Top W Helicity Measurement (lepton p_T method) Blessing

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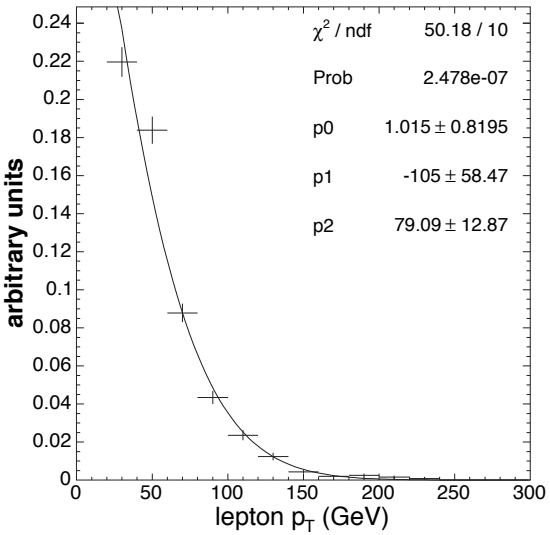
supporting notes: CDF 6950 and CDF 6949

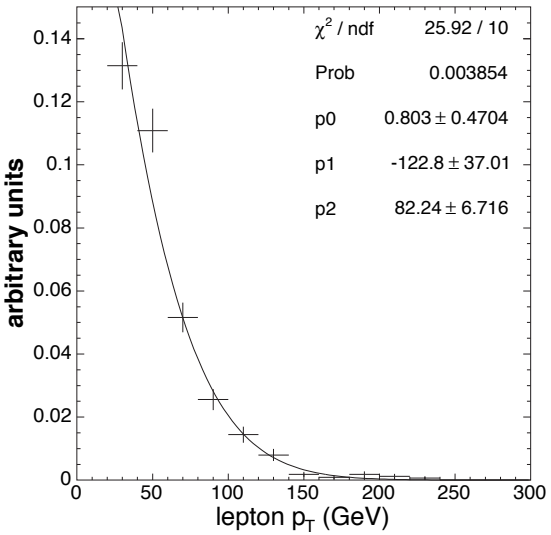
visit the analysis homepage

Use a better functional form for the double-tag bg PDFs

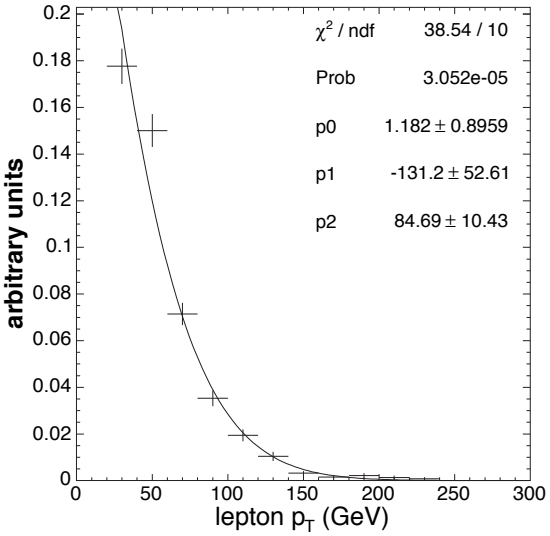
CEM 3 jets



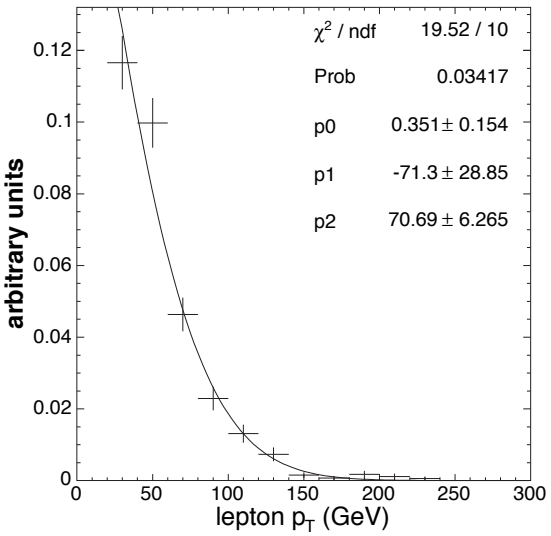
CEM $\geq 4jet$



CMUP/CMX 3 jets



CMUP/CMX $\geq$ 4 jets



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Use the latest dilepton background estimate

event type	ee	$\mu\mu$	$e\mu$
WW/WZ	0.21 ± 0.06	0.18 ± 0.05	0.34 ± 0.10
Drell-Yan	0.36 ± 0.28	0.07 ± 0.34	-
$Z \to \tau\tau$	0.09 ± 0.03	0.11 ± 0.03	0.22 ± 0.07
Fakes	0.26 ± 0.11	0.16 ± 0.07	0.69 ± 0.28
Total Background	0.9 ± 0.4	0.5 ± 0.1	1.3 ± 0.3
$t\bar{t}$ ($\sigma = 6.7\mathrm{pb}$)	1.9 ± 0.3	1.8 ± 0.3	4.5 ± 0.6
Total SM expectation	2.8 ± 0.5	2.4 ± 0.3	5.7 ± 0.7
observed	1	3	9

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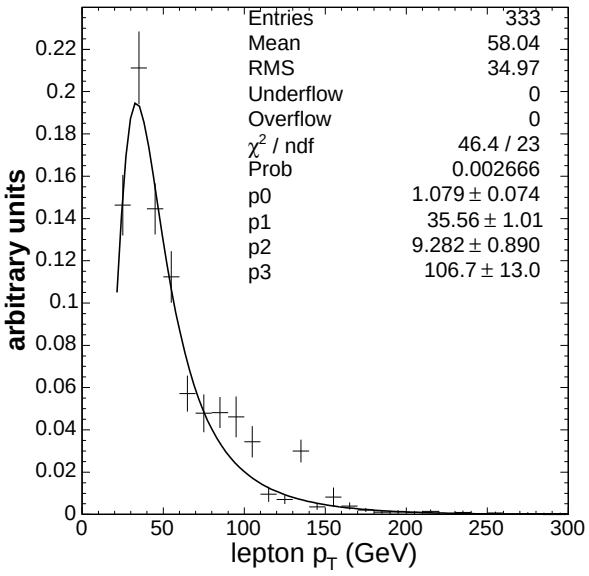
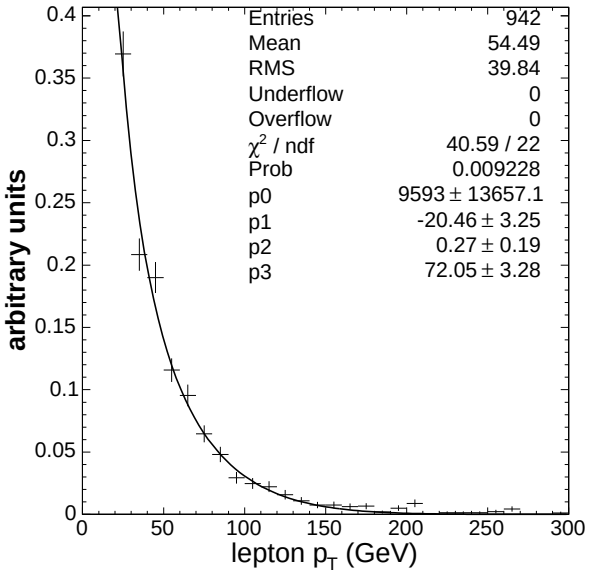
Update the dilepton bg PDFs

