

EWK & searches WG summary talk (exp.)

DIS 2010
Firenze, 23.04.2010
A. Parenti
(DESY)



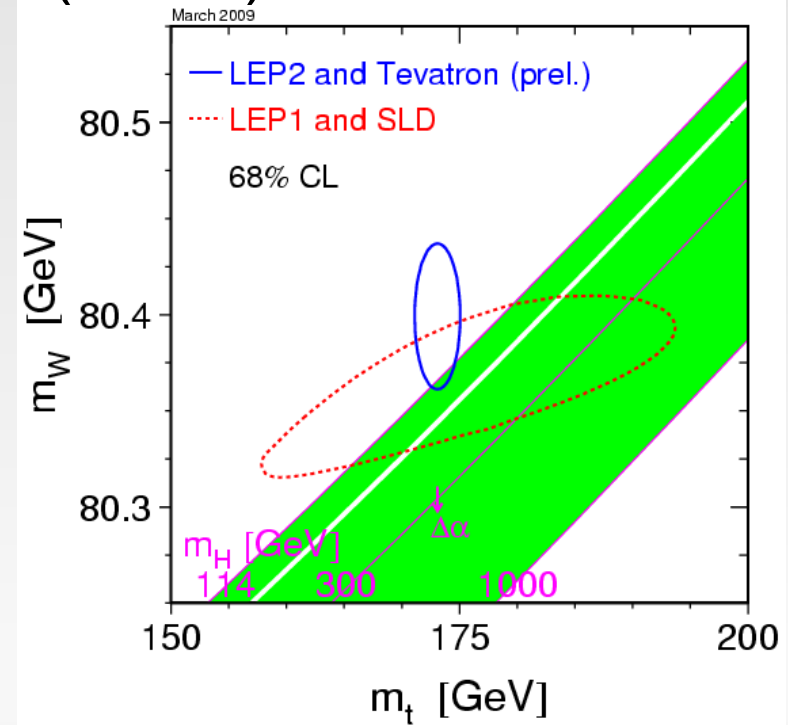
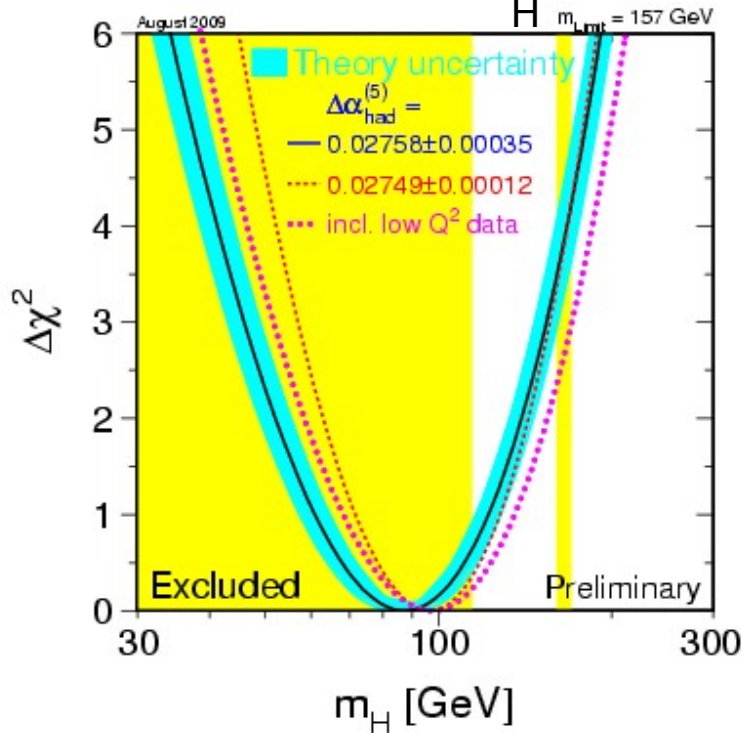
Contributions

- Despite the volcano eruption, we had quite a number of talks:
 - 28 EWK sessions
 - 6 EWK+PDF session
 - 5 EWK+QCD session
 - 4 EWK+Future session
- ... some of them were given via evo
- ... but only a few (7) were cancelled.
- I will show a personal choice of results... not possible to cover all of them here!

Search for SM Higgs

- Low masses are currently favoured:
 - Direct: $M_H > 114.4$ GeV (LEP) at 95% CL

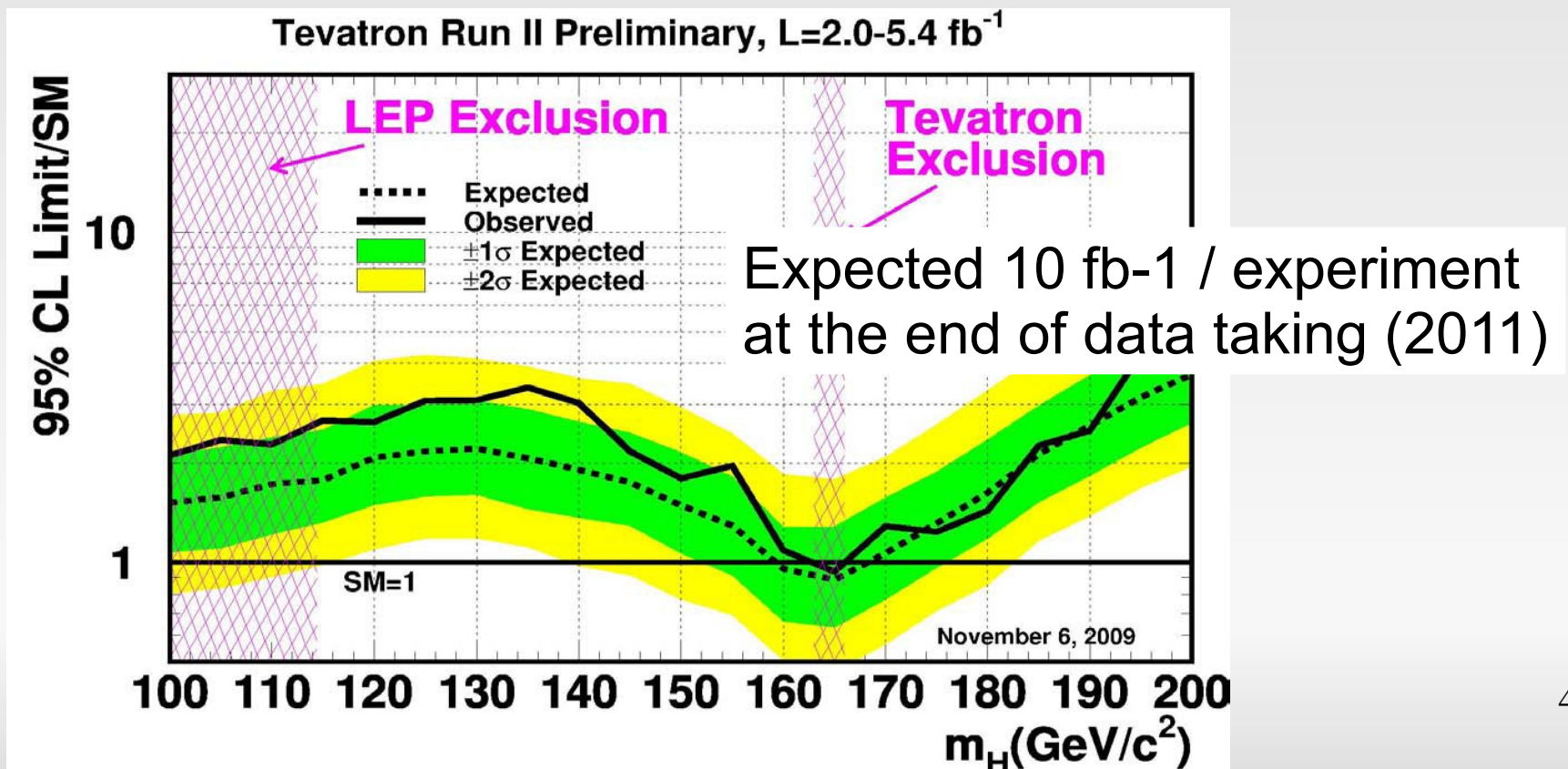
- EW fits: $M_H < 186$ GeV with (LEP2) at 95% CL



