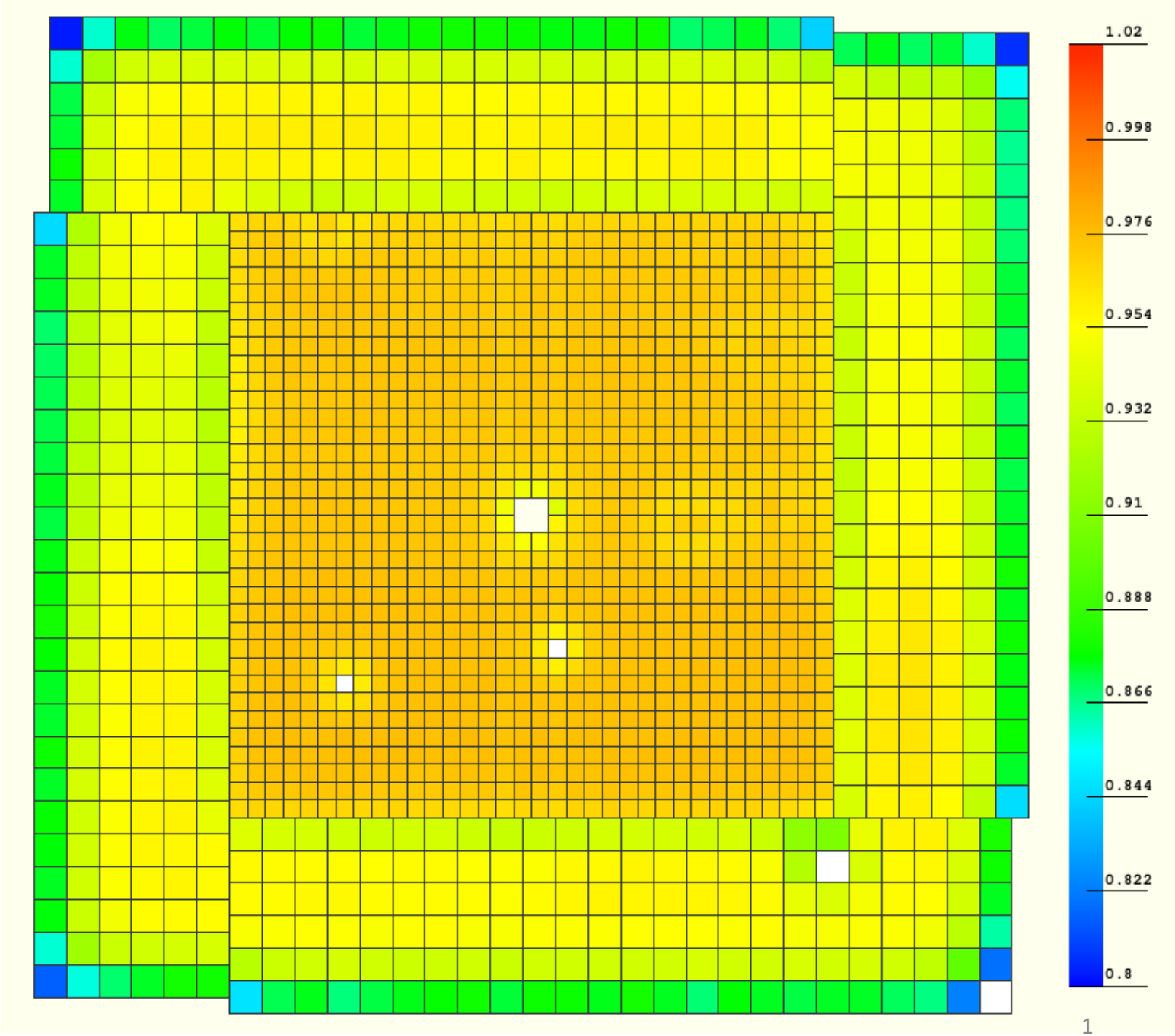
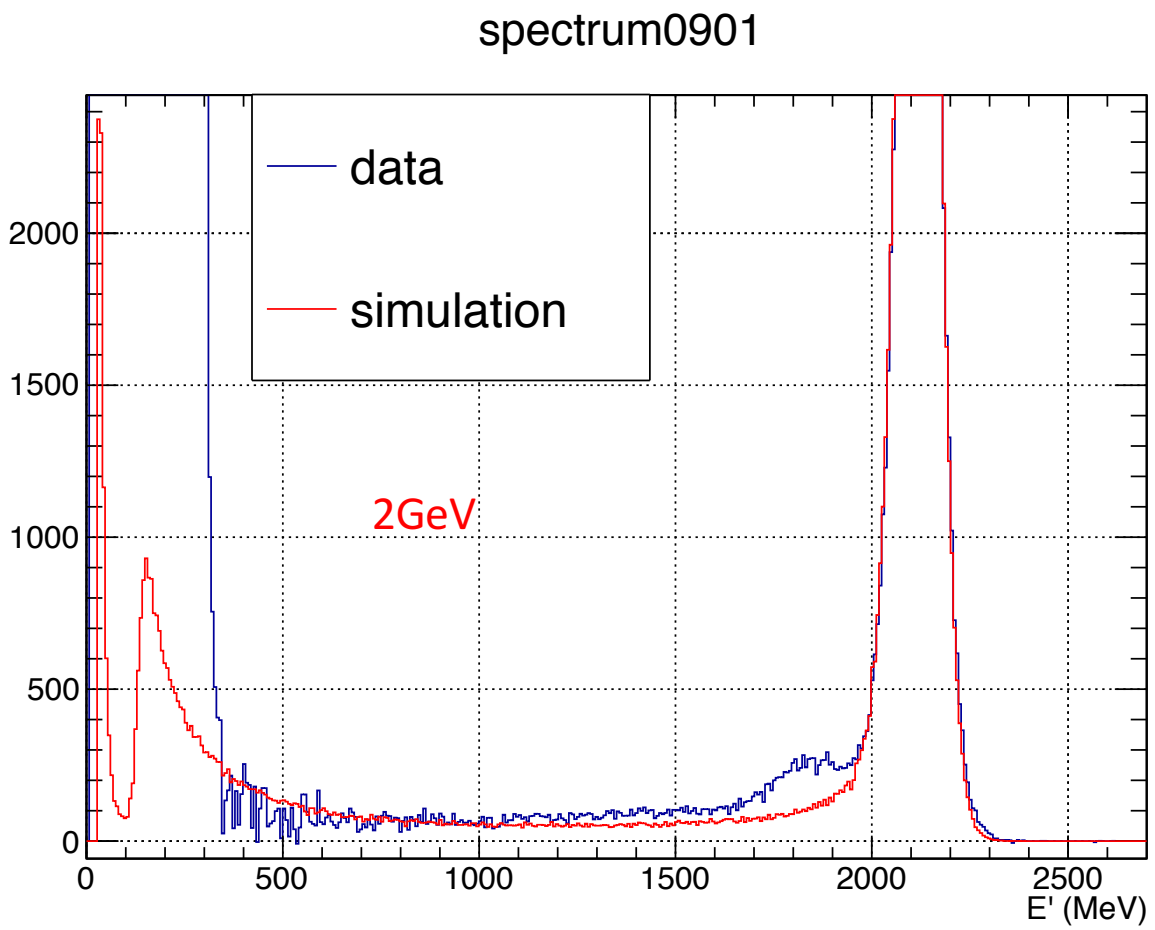
Study the spectrum from each layer of HyCal module near the transition region to understand the discrepancy between data and simulation

