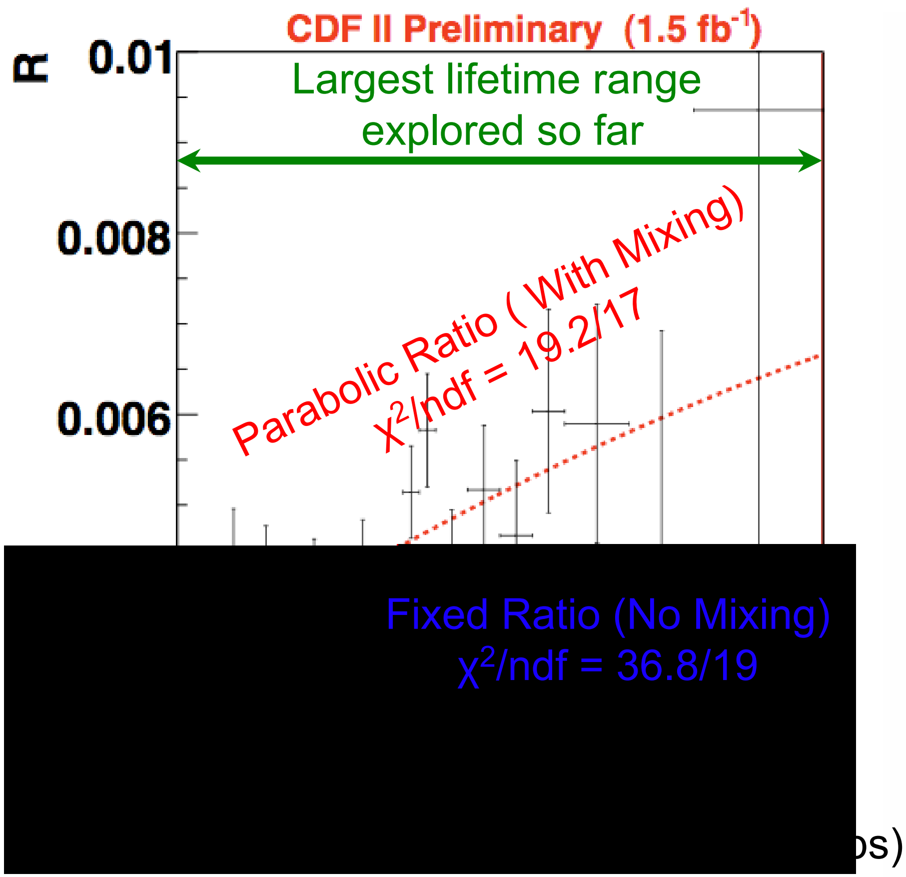


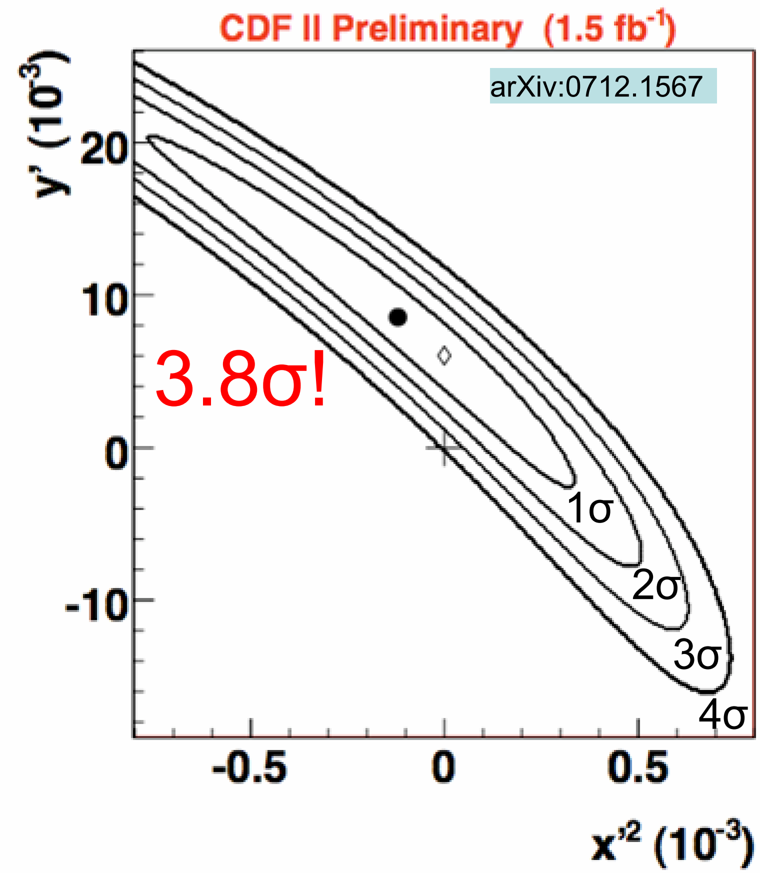
PRL 99, 052001 (2007)

D Mixing

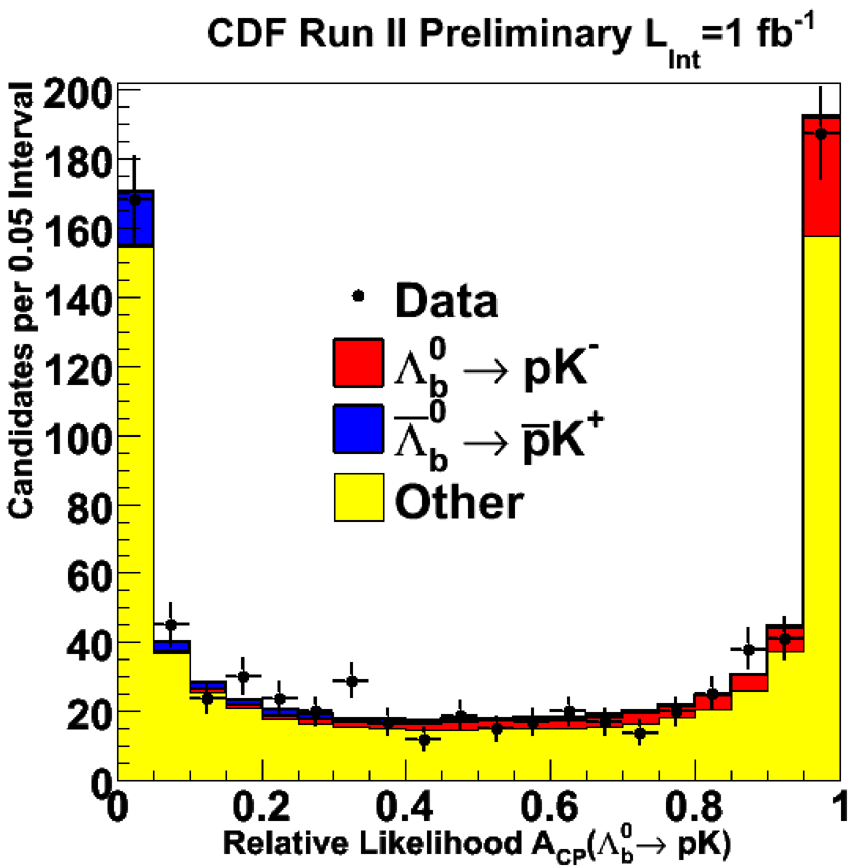
Gustaaf Brooijmans

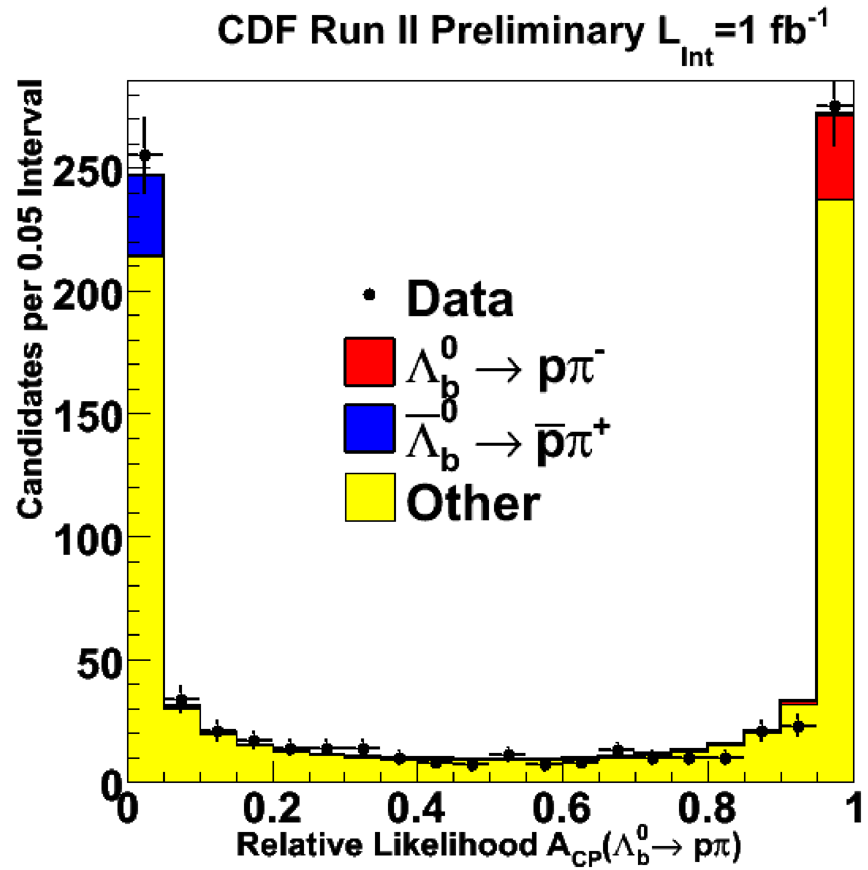
$$R(t) = R_D + \sqrt{R_D}y't + \frac{x'^2 + y'^2}{4}t^2$$





- Follows BABAR and Belle D mixing results from B lifetime difference, March '07





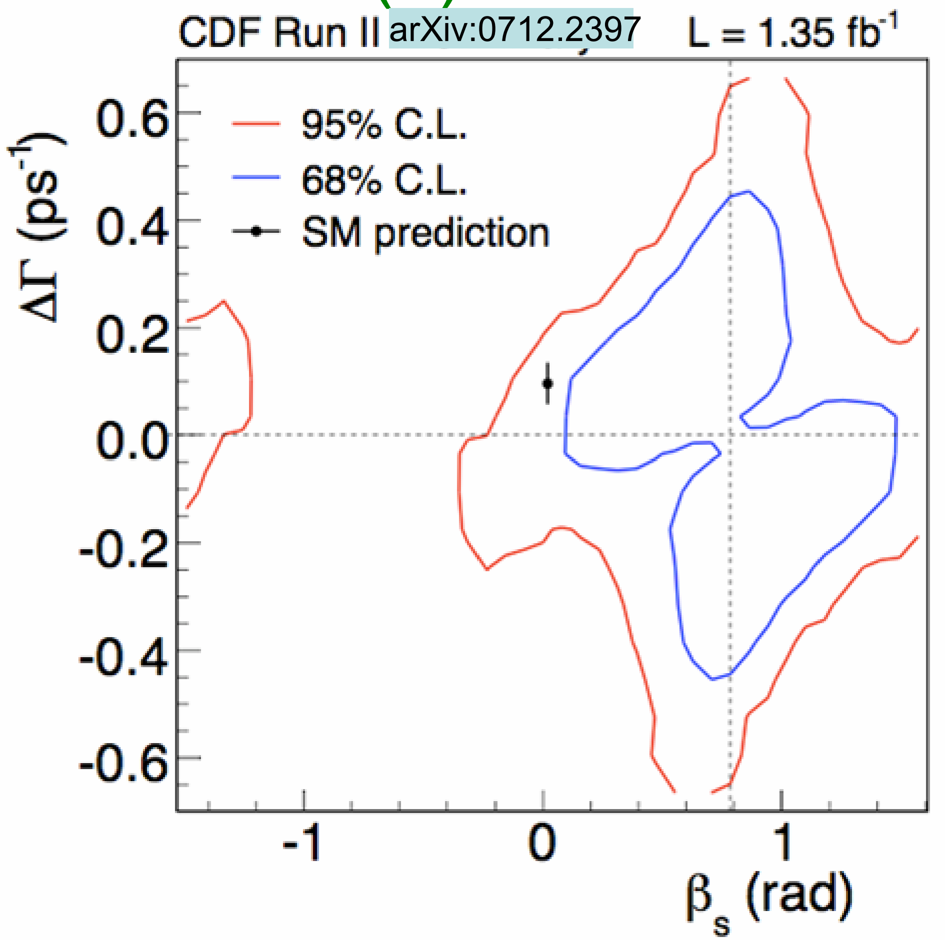
$$A_{cp}\left(\Lambda_b \to p^{\pm}K^{\mp}\right) = 0.37 \pm 0.17 \pm 0.03$$

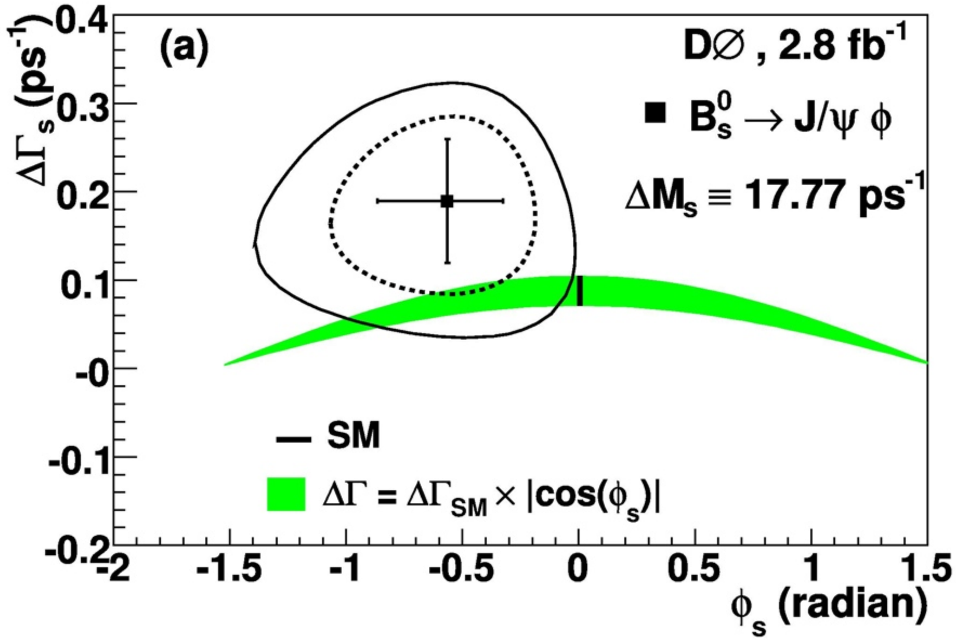
$$A_{cp}\left(\Lambda_b \to p^{\pm}\pi^{\mp}\right) = 0.03 \pm 0.17 \pm 0.05$$