SM Higgs @ TEVATRON

Ken Herner

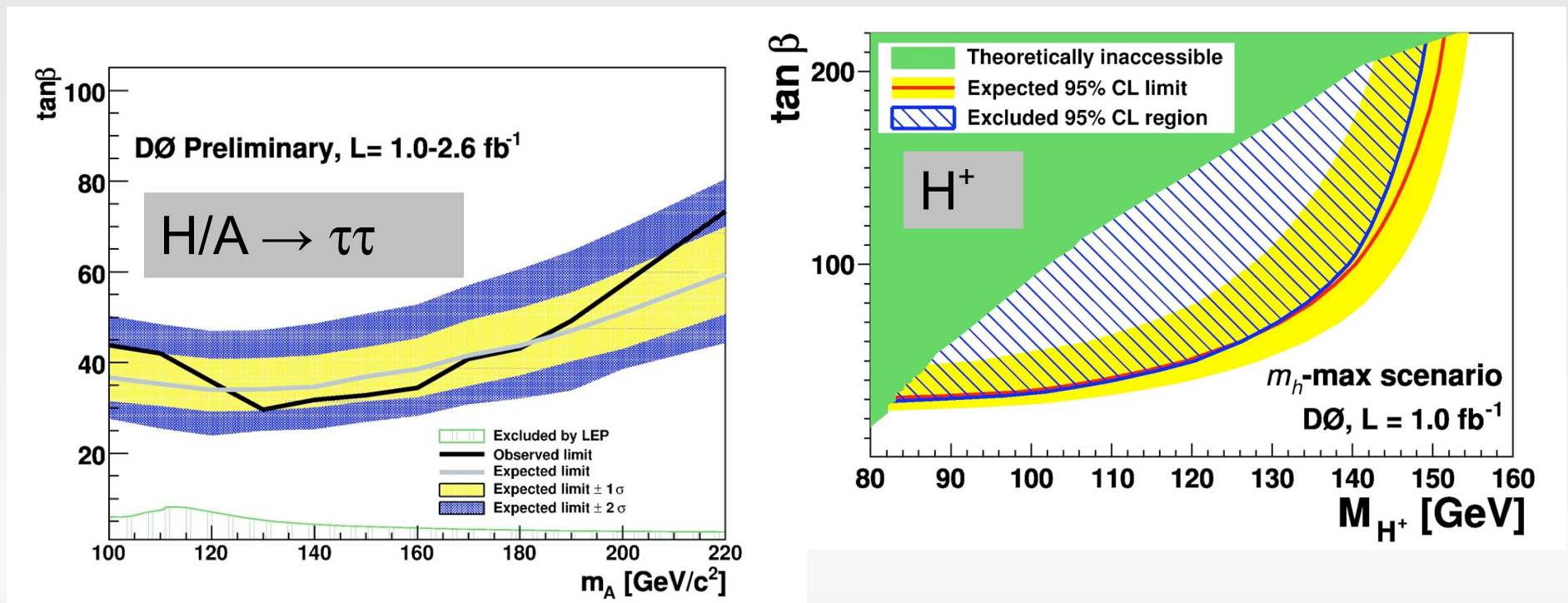
- 25-30 channels per experiment:
 - Low mass Higgs: WH, ZH production
 - High Higgs mass: two leptons ($\mu\mu$, $ee, e\mu$) + MET



BSM Higgs @ TEVATRON

Chris Hays

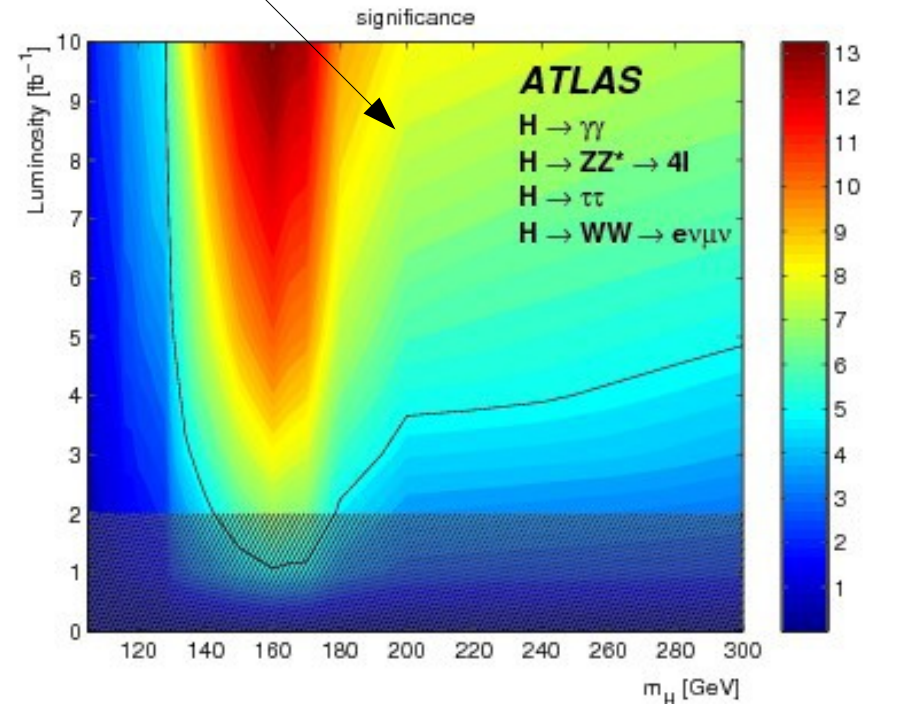
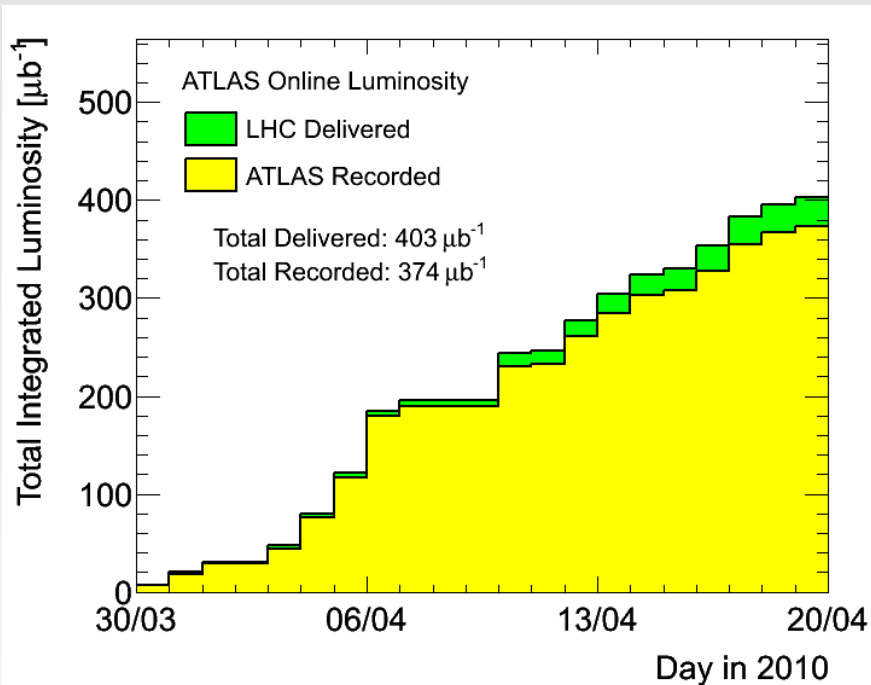
- Additional Higgs predicted by various theories:
 - Minimal SUSY, Next-to-Minimal SUSY, fermiophobic Higgs...



