ψ' : towards solving the 2/4-prong puzzle

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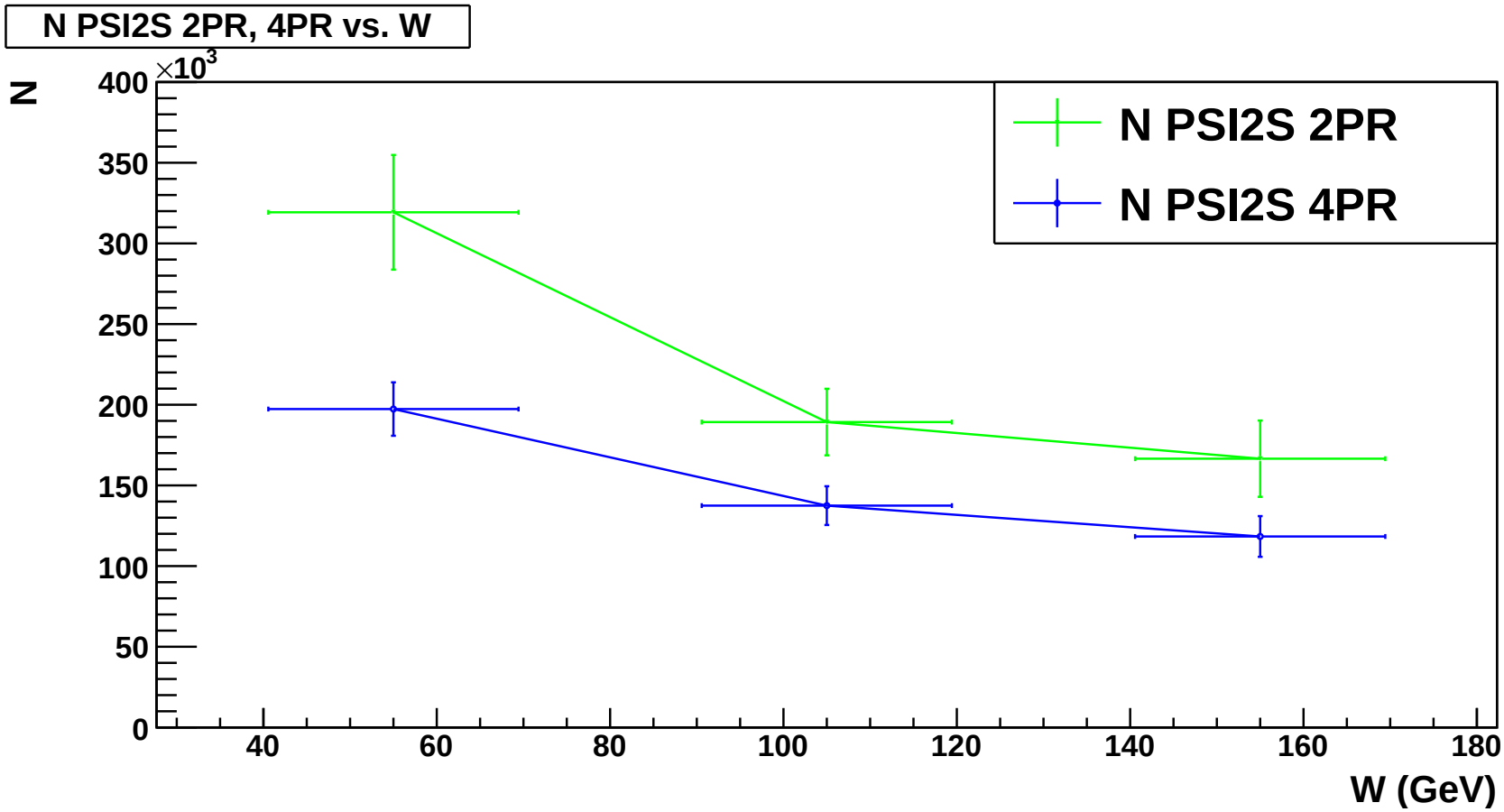
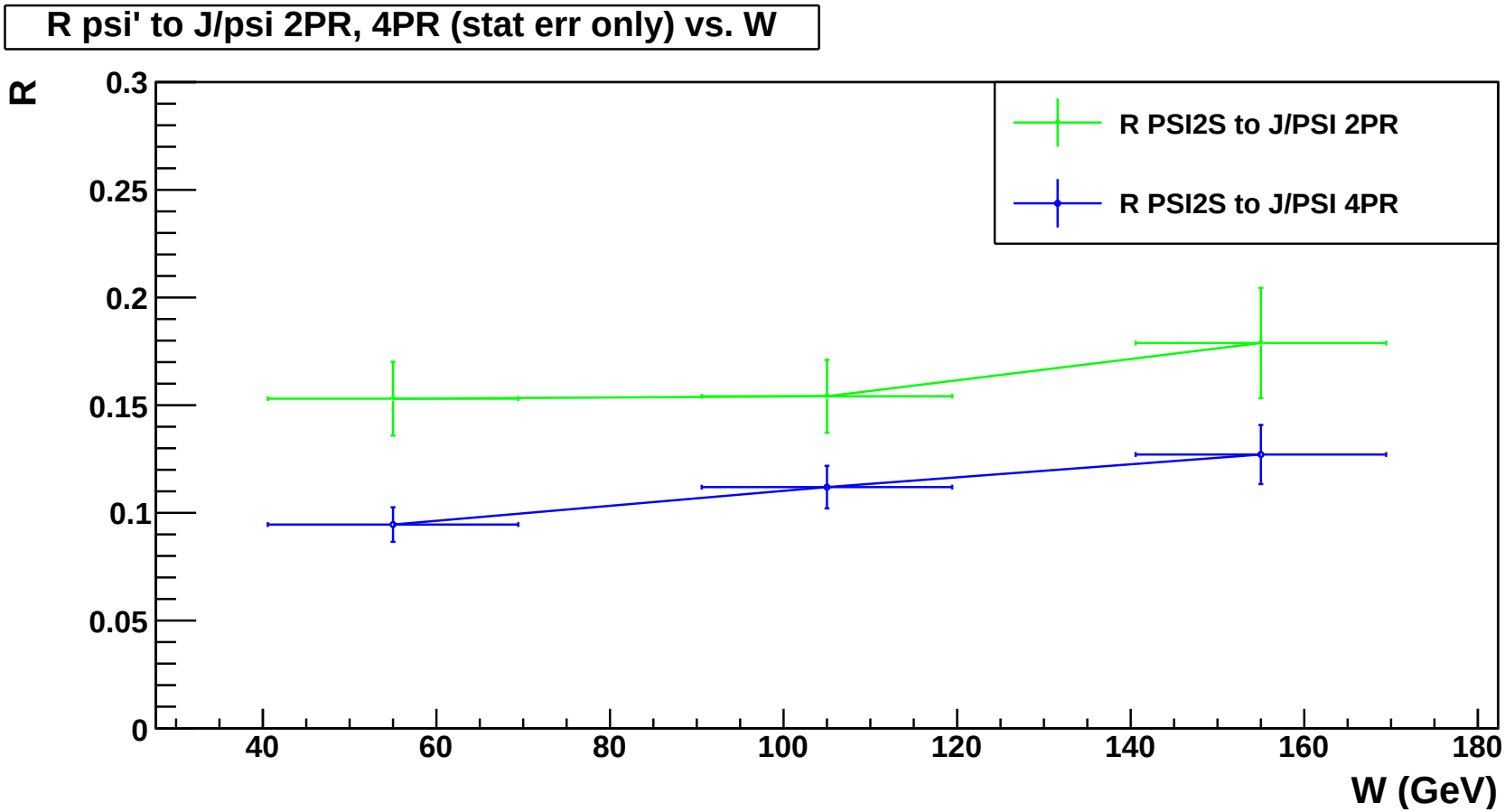
Quick reminder: 2PR, 4PR: Number of events



