Update on exclusive ψ' and J/ψ in photoproduction

(Weighted Muon Corrections for BAC)

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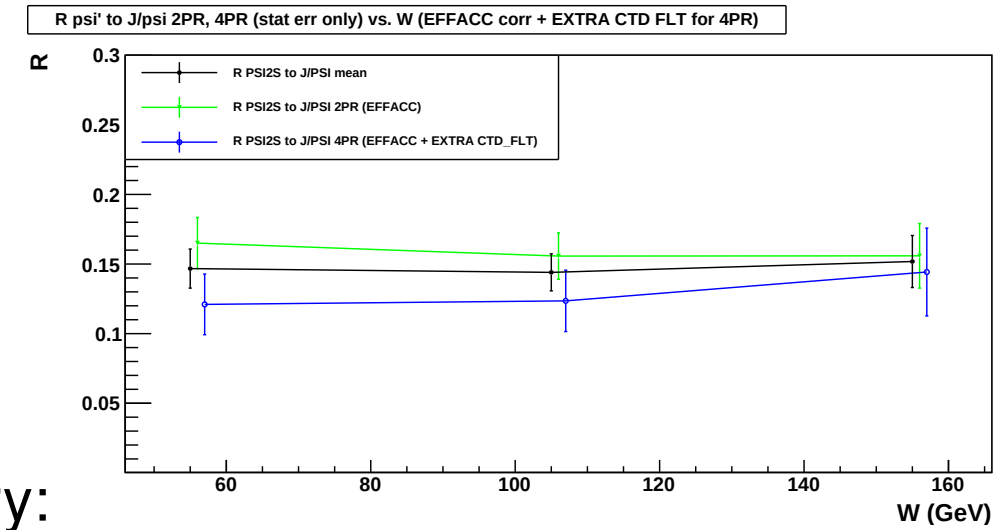
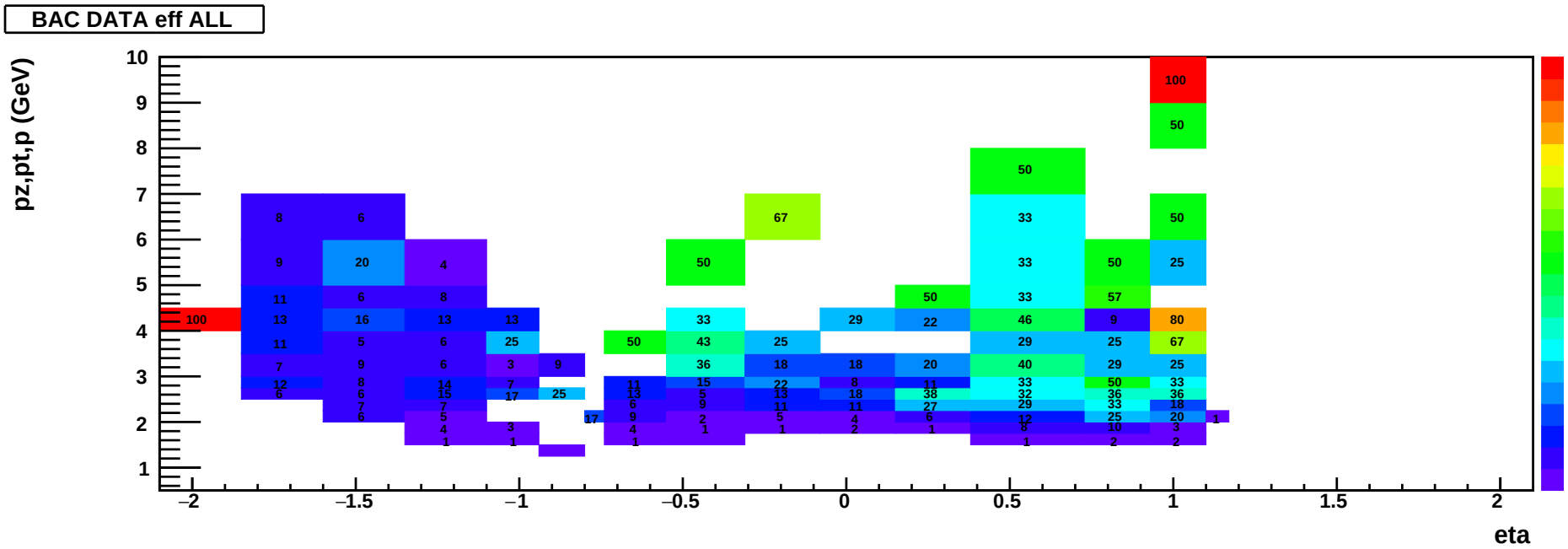
ZEUS Analysis Forum, DESY/Vidyo meeting, 14-Apr-2020

Outlook: R : ψ' to J/ψ cross section ratio



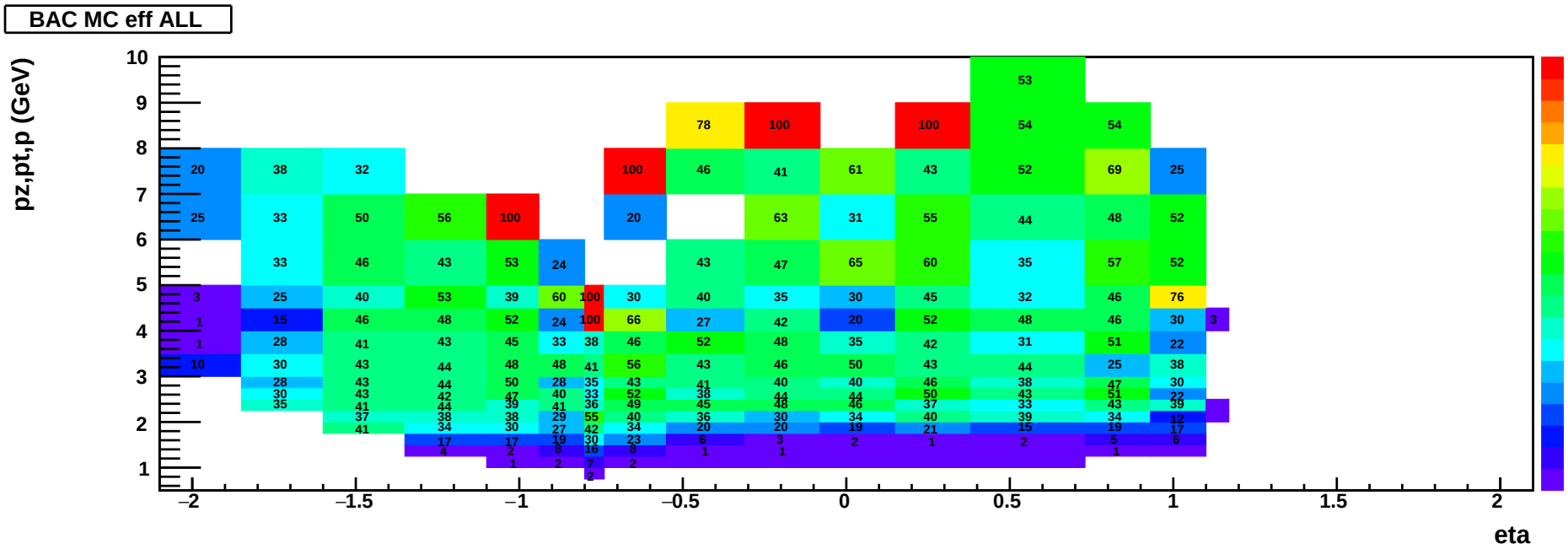
- last ZAF meeting in February:
  weighted muon corrections for B/RMUO and FMUON presented
- agreement for 2- and 4-prong channels
- simplified approach: single muon correction for all trigger levels and off-line reconstruction
- the same scheme was now repeated for BAC (see control plots)
- ... and for combined selection i.e.:
  at least one muon in F/B/RMUO or BAC (see control plots)
- conclusions and plans for next weeks

New corrections: example of $(p_z, p_t; \eta)$ BAC - DATA



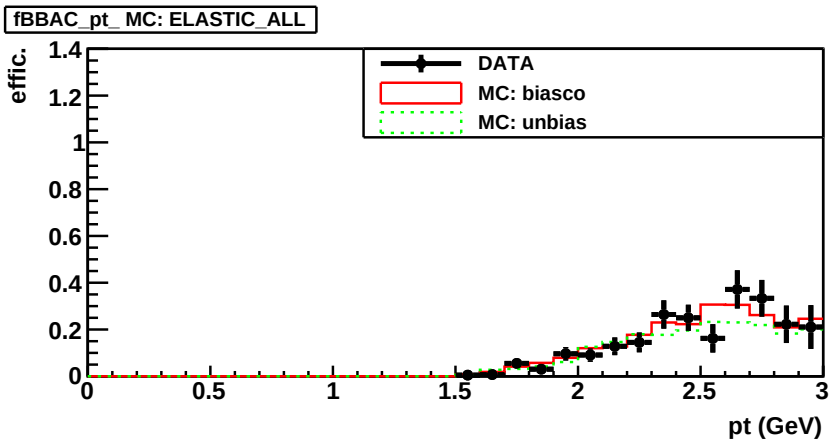
- RBAC-BBAC-FBAC (along eta)
- probability (%) to fire FLT-SLT-TLT-REC by muon on $(p_z, p_t; \eta)$ grid
- current choice for small p_t, p_z: 250 MeV per bin
- size of the grid is subject to systematics

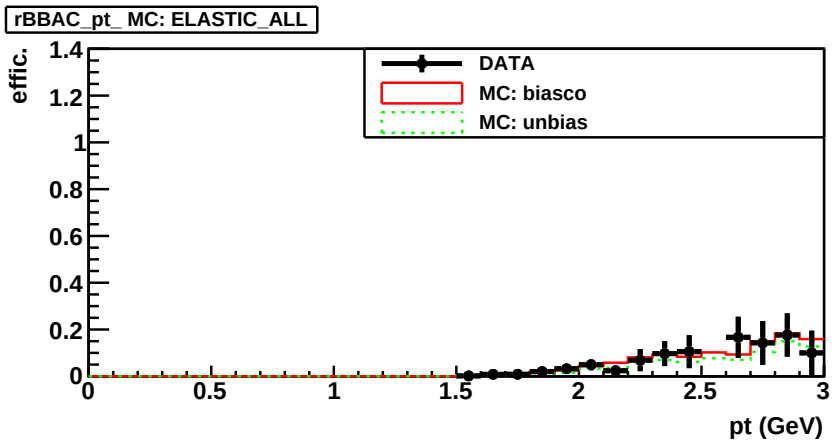
New corrections: example of $(p_z, p_t; \eta)$ BAC - MC

