# CDF Activities

Simona Rolli
Tufts University

# Outline

- Service work
  - PerfIDia
  - Code management and code migration
- Physics analysis
  - Very Exotic Processes
  - Search for LeptoQuarks
- Miscellanea (talks, presentations)

# Service Work

- I have been involved in several specific software responsibilities over the years:
  - evtNtuple (SR)
  - TRGSim++ (SR)
  - PerfIDia (SR)
  - Operating System migration and Software validation (SR)
- general tasks to fulfill
  - Shifts
  - GodParenting Committees (none in 2010)
- and groups leaderships
  - Exotics, VEP, Trigger and Datasets, etc.

# Physics Analyses

- Exotic Searches
  - Simona Rolli, Gabriel Dunn, Stefania Vitillo - Searches for 1st and 2nd generation Leptoquarks
  - Simona Rolli at al.
    - VEP group analyses:
      - Z' searches
      - Multijets bump searches
      - Anomalous events in MET + jets
      - Fermiophobic Higgs in 4-$\gamma$ final state
      - Search for W' in e-$\nu$

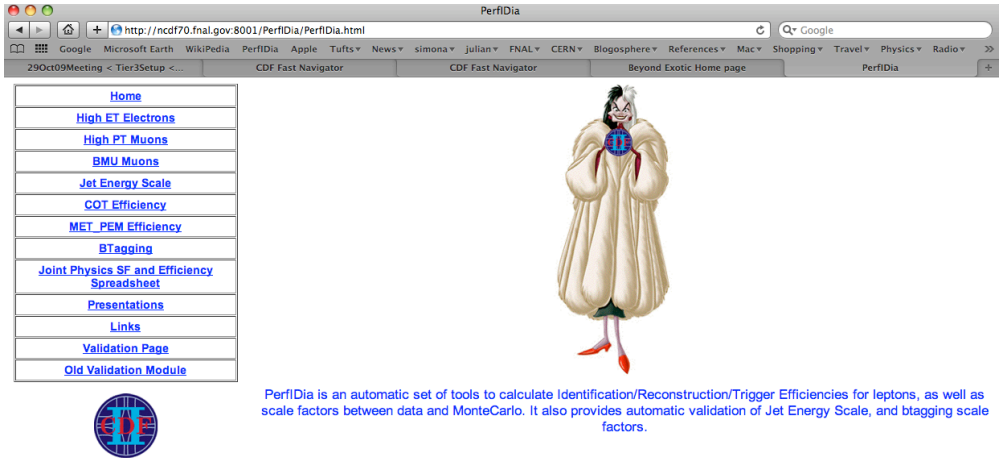
# Service Work

# PerfIDia (Performance and ID instant answer)

## 2007-present (Simona Rolli)

**Much of the analysis infrastructure at CDF is now run in an automatic way to guarantee smooth results delivery in the final years of the experiment**

**Some aspects of all analyses are in common:**
**lepton ID efficiency, reconstruction,trigger**
**Jet Energy corrections**
**B-tagging Scale factors**
**tau reconstruction**
**……**




**We are providing a common software framework which incorporates all the relevant piece of code and produces output tables, plots and documentation on the web for every new batch of processed data.**
**One coordinator (SR) and several experts on call**

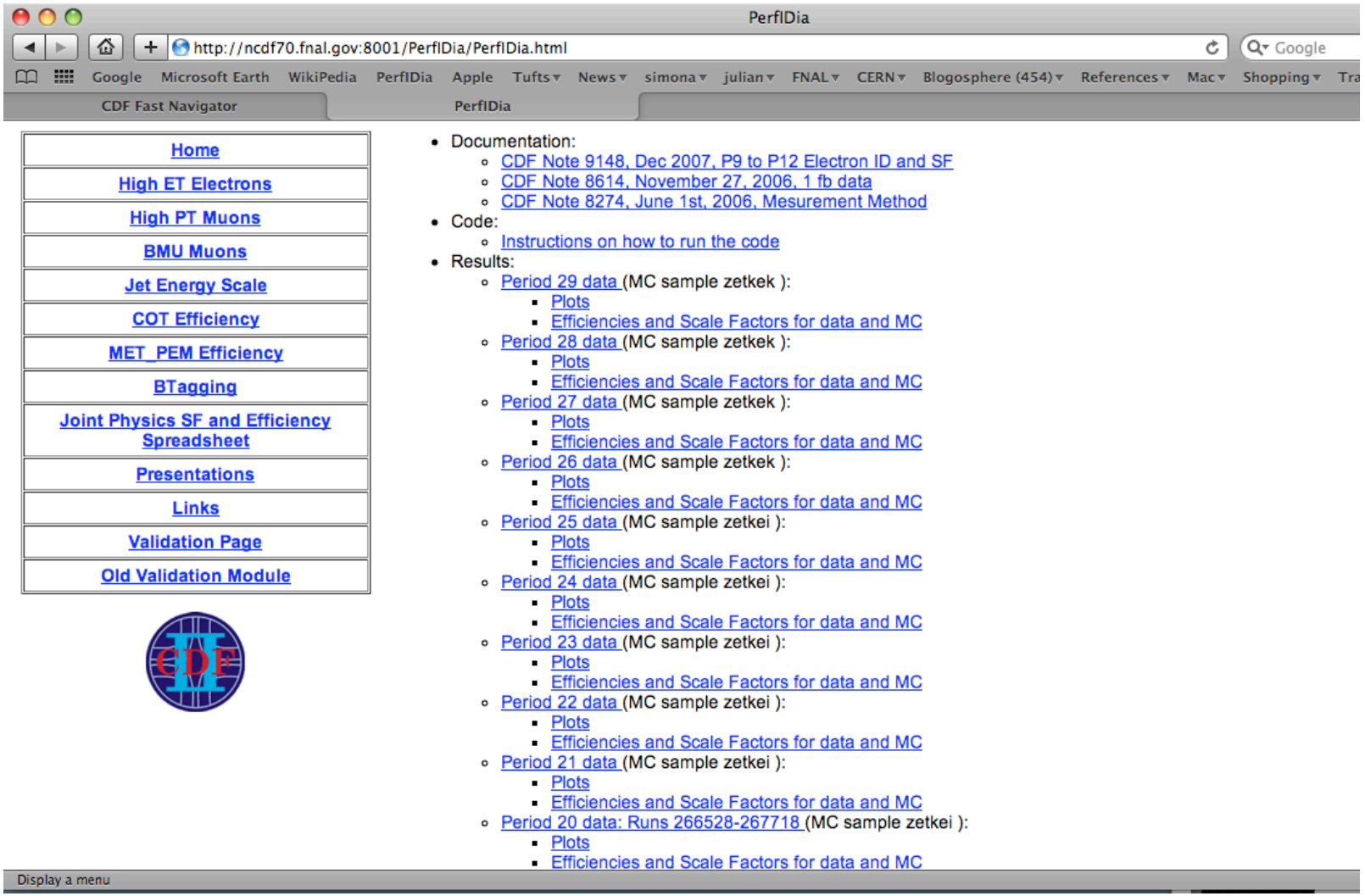
# PerfIDia (cont'd)

- Automatic tool to check data stability (high PT Leptons)
  - All code in one common place (cvs)
- TopNt and StNtuple produced shortly after Production data is available: target 4-6 weeks after Production. Turnover rate ~2.5 months.
- The ID code is launched to validate the new ntuples and determine the various efficiencies and SF
  - Dependency on several tasks:
    - Good Run List
    - Skimmed Data (to avoid large volumes of files)
    - …
- Output is posted as plots and tables onto PerfIDia web page
- Joint Physics group does the final sign off