$B_s \to J/\psi\ \varphi$ CP Signal

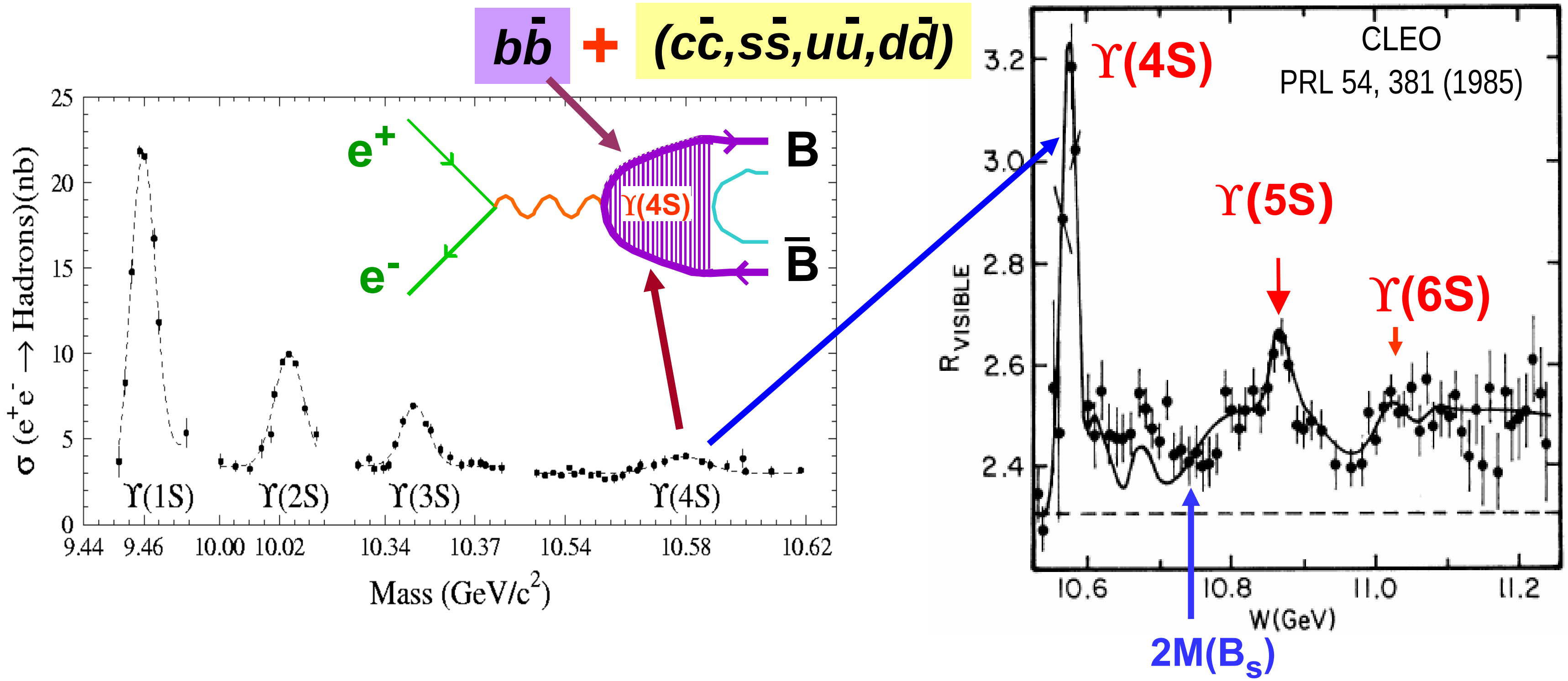
CDF(D0): SM probability:
15(7)% ✓

Mildly inconsistent with SM





On the watch list



$e^+ e^-$ -> Y(5S) -> $B\bar{B}$, $B^*\bar{B}$, $B^*\bar{B}^*$, $B\bar{B}\pi$, $B\bar{B}\pi\pi$, $B_s\bar{B}_s$, $B_s^*\bar{B}_s$, $B_s^*\bar{B}_s^*$

~10^5 B_s mesons per 1 fb^{-1} at Y(5S)

>1000 fb^{-1} needed, will have to wait for super-Belle

Measuring φ_s at LHC **Alessio Sarti**

From Z. Ligeti et al hep-ph/0604112
Allowed regions CL > 0.90, 0.32, 0.05

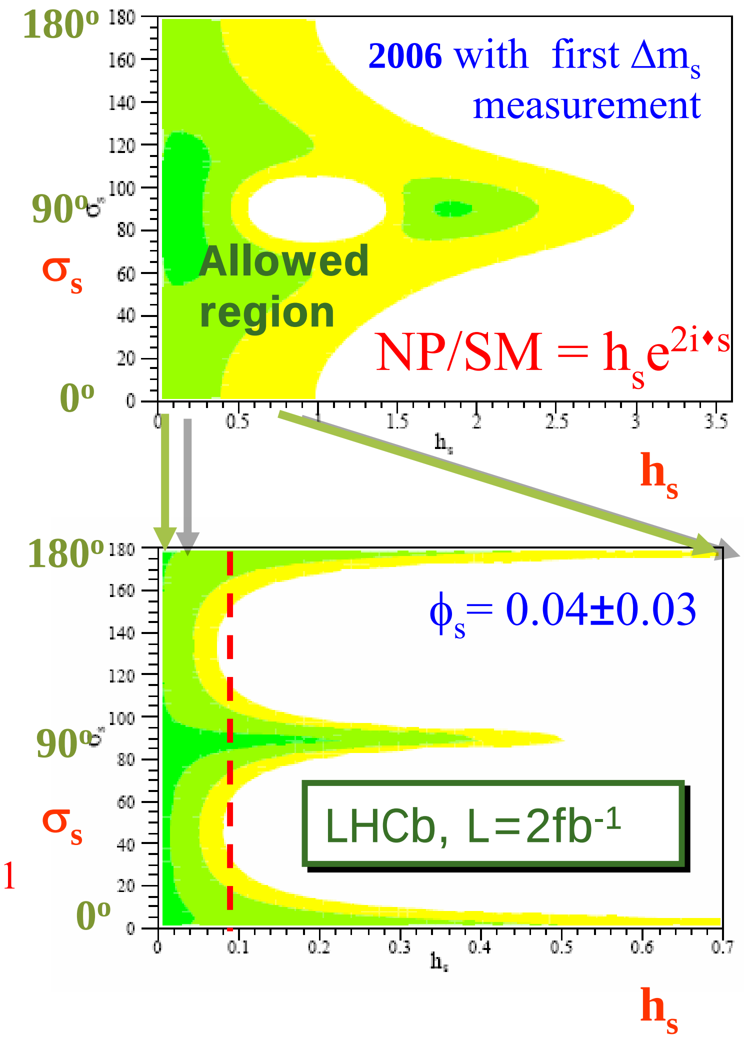
With 2009 data

	ATLAS	CMS	LHCb
$\sigma(\phi_s)$	0.159	-	0.042
$\sigma(\Delta\Gamma_s)/\Delta\Gamma_s$	0.41	0.13	0.12

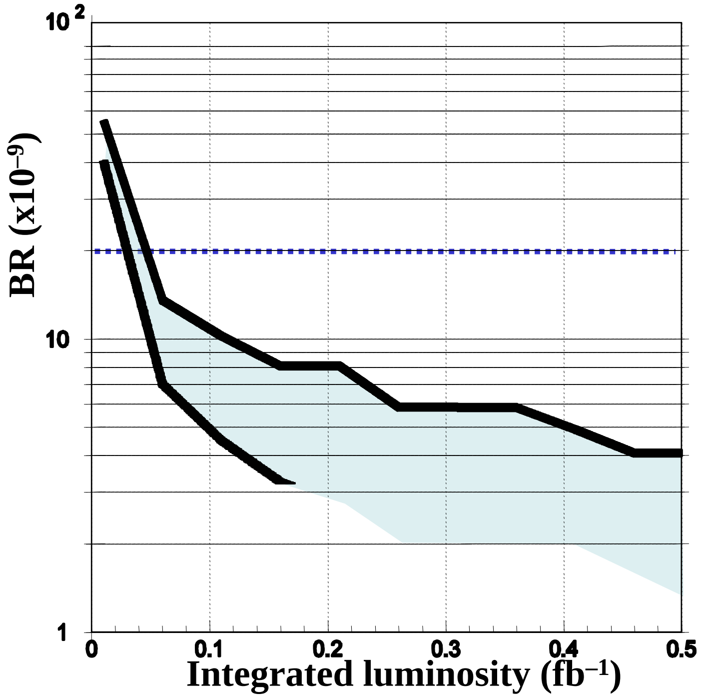
LHCb: BSM effect down to the level of SM can be excluded/ discovered with the 2009 data ($J/\psi\ \eta$, $\eta_c\ \phi$, $D_s^+D_s^-$ can be added. No angular analysis, but smaller statistics)

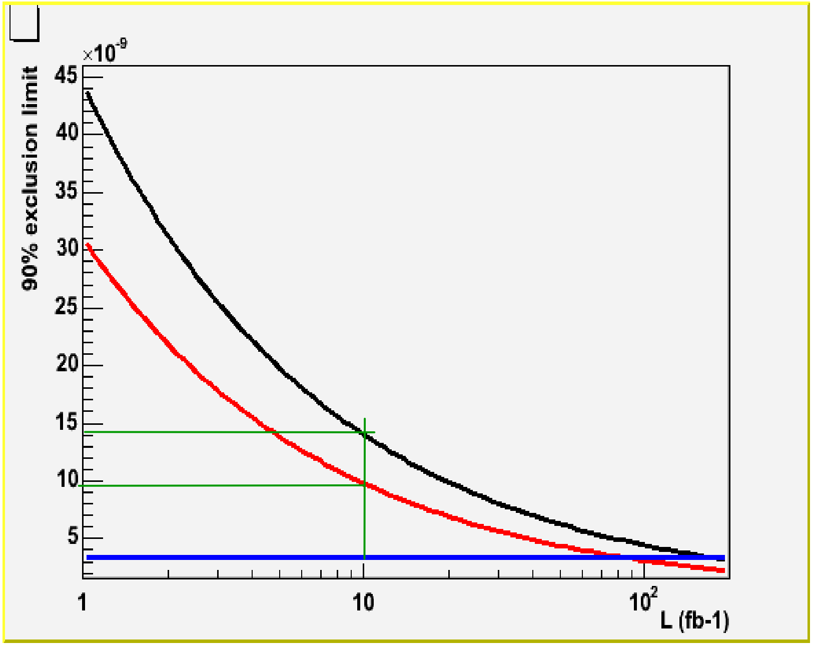
With > 2009 data

ATLAS and CMS: $\varphi_s \approx 0.04$ with 30 fb^{-1} data LHCb By ~2013, SM prediction of tested to 5 sigma level



B_s->mu mu at LHC

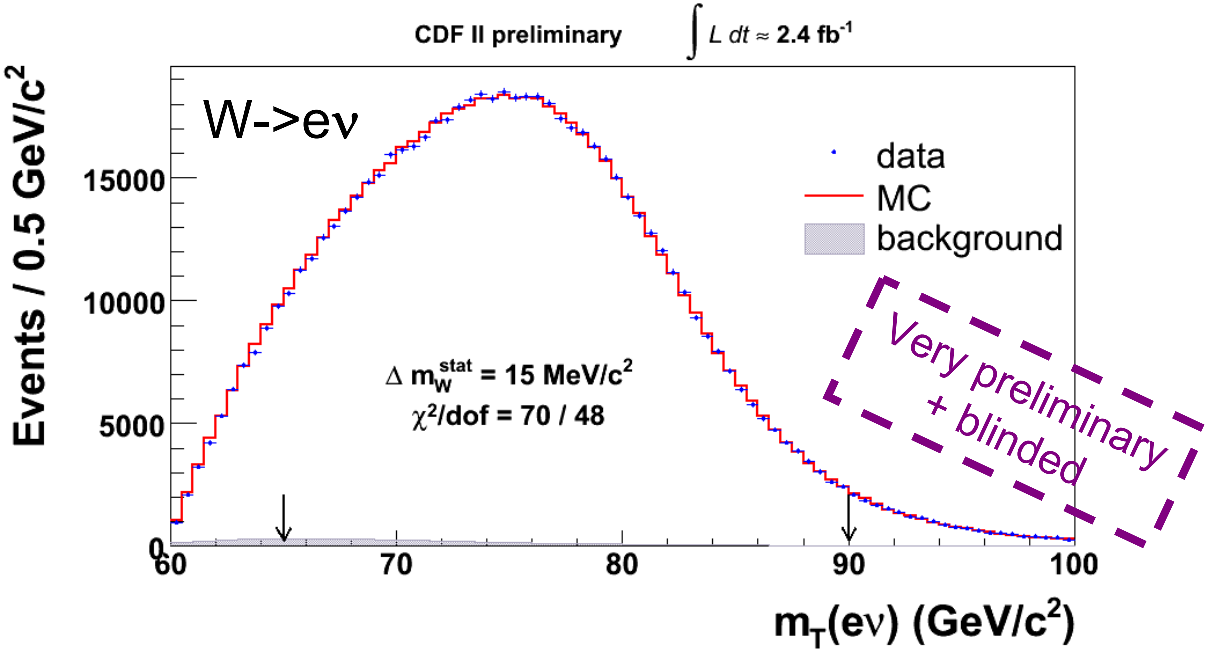




Exclusion:
0.1 fb^{-1} ⇒ BR < 10^{-8}
0.5 fb^{-1} ⇒ < SM

Electroweak

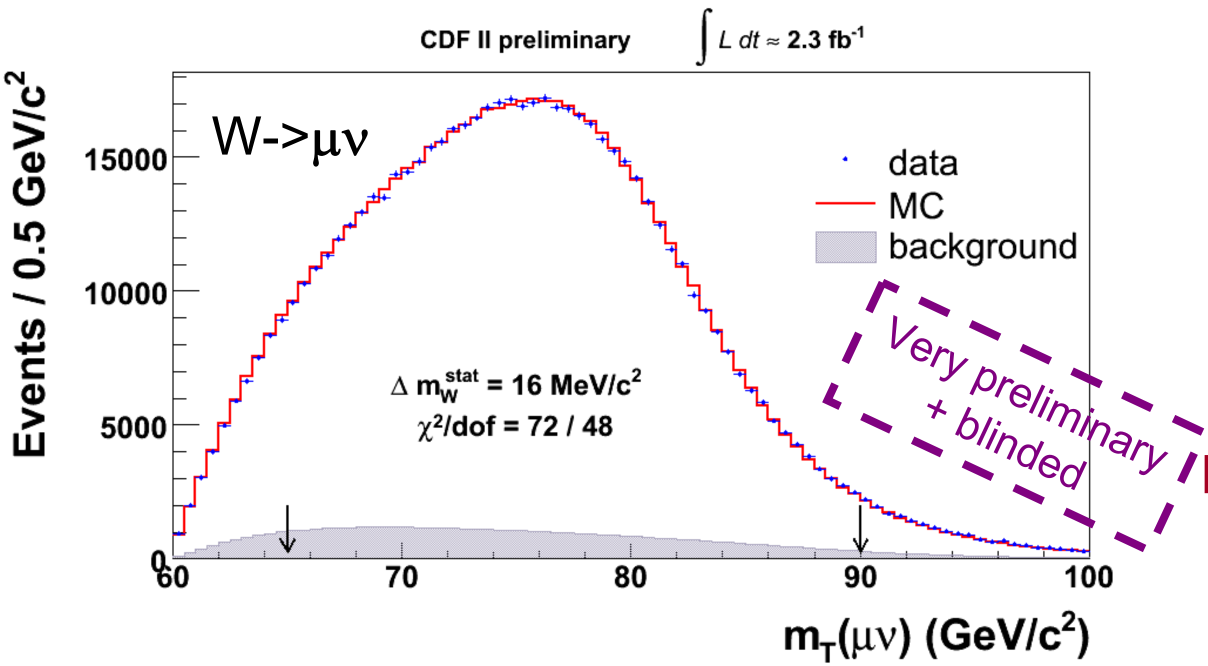
Preview of New W Mass Results



Ilija Bizjak

W->eν

	Δm_W^{stat}
published (200pb^{-1})	48MeV
expected (2.4fb^{-1})	14MeV
fit (2.4fb^{-1})	15MeV