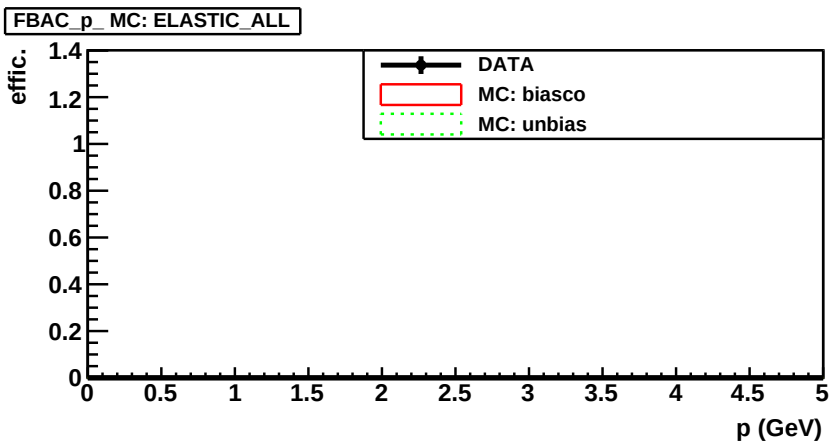


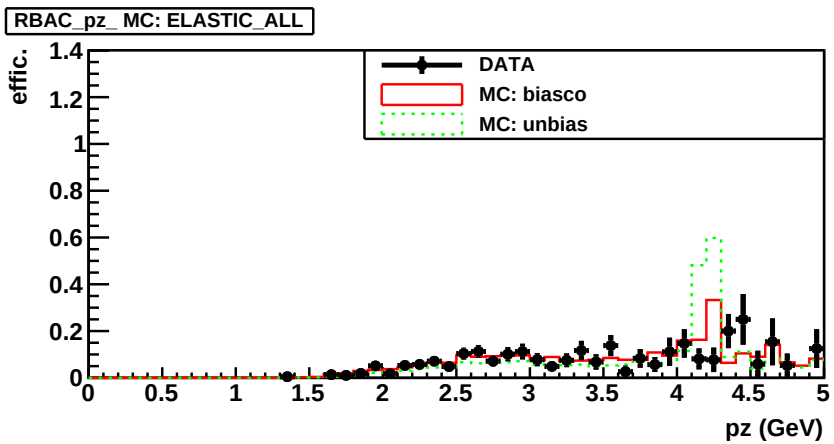
- RBAC-BBAC-FBAC (along eta)
- different composition of J/ψ, ψ', Bethe-Heitler MC was tested
- current choice: reweight the MC samples
  keep the J/ψ : ψ' : BH ratio as in DATA

BAC muon efficiency: after corrections



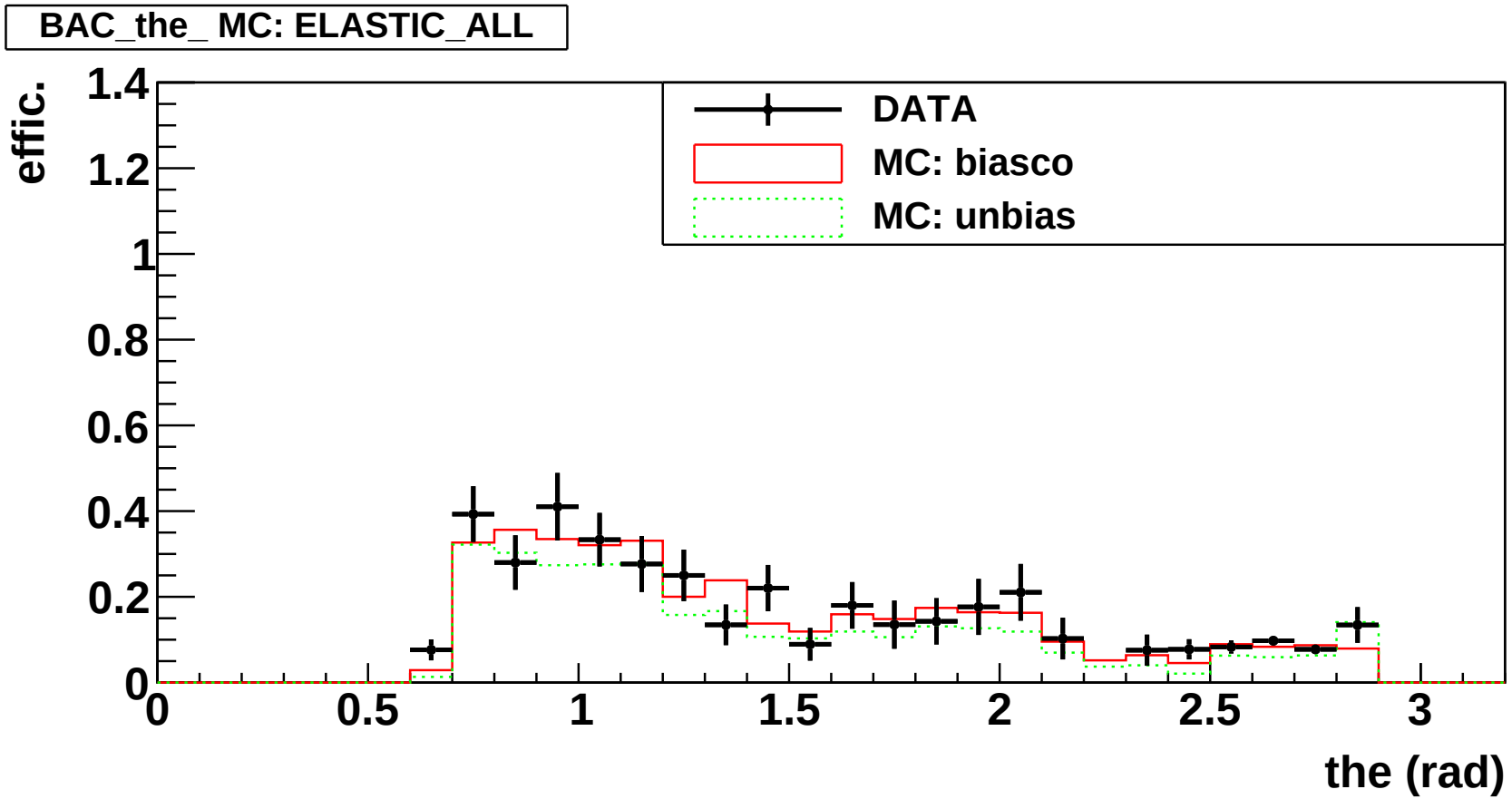






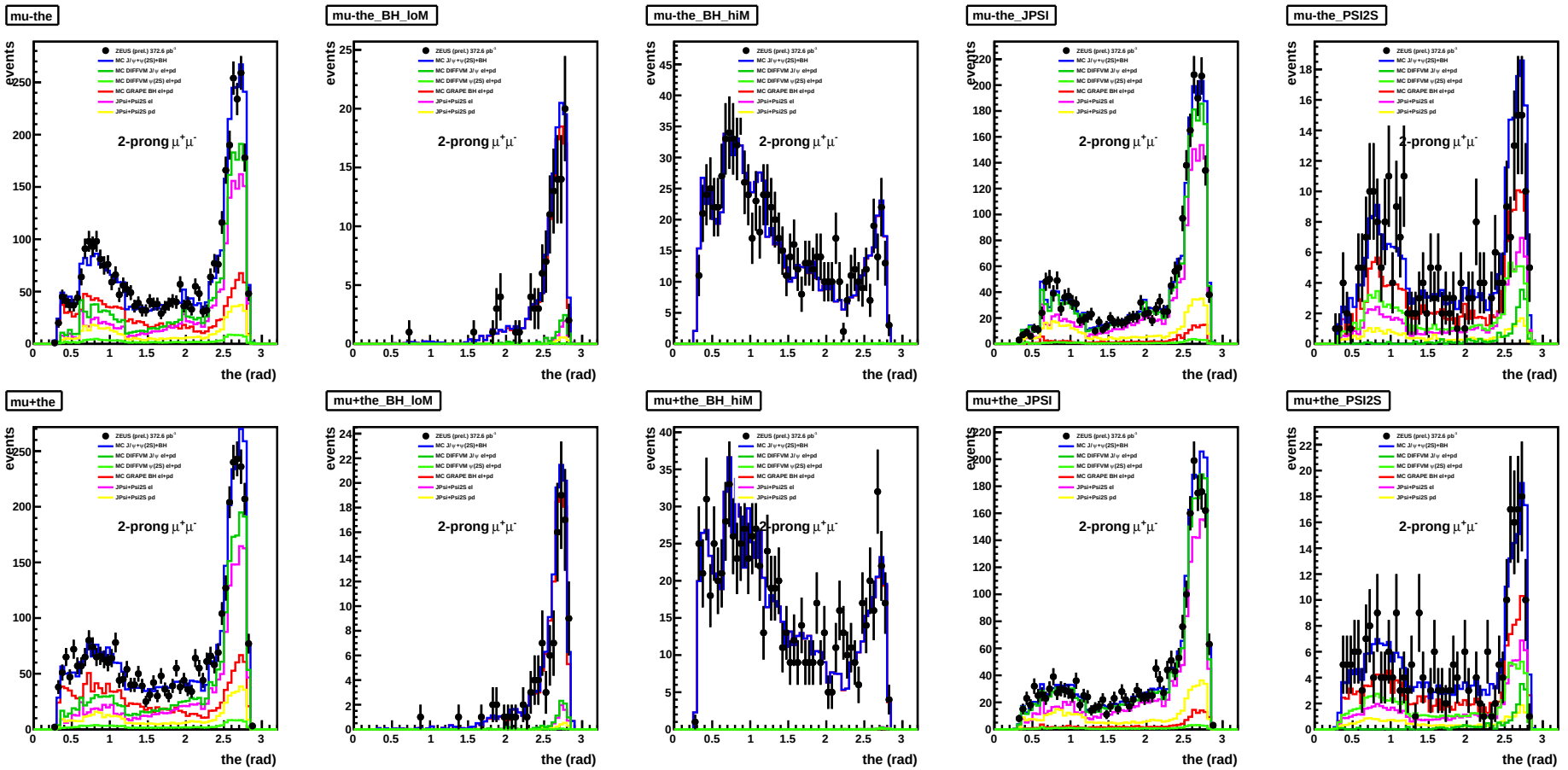
- fBAC,rBBAC, FBAC,RBAC efficiency after corrections
- full FLT-SLT-TLT-REC chain for single muon (p_t, p, p_z respectively)