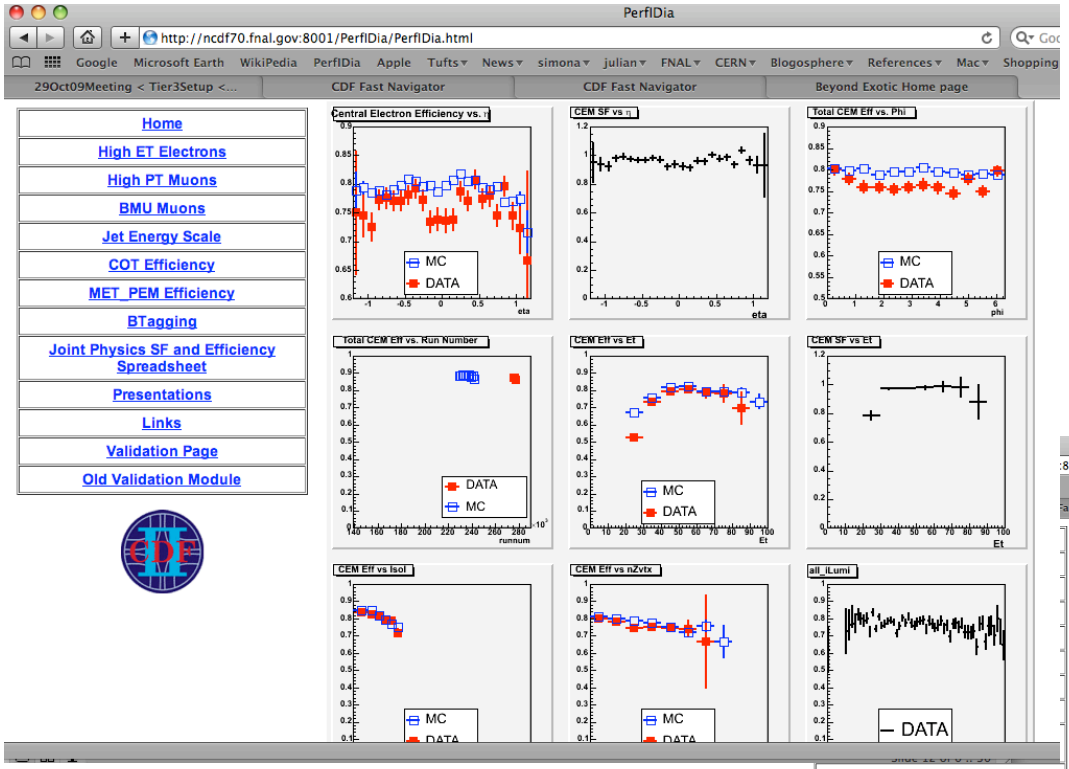
# Typical timeline for result production

- **Period 29**
  - Blessing of P29 high PT Lepton Efficiencies and SF, August 31, 2010
  - Pre-Blessing of P29 high PT Lepton Efficiencies and SF, August 18, 2010
- **Period 28**
  - Blessing of P28 high PT Lepton Efficiencies and SF, May 26, 2010
  - Pre-Blessing of P28 high PT Lepton Efficiencies and SF, May 5th, 2010
- **Period 27**
  - Blessing of P27 high PT Lepton Efficiencies and SF, May 5, 2010
  - Pre-Blessing of P27 high PT Lepton Efficiencies and SF, April 21, 2010
- **Period 26**
  - Blessing of P26 high PT Lepton Efficiencies and SF, March 17, 2010
  - Pre-Blessing of P26 high PT Lepton Efficiencies and SF, Feb 10, 2010
- **Period 25**
  - Blessing of P25 high PT Lepton Efficiencies and SF, October 21st 2009
  - Pre-Blessing of P25 high PT Lepton Efficiencies and SF, October 7th 2009
- **Period 24**
  - Blessing of P24 high PT Lepton Efficiencies and SF, September 23 2009
  - Pre-Blessing of P24 high PT Lepton Efficiencies and SF, September 9 2009
- **Period 23**
  - Blessing of P23 high PT Lepton Efficiencies and SF, July 1st 2009
  - Pre-Blessing of P23 high PT Lepton Efficiencies and SF, June 17 2009
- **Period 22**
  - Blessing of P22 high PT Lepton Efficiencies and SF, June 17 2009
  - Pre-blessing of P22 high PT Lepton Efficiencies and SF, May 20 2009
- **Period 21**
  - Blessing of P21 high PT Lepton Efficiencies and SF, May 13 2009
  - Pre-Blessing of P21 high PT Lepton Efficiencies and SF, April 8 2009
- **Period 20**
  - Blessing of P20 high PT Lepton Efficiencies and SF, March 4th 2009
  - Pre-Blessing of P20 high PT Lepton Efficiencies and SF, Feb 11 2009
- **Period 19**
  - Blessing of P19 high PT Lepton Efficiencies and SF, Feb 11 2009
  - Pre-Blessing of P19 high PT Lepton Efficiencies and SF, Jan 14 2009
- **Period 18**
  - Blessing of P18 high PT Lepton Efficiencies and SF, Dec 17 2008 update (CMX trigger eff and ele ID update)
  - Blessing of P18 high PT Lepton Efficiencies and SF, Dec 10 2008
  - Preliminary Look at high PT Leptons P18 data, Nov 26 2008