W->μν

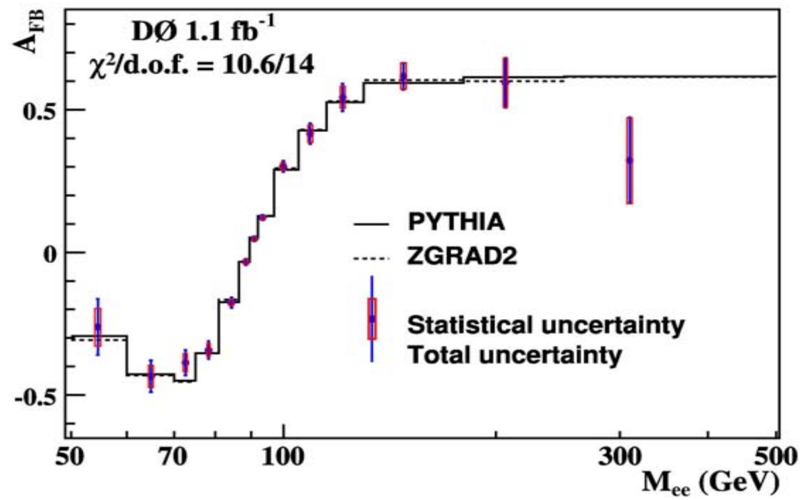
	Δm_W^{stat}
published (200pb^{-1})	54MeV
expected (2.3fb^{-1})	16MeV
fit (2.3fb^{-1})	16MeV

Kajari: ATLAS: 7 MeV/channel

Z/γ* forward-backward asymmetry

Emily Nurse

New 1.1 fb^{-1} DØ measurement (~36,000 $Z \rightarrow ee$ events with $|\eta_e|<2.5$)

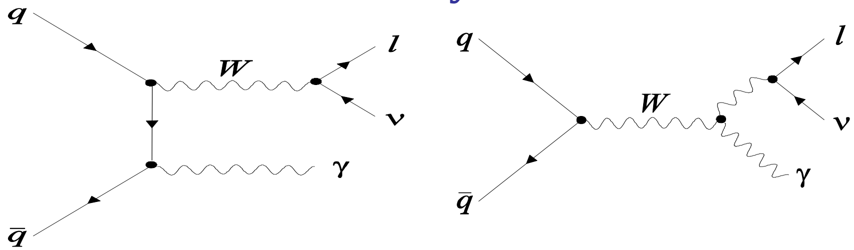


- Measurement consistent with the SM prediction (note: large M_{Z/γ^*} region sensitive to a new Z′ boson).
- $\sin^2\theta_w^{eff}$ extracted from fit to A_{FB}:
  - 0.2327 ± 0.0019 (DØ 1.1 fb^{-1}) arXiv:hep-ph/0804.3220
  - 0.23152 ± 0.00014 (current world average)

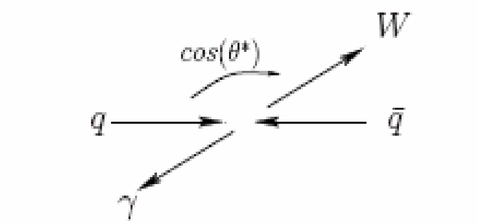
Wγ analysis: Radiation Amplitude Zero

Ia Iashvili

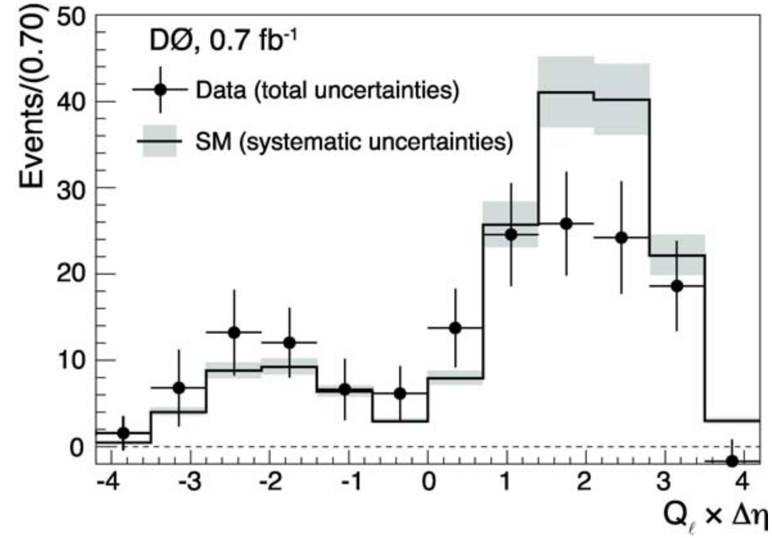
- Photons radiated from quark and W lines interfere destructively

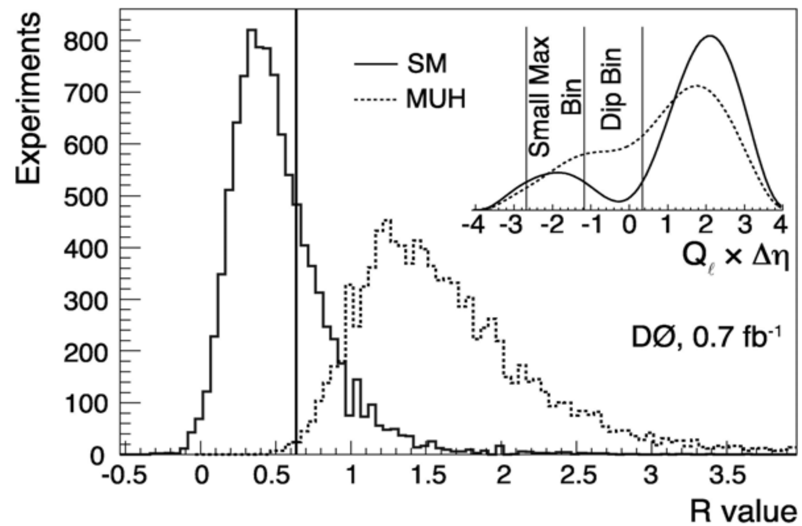


- ❑ Zero amplitude at
  - ➢ cosθ* =+1/3 for u dbar →W^+ γ
  - ➢ cosθ* = -1/3 for d ubar →W^- γ



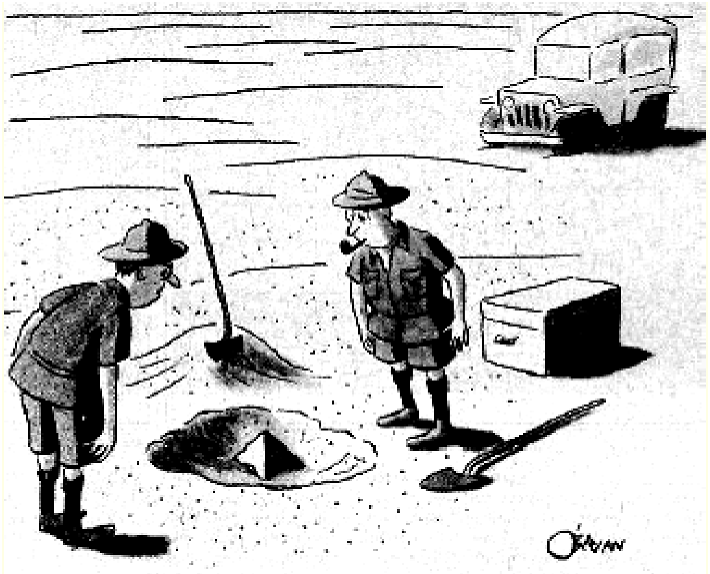
- ❑ No measurement of pz of ν: use Q_l ($_\gamma$ - $_l$) to observe "dip" in the distribution
- ❑ Non-SM coupling may fill the "dip"





- **DØ:** No dip hypothesis ruled out at 2.6 σ level ⟹ constitutes first indication for radiation-amplitude zero in *Wγ*.

Searches



"This could be the discovery of the century. Depending, of course, on how far down it goes"