SM Higgs @ ATLAS

Elias Coniavitis

- LHC plans for 2010-2011: 1fb^{-1} @ 7 TeV
- Discovery potential @ 14 TeV

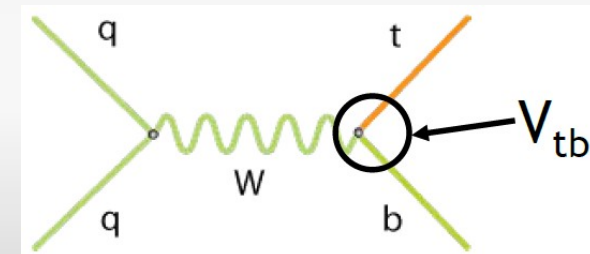


- 5σ discovery sensitivity in 143-179 GeV with 2fb^{-1}

Single top @ TEVATRON

Sandra Leone

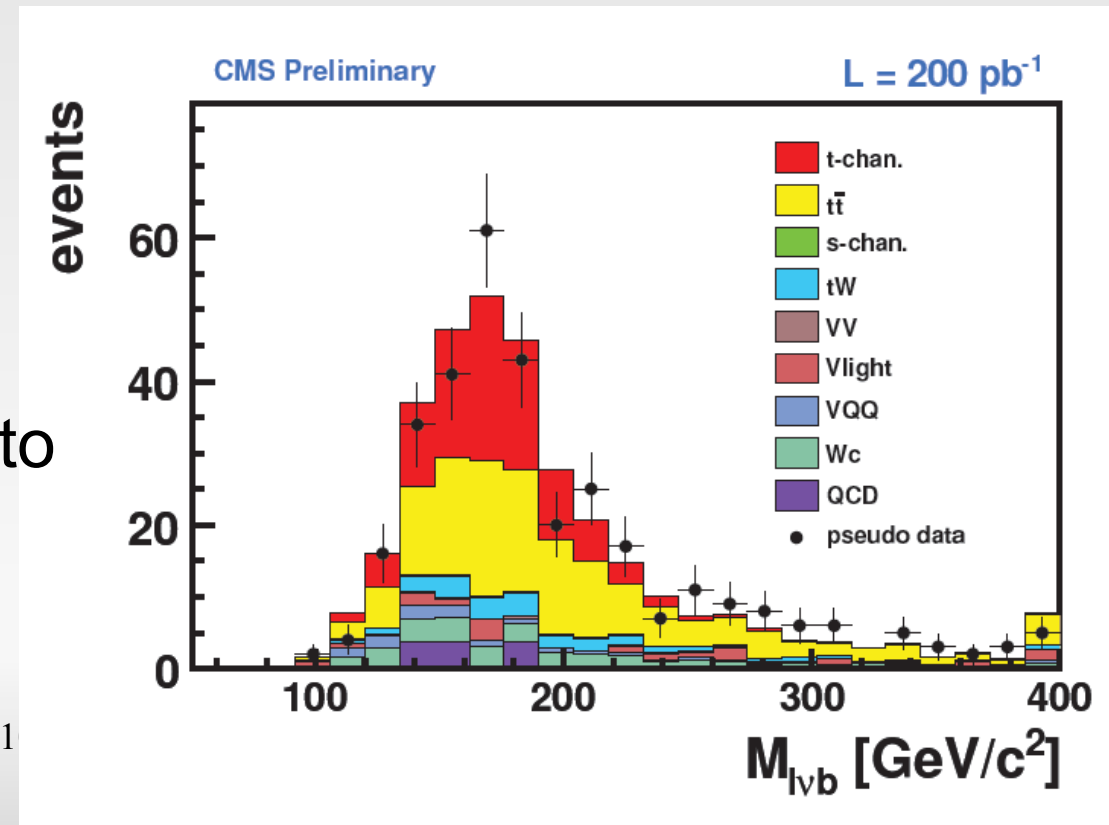
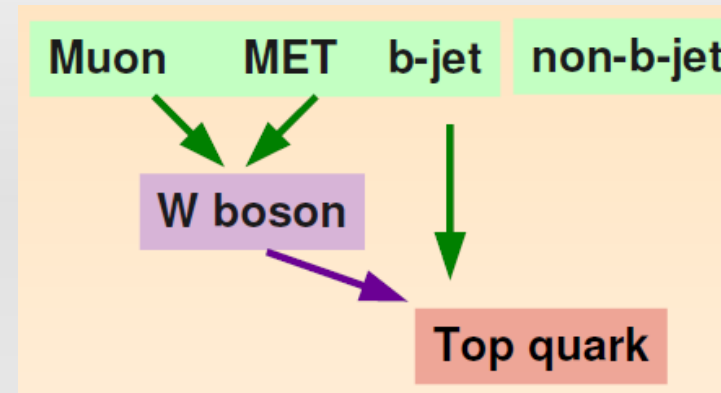
- Multivariate tools to establish small signals buried underneath large backgrounds (tt, W+LF, W+HF)
- Same final state as WH:
 - σ_t measurement mandatory for low mass Higgs search
- Cross section measurement (2.1-3.2 fb⁻¹)
 - Many different techniques, all results are consistent!
 - $\sigma_t = 2.76^{+0.58}_{-0.47}$ (stat + syst) pb
- Direct measurement of $|V_{tb}|$: 0.88 ± 0.07 (stat+syst)
 - Same precision of the theory prediction!



Single top @ CMS

Jeannine
WagnerKuhr

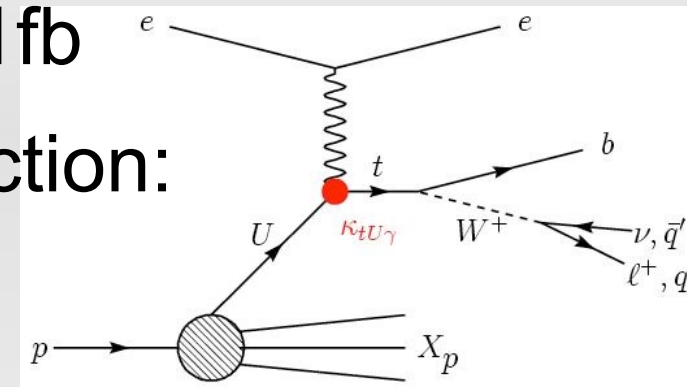
- Reconstruction of single top events:
- With 200 pb⁻¹ @ 10TeV:
 - 126 single top events
 - 229 background events (136 tt, 55 W/Z+jets)
- @ 7TeV:
 - Signal and background to be scaled down by a factor ~2.



Single top @ HERA

David South

- Tiny SM cross section, less than 1fb
- HERA can measure FCNC production:
 - Anomalous coupling $\kappa_{tU\gamma}$
- H1 measured single top in had.+lep. channels, ZEUS in lep. channel only.
- Upper bounds at 95% CL:
 - H1: $\sigma(ep \rightarrow etX) < 0.25 \text{ pb}$
 - ZEUS: $\sigma(ep \rightarrow etX) < 0.13 \text{ pb}$
 - ...that corresponds to $\kappa_{tU\gamma} < 0.18$ (H1), < 0.13 (ZEUS)



Top charge asymmetry @ TEVATRON

Ford Gaberson

- Top charge asymmetry:
 - $A_{fb} = 0$ @ LO
 - $A_{fb} = 0.05 \pm 0.015$ @ NLO

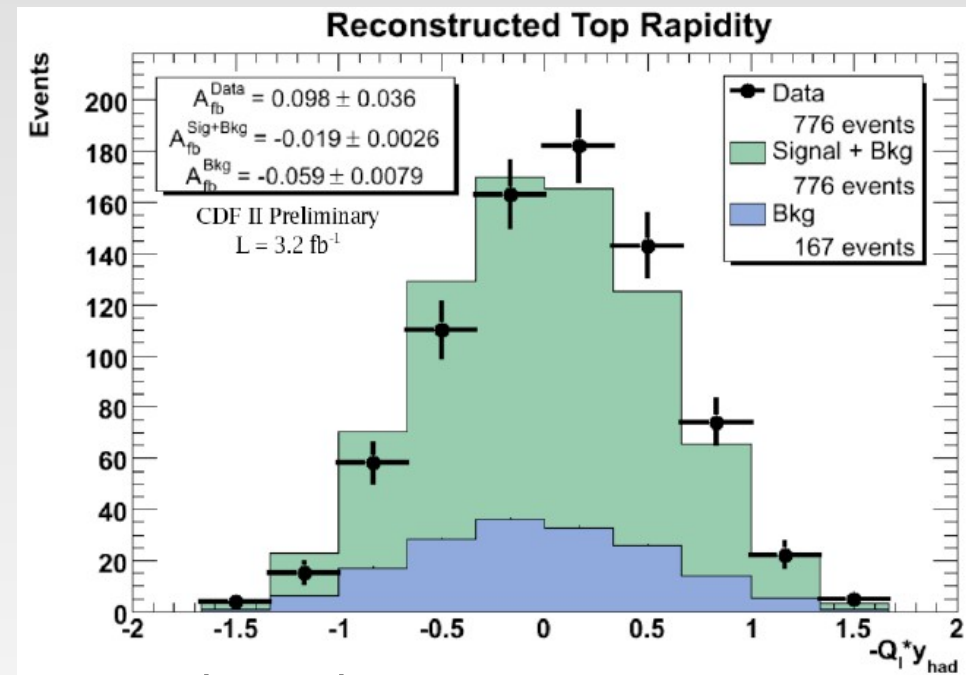
$$A_{fb} = \frac{N_t(p) - N_t(\bar{p})}{N_t(p) + N_t(\bar{p})}$$

- CDF (3.2fb⁻¹):

- $A_{fb} = 0.193 \pm 0.065(\text{stat}) \pm 0.024(\text{syst})$

- D0 (0.9 fb⁻¹):

