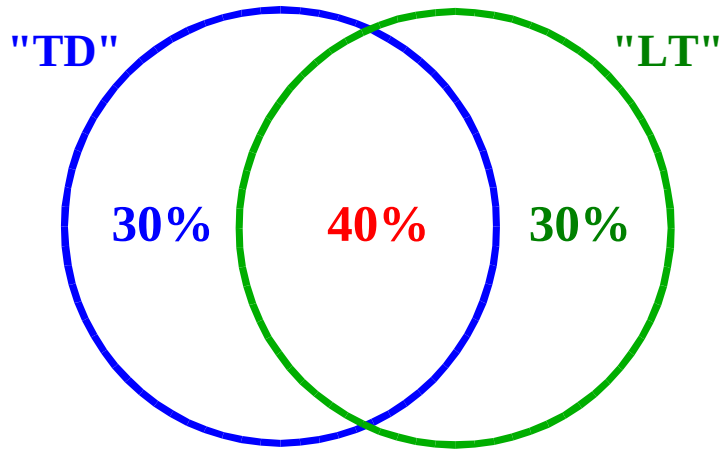
Overlap Between Two WW Analyses

"TIGHT−DILEPTON" & "LEPTON+TRACK" ANALSIS GROUPS

"TD" **"LT"**

- Run full analysis on 100k Pythia WW Monte Carlo events (wtop0f).
- Results :



TOTAL	**: 7655**
LT ONLY	**: 2281**
TD ONLY	**: 2291**
OVERLAP	**: 3083**

(1) Why ?

(2) Implications for the compatibility of the measurements ?

(1) **Why ?**

Why is the acceptance of both analyses calculated on Pythia WW MC identical ?

[when LT quoted yield is 30% larger]

- Both groups have double checked that they can reproduce the acceptance numbers in respective notes.
- ALPGEN ↔ PYTHIA might account for 10−15%.
- This is acceptance BEFORE (data/MC) scale factors have been applied. The TD analysis takes a bigger hit here because :
  - **i.** inclusion of PHX−PHX category means a larger fraction of the TD acceptance is in a low−luminosity category.
  - **ii.** TD analysis takes double hits on lepton ID scale factors.

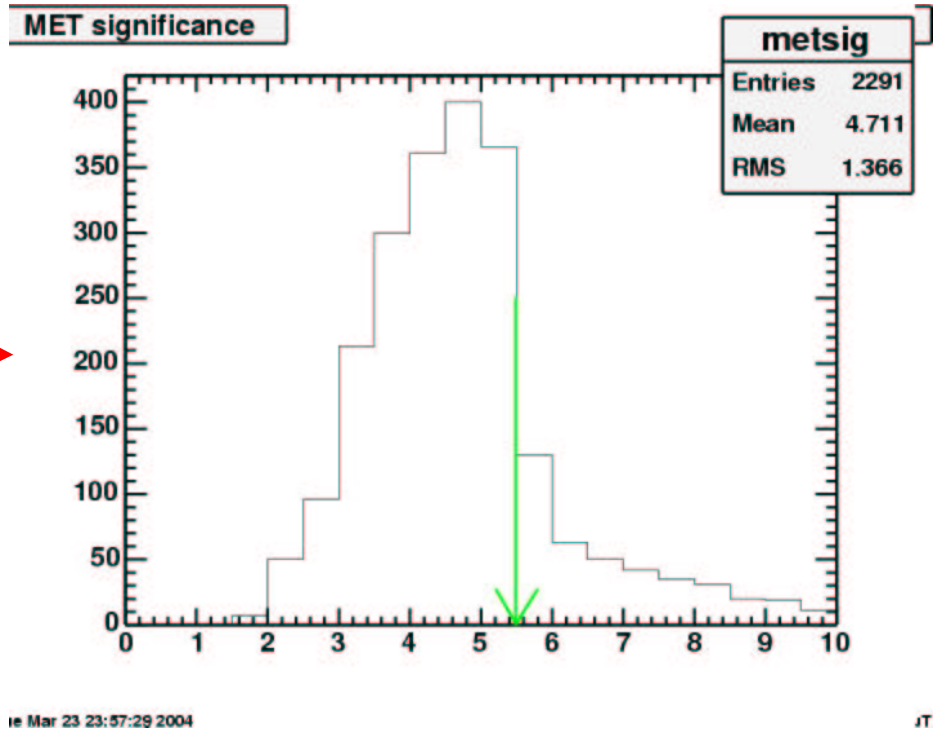
Why is the overlap so small ?

Don't be too shocked .... remember that :

- BOTH analyses are very low acceptance. For every 100 WW→lνlν (l=e,μ,τ) events at CDF, each analysis hopes to collect 6 or 7 events. Not impossible to "miss" each other.
- BOTH analyses are making harsh and DIFFERENT topological cuts (e.g. METSIG, 0−jet) to remove LARGE backgrounds.

Events Missing in LT Analysis :

- 2291 events unique to “tight−tight” analysis
- 80% due to METSIG cut :
  - LT applies tighter cut
    - Higher METSIG cut value
    - Applied to all candidates at all invariant masses
- Remaining 20%:
  - half have no high pt track in central
  - Rest fail MET>40 in Z window, δϕ(MET,tl)



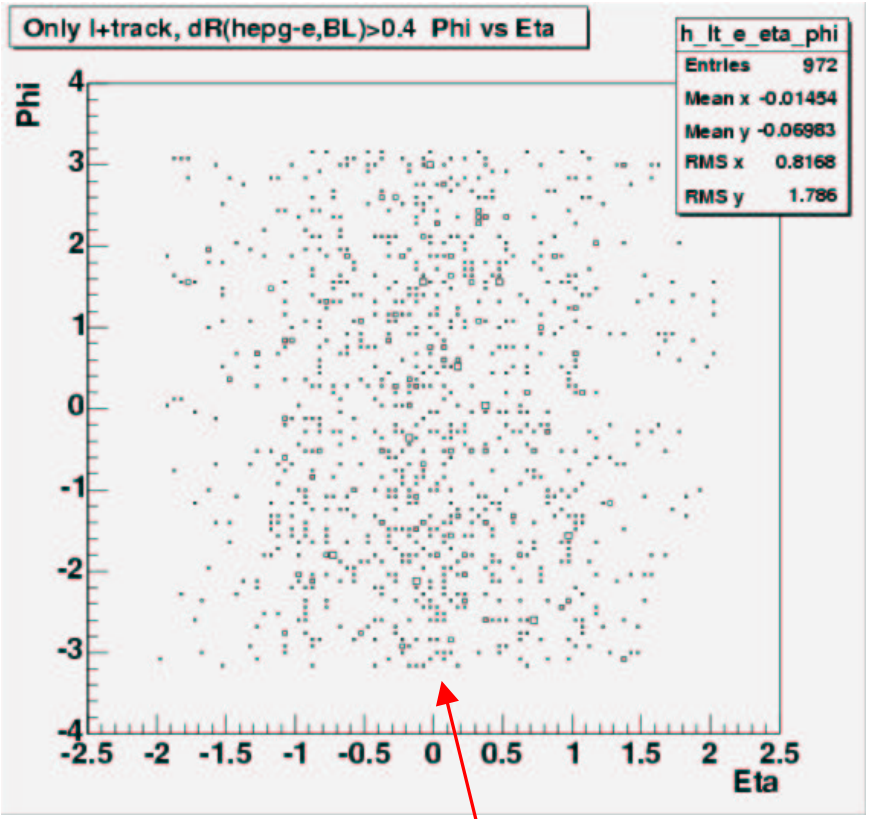
Events Missing in TD Analysis :

