

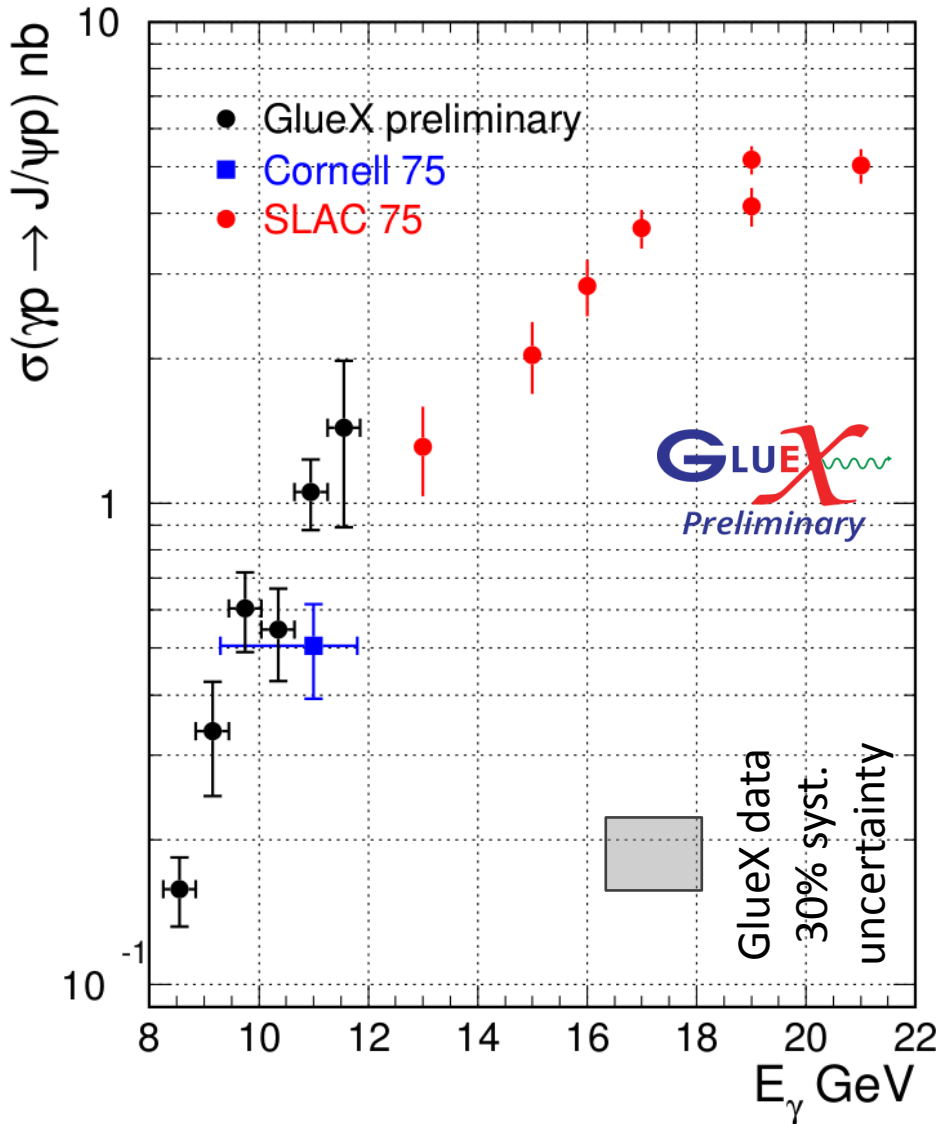
Update on J/ψ cross-section

- Study of the systematics:
 - normalization systematics by comparing the flux normalized yields for BH and J/ψ , for different run periods and reconstruction versions
 - Systematics related to relative (BH/ J/ψ) MC efficiency
 - Pion suppression
 - BH calculations: TCS interference with BH, numerical issues
 - ρ' contribution to the continuum
 - (expecting input from you)
- Path towards publication
 - What's remaining to be done
 - Anticipated timeline

Update on J/ψ cross-section

- Using latest reconstruction/analysis of all the data: sim-recon 2.20.1, REST production ver5 (2016) and ver2 (2017)
- Cross-section normalization to Bethe-Heitler (BH) continuum in 1.5-2.5 GeV invariant mass
- Further improvements: finer (5 MeV) binning, simplified cuts for better modeling (exclude dE/dx cut)

J/ψ cross-section – preliminary results

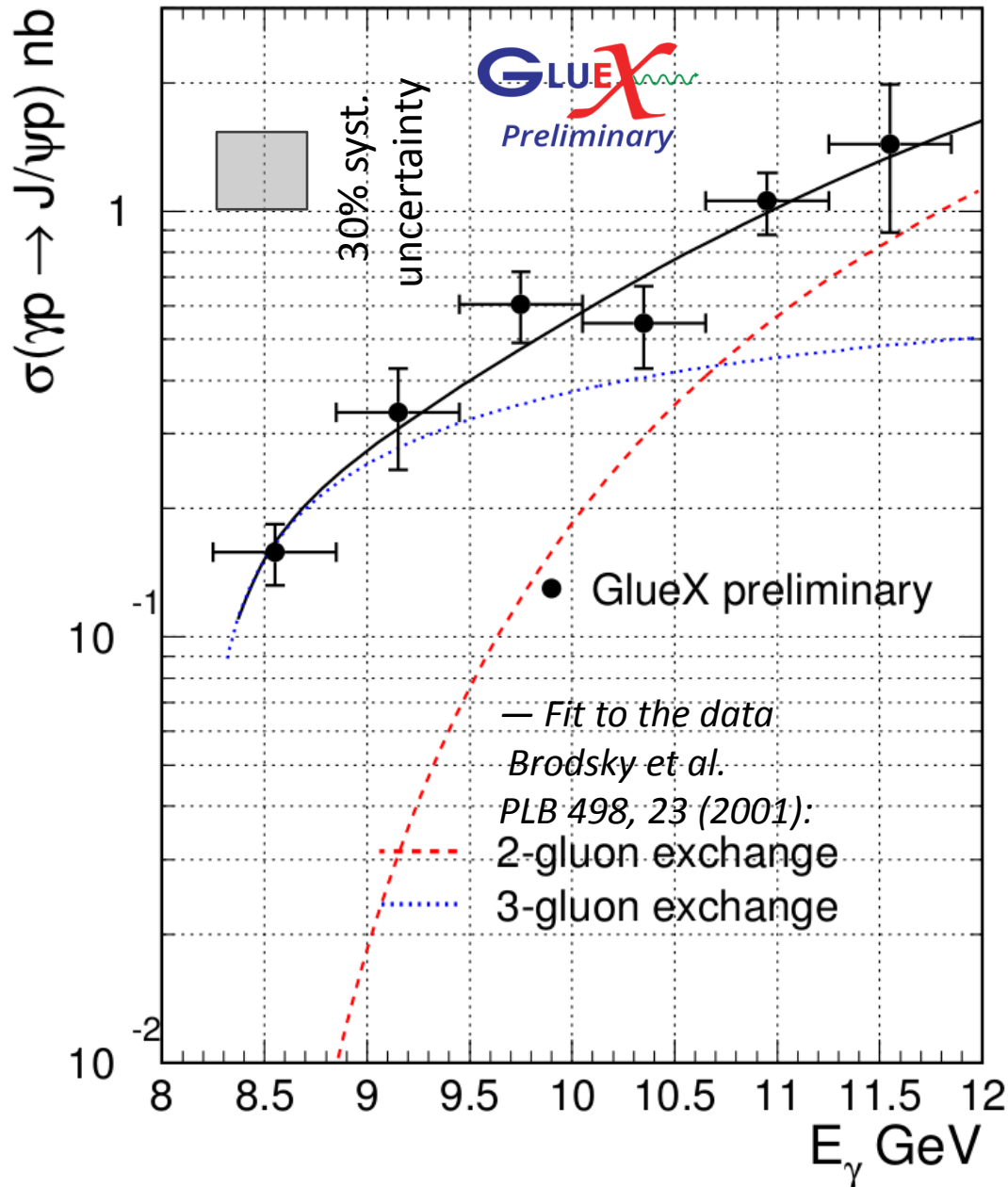


SLAC results calculated from $d\sigma/dt(t=t_{\min})$ using t -slope of $2.9 \pm 0.3 \text{ GeV}^{-2}$ (measured at 19 GeV)

Cornell data:

- t -slope $1.25 \pm 0.2 \text{ GeV}^{-2}$
- horizontal errors represent acceptance