BAC muon efficiency: after corrections



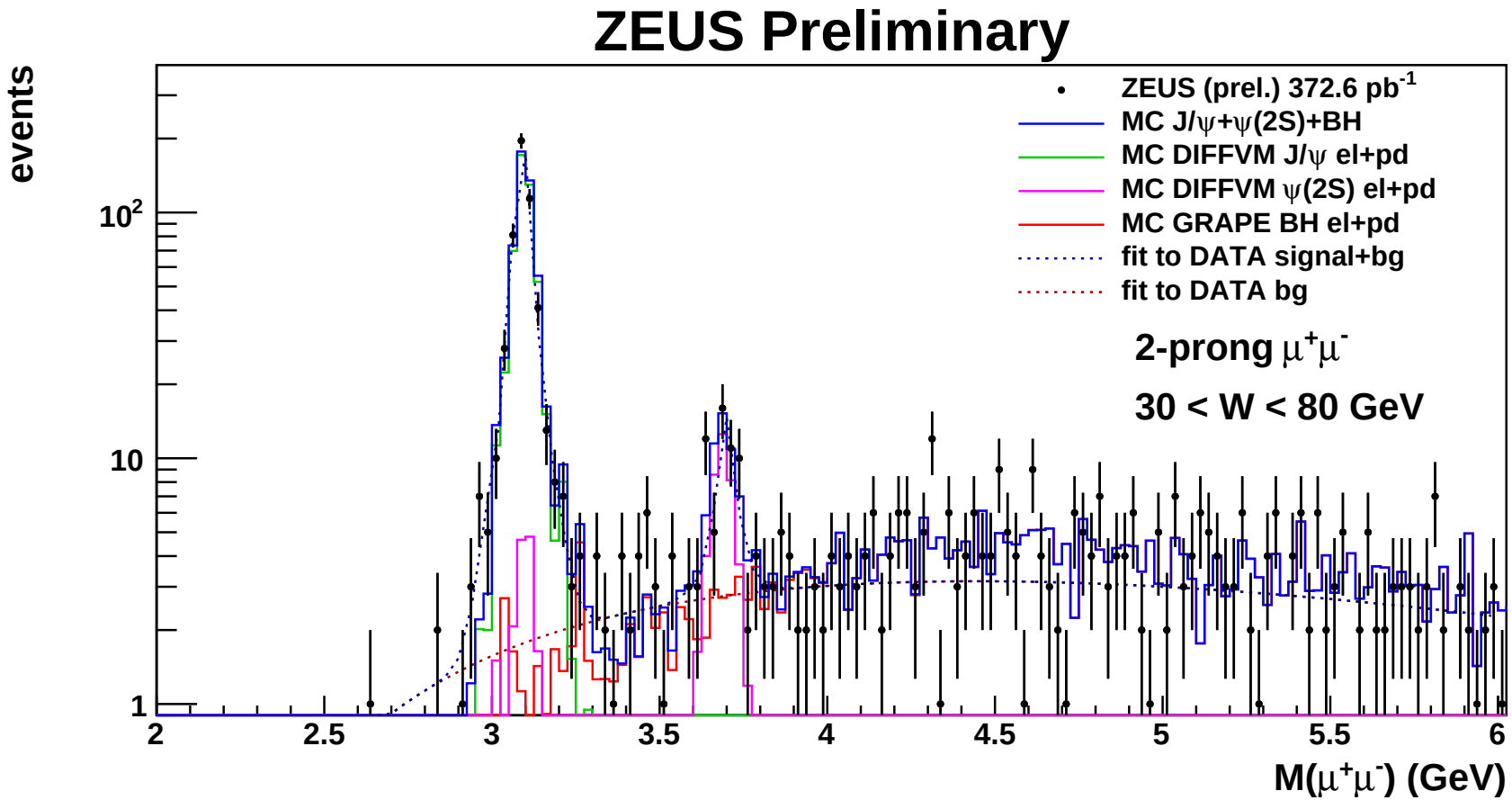
- only muons with $p > 3$ GeV (from plateau)
- full FLT-SLT-TLT-REC chain for single muon (θ_μ)

Muons in BAC: corrected θ distribition of $\mu^{\pm}$



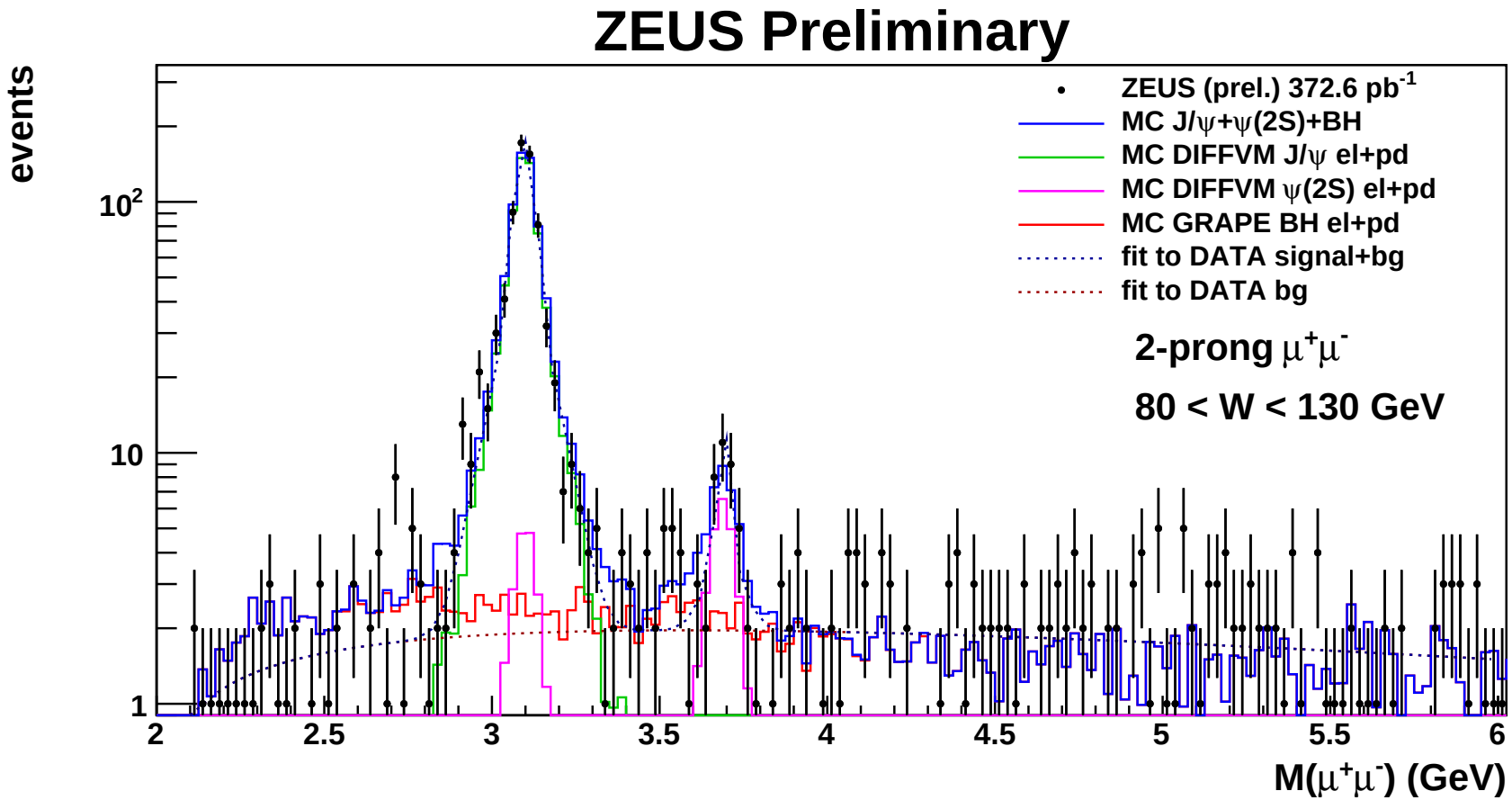
- BAC muons: $\theta_{\mu^{\pm}}$ in mass bins: ALL, BH-loM, BH-hiM, J/ψ, ψ'
- up: θ_{μ^-}
- down: θ_{μ^+}

BAC di-muon mass distribution: W1



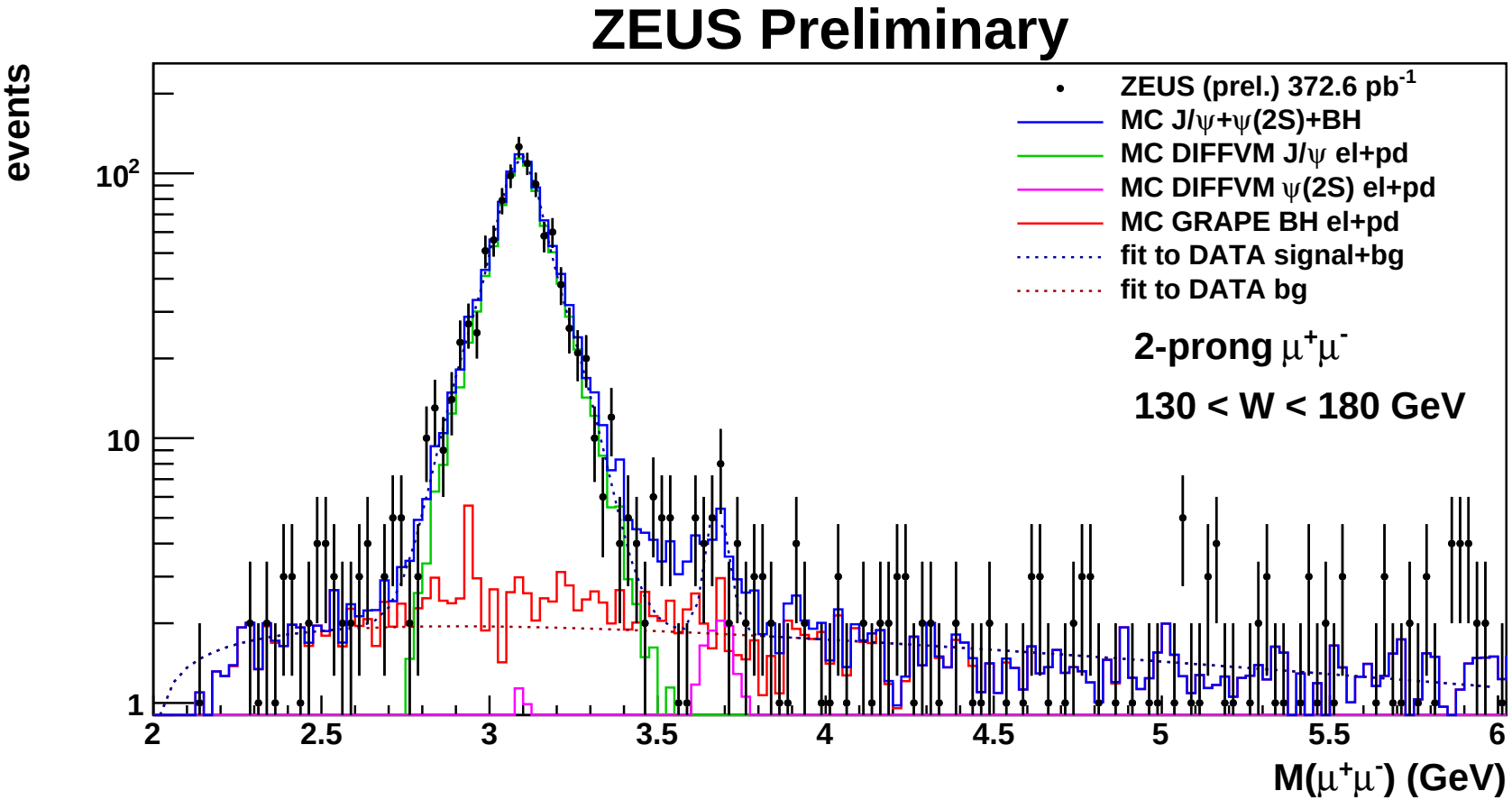
- W1: (50-80) GeV
- events yield from double-Gaussian fit for signal + continuous BH BG
- `TFracFitter` (histogram template fit) for resonant BG subtraction