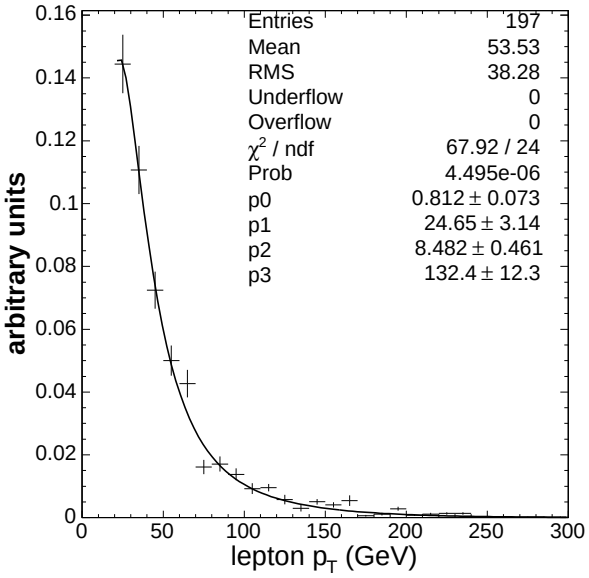
ee



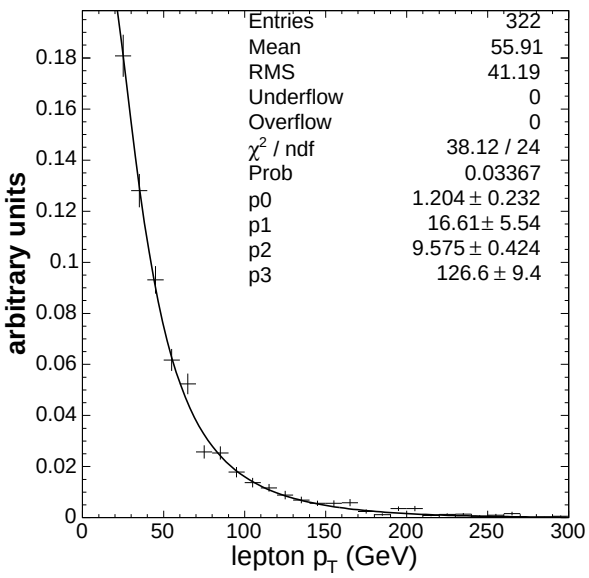
em



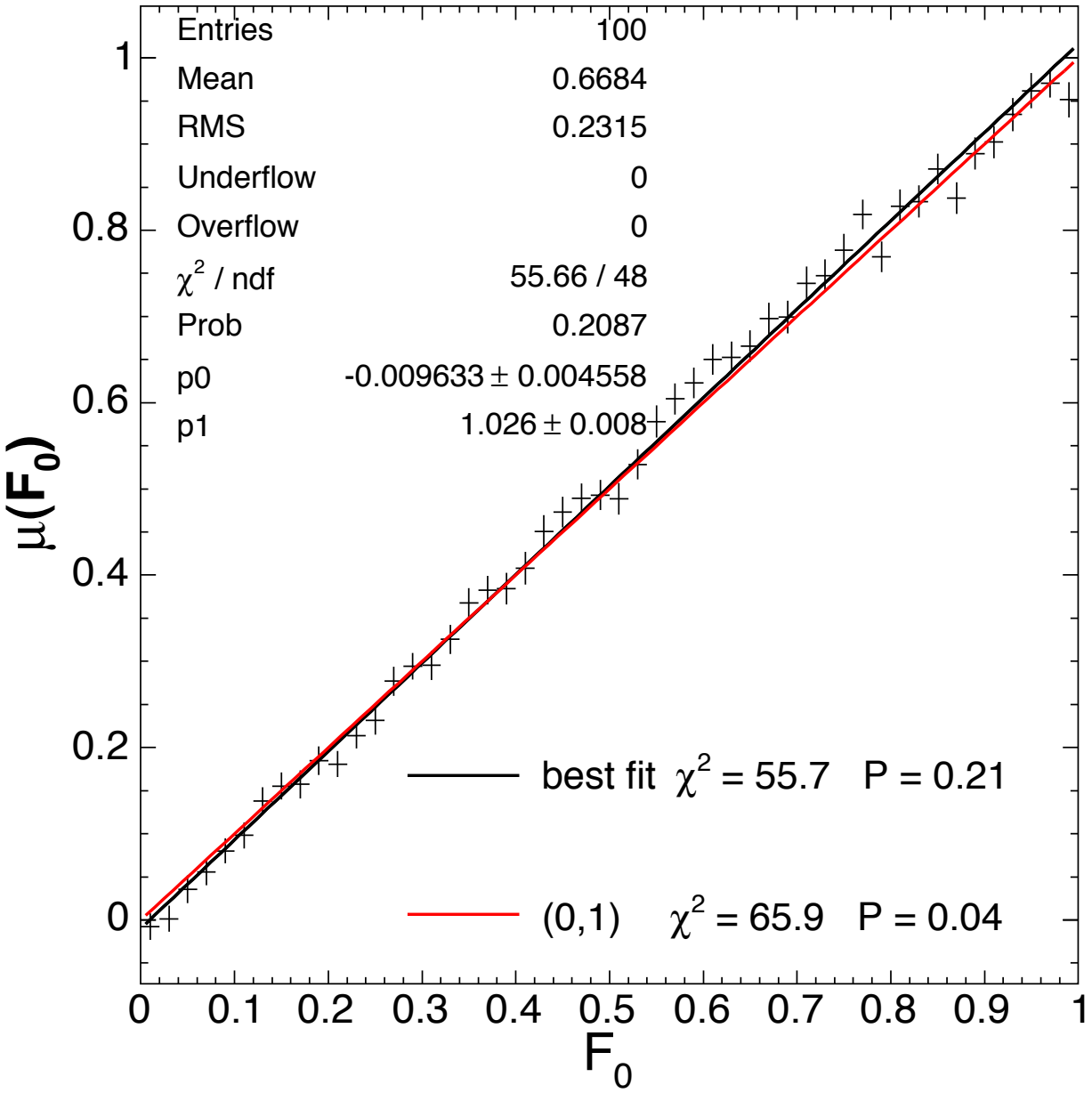
mm



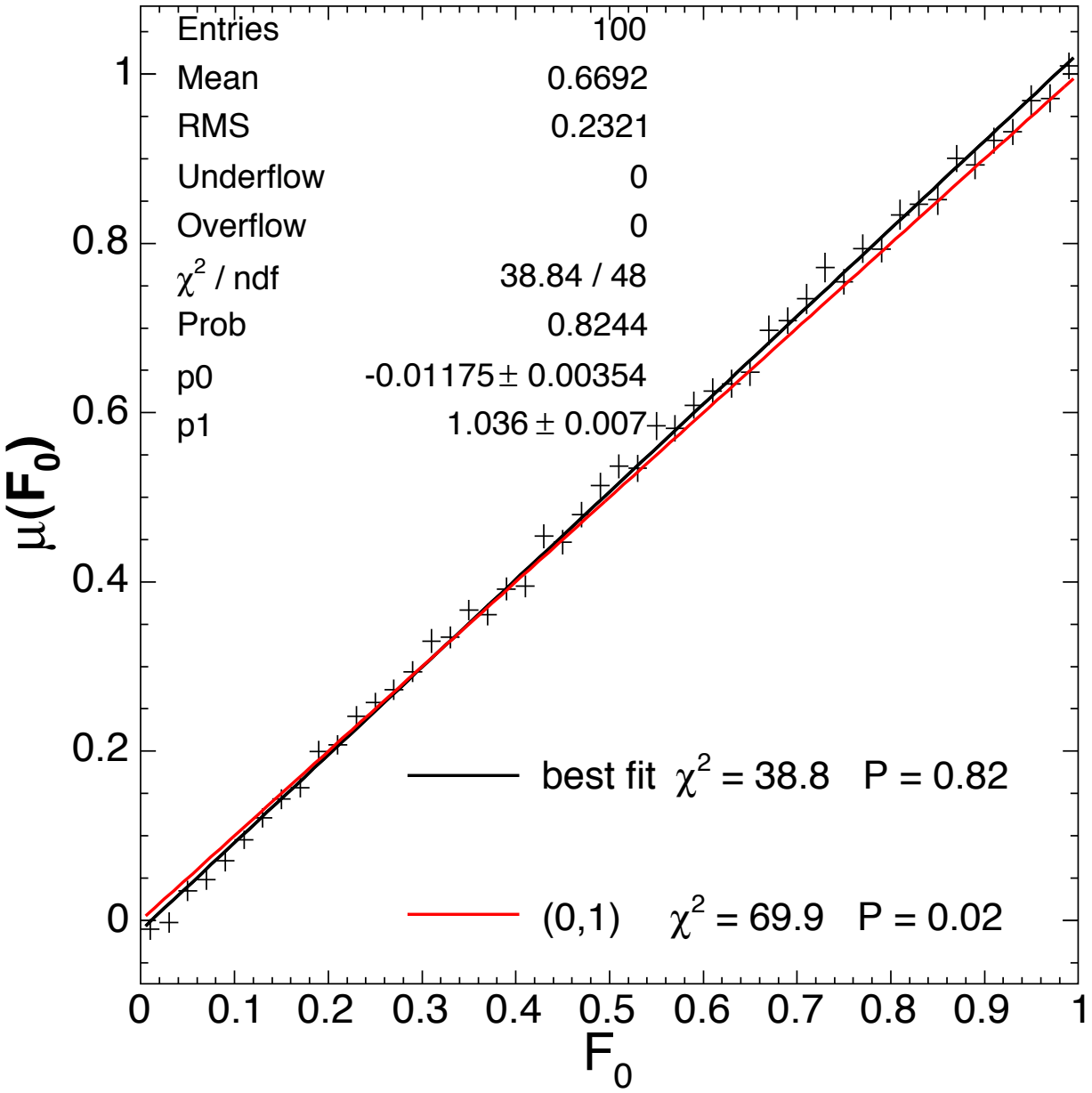
ll



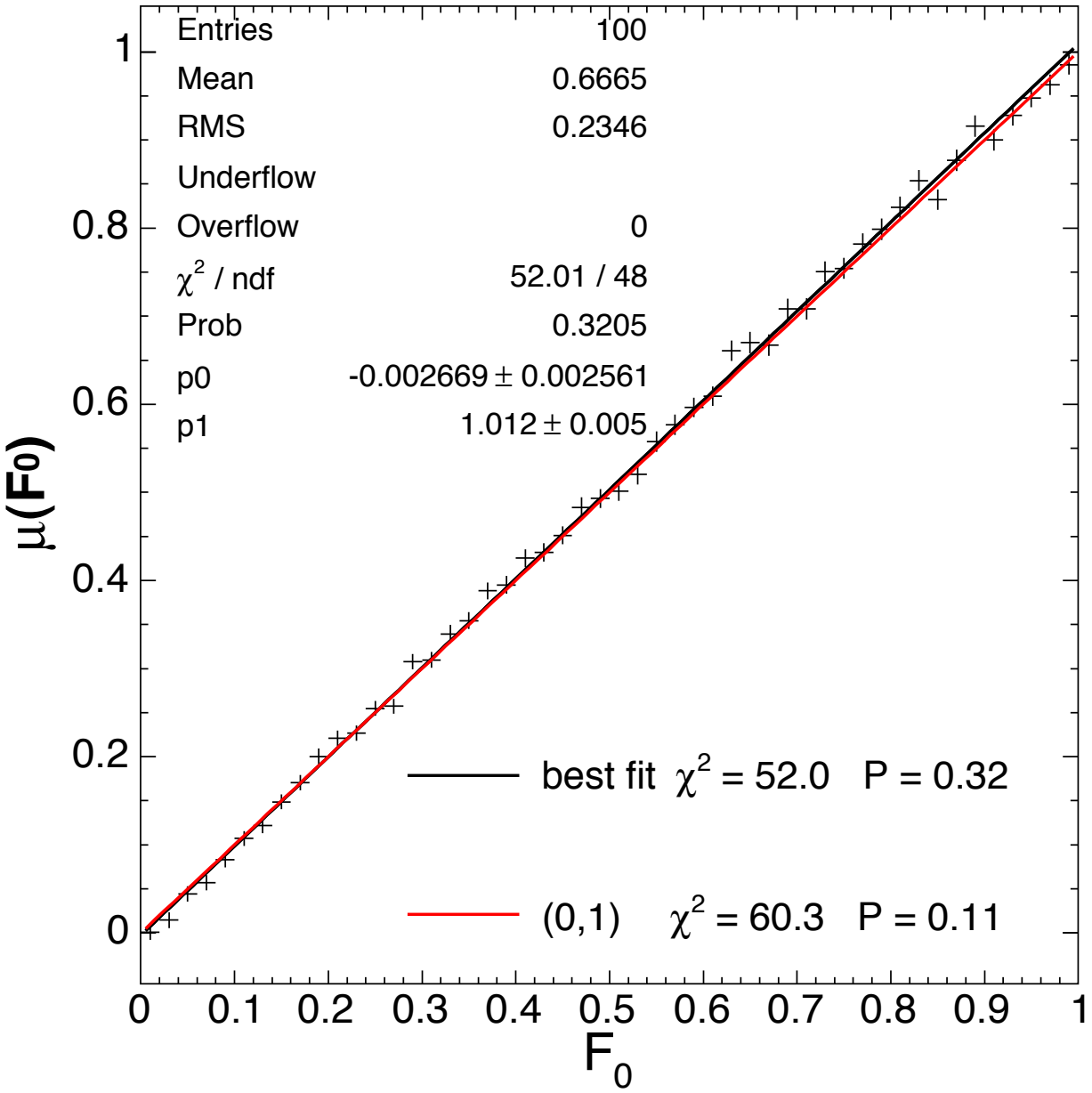
Is the fit procedure unbiased? (in dileptons only)



Is the fit procedure unbiased? (in l+jets only)



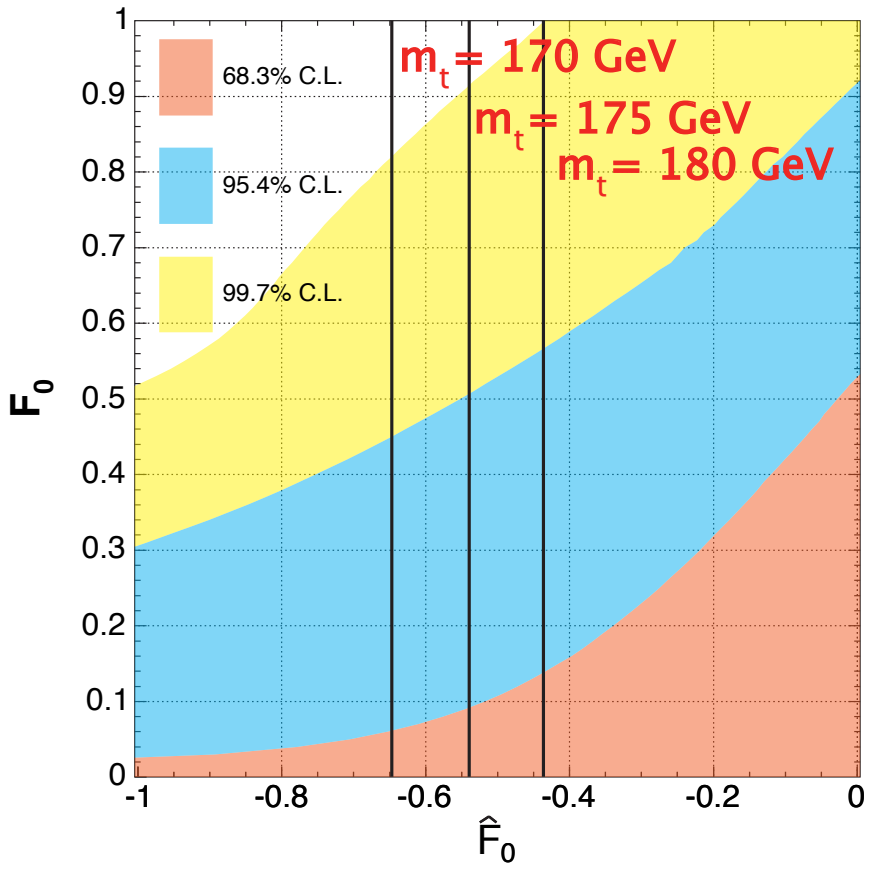
Is the fit procedure unbiased? (in combined analysis)



about that top mass systematic...

- Kevin suggests we consider removing the systematic due to uncertainty on the top-mass
- instead, quote $F_0(m_t)$
- the most obvious way to do this is to use a linear expansion about the current result
