

# Simulation Update

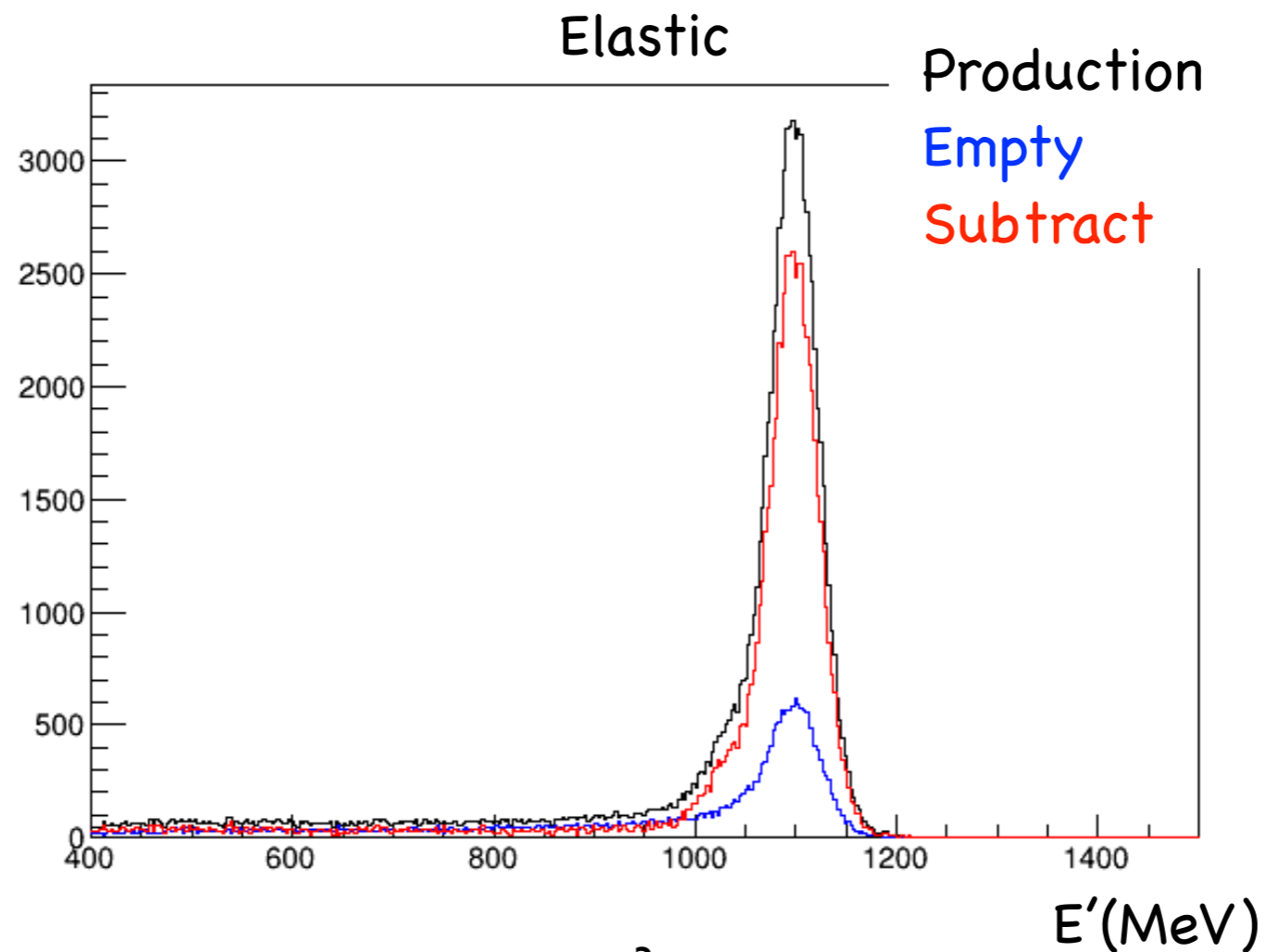
Chao Gu

# Progress Update

- Compare the simulation result with the data (prepare for the radiative correction study)
- Simulation:
  - Geant4 simulation originally written by Chao Peng
  - The geometries is updated with survey reports and drawings, the z position of detectors is updated with Weizhi's calibration results (a backup slide lists all the references)
  - The digitization and reconstruction part (for HyCal) of the simulation package is rewritten with the most recent database
- Data:
  - Roughly background subtraction with the empty run