BAC di-muon mass distribution: W2



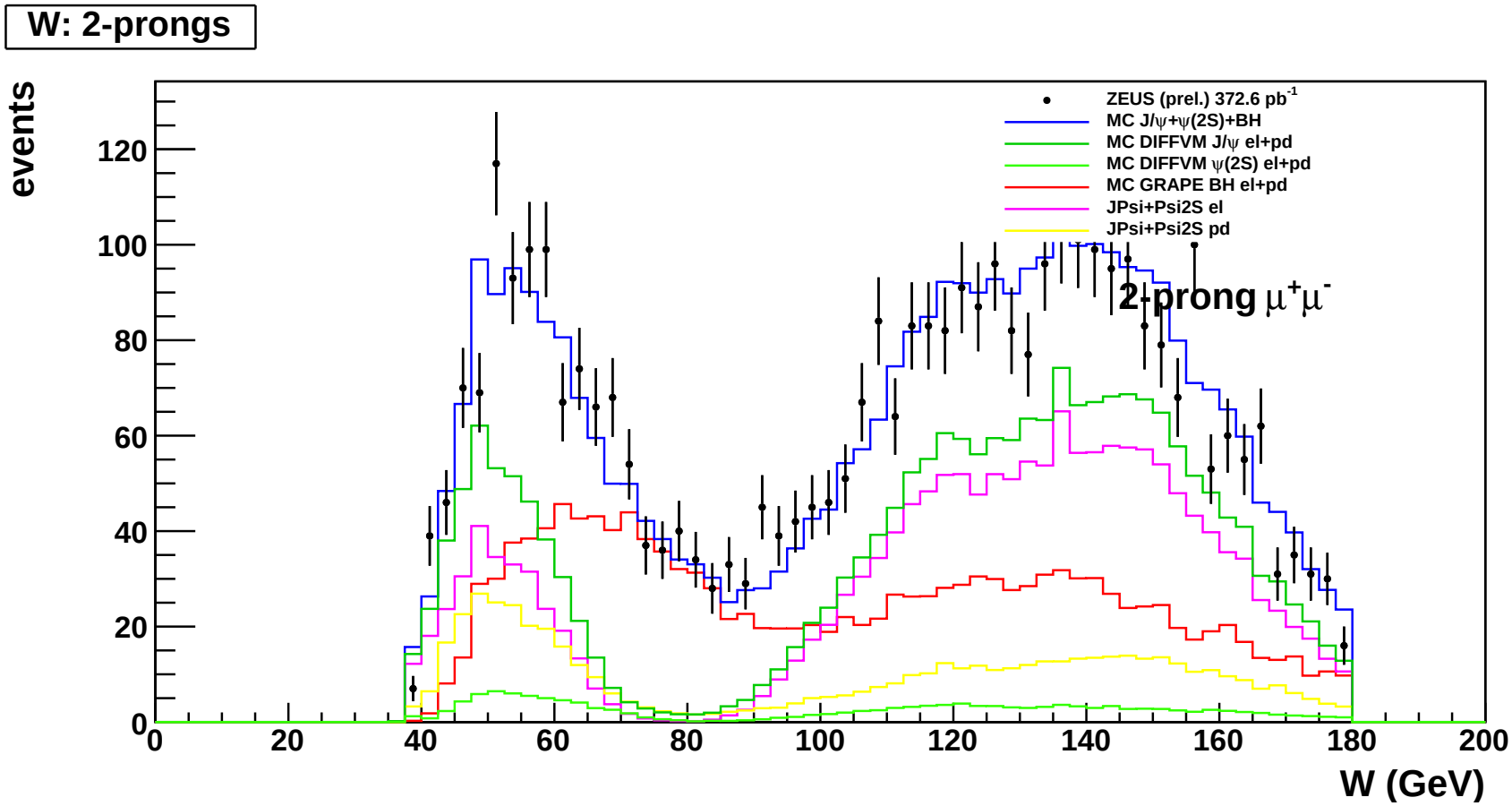
- W2: (80-130) GeV

BAC di-muon mass distribution: W3



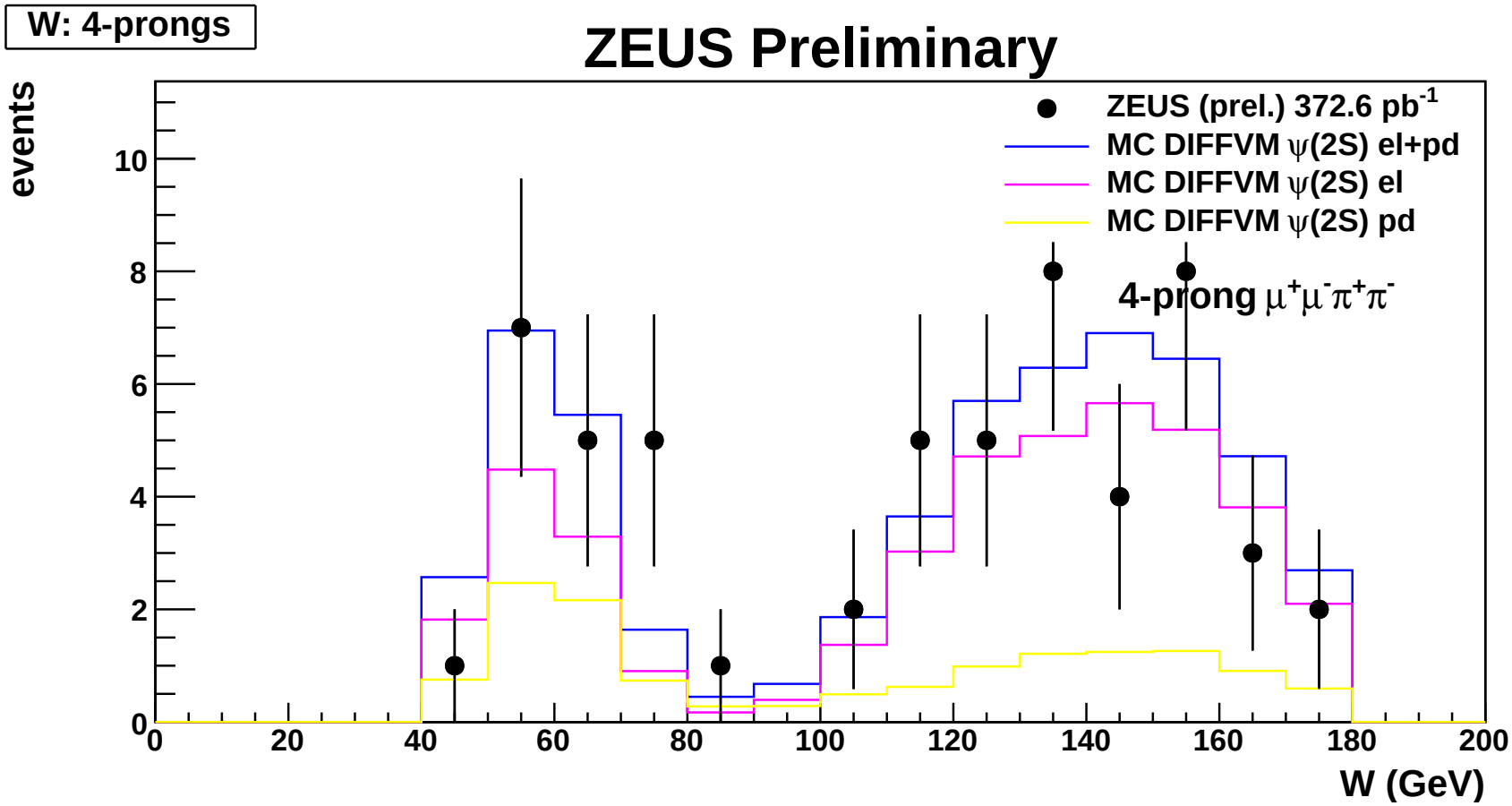
- W3: (130-180) GeV

BAC *W* distribution: 2-prong



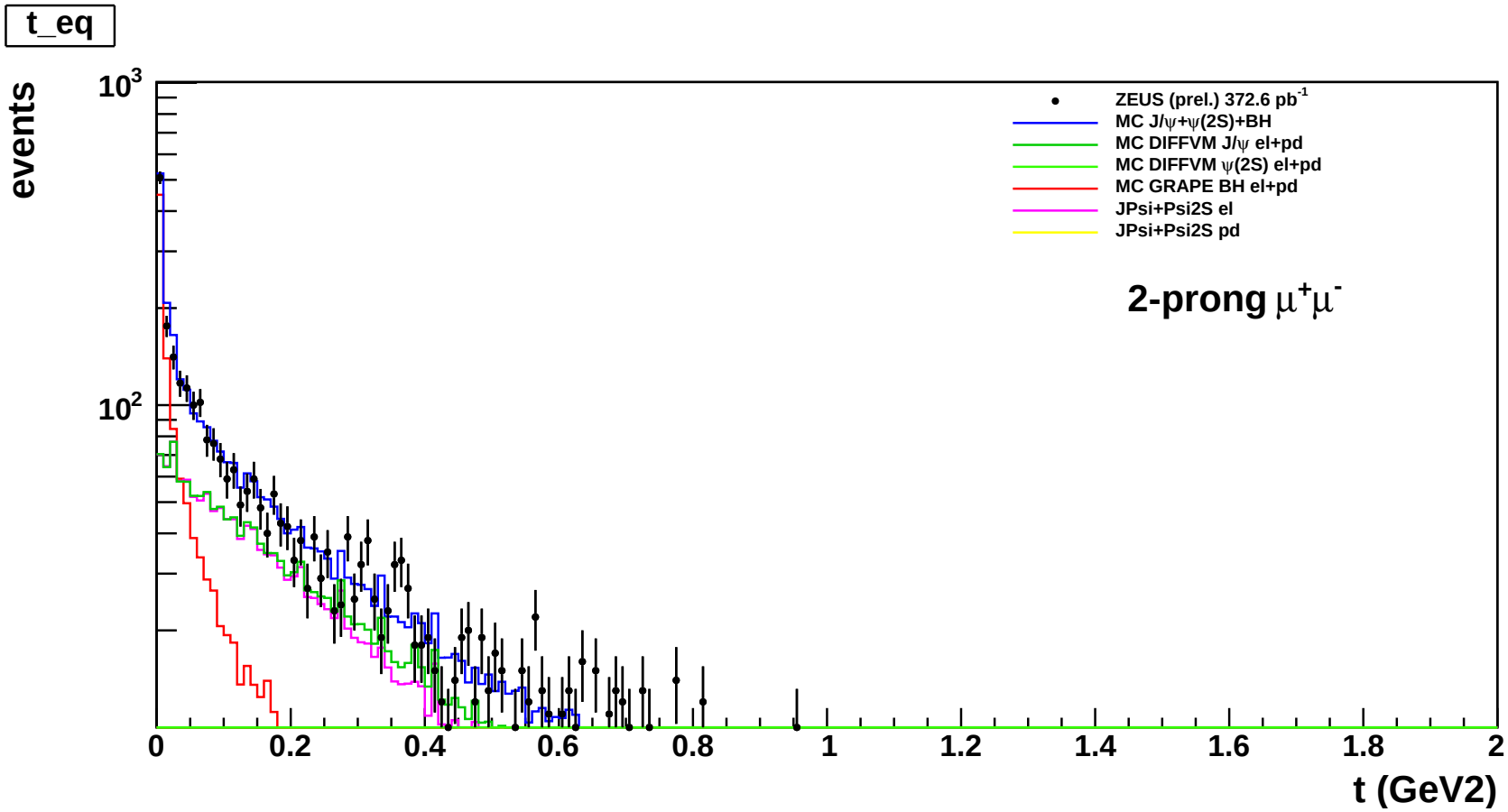
- BAC *W* distribution, 2-prong