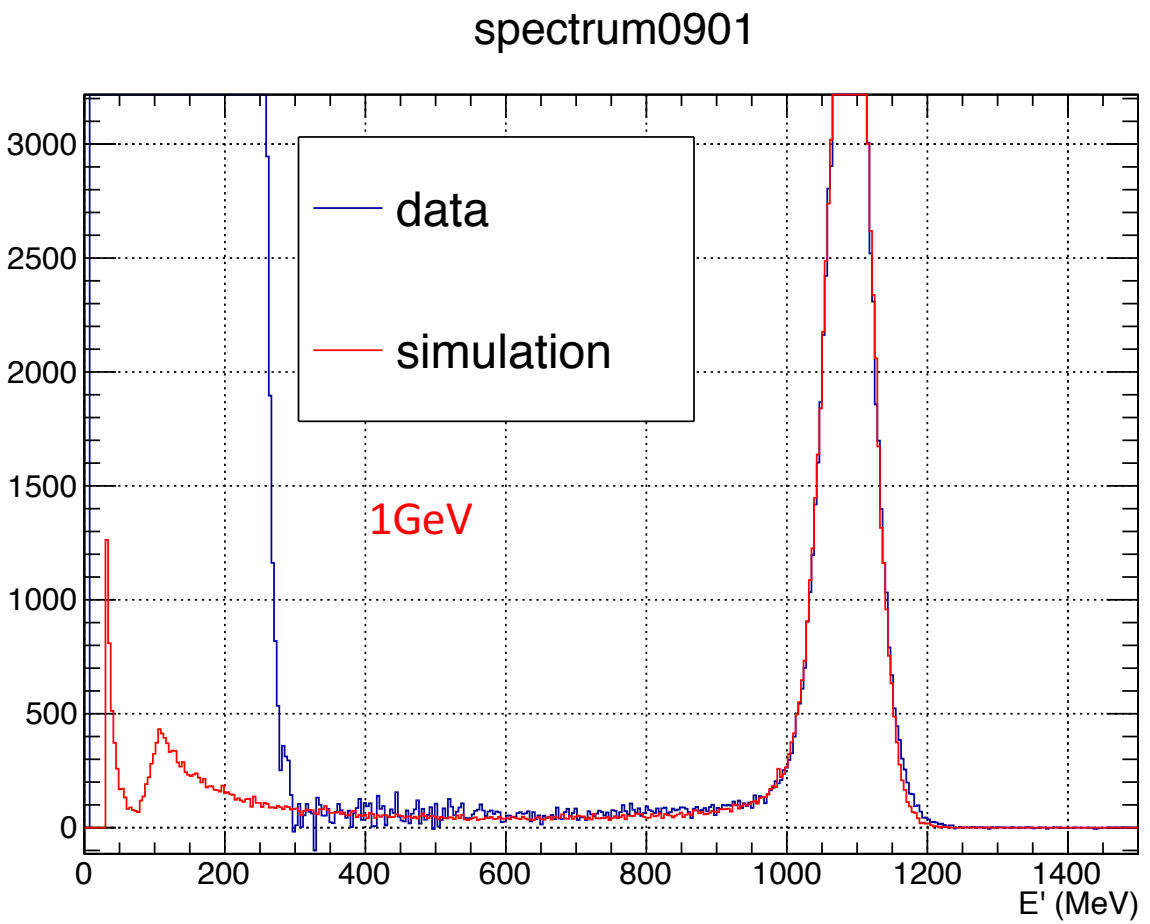
Energy spectrum is the energy distribution of a module, without any event selection. But require GEM matching condition.