- 2281 events unique to "lepton+track" analysis.
- 32% (719) DO have 2 baseline leptons
  - ≈1/4 fail strict CAL+TRK iso.
  - ≈3/4 fail jet veto
- 68% (1561) do NOT have 2 baseline leptons (therefore harder to examine within our analysis structure), but a first look indicates :
  - TRUE e−e events : 382
  - TRUE e−μ events : 729
  - TRUE μ−μ events : 137

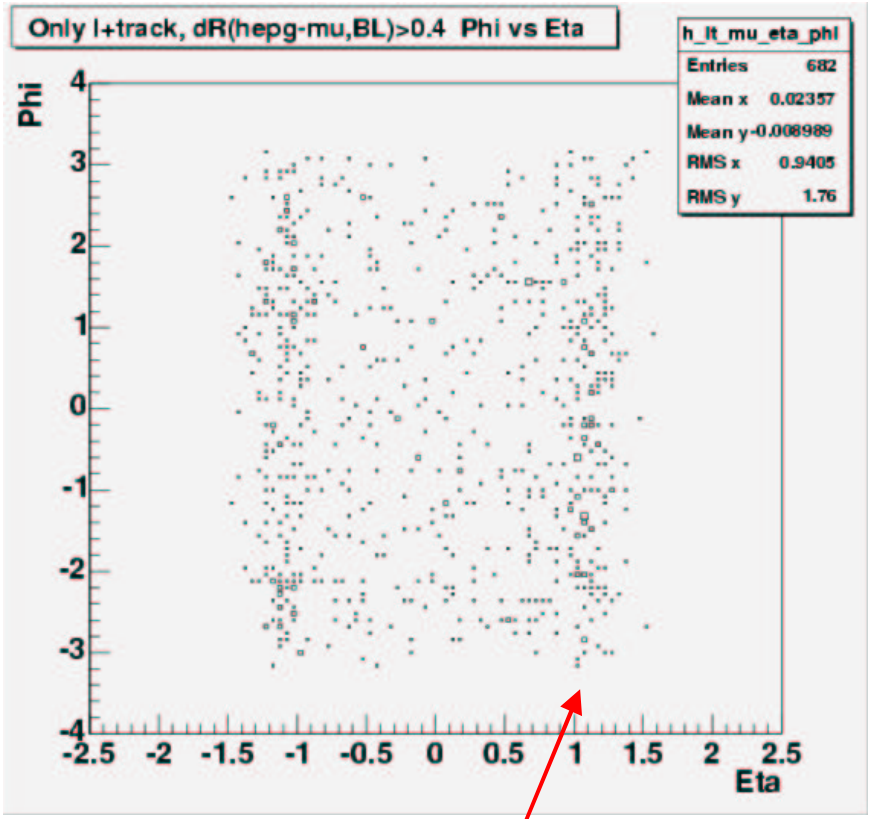
  } → relative proportions make sense, given our CMIO lepton category
  - Remainder (313) are events containing τ's

Events Missing in TD Analysis :

- Some evidence for the missing tight leptons being in detector regions where we will naturally loose them, but this is still being looked at :



statistics low, probably a combination of cuts responsible.



at high eta we rely on CMIO, and in e−μ events calorimeter fiducial cuts are applied.

(2) **Implications for the compatibility of the measurements ?**

- Basically, no.
- Naïve calculation of the statistical significance of the discrepancy :

$$\frac{\mathrm{LT}-\mathrm{TD}}{\sqrt{\sigma_{\mathrm{LT}}^2+\sigma_{\mathrm{TD}}^2}} = 0.64 \text{ "sigmas"}$$

combining statistical errors *only*

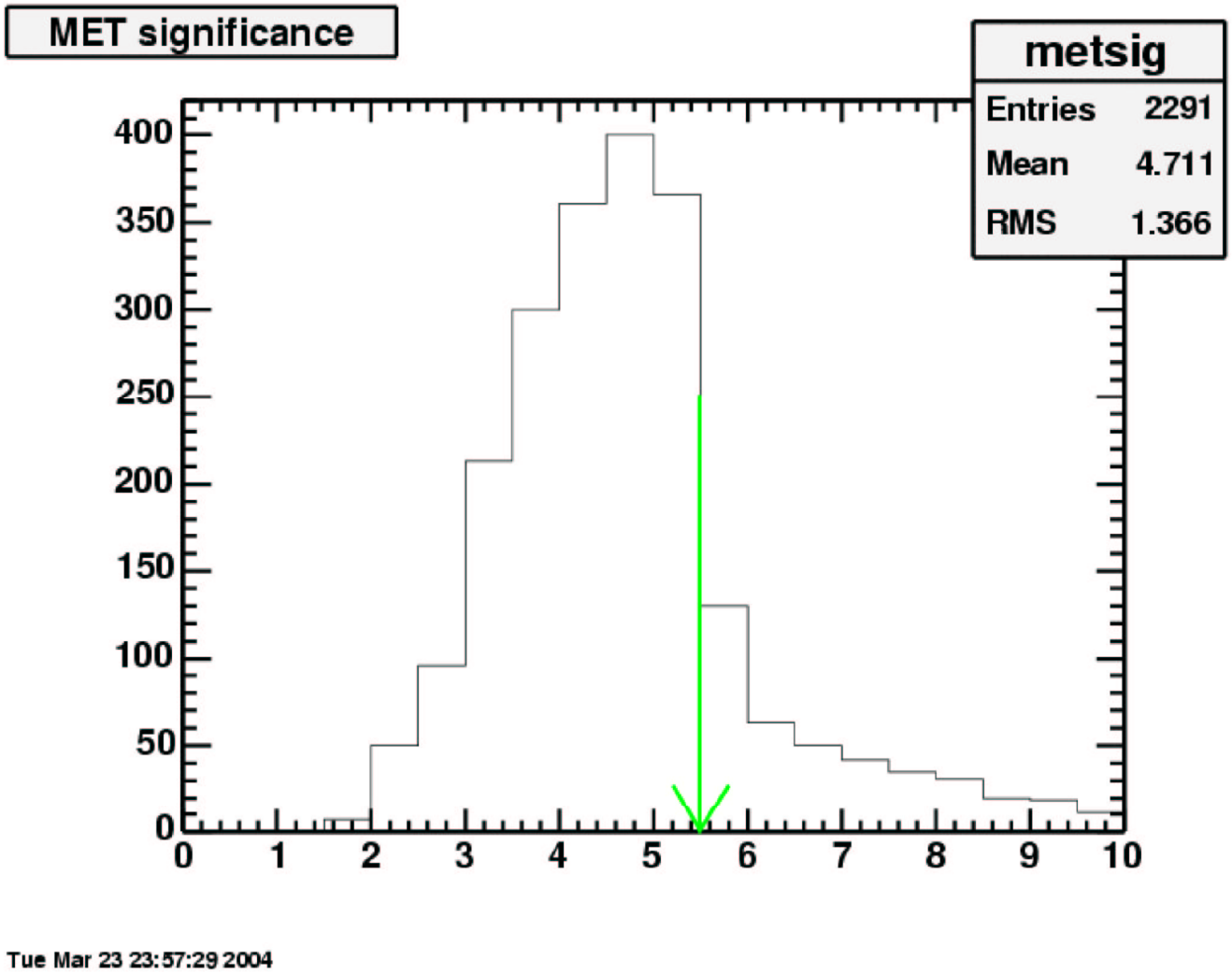
- Pseudo−experiments confirm that the 40% overlap hardly changes this naïve estimate.
- **"Less than 1−sigma effect"**