- (dominated by J/ψ and BH)

BAC W distribution: 4-prong



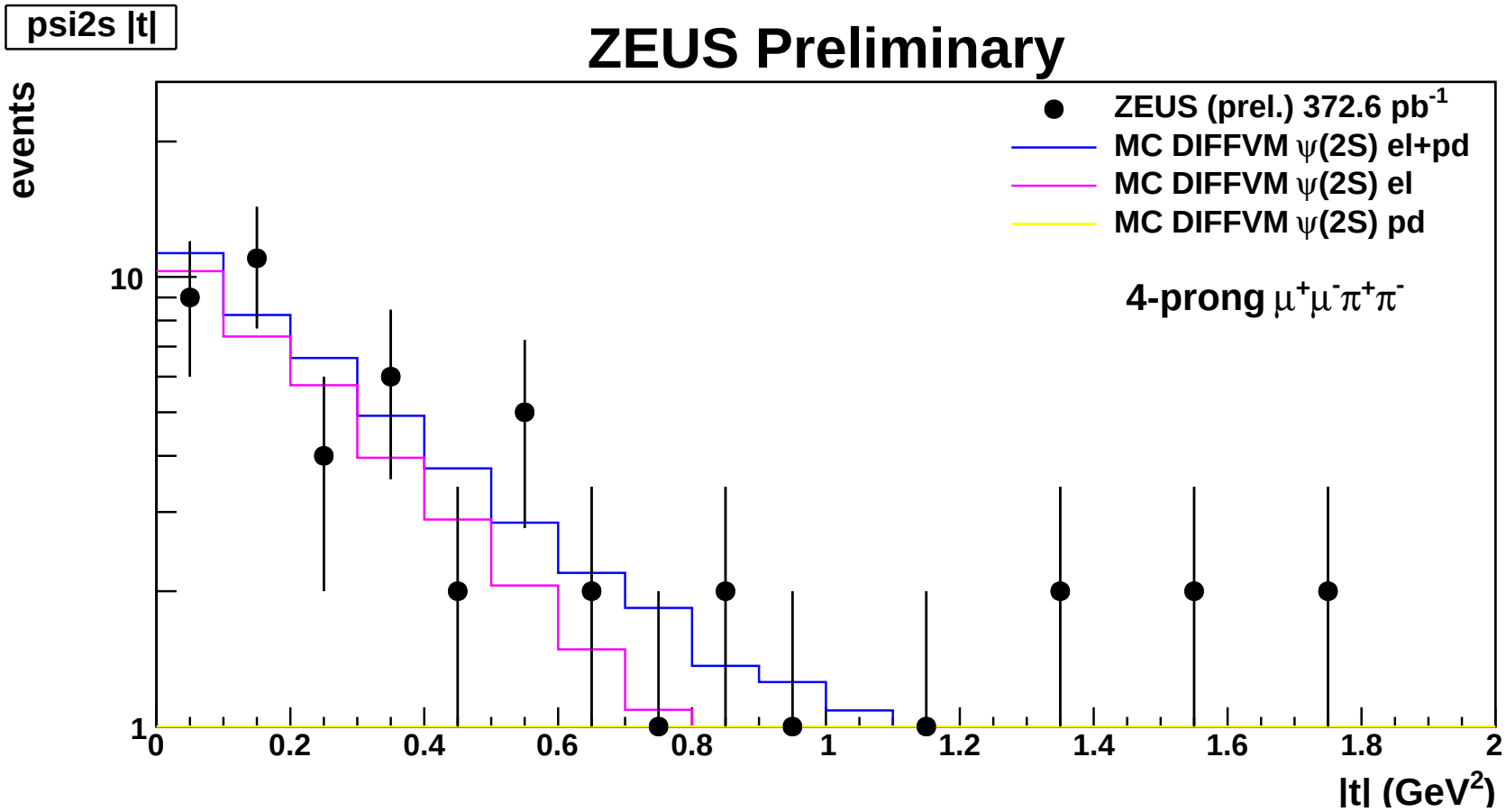
- BAC W distribution, 4-prong
- clean ψ' sample

BAC $|t|$ distribution: 2-prong



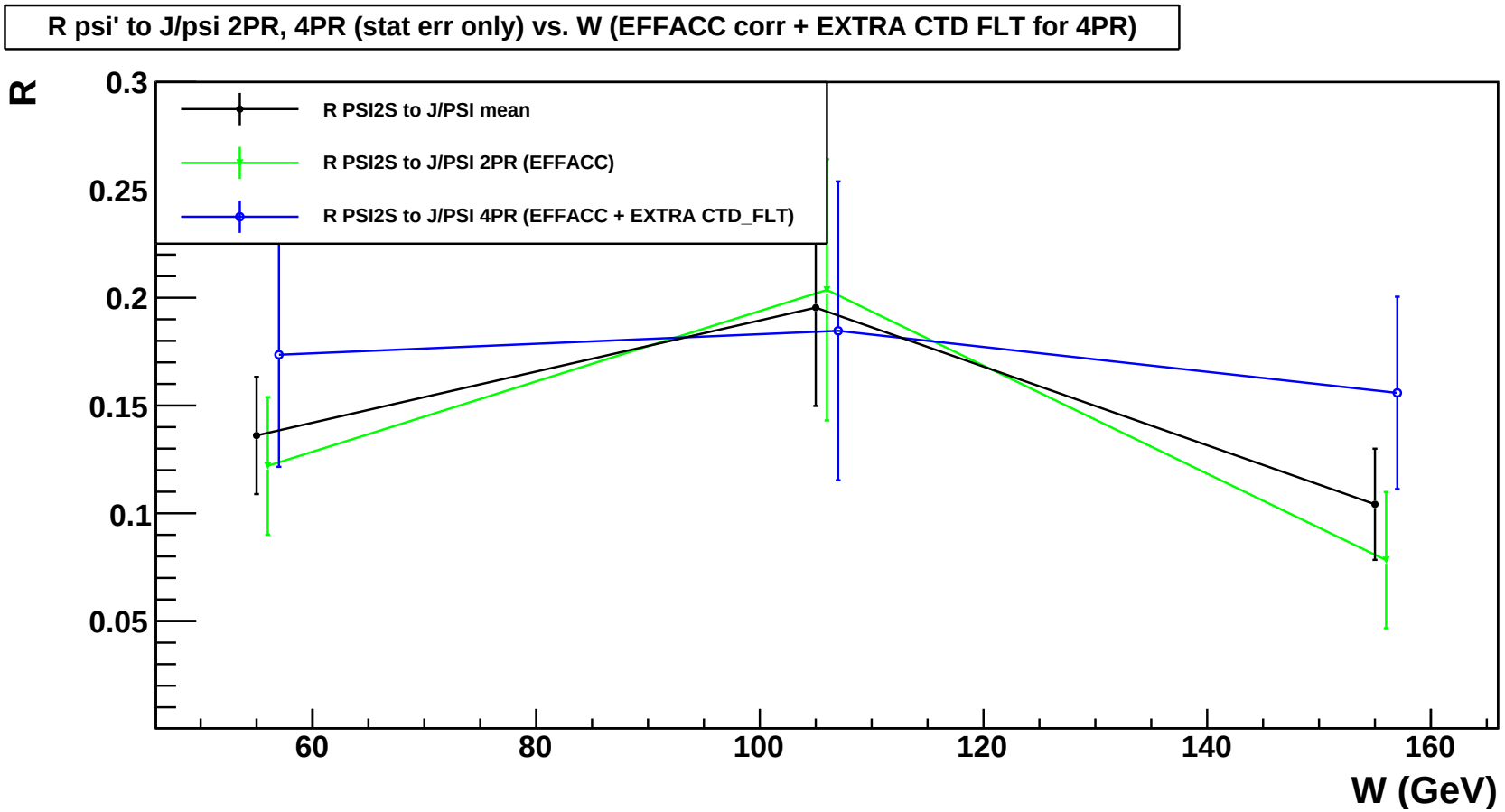
- BAC $|t|$ distribution, 2-prong
- (dominated by J/ψ and BH)