- $A_{fb} = 0.12 \pm 0.08(\text{stat}) \pm 0.01(\text{syst})$



Anomalous top prod. @ TEVATRON

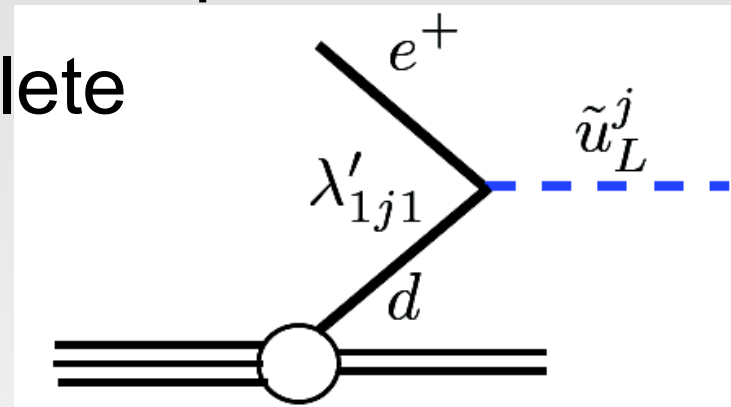
Maxim Perfilov

- TEVATRON searches for anomalous top production in many hypothesis. For example...
- $W' \rightarrow tb$ (CDF, 1.9 fb⁻¹)
 - $M(W') > 800$ GeV [$M(W') > M(\nu_R)$]
 - $M(W') > 825$ GeV [$M(W') < M(\nu_R)$]
- FCNC (CDF, 2.2 fb⁻¹)
 - $\kappa_{tg} / \Lambda < 0.069$ [assuming $\kappa_{tg} = 0$]
- Fourth generation (CDF, 4.6 fb⁻¹)
 - $M(t') > 335$ GeV

Squark production @ H1

Michael Herbst

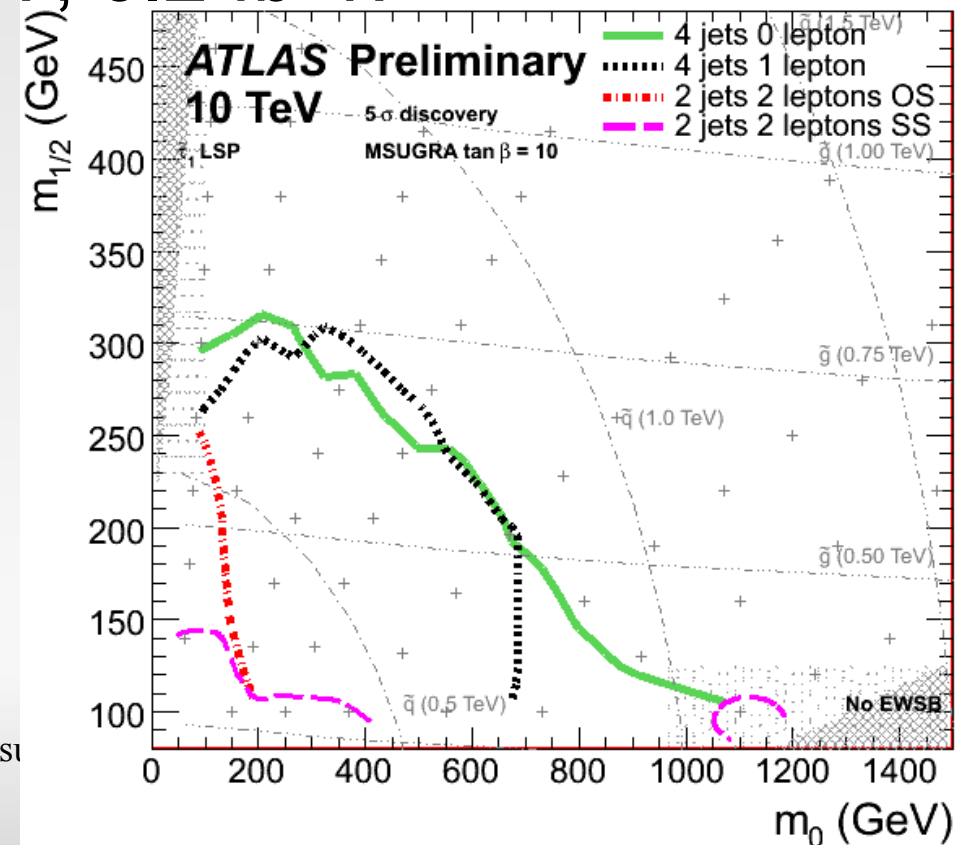
- R-parity = $(-1)^{3B+2S} = 1$ (SM), -1 (SUSY)
- In RPV SUSY single sparticles can be produced:
- RPV SUSY searched for in complete HERA data set (338 pb⁻¹)
- No sign of SUSY has been found
- Limits extracted for MSSM, mSUGRA
- Assuming a Yukawa coupling of electro-magnetic strength $\lambda_{1j1} = \lambda_{1k} = 0.3$:
 - $m(\tilde{u}) > 275$ GeV, $m(\tilde{d}) > 295$ GeV @ 95%CL



SUSY @ ATLAS

Iris Borjanovic

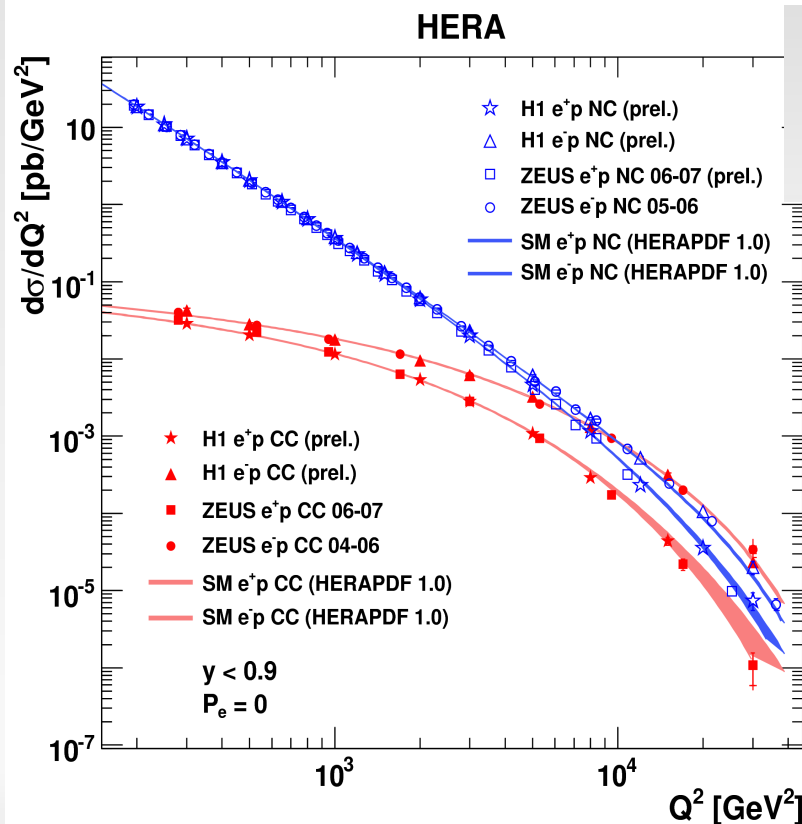
- SUSY particle decays into LSP generating a cascade → golden discovery channel: MET + multi-jets + (leptons)
- Discovery reach @ 10 TeV, 0.2 fb⁻¹:
 - Masses up to 600-700 GeV can be excluded
- Similar reach @ 7 TeV, with 0.7-0.8 pb⁻¹



Quark radius, CI @ HERA

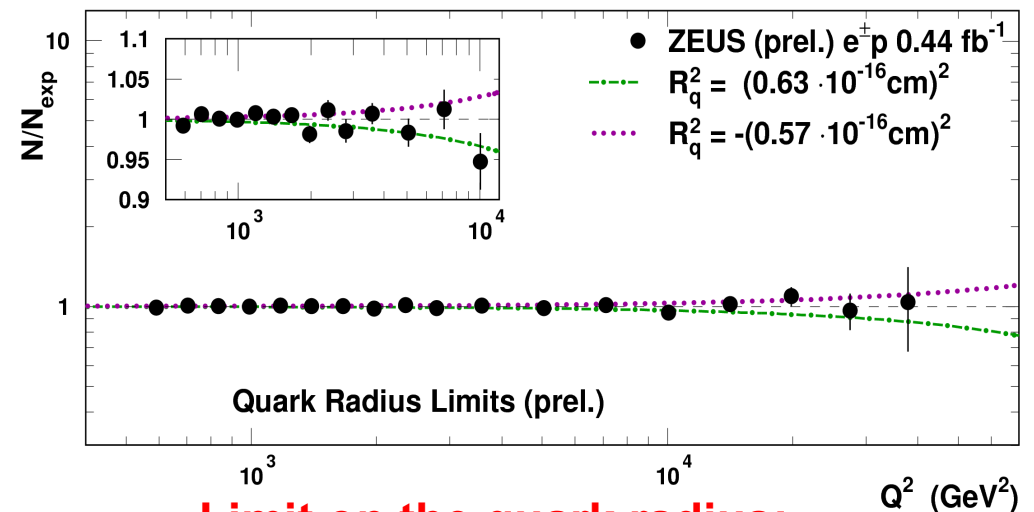
Ilias
Panagoulas

- Full HERA NC statistics used to investigate quark radius, CI models, heavy leptoquarks, large extra dimensions. **Strong limits extracted.**



$$\frac{d\sigma}{dQ^2} = \frac{d\sigma^{SM}}{dQ^2} \left[1 - \frac{R_q^2}{6} Q^2 \right]^2$$