Same

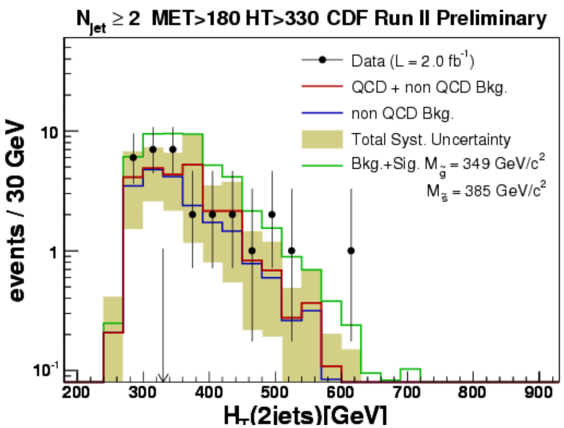
Unobserved

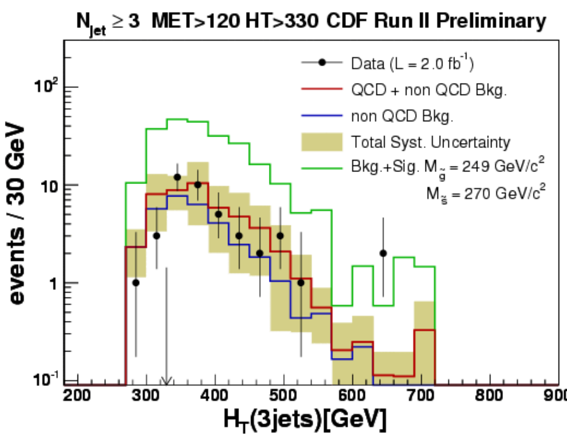
Stuff

Yearly

Squarks and Gluinos

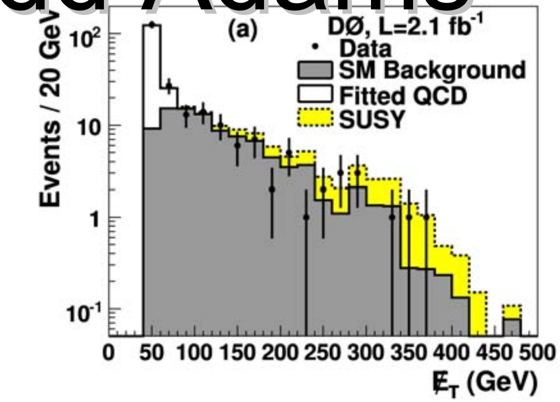
Todd Adams

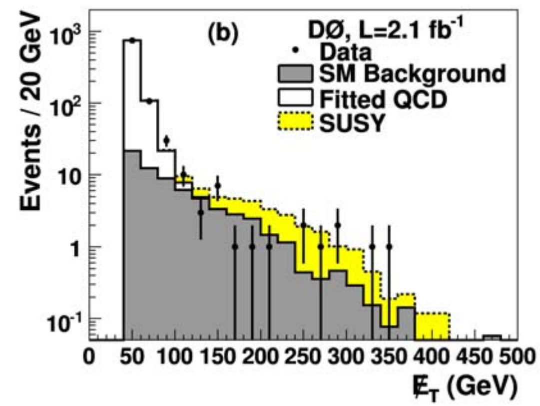




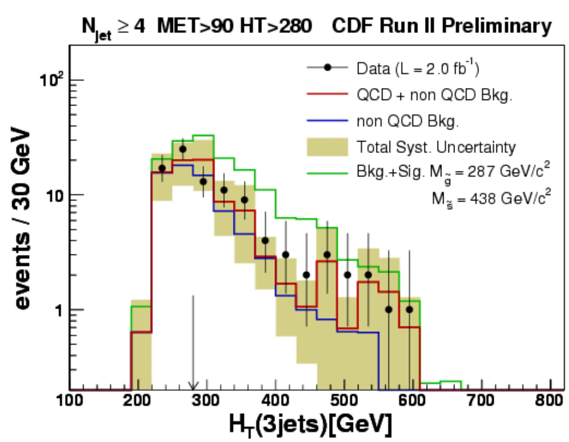
Distinguish from QCD

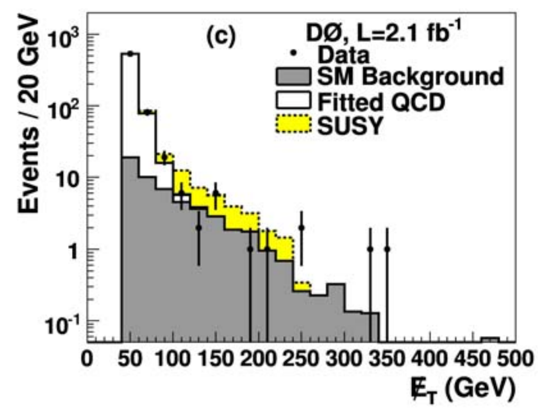
Optimize for multiple SUSY





2.0 fb^{-1}

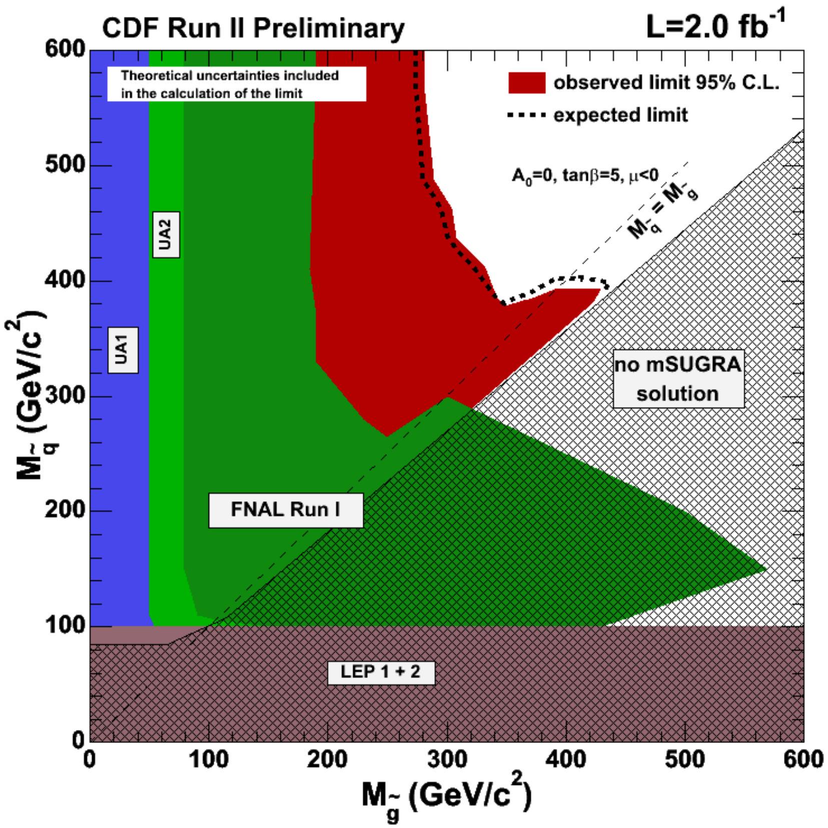


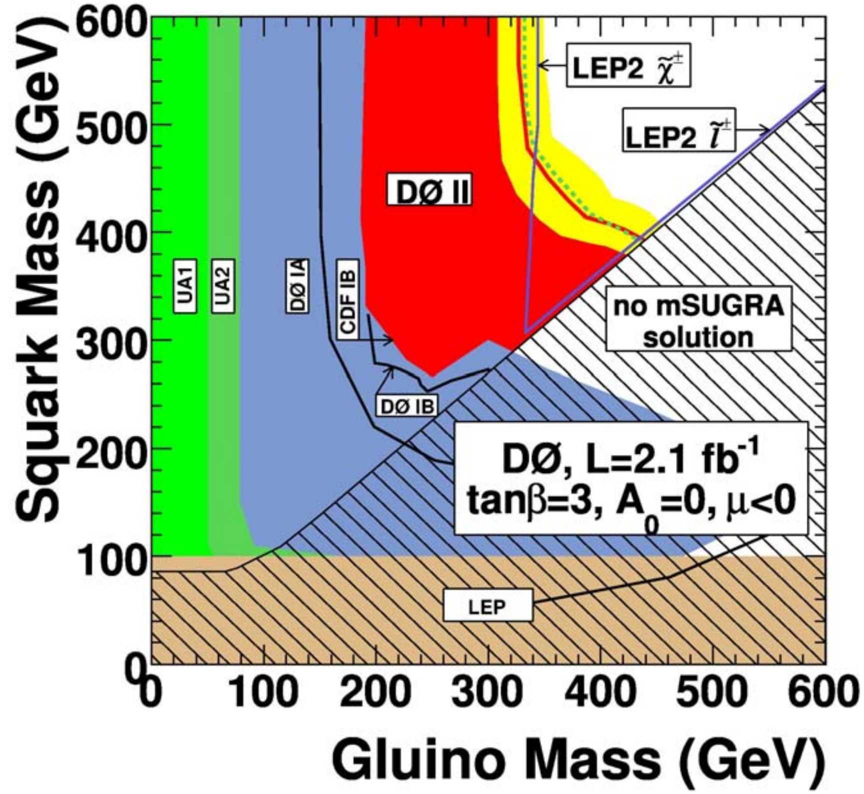


2.1 fb^{-1}

Mass Limits

2.0 fb^{-1} 2.1 fb^{-1}





M > 392 GeV [M($\tilde{q}$)=M($\tilde{g}$)]

M($\tilde{g}$) > 280 GeV

M($\tilde{q}$) > 392 GeV

M($\tilde{g}$) > 327 GeV

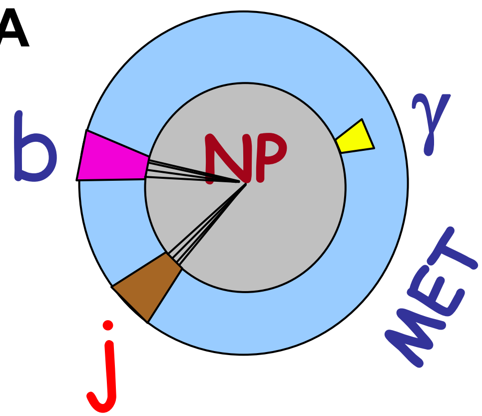
PLB 660, 449 (2008)

Anomalous γ b MET+ X

Shin Shan Yu

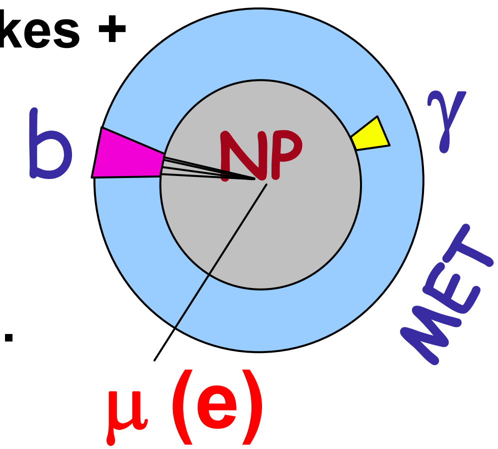
- **X = jets, background mostly fakes**
- **GMSB, mSUGRA**
- **No excess**

637±139 (exp) vs. 617 (obs)

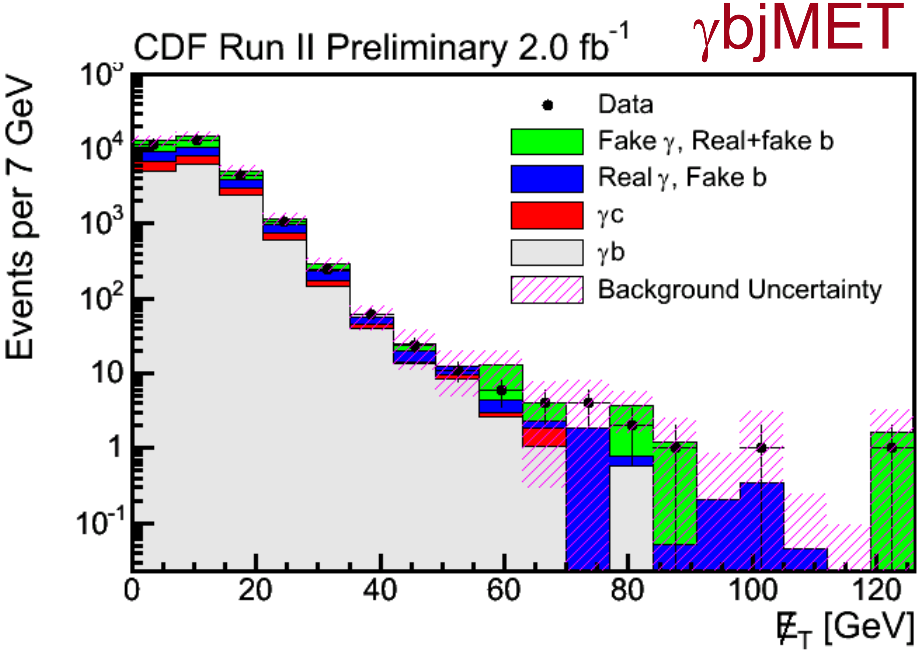


- **X = e or μ, backgrounds: fakes + $t\bar{t}\gamma$**
- **MSSM**
- **No excess**

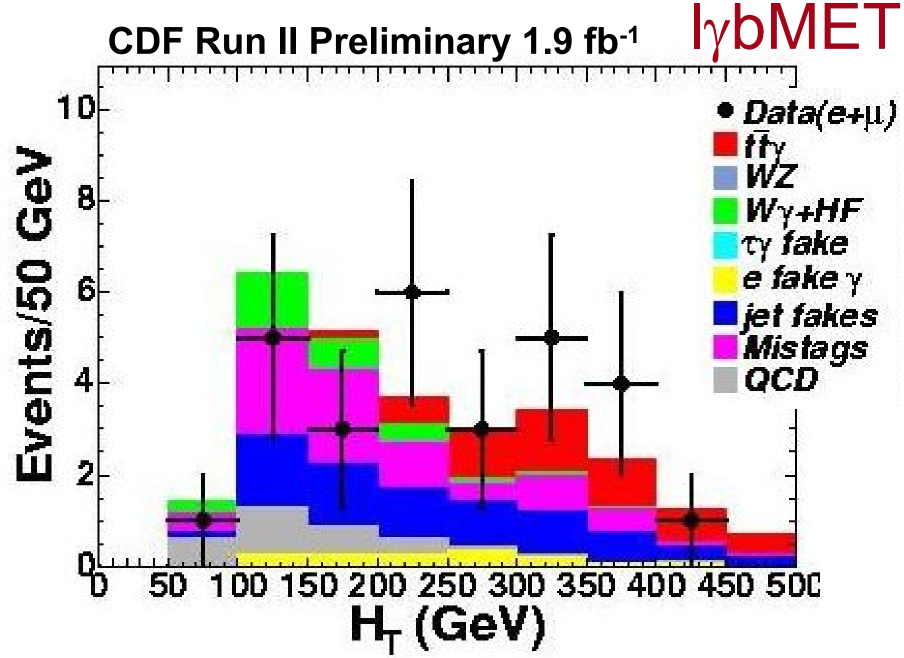
27.9±3.6 (exp) vs. 28 (obs)



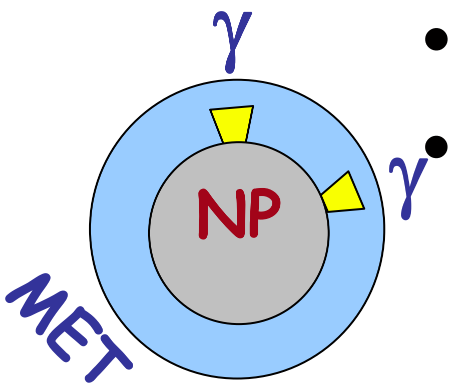
γbjMET



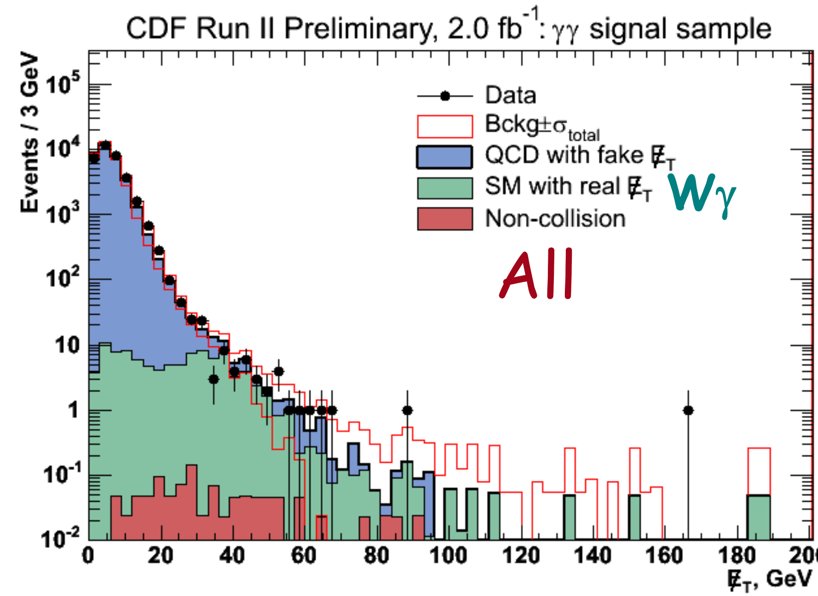
lγbMET



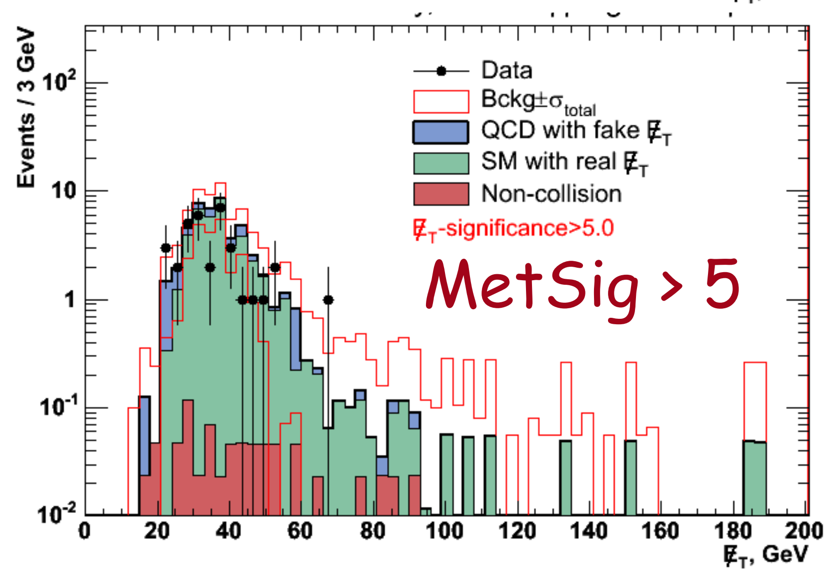
Anomalous $\gamma\gamma$ MET in 2.0 fb^{-1}



- SUSY, Higgs
- Build a "MET resolution model" to calculate MET significance

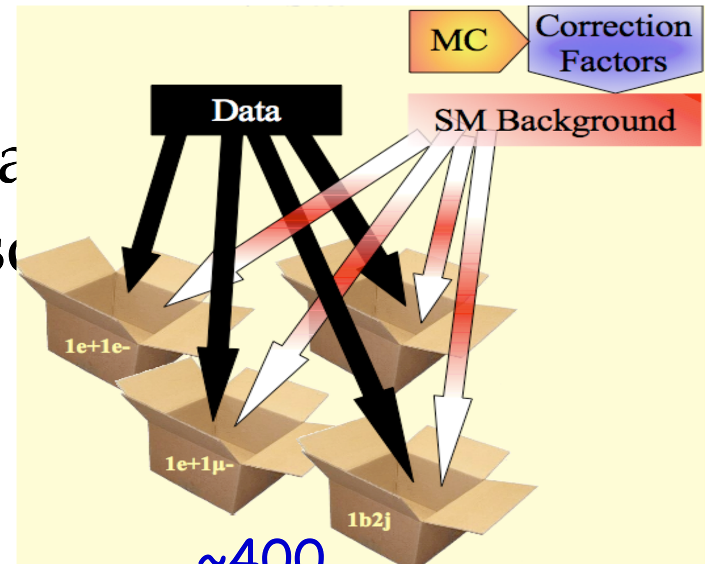


	MetSig > 3.0	MetSig > 4.0	MetSig > 5.0
EWK	53.6 ± 8.9	47.3 ± 8.0	41.6 ± 7.0
QCD	52.1± 11.5	15.4 ± 3.8	6.2 ± 2.7
Non-collision	0.90 ± 0.32	0.85 ± 0.30	0.80 ± 0.27
Total	106.6 ± 14.5	63.6 ± 8.9	48.6 ± 7.5
Observed	120	52	34



Global Search in 2.0 fb^{-1}: Vista

- Identify physics objects with $p_T > 17$ GeV
- No significant discrepancy
- Most discrepant distributions a due to difficulty in modeling s emission