- example: in l+jets we expect a shift of $\Delta F_0 = 0.11$; we observe $\hat{F}_0 = 0.88$
- We *could* quote $F_0(m_t) = (-2.27 + 0.018 m_t)^{+??}_{-??}(stat.syst.)$
- This expansion isn't valid outside of the ± 5 GeV top mass uncertainty
- How do we maintain physical intervals?
- For this iteration of the analysis, lets keep the top mass systematic

more on the top-mass systematic



- setting limits with this approach is more straightforward
- shift the MLE $\hat{F}_0$ by the top-mass systematic
- read off the x% CL limit using the Feldman Cousins belts
- example:
  $F_0 < (-4.39 + 0.022 m_t)$ @ 95%CL

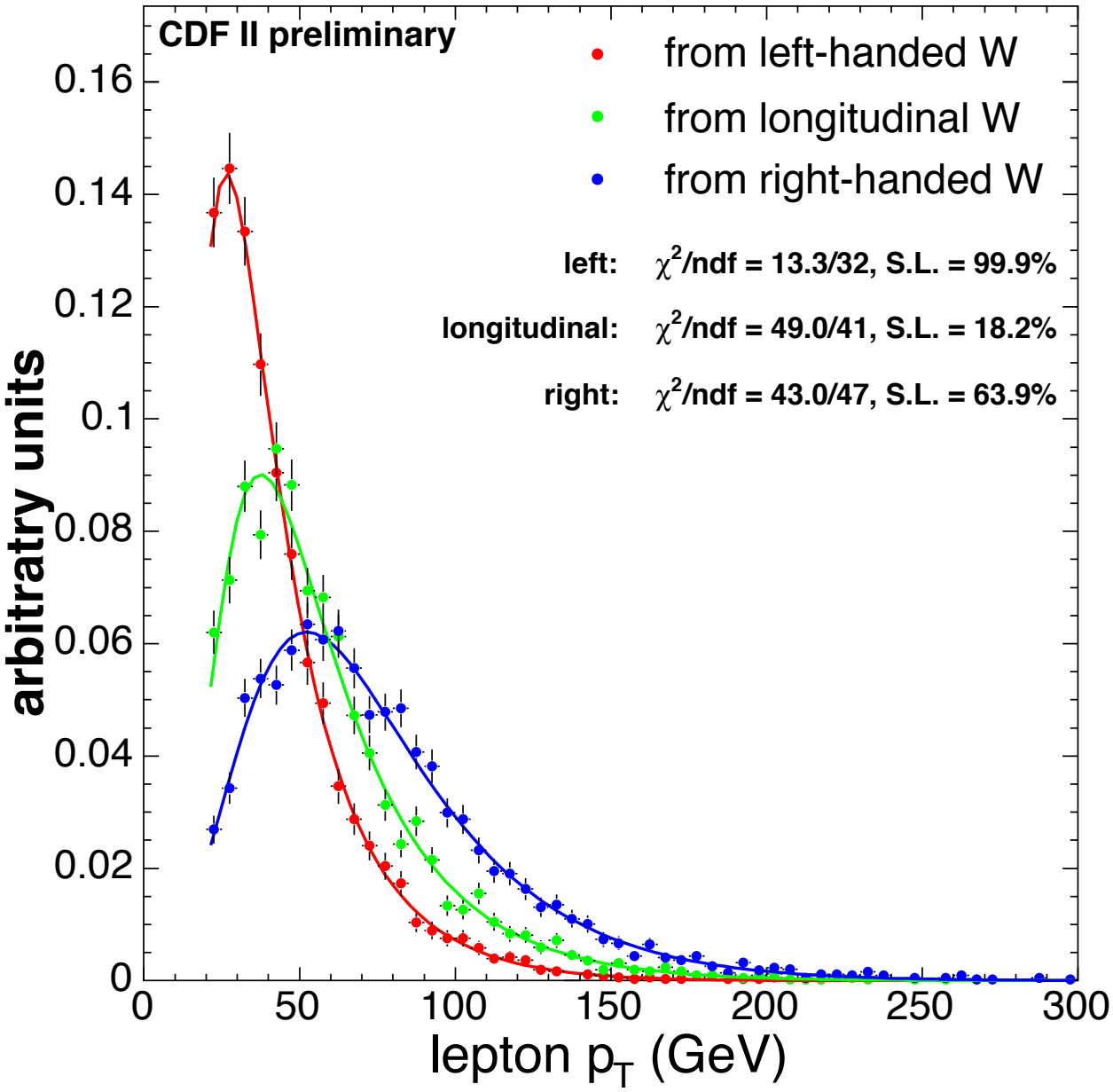
lepton+jets acceptance ratios, $a_{0L,s}$ (for blessing)