Summary

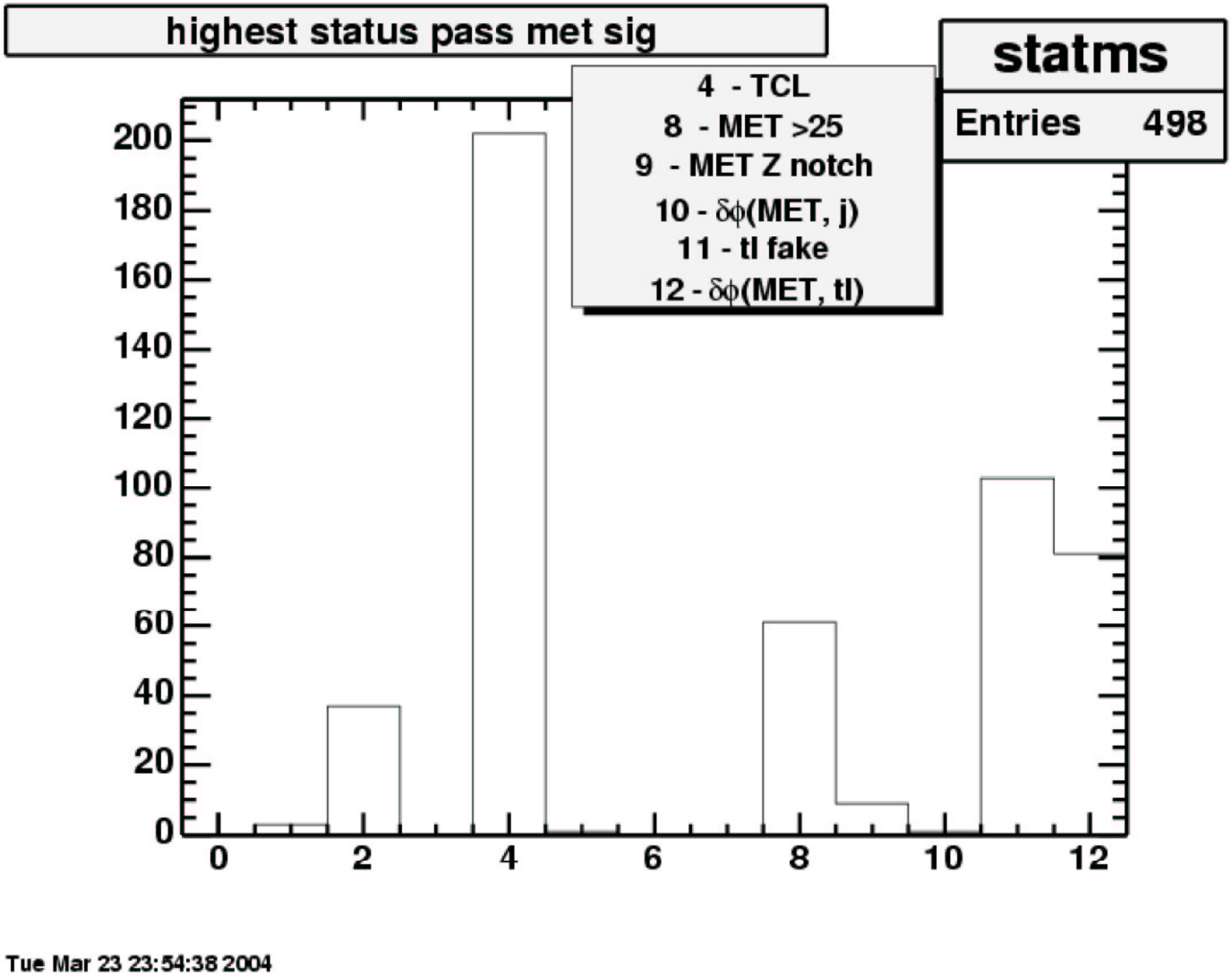
- Overlap lower than expected but maybe not so surprising.
- Big picture :
  - LT analysis is losing TD events due to topology cuts (which are designed to reject background).
  - TD analysis is losing LT events mainly due to tight lepton requirements. Topology cuts (jet−veto) also play a part.

BACKUP SLIDES

Events Missing in TL Analysis :