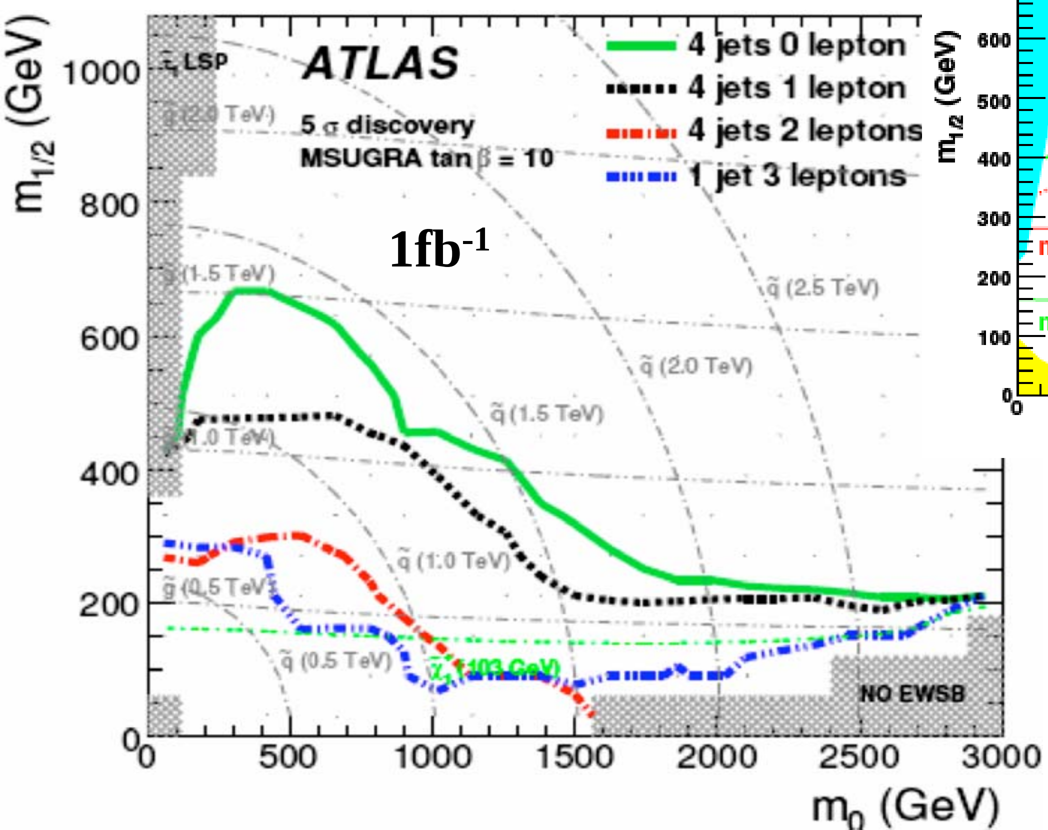


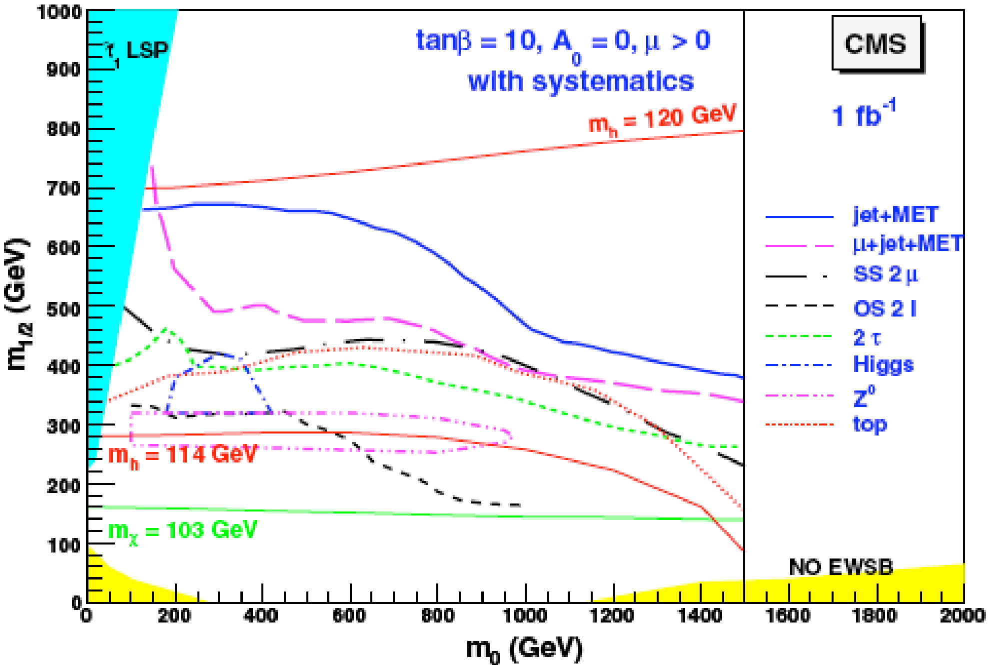
~400 exclusive final states. Compare populations and kinematic distributions.

Final State	Data	Background	σ
$be^{\pm}\not{p}$	690	817.7 ± 9.2	-2.7
$\gamma\tau^{\pm}$	1371	1217.6 ± 13.3	$+2.2$
$\mu^{\pm}\tau^{\pm}$	63	35.2 ± 2.8	$+1.7$

SUSY Searches at LHC Oleg Brandt

Plans for searches with 0 to 3 leptons +MET

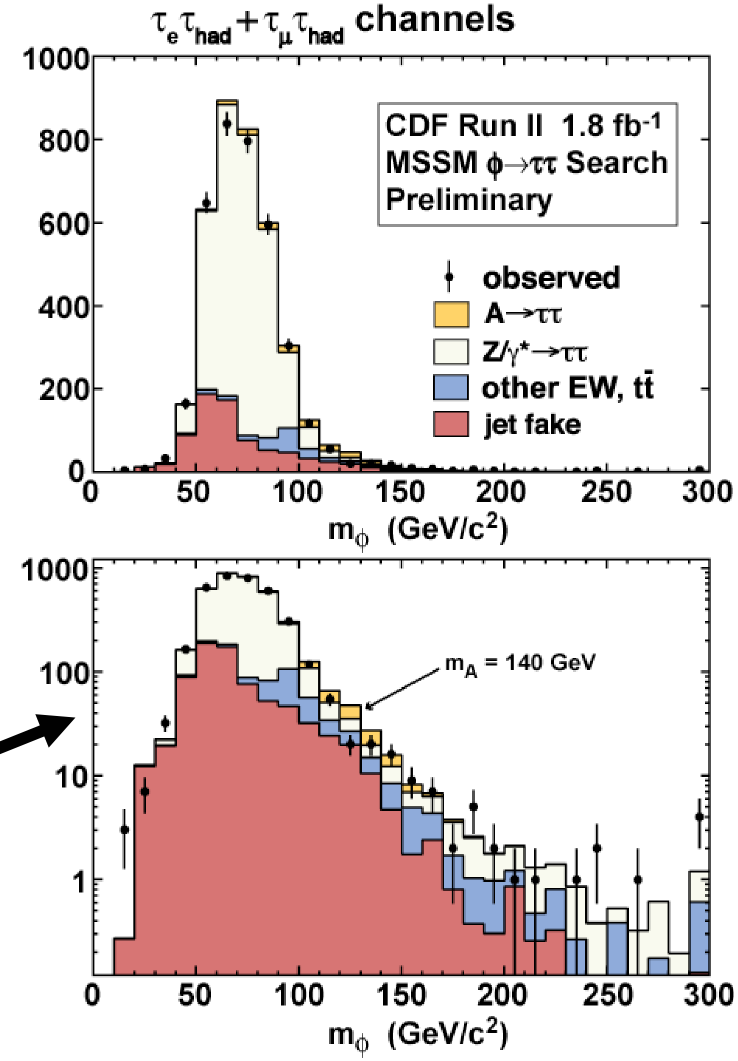




BSM Higgs Searches at TeV Frank Filthaut

- Good progress in non-SM Higgs boson searches
- starting to probe "interesting" regions of parameter space

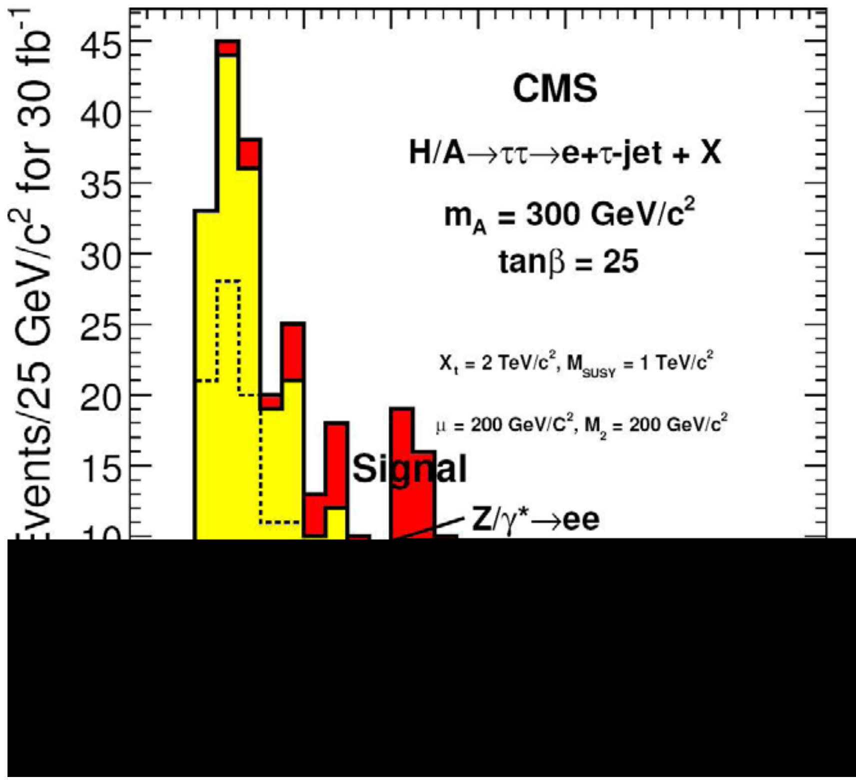
Last year's excess for 160 GeV not present with 1.8 fb^{-1}



BSM Higgs Searches at LHC

Wolfgang Mader

- Branching Fraction h->mu mu is highly suppressed in Standard Model but enhanced with tan(beta) in MSSM
  - Also many scenarios in which h->tau tau is enhanced
  - Conclude it is important to think outside the SM box



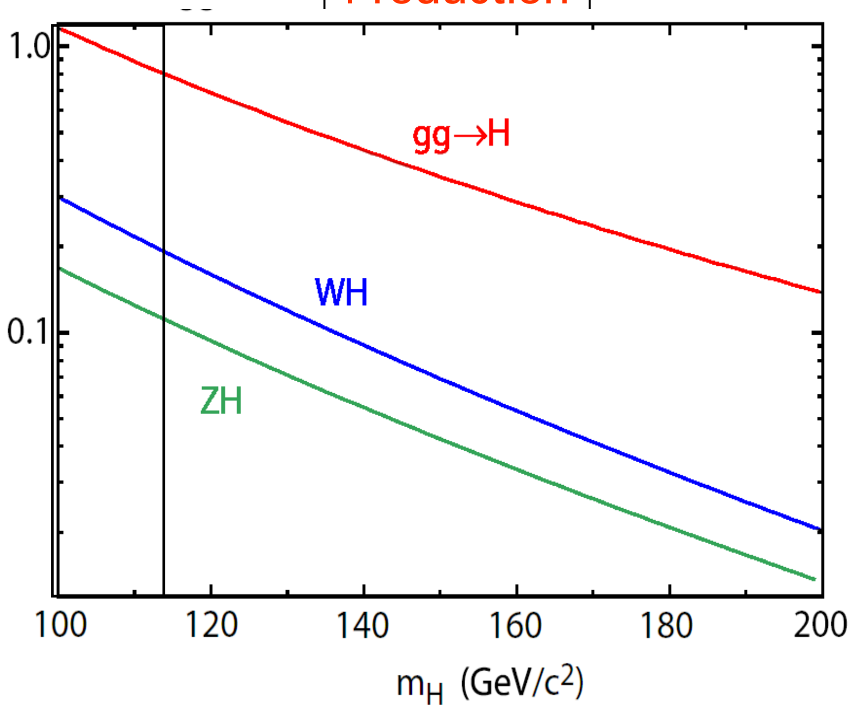
[redacted]

SM Higgs Searches

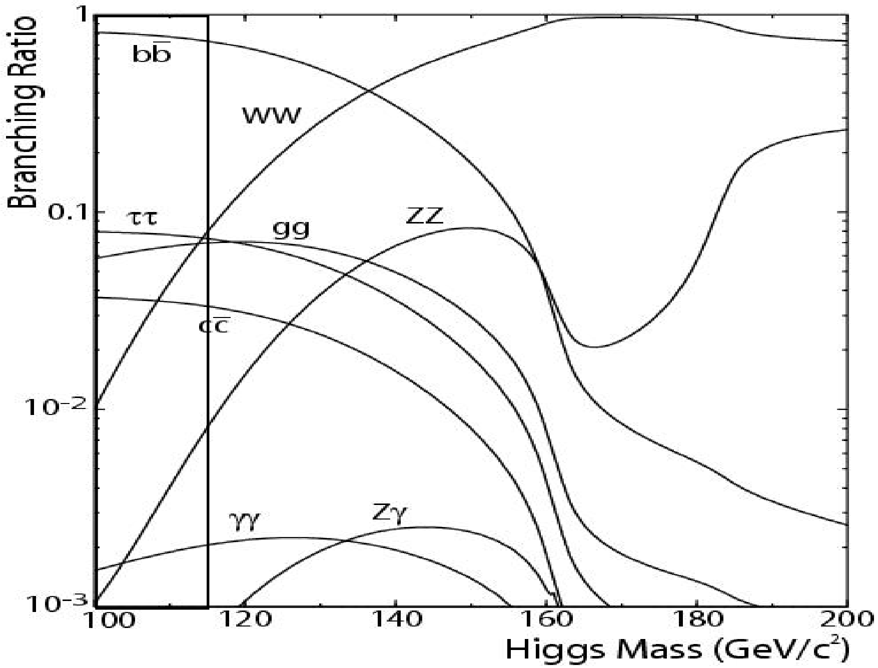
Tevatron SM Higgs Production and Decays

R. Hughes, Gregorio Bernardi

Production



Decays

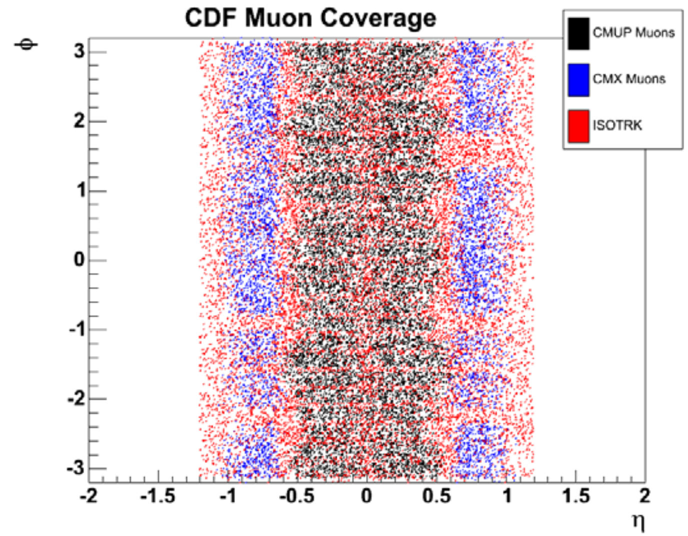


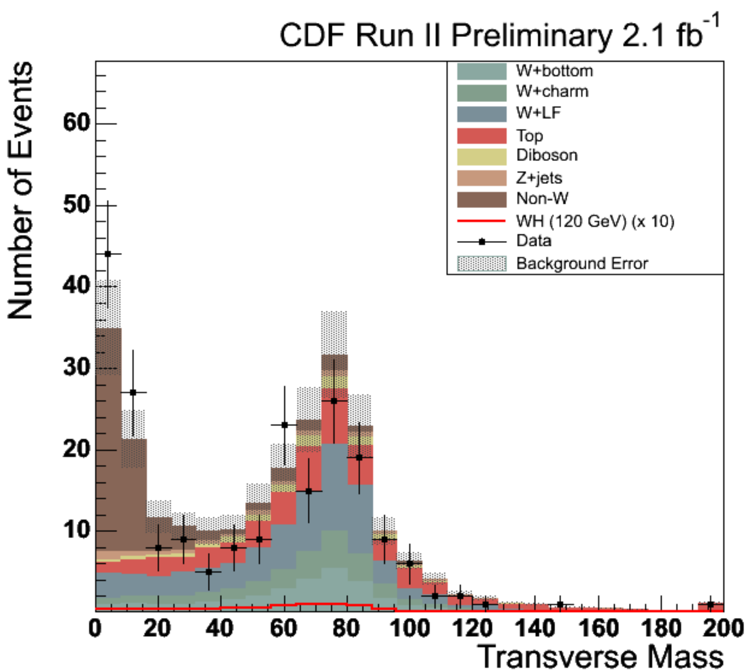
Production cross section (m_H 115-180)
→ in the 0.8-0.2 pb range for gg → H
→ in the 0.2-0.03 pb range for WH associated vector boson production