- Number of $\psi(2S)$ events from 2PR and 4PR corrected for acceptance and BR
- ("acceptance" means here "acceptance*efficiency")

Quick reminder: R: stat. only errors



- cross section ratio R of $\psi(2S)$ to J/ψ from 2PR and 4PR
- stat only errors

First idea:

- the problem could be related to slow pions (MC is over-optimistic describing slow pions (?), estimated efficiency to high, $\rightarrow$ less corrected events)
- in fact: one of the differences between DIS and PHP ψ' analysis were weaker cuts on pions tracks in PHP selection
- but after requiring $N_{SL} >= 3$ also for pions it still persisted...

Further investigation

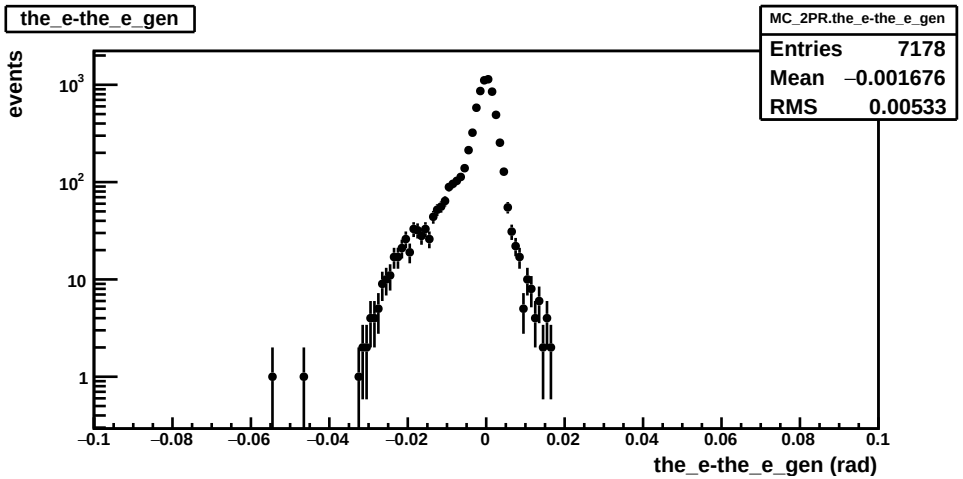
- there was no 2/4-prong discrepancy in ψ' in DIS analysis (observed agreement within one sigma)
- lets try to modify PHP code to select the DIS events
- keep the overall structure, modify only the cuts
- bring the cuts as close as possible to DIS selection
- do not use muon corrections (even for CAL MV finder)