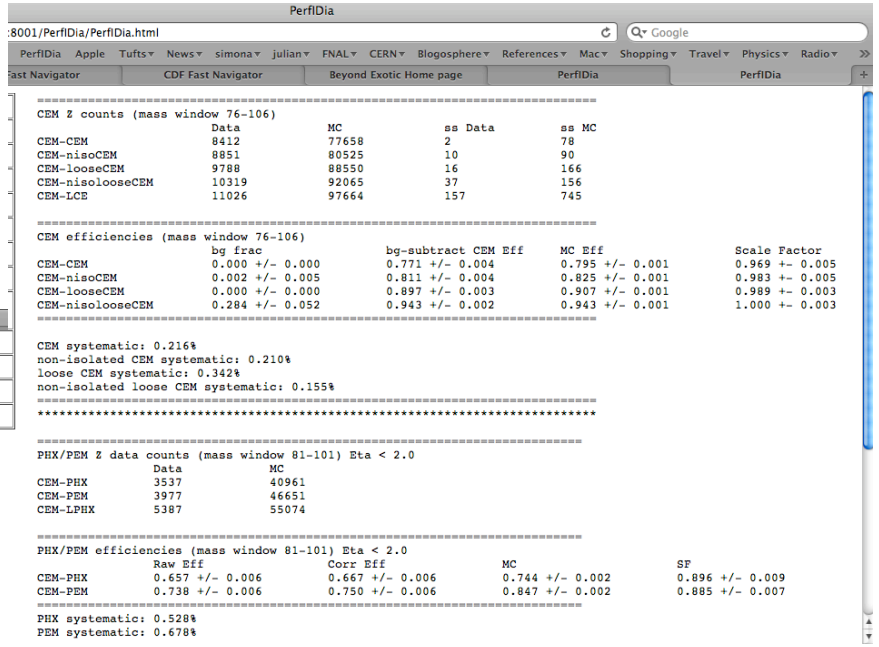
# Example: Electron ID



# Example: Electron ID



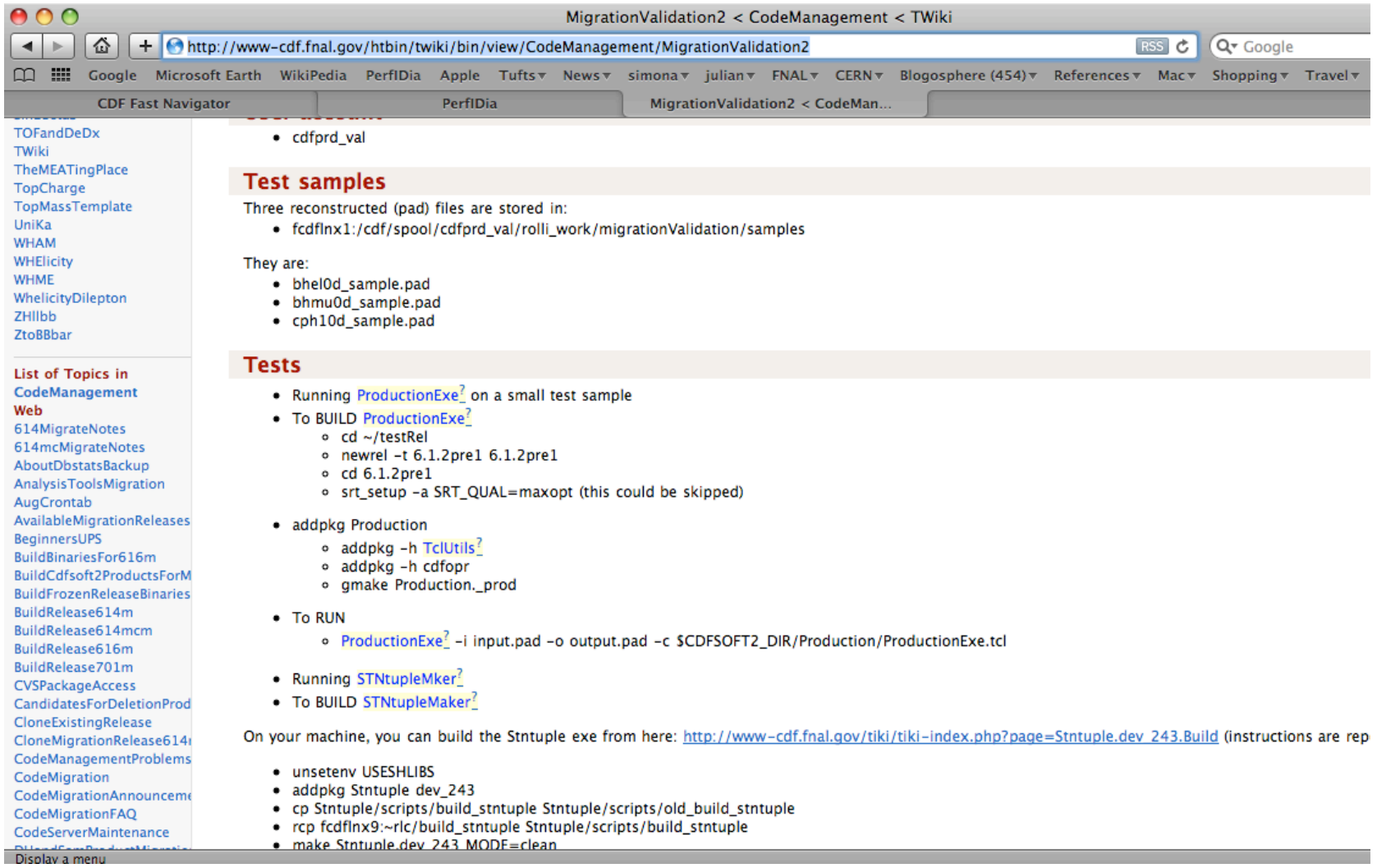




# CDF Code migration

- Software migration validation
  - CDF software releases pretty much stable
    - A few hurdles were fixed in 2010:
      - MC release to be brought up to date with data release
        - Simona Rolli , C.Vellidis (Athens), R.Tesarek(FNAL)
      - OS migration (SL3 to SL4 and SL5)
        - Simona Rolli ,L.Garren (FNAL),J.Bellinger (UW Madison), S. Lammel (FNAL)
      - Migration completed in April 2010
        - http://www-cdf.fnal.gov/htbin/twiki/bin/view/CodeManagement/MigrationValidation2

# Code migration (cont'd)



# Talks and Presentations

- Simona Rolli, Les Recontres de Physique de la Valle d'Aoste, La Thuile, Italy, March 2010
  - QCD Results from the TeVatron
- Simona Rolli, PHENO Workshop, Madison, WI, May 2010
  - Results on searches for new physics at the TeVatron

- Simona Rolli, IV international workshop on the interconnection between particle physics and cosmology, Torino, July 2010
  - Recent Results from the Tevatron
- Simona Rolli, HCP Workshop, Toronto, Canada, August 2010
  - Status of the Tevatron

# Physics Analyses

# Searches for LeptoQuarks

- **Leptoquarks (LQ)** are hypothetical particles which appear in many SM extensions to explain **symmetry between leptons and quarks**
  - SU(5) GUT model
  - superstring-inspired models
  - 'colour' SU(4) Pati-Salam model
  - composite models
  - technicolor

•LQs are **coupled to both leptons and quarks** and carry SU(3) color, fractional electric charge, baryon (B) and lepton (L) numbers

**•LQs can have**:

–spin 0 (scalar)

•couplings fixed, i.e., no free parameters

•Isotropic decay

–spin 1 (vector)

•anomalous magnetic ($k_G$) and electric quadrupole ($\lambda_G$) model-dependent couplings

–Yang-Mills coupling: $k_G = \lambda_G = 0$

–Minimal coupling: $K_G = 1$, $\lambda_G = 0$

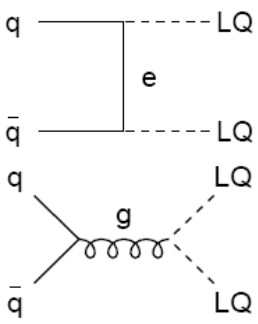
–Decay amplitude proportional to $(1 + \cos\theta^*)^2$

- **Experimental evidence searched:**
  - indirectly: LQ-induced 4-fermion interactions
  - directly: production cross sections at collider experiments

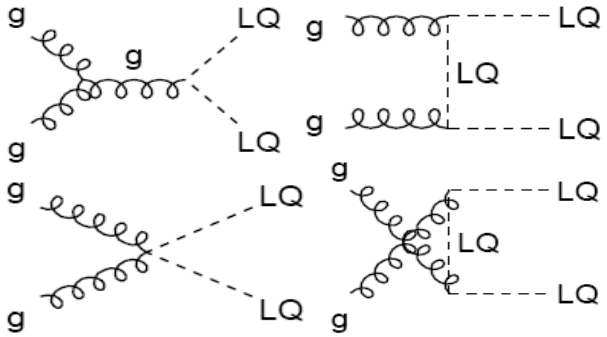
# LQ at Hadron Colliders

- **Pair production**
  - Practically independent of Yukawa coupling λ (only g-LQ-LQ vertex)
  - Depends mainly on LQ mass

$q\bar{q} \rightarrow LQ\,\overline{LQ}$




$gg \rightarrow LQ\,\overline{LQ}$




**Decay**

- Each generation can decay into 3 final states:

$\beta$ = Br (LQ→lq)

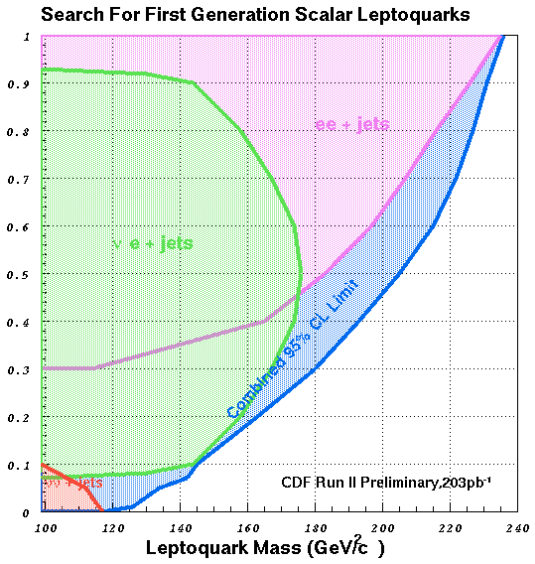
Exclusive to the Tevatron

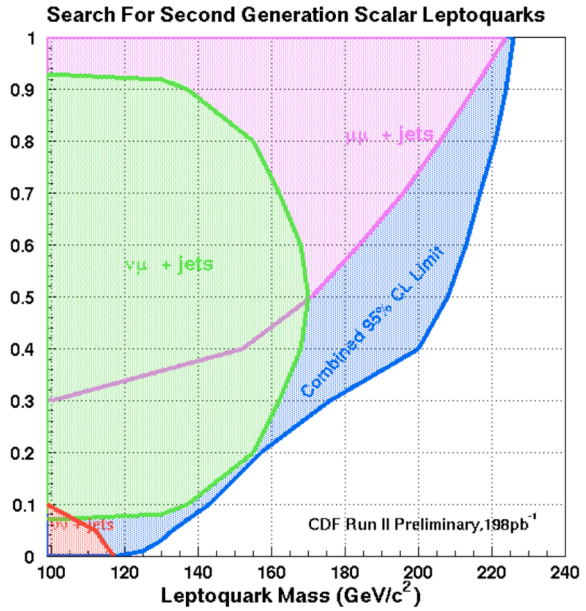
| | 1st Generation | 2nd Generation | 3rd Generation |
|---|---|---|---|
| $\beta = 1$ | $LQ\,\overline{LQ} \rightarrow e^- e^+ q\bar{q}$ | $LQ\,\overline{LQ} \rightarrow \mu^+ \mu^- q\bar{q}$ | $LQ\,\overline{LQ} \rightarrow \tau^+ \tau^- q\bar{q}$ |
| $\beta = 0.5$ | $LQ\,\overline{LQ} \rightarrow e^{\pm} \nu_e q_i q_j$ | $LQ\,\overline{LQ} \rightarrow \mu^{\pm} \nu_\mu q_i q_j$ | $LQ\,\overline{LQ} \rightarrow \tau^{\pm} \nu\, q_i q_j$ |
| $\beta = 0$ | $LQ\,\overline{LQ} \rightarrow \nu_e \nu_e q\bar{q}$ | $LQ\,\overline{LQ} \rightarrow \nu_\mu \nu_\mu q\bar{q}$ | $LQ\,\overline{LQ} \rightarrow \nu_\tau \nu_\tau q\bar{q}$ |