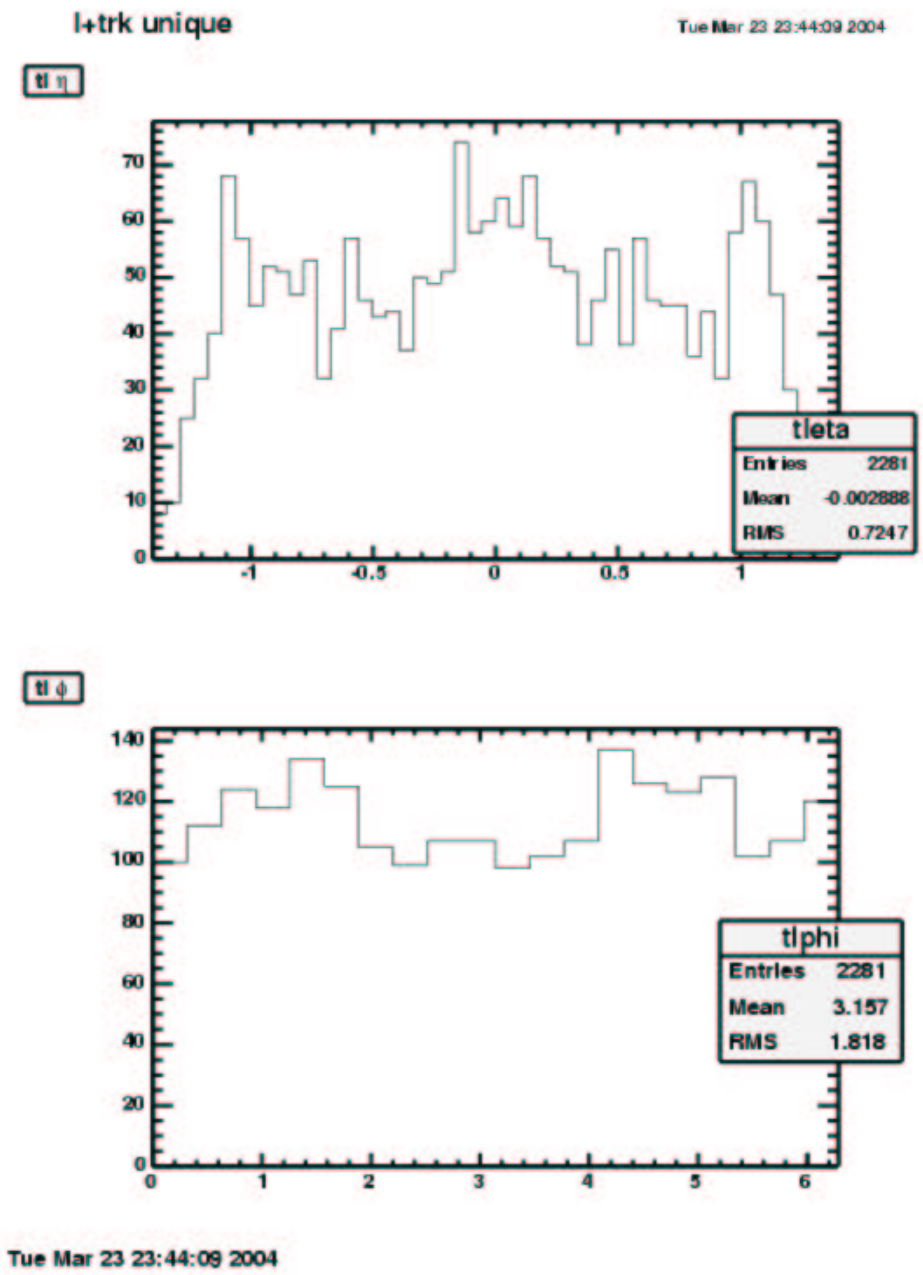
Events Missing in TL Analysis :



Events Missing in TD Analysis :

Category	ID	ISO	Conv+Cosm	Z veto	$\not\!\!E_T > 25$ GeV	$\Delta\phi$	0j	OS
TCE-TCE	75	47	42	42	42	42	0	0
TCE-PHX	35	30	28	28	28	28	2	0
PHX-PHX	3	3	3	3	3	3	0	0
TCE-CMUP	131	96	88	88	88	86	0	0
TCE-CMU	23	17	17	17	17	17	0	0
TCE-CMP	41	28	28	28	28	28	0	0
TCE-CMX	71	43	39	39	39	39	0	0
TCE-CMIO	40	30	30	30	30	29	0	0
PHX-CMUP	42	39	39	39	39	38	2	0
PHX-CMU	14	11	11	11	11	11	0	0
PHX-CMP	9	9	9	9	9	9	0	0
PHX-CMX	19	19	19	19	19	19	1	0
PHX-CMIO	13	13	13	13	13	12	1	0
CMUP-CMUP	44	31	31	31	31	31	0	0
CMUP-CMU	19	14	14	14	14	14	0	0
CMUP-CMP	21	15	15	15	15	14	0	0
CMUP-CMX	44	32	32	32	32	31	0	0
CMUP-CMIO	40	29	29	29	29	28	0	0
CMX-CMX	5	3	3	3	3	3	0	0
CMX-CMU	4	1	1	1	1	1	0	0
CMX-CMP	6	6	6	6	6	6	0	0
CMX-CMIO	20	14	14	14	14	14	0	0
TRILEPTON	0	0	0	0	0	0	0	0

Events Missing in TL Analysis :



Statistical compatibility of two WW analyses

Take numbers from CDF−6872 & CDF−6909 :

WW−TIGHT ("A") :

- ww_mean = 11.3
- bk_mean = 4.77

L+T ("B") :

- ww_mean = 16.45
- bk_mean = 15.27

Proper definition of overlap (thanks Peter) :

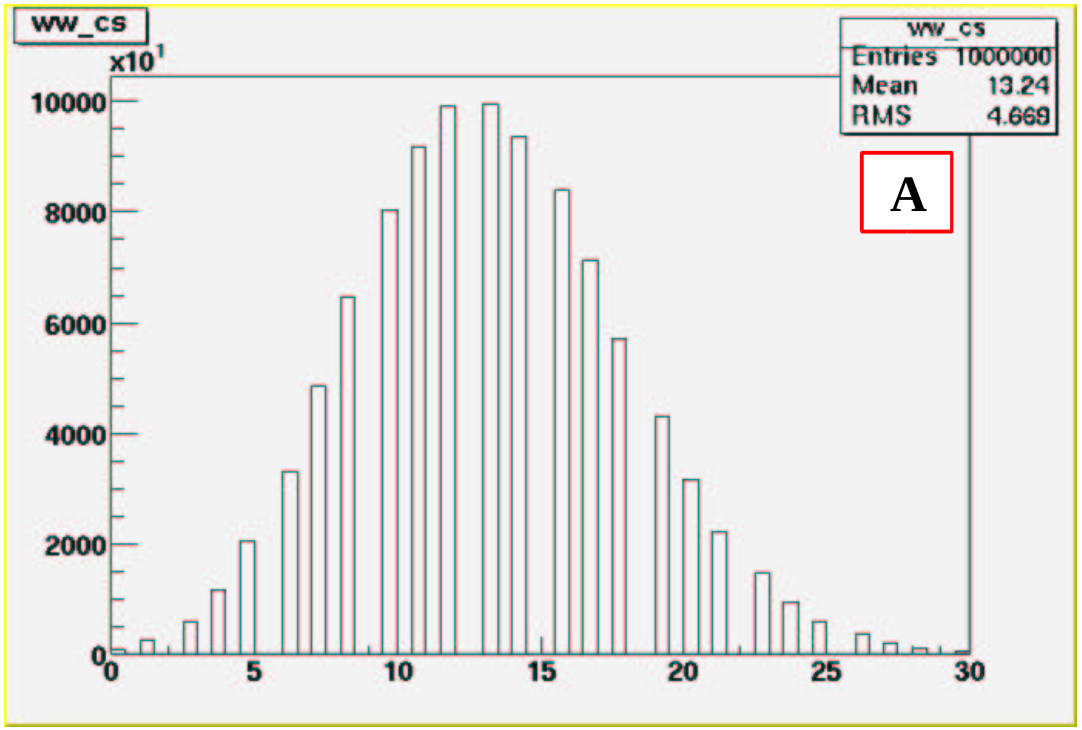
$$\text{overlap} = \frac{A \cap B}{A \cup B}$$