# of jets	3	≥ 4
CEM	0.790 ± 0.036	0.715 ± 0.030
CMUP+CMX	0.712 ± 0.035	0.751 ± 0.034
combined	0.754 ± 0.025	0.732 ± 0.022

dilepton acceptances (for blessing)

sample	ee	$\mu\mu$	$e\mu$
A_{00}	0.0024 ± 0.0002	0.0027 ± 0.0002	0.0060 ± 0.0003
A_{0L}	0.0019 ± 0.0001	0.0023 ± 0.0002	0.0049 ± 0.0002
A_{LL}	0.0016 ± 0.0001	0.0022 ± 0.0002	0.0040 ± 0.0002

signal model (for blessing)



systematics lepton+jets only (for blessing)

Source	$\Delta\hat{F}_0$
background normalization	0.11
top mass uncertainty	0.09
ISR/FSR	0.04
PDF uncertainty	0.03
shape uncertainty	0.03
MC statistics	0.01
acceptance correction	0.01
trigger correction	0.01
total	0.17

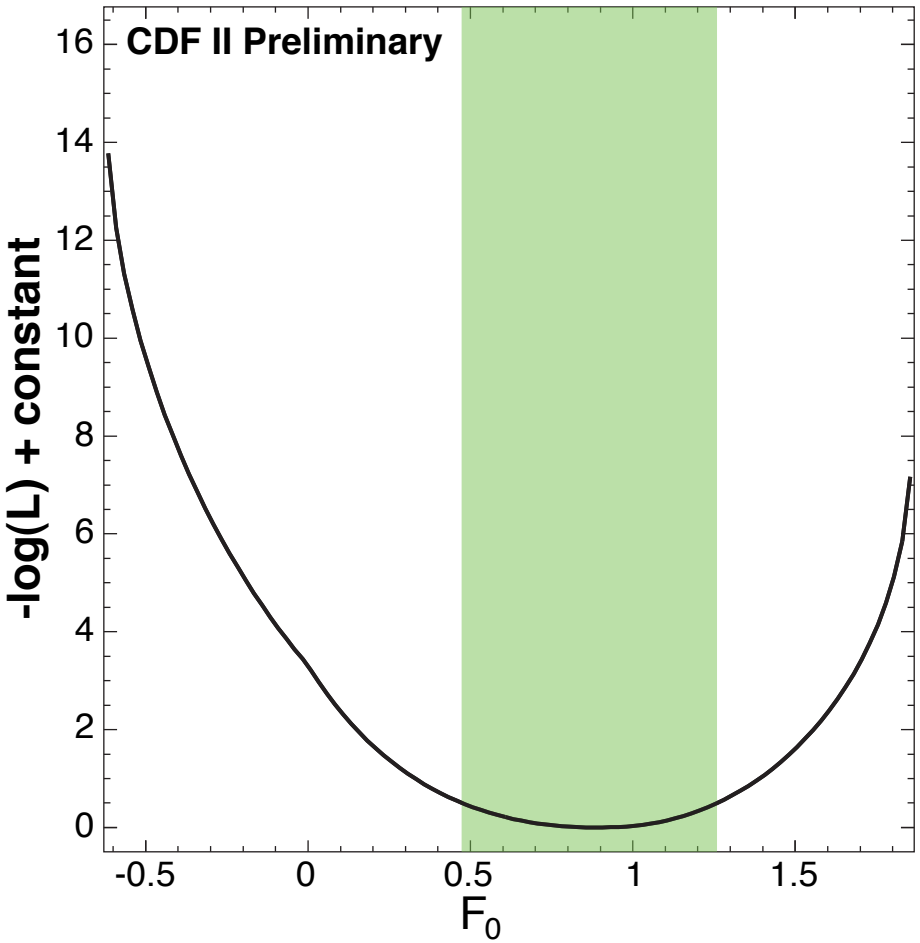
systematics, dileptons only (for blessing)

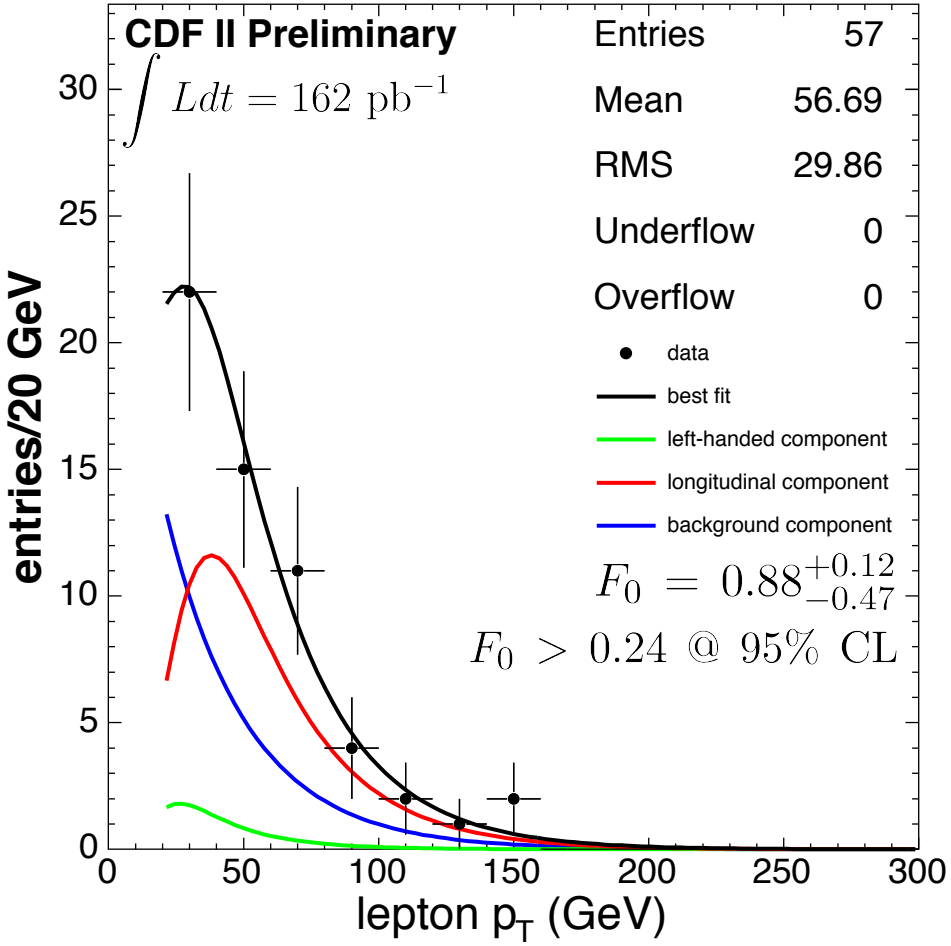
Source	$\Delta\hat{F}_0$
top mass uncertainty	0.12
ISR/FSR	0.06
background normalization	0.04
PDF uncertainty	0.04
acceptance correction	0.03
shape uncertainty	0.02
trigger correction	0.02
MC statistics	0.01
total	0.16

systematics for the combined analysis (for blessing)

Source	$\Delta\hat{F}_0$
top mass uncertainty	0.11
l+jets bg. normalization	0.10
ISR/FSR	0.05
PDF uncertainty	0.03
dilepton bg. normalization	0.02
l+jets shape uncertainty	0.02
acceptance correction	0.02
trigger correction	0.02
dilepton shape uncertainty	0.01
MC statistics	0.01
total	0.17

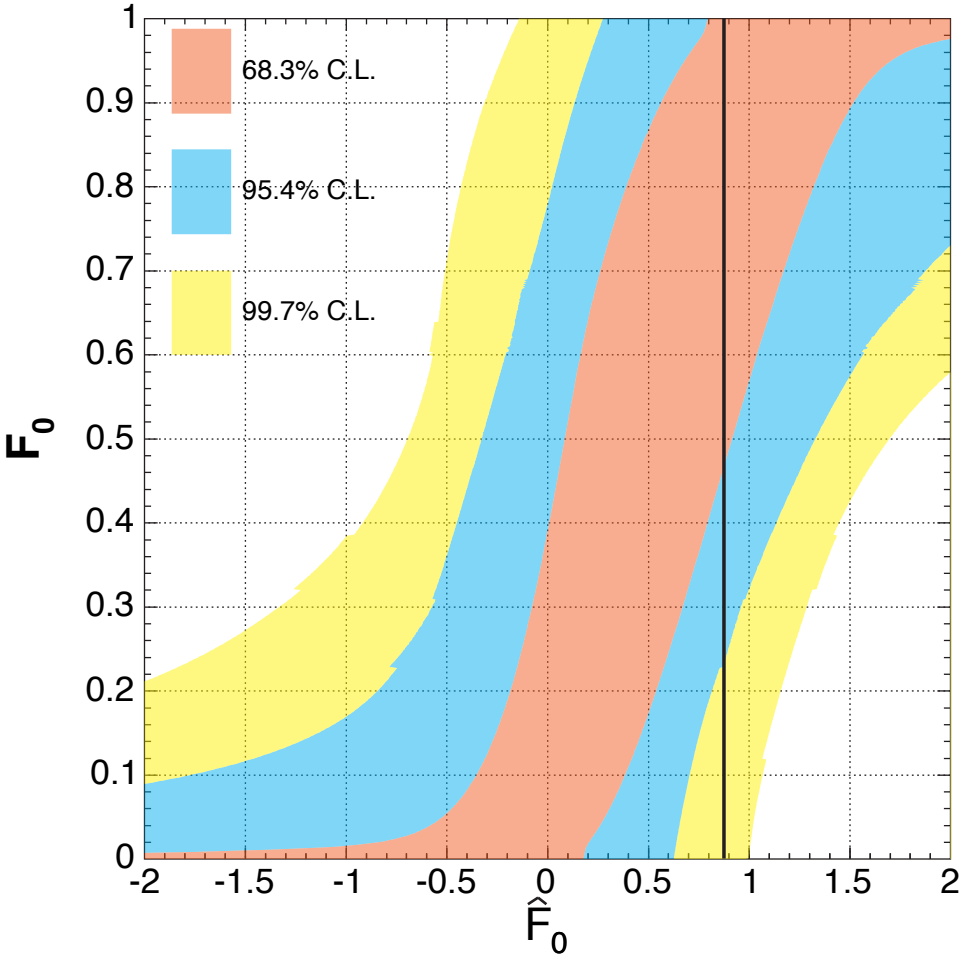
lepton+jets-only result (for blessing)