# LQ at CDF

Tufts is the primary institutions doing LQ searches in RunII:

- 1st gen, eeqq, evqq + combined result (Simona - PhysRevD72 2005)
- 2nd gen:μμqq,μνqq + combined result (D. Ryan,S.R. - PhysRevD73 2006)
- 3rd gen:ττqq (H.Sun, S.R.,K.Sliwa - not published)



# LQ at large..

Since October 2007 Simona Rolli has been on the PDG author list as the author of the LeptoQuark minireview

## The Review of Particle Physics

K. Nakamura *et al.* (Particle Data Group), J. Phys. G **37**, 075021 (2010)


K. Nakamura,[1,2] K. Hagiwara,[2] K. Hikasa,[3] H. Murayama,[1,4,5] M. Tanabashi,[6] T. Watari,[1] C. Amsler,[7] M. Antonelli,[8] D.M. Asner,[9] H. Baer,[10] H.R. Band,[11] R.M. Barnett,[5] T. Basaglia,[12] E. Bergren, J. Beringer,[5] G. Bernardi,[13] W. Bertl,[14] H. Bichsel,[15] O. Biebel,[16] E. Blucher,[17] S. Blusk,[18] R.N. Cahn,[5] M. Carena,[19,17] A. Ceccucci,[12] D. Chakraborty,[20] M.-C. Chen,[21] R.S. Chivukula,[22] G. Cowan,[23] O. Dahl,[5] G. D'Ambrosio,[24] T. Damour,[25] D. de Florian,[26] A. de Gouvêa,[27] T. DeGrand,[28] G. Dissertori,[29] B. Dobrescu,[19] M. Doser,[12] M. Drees,[30] D.A. Edwards,[31] S. Eidelman,[32] J. Erler,[33] V.V. Ezhela,[34] W. Fetscher,[29] B.D. Fields,[35] B. Foster,[36] T.K. Gaisser,[37] L. Garren,[19] H.-J. Gerber,[29] G. Gerbier,[38] T. Gherghetta,[39] G.F. Giudice,[12] S. Golwala,[40] M. Goodman,[41] C. Grab,[29] A.V. Gritsan,[42] J.-F. Grivaz,[43] D.E. Groom,[5] M. Grünewald,[44] A. Gurtu,[45,12] T. Gutsche,[46] H.E. Haber,[47] C. Hagmann,[48] K.G. Hayes,[49] M. Heffner,[48] B. Heltsley,[50] J.J. Hernández-Rey,[51†] A. Höcker,[12] J. Holder,[37] J. Huston,[22] J.D. Jackson,[5] K.F. Johnson,[10] T. Junk,[19] A. Karle,[11] D. Karlen,[52] B. Kayser,[19] D. Kirkby,[21] S.R. Klein,[53] C. Kolda,[54] R.V. Kowalewski,[52] B. Krusche,[55] Yu.V. Kuyanov,[34] Y. Kwon,[56] O. Lahav,[57] P. Langacker,[58] A. Liddle,[59] Z. Ligeti,[5] C.-J. Lin,[5] T.M. Liss,[60] L. Littenberg,[61] K.S. Lugovsky,[34] S.B. Lugovsky,[34] J. Lys,[5] H. Mahlke,[50] T. Mannel,[62] A.V. Manohar,[63] W.J. Marciano,[61] A.D. Martin,[64] A. Masoni,[65] D. Milstead,[66] R. Miquel,[67] K. Mönig,[68] M. Narain,[69] P. Nason,[70] S. Navas,[71†] P. Nevski,[61] Y. Nir,[72] K.A. Olive,[73] L. Pape,[29] C. Patrignani,[74] J.A. Peacock,[75] S.T. Petcov,[76,1,77] A. Piepke,[78] G. Punzi,[79] A. Quadt,[80] S. Raby,[81] G. Raffelt,[82] B.N. Ratcliff,[83] P. Richardson,[64] S. Roesler,[12] S. Rolli,[84] A. Romaniouk,[85] L.J. Rosenberg,[15] J.L. Rosner,[17] C.T. Sachrajda,[86] Y. Sakai,[2] G.P. Salam,[87] S. Sarkar,[88] F. Sauli,[12] O. Schneider,[89] K. Scholberg,[90] D. Scott,[91] W.G. Seligman,[92] M.H. Shaevitz,[93] M. Silari,[12] T. Sjöstrand,[94] J.G. Smith,[28] G.F. Smoot,[5] S. Spanier,[95] H. Spieler,[5] A. Stahl,[96] T. Stanev,[37] S.L. Stone,[18] T. Sumiyoshi,[97] M.J. Syphers,[19] J. Terning,[98] M. Titov,[99] N.P. Tkachenko,[34] N.A. Törnqvist,[100] D. Tovey,[101] T.G. Trippe,[5] G. Valencia,[102] K. van Bibber,[48] G. Venanzoni,[8] M.G. Vincter,[103] P. Vogel,[104] A. Vogt,[105] W. Walkowiak,[62] C.W. Walter,[90] D.R. Ward,[106] B.R. Webber,[106] G. Weiglein,[31] E.J. Weinberg,[93] J.D. Wells,[107] A. Wheeler,[83] L.R. Wiencke,[108] C.G. Wohl,[5] L. Wolfenstein,[109] J. Womersley,[110] C.L. Woody,[61] R.L. Workman,[111] A. Yamamoto,[2] W.-M. Yao,[5] O.V. Zenin,[34] J. Zhang,[112] R.-Y. Zhu,[113] P.A. Zyla[5]

*Technical Associates:* G. Harper,[5] V.S. Lugovsky,[34] P. Schaffner[5]

# LQ Current activity

Simona Rolli and Gabriel Dunn are updating the currently published results with larger statistics

We will be able to set higher limits before the LHC explores a new energy frontier

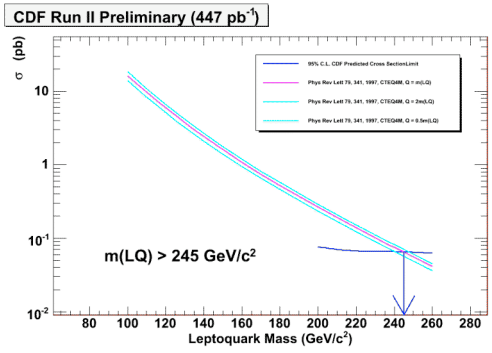
**Expectations:**

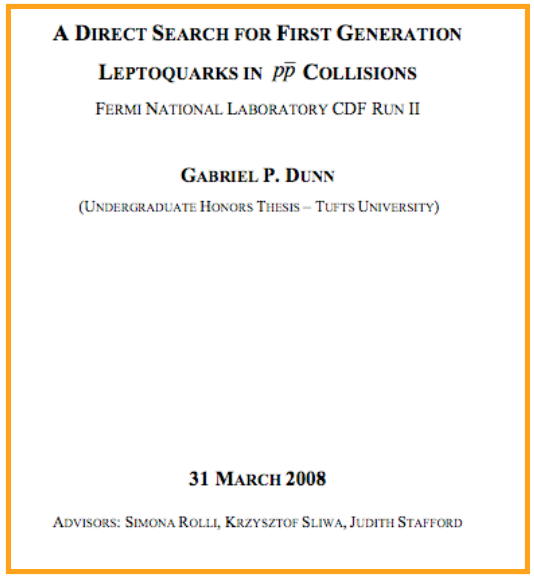
$\beta = 1$ mass limit up to 250-300 GeV/$c^2$

$\beta = 0.5$ mass limit up to 230-280 GeV/$c^2$

**Phys.Rev.D71:057503,2005**

In 2008 Gabe and I worked together for Gabe's undergraduate thesis. We revisited the 1st generation analysis with CC electrons and used twice the luminosity of the published results