BAC $|t|$ distribution: 4-prong



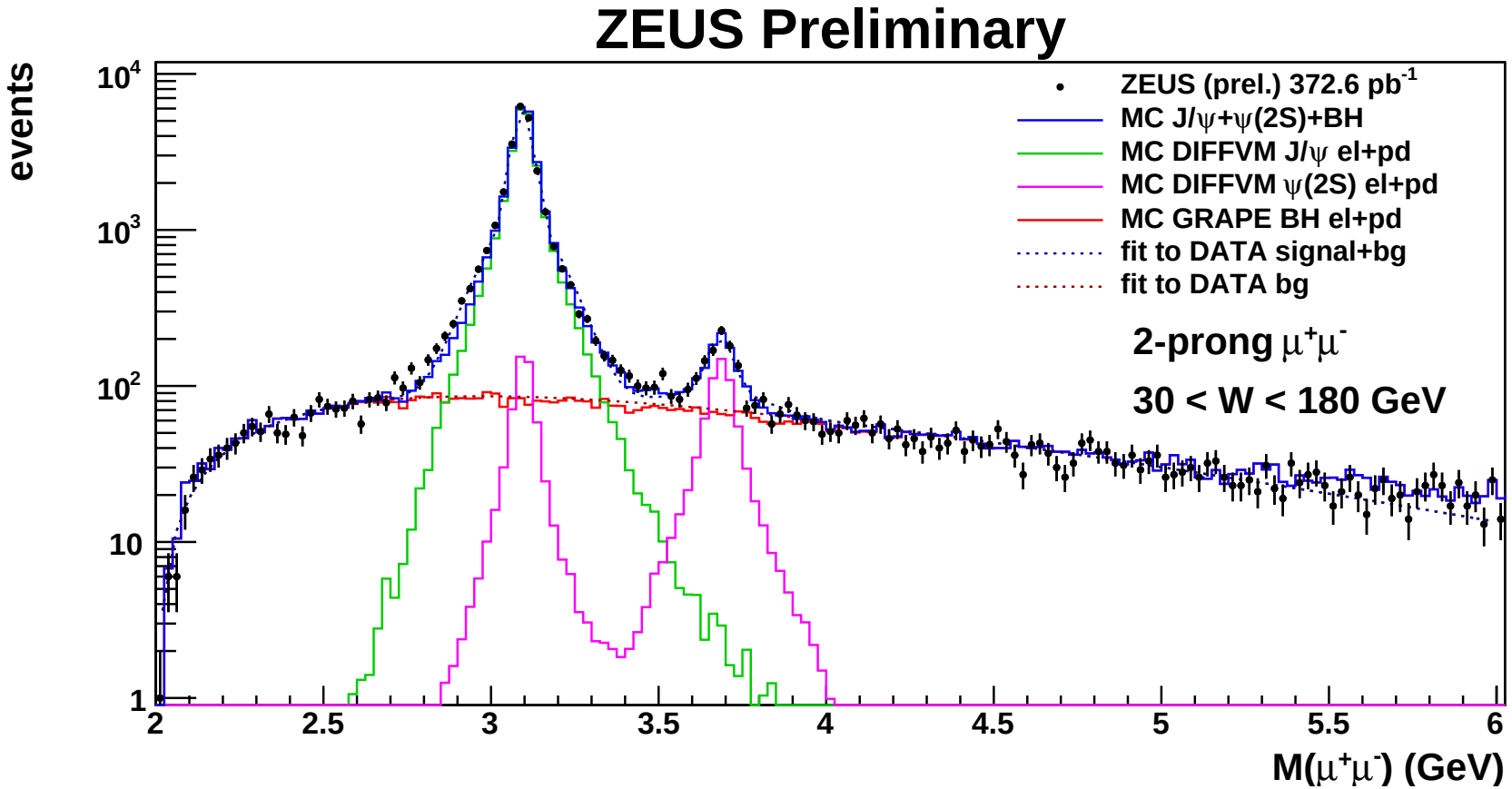
- BAC $|t|$ distribution, 4-prong
- clean ψ' sample

R (BAC data only): ψ' to J/ψ weighted mean value



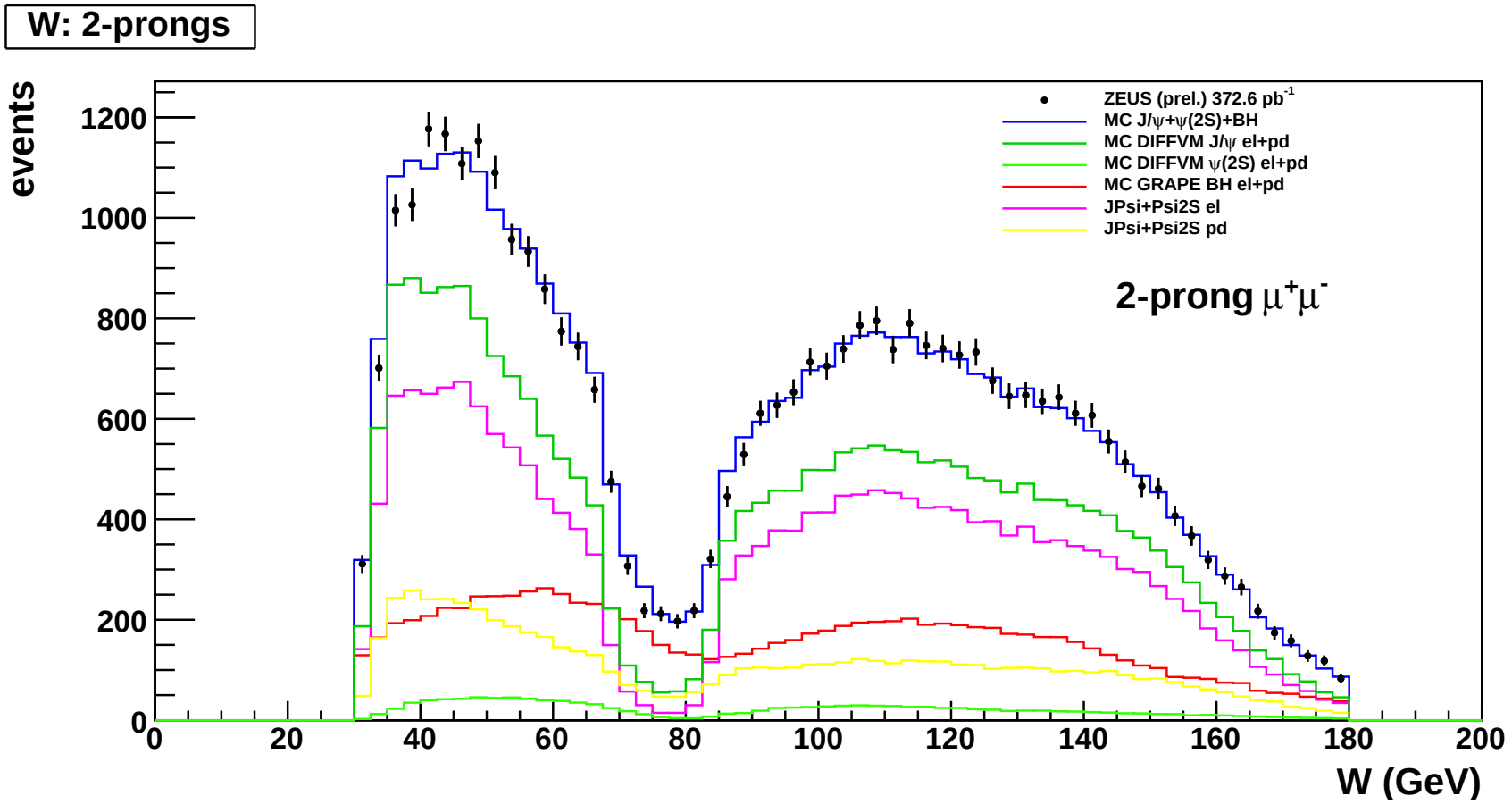
- ratio of no. of events corrected for BR and effic/acceptance and CDT FLT track veto efficiency
- **black:** weighted mean value for 2- and 4-prong channels

F/B/RMUO or BAC: di-muon mass distribution



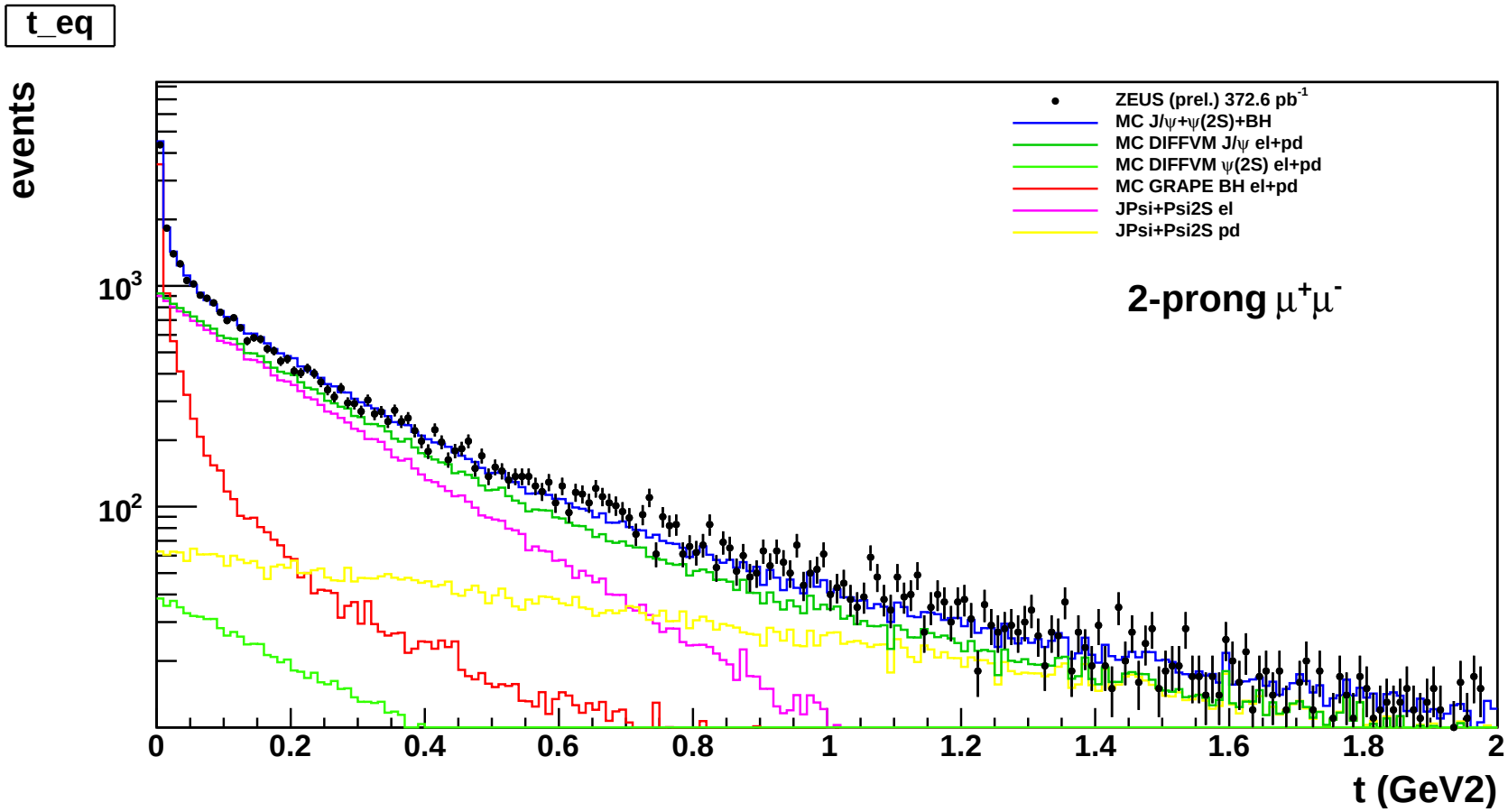
- combined selection: at least one muon in F/B/RMUO or BAC (all trigger levels plus off-line reconstruction)
- all *W* bins