ZEUS



**Limit on the quark radius:
 $R < 0.63 \times 10^{-3} \text{ fm @ 95\% CL}$**

Direct searches for new physics @ B-factories

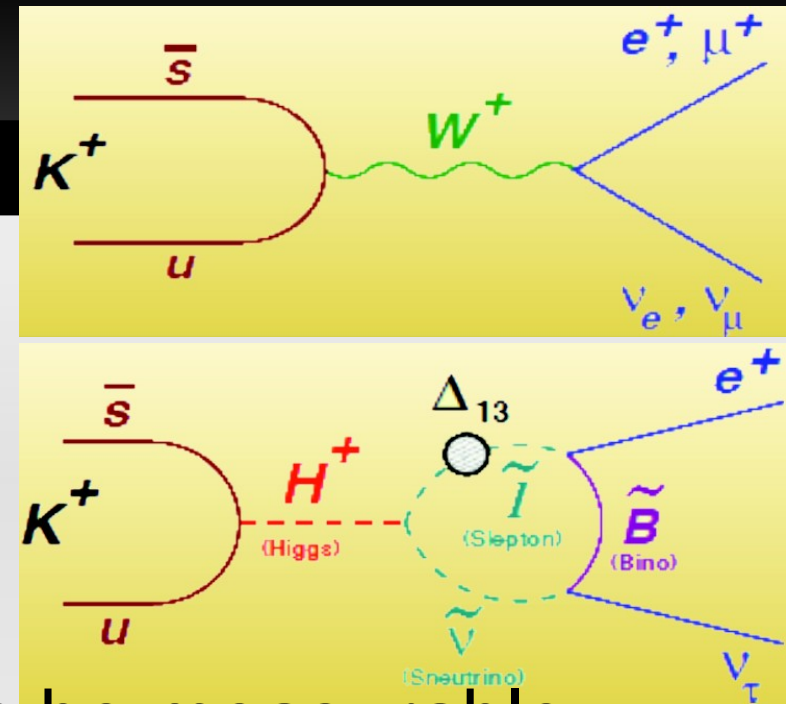
Alberto Cervelli

- Next-to-Minimal SSM Higgs: $Y(3S) \rightarrow \gamma A^0$, $A^0 \rightarrow \chi^0 \chi^0$
 - Data sample: 122×10^6 of $Y(3S)$ @ BABAR
 - $B(Y(3S) \rightarrow \gamma A^0) \times B(A^0 \rightarrow \text{invisible}) < (0.7-31) \times 10^{-6}$ @90% CL [in the range $m(A^0) < 7.8$ GeV]
- Many other searches (but no deviations from SM):
 - LFV in Y decays: $Y(2S, 3S) \rightarrow \mu\tau, e\tau$
 - LFV in tau decays: $\tau^\pm \rightarrow e^\pm \gamma, \mu^\pm \gamma$
 - $B \rightarrow K^{(*)} \nu\nu$: $B < 10^{-5}$ in SM, $\times 5-10$ in SUSY/DM

R_K with NA62

Mauro Raggi

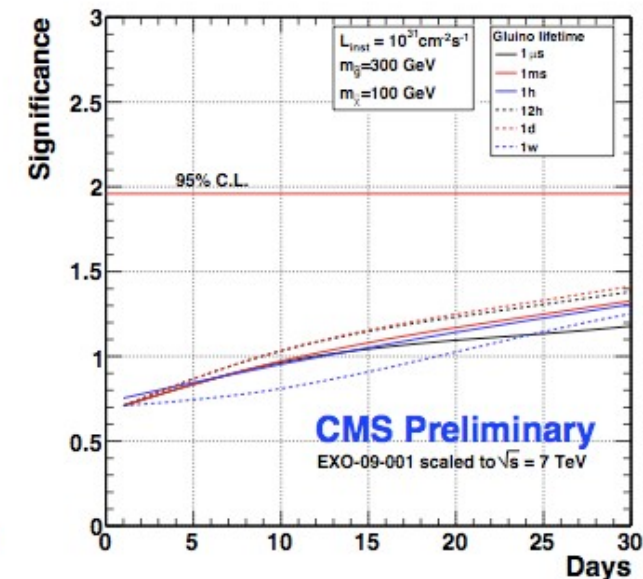
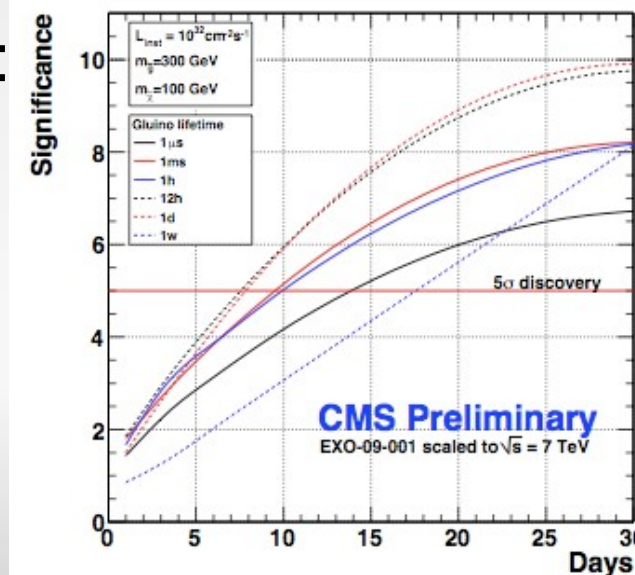
- $R_K = \frac{\Gamma(K^\pm \rightarrow e^\pm \nu)}{\Gamma(K^\pm \rightarrow \mu^\pm \nu)}$
- Very precise prediction in SM
 - $R_K(\text{SM}) = (2.477 \pm 0.001) \times 10^{-5}$
- The contribution from BSM can be measurable
 - $R_K(\text{MSSM}) = R_K(\text{SM}) \times (1 + 0.013)$ [1.3% increase]
- NA62 (40% of data analysed):
 - $R_K = (2.500 \pm 0.016) \times 10^{-5}$ (compatible with SM)
 - 0.64% precision \rightarrow 1.3% effect not yet excluded
 - 0.1% precision expected for NA62 – phase II



Early searches @ CMS

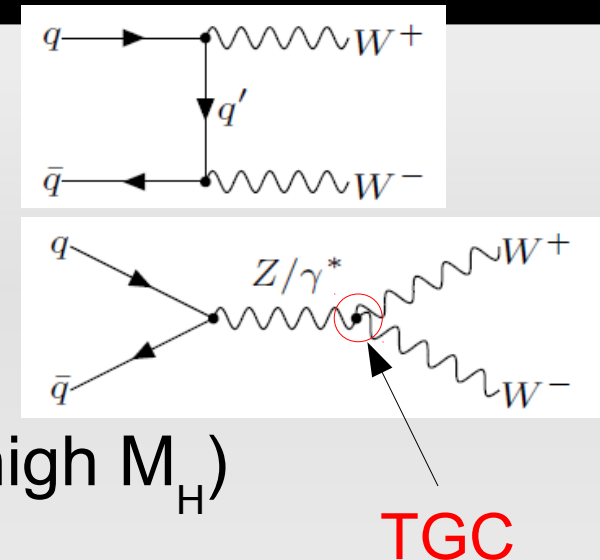
Francesco
Santanastasio

- Heavy Stable Charged Particles (HSCP):
 - high momentum (>100 GeV), low β ($<$ or $\ll 1$)
 - β measured with dE/dx in tracker, TOF in μ chambers
- Stopped gluinos
 - Long lived gluino hadronizes and can stop in CMS, and decay after seconds, days, weeks...
 - Reach @ 7 TeV:



Diboson production @ TEVATRON

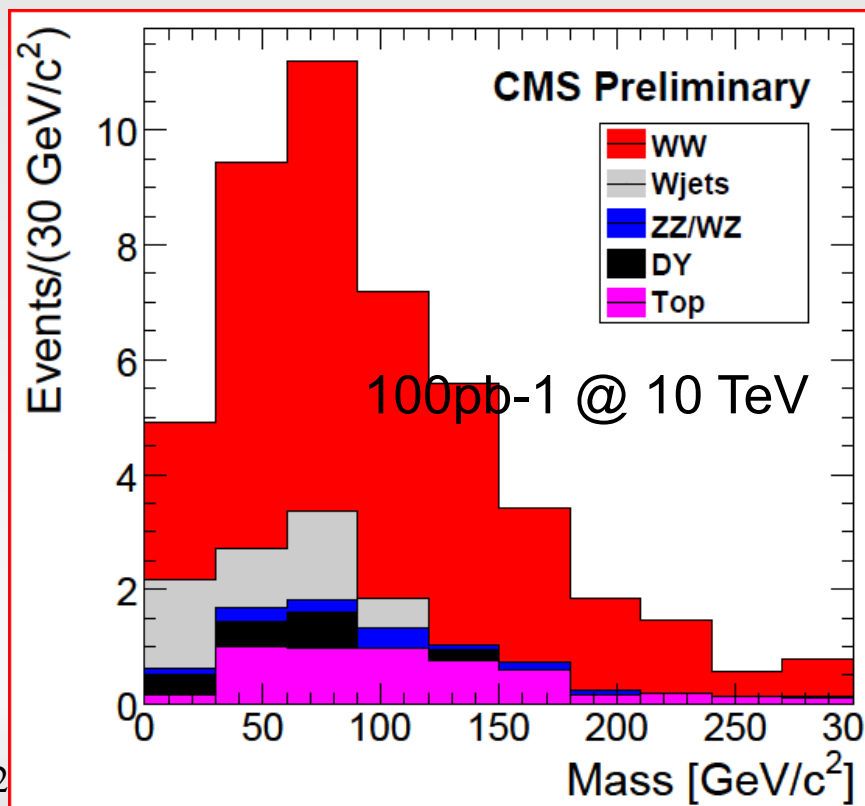
- Why?
 - Test of EW sector of SM
 - Probe of new physics
 - Higgs physics ($H \rightarrow WW$ dominant at high M_H)
- $Z\gamma$, ZZ , WW , $WW+WZ+ZZ$, $WW+WZ$ cross sections were measured: no deviation from SM.
 - eg $\sigma(Z\gamma) = 4.96 \pm 0.30 \pm 0.30$ pb (D0)
 4.74 ± 0.22 pb (NLO)
- Stringent limits on BSM Triple Gauge boson Couplings (TGP) were set.



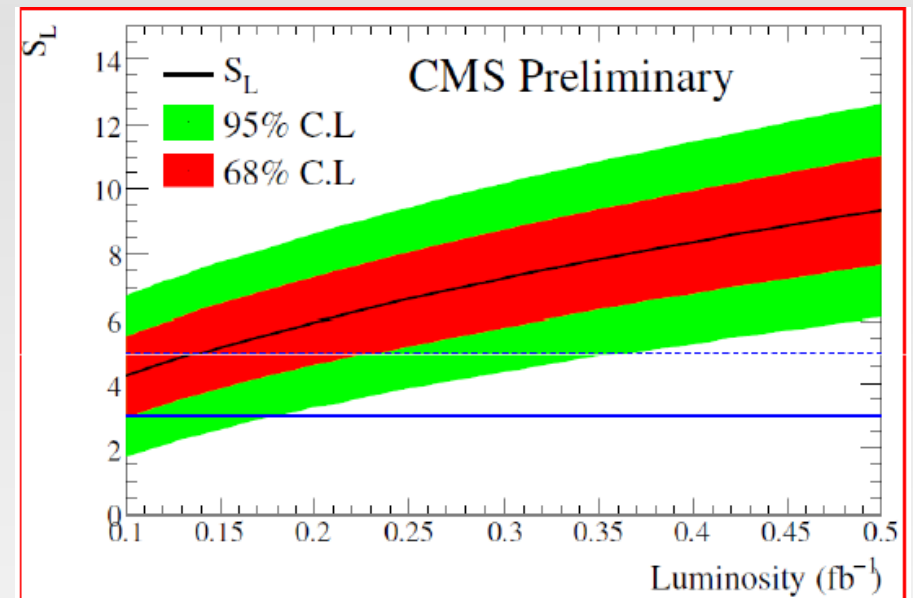
Diboson production @ CMS

Francesco
Fabozzi

- WW events; selection:
 - 2 opposite sign leptons,
missing ET



- WZ events:

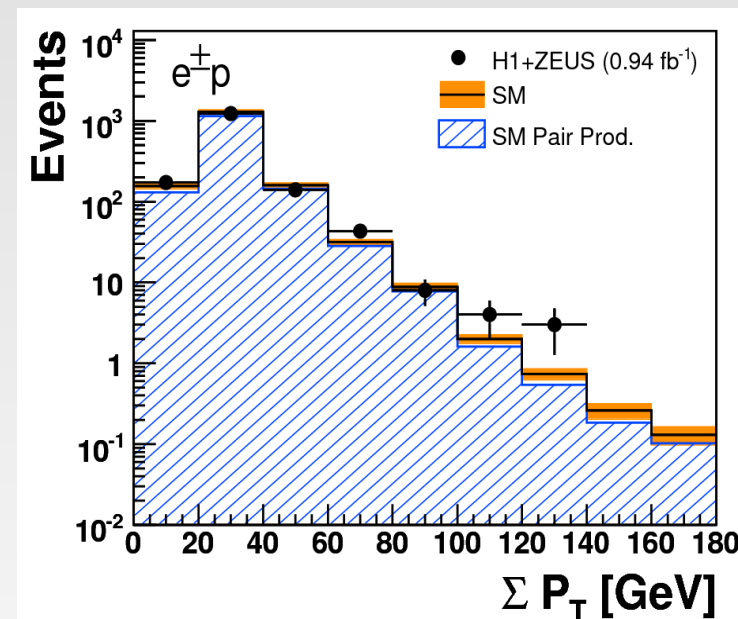
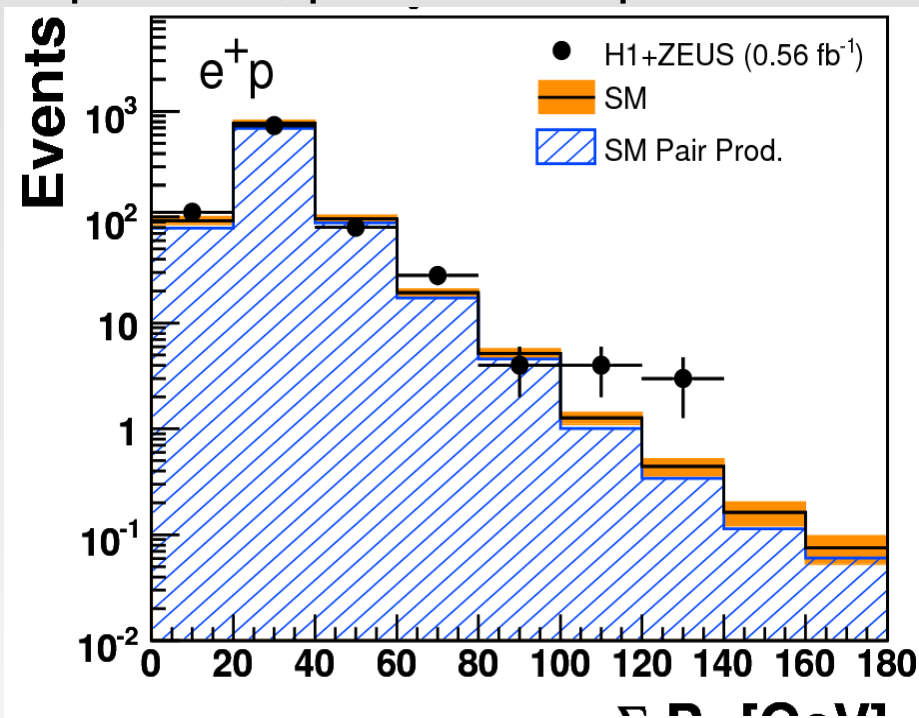


- 5 σ significance @95% CL with 350 pb⁻¹ @ 10 TeV.

Multi-leptons @ HERA

Andrea Parenti

- Analysis based on the full ZEUS+H1 data sample, $L=0.94 \text{ fb}^{-1}$ QED process, precise SM predictions \rightarrow look for deviations.