A DIRECT SEARCH FOR FIRST GENERATION LEPTOQUARKS IN $p\bar{p}$ COLLISIONS

FERMI NATIONAL LABORATORY CDF RUN II

GABRIEL P. DUNN

(UNDERGRADUATE HONORS THESIS – TUFTS UNIVERSITY)

31 MARCH 2008

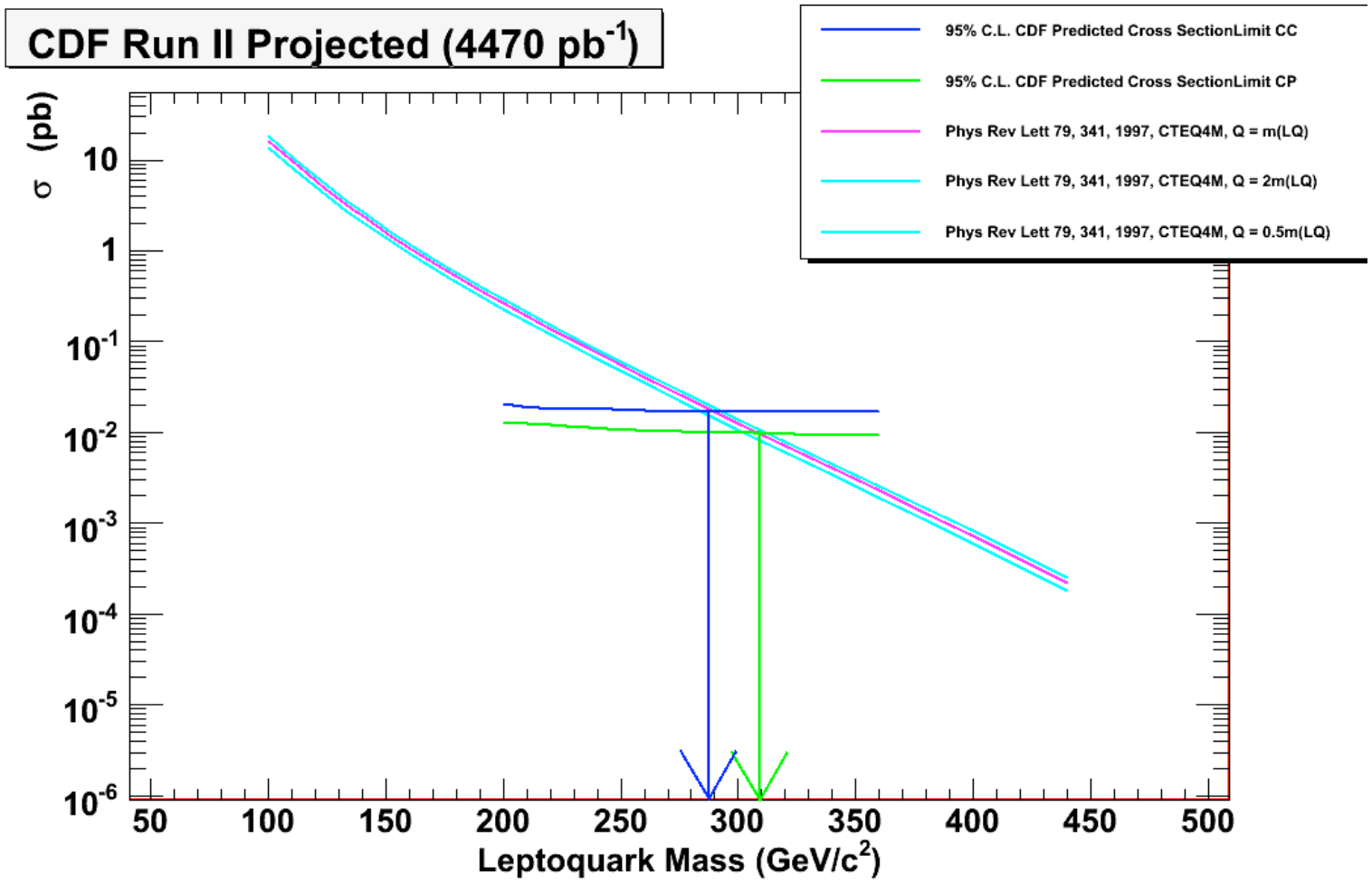
ADVISORS: SIMONA ROLLI, KRZYSZTOF SLIWA, JUDITH STAFFORD

# LQ authors/students

- In 2009-2010 Gabriel Dunn was at Fermilab
- In 2010 Stefania Vitillo (undergraduate student from Pisa) spent 2 months at FNAL
  - Honor thesis discussed on October 12, 2010 ( Simona supervisor)

- We have been working on 1st generation decaying into :LQ→eeqq and LQ→lνqq
  - Signal Efficiencies:
    - we used the same signal efficiencies as from the published analysis
      - We have generated new MC signal using a more recent release and checked that the efficiencies are the same
  - Background
    - We re-evaluated the Z+2 jets, W + 2 jets background as well as ttbar using the new MC. alpgen samples and cross section (x k-factor ~1.3)
    - We re-calculated the QCD fake contribution using SS method and Iso method
  - Systematic uncertainty: we haven't reassessed it yet, so we applied a conservatively large stat+sys error in the calculation of the limit
  - We looked at ~2.4fb$^{-1}$ data and extrapolated sensitivity to 4.7 fb$^{-1}$ (eeqq)
  - We did sensitivity studies for 5.3fb$^{-1}$ (e nu qq)

# LQ Results: eejj

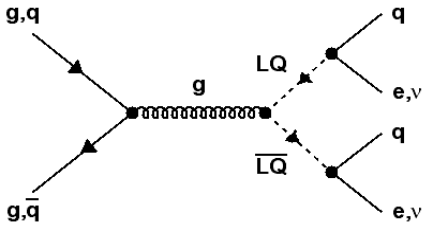


# LQ Results: e nu jj

## lepton + MET + jets

### Selection

1central electrons with $E_T$ > 25 GeV
MET > 60 GeV
Veto on 2nd electron, central loose or Plug
2 jets with $E_T$ > 30 GeV
$\Delta\phi$ (MET-jet) > 10°
$E_T(j1) + E_T(j2)$ > 80 GeV
$M_T(e\text{-}\nu)$ > 120
LQ mass combinations




**SM background**

- W +2jets
- Top (l + jets and dilepton)
- QCD/Fakes

Università di Pisa
Facoltà di Scienze Matematiche, Fisiche e Naturali
Corso di Laurea in Fisica

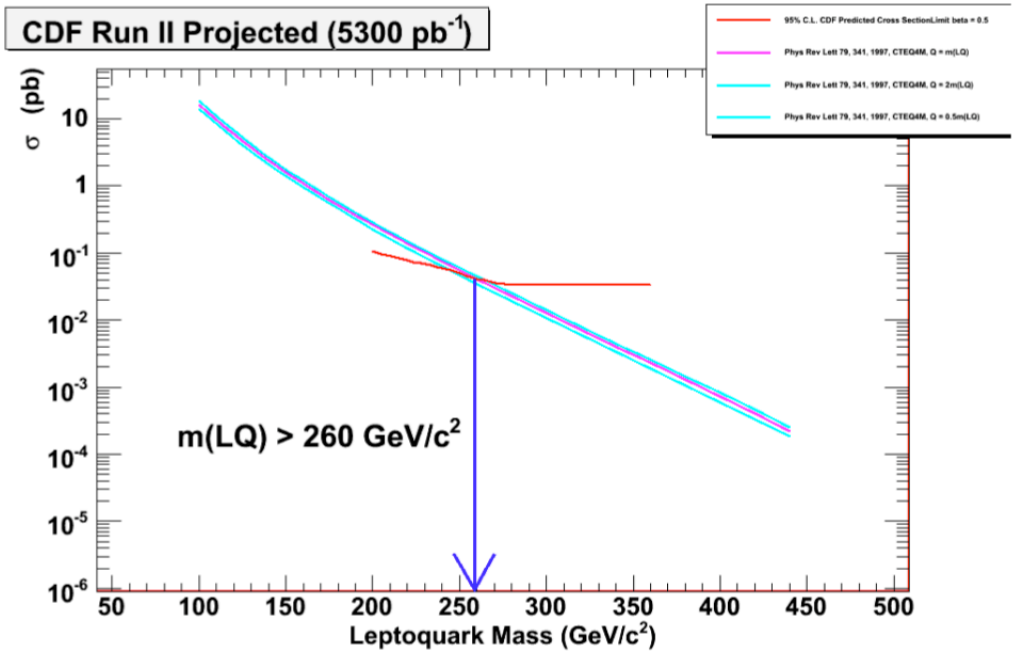
Anno Accademico 2009/2010

Elaborato Finale

Ricerca di Leptoquark nel canale di decadimento $e\nu \to jj$ nell'esperimento CDF