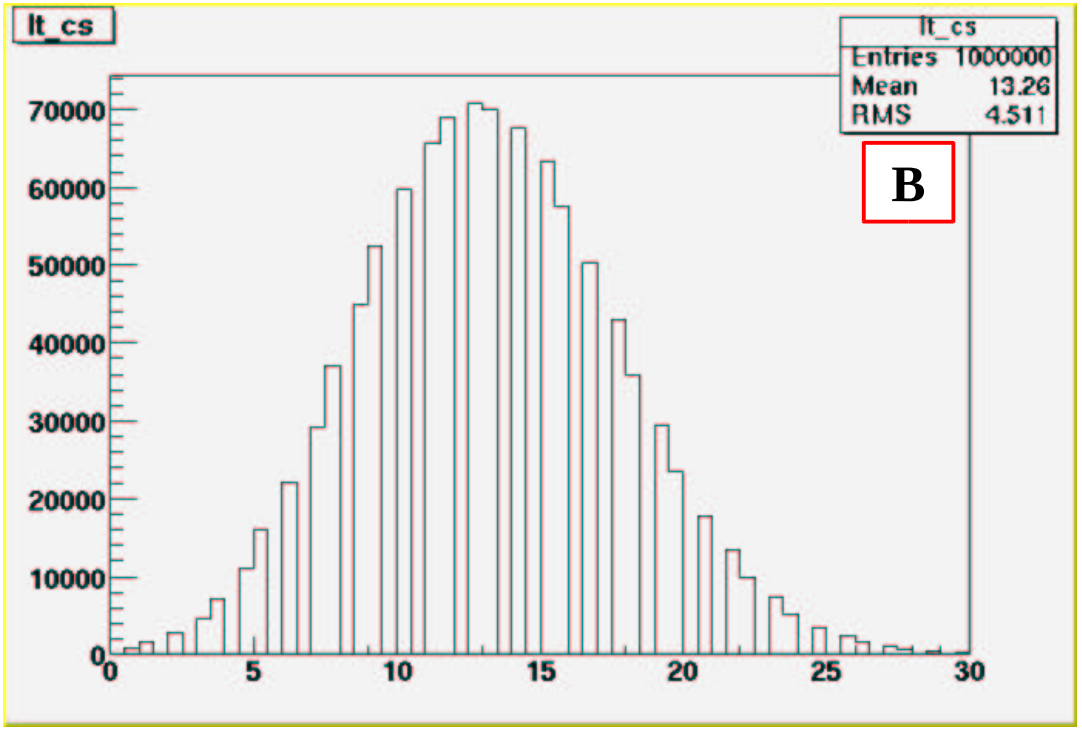
Then because of the different signal and background sizes, the range of overlap is limited :