F/B/RMUO or BAC: di-muon W distribution



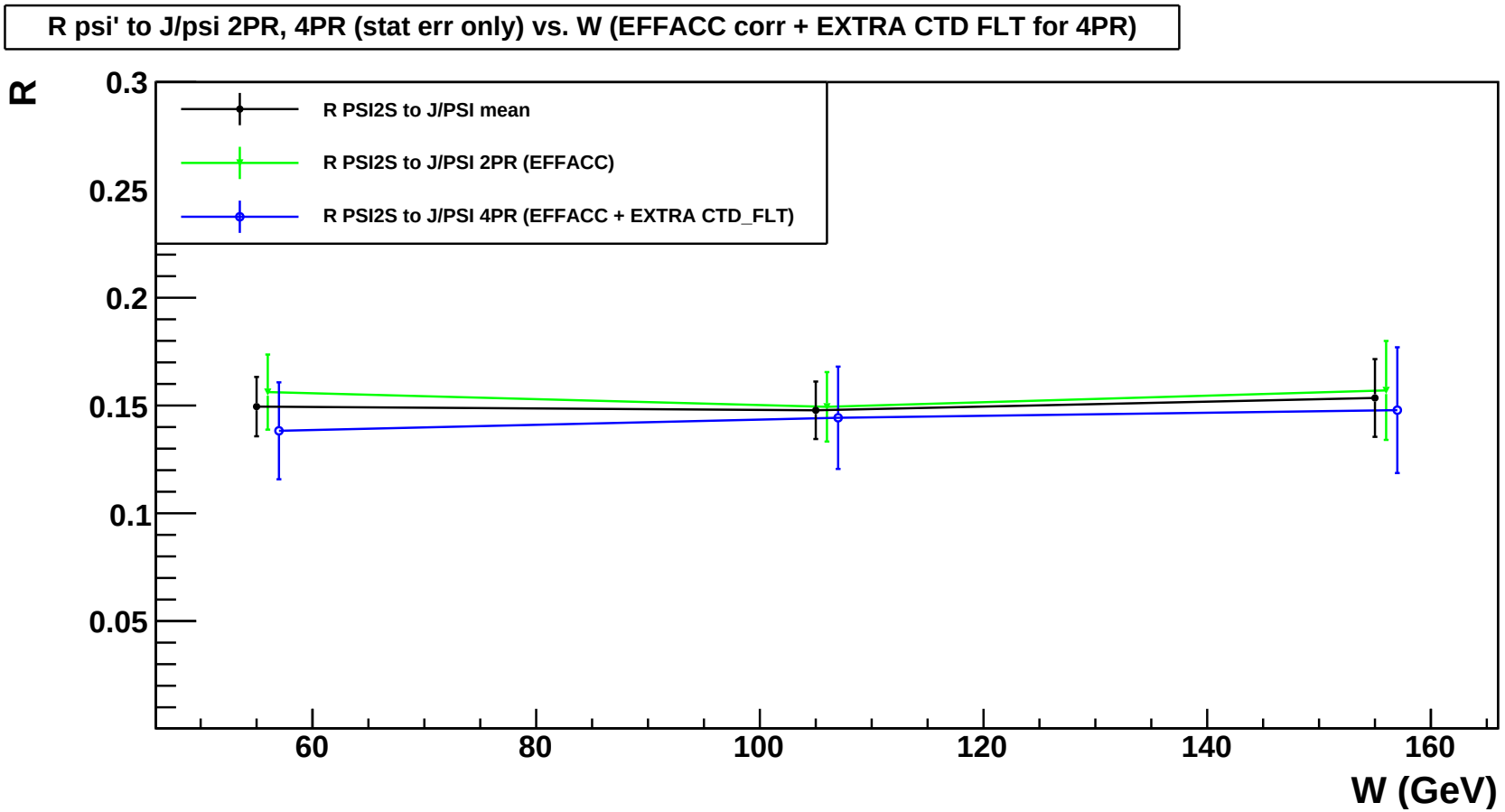
- combined selection: at least one muon in F/B/RMUO or BAC (all trigger levels plus off-line reconstruction)

F/B/RMUO or BAC: di-muon $|t|$ distribution



- combined selection: at least one muon in F/B/RMUO or BAC (all trigger levels plus off-line reconstruction)

R (F/R/BMUO or BAC): ψ' to J/ψ weighted mean value



- ratio of no. of events corrected for BR and effic/acceptance and CDT FLT track veto efficiency
- **black:** weighted mean value for 2- and 4-prong channels

Systematics: to be investigated

- BR: Branching Ratios (J/ψ, ψ': 2- and 4-prong)
- muon corrections (different grid, $\pm$ stat errors on corrections weights)
- CTD FLT 4PR corrections (from DIS sample, w.r.t. the FLT30)
  (are in STAT, but will differ for different SLOW PIONS cuts)
- p.diss fraction (J/ψ, ψ')
- different MC model:
  reweighting (*b*-slope, W^{δ}, (M_X ?) for J/ψ, ψ'; elastic and p.diss)
- different *N* event estimators (Double Gaussian fit, TFF, event counting in mass window)
- SLOW PIONS quality cuts: track vertex, N_{SL}/MIN/MAX, pt, ...
- any other ideas ?

Conclusions

- new muon correction scheme (weighted corrections) implemented for BAC and combined selection F/B/RMUO or BAC
- tested on 2-prong and 4-prongs samples
- no serious DATA/MC discrepancy found
- corrected MC reproduces single MUON efficiency curves from DATA
- **consistent ψ' / J/ψ ratio R for 2-prongs and 4-prongs**
- **consistent R values for FBRMUO and for BAC based selections**

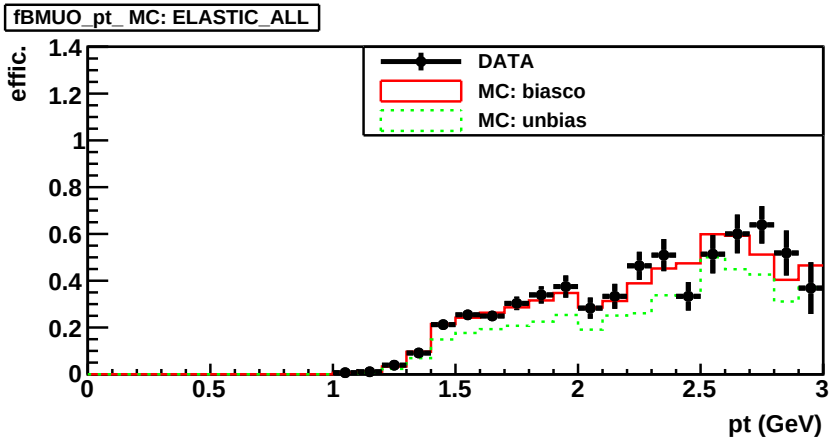
Plans

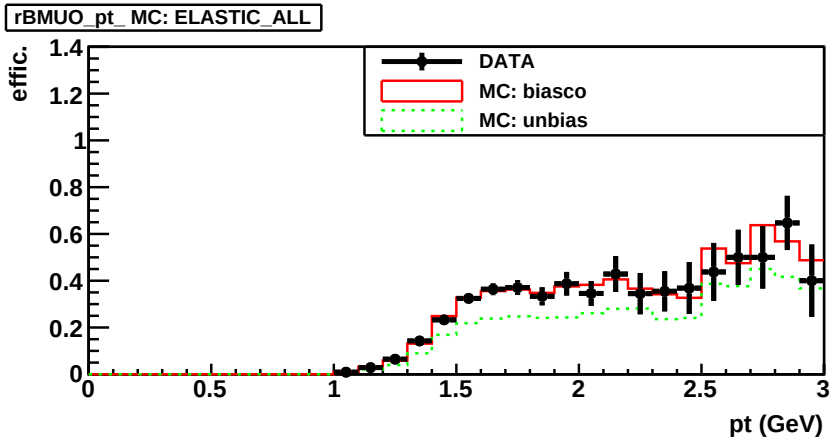
- decide on final ("base line") selection (esp. pion cuts)
- for statistical error on R use full corelation matrix form $N_{J/\psi}$ and $N_{\psi'}$ fit
- consistent usage of BAC also for CTD FLT *track veto* corrections (low statistic DIS sample)
- treatment of empty bins on (p_t, η) grid for muon corrections
- R vs. $|t|$ (as in DIS paper) (3 $|t|$ bins ?)
  "machinery" analogous to R vs. W
- calculate systematic error bands
- plot theory curves on top of R plots