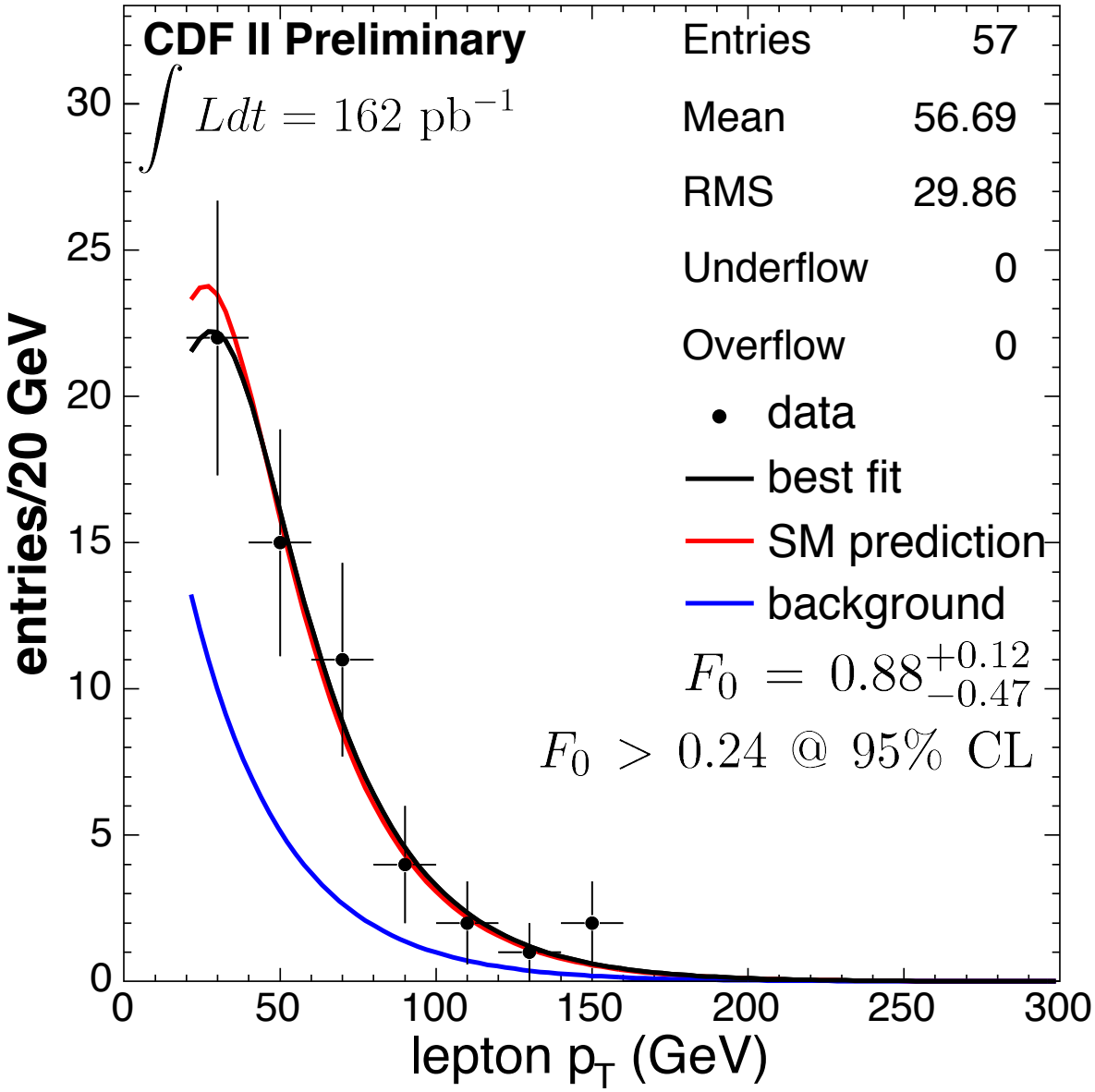
- Left: projection of $-\log(\mathscr{L})$
- Right: distribution of charged-lepton p_T overlaid with PDFs
- $\hat{F}_0 = 0.88$

lepton+jets-only result (for blessing)