overlap (SIGNAL) $\in [0.0, 0.69]$

overlap (BACKGROUND) $\in [0.0, 0.31]$

assume no background overlap for now

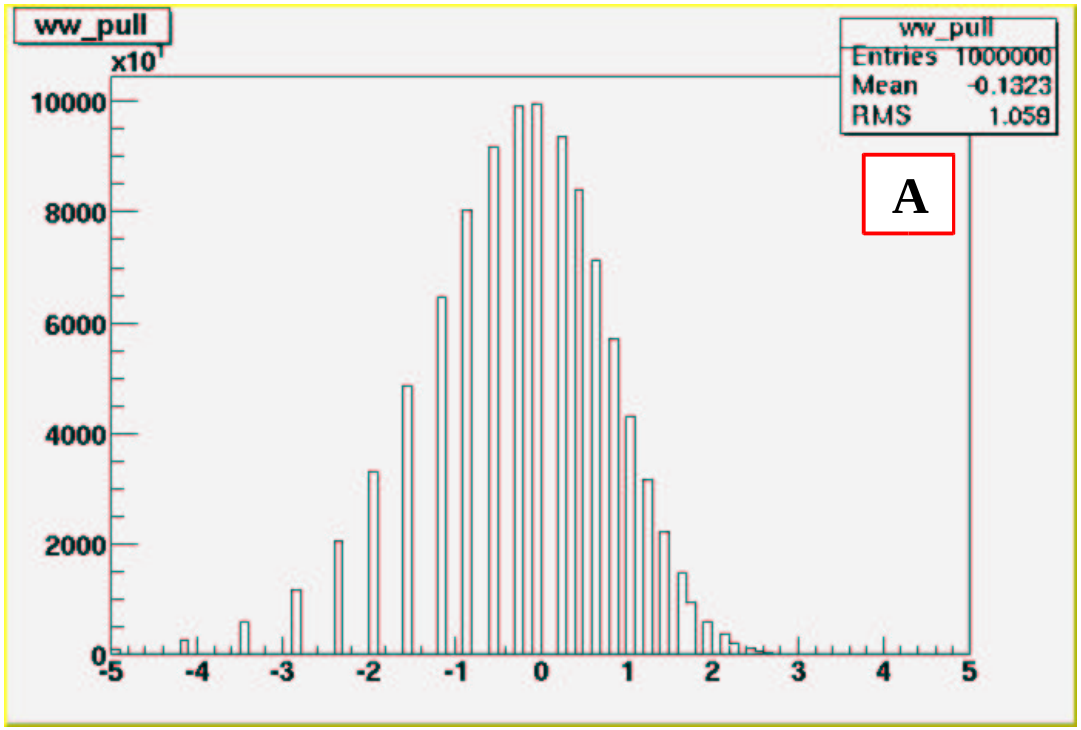


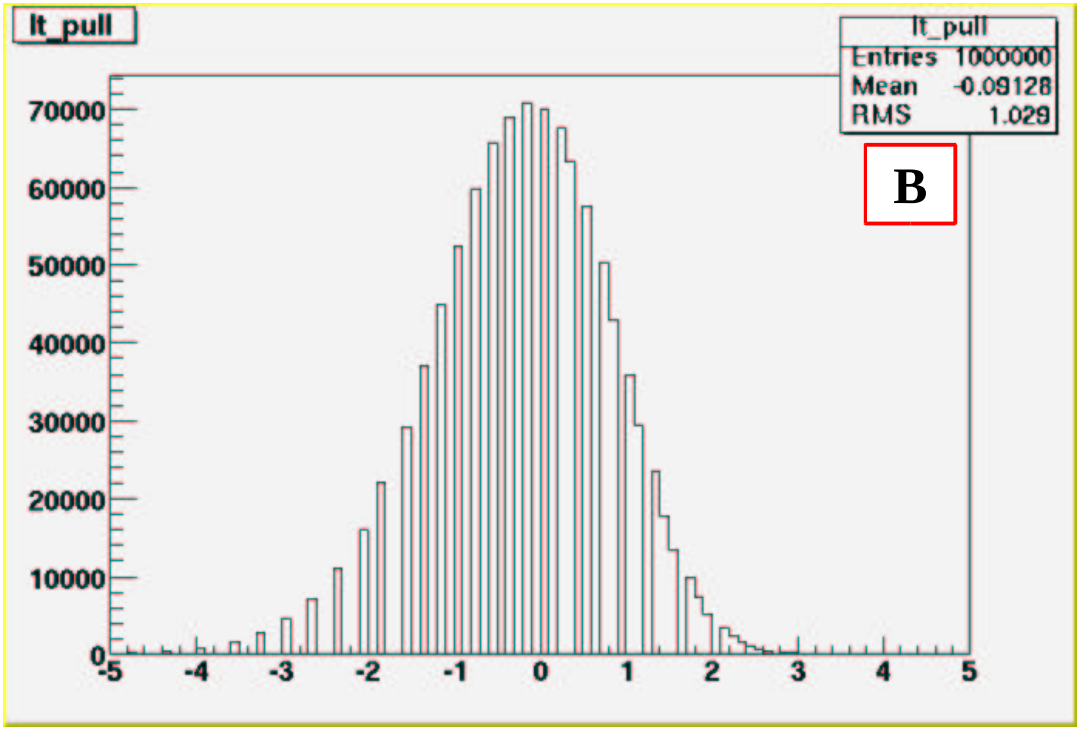


OVERLAP = 0.0

Pseudo−experiment results :

- 1 million pseudo−experiments
- measured cross−sections unbiased (of course, since I'm only using the expectation numbers in the pseudo−experiment generation)
- discrete distribution of measured cross sections due to Poisson statistics.

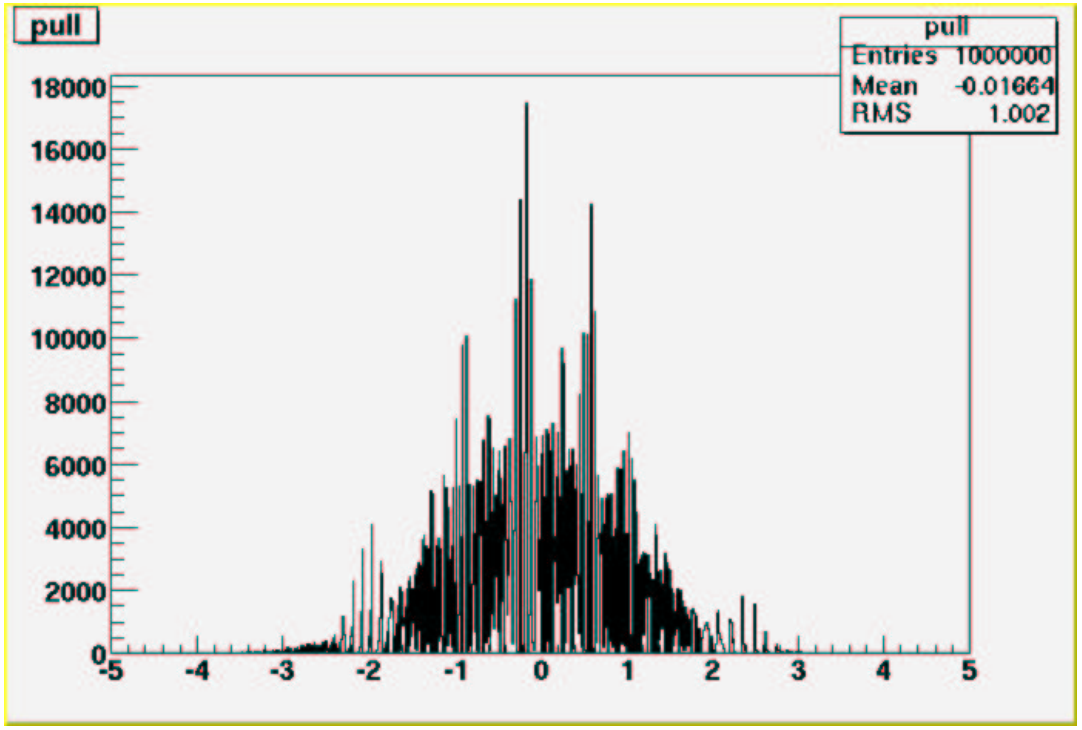




OVERLAP = 0.0

Pull distributions :

- errors on measured cross−section for each pseudo−experiment are just sqrt(n) (Feldman−Cousins too time consuming)
- pull distributions still reasonable − slightly more asymmetric for "A" as expected.
- Quantitative :
  - fraction < 1σ = 67.7% ("A")
  - fraction < 1σ = 66.9% ("B")
- Should be 68.3% for perfect 1σ coverage, but simplified error treatment is clearly not too bad.