Candidato:
Stefania Vitillo

Relatore:
Dott.ssa Simona Rolli
Correlatore:
Dott.ssa Sandra Leone



# LQ Plans

- Stefania will continue to work from Pisa in 2011 on e $\nu$ jj
- Gabe is now at Berkeley and will try to continue to work on ee jj and $\mu\mu$jj
- Updating only selected parts of the publishes analyses we will be able to update the results to current Tevatron statistics
- The channels will be combined

Joint likelihood formed from the product of the individual channels likelihood.
The searches in the dileptons and lepton + MET channels use common criteria and sometime apply the same kind of requirements ( for example on lepton identification) so the uncertainties in the acceptances is considered completely correlated ( which gives the most conservative limit).
When calculating the limit combination including also the $\nu\nu$jj channel the uncertainties in the acceptances are considered uncorrelated.

$$\sigma_{LIM} = N_{LIM}/(\varepsilon_{average} \times L)$$

$\varepsilon_{average} = (\beta^2\varepsilon(eejj) + 2\beta(1-\beta)\varepsilon(e\nu jj) + \beta^2\varepsilon(ee \text{ as } e\nu))$ for the 2 channels case and

$\varepsilon_{average} = (\beta^2\varepsilon(eejj) + 2\beta(1-\beta)\varepsilon(e\nu jj) + (1-\beta)^2\varepsilon(\nu\nu jj) + \beta^2\varepsilon(ee \text{ as } e\nu))$ for the 3 channels case.

# VEP analyses

VEP group (a subgroup of the Exotic Physics Group)
S.R. has been convener since May 2009

VEP is a working group:

prepare analyses to proceed to Exotic forum for blessing. The details needs to be solved in the VEP group;

VEP is a small group, a few analyses ongoing

Restructured meeting schedule: every other week on Tuesday, mandatory short status report from everybody;
Larger status reports less frequently.
Out of 9 analyses, 6 have been blessed ( > 80% of Exotics analyses blessed in 2010) and presented at conferences

# VEP Analyses at Conferences

Being the main topics of conference talks

## BSM Searches at CDF

*Ray Culbertson, FNAL,*
*for the CDF Collaboration*

**Recent CDF Results:**

- **Search in the γγ Spectrum**
- **Search in the μμ Spectrum**
- **Search for QQ →(3j)(3j)**
- **Search in lγbMET**

HCP 2010 4 Ray Culbertson

# Beyond VEP

As of October 2010, S.R. has been nominated new Exotics Convener for 2011-2012 and confirmed by the CDF EB

**CDF Executive Board meeting**
10/7/2010

Giovanni and Rob

**Our Nominations To Replace them**

- Simona Rolli – Exotics
  senior researcher with Tufts who has been active in this group since joining CDF many years ago and is currently leading the VEP Sub group

- Mary Convery – QCD
  Currently an associate scientist with Fermilab in accelerator div. Remained active in QCD group and has served as convener as a PD

- Robert Harr – B
  Professor, Wayne St. Very active in this group and has held a number of service and sub group roles

# Exotics in 2011

**CDF Collaboration Meeting, October 2010**

## Searches at CDF in 2011

- As obvious, the start-up of the LHC makes direct searches at CDF being less atractive for not being at the energy frontier any longer.
- Our strength: large datasamples and well understood objects/tools.
- Some topics will soon become "pointless" for us.

  Trying to have final results published before LHC results make them useless.

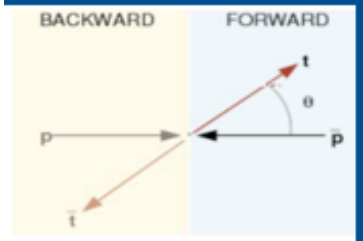
  Strategy will have to change: looking for favorable corners of phase space or not dedicated analyses.

⇒ Stop in low-pt dileptons
⇒ CHAMPS and WIMPS
⇒ Magnetic Monopoles
⇒ Jet+MET and $\gamma$+MET
⇒ Hidden valley models: dark photons
⇒ Split SUSY models: stopped gluinos
⇒ Signature-based searches
⇒ Your favorite search at LHC
⇒ . . . ?

- Some topics are (likely) competitive with first LHC dataset ($\sim 1$ fb$^{-1}$)
  - ⇒ Low-mass objects or striking signatures with low production rate.
  - ⇒ Searches relying on well understood tools.
  - ⇒ Soft objects, large acceptance needs, . . .
- Some topics are complementary to LHC:
  - ⇒ Models may require "low energy" results to be understood.
  - ⇒ Having "negative" results are important even if they find something.

# Exotics in 2011 (cont'd)

## - Forward-backward asymmetry

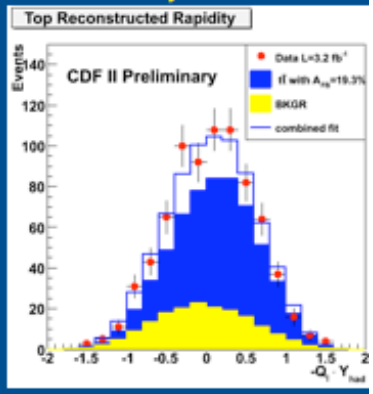



$$A_{fb} = \frac{F - B}{F + B}$$

New physics could give rise to asymmetry (Z', axigluons etc)
Standard Model predicts: $A_{FB}$ = 0.05±0.015 (NLO QCD)

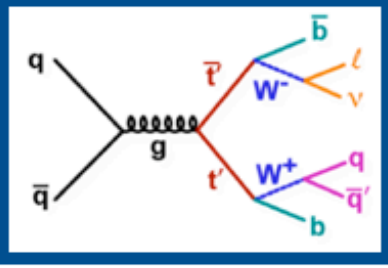
CDF (3.2 fb$^{-1}$):
Afb = 0.19 ± 0.07 (stat) ± 0.02 (syst)

D0(4.3fb$^{-1}$):
Afb = 0.08 ±0.04(stat)±0.01(sys)

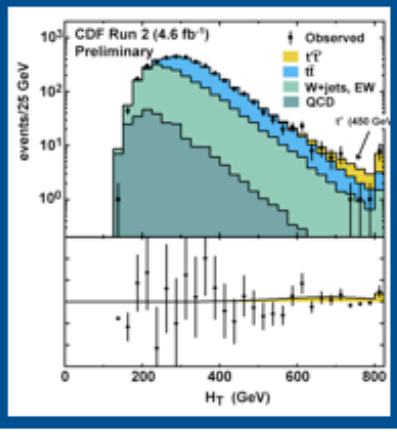


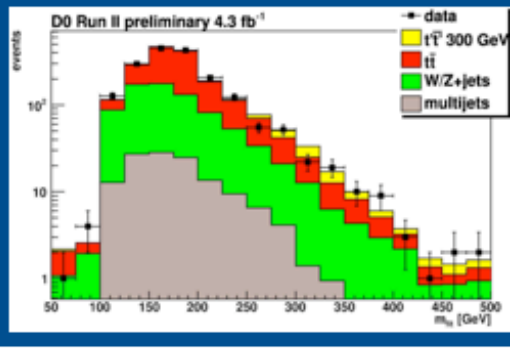

## - Apparent heavy top quark events

Search for a heavy t-like quark, decaying to Wb in the same way as top




Less than 2σ significance

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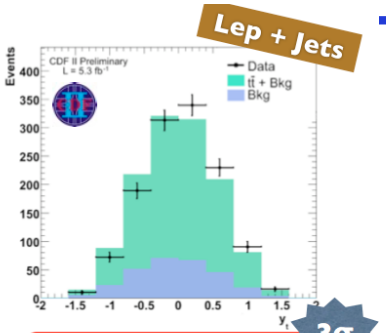
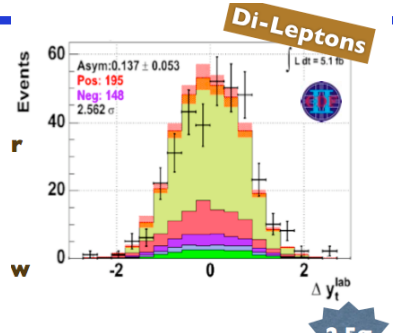
# Forward-backward asymmetry