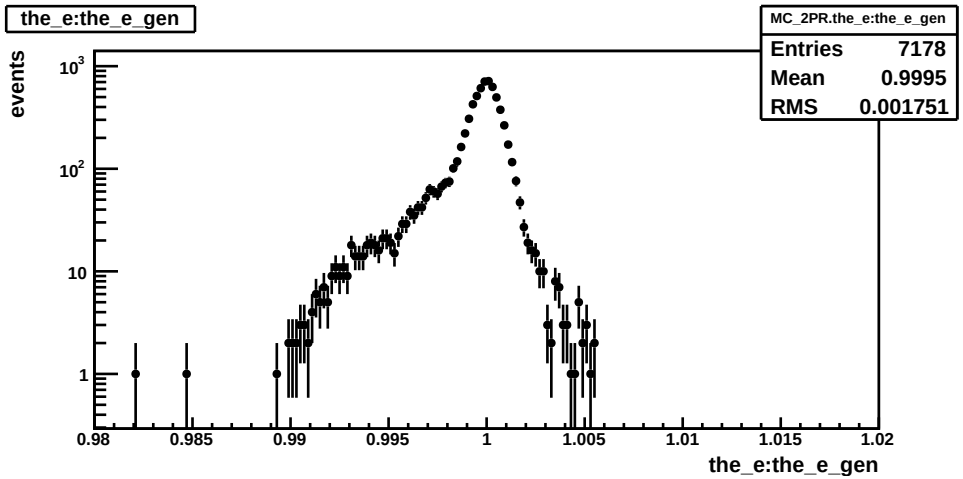
DIS: Selection cuts (only difference w.r.t. the PHP)

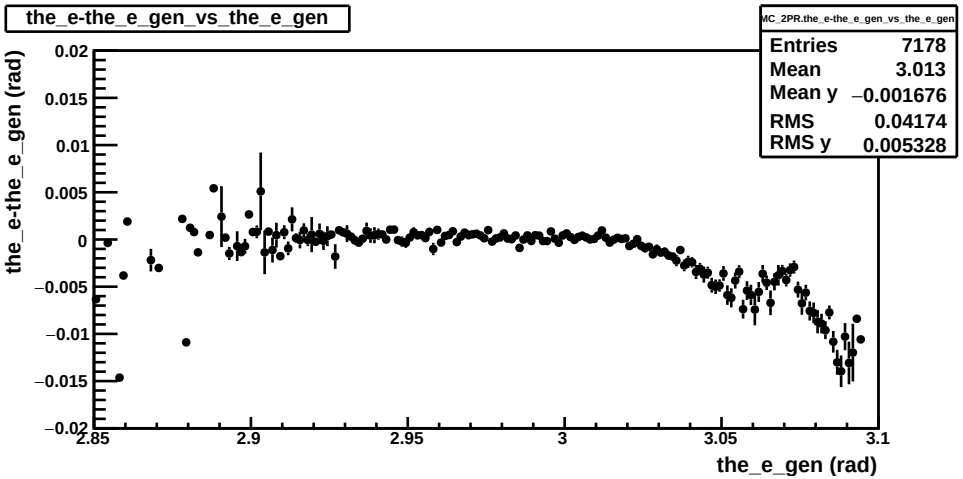
- trigger (use only TLT):
  - SPP02 || SPP05 (2004 - 2005)
  - SPP05 || SPP09 || HFL17 (2006 - 2007)
- select events with scattered electron (Sinistra):
  - $E_e > 10$ GeV, $p > 0.9$
  - (but no XY box cut, no cooling pipes and CAL super-crack cuts)
  - use only electrons without matched CTD track(*)
- increase W range from (30-180) $\rightarrow$ (30-210) GeV
- no cut on muon p_t
- use the same tuning of MV MIP finder (p, isolation criteria, etc...)
- use the same elasticity (exclusivity) cut : accepted uranium signal not associated with any track reduced from 0.5 to 0.4 GeV
- Evtake == 1 OR Evtake == 2 (in PHP was only Evtake == 1): ($L = 333 \rightarrow L = 365 \text{pb}^{-1}$)

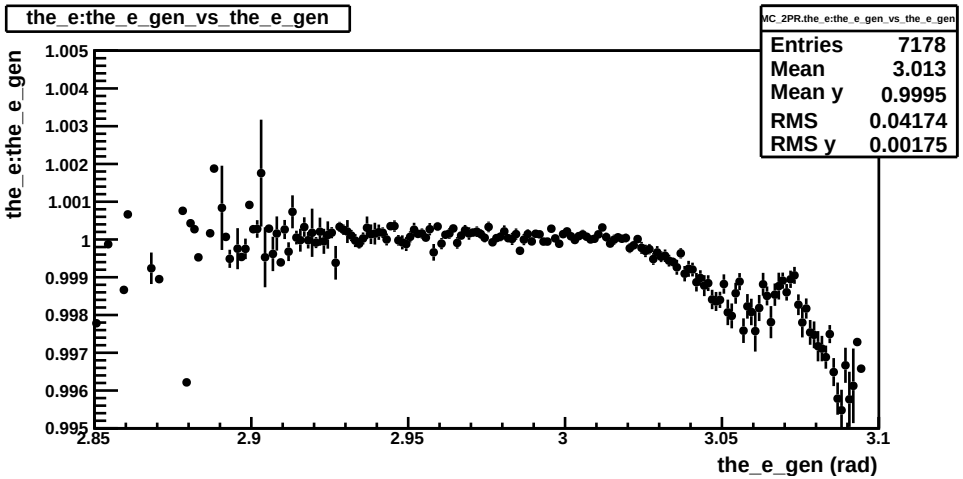
(*) simplifies the code, allows for extraction of CTD FLT 2/4-prong inefficiency from data