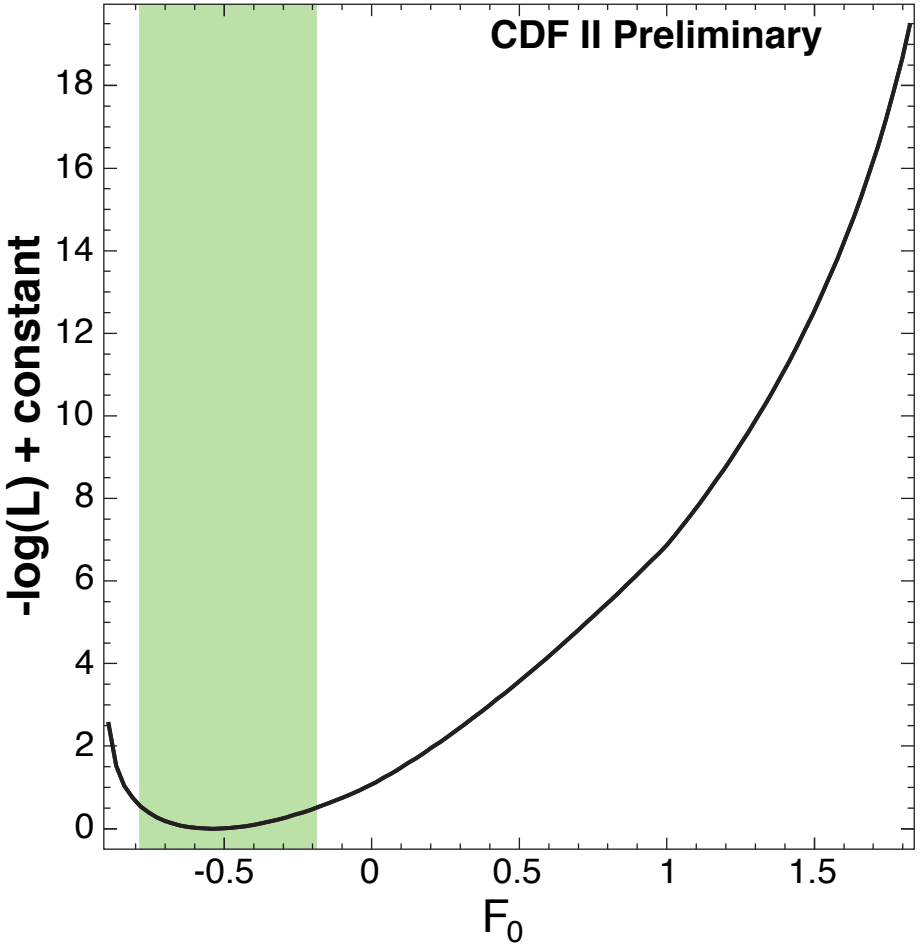


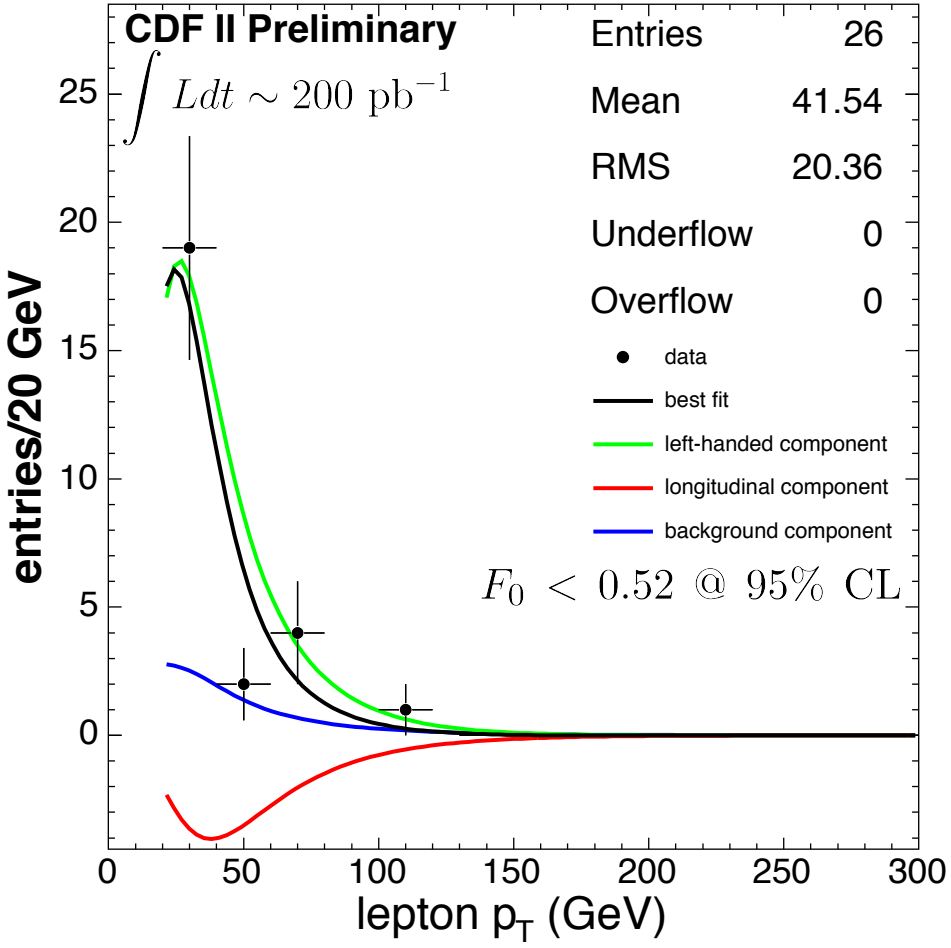
- 1, 2 and 3 σ Feldman Cousins confidence belts for the lepton+jets only analysis
- The heavy line represents the experimental outcome, $\hat{F}_0 = 0.88$
- $F_0 = 0.88^{+0.12}_{-0.47}$ (stat. + syst.)
- $F_0 > 0.24$ @ 95%CL

lepton+jets-only result with SM prediction (for blessing)



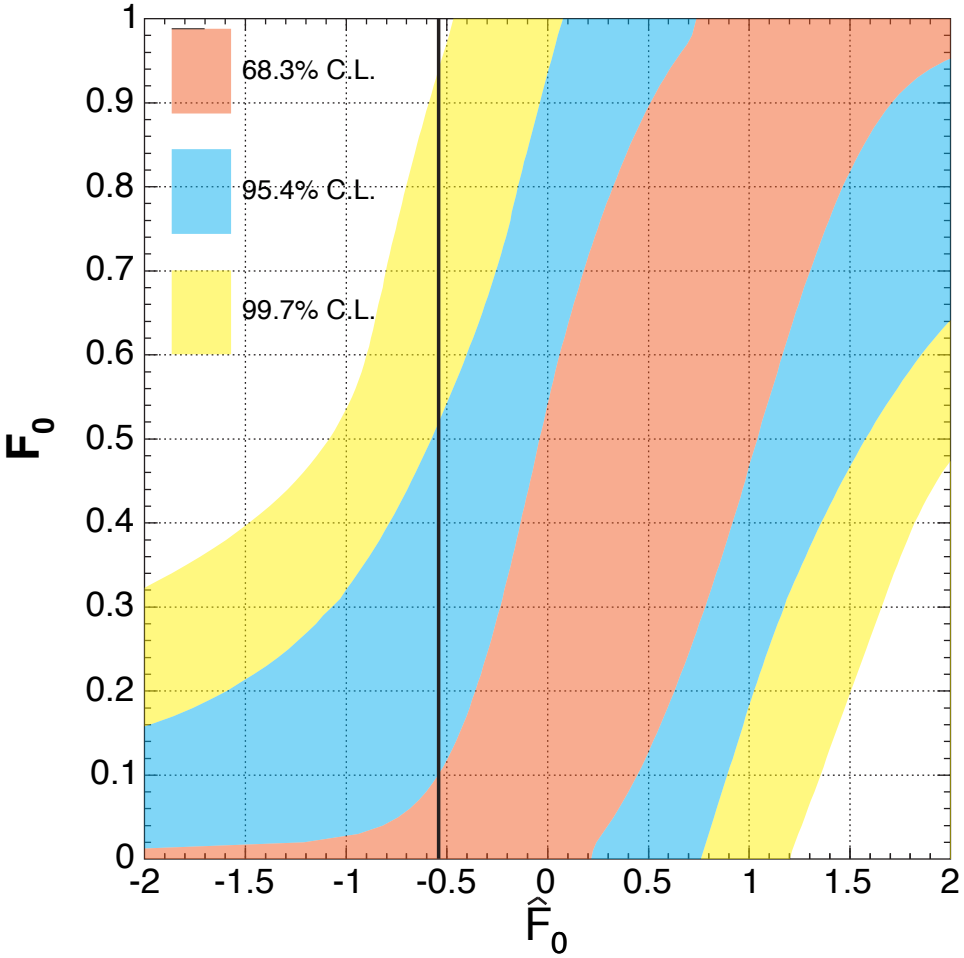
dileptons-only result (for blessing)





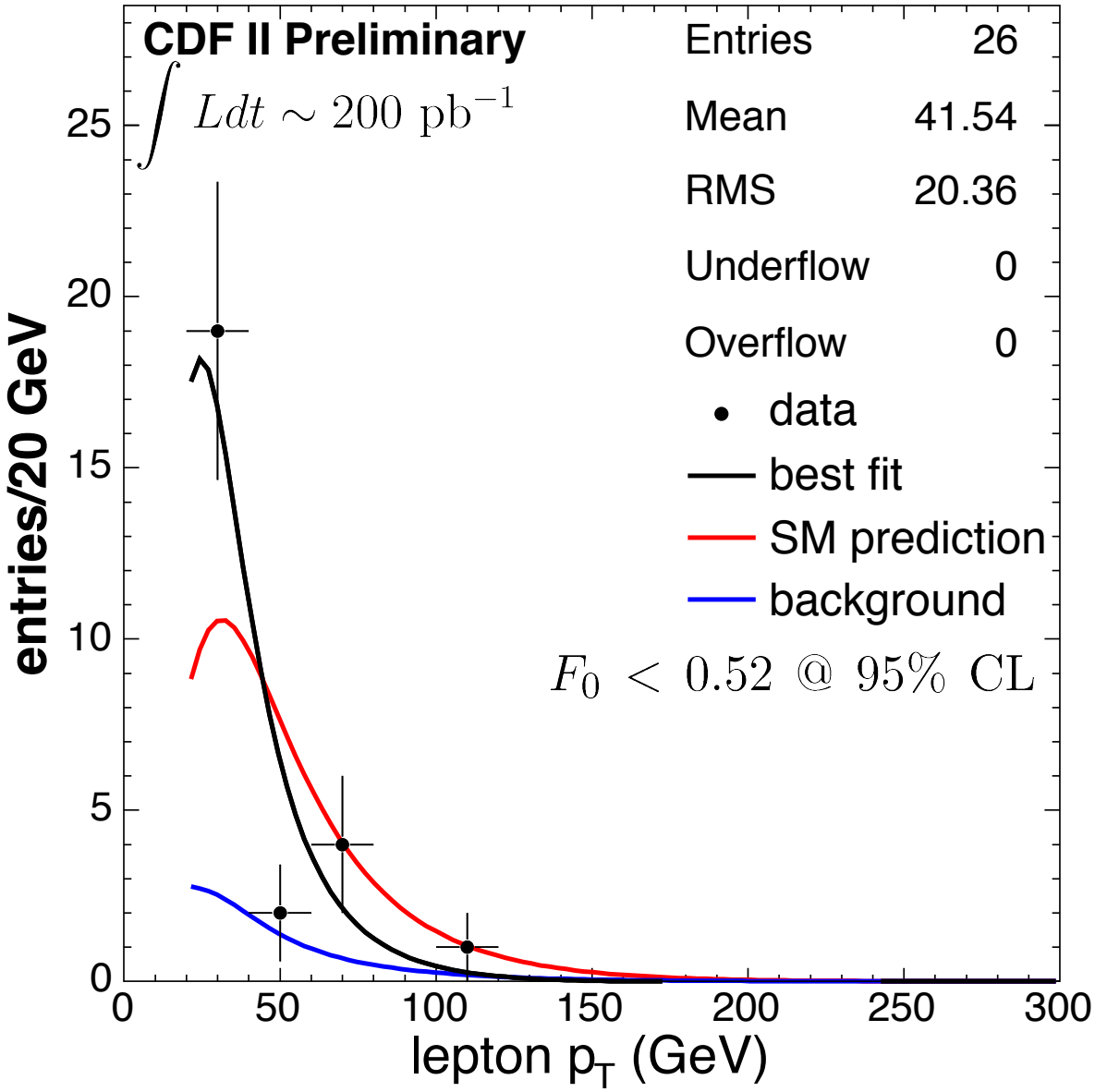
- Left: projection of $-\log(\mathscr{L})$
- Right: distribution of charged-lepton p_T overlaid with PDFs
- $\hat{F}_0 = -0.54$

dileptons only result (for blessing)