# Progress Update

- Compare the simulation with the data
- 1.1 GeV production run 1288, empty target run 1289
- The yield of the empty target run is scaled by the ratio between the live charge of the production run and the empty target run

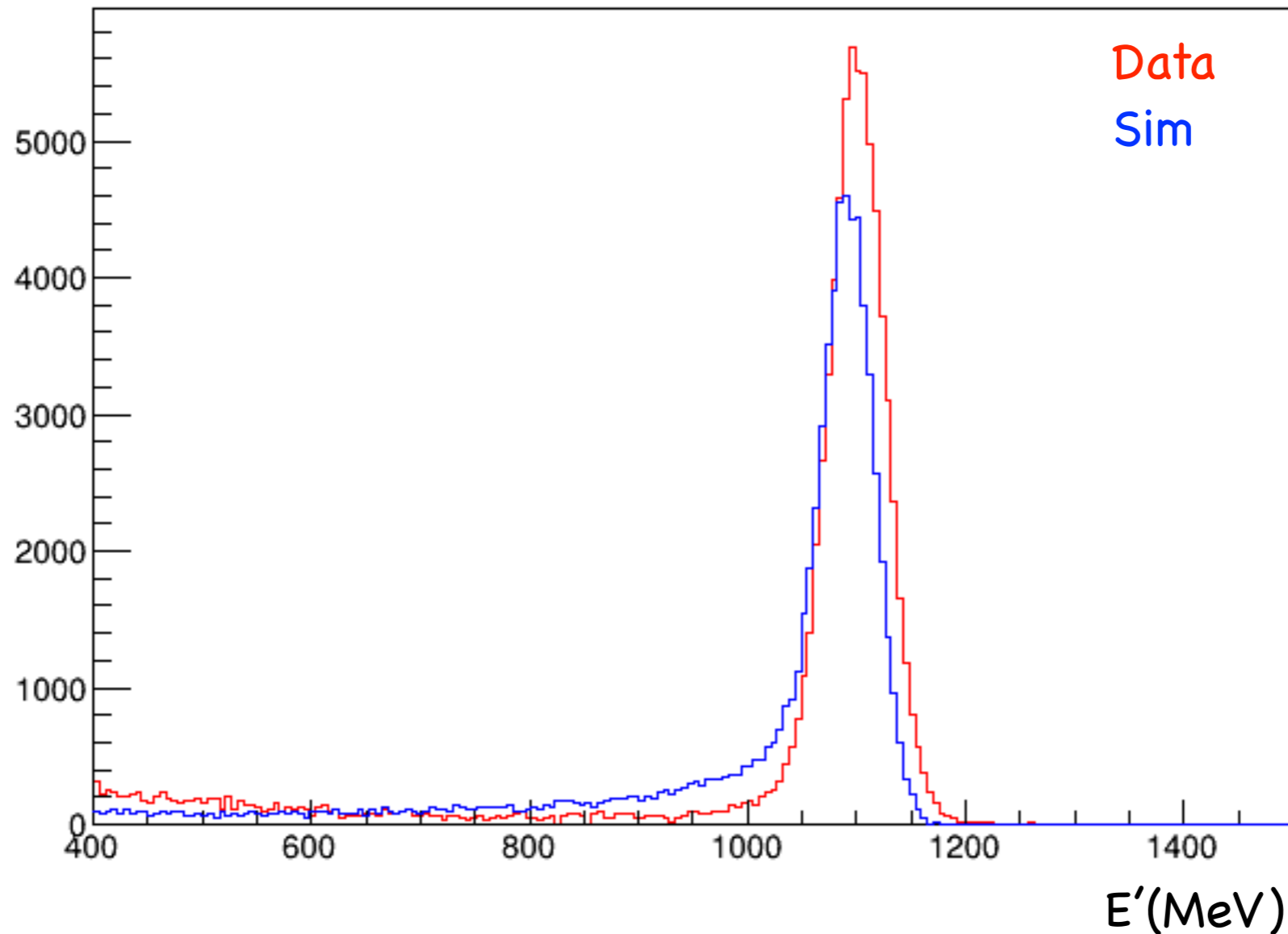


# Progress Update

- Compare the simulation with the data
  - Only compare elastic peak at first
  - Apply the luminosity to the simulation to compare with data
  - Density of the H<sub>2</sub> target:  $1.8 \times 10^{18}$  atoms/cm<sup>2</sup>
  - 30000 events were generated for simulation: the integrated cross-section for these events is 2199.3 ubarn, so the effective luminosity is  $13.64 \text{ ubarn}^{-1}$ , thus the effective beam charge for 30k events is  $13.64 \times 10^{30} / (1.8 \times 10^{18} / 1.6 \times 10^{-19}) = 1212.5 \text{ nC}$
  - The live charge of run 1288 is 40731.3nC, only the first 1M events (out of 12.2M) is selected for compare, so the charge used for compare is 3338.6nC
  - Which means that if we scale the simulated spectrum with  $3338.6 / 1212.5 = 2.754$ , the simulation and the data would have the same luminosity

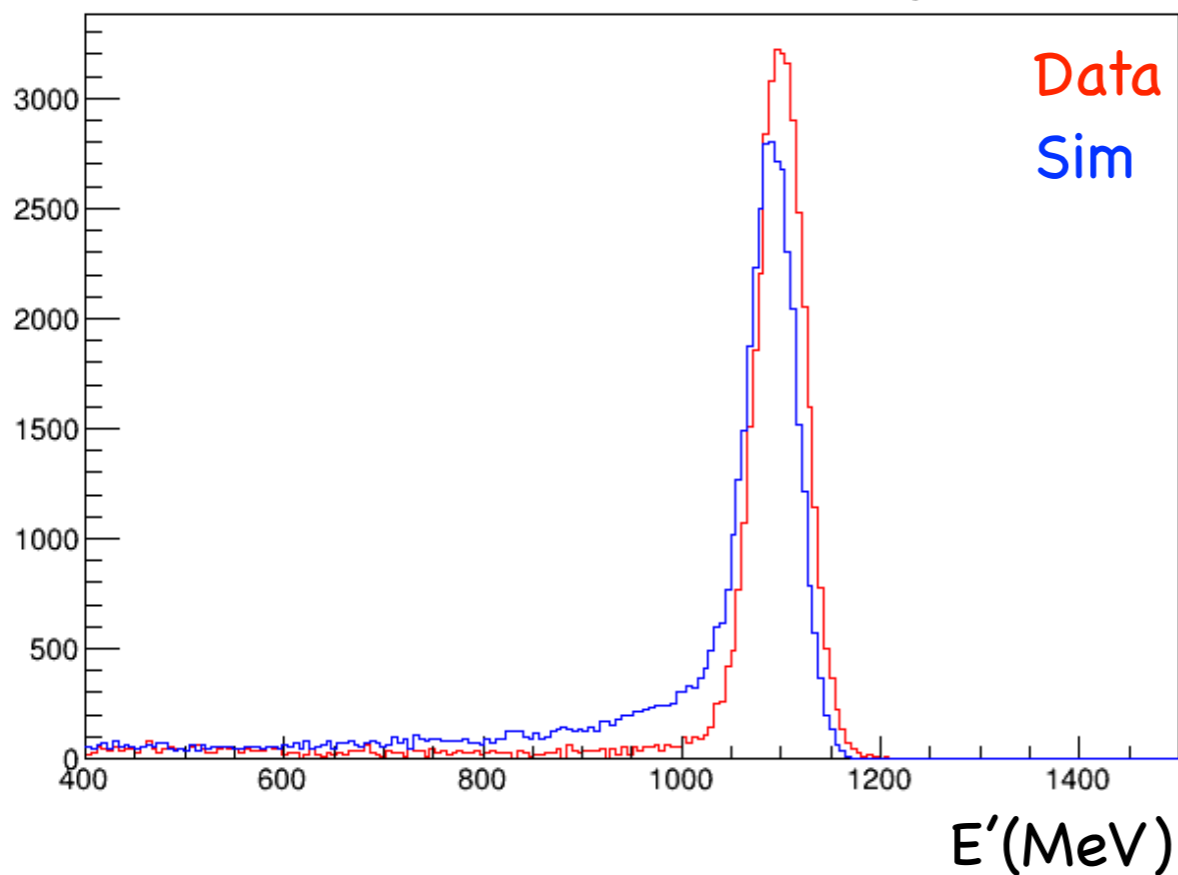
# Progress Update

Elastic spectrum

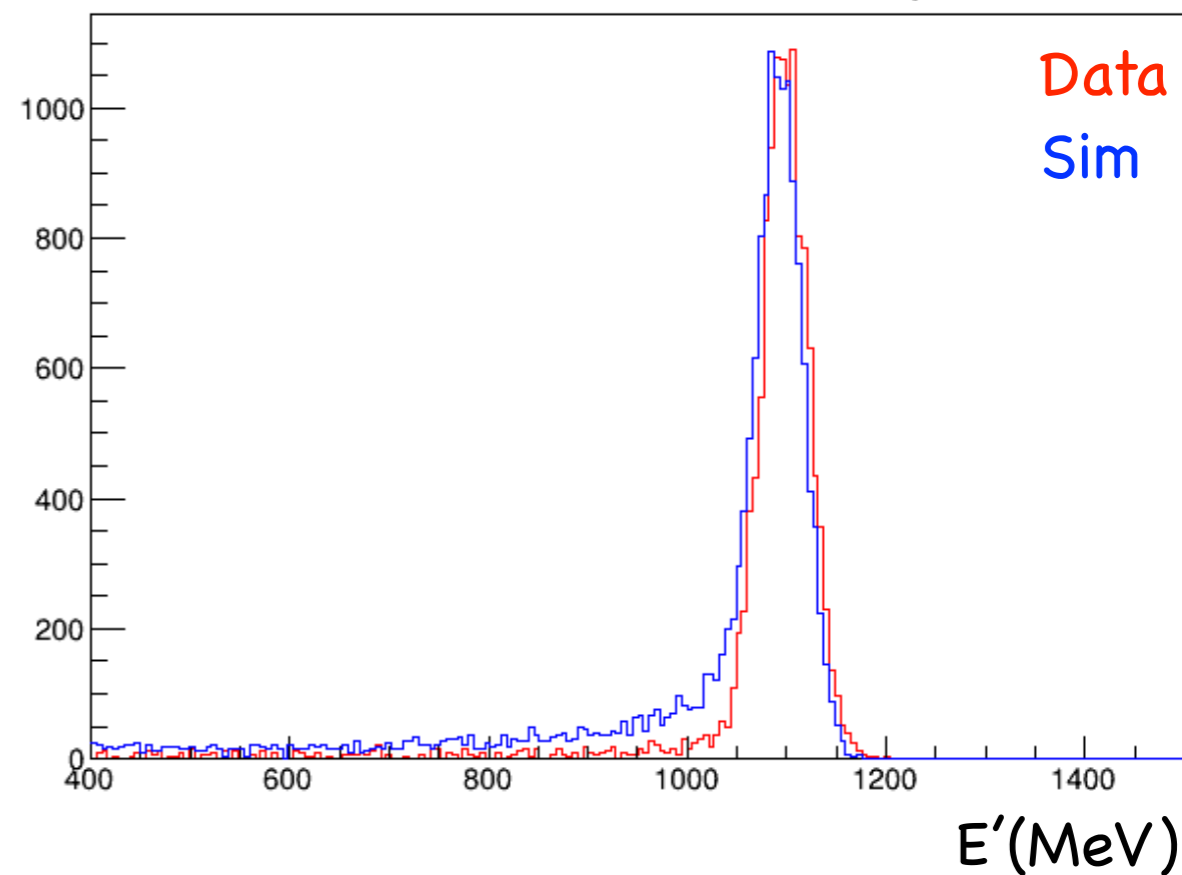


In this plot, the elastic peak of the simulation is scaled by the luminosity difference, the scale factor is 2.754

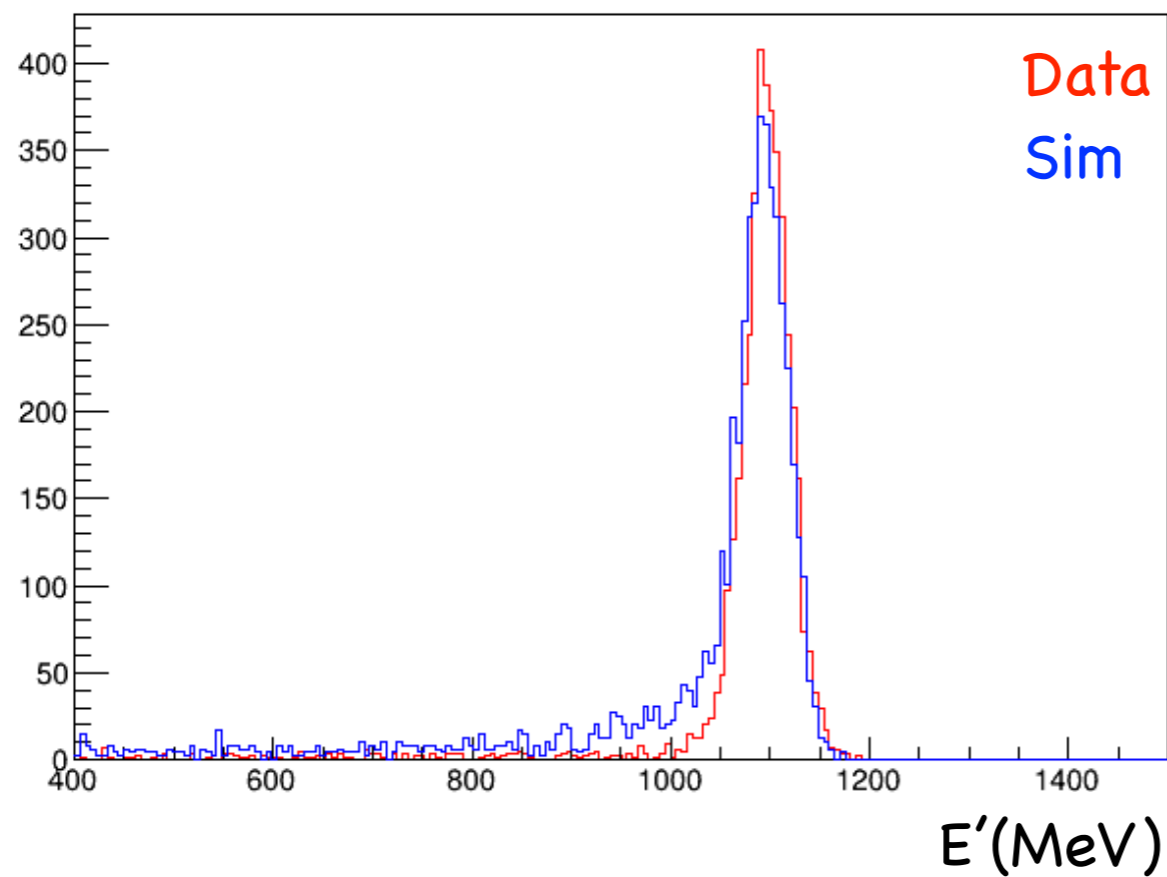
0.6 < theta < 1.0 deg



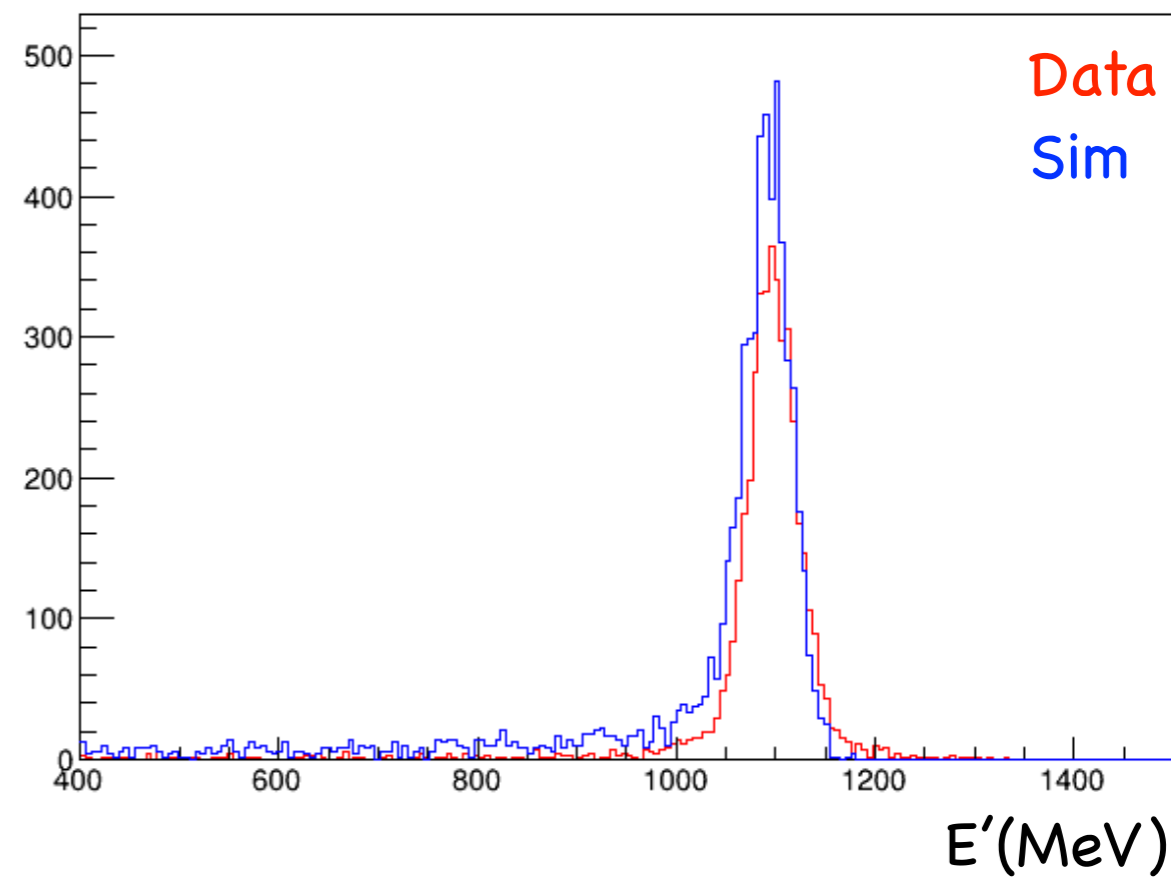
1.0 < theta < 1.5 deg



1.5 < theta < 2.0 deg



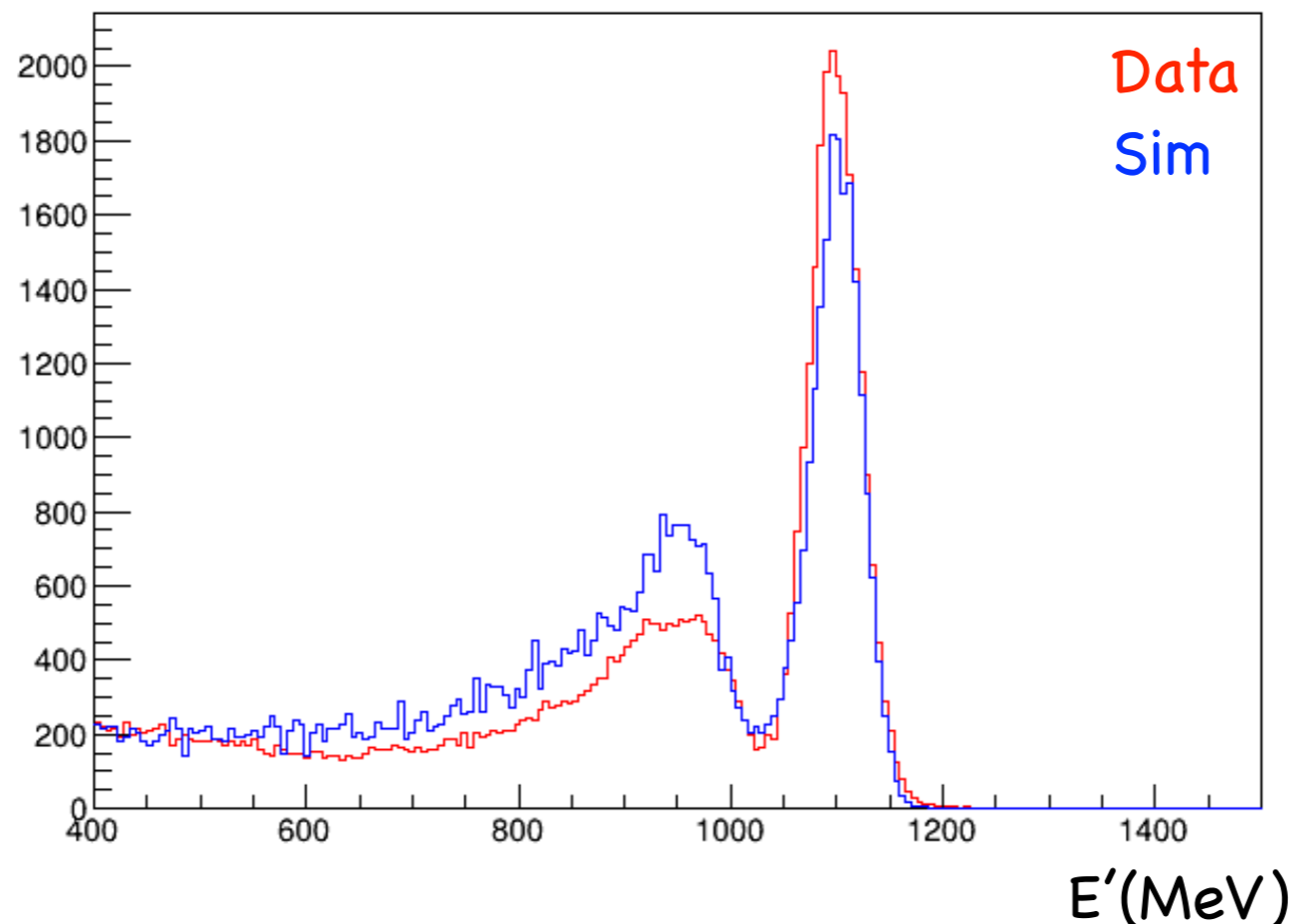
theta > 2.0 deg



# Progress Update

- Compare the simulation with the data
  - Compare the elastic and the Moller events together
  - The Moller events is simulated separately and scaled by the effective beam charge to give the same luminosity as the elastic simulation
  - The scale factor of the elastic simulation is 2.754, and the scale factor of the Moller simulation is 3.198

Elastic + moller spectrum



Backups



# Simulation Update

- Geometry in the simulation:
  - Z position for target, GEM and HyCal (most critical): survey reports and Weizhi and Xinzhan's calibration results
  - Target windows: <https://drive.google.com/file/d/OB1LIET0ObDOMREc2aEhfMmNhMzQ/view>
  - Downstream chamber: [https://userweb.jlab.org/~mezianem/PRAD/2nd\\_chamber\\_final.pdf](https://userweb.jlab.org/~mezianem/PRAD/2nd_chamber_final.pdf)
  - Vacuum box: [https://userweb.jlab.org/~mezianem/PRAD/PRad\\_Vacuum\\_box.pdf](https://userweb.jlab.org/~mezianem/PRAD/PRad_Vacuum_box.pdf) and [https://userweb.jlab.org/~mezianem/PRAD/PRad\\_window.pdf](https://userweb.jlab.org/~mezianem/PRAD/PRad_window.pdf)
  - GEM: personal discussion with Xinzhan
  - HyCal: [https://userweb.jlab.org/~mezianem/PRAD/HyCal\\_Drawings.pdf](https://userweb.jlab.org/~mezianem/PRAD/HyCal_Drawings.pdf) and a few other talks

# Progress Update

Simulation