DIS: scattered electron: kinematics resolution: θ_e

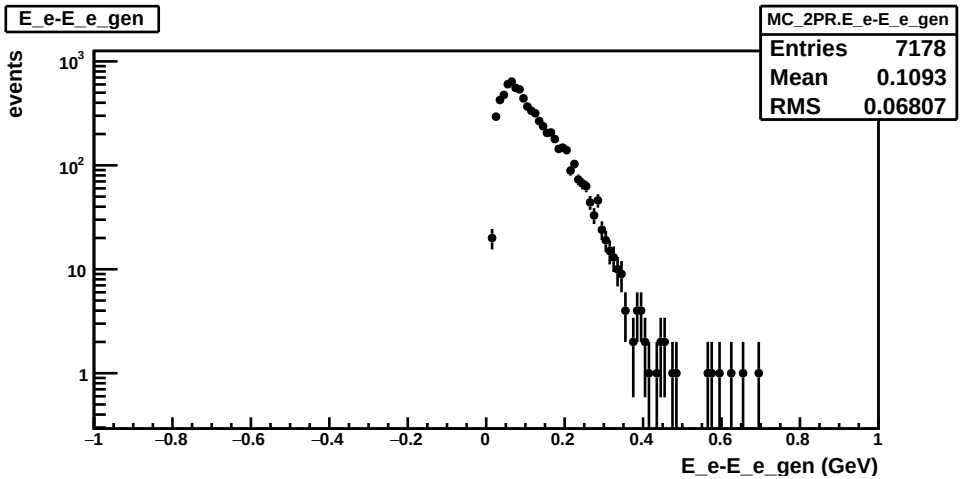


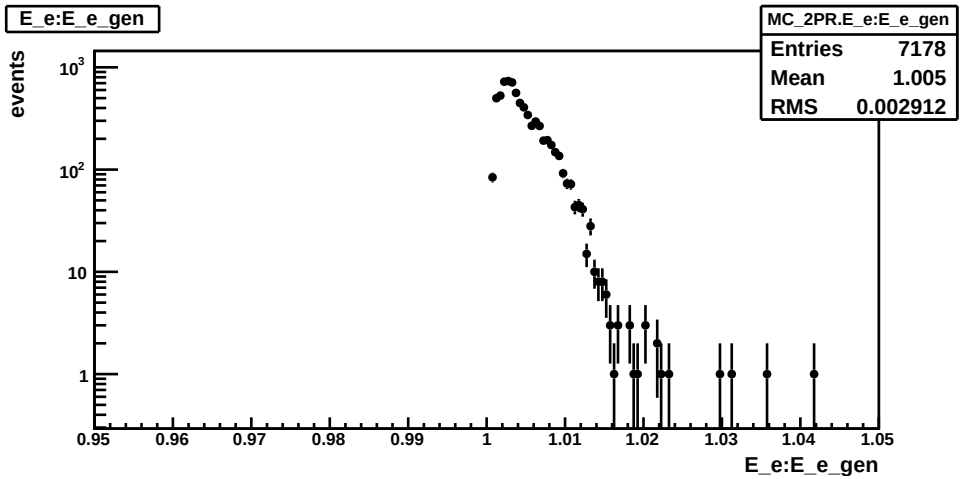


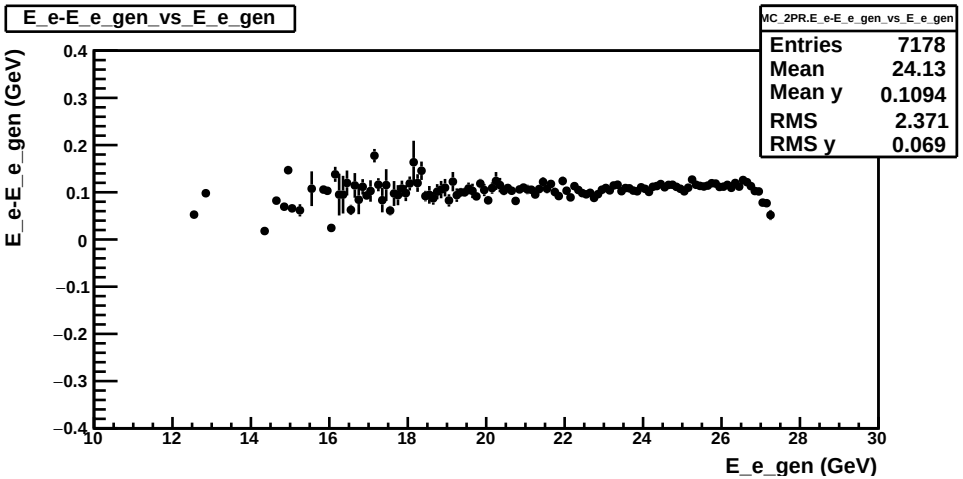


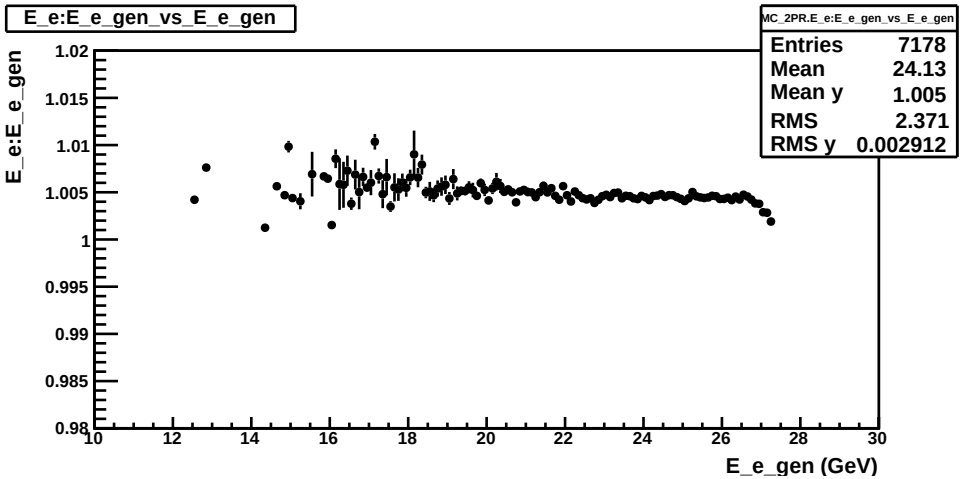


DIS: scattered electron: kinematics resolution: E'_e