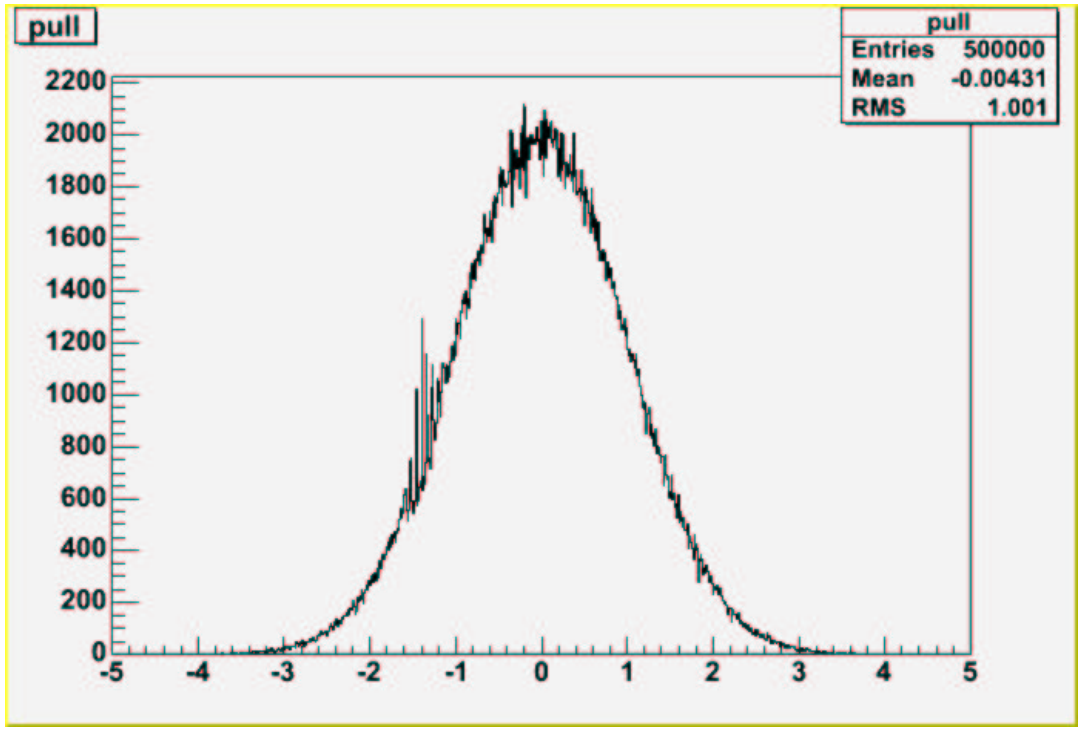
OVERLAP = 0.0

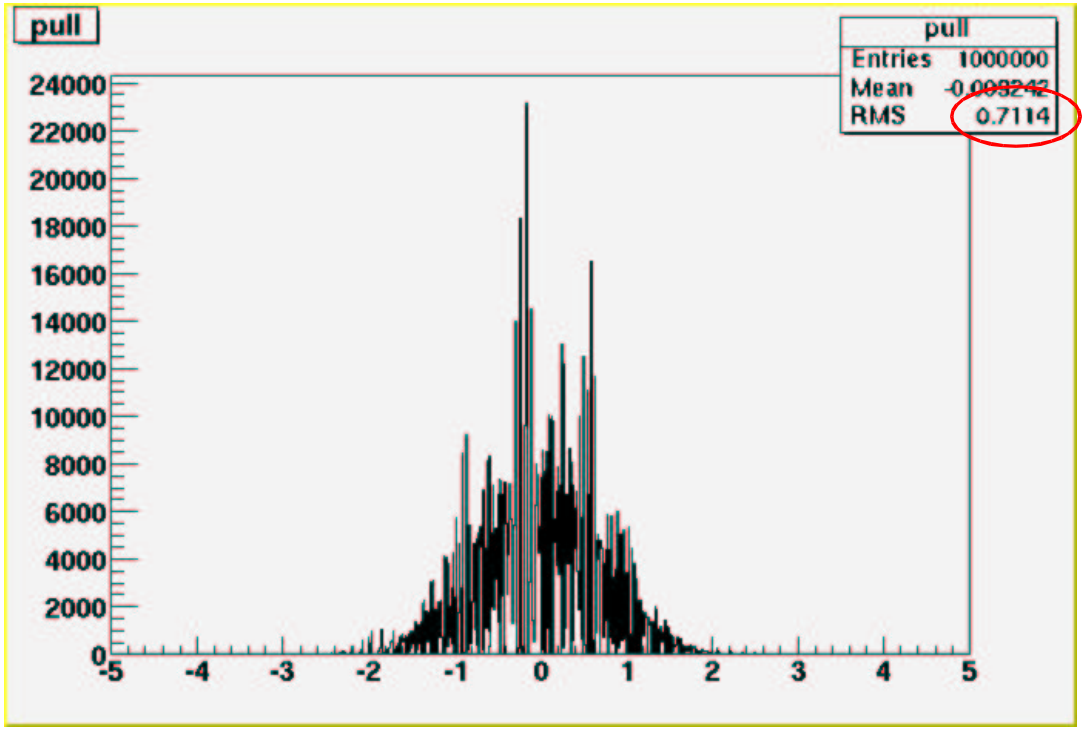
Compatibility of 2 measurements :

- pull distribution has a lot of structure
- but coverage is about right :
  - fraction < 1σ = 68.0% ("A−B")
- With 50 times the data, things look much more Gaussian, so structure above is still due to discrete statistics :

$$\text{compatibility pull} = \frac{A-B}{\sqrt{\sigma_A^2+\sigma_B^2}}$$

[N.B. The two measurements are only **0.64** σ discrepant according to this definition]





OVERLAP = 0.69 (MAX)

Compatibility of 2 measurements :

- Coverage reflects correlation :
  - fraction < 1"σ"= 84.1% ("A−B")

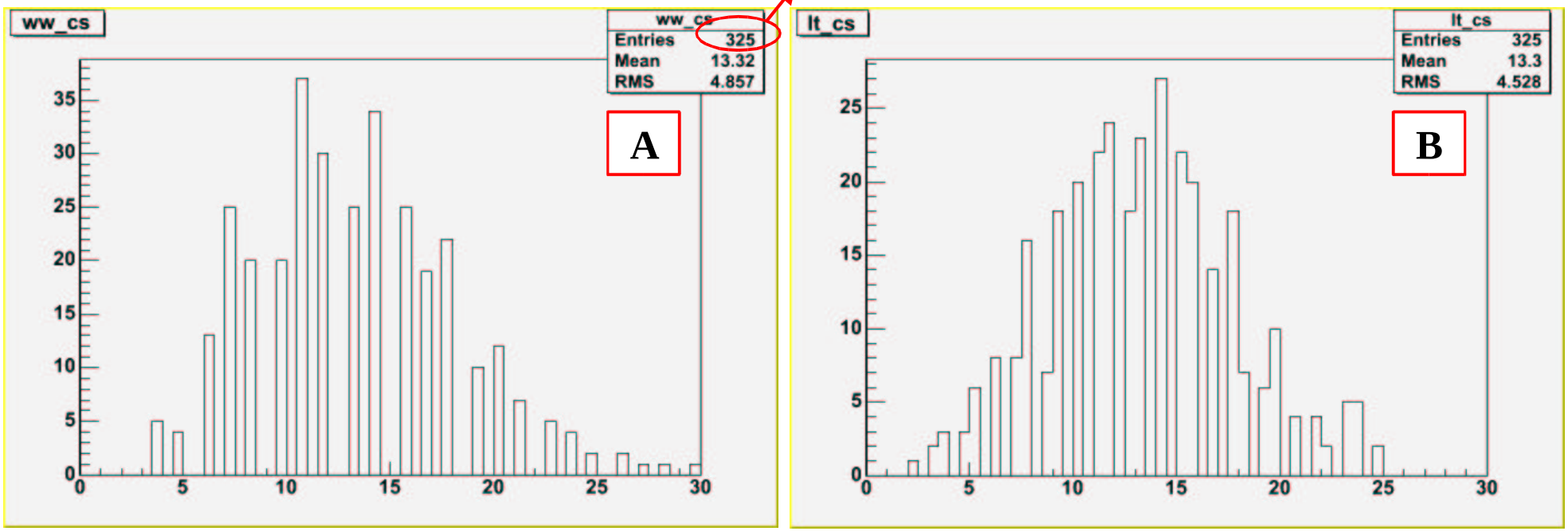
Another way of saying the same thing :

- With no overlap, the probability for the 2 measurements to be > 1"σ" away is 32% (tautology).
- With maximal allowed signal overlap (but no background overlap), this probability drops to 16%.