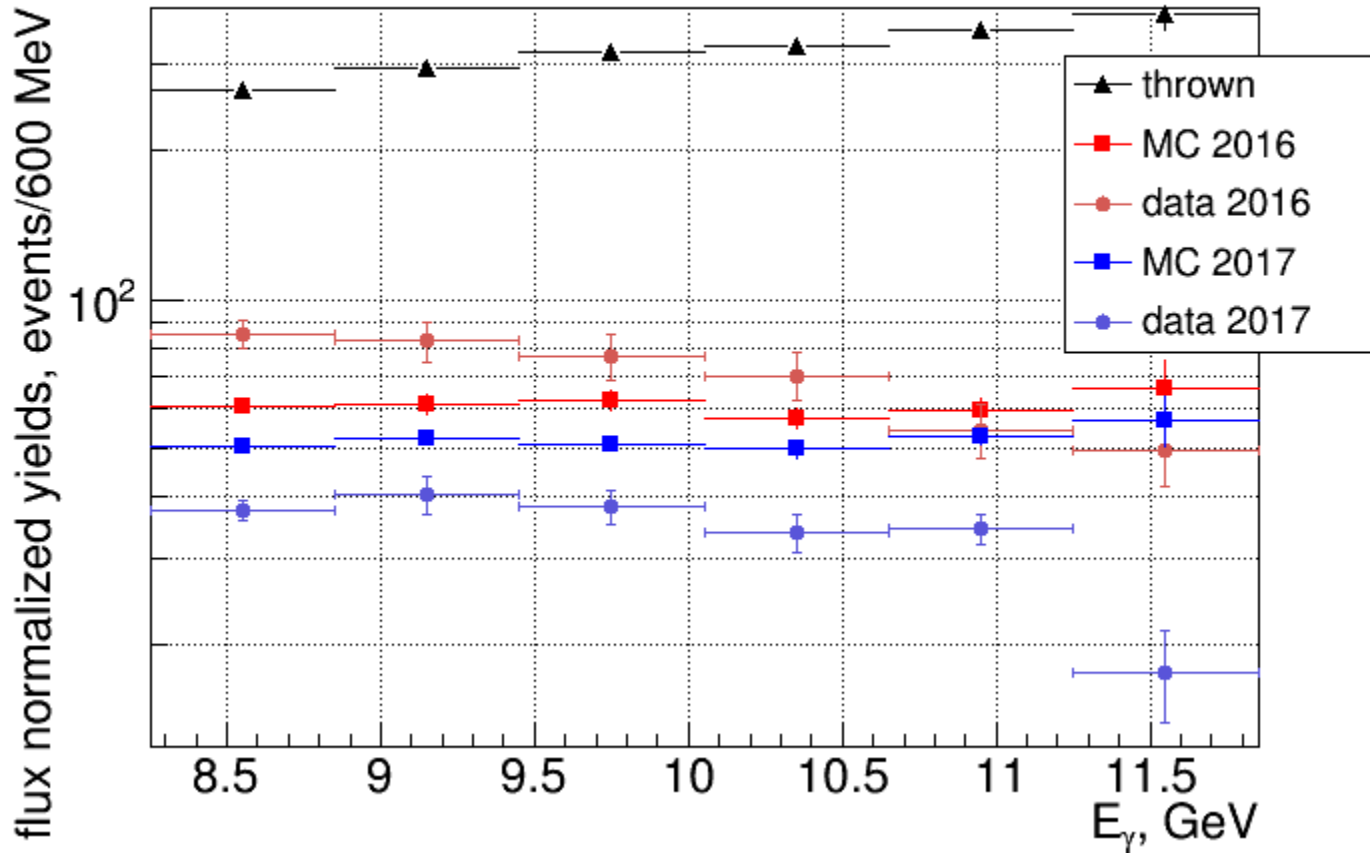
J/ ψ cross-section – preliminary results



- Theory gives only shapes of the curves
- Fit to the data with two parameters - the amplitudes of 2- and 3-gluon exchange
- Data near threshold consistent with 3-gluon exchange

Normalization systematics – BH yields

$1.5 < M(e^+e^-) < 2.5$ GeV

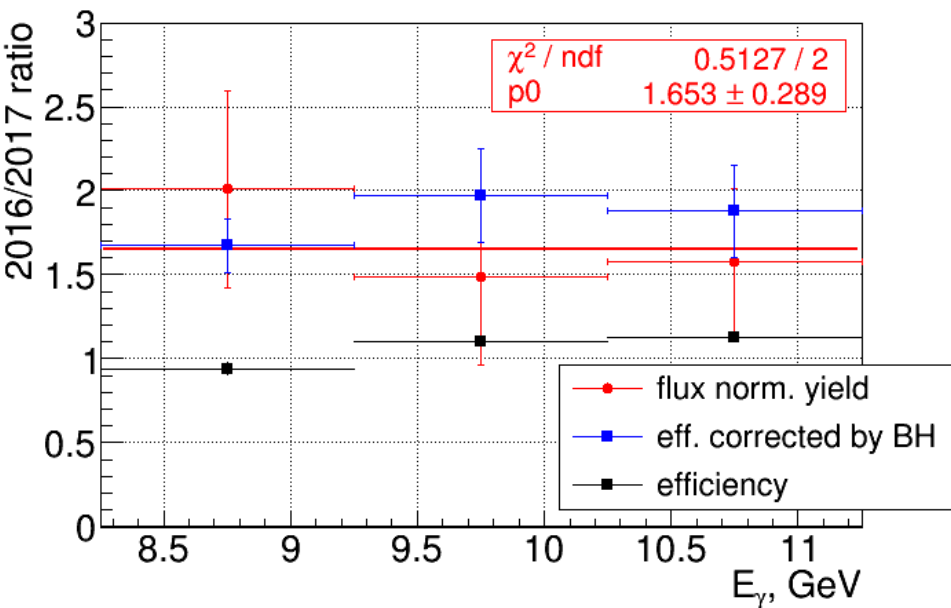


BH yields corrected for π contamination in bins of energy

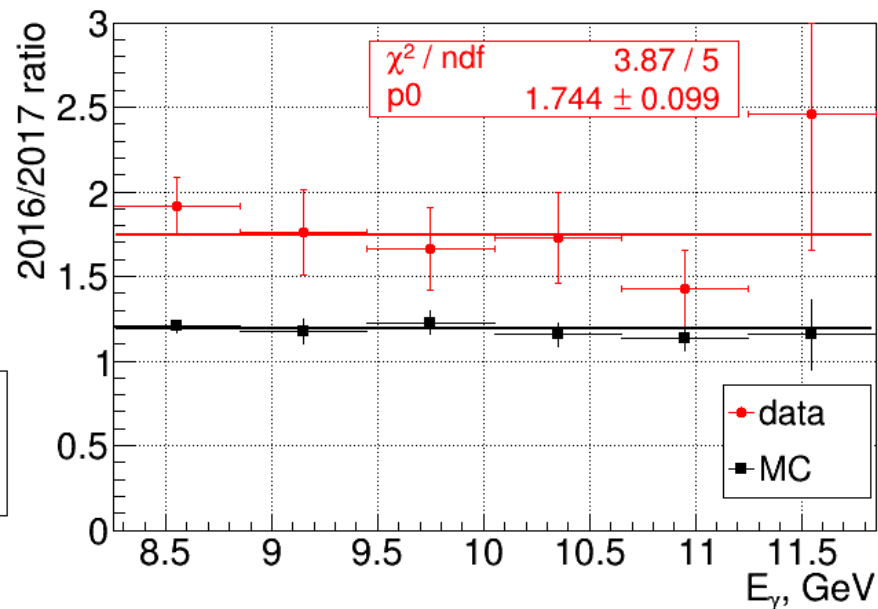
- BH simulations from R.Paremuzyan, based on:
- Berger, E., Diehl, M. & Pire, B. Eur. Phys. J. C (2002) 23: 675.

Normalization systematics – J/ψ vs BH

J/ψ new reconstruction



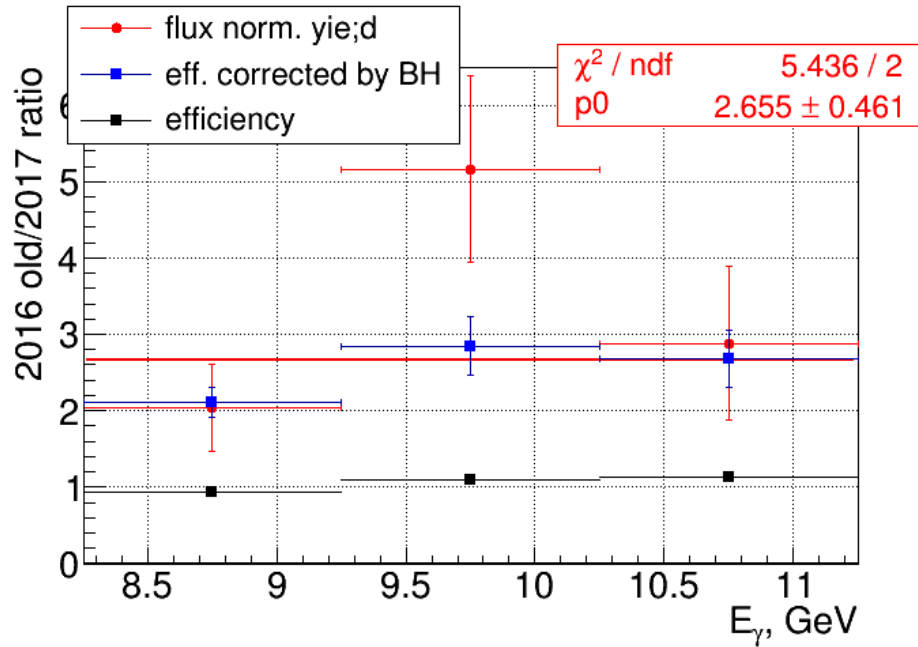
BH new reconstruction



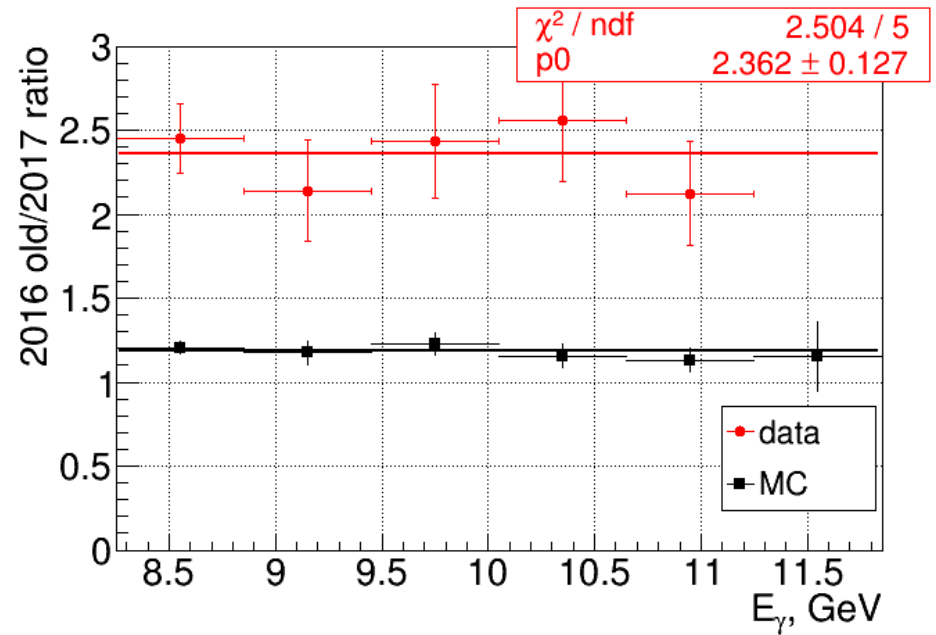
Change of the yields (2016 to 2017) for J/ψ and BH
- same with 18% error (J/ψ /BH=0.95±0.17)