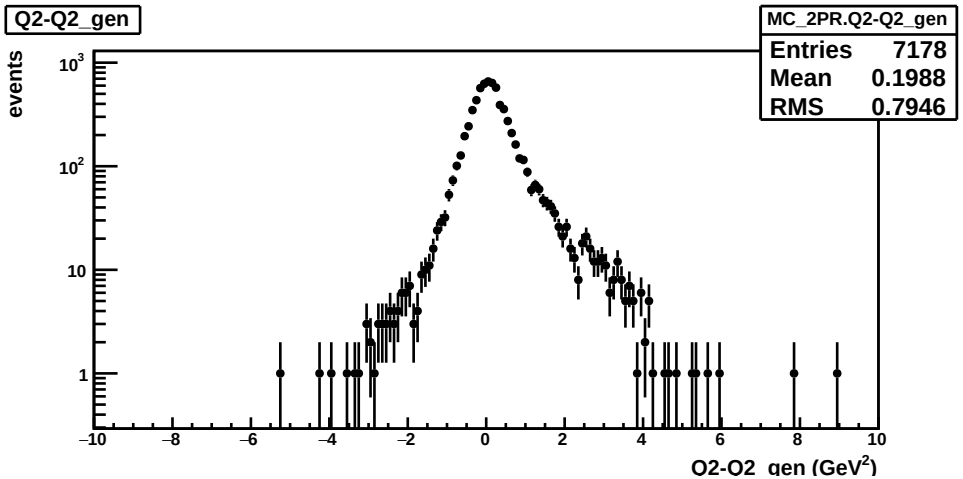


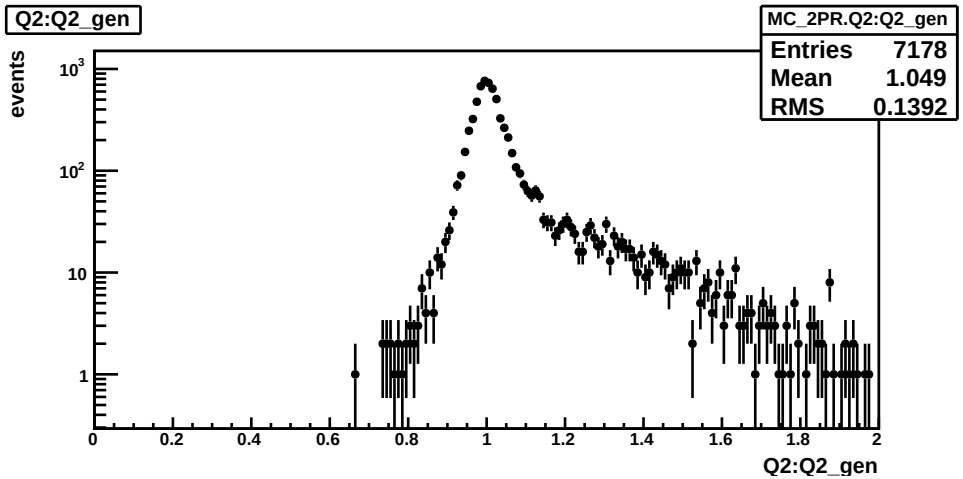


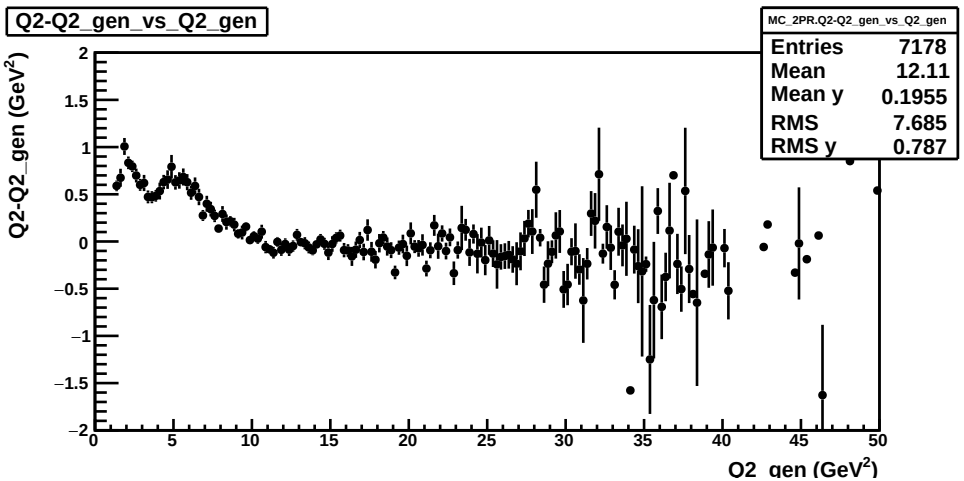


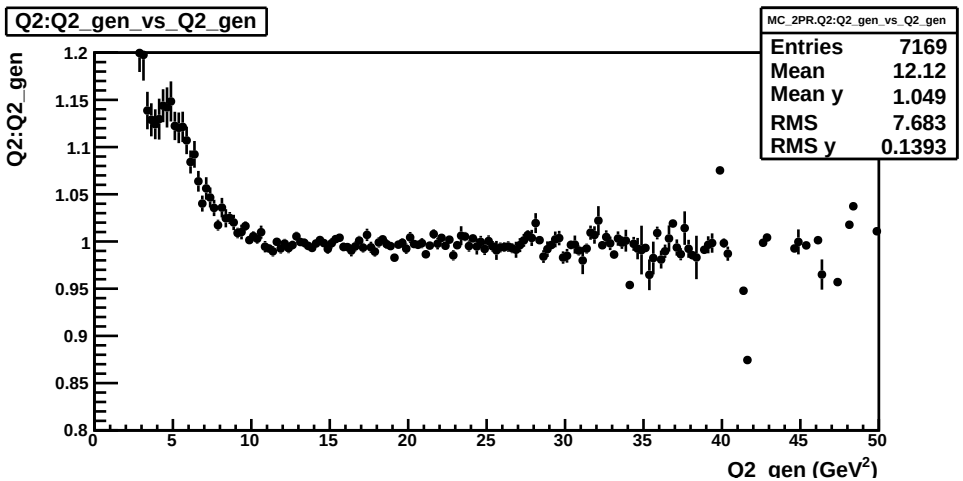
constrained method: $E'_e = \frac{2E_e - (E - p_Z)_V}{1 - \cos\theta_e}$

DIS: scattered electron: kinematics resolution: Q^2