- **Top Forward Backward Asymmetry is Getting Freaky**
- **Tevatron is special: $p\bar{p}$ collider**
  - **NLO QCD predicts small asymmetry from $q\bar{q} \rightarrow t\bar{t}$**
  - **Ideally suited to discover new physics with axial vector coupling**
- **Possible physics explanation is a new massive gluon with axial vector coupling**
- **$M_{G'} > 2$ TeV can still create a large $A_{FB}$ via interference with gluon**

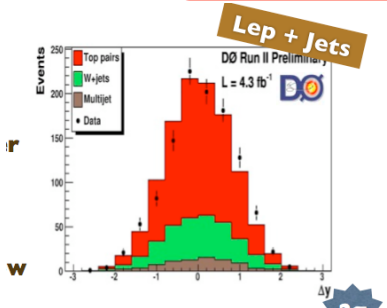



$A_{FB} = 15 \pm 5_{stat+sys}$ %

$A_{FB}^{SM} = 5.0 \pm 1.5$ %




$A_{FB}^{raw} = 14 \pm 5_{stat}$ %

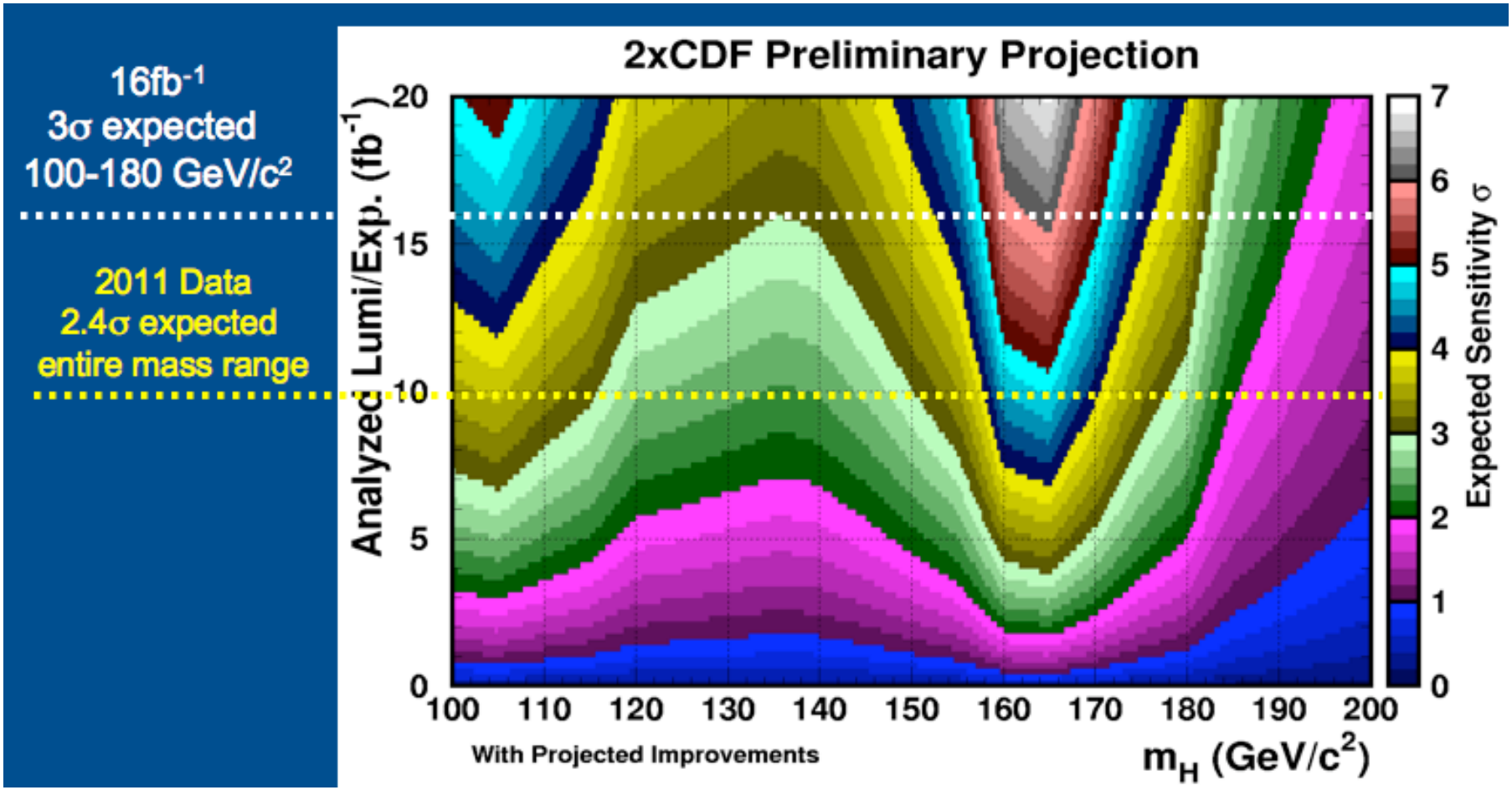



$A_{FB}^{data-bkg} = 8 \pm 4_{stat+sys}$ %

$A_{FB}^{mc@nlo} = 1^{+2.0}_{-1.0}$ %

- **Difficult to probe $A_{FB}$ @ LHC (pp) and $M_{G'} > 2$ TeV out-of-range of Tevatron**
- **Combined LHC/TeV effort required to discover gluon and probe coupling**

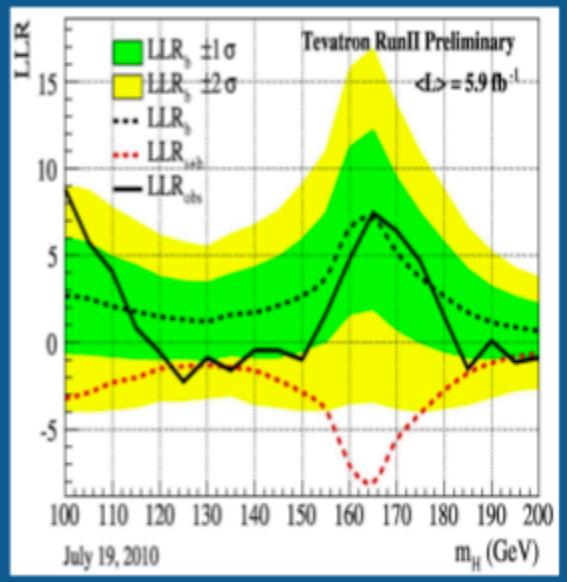
# Higgs in 2011 and beyond

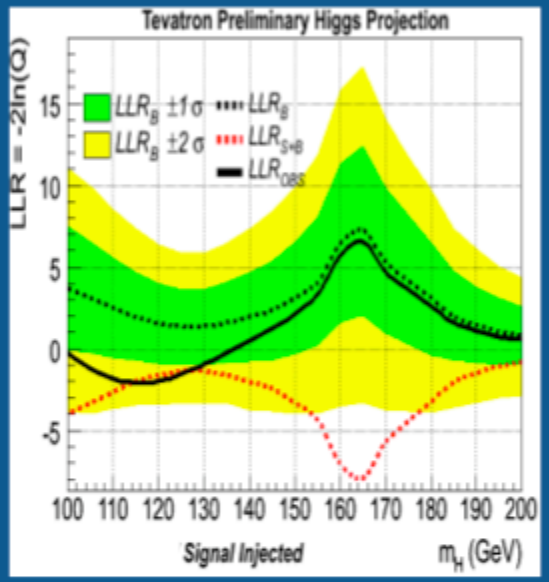


# Higgs Low mass

## Excess in the 115-150 GeV Region

We currently observe about one sigma 'excess' in the low mass region




We injected Higgs signals at 115 GeV and calculated "observed" LLR curve.

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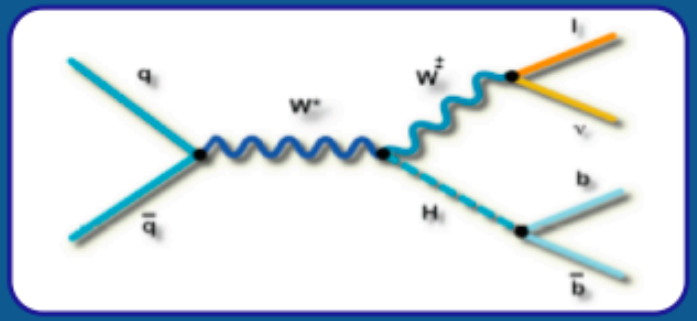
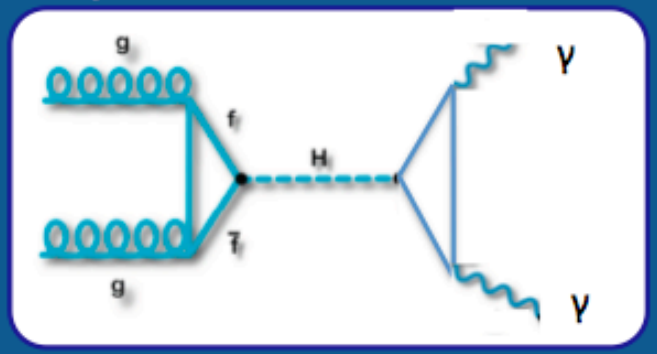
# Tev-LHC complementarity

'Tevatron'




Tree level coupling to b quark and W boson

'LHC'




Higgs couples to massless particles via loops with top and W, plus possibly new physics particles

Associated production is dominant mode for Higgs masses below 135 GeV at the Tevatron. Significantly better S/B than at LHC.

Gluon fusion into di-photons dominates Higgs sensitivity at LHC.

Gluon Fusion is also used for high mass exclusion at Tevatron in WW decays (direct coupling !).

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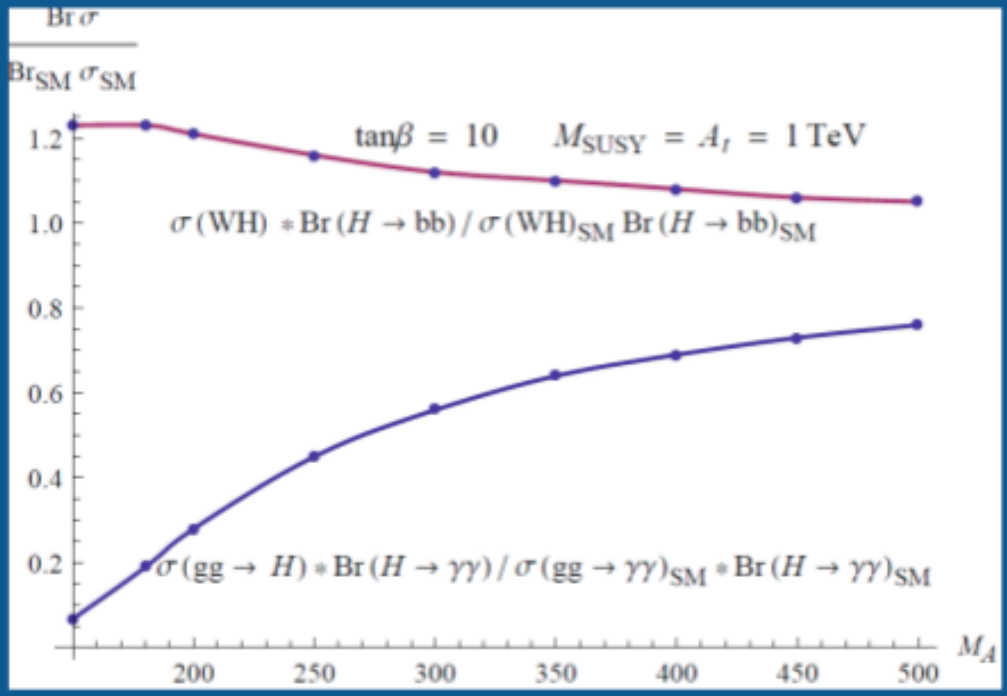
# TeV LHC complementarity

Generic 2 Higgs Doublet Model with M(Higgs)=120 GeV

Ratio to SM

Ratio is sensitive to physics beyond the Standard Model




M(A) (GeV)

- Powerful tool to understand nature of Higgs.
- bb final at Tevatron dominant for 115-130 GeV.

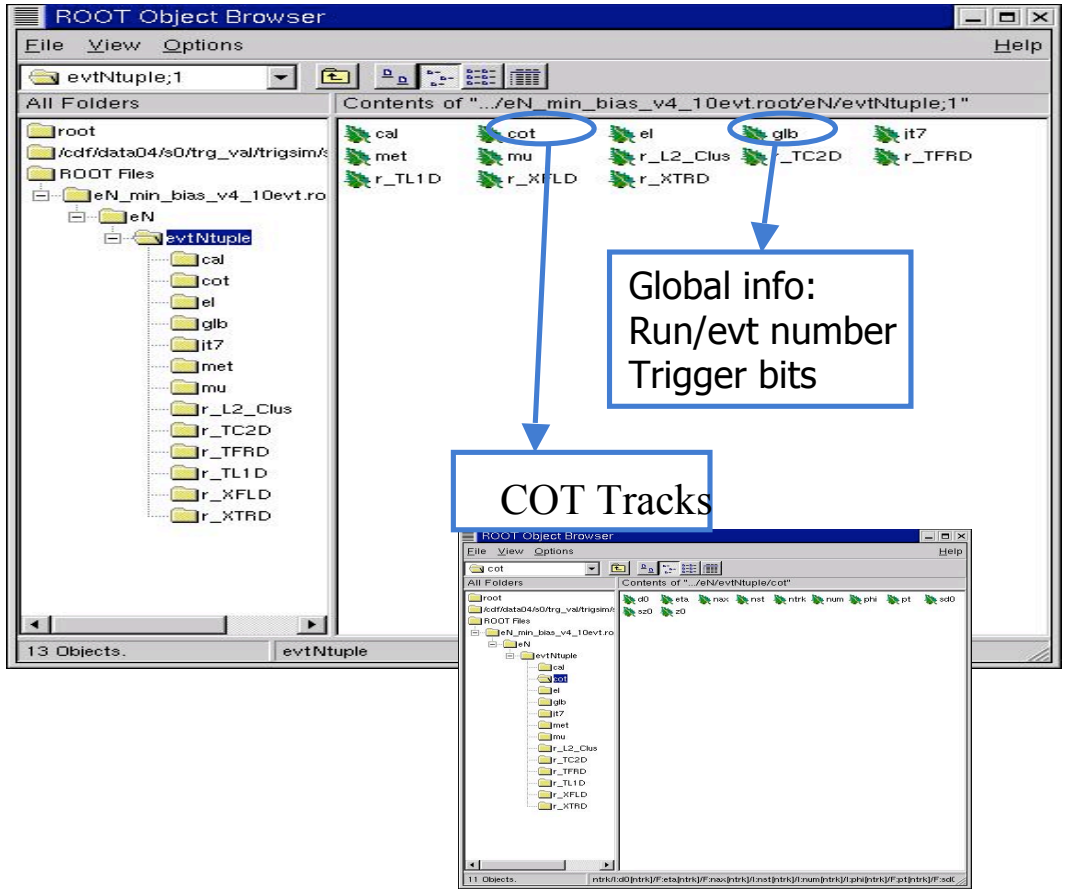
# Backup Slides

# evtNtuple

## 2001-present

**Event information is translated into ROOT branches:**

- **High Level Objects**
- **Trigger Information**
- **Raw Data Information**
- **Simulated information**




eN has been one of the analysis tools used in CDF until recently

http://ncdf70.fnal.gov:8001/talks/eN/eN.html

S.R.,A.Yagil, C.Ferretti

# TRGSim++

## 2000-present (Simona Rolli)

**set of (C++) packages which emulate the various trigger levels decision steps (CDF trigger is fully digital)**

- **offline tool to calculate rates and efficiencies;**
- **online monitoring tool.**

**TRGSim++ modules run off detector raw data and produce emulated trigger data identical to real hardware data.**

**Trigger decision steps: A_C++ modules, organized in packages:**

- **CalTrigger**
- **MuonTrigger**
- **XFTSim**
- **SVTSim**
- **XTRPSim**
- **L2/L1GlobalTrigger**
- **TriggerMods**
- **TriggerObjects**

http://ncdf70.fnal.gov:8001/trigsim/trgsim.html