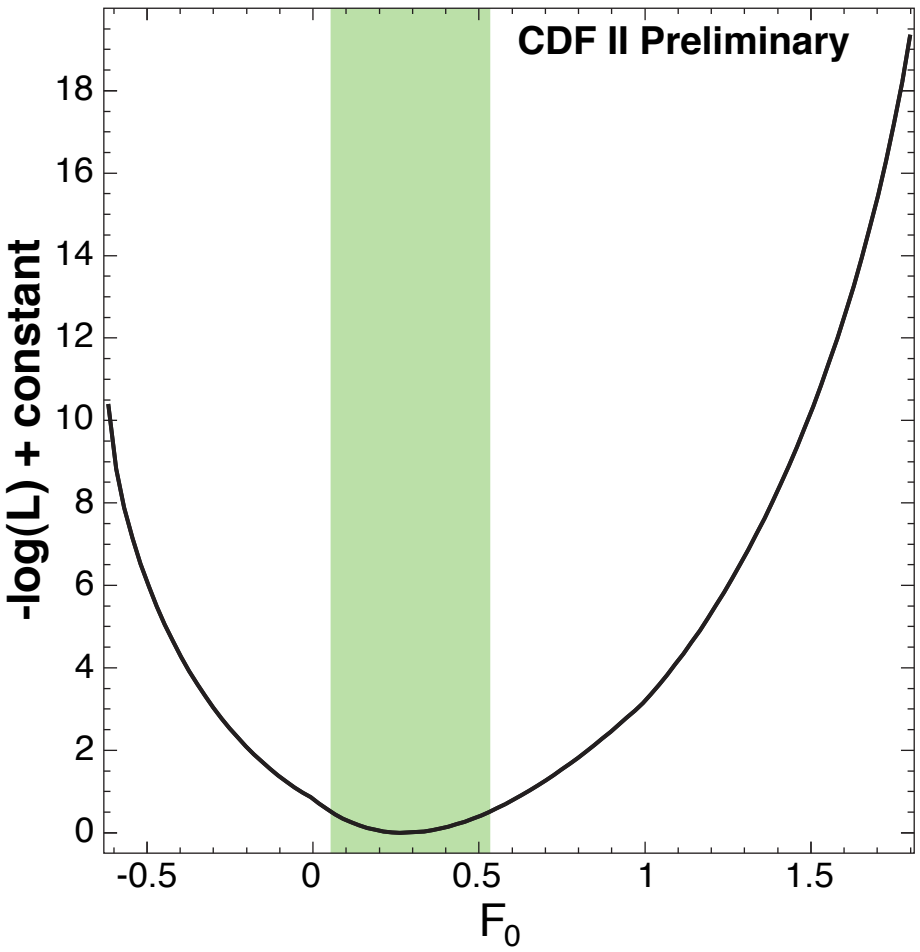


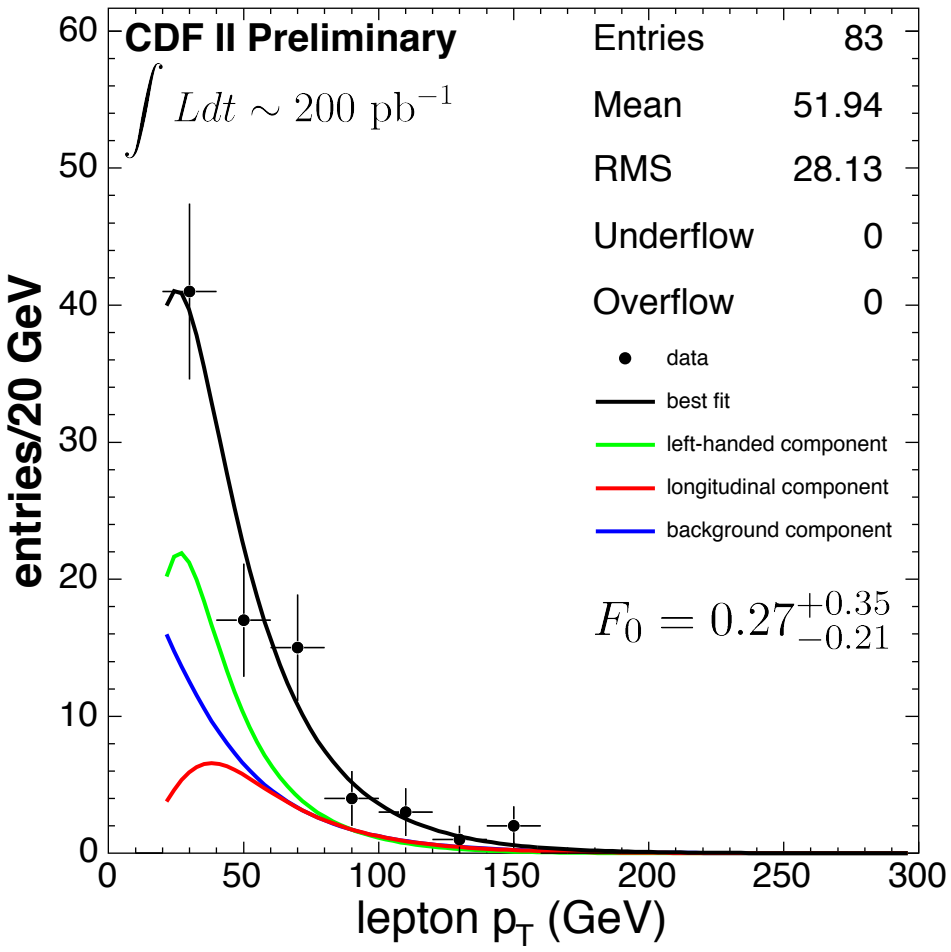
- 1, 2 and 3 σ Feldman Cousins confidence belts for the dileptons only analysis
- The heavy line represents the experimental outcome, $\hat{F}_0 = -0.54$
- $F_0 < 0.52$ @ 95% CL

dileptons-only result with SM prediction (for blessing)



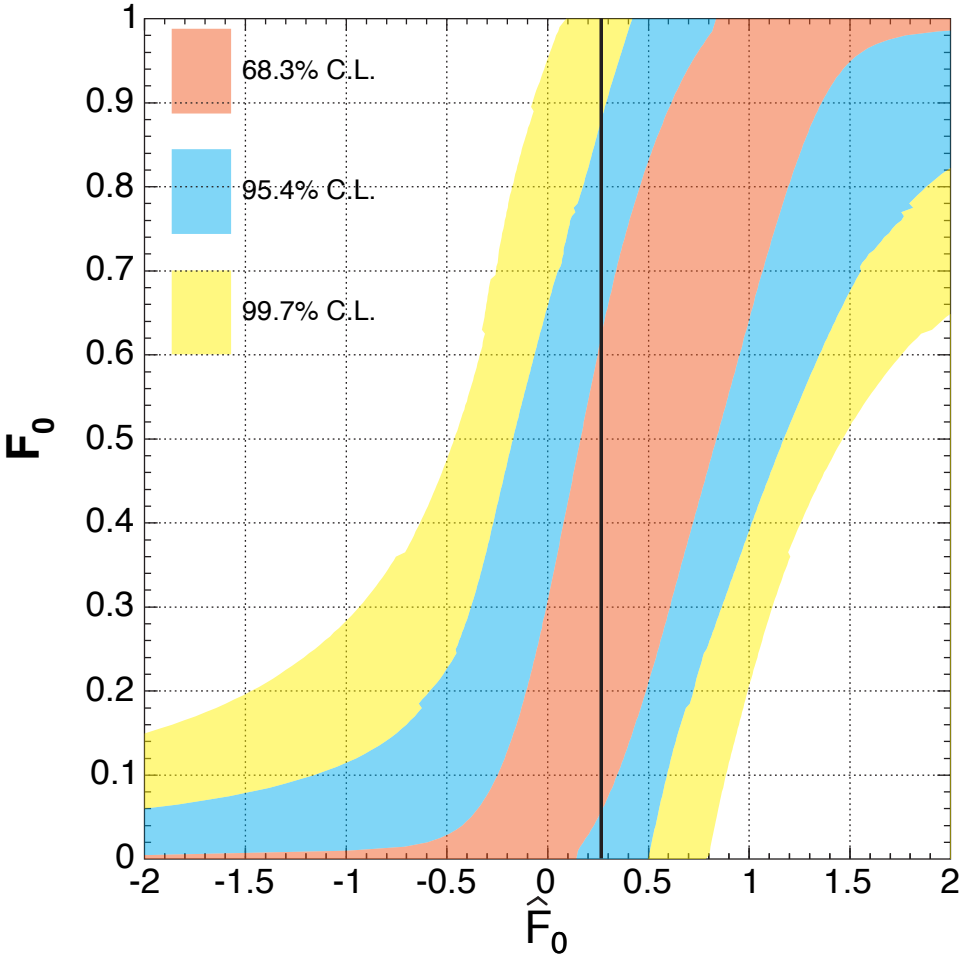
combined result (for blessing)