MC vs data near transition region

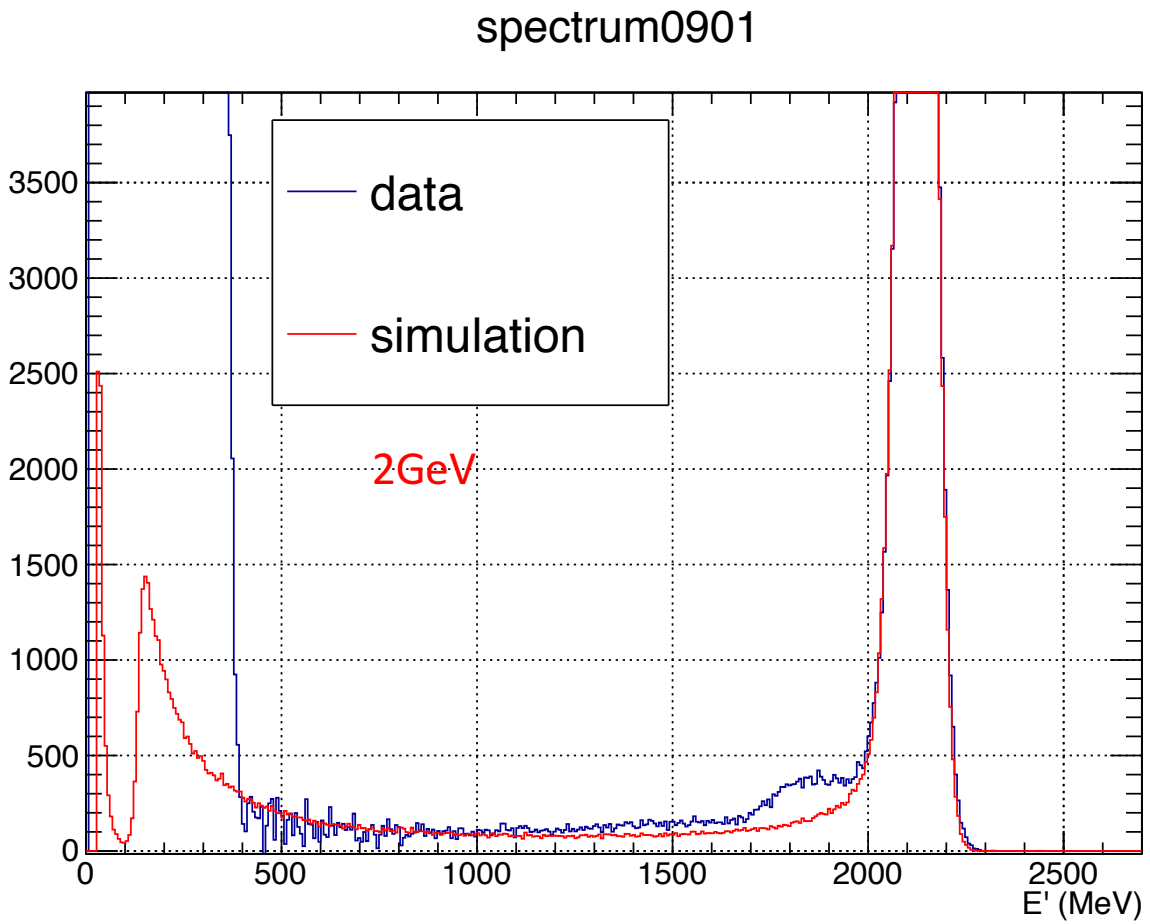
Outermost PWO layer