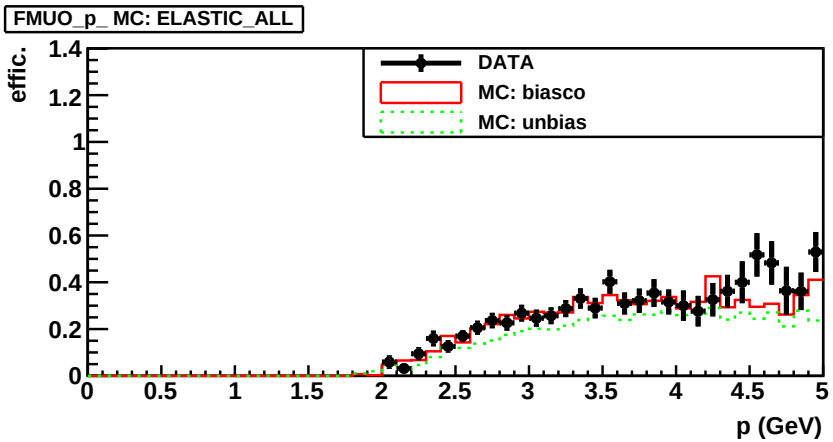
BACKUP PLOTS

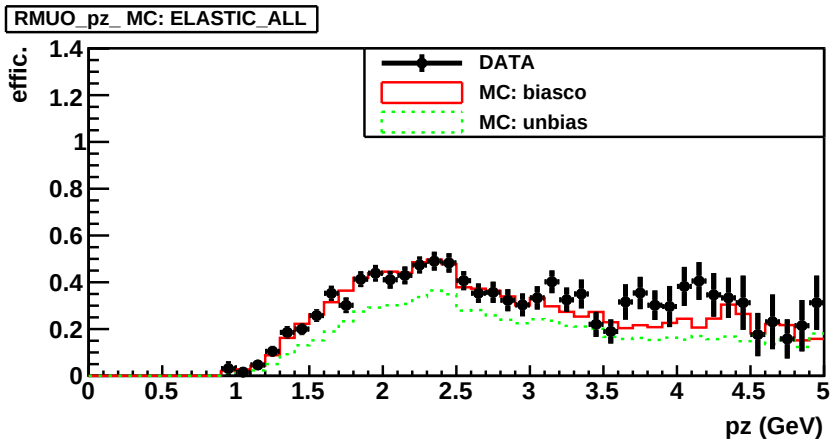
- BACKUP PLOTS...

Muon Efficiency: F/B/RMUO after corrections



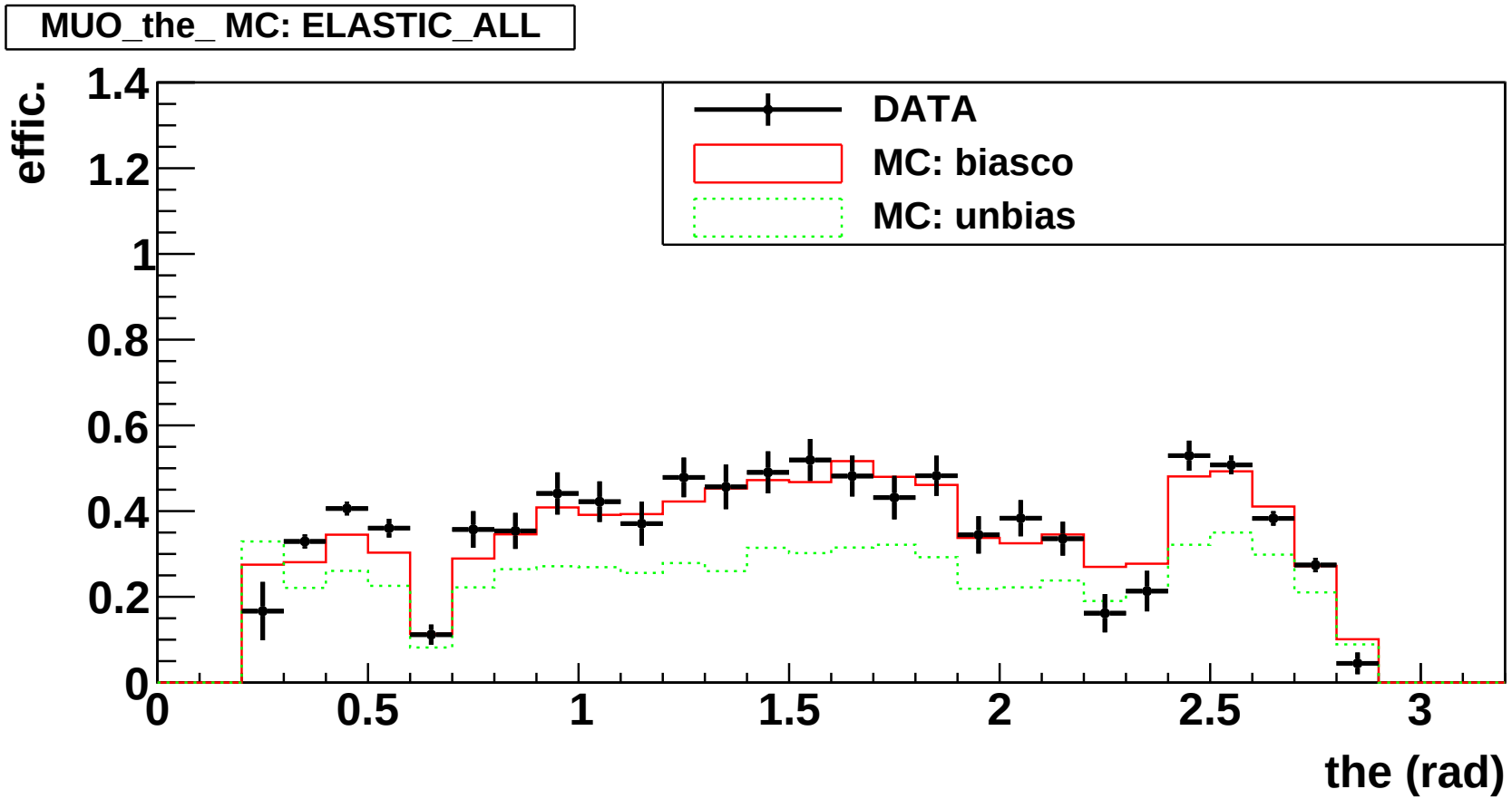






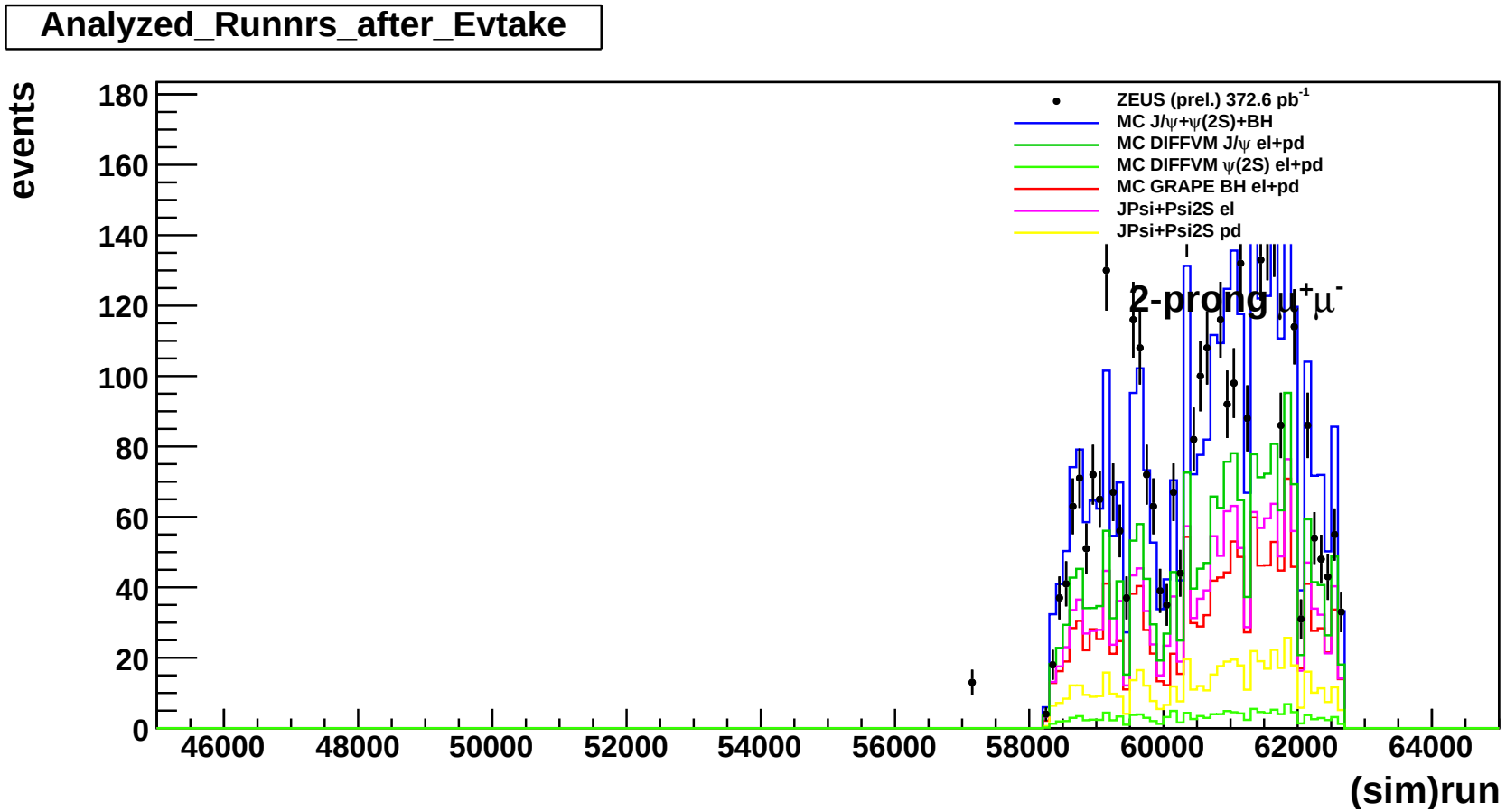
- F/B/RMUO efficiency after weighted corrections
- full FLT-SLT-TLT-REC chain for single muon (p_t, p, p_z respectively)

Muon Efficiency: F/B/RMUO after corrections



- F/B/RMUO efficiency after weighted corrections
- full FLT-SLT-TLT-REC chain for single muon (θ_μ)
- some discrepancy for FMUON chambers

BAC: Analyzed Runnrs after Evtake



- number of events selected after final cuts (2-prongs) vs. run number
- only runs with full BAC FLT-SLT-TLT chain implemented
- MC samples reweighted to Lumi of each data taking period
- MC after (averaged over all periods) muon corrections