constrained method: $Q^2 = 2E_e E'_e(1 + \cos\theta_e)$

Event yield (DIS): HERA-II ($L = 365$ pb^{-1})

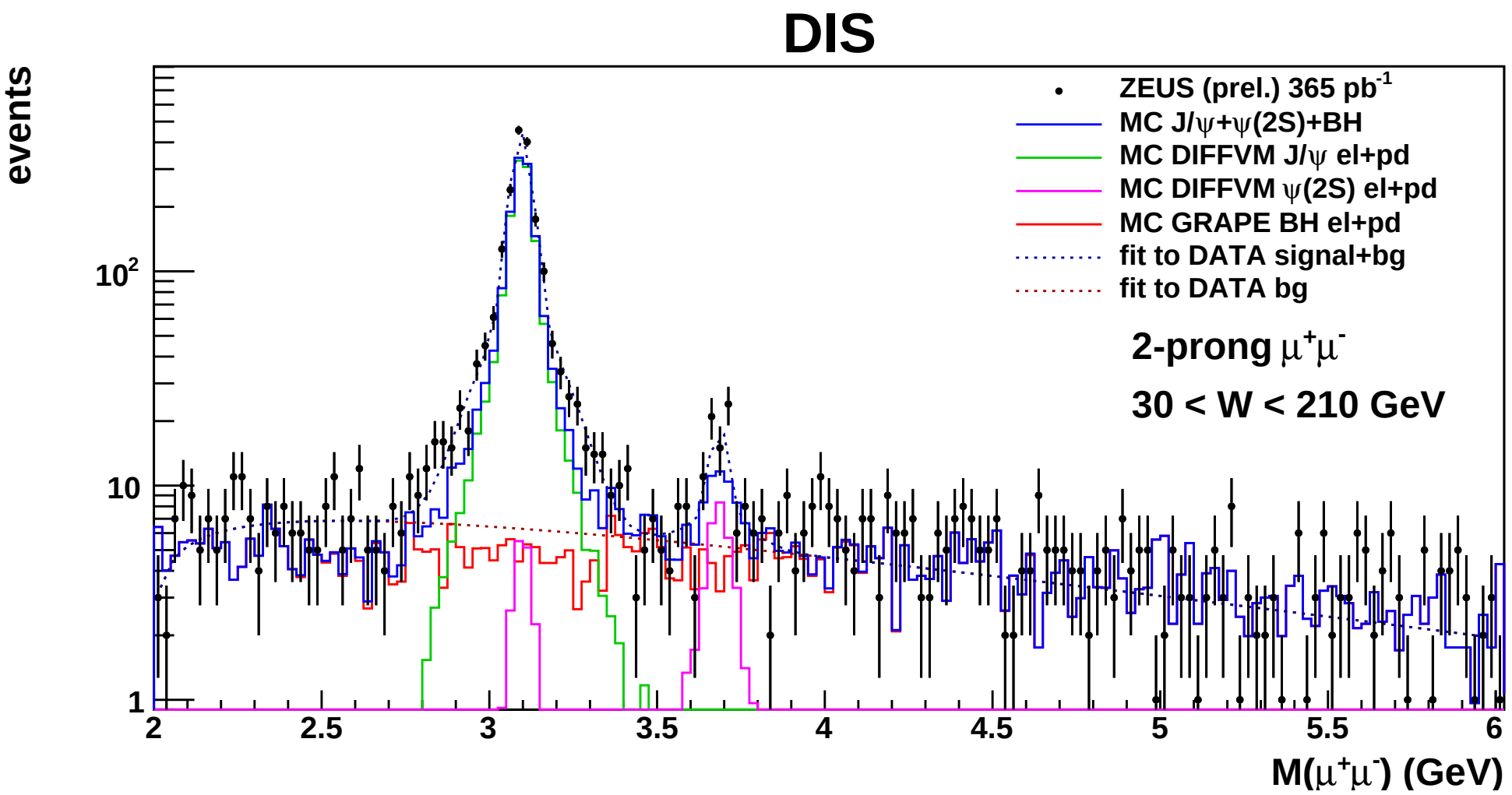
	$N_{J/\psi}$	$N_{\psi'}$: 2-PR	$N_{\psi'}$: 4-PR
NK	1738 ± 42	66 ± 11	82 ± 9
GG	1739 ± 46	48 ± 11(*)	51 ± 7

Nataliia's numbers from:

`www-zeus.desy.de/~kovalch/ZEUS_ONLY/psi_prim/psi_prim.html`

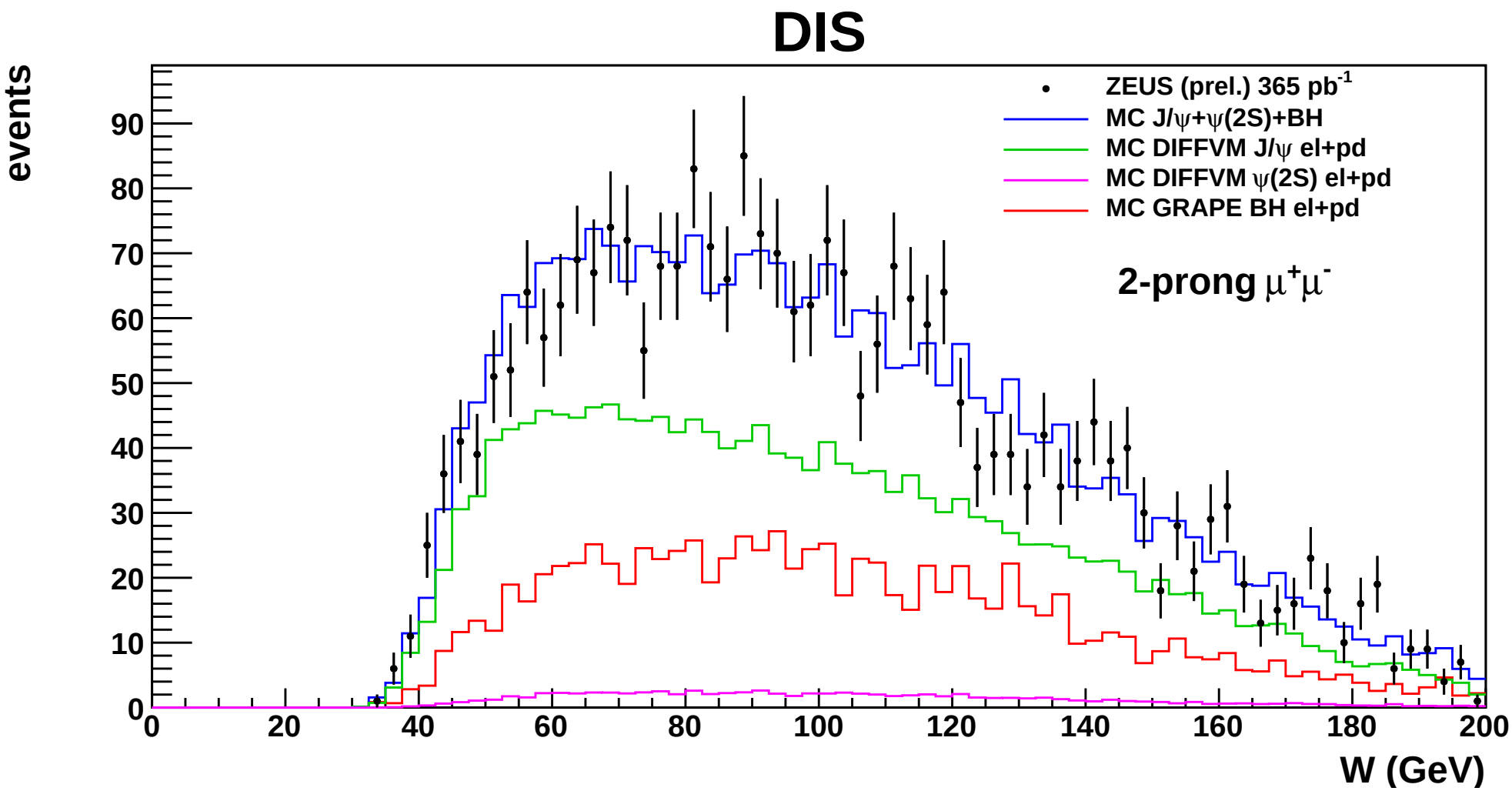
(*) see next page: different signal estimator used
by NK (event counting in mass window) and GG (double Gaussian fit)

DIS: 2-prong, di-muon mass distribution



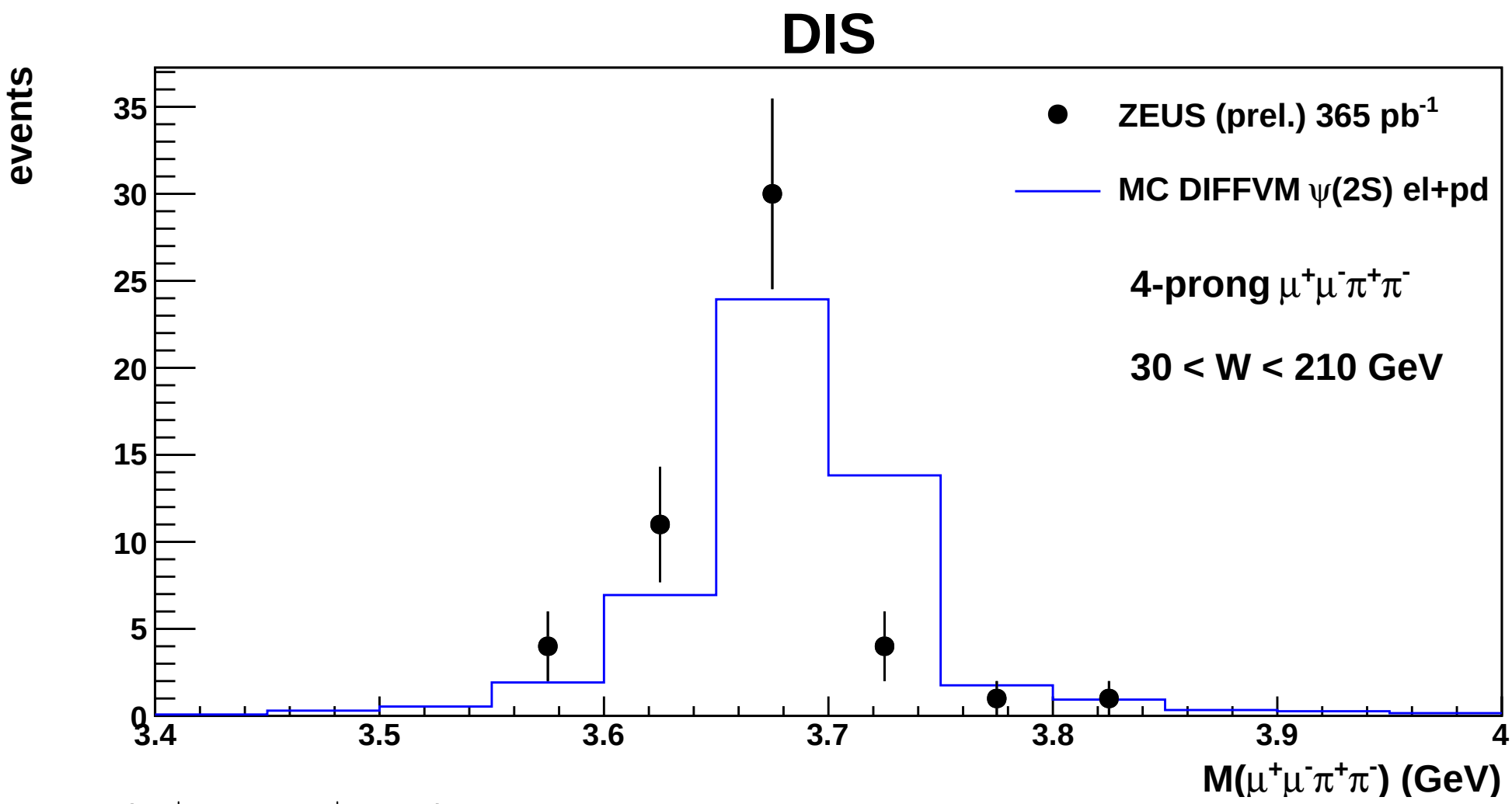
$M(\mu^+, \mu^-)$

DIS: 2-prong, W distribution



$$W = \sqrt{2E_p(E - p_Z)_V - Q^2 + M_p^2}$$

DIS: 4-prong mass distribution



$M(\mu^+, \mu^-, \pi^+, \pi^-)$

acceptance: (DIS): HERA-II ($L = 365$ pb^{-1})

	acc : $N_{J/\psi}$	acc: $N_{\psi'}$: 2-PR	acc: $N_{\psi'}$: 4-PR
NK	0.315 ± 0.003	0.358 ± 0.006	0.152 ± 0.002
GG	0.244	0.264	0.082

- GG: acceptance in MC phase space $Q^2 > 5$ GeV
- 2-PR: ratio of ψ'/ψ acceptances OK
- 4-PR: GG: much smaller acceptance
  (but compatible with smaller number of 4-prong events...)

R: (DIS): HERA-II ($L = 365$ pb^{-1})

	$R_{\psi'/J\psi}$: 2-PR	$R_{\psi'/J\psi}$: 4-PR
NK	0.257 ± 0.053	0.291 ± 0.035
GG	0.192 ± 0.048	0.255 ± 0.036

- NK/GG : Ratios are compatible
  (smaller GG value of 2-prong R due to signal extraction method not adequate for low stat. DIS analysis)
- GG: no 2PR/4PR discrepancy (R_{4PR} even higher then R_{2PR})

Summary/Conclusions/Plans

- DIS 4-prong channel: smaller number of events selected by GG
  $\rightarrow$ got Nataliia's event lists
  (thanks to Ingo for extracting old `/zow` backup !!)
  $\rightarrow$ compare event-by-event which cuts are responsible
- smaller acceptance in all DIS channels
- despite the above:
  no 2/4-prong discrepancy in DIS channel observed
- next steps:
  investigate the influence of muon corrections
  and CTD FLT (track veto)