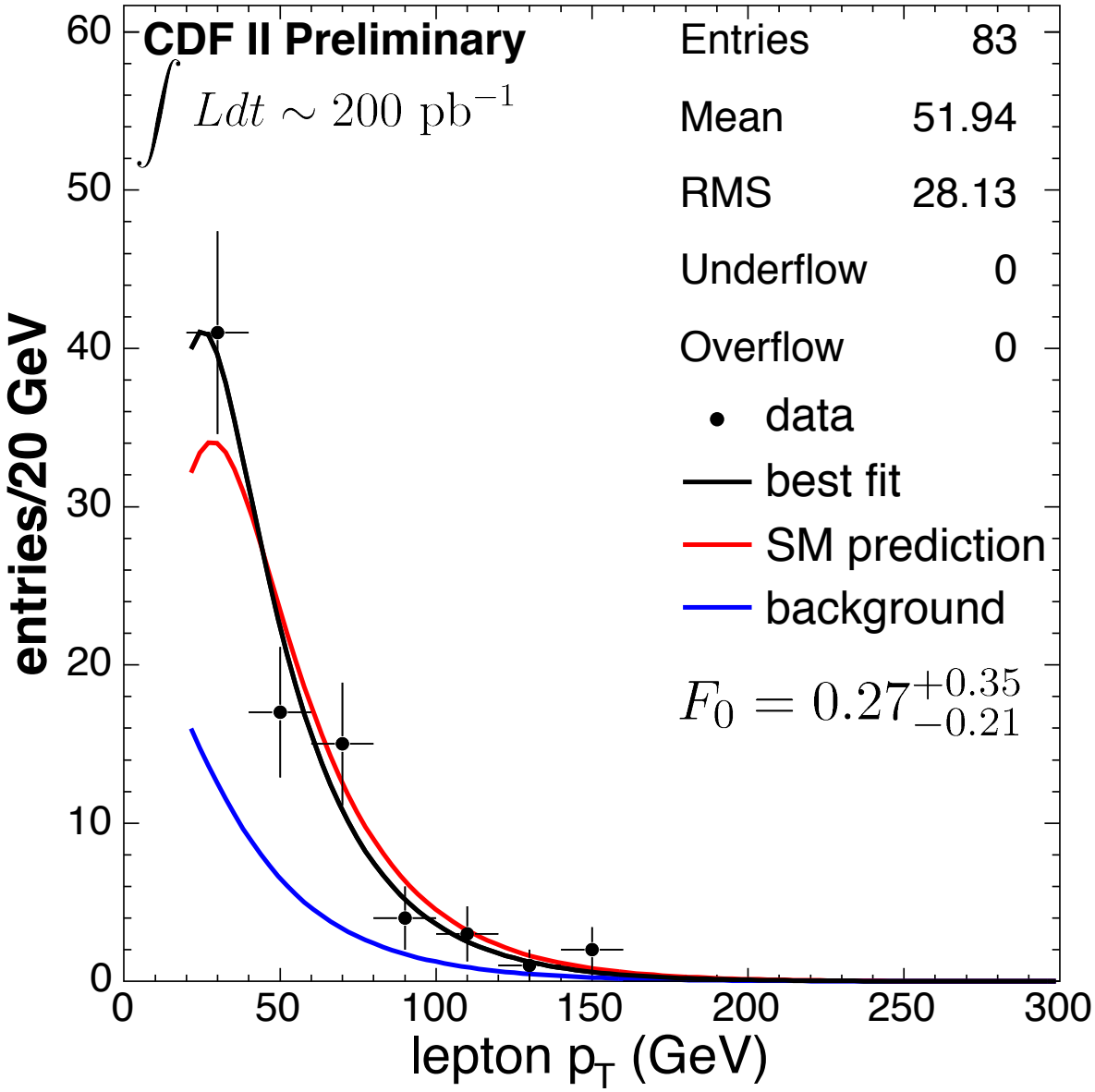
- Left: projection of $-\log(\mathscr{L})$
- Right: distribution of charged-lepton p_T overlaid with PDFs
- $\hat{F}_0 = 0.27$

combined result (for blessing)



- 1, 2 and 3 σ Feldman Cousins confidence belts for the combined analysis
- The heavy line represents the experimental outcome, $\hat{F}_0 = 0.27$
- $F_0 = 0.27^{+0.35}_{-0.21}$ (stat. + syst)
- $F_0 < 0.88$ @ 95% CL

combined result with SM prediction (for blessing)



conclusions

- We measured the F_0 in the lepton+jets and dilepton channels
- the combined result, $F_0 = 0.27^{+0.35}_{-0.21}$ (stat. + syst) is consistent with the SM prediction $F_0 = 0.7$
- The lepton+jets result, $F_0 = 0.88^{+0.12}_{-0.47}$ (stat. + syst.). is consistent with the SM
- The discrepancy in the dilepton sample, $F_0 < 0.52$ @ 95% CL, *is* interesting, but it's only at the 2 σ level.

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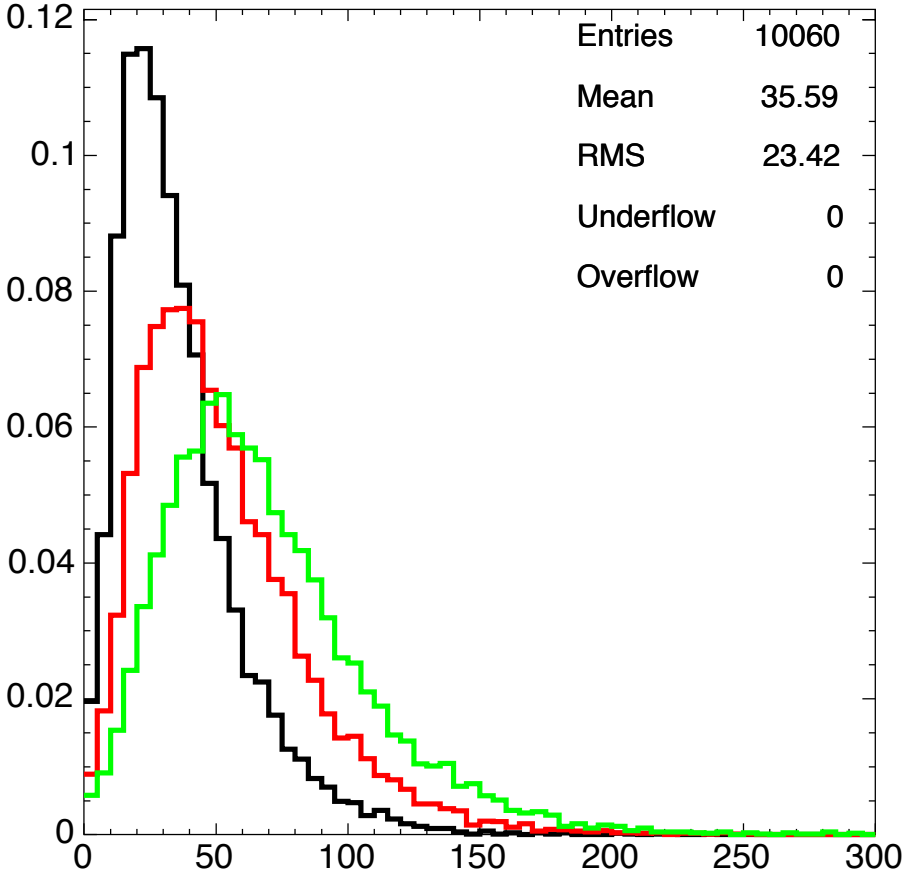
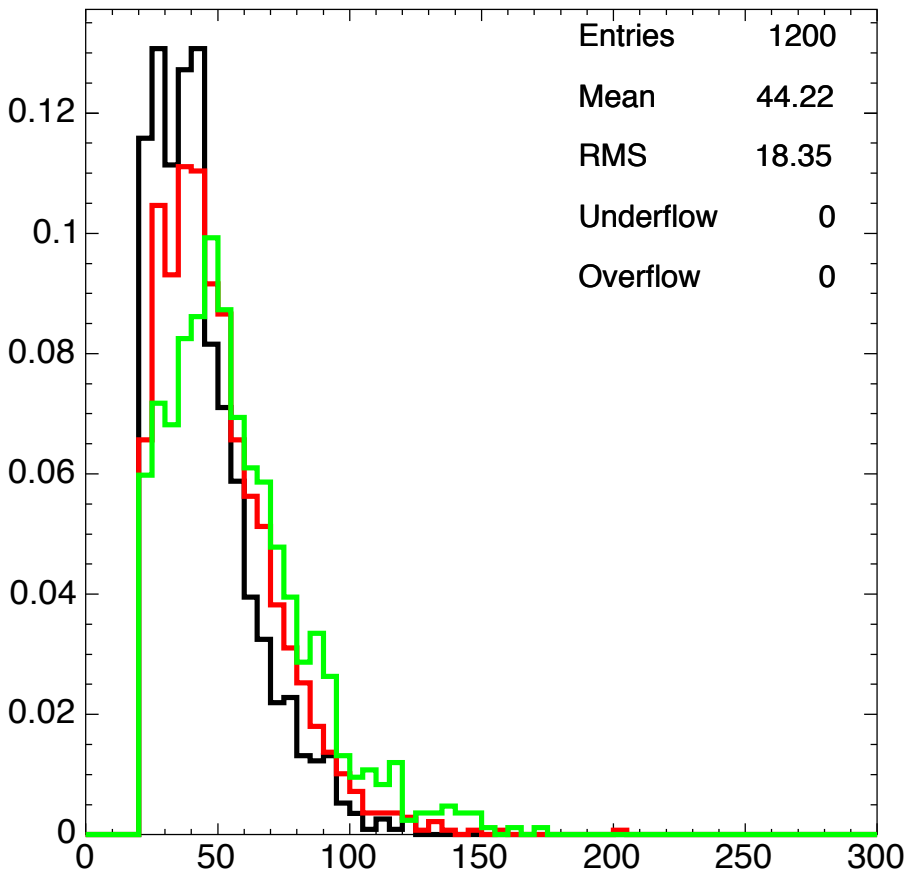
backup material

lepton+track $\not{E}_T$ cut





- left: Generator-level lepton p_T from $t\bar{t} \to \ell\ell\nu\nu bb$ (no cuts).
- right: Require both charged-leptons have $p_T > 20$ GeV and $\not{E}_T > 25$ GeV. If $76 < m_{\ell\ell} < 106$, require $\not{E}_T > 40$ GeV.
- This greatly reduces separation b/w signal components.

Fits to Dilepton Subsamples

- $e\mu$ only: $\hat{F}_0 = -0.24$
- $e\mu + ee$: $\hat{F}_0 = -0.07$
- $e\mu + \mu\mu$ only: $\hat{F}_0 = -0.50$