Normalization systematics – J/ψ vs BH

J/ψ old reconstruction

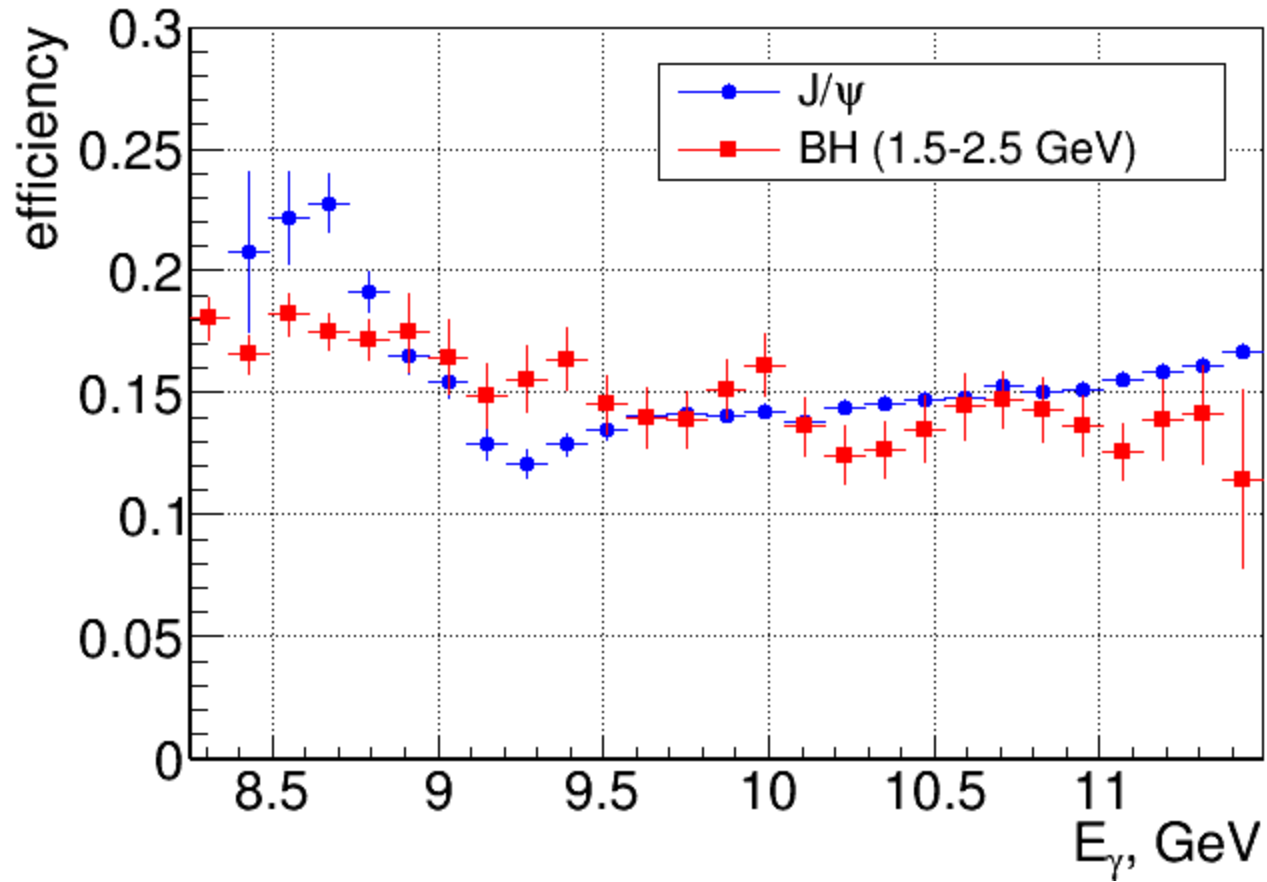


BH old reconstruction

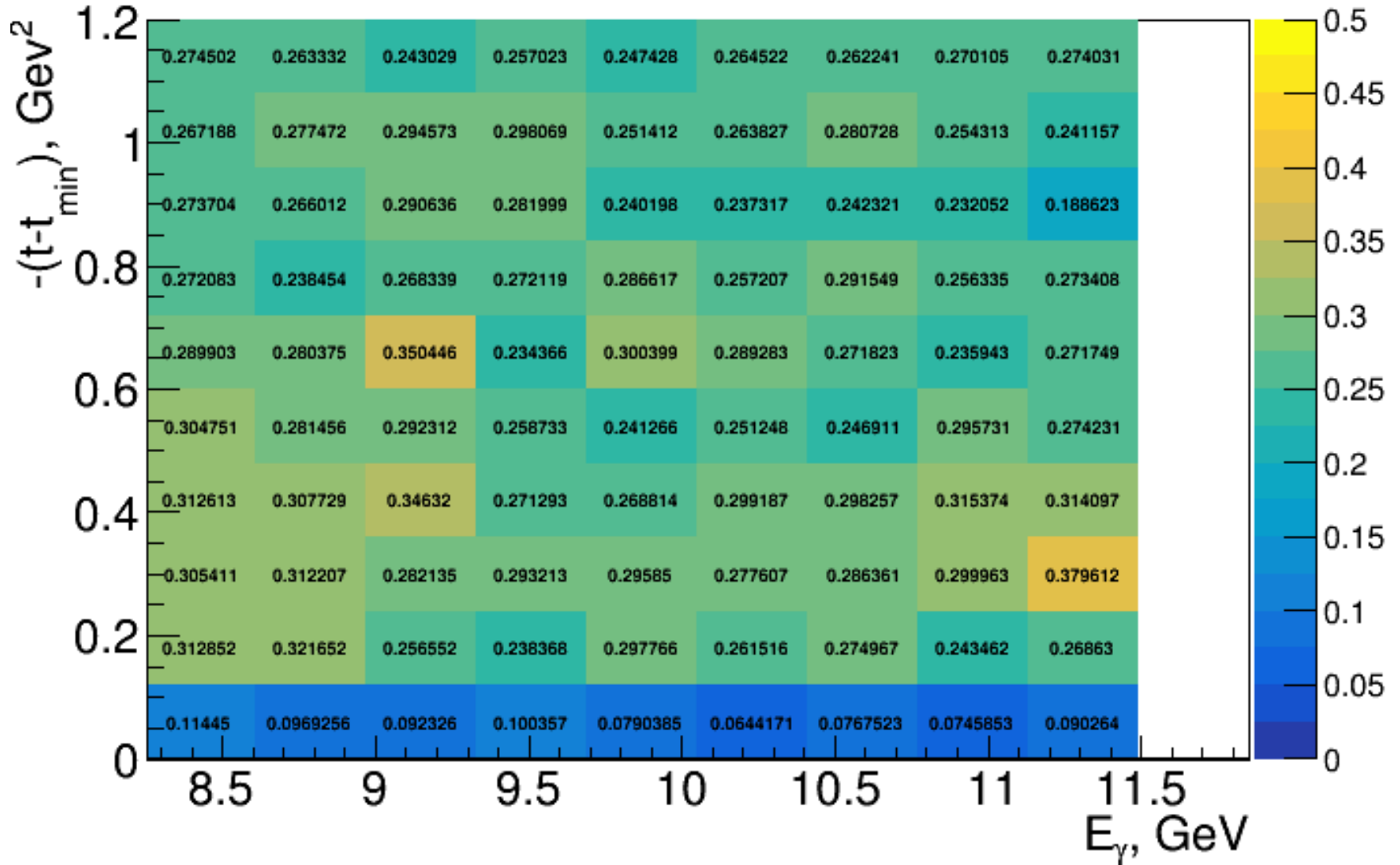


Change of the yields (2016 old recon. to 2017) for J/ψ and B
- same with 18% error (J/ψ /BH=1.12±0.20)

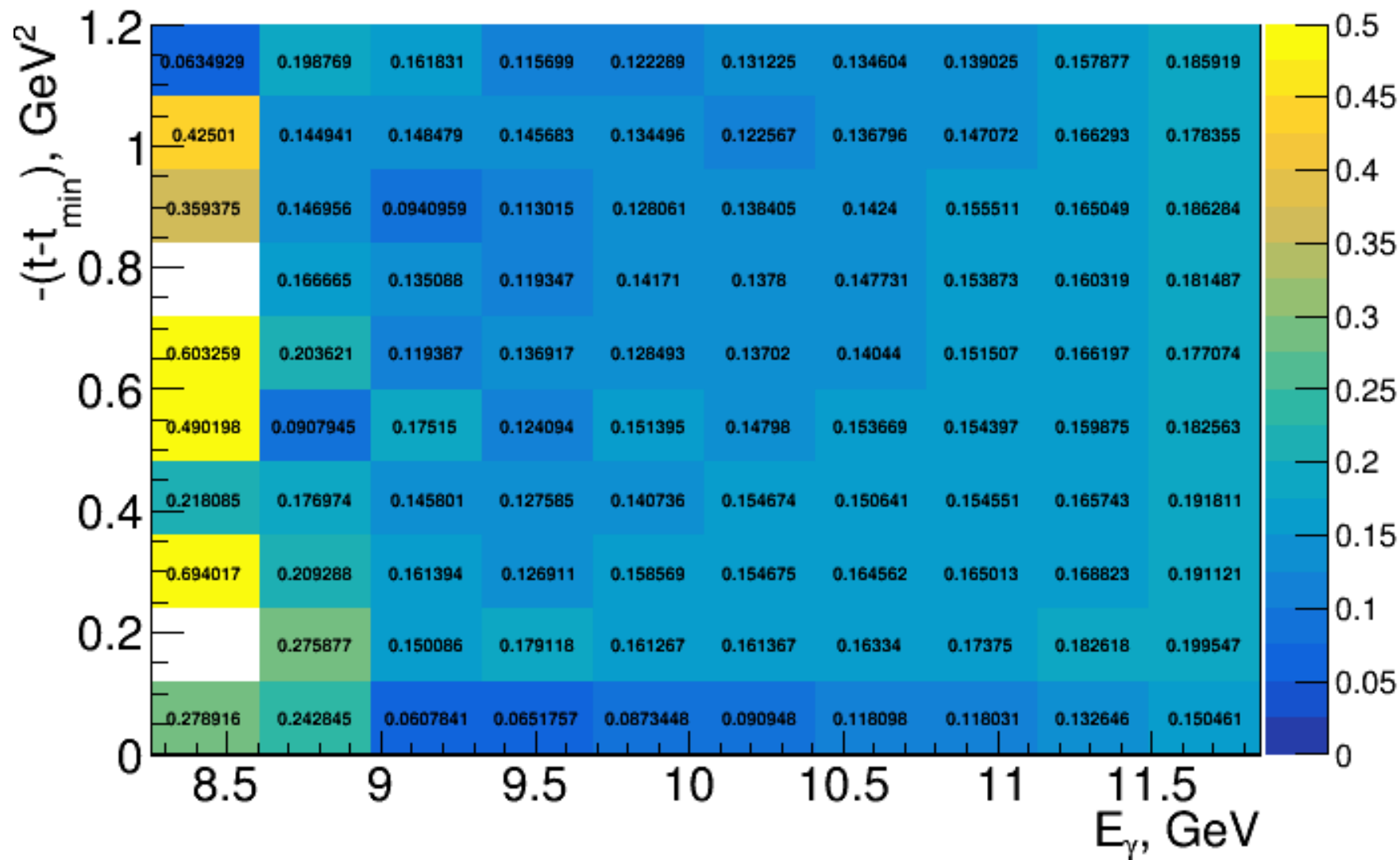
Systematics on BH - J/ ψ relative efficiency



BH efficiency – energy vs t

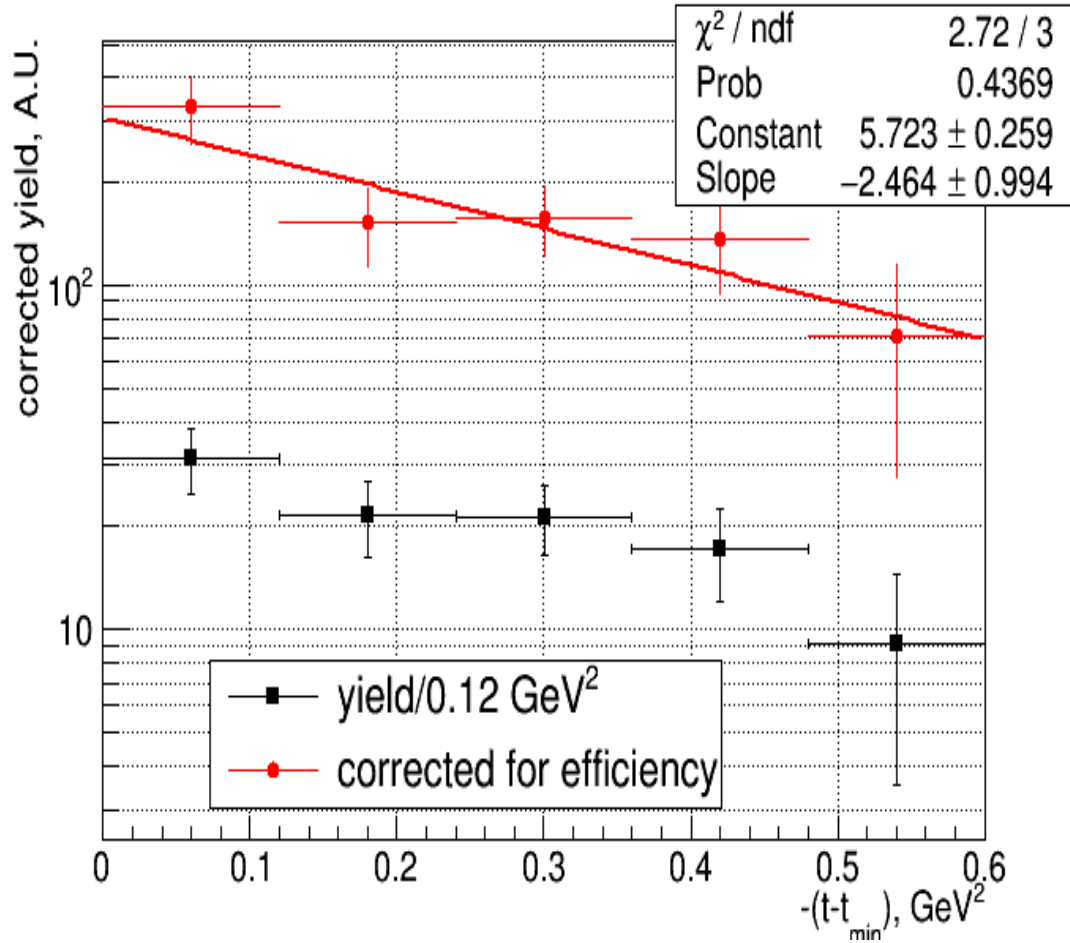


J/ψ efficiency – energy vs t



Systematics on BH - J/ ψ relative efficiency

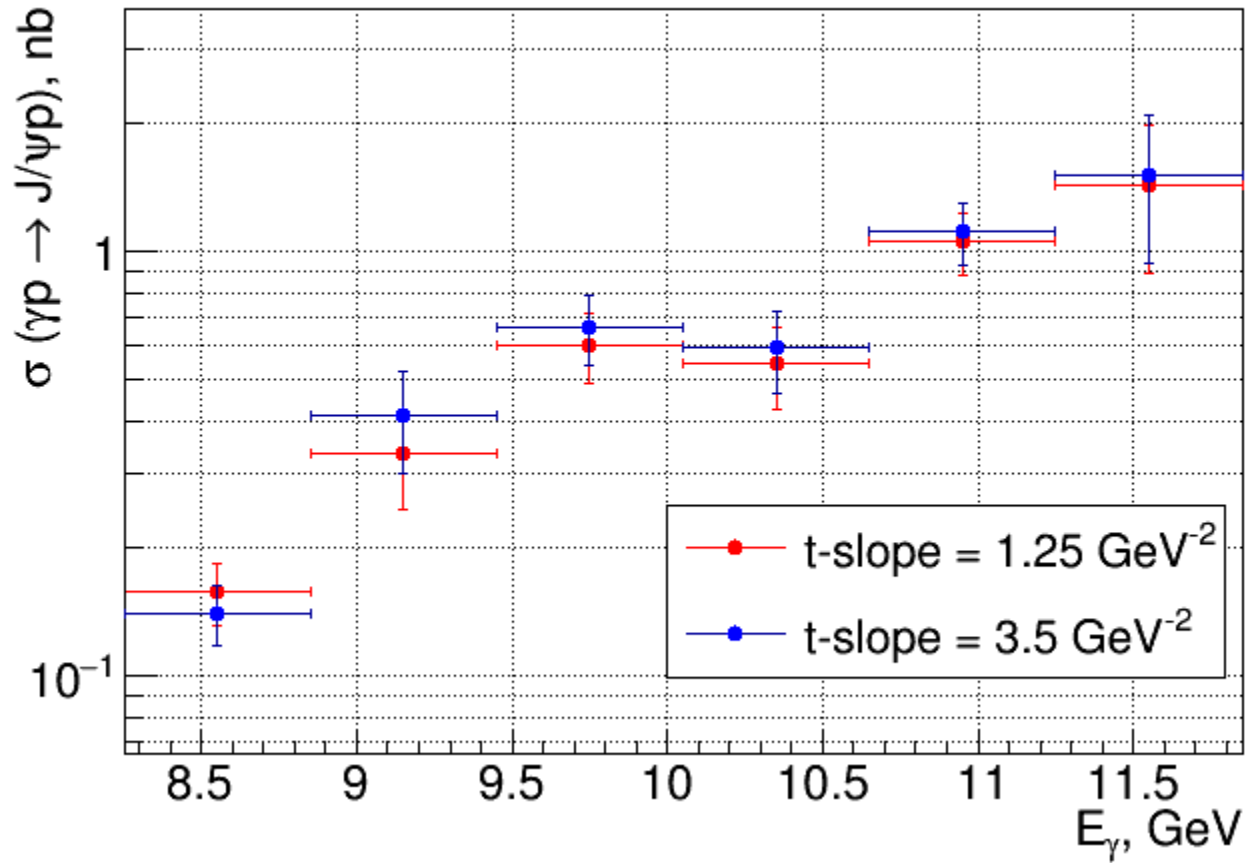
J/ ψ t-dependence corrections (2016+2017)



Cornell: $1.25 \pm 0.2 \text{ GeV}^{-2}$ at $E_g = 11 \text{ GeV}$

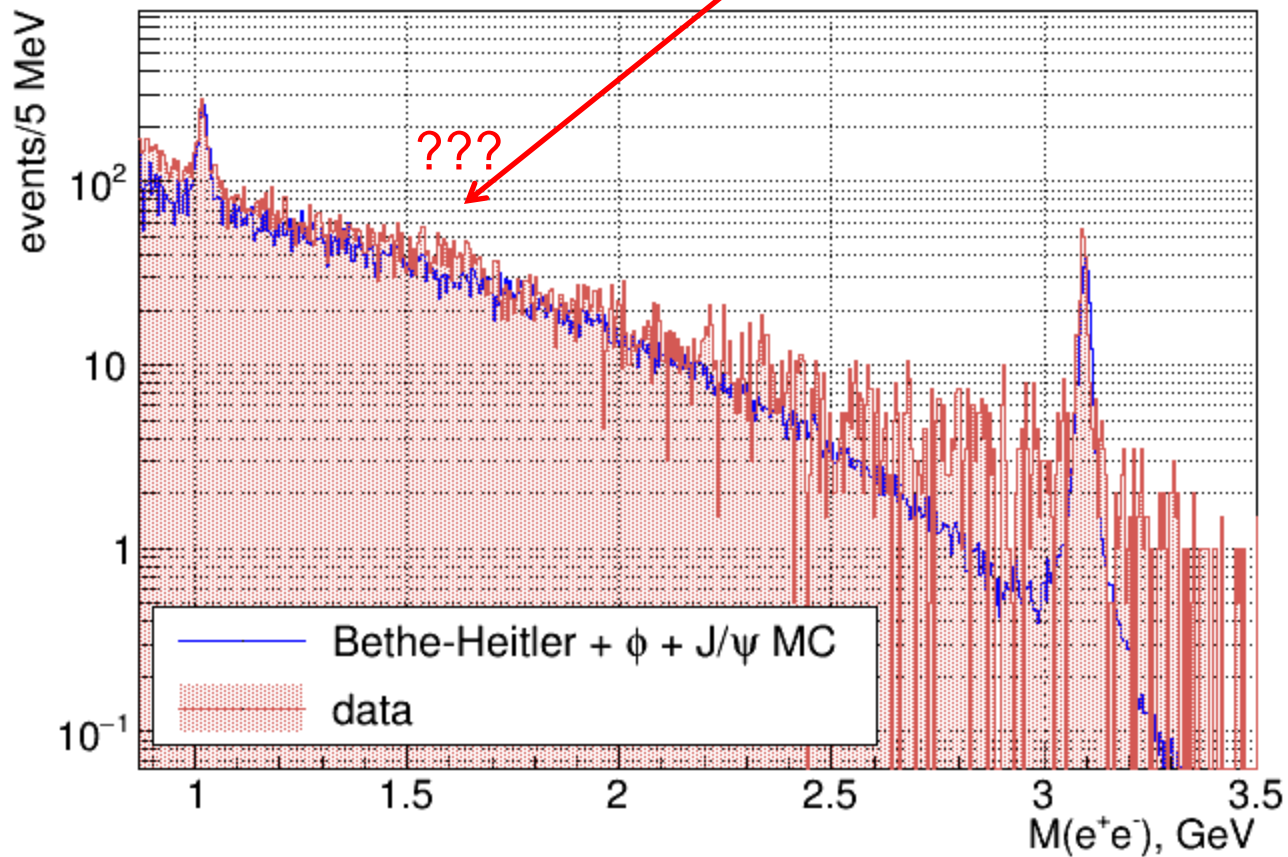
SLAC: 2.9 at $E_\gamma = 19 \text{ GeV}$

Systematics on BH - J/ ψ relative efficiency

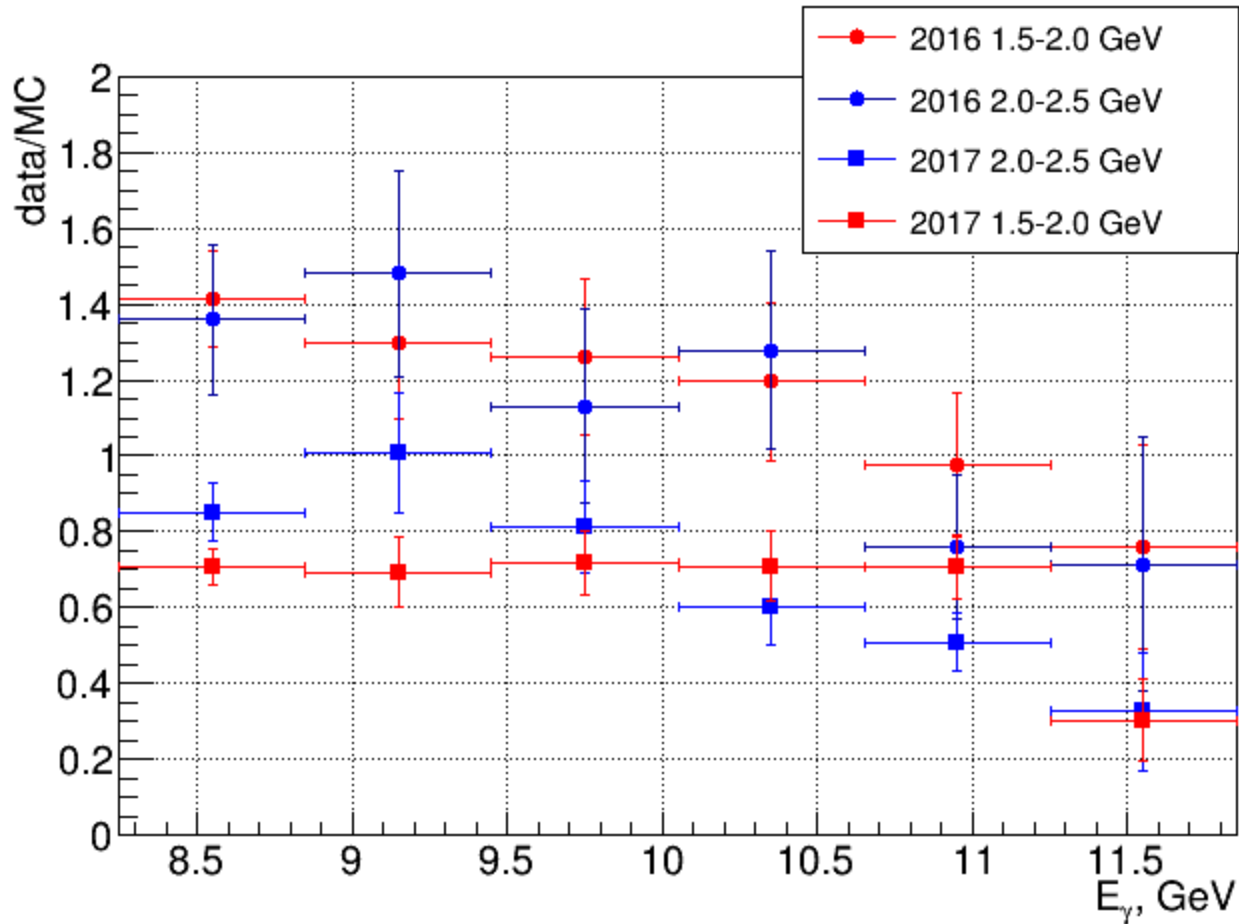


Fit of the absolute deviations gives **9% error**

Systematics on BH – $\rho'(1600)$ effect

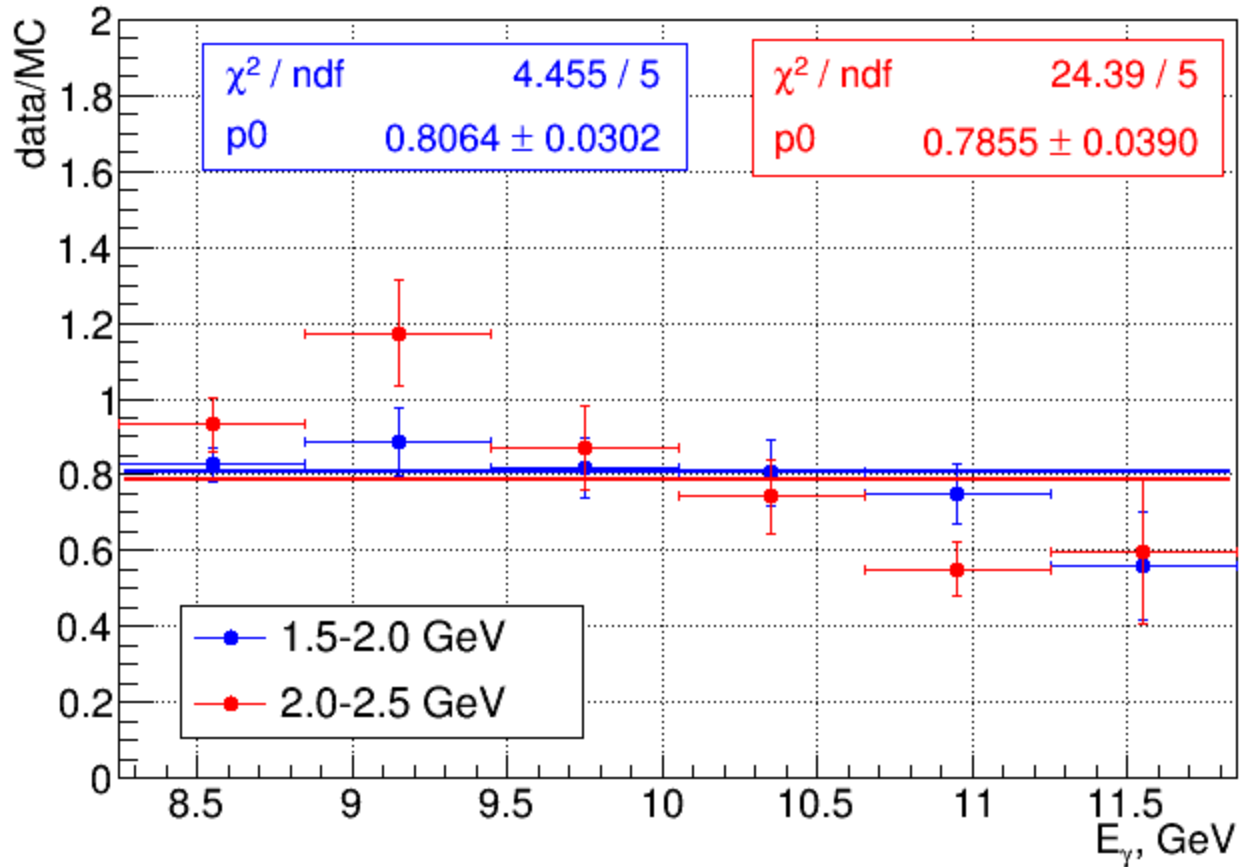


Systematics on BH – ρ' effect



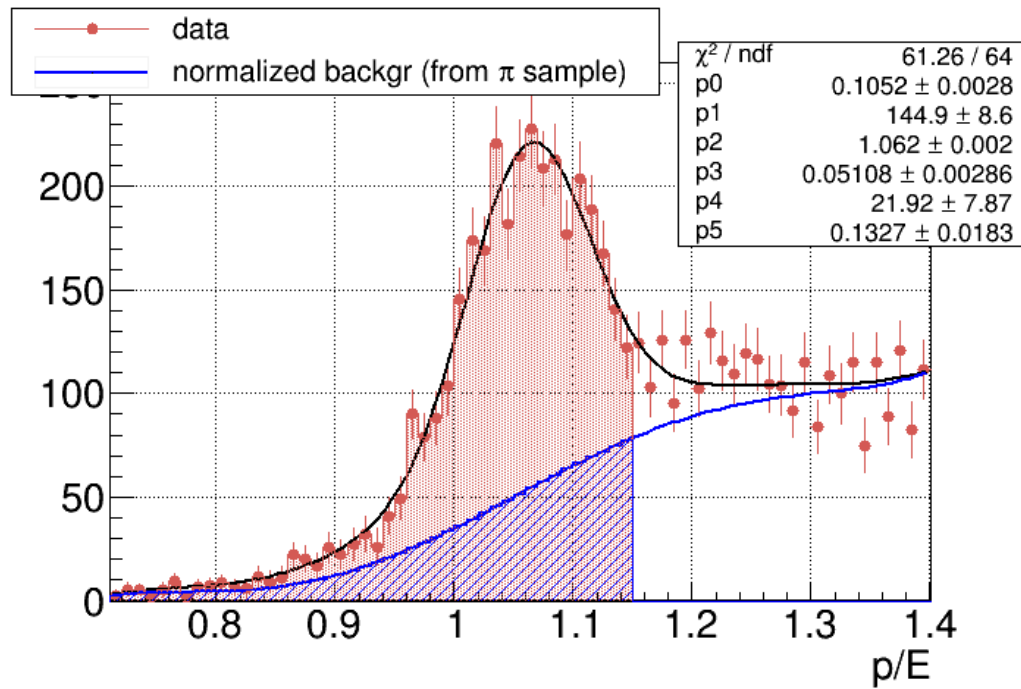
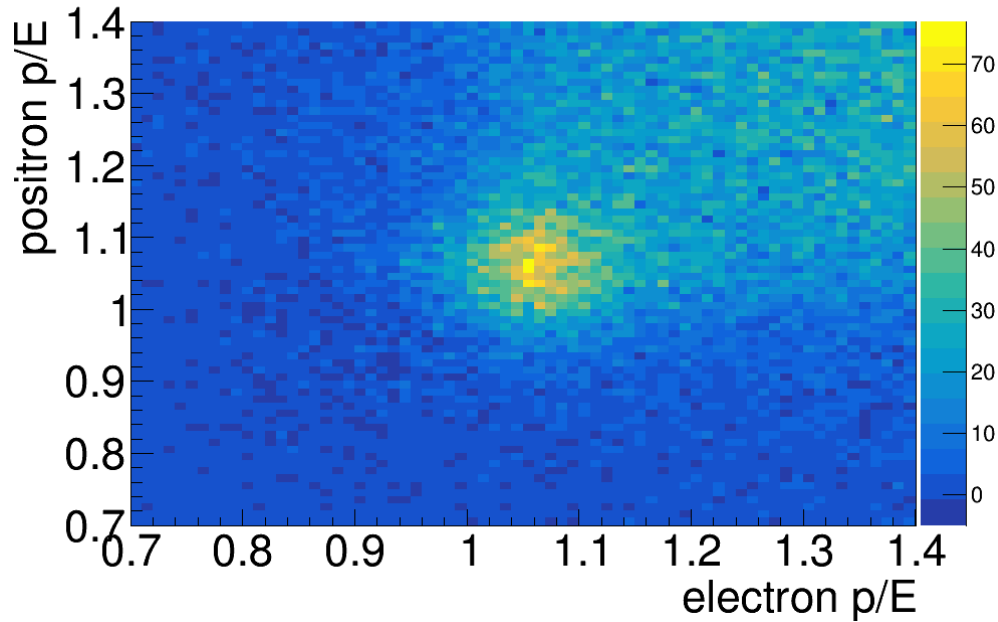
Fit of the absolute deviations gives **9% error**

Systematics on BH – ρ' effect



Ratio = 1.027 \pm 0.049 5% error

Electron/proton separation using p(tracking)/E(calorimetry)



- $36 \pm 1.2\%$ contamination in 1.5-2.5 GeV $M(e^+e^-)$ region with 2σ cut on electrons
- BH yields corrected in bins of energy – percentage slightly varies with energy
- Background shape from pion sample (p/E anti-cuts)
- Contribution to systematics $\sim 5\%$ based on different pion shapes

J/ ψ cross-section - systematics so far

Systematic error from	Estimate (%)
J/ ψ to BH relative yield	18
BH x-section calculations	10
Pion contamination in BH	5
ρ' contribution to BH	5
t-efficiency	9
Total (so far)	23.6

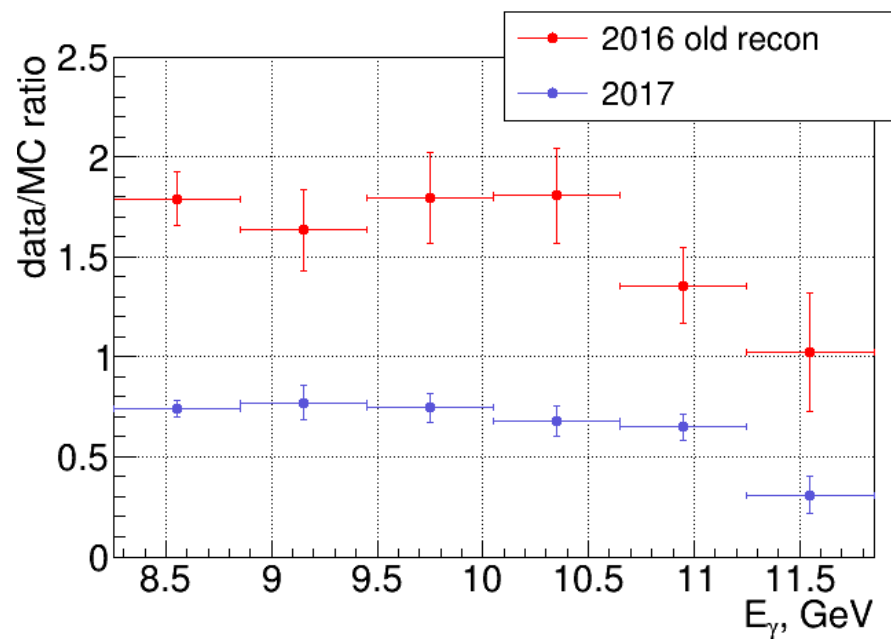
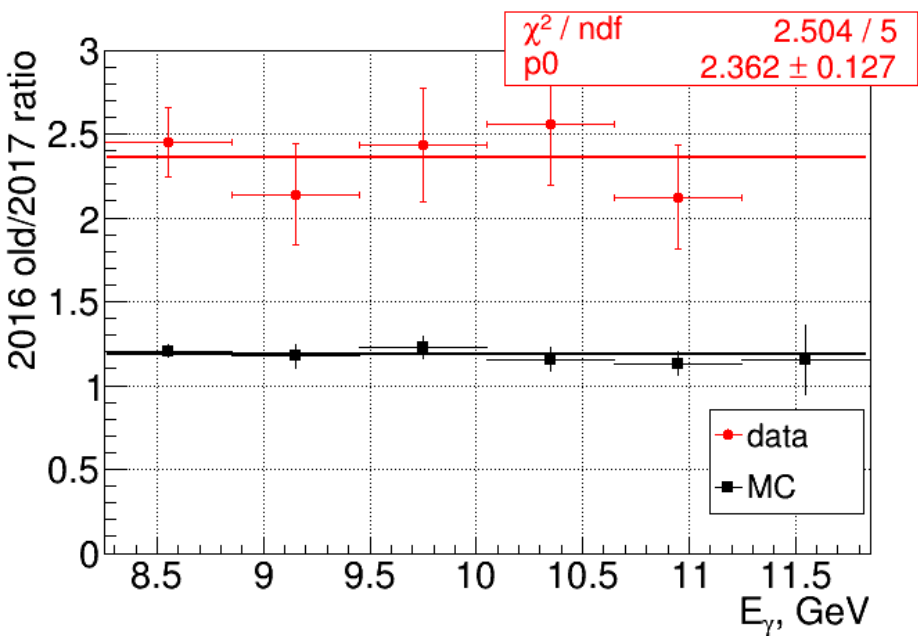
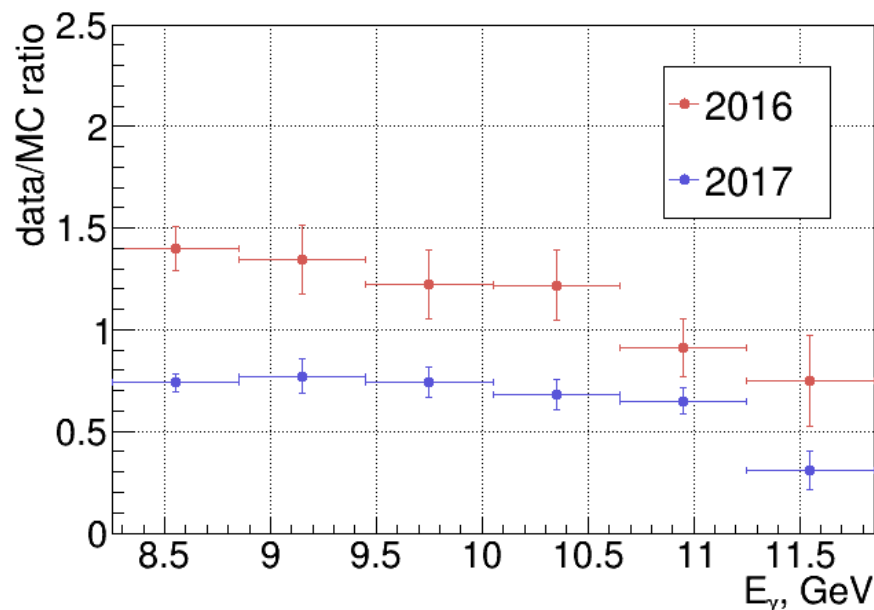
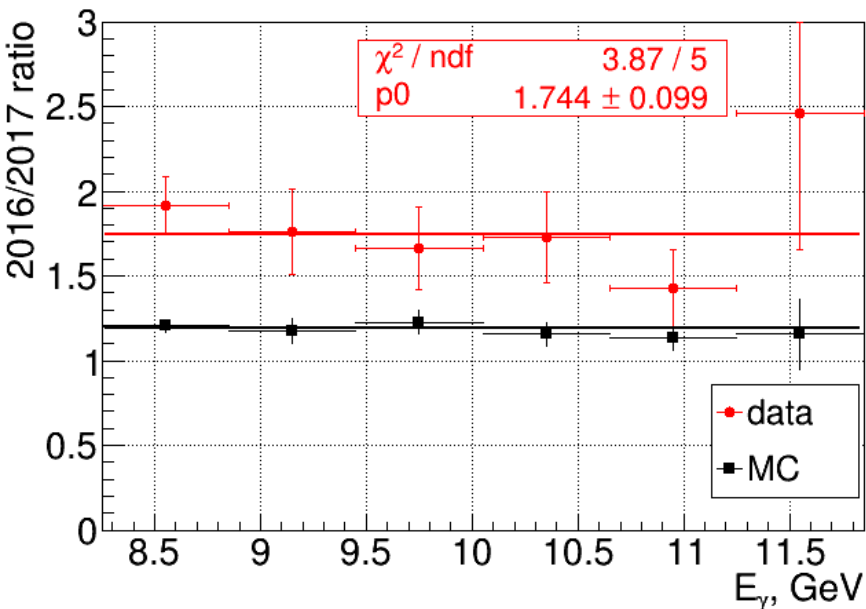
Remaining to be done (my list)

- REST production and analysis of 2016 (first) and 2017 data, using latest sim-recon
- Generate MC sets of data for each period for BH and J/ψ (and ϕ ?) with the latest sim-recon.:
 - For J/ψ with two different t-slopes 1.25 GeV^{-2} (Cornell) and 4 GeV^{-2} (close to BH t-slope)
 - Including Richard's generator for BH
- Repeating the whole J/ψ analysis
- Further work on systematics based on the new results
- Setting limit on pentaquark BR (Sean, Alex A.)
 - Procedure with bins
 - Unbinned analysis:
 - so far JPAC model implemented (Alex A.), need to add flux and efficiency to the pdf
 - how to take into account background (accidental, physics etc.)?
 - effect of the t-channel model (JPAC) might be significant – need other models, but how to take into account s/t-channel interference
- Writing the analysis notes (in parallel)
- Writing the paper (in parallel)

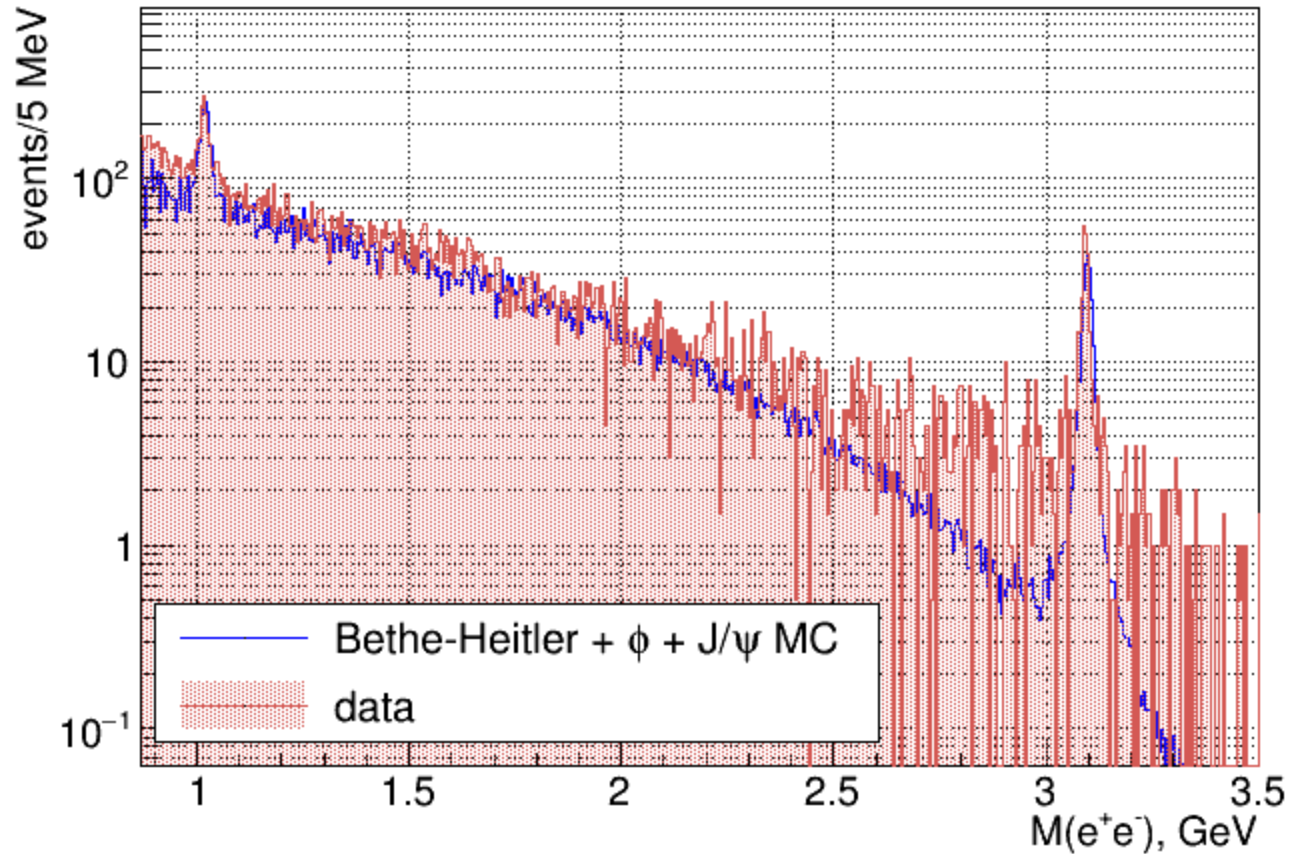
Timeline

- Finishing REST production and analysis launch by the end of August (fall 2018 run starts at that time!)
- Results ready by end of September
- Analysis notes and paper ready by end of October and submitted to the review committee
- Paper submitted for publication by the end of the year

Flux normalized yields (BH)

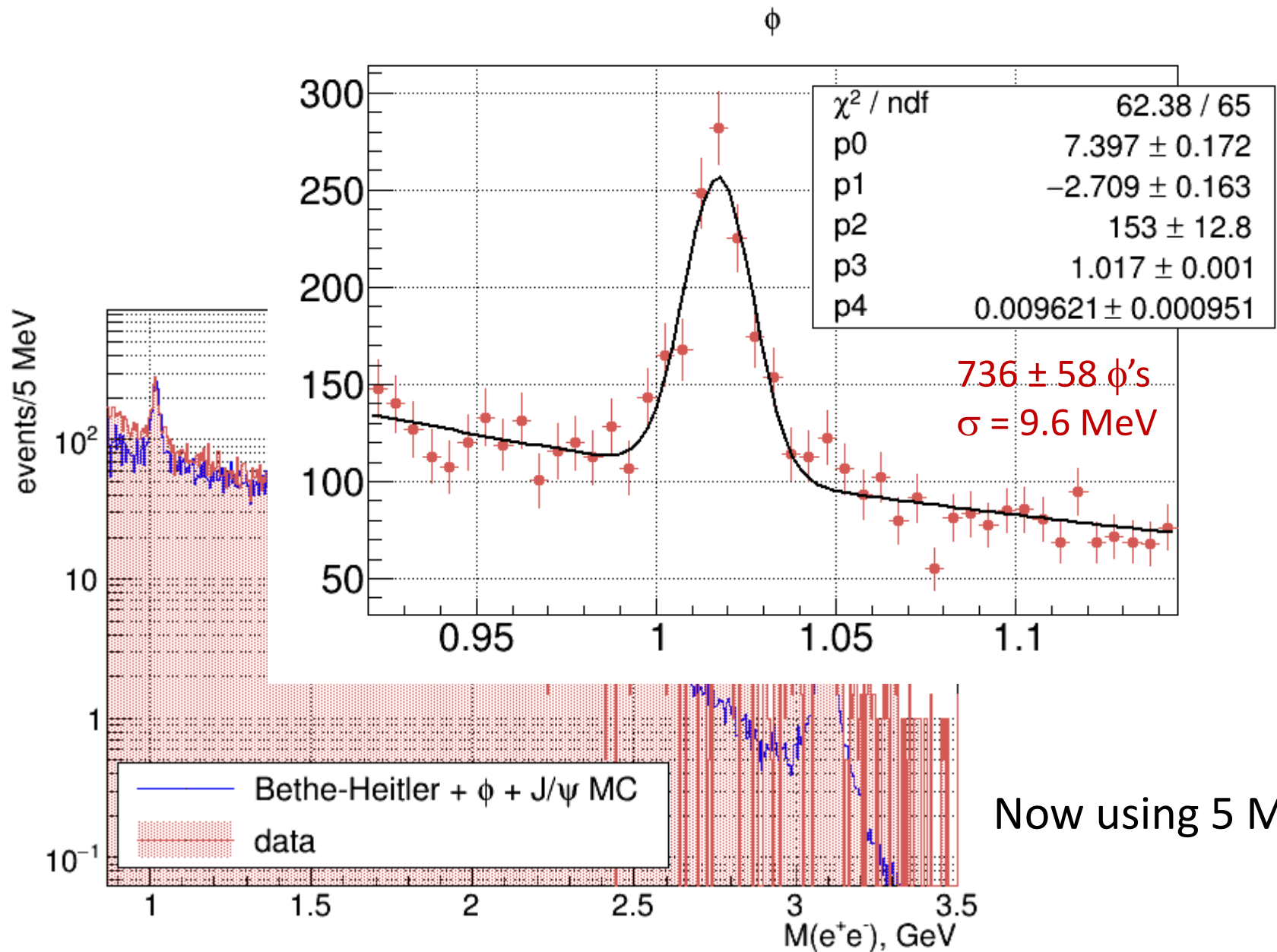


Invariant mass spectrum



Now using 5 MeV bins

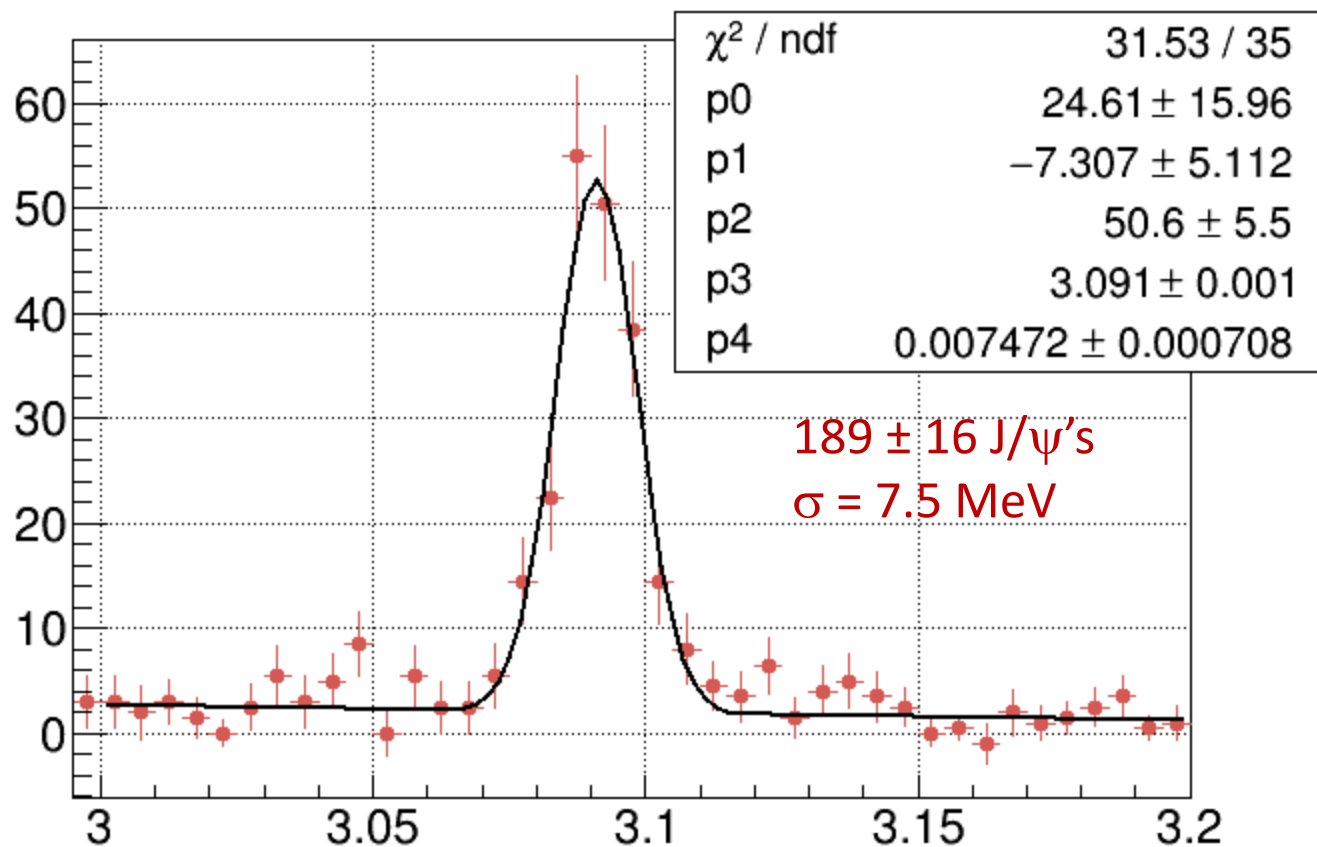
Invariant mass spectrum



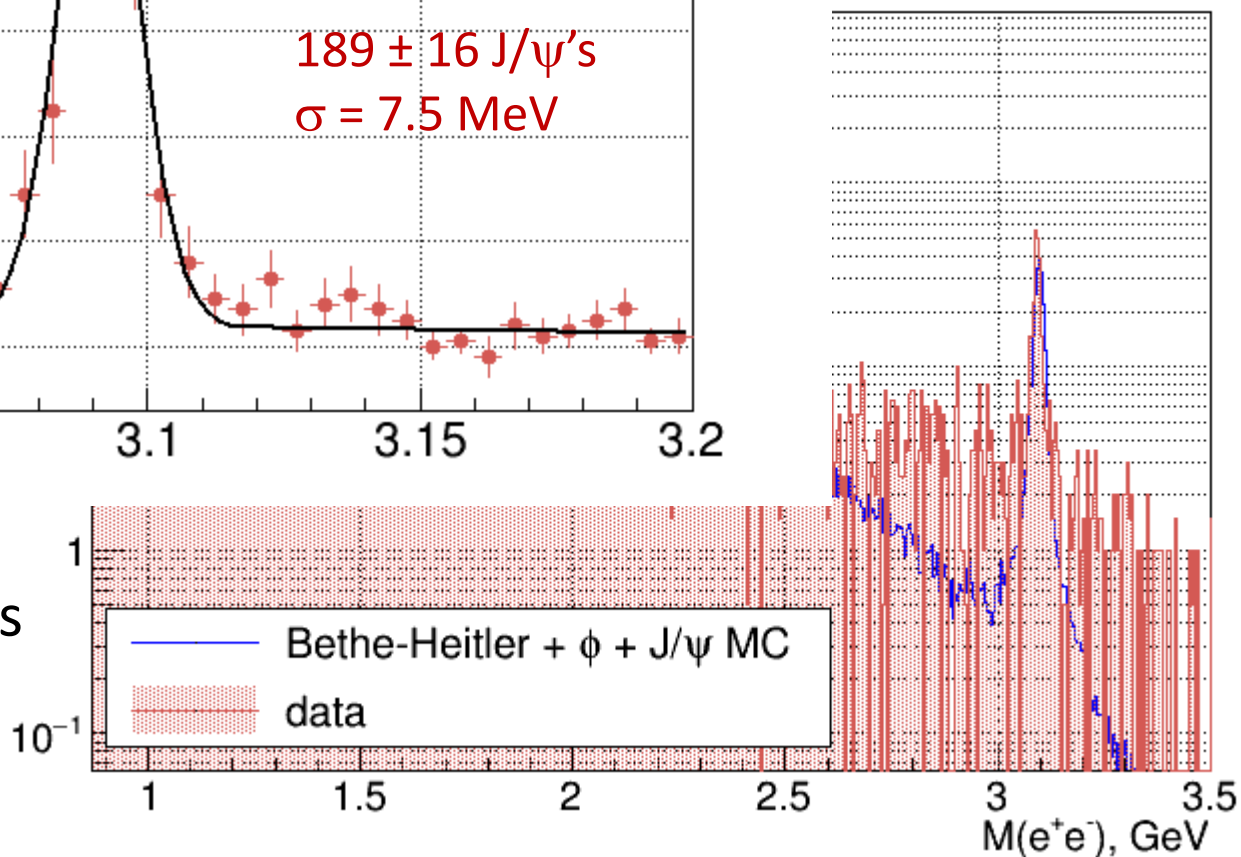
Now using 5 MeV bins

Invariant mass spectrum

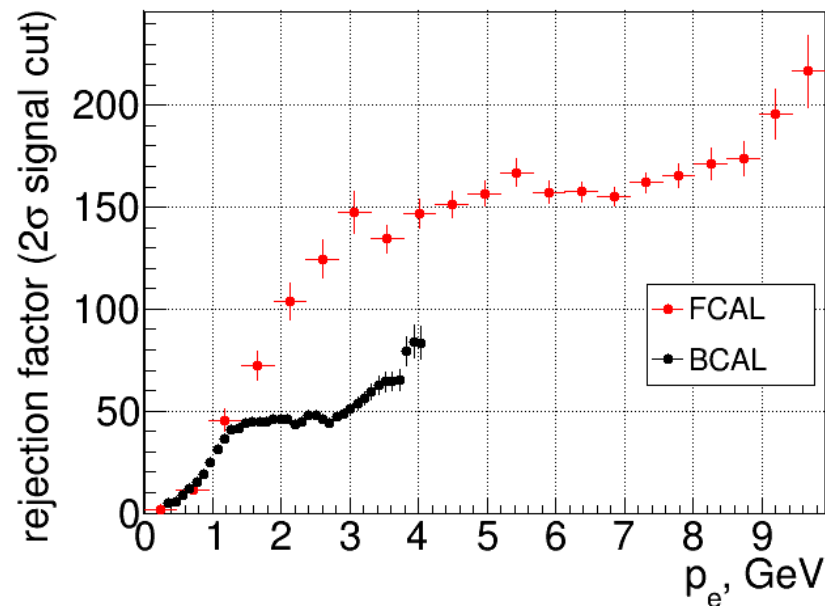
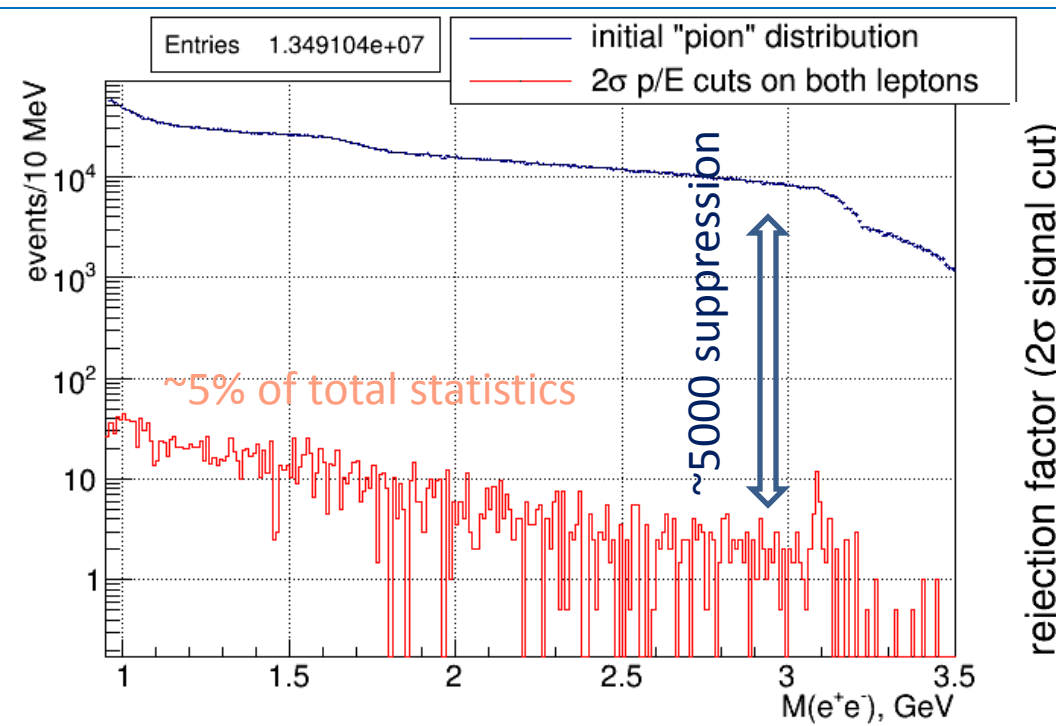
J/ ψ



Now using 5 MeV bins



Electron/proton separation using p(tracking)/E(calorimetry)



- Suppression factor of ~ 5000 by p/E cuts only
- Different for BCAL and FCAL; depends on energy