Multi-Leptons at HERA (0.94 fb^{-1})

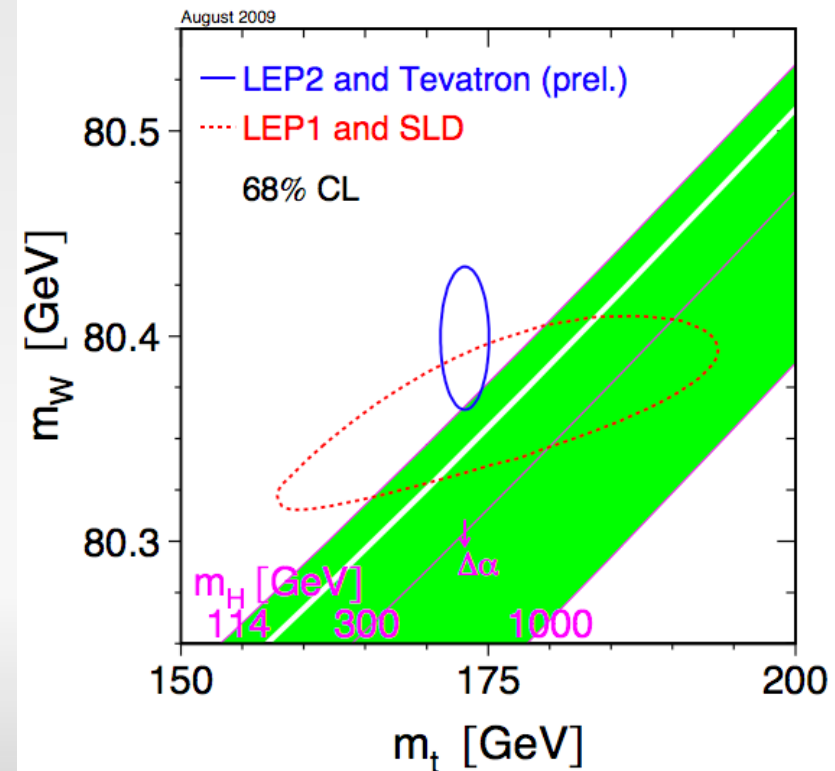
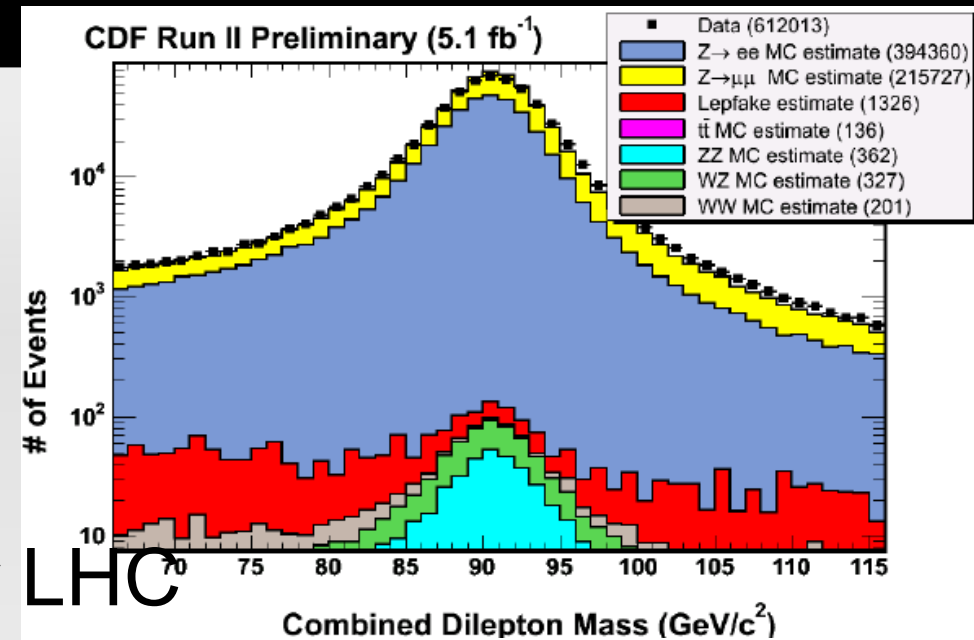
7 high- Σp_T events
observed in e^+p data

23.04.2010

$\Sigma P_T > 100 \text{ GeV}$				
Data sample	Data	SM	Pair Production (GRAPE)	NC DIS + QEDC
e^+p (0.56 fb^{-1})	7	1.94 ± 0.17	1.52 ± 0.14	0.42 ± 0.07
e^-p (0.38 fb^{-1})	0	1.19 ± 0.12	0.90 ± 0.10	0.29 ± 0.05
All (0.94 fb^{-1})	7	3.13 ± 0.26	2.42 ± 0.21	0.71 ± 0.10

W/Z properties @ TEVATRON

- Very large W/Z sample:
- EWK precision tests:
 - eg $\sin^2\theta_W$ from Z Afb
- Constraint to the PDFs for LHC
- M_W measurement:
 - 80.420 ± 0.031 (TEVATRON)
 - 80.399 ± 0.023 (World Av.)
- ... also constraints the Higgs sector

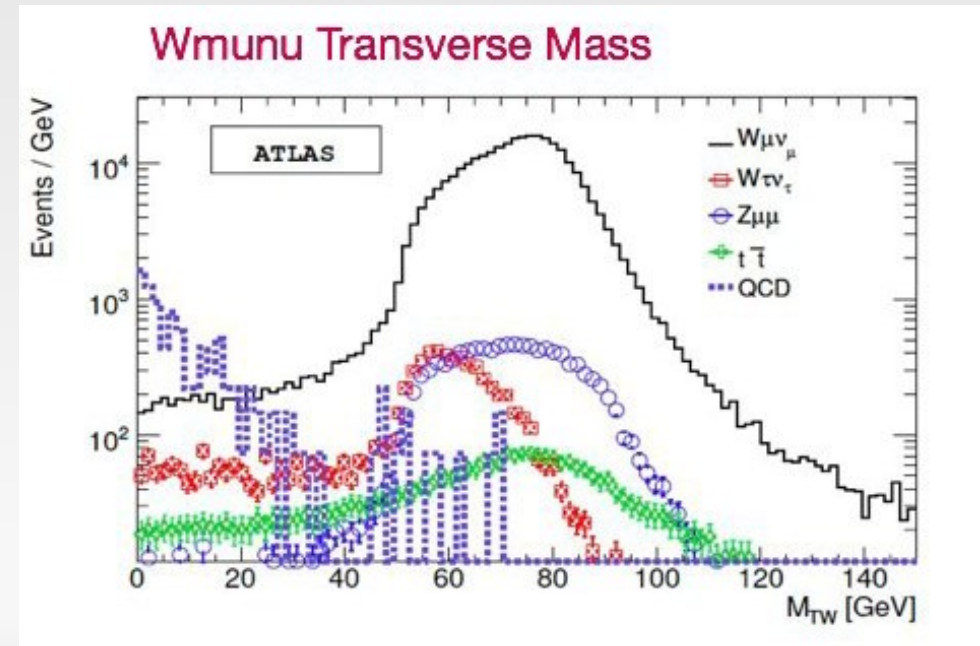
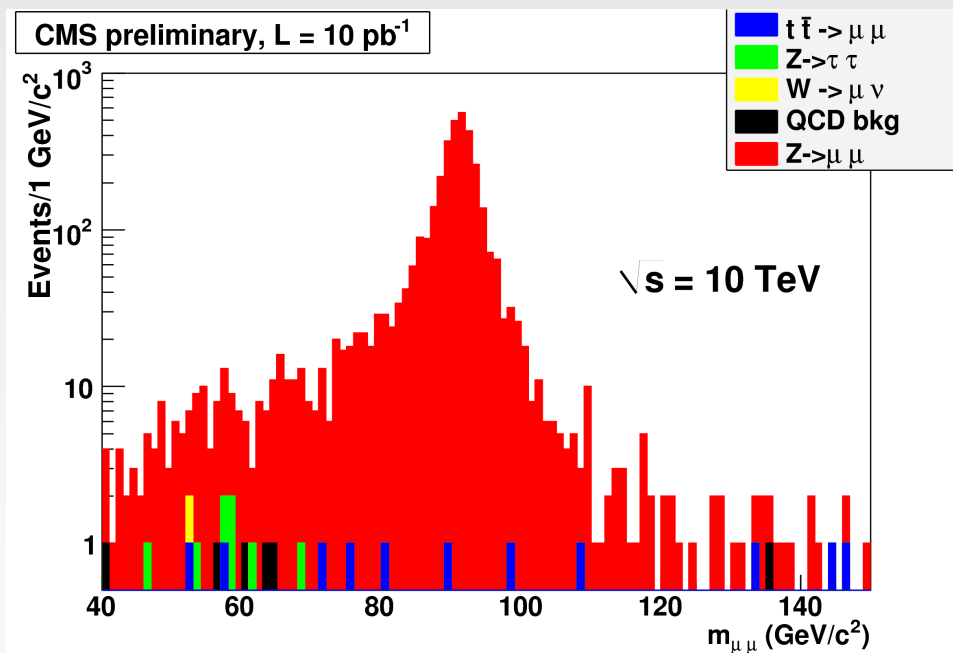