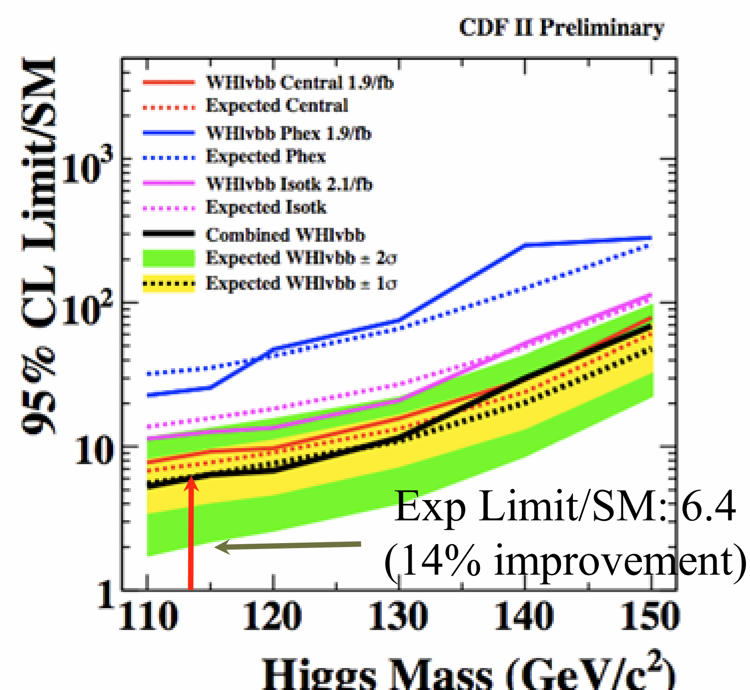
Dominant Decays
→ bb for M_H < 135 GeV
→ WW* for M_H > 135 GeV

Adding Acceptance to WH: ISOTrack

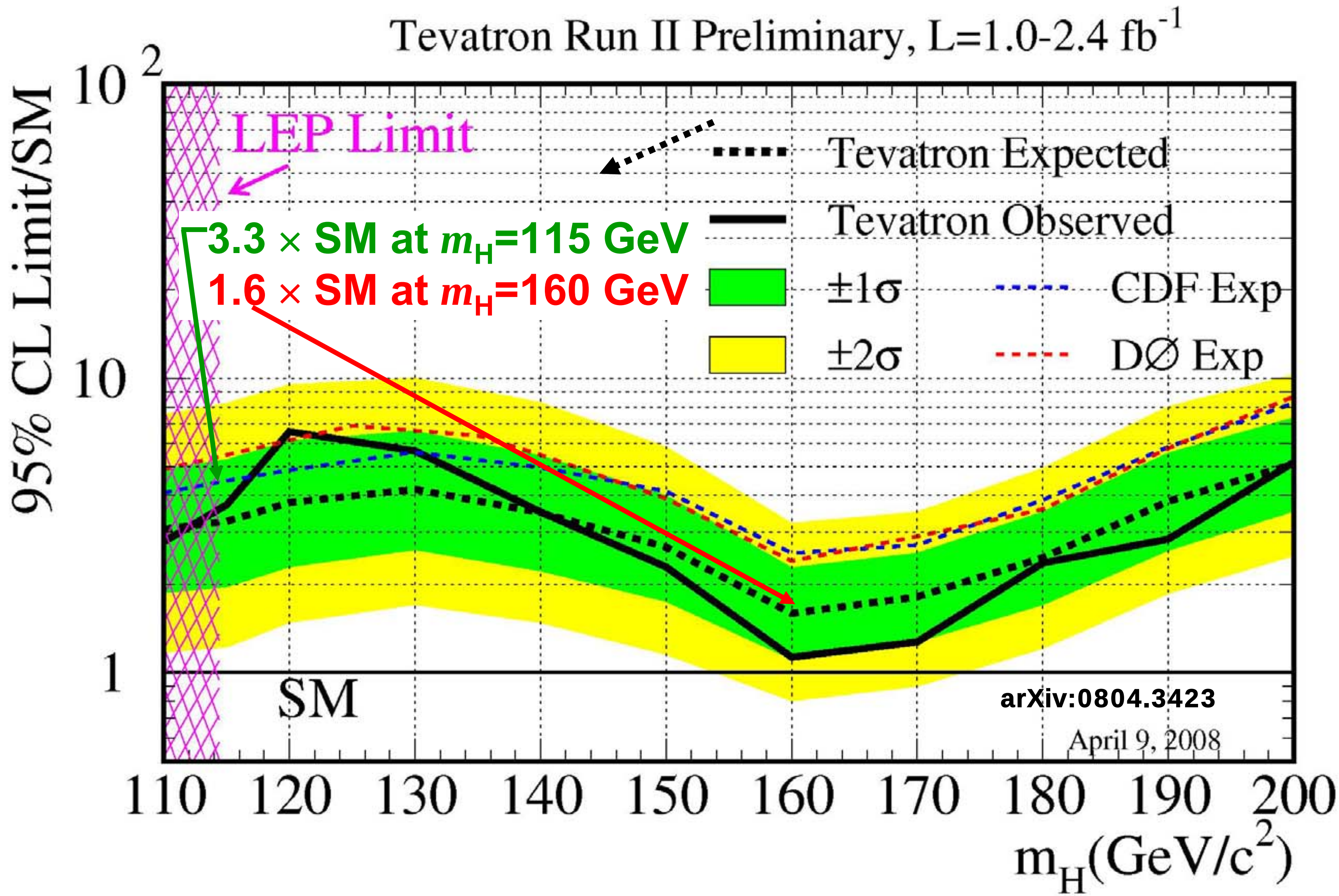
- Look for WH events which fail standard lepton selection
- Use MET + 2jet trigger
- Only use track info: no CAL or Muon chamber info
- Increases acceptance by 25%!







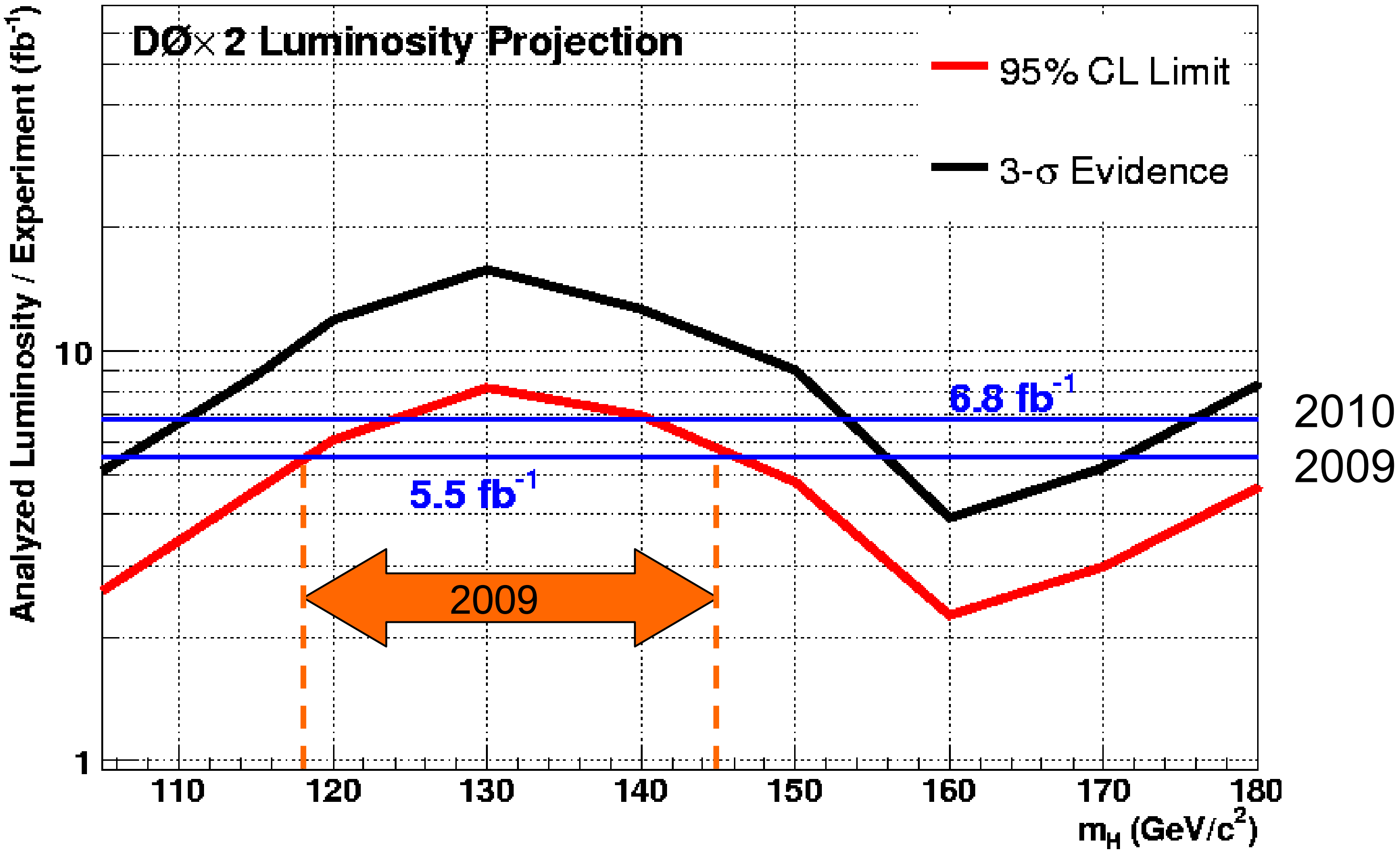
Post-Moriond 2008



Observed limit at m_H= 160 Gev: 1.1 x SM (3.6 @ 115 GeV)

➔Very close to excluding a 160 GeV SM Higgs. @ ICHEP: ~ 3 fb^{-1}

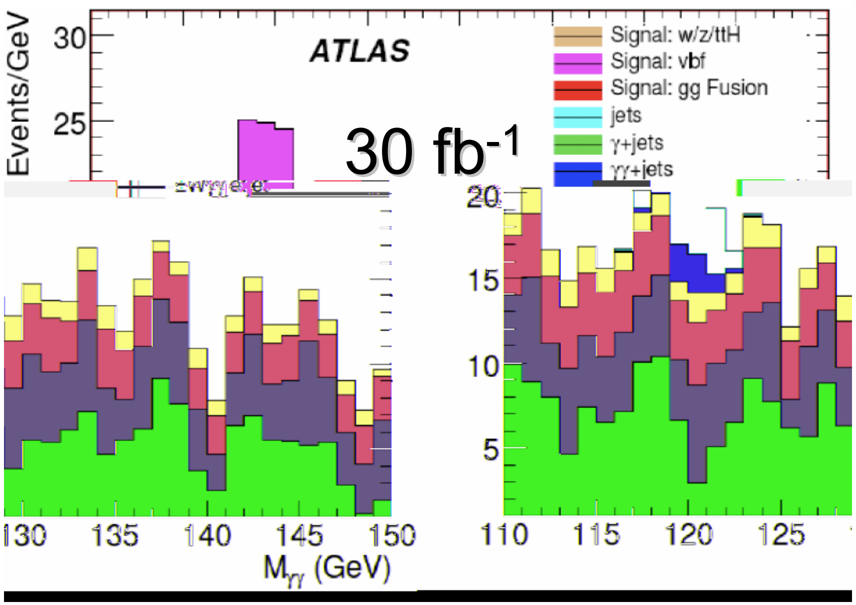
Expected Higgs sensitivity



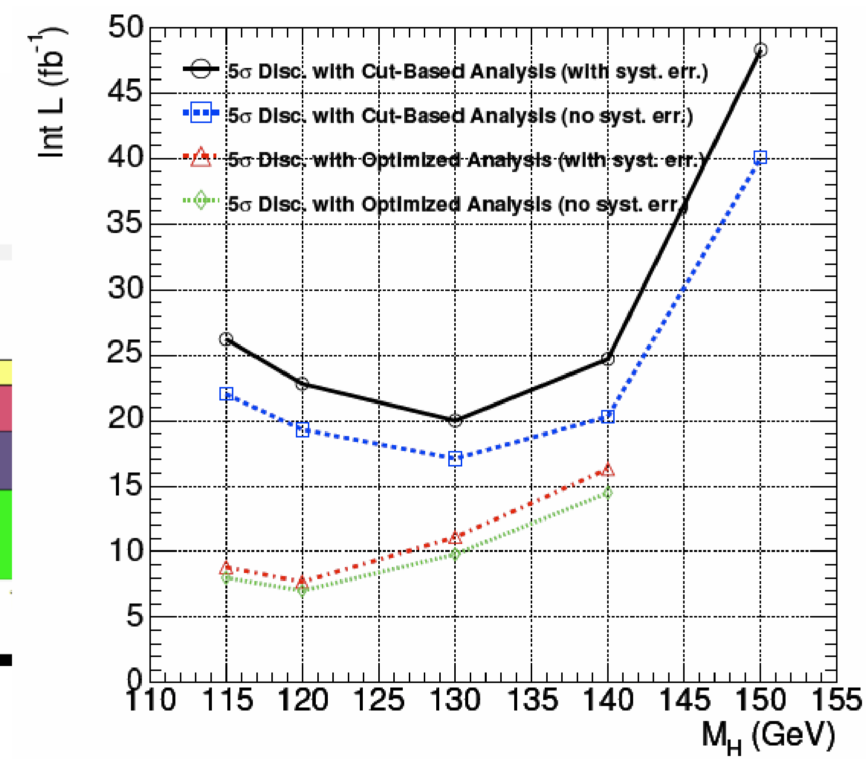
By the time LHC produces Higgs Physics (end 2009), precision EW meas. + Tevatron might allow SM Higgs only with mass between 118 and 145 GeV, definitely only a light Higgs boson, which will take some time to be found at LHC (> 1 fb^{-1}) ➔ LHC/Tevatron complementarity H→ γγ vs H→ bb

LHC SM Higgs Search

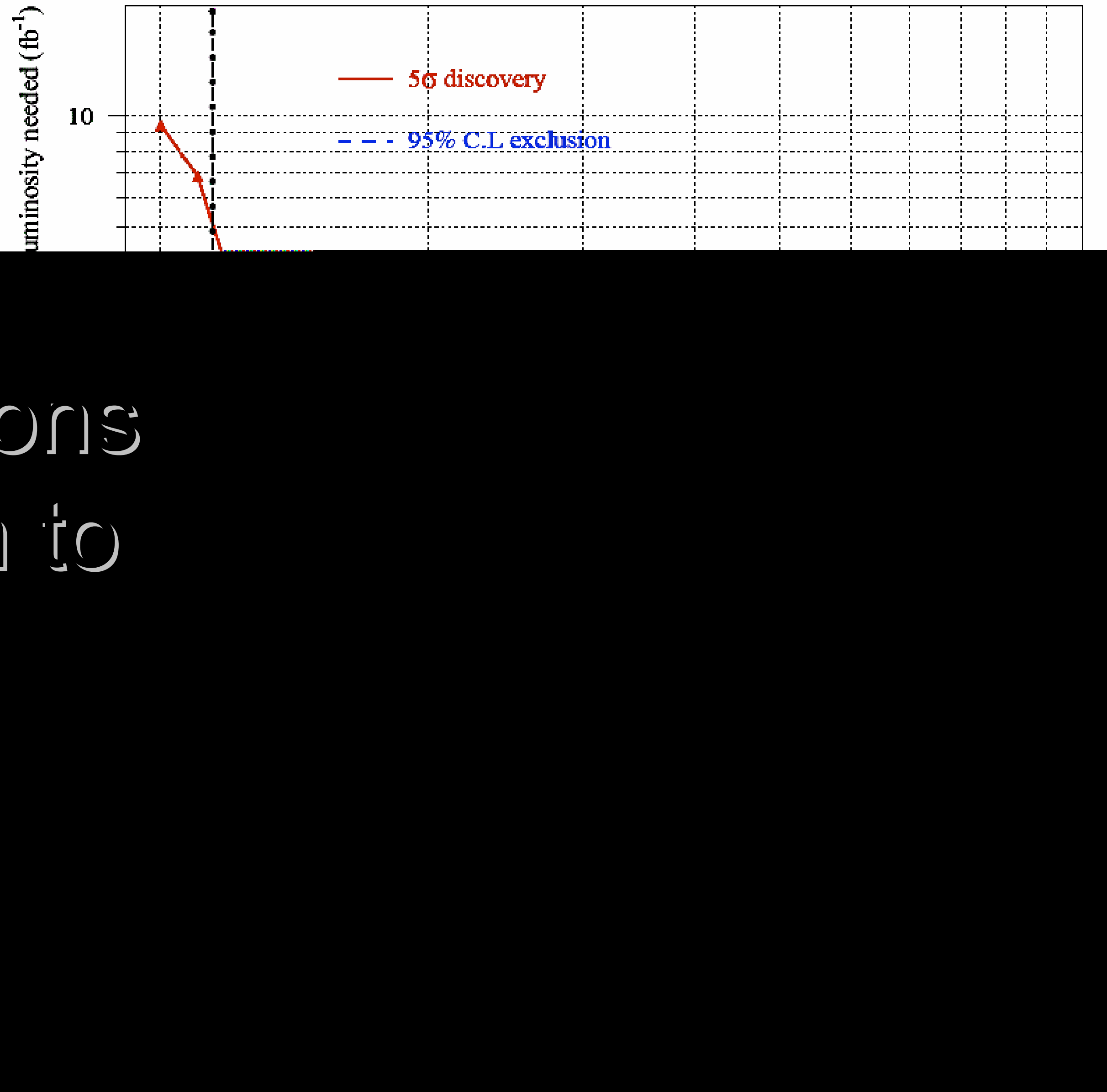
$$pp \to H \to \gamma\gamma$$



CMS



Combined CMS and ATLAS Reach



Warning:
These projections are stale, soon to be updated

Non-SM Higgs Decays **Spencer Chang**

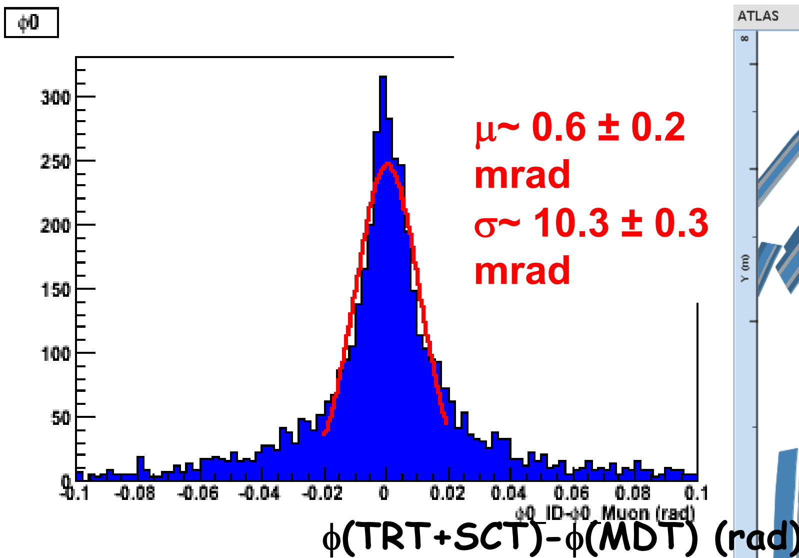
Raining on the SM parade?

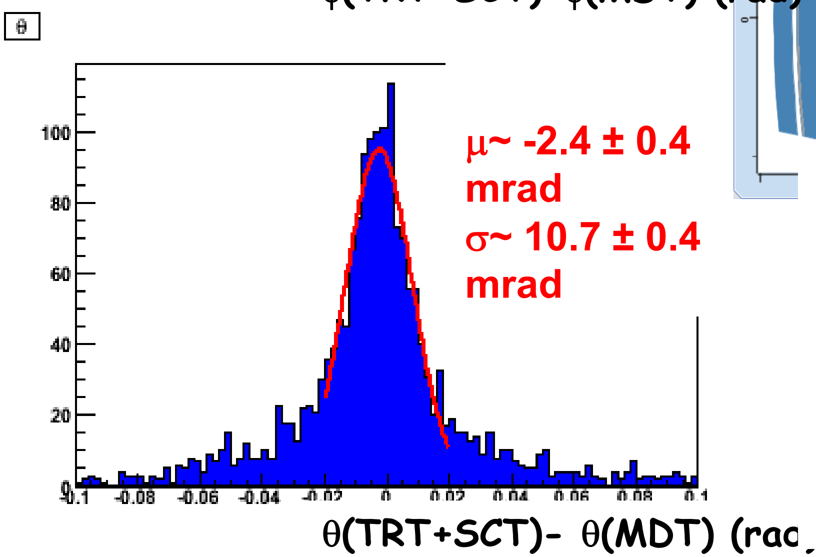
- Higgs could have a large coupling to a new non-stable (relatively) light object
- In that case:
  - **the LEP Higgs bound will be eroded**
  - **More luminosity is required to produce and detect the higgs in its SM decay modes**

LHC Commissioning

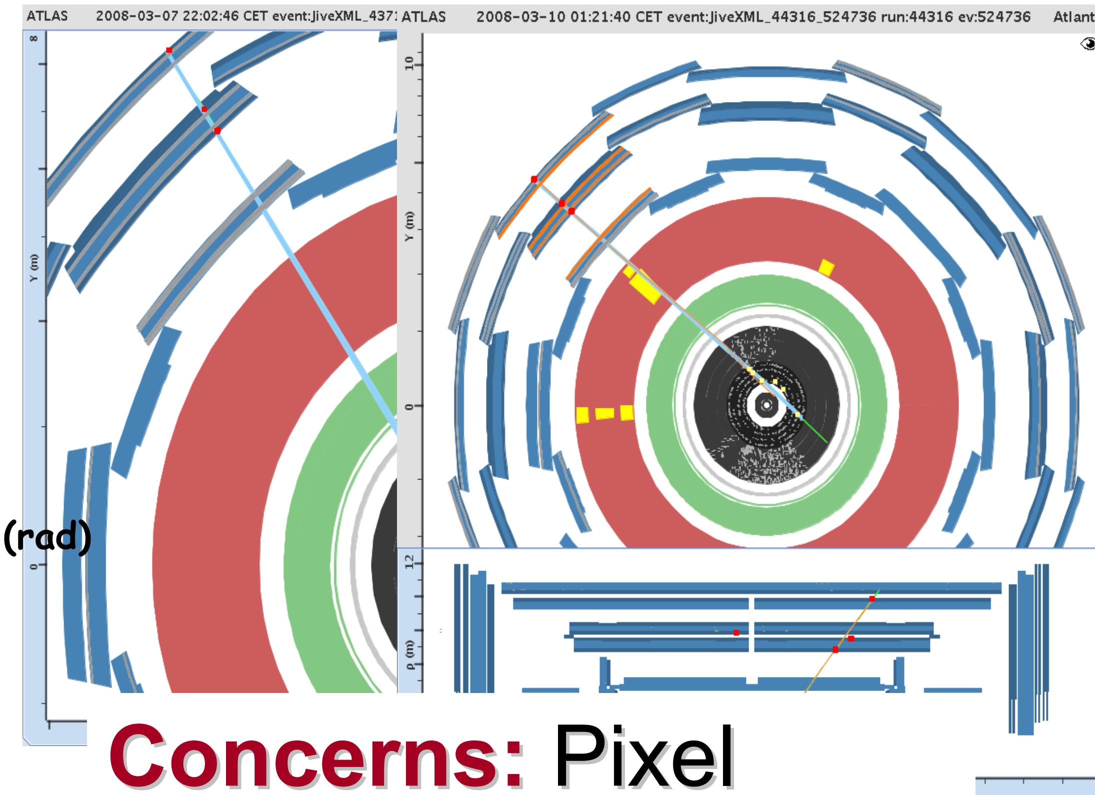
ATLAS: TRT+SCT and Muon

Juergen Thomas





Difference of track position (η,φ)
TRT+SCT vs. Muon (MDT)