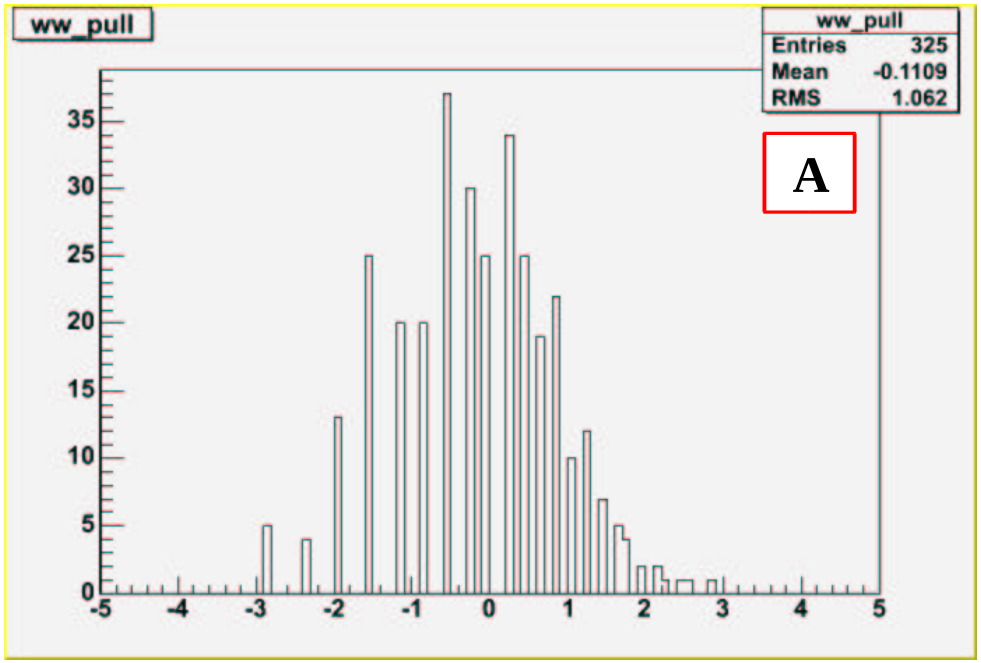
Pythia Pseudo−Experiments :

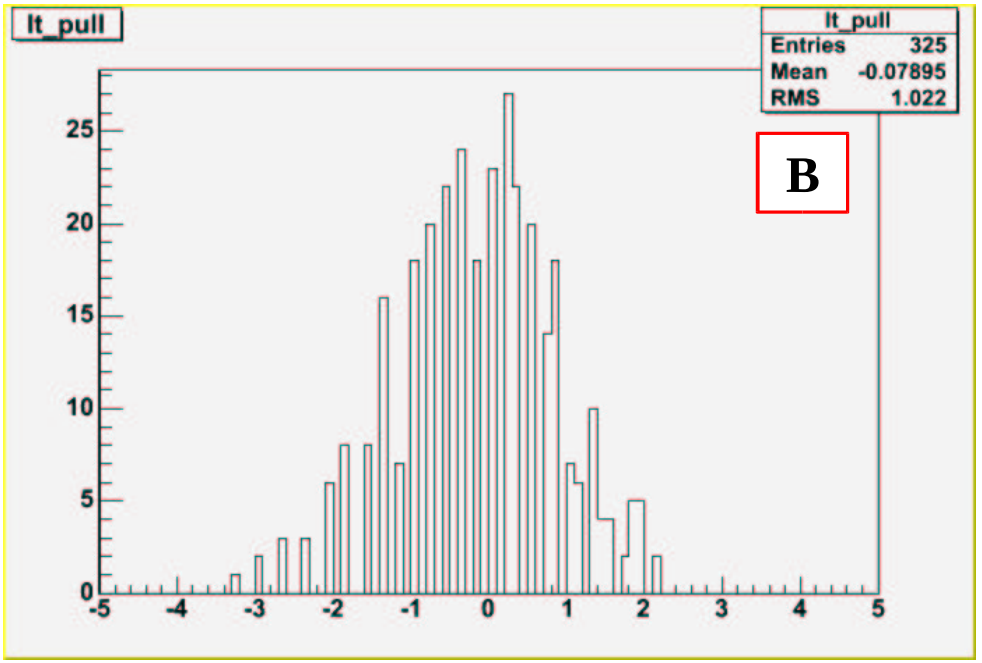
- Alternative approach : use Pythia WW overlap event lists.
- For each pseudo−experiment, Poisson fluctuate the total (WWT+LT) event yield and select this N events at random from Susana's & Peter's combined list (containing events which pass one or both analyses). Ask which of the N pass both analyses − hence using the full correlation between the 2 analyses.
- PROBLEM : this would give on average the same number of events selected in the WWT and LT analyses, since they have identical acceptance on this sample. I model this by randomly rejecting ~30% of the selected WWT events.

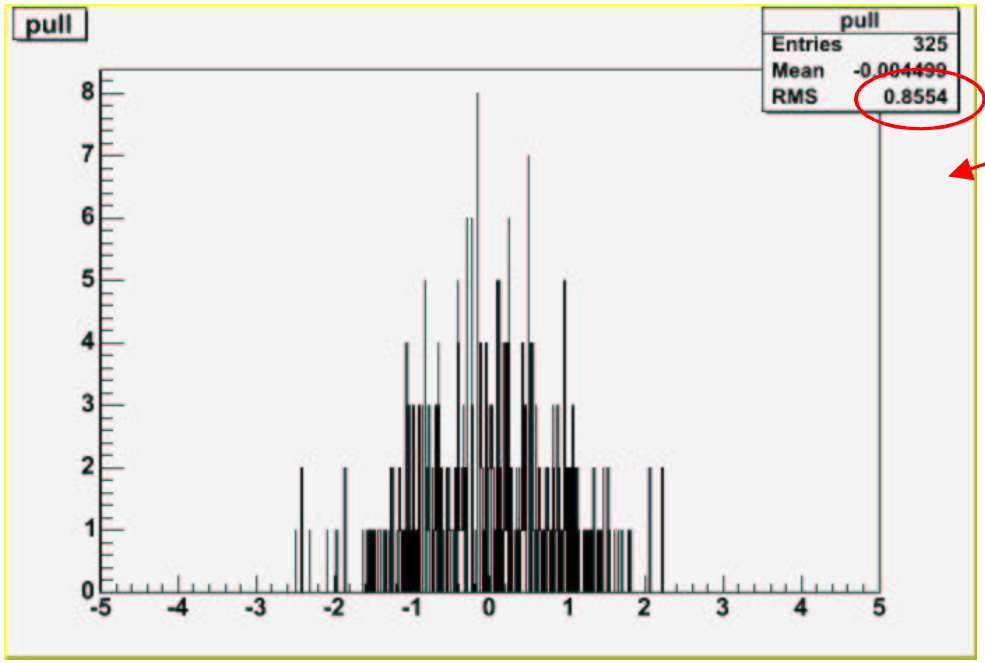
limited number of expts



Pythia Pseudo−Experiments :







- Individual pulls still look OK.
- Compatibility pull shows effect of correlations.
  - fraction > 1σ = 35 ± 3% ("A")
  - fraction > 1σ = 31 ± 3% ("B")
  - fraction > 1"σ" = 24 ± 3% ("A−B")
  - fraction > 0.64"σ" = 47 ± 3% ("A−B")
- **RESULTS ARE COMPATIBLE**