W/Z production @ LHC

Piergiulio Lenzi
Sara Borroni

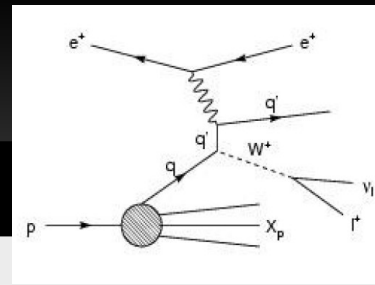
- W/Z looked for in the leptonic channel.
- Large sample already with 10 pb⁻¹ @ 10 TeV

- W/Z looked for in the leptonic channel.
- Large sample already with 50 pb⁻¹ @ 14 TeV

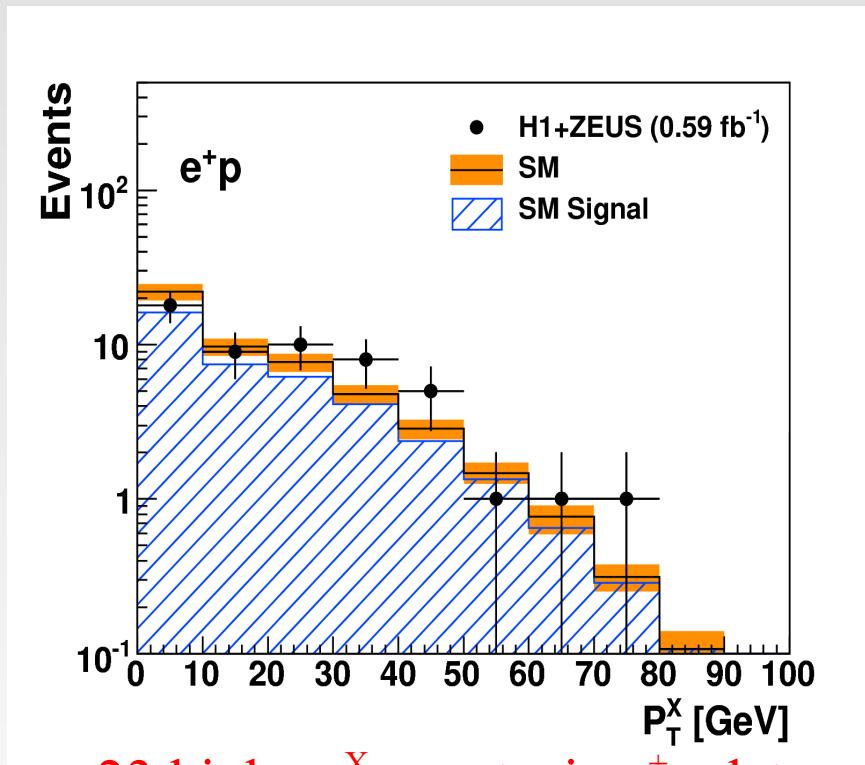


Isolated leptons @ HERA

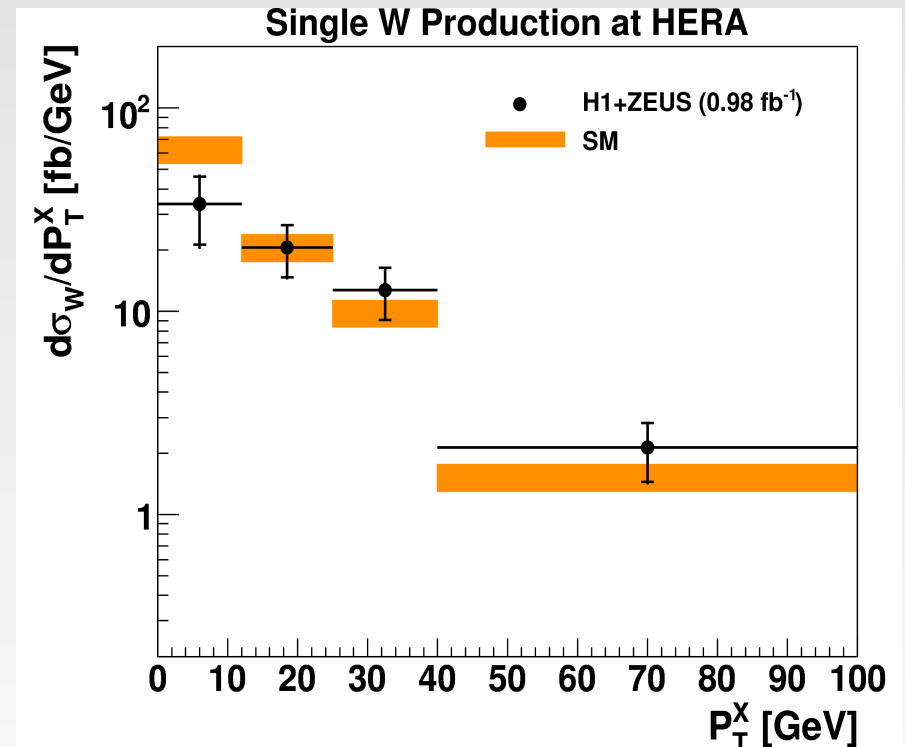
David South



- Analysis based on the full ZEUS+H1 data sample, $L=0.98 \text{ fb}^{-1}$. Dominant SM process: W production.



23 high- p_T^X events in e^+p data,
 14 ± 0.9 predicted

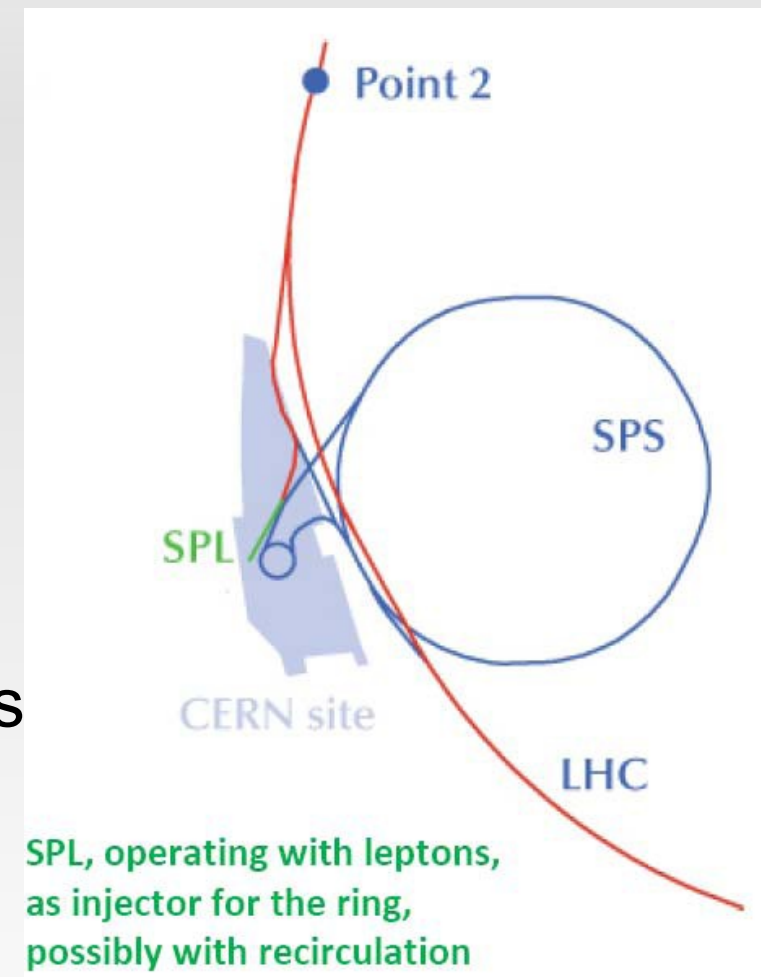


W production cross section measured

Future: LHeC

Georges
Azuelos

- Two options:
 - Ring-ring option
 - Ring-linac option (not shown)
- Why:
 - Clean environment, better S/N
 - Improved PDFs
 - LQs, heavy and excited fermions diquarks



Conclusion

- HERA started to provide results with full statistics ($\sim 0.5 \text{ fb}^{-1}/\text{experiment}$), and to combine results;
- TEVATRON is running well and providing interesting results; they expect $10 \text{ fb}^{-1}/\text{experiment}$ at the end of data taking (2011);
- LHC has just started, and already with the data collected in 2010 nice results should come (eg single-top, SUSY, W/Z single and couple production)
- Future: LHeC (ideal machine for PDF, but also for searches)

THANKS!

BACKUP SLIDES

SM Higgs: production and decay

- At the TEVATRON:

