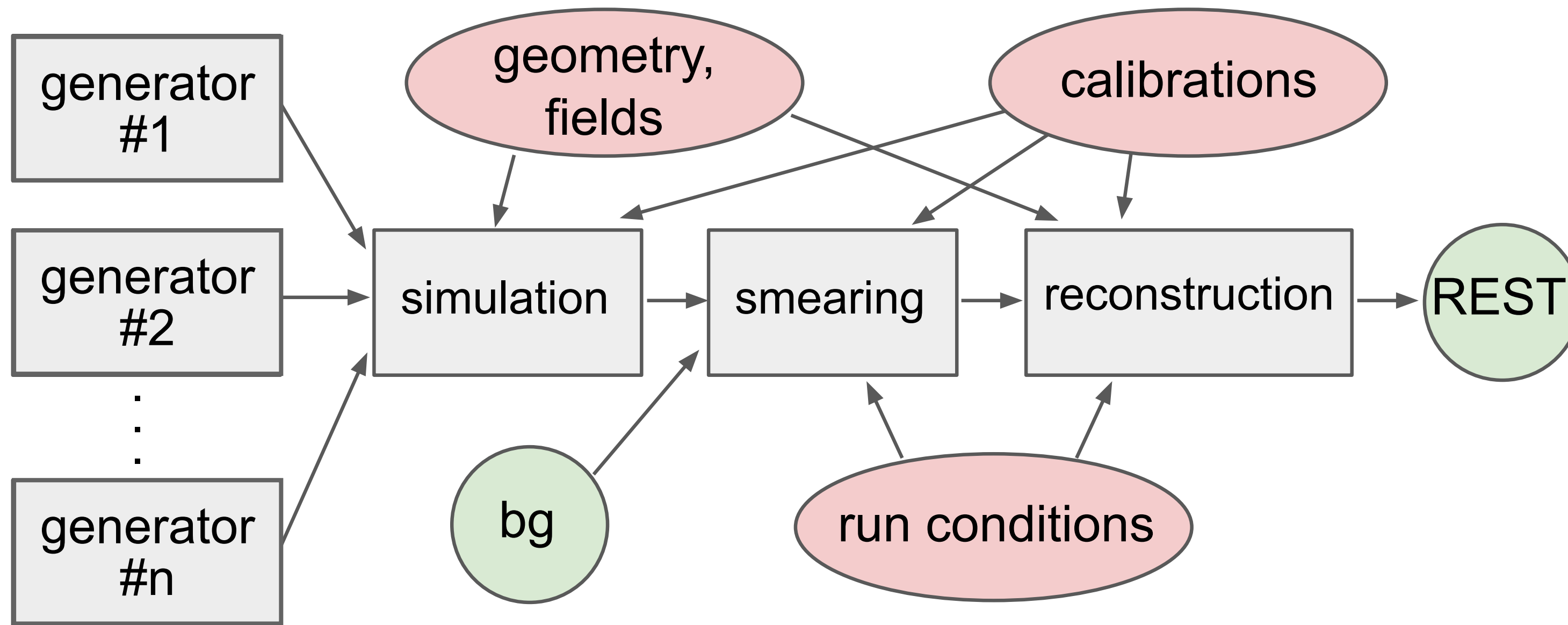


# Monte Carlo Production Using gen amp V2

Kevin Saldaña



# Motivation



- Detector efficiency, amplitude fits, understand signal/background contributions
- Include physics processes: t-slope, energy dependence, angular distributions, etc.
- Occurs in the generation step.....

# Motivation Cont.

## Generators

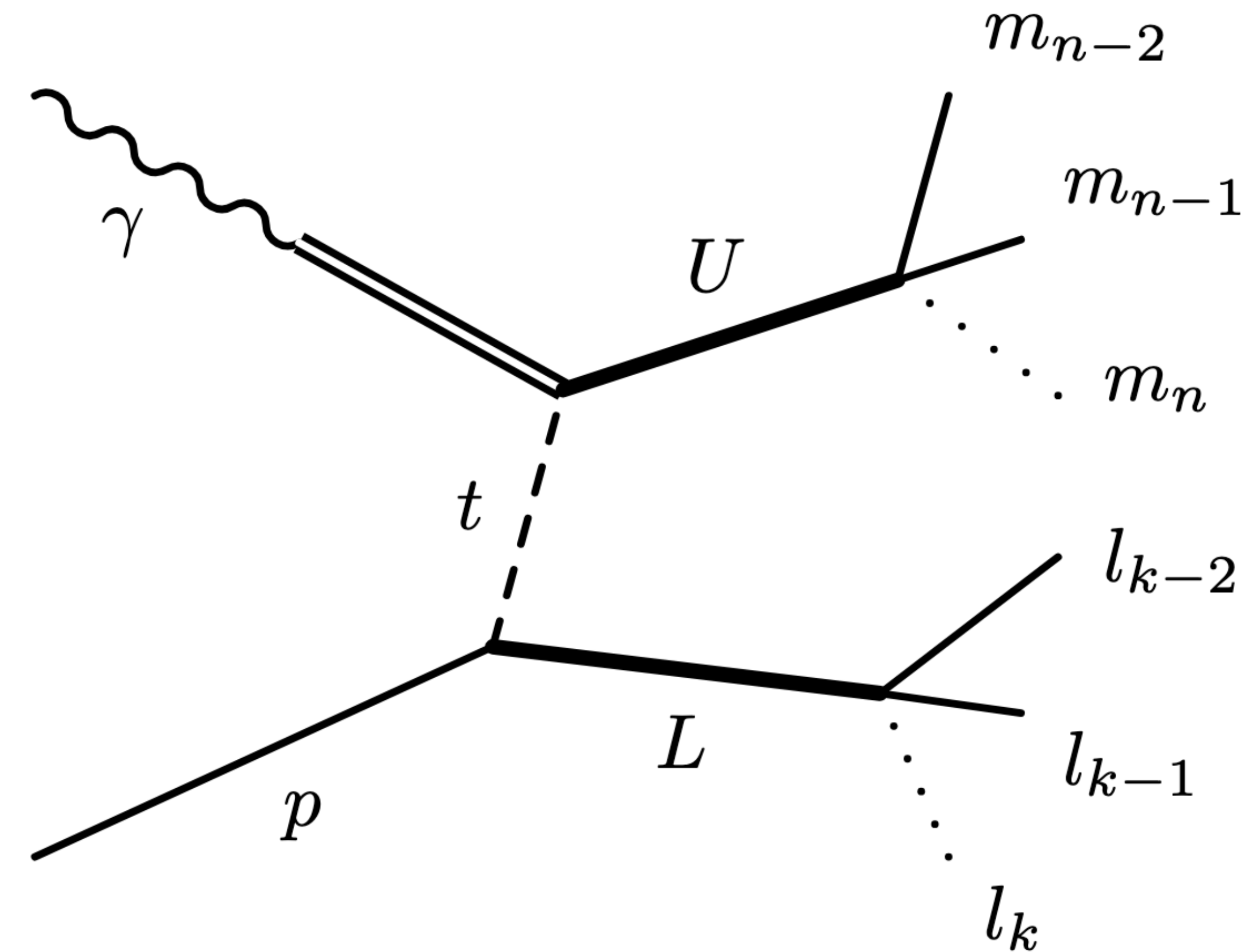
- Variety of generators to fit your purpose.
- Requirements:
  - Config file
  - Initialize parameters
  - Include arguments
- This tutorial will give an example to generate a sample using gen amp V2.





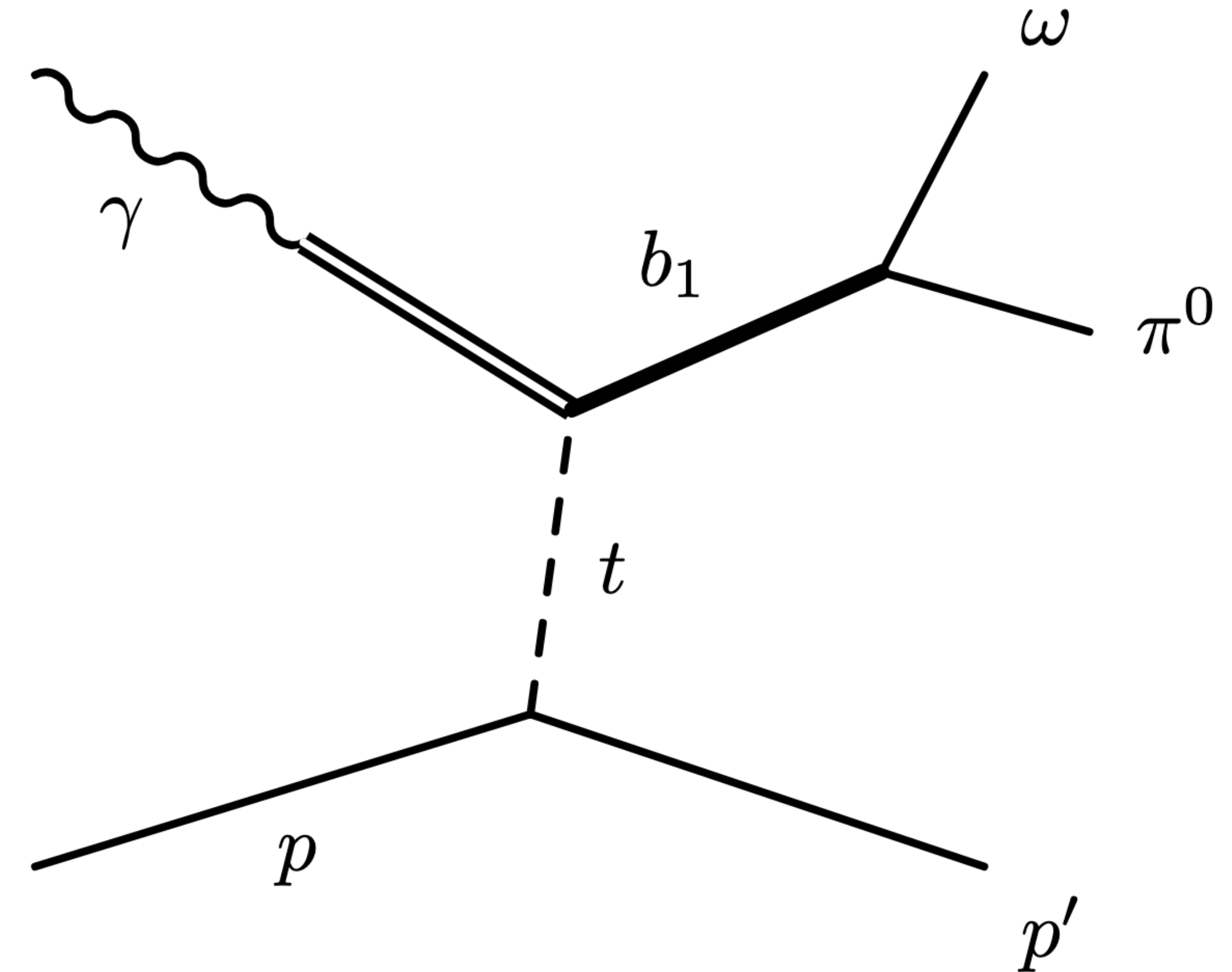
# Gen amp V2

- Phase space (**PS**) generator with AmpTools compatibility for amplitude analysis.
- Series of sequential two-body decays ( like most GlueX generators ).
- Dependence of upper/lower (**UV/LV**) vertex and momentum transfer **t**.
- Importance sampling for included physics.
- Weights included for **dependencies** to get **PS** distribution.



# Example: $\gamma p \rightarrow b_1 p \rightarrow \omega \pi^0 p$

- Generate (PS) MC for analysis.
- Flags are used in either the first commented line in the config file (MCWrapper) or used on the command line
  - Ability to generate PS by switching off accept/reject stage using -f
  - Add t slope similar to data using -t flag
  - Important sampling around resonance with -uvBW/lvBW flag
- Use diagnostic/output file to check configuration

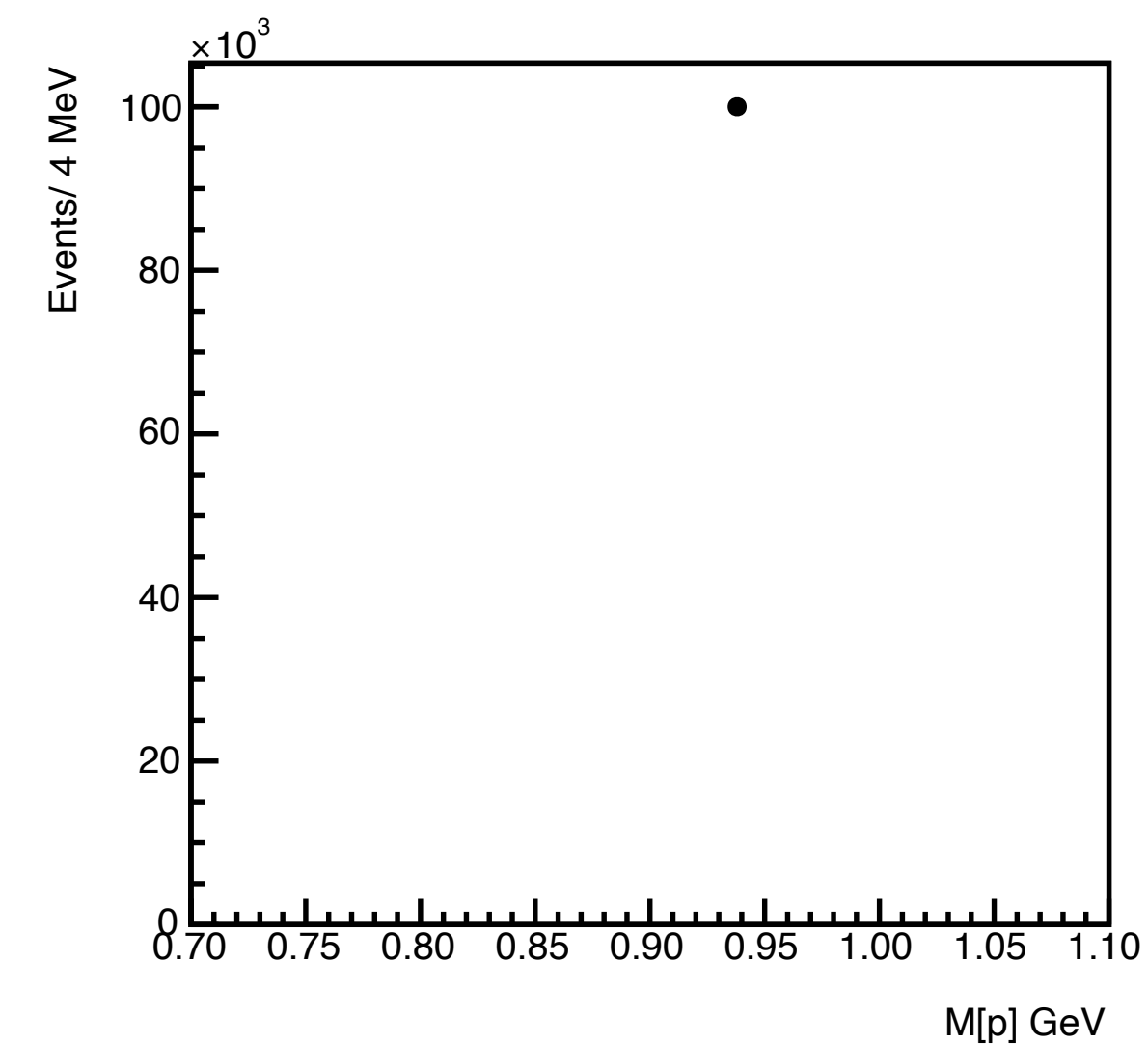
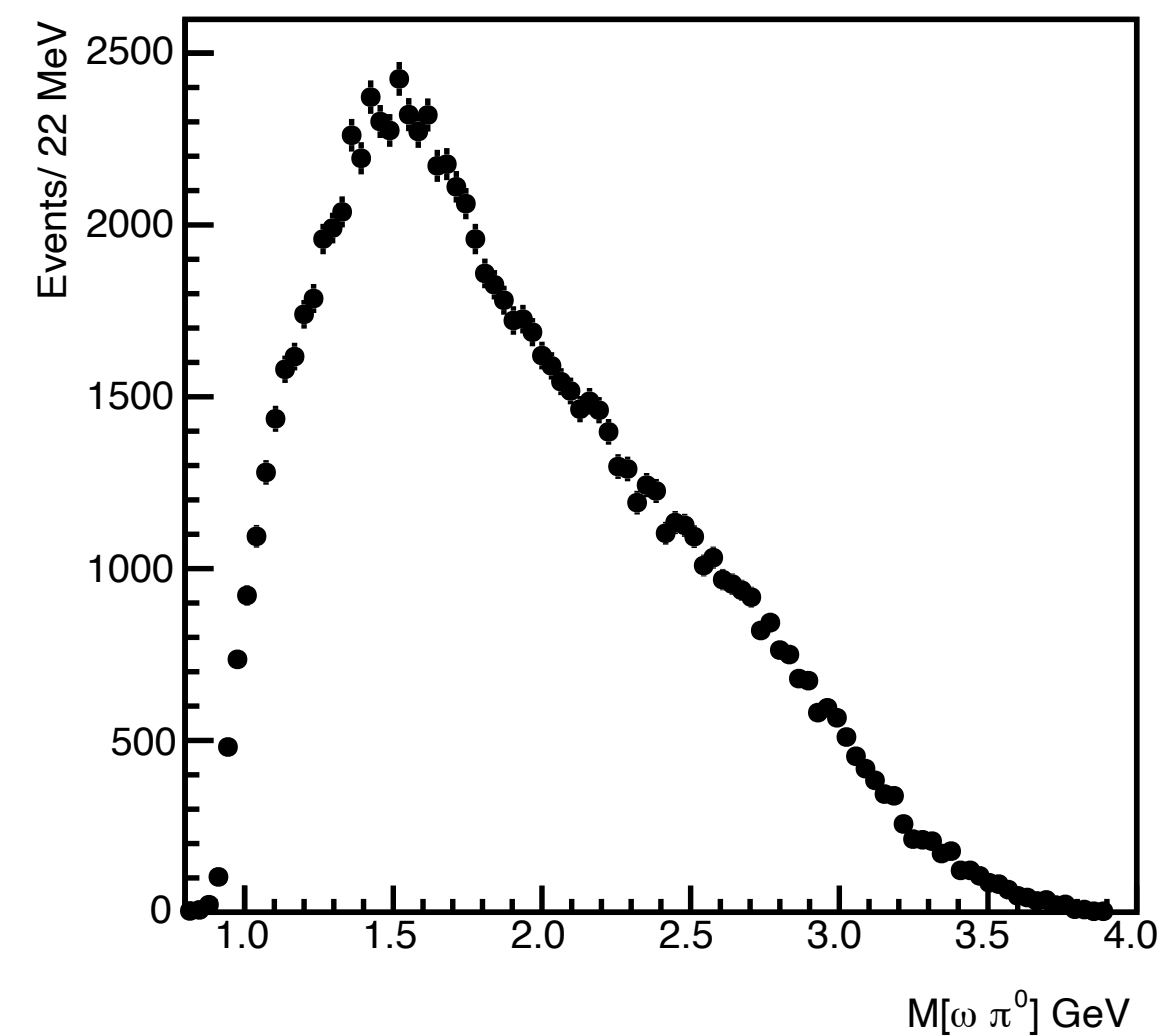
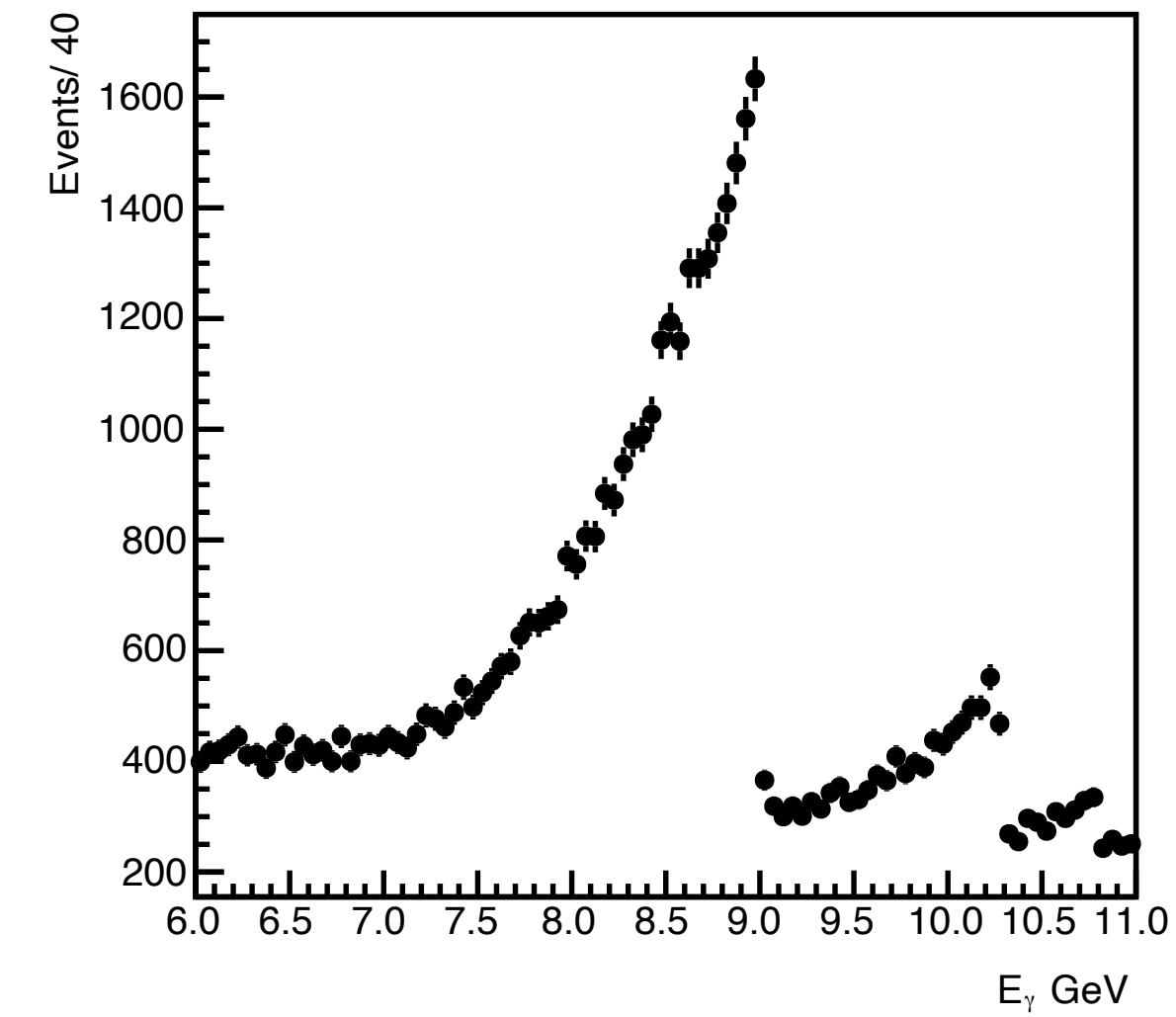
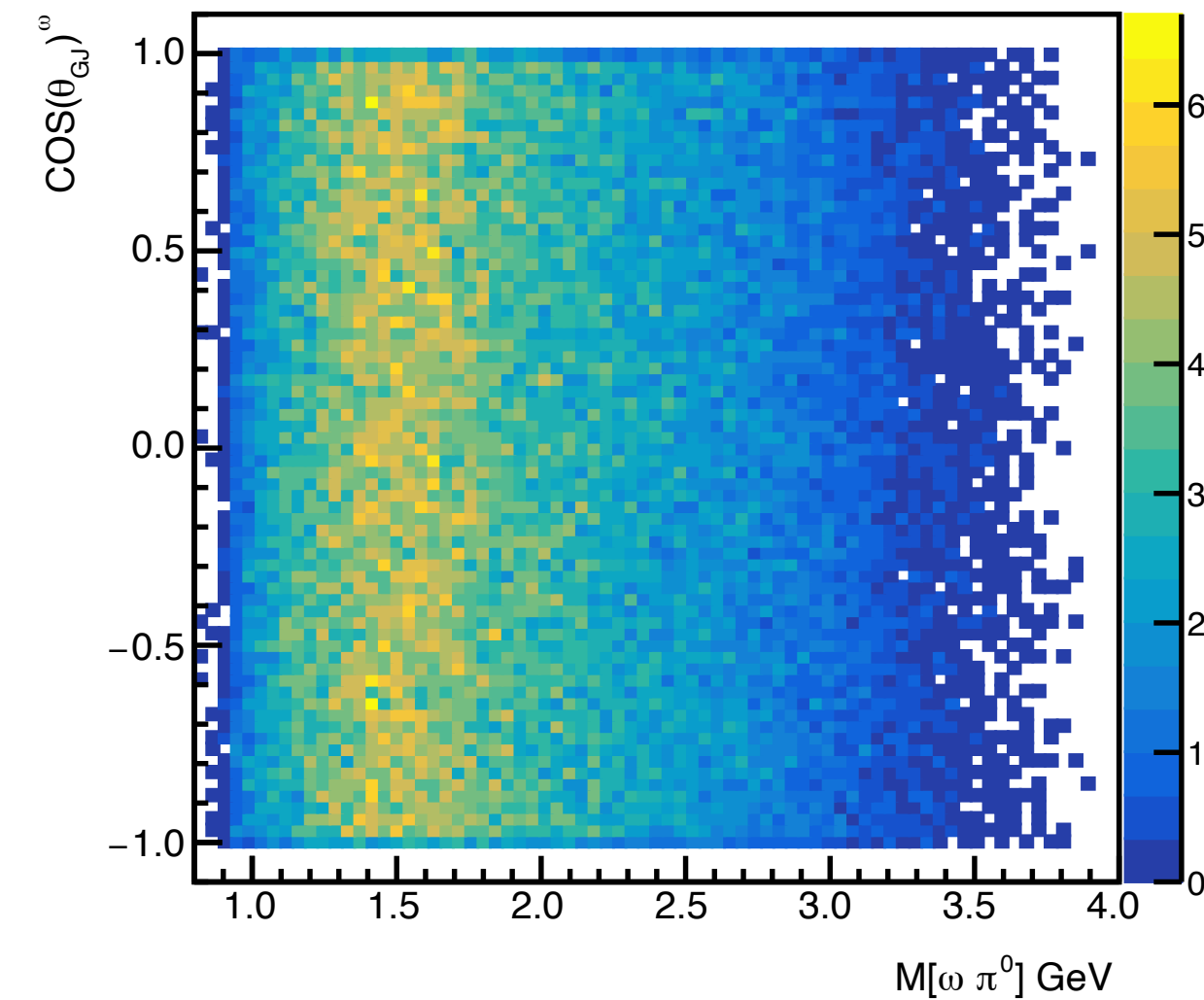
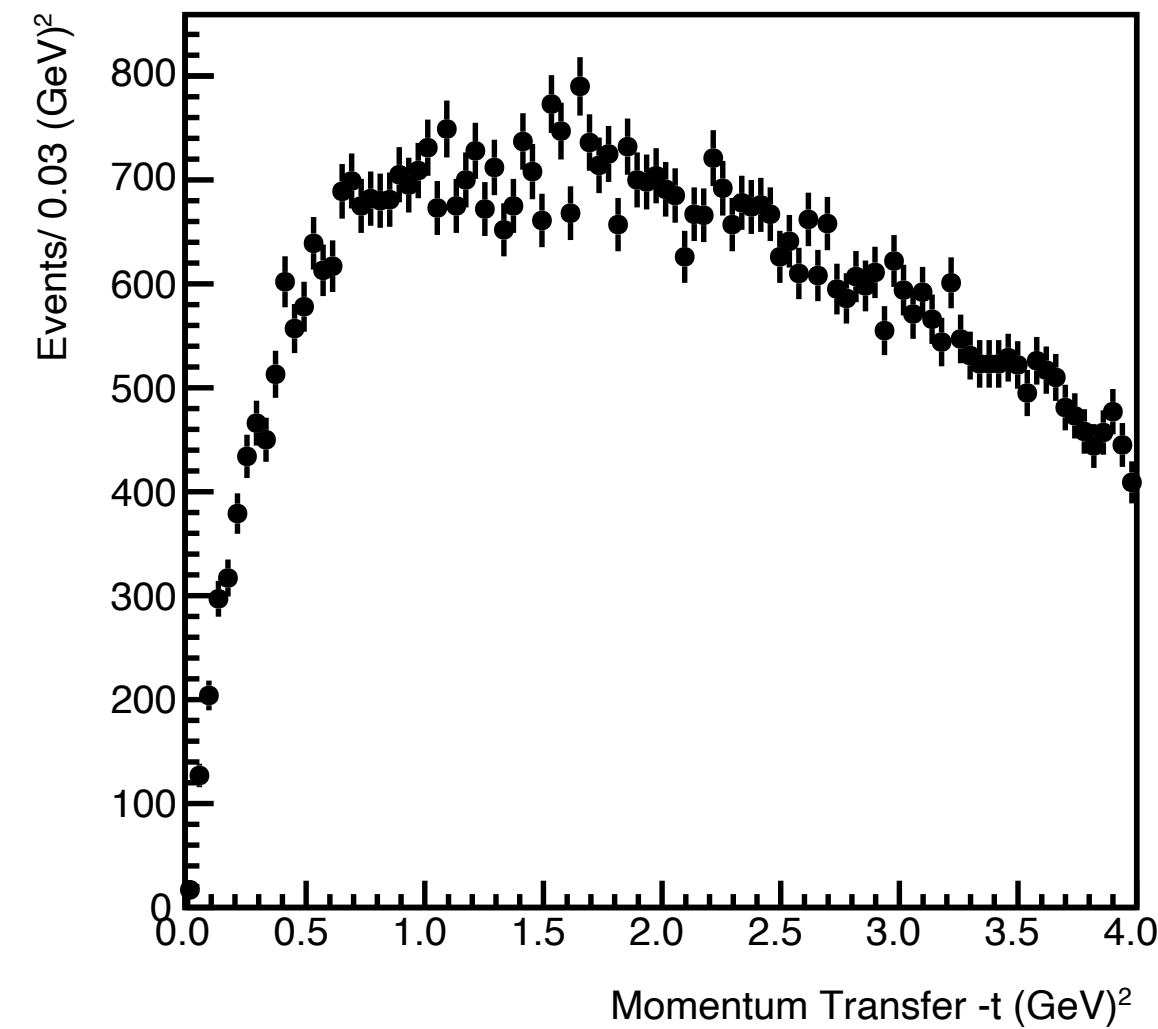


```
# -uv 23 -lv 1 -f -fsroot
# -uv 23 -lv 1 -f -t 2.0 1.0
# -uv 23 -lv 1 -f -t 2.0 1.0 -uvBW 1.2295 0.142 1.0
reaction OmegaPiProton Beam Proton Omega Pi0
```

# Output check

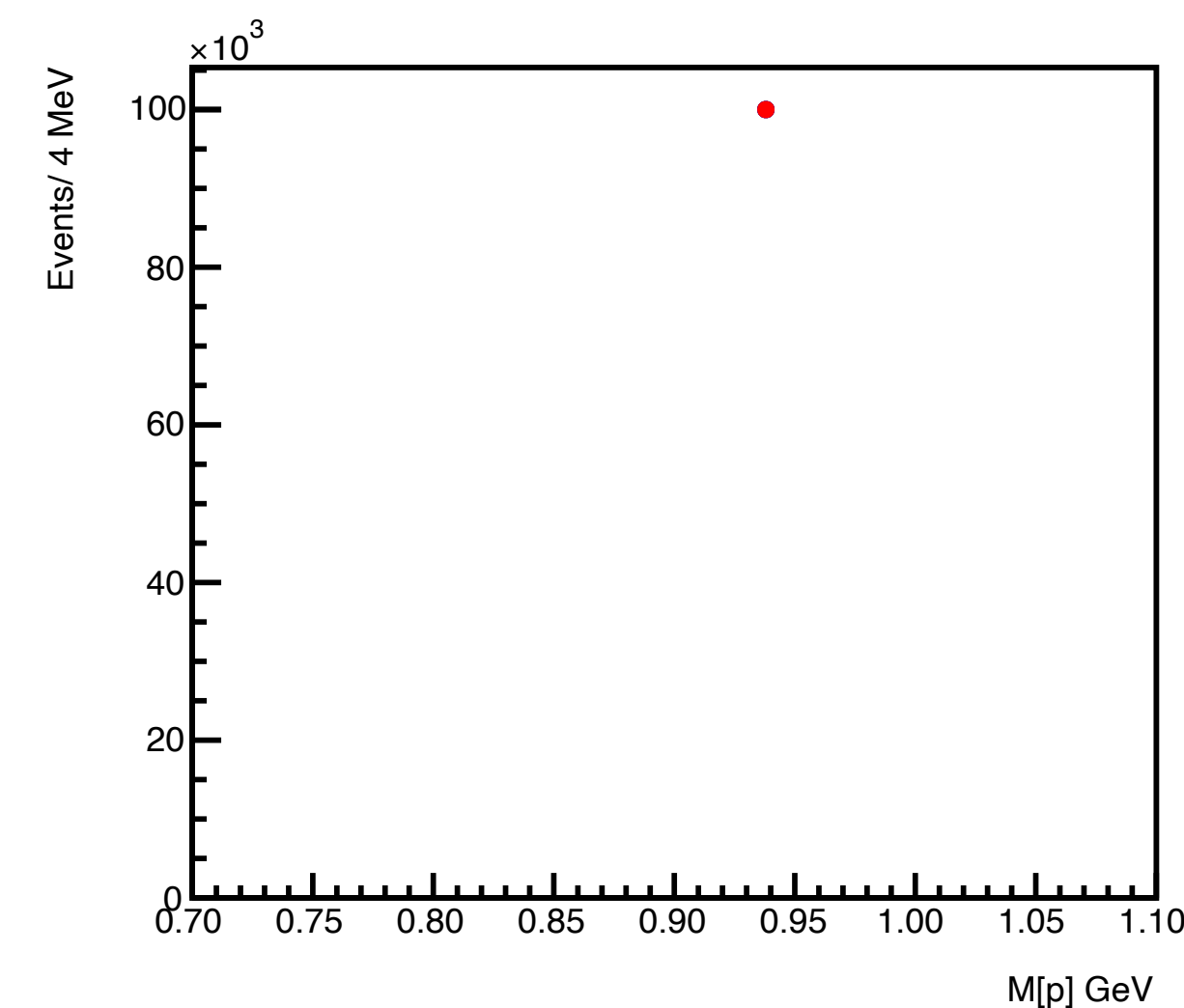
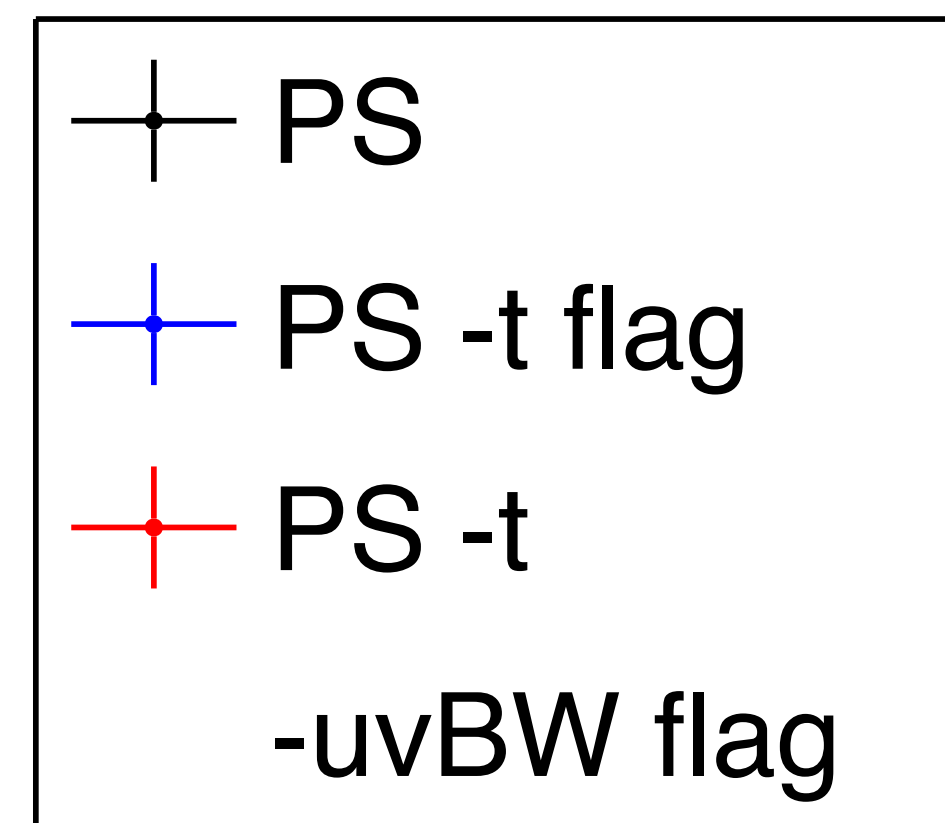
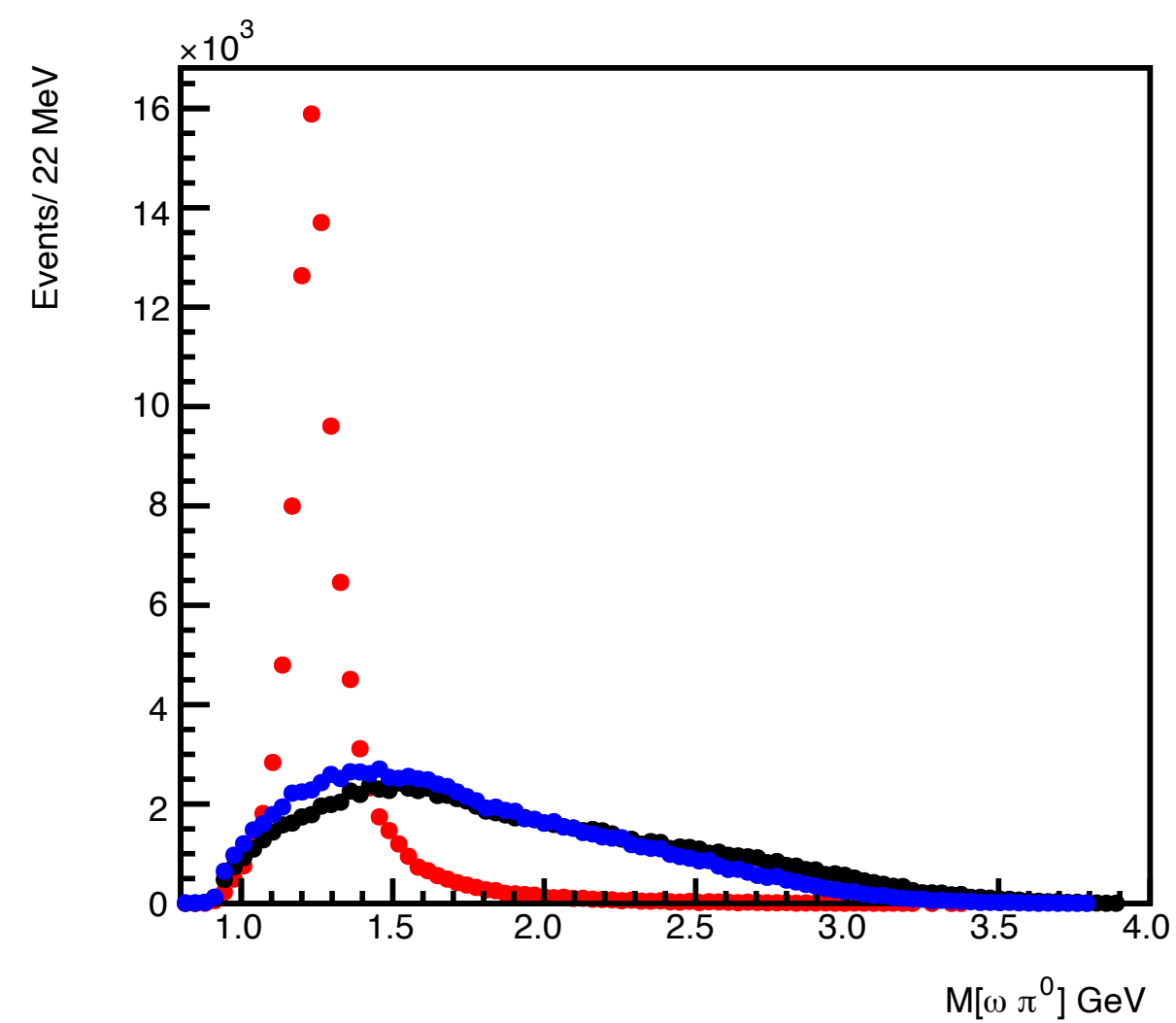
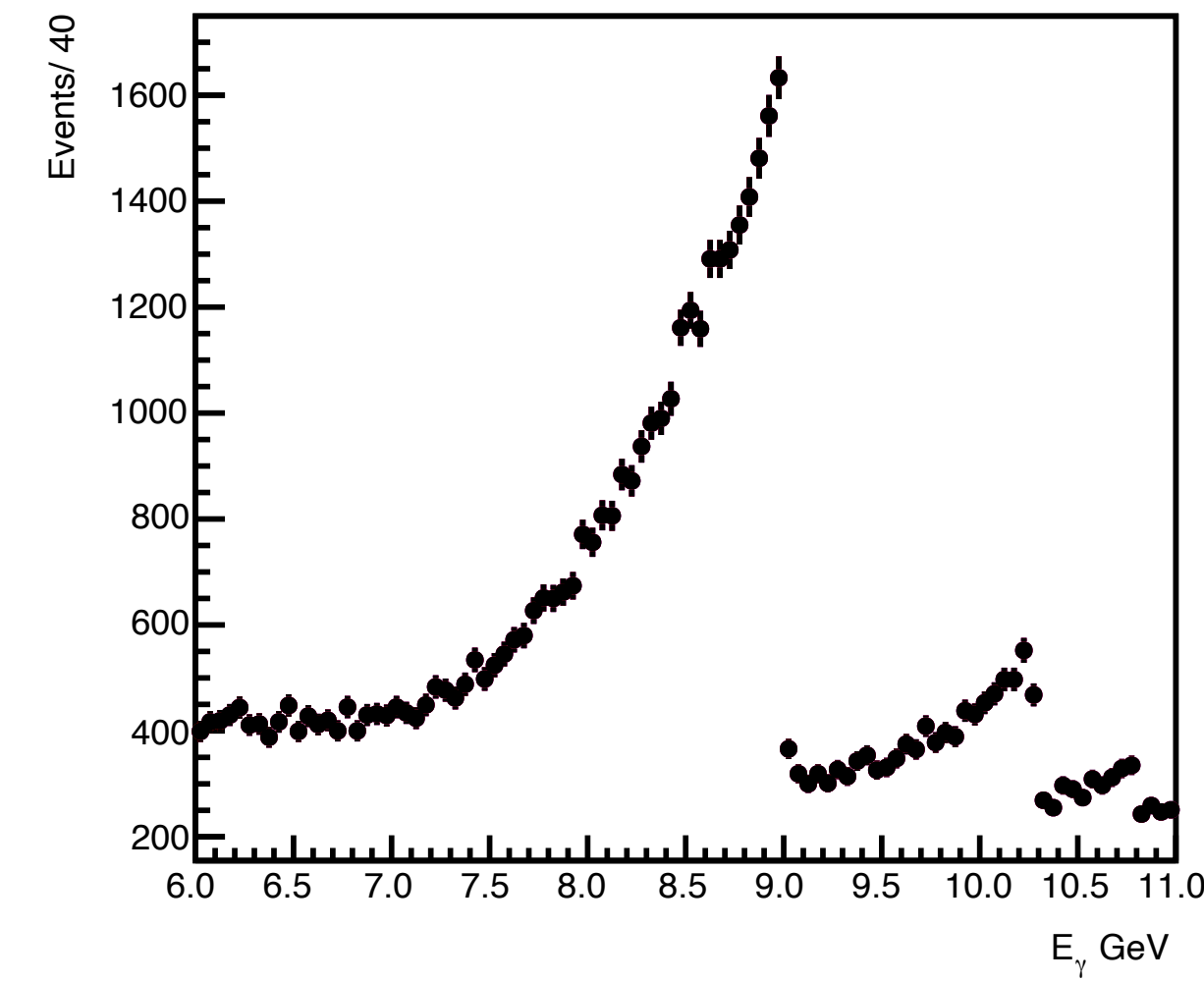
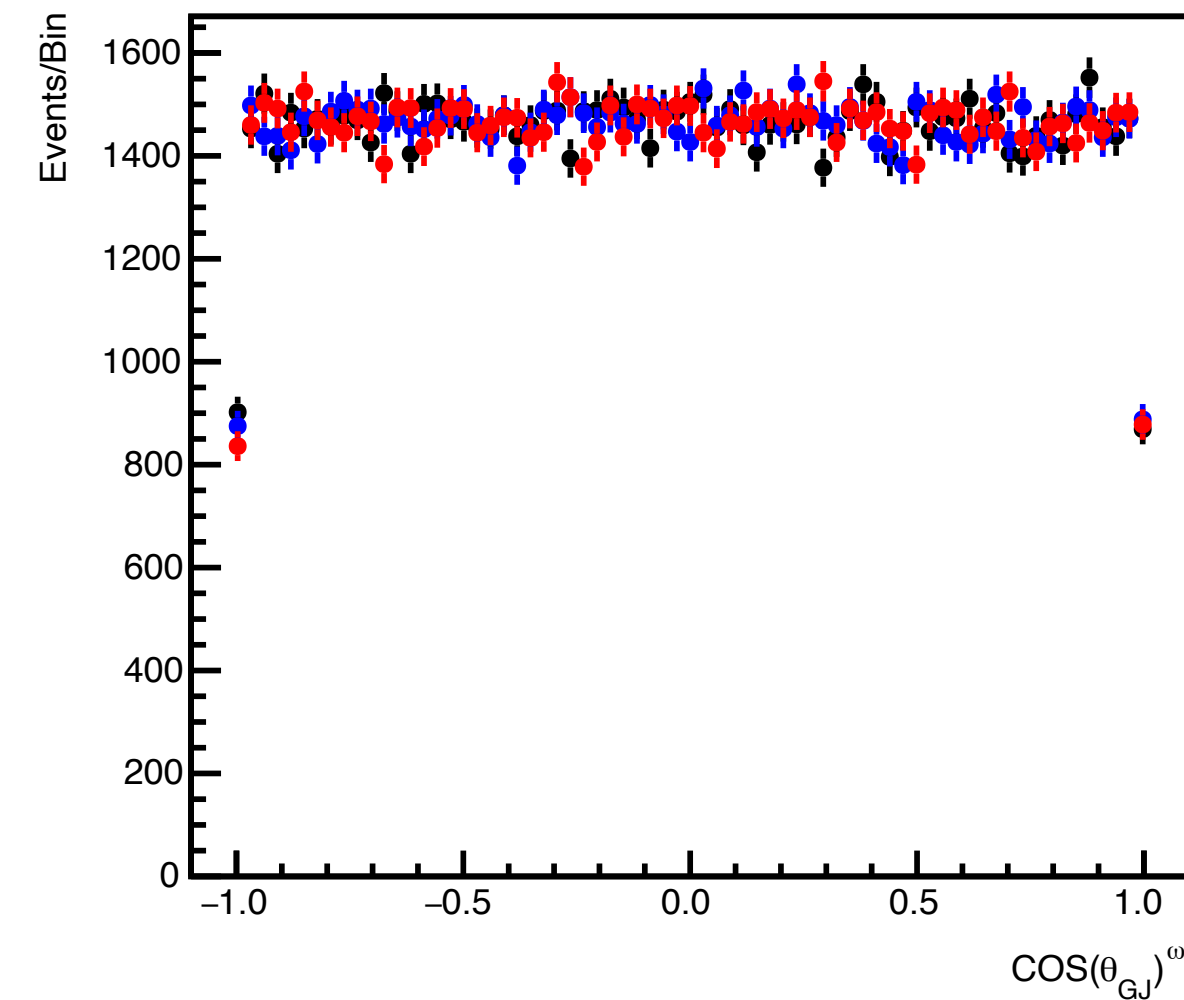
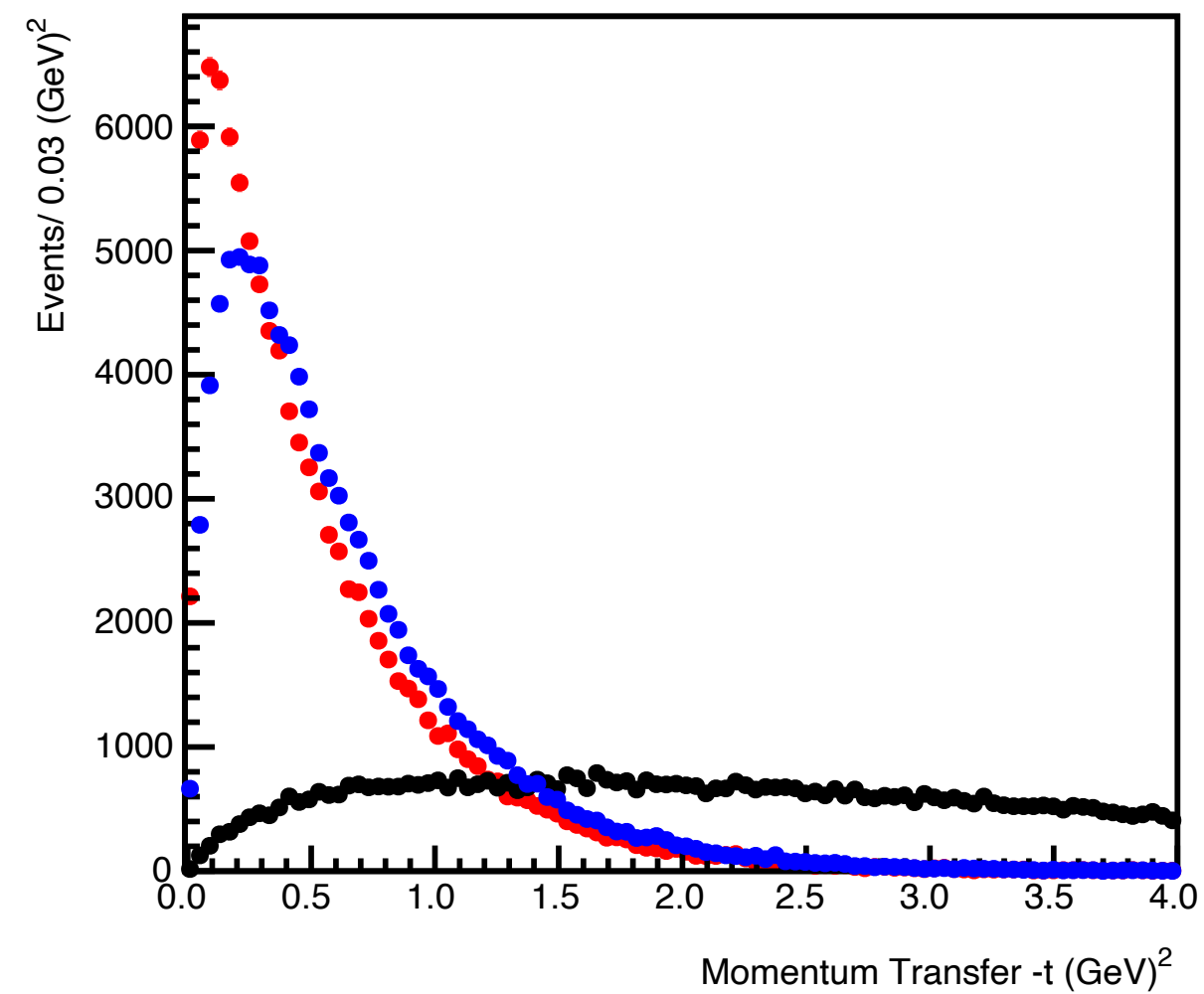
```
gen_amp_V2 -ac genPS.cfg -o test_b1.root -uv 23 -lv 1 -f -fsroot -n 100000
```

- We first take a look at what we consider **PS**.
- Used `plotPhaseSpace.C` for plots on the right.



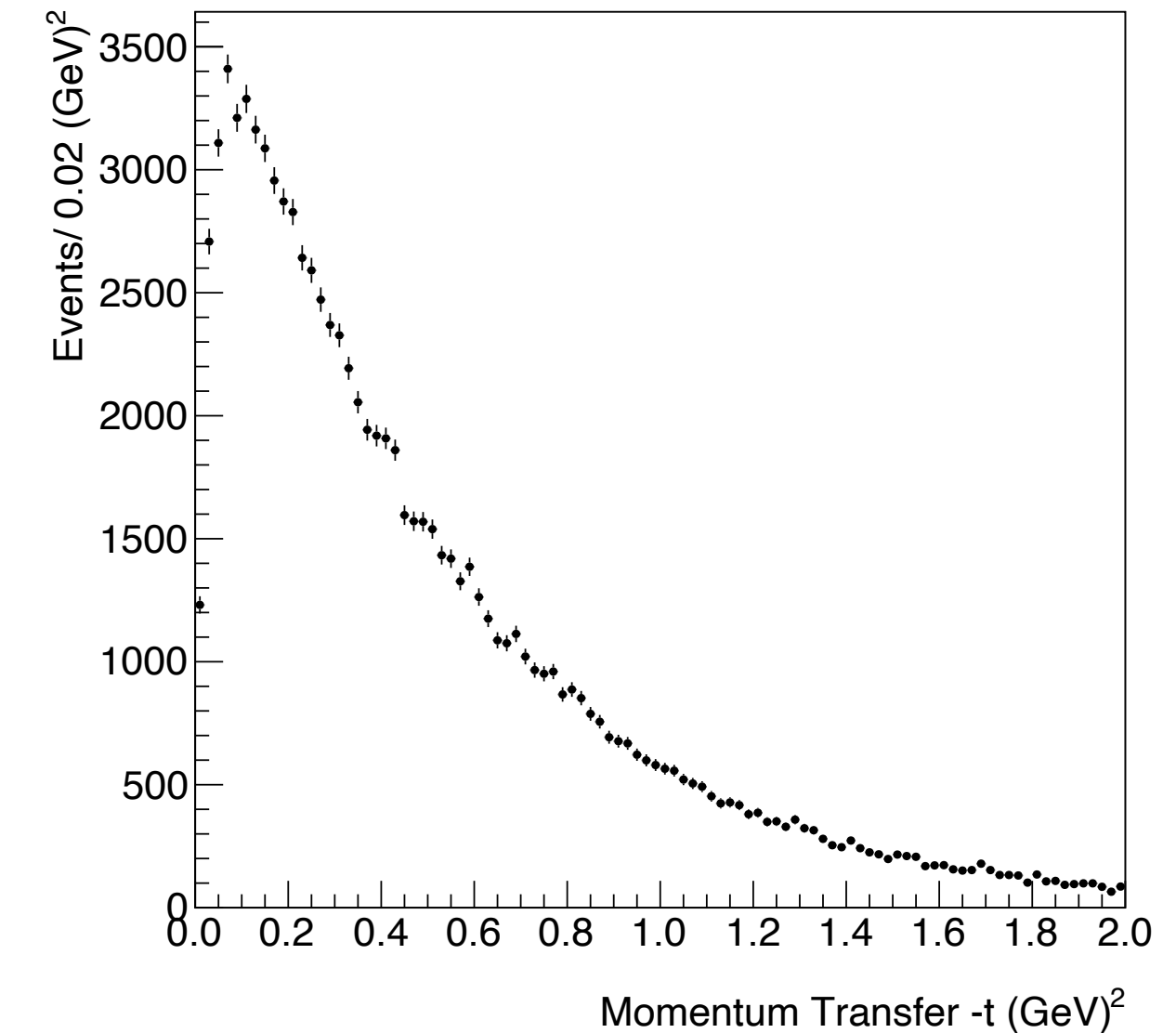
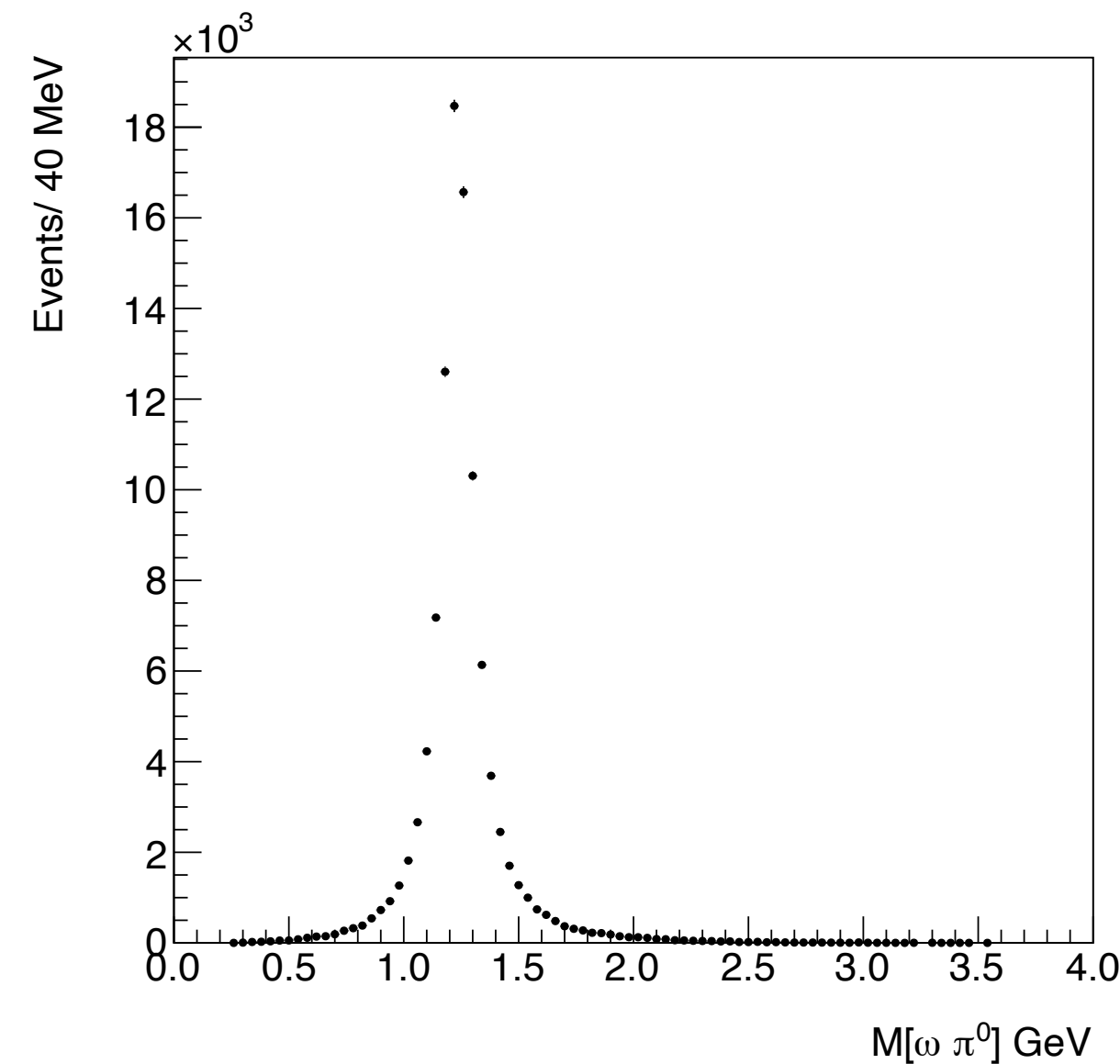
# Flag output comparisons

- UV, LV, t  
correlated values.

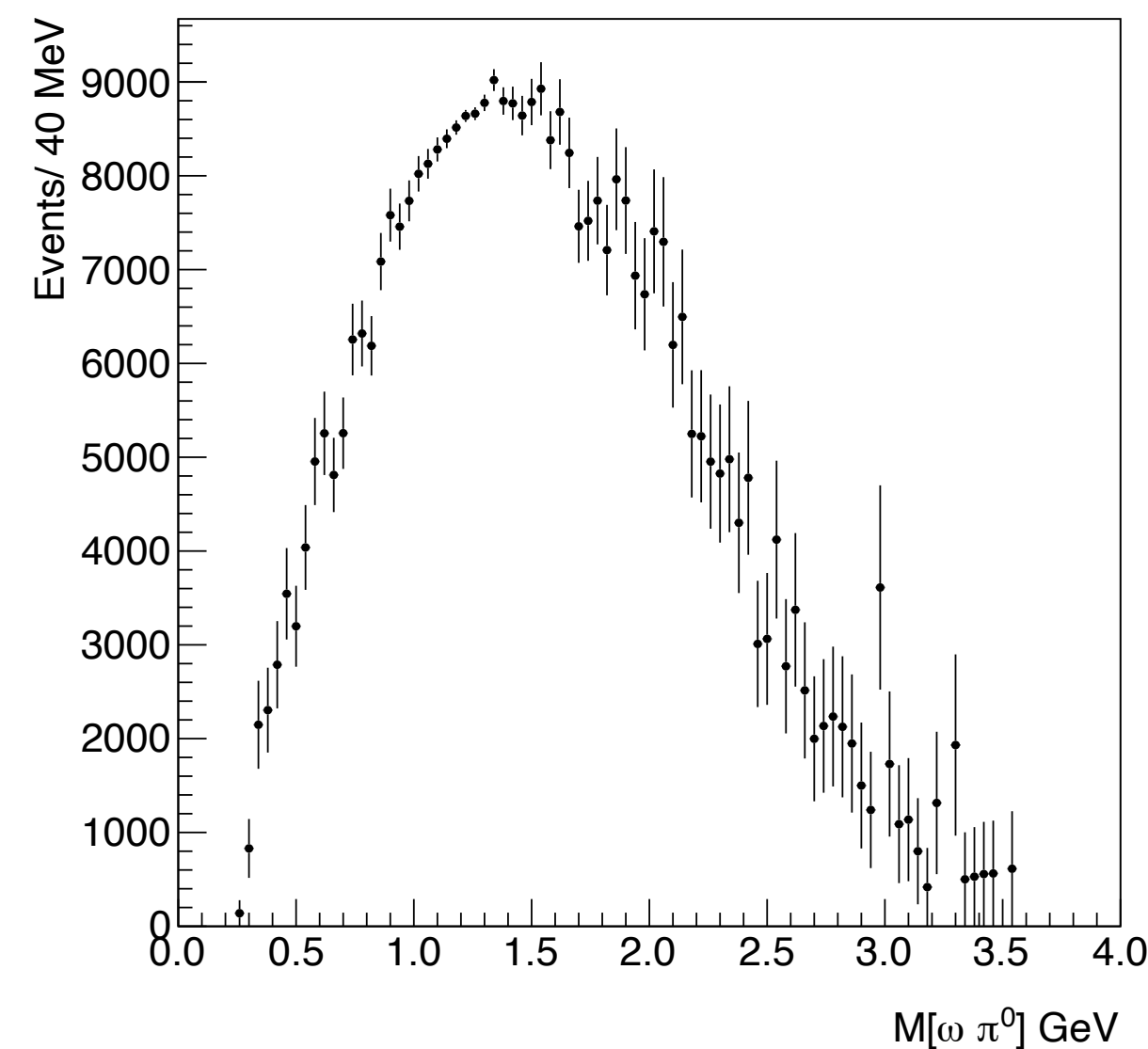


# Event Weights

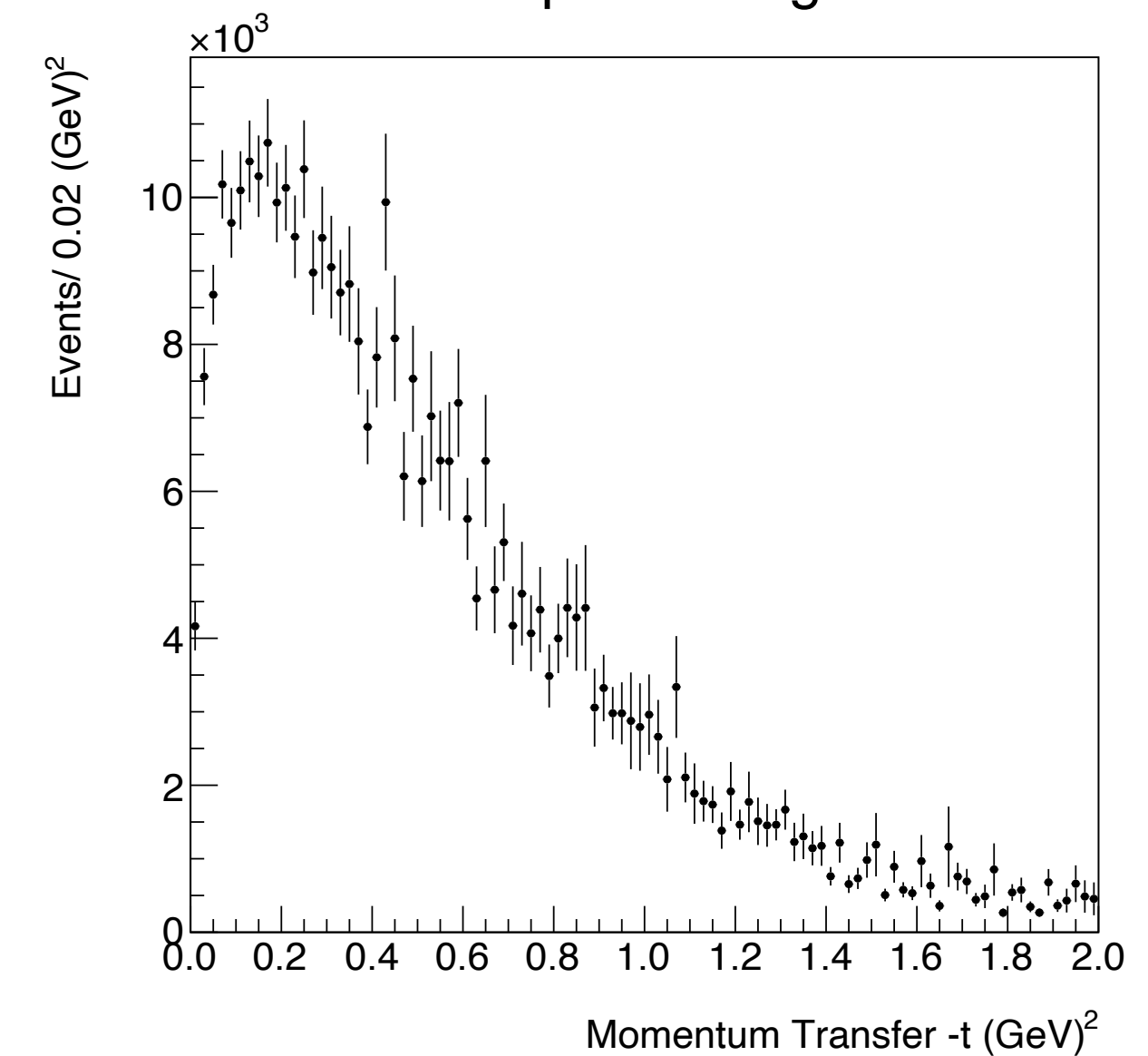
- Weights  $W(\text{UV}, \text{LV}, t)$  calculated to revert back to PS.
- mask flag gives option to toggle on/off weight for each dependence
- This example toggles off  $t$  portion of weight but keeps the UV, LV weight.



Phase Space Weighted



Phase Space Weighted





# AmpTools compatibility

- Structure built to support AmpTools for generating amplitudes.

$$\sum_{i=1}^N \ln \mathcal{I}(\mathbf{x}_i; \boldsymbol{\theta}) \rightarrow \sum_{i=1}^N w_i \ln \mathcal{I}(\mathbf{x}_i; \boldsymbol{\theta})$$

$$\frac{1}{M_g} \sum_{i=1}^{M_a} A_{\sigma, \alpha}(\mathbf{x}_i) A_{\sigma, \alpha'}^*(\mathbf{x}_i) \rightarrow \frac{1}{M_g} \sum_{i=1}^{M_a} w_i A_{\sigma, \alpha}(\mathbf{x}_i) A_{\sigma, \alpha'}^*(\mathbf{x}_i)$$

- Important to understand what distributions to bring to accept/reject stage

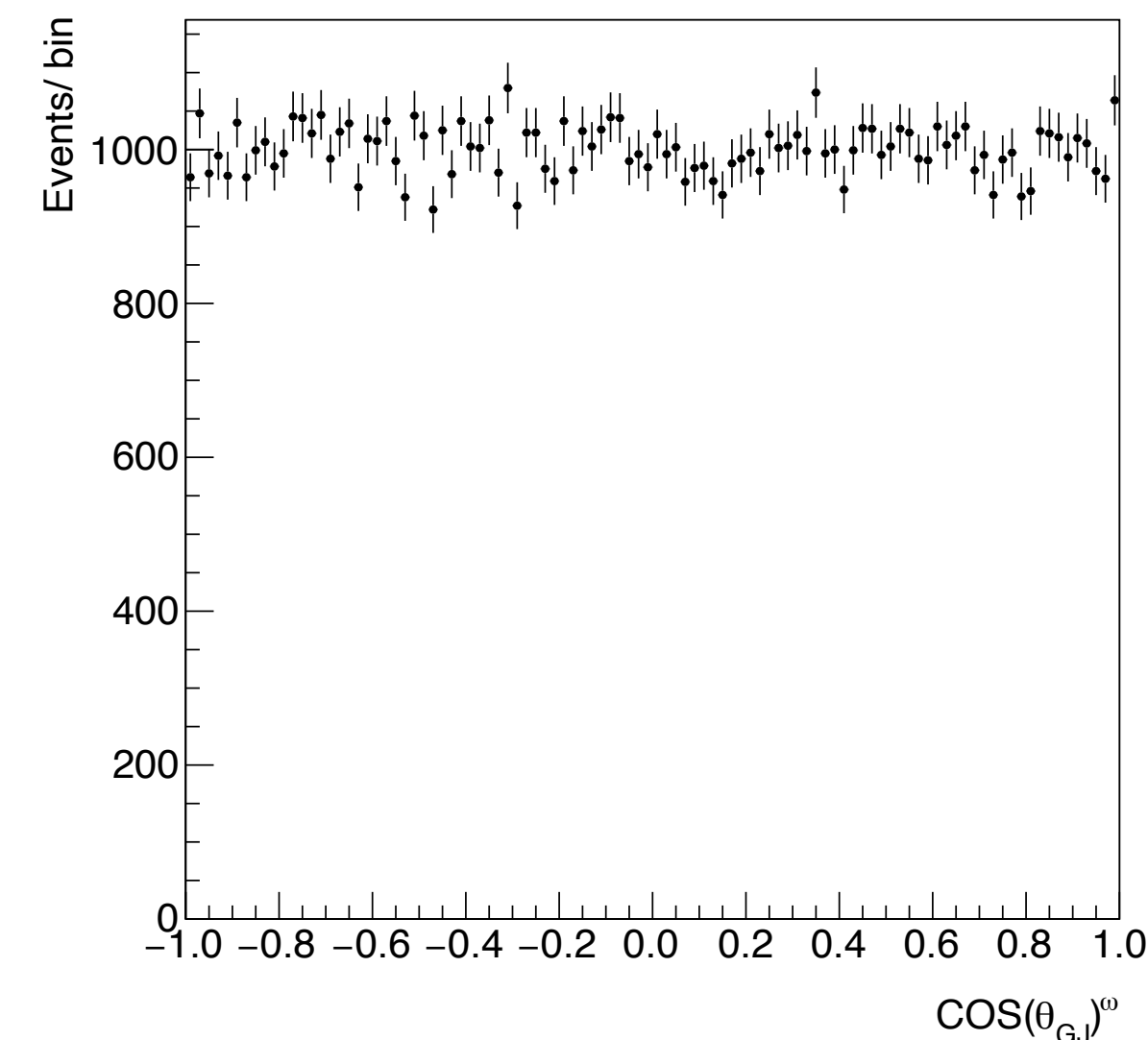
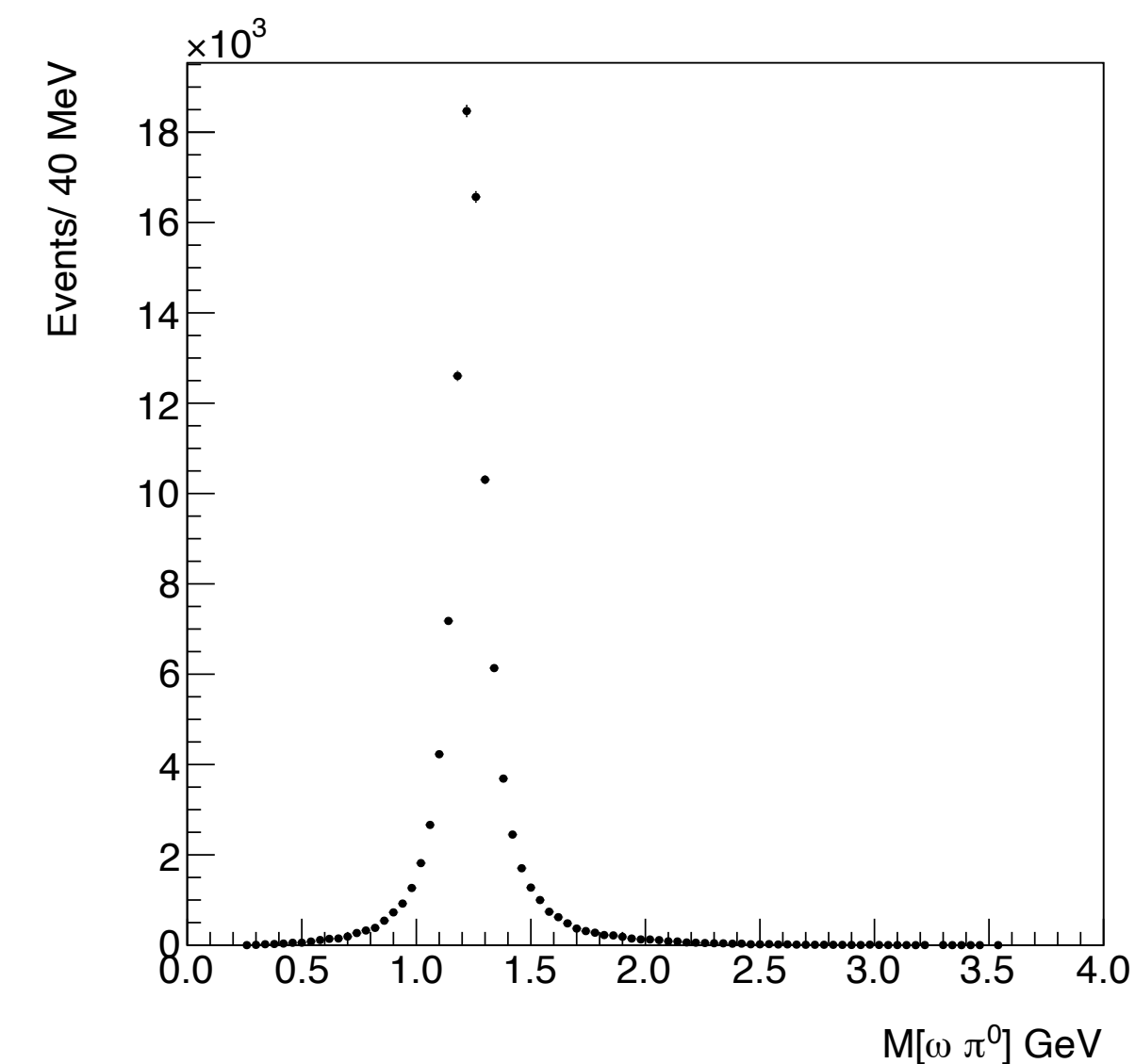
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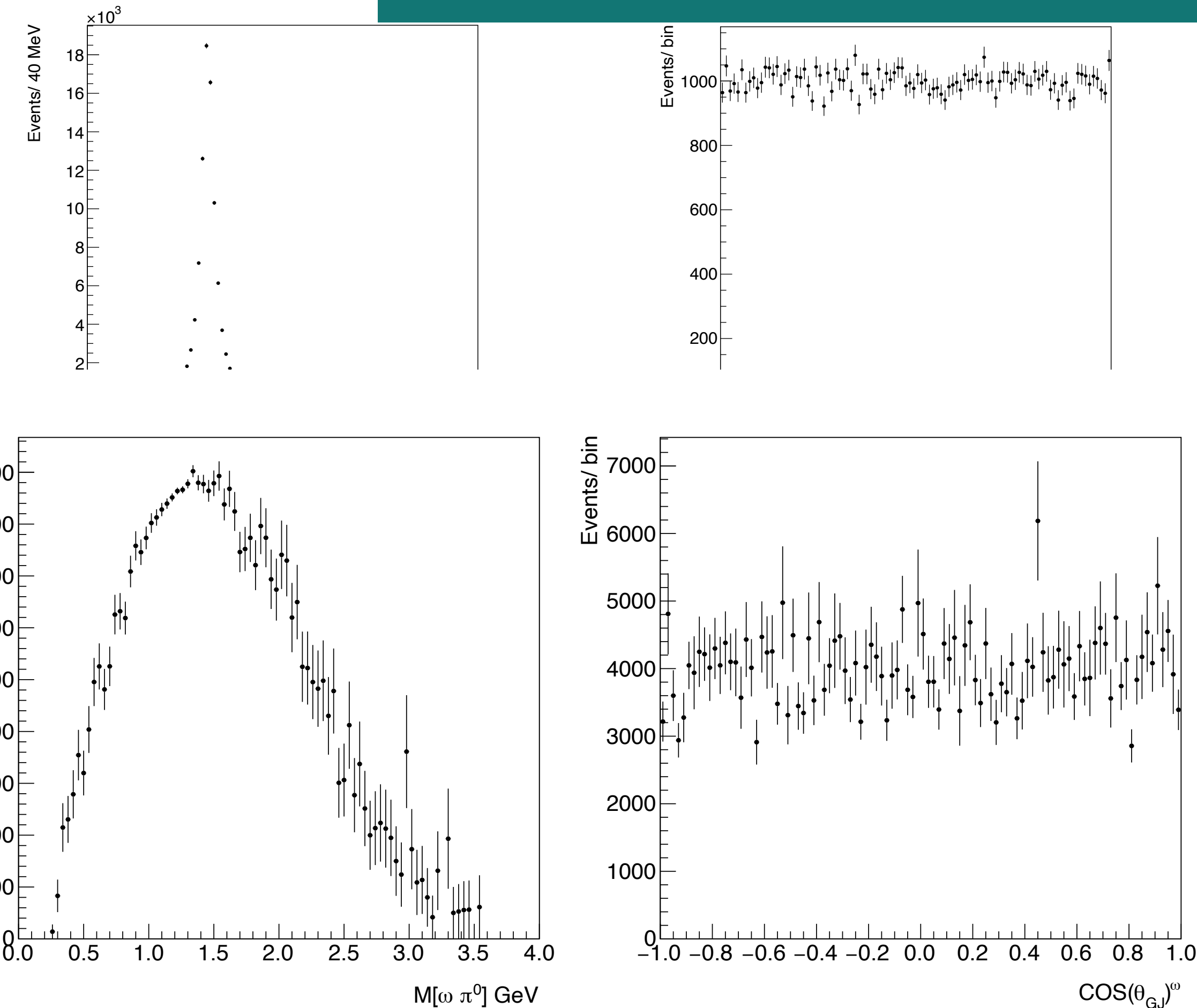
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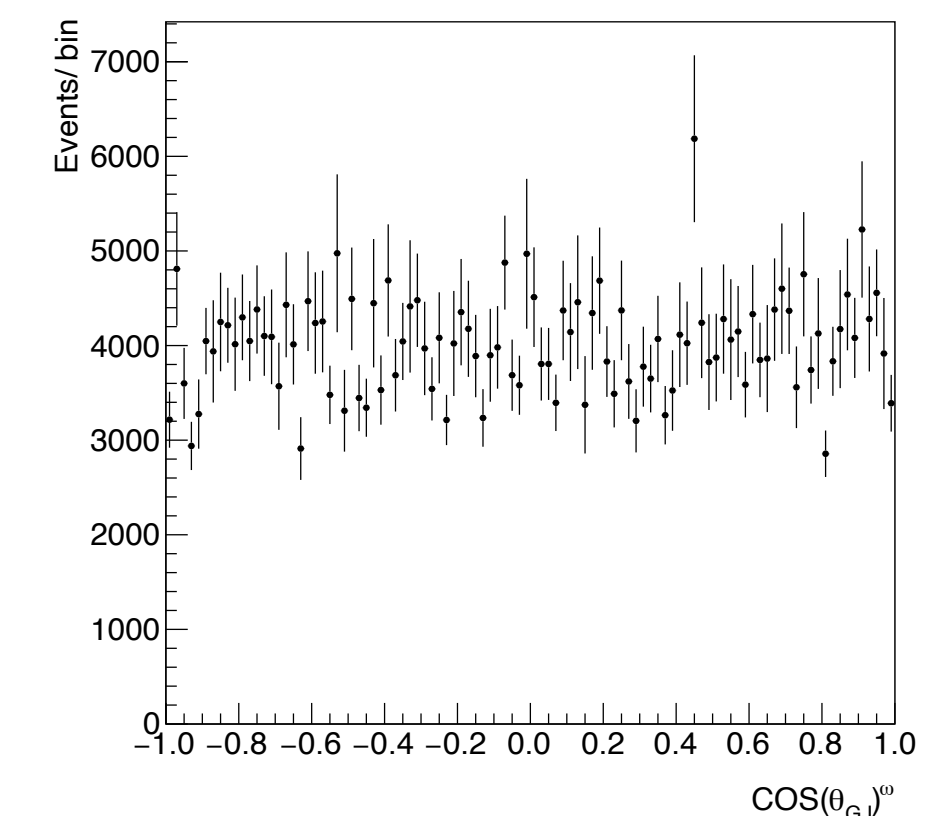
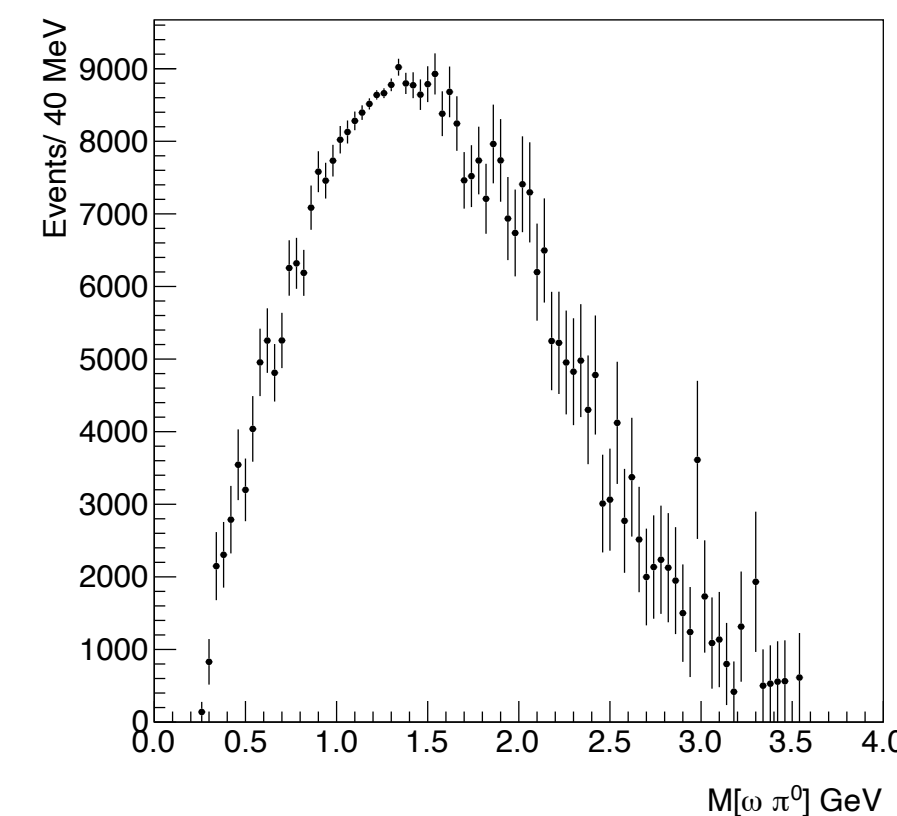
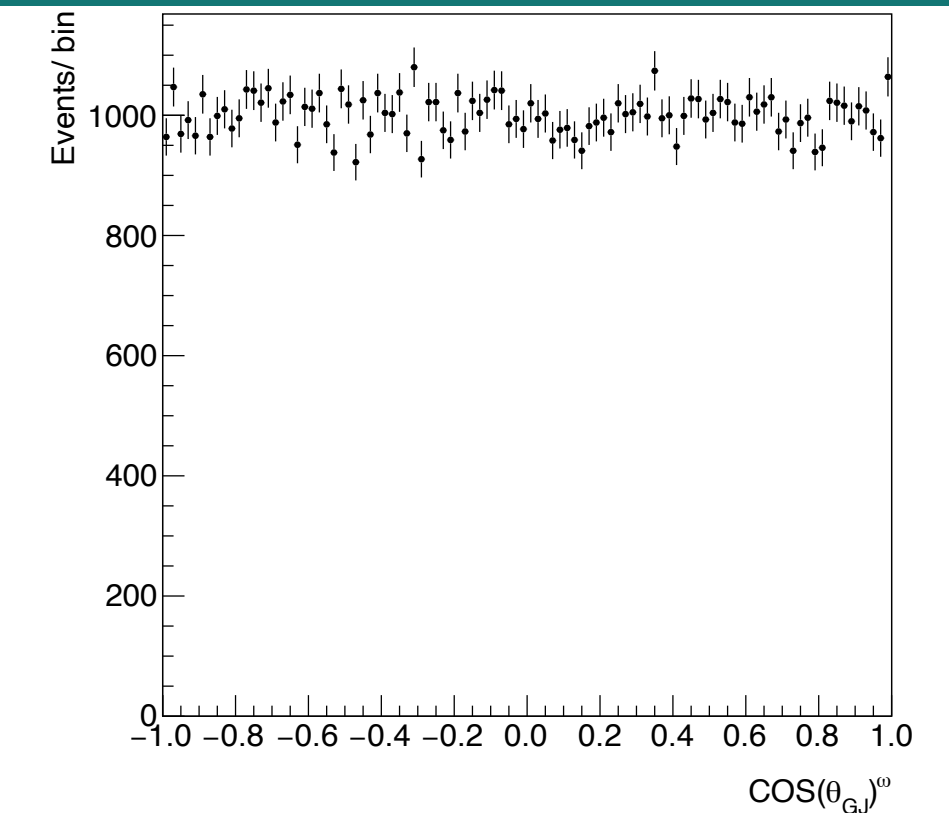
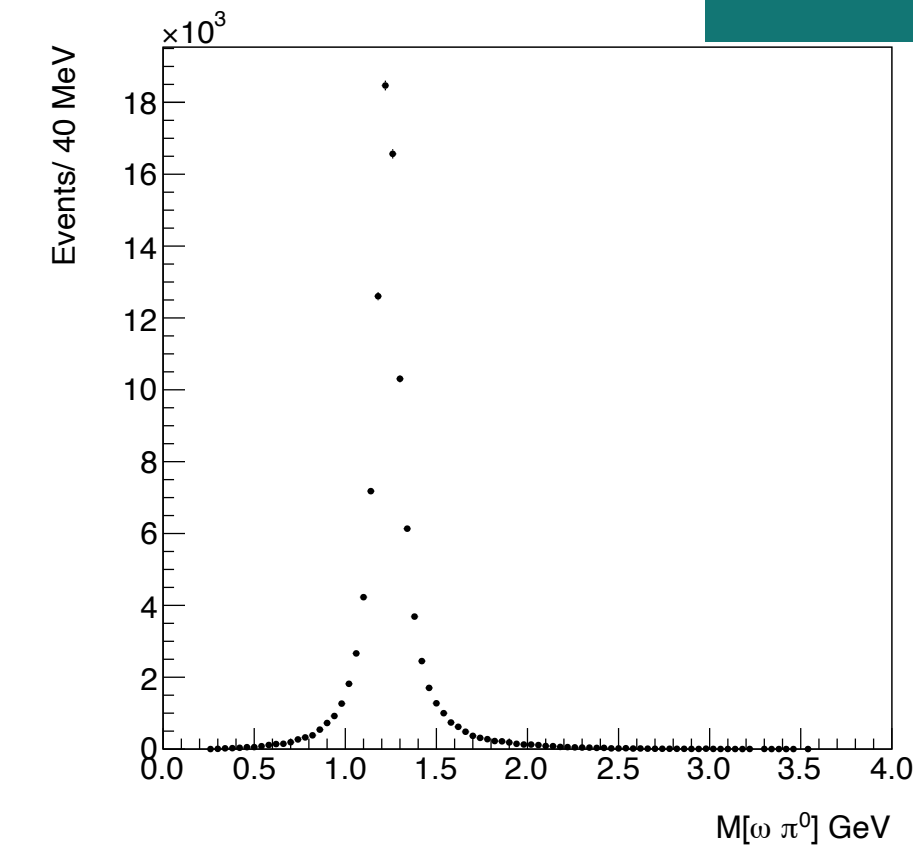
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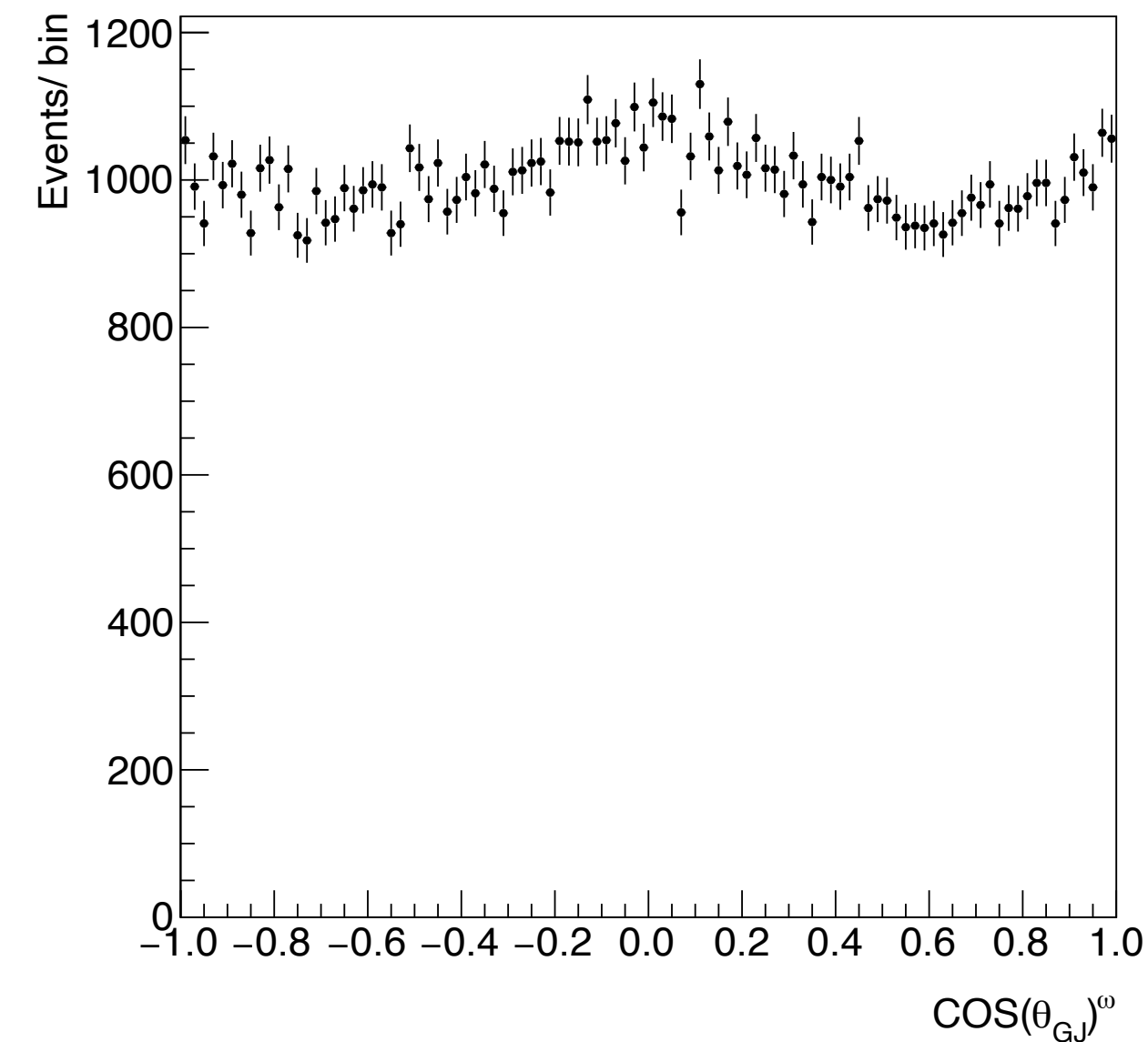
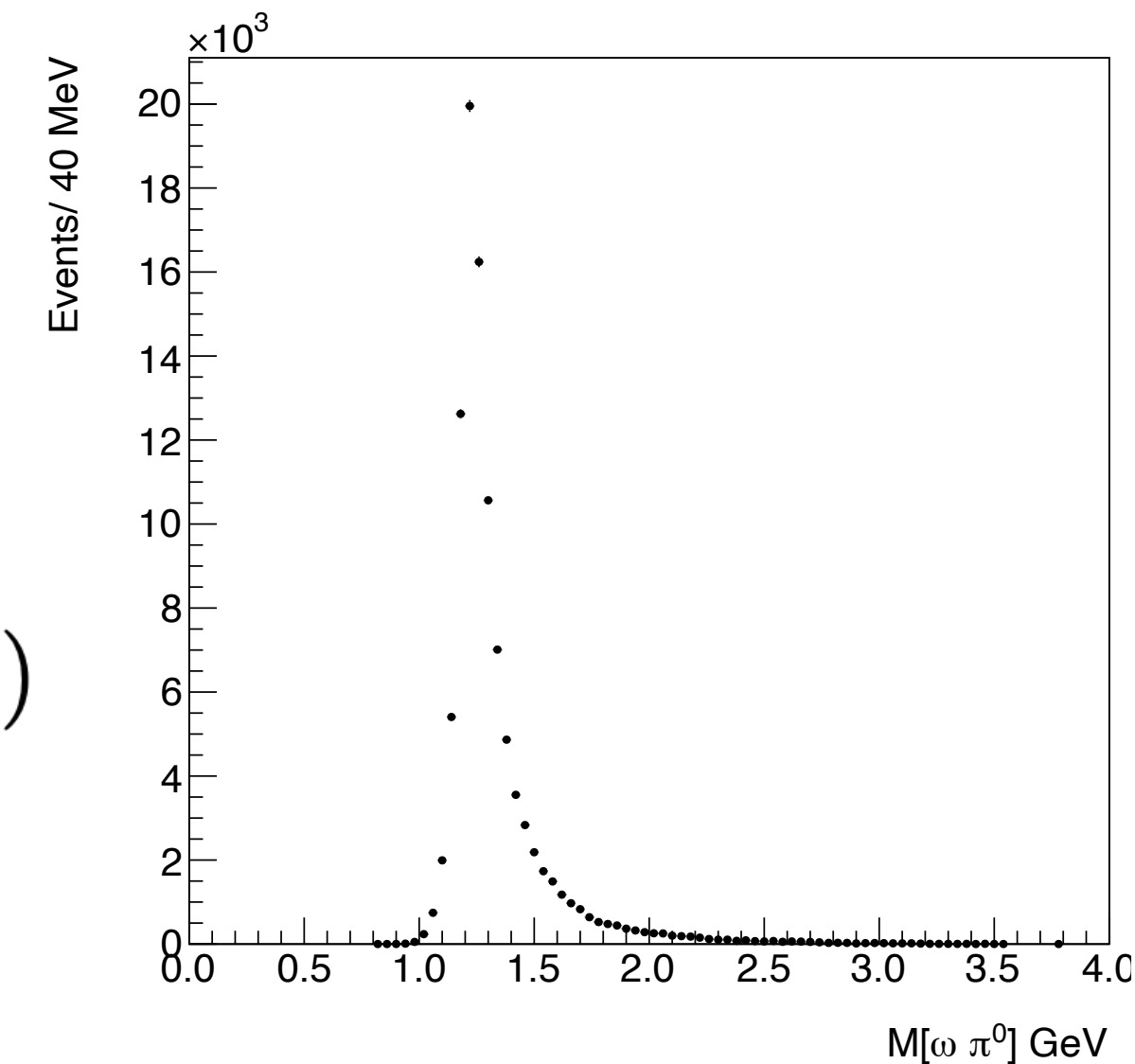
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# Resources

## Documentation:

- [Workshop repository](#)
- [Generators](#)
- Gen amp V2: [GlueX-doc-6440-v2](#)
- AmpTools: [GitHub repository](#)



# Conclusion

- Monte Carlo Generation is an important analysis step.
- Variety of generators that satisfy analysis needs
- Example using gen amp V2
  - Generate phase space
  - Toggle on/off parameters
  - Ability to use AmpTools with generated PS