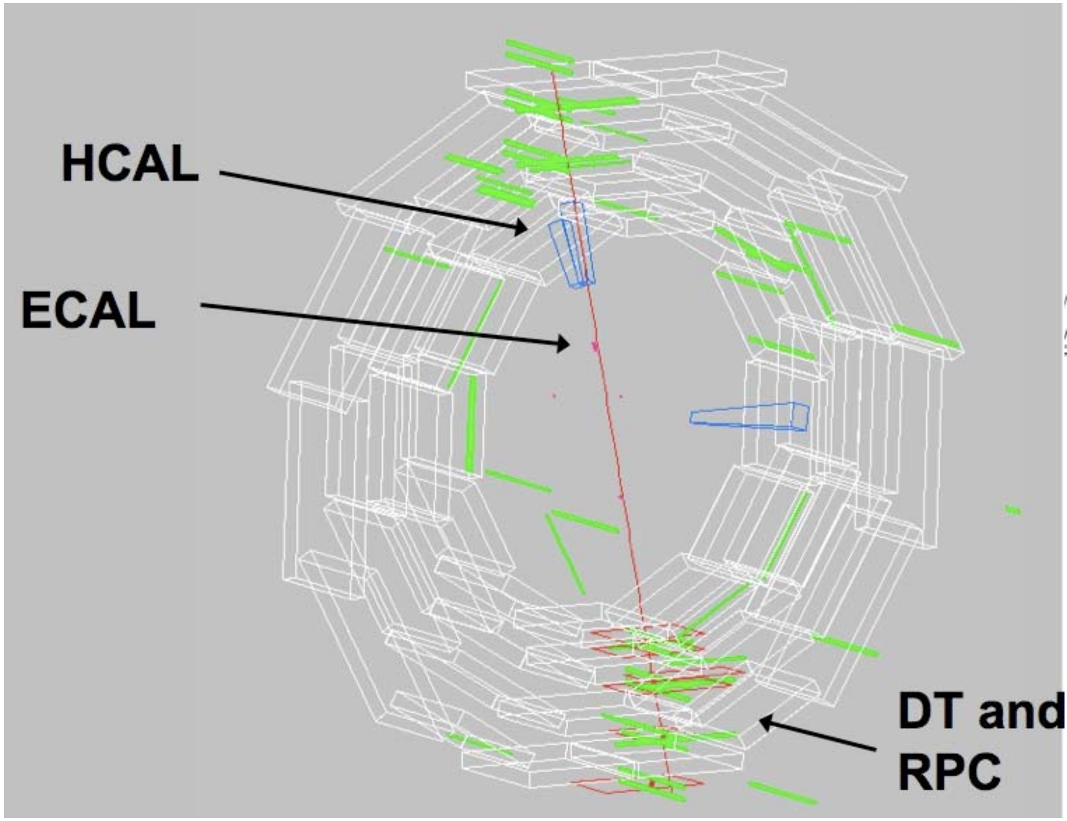


Concerns: Pixel cooling problem cut shorts commissioning

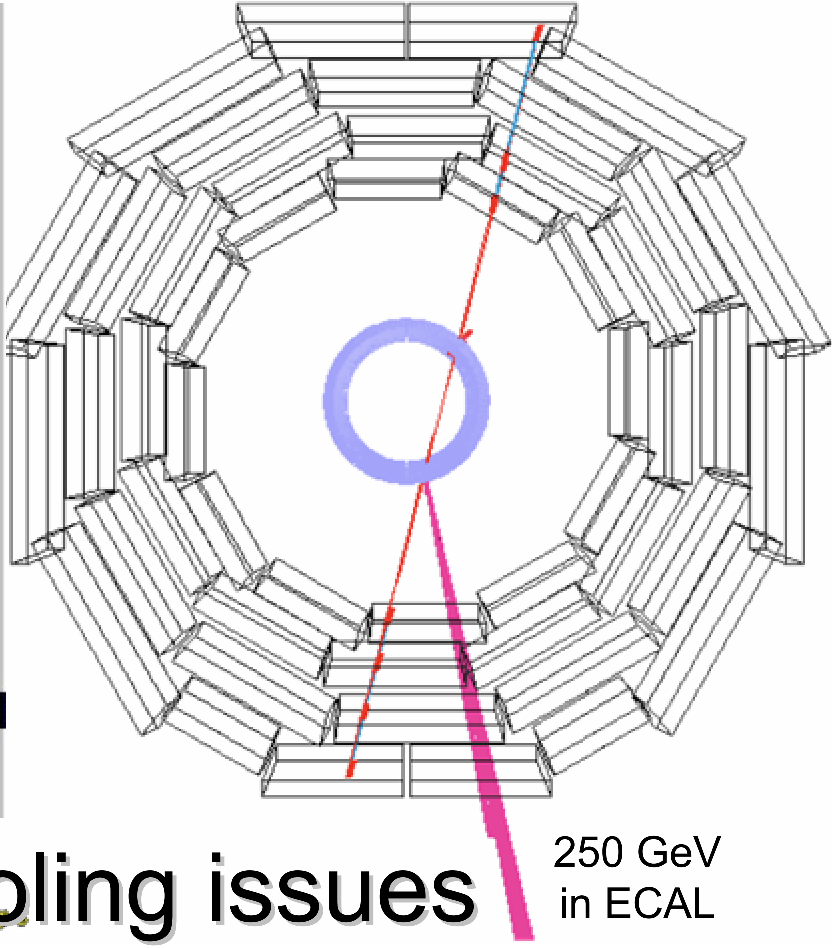
CMS Commissioning

Luca Malgeri

A muon coincidence



A showering muon



CMS also has tracker cooling issues

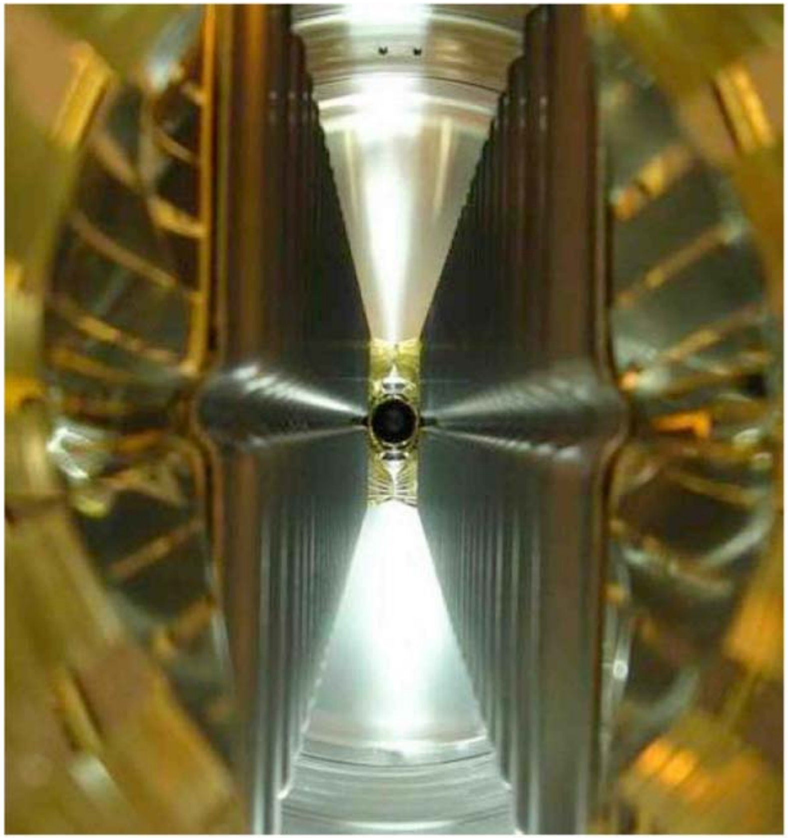
LHCb Commissioning - The VErtex LOcator **Staphane Monteil**

✓**The detectors and their electronics are fully installed, and all the subsystems have been checked out successfully (reproducibility of the repositioning, cooling…)**

✓**One half has been read out successfully under Neon atmosphere. The test of the other half is ongoing.**

✓**The full system will next be checked under vaccum.**

✓**S/N > 20 measured in test beam corresponding to resolution σ_{IP} =9-20 um in ϕ, 9-25 in R. Confirmed in situ.**

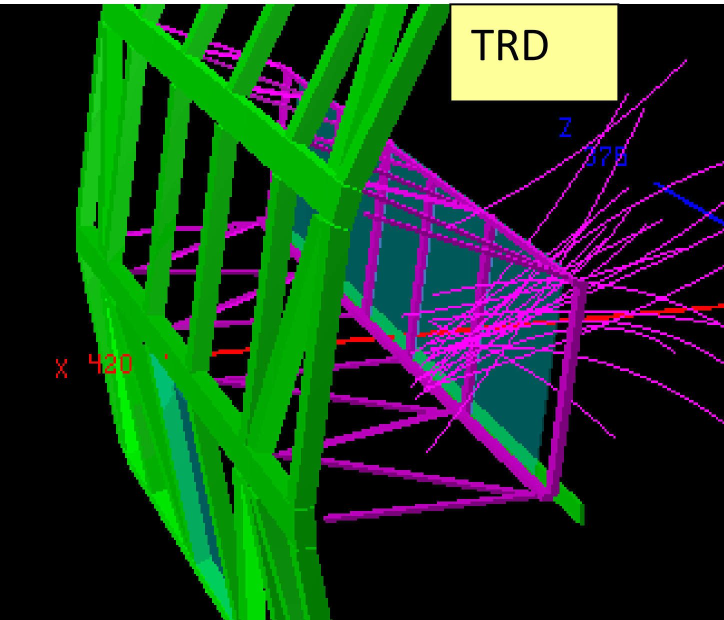


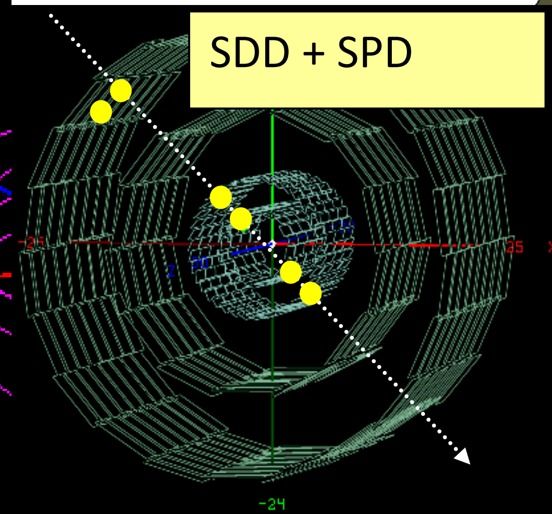
Beam-eye view of the VELO

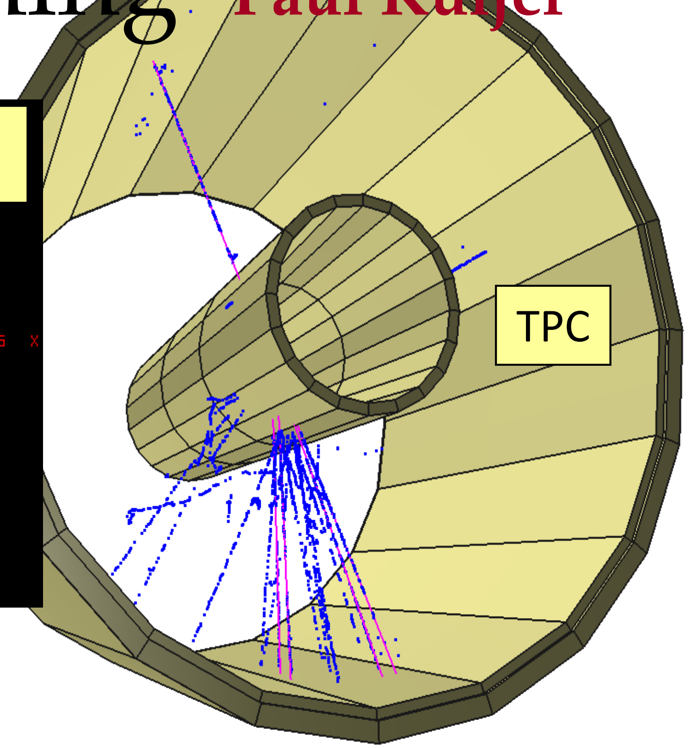
Concern: Outgassing in outer tracking chambers appears to be fixed – is this really?

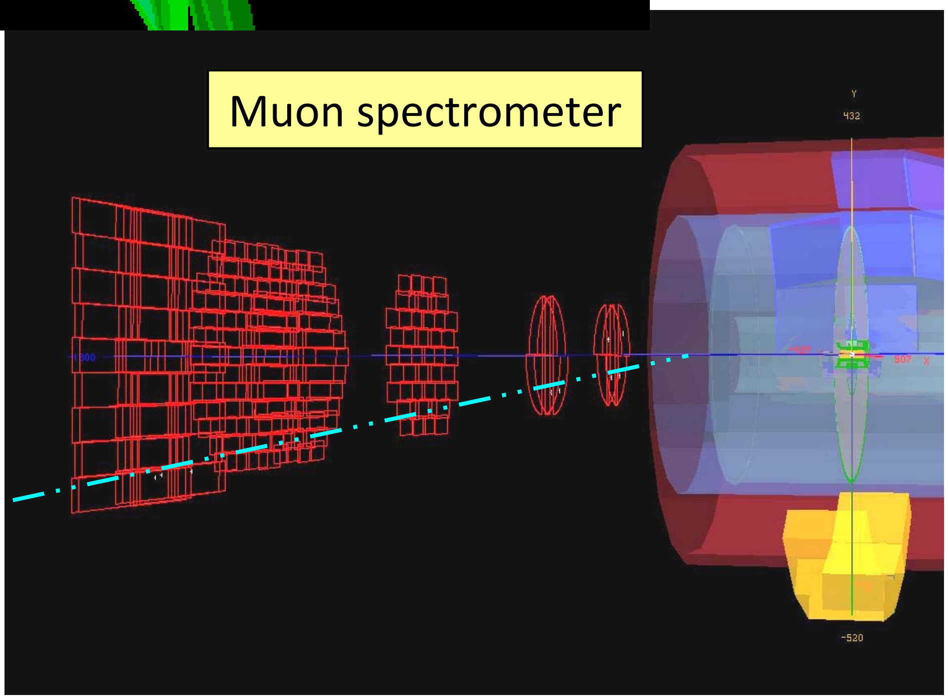
ALICE Commissioning

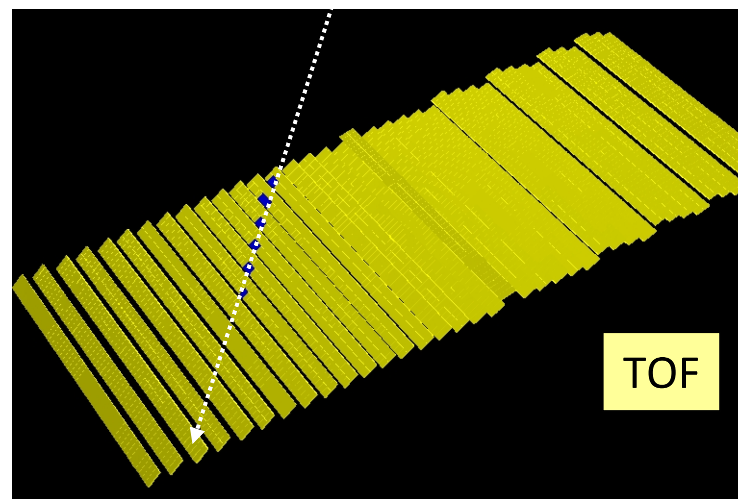
Paul Kuijer









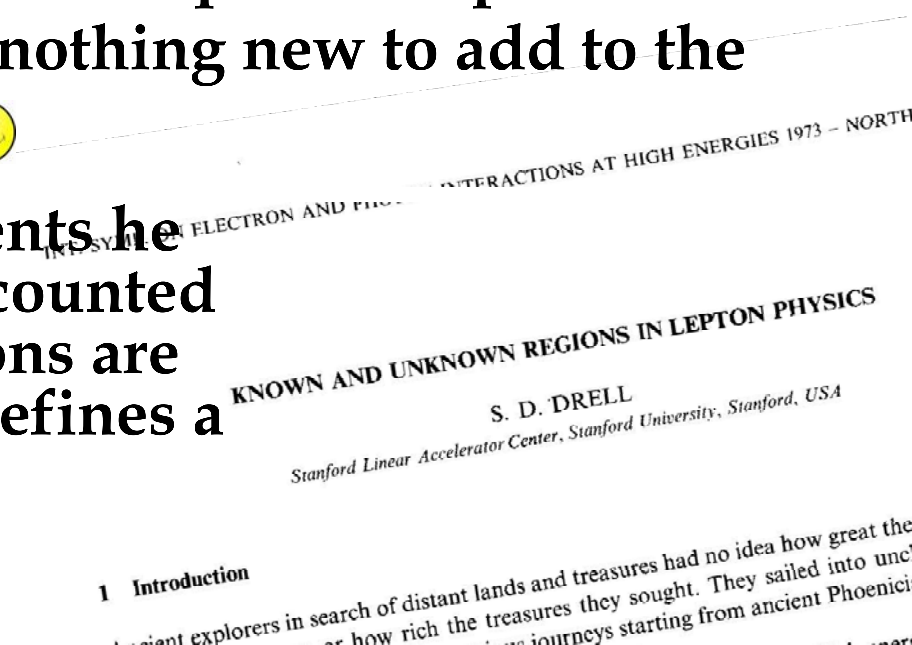


Historical Context

- Perhaps HCP2008 is not unlike pre-Nov. revolution 1973 "Electron-Photon" Conference in Bonn:
- From S. Drell's summary talk:

– **"The notion of weak binding of light quarks (Mq~300 MeV) to form the nucleon is in accord with analyses of baryon spectra and transition amplitudes…The basic problem of why we don't "see" free, individual quarks or partons of the nucleon persists…and I have nothing new to add to the resolution of this problem."**

– **But based on scaling arguments he states "These facts can be accounted for by asserting that the gluons are very heavy, and their mass defines a scale of new physics."**


ELECTRON AND PH… INTERACTIONS AT HIGH ENERGIES 1973 – NORTH

KNOWN AND UNKNOWN REGIONS IN LEPTON PHYSICS

S. D. DRELL

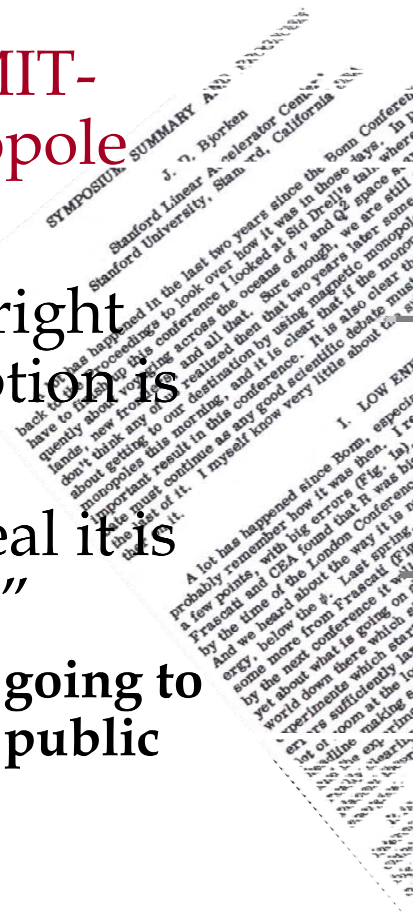
Stanford Linear Accelerator Center, Stanford University, Stanford, USA

1 Introduction

…cient explorers in search of distant lands and treasures had no idea how great the… …or how rich the treasures they sought. They sailed into unc… …journeys starting from ancient Phoenici…

HCP2009? 2010?2011?

- Perhaps some HCP soon will be like the 1975 Lepton-Photon at Stanford:
- A host of revolutionary results from SPEAR, MIT-BNL, Doris, and a reported CR magnetic monopole
- From J.D. Bjorken's summary talk:
  - "We must be absolutely sure we are on the right track and that the [tricolored] quark description is right."
  - "…it is clear that if the monopole event is real it is the most important result in this conference"
  - **"Where are we going? The answer is easy. We are going to do more experiments and (our patrons, the general public willing) build new machines."**



Hopes, Wishes, Conclusions

- May we live in exciting times, like 1974
- May history be kind to us and say we were at least on the right track
- May the new physics be so compelling that our patrons will be willing and we can state:
  - "**Where are we going? The answer is easy. We are going to do more experiments and (our patrons, the general public willing) build new machines.**"

J.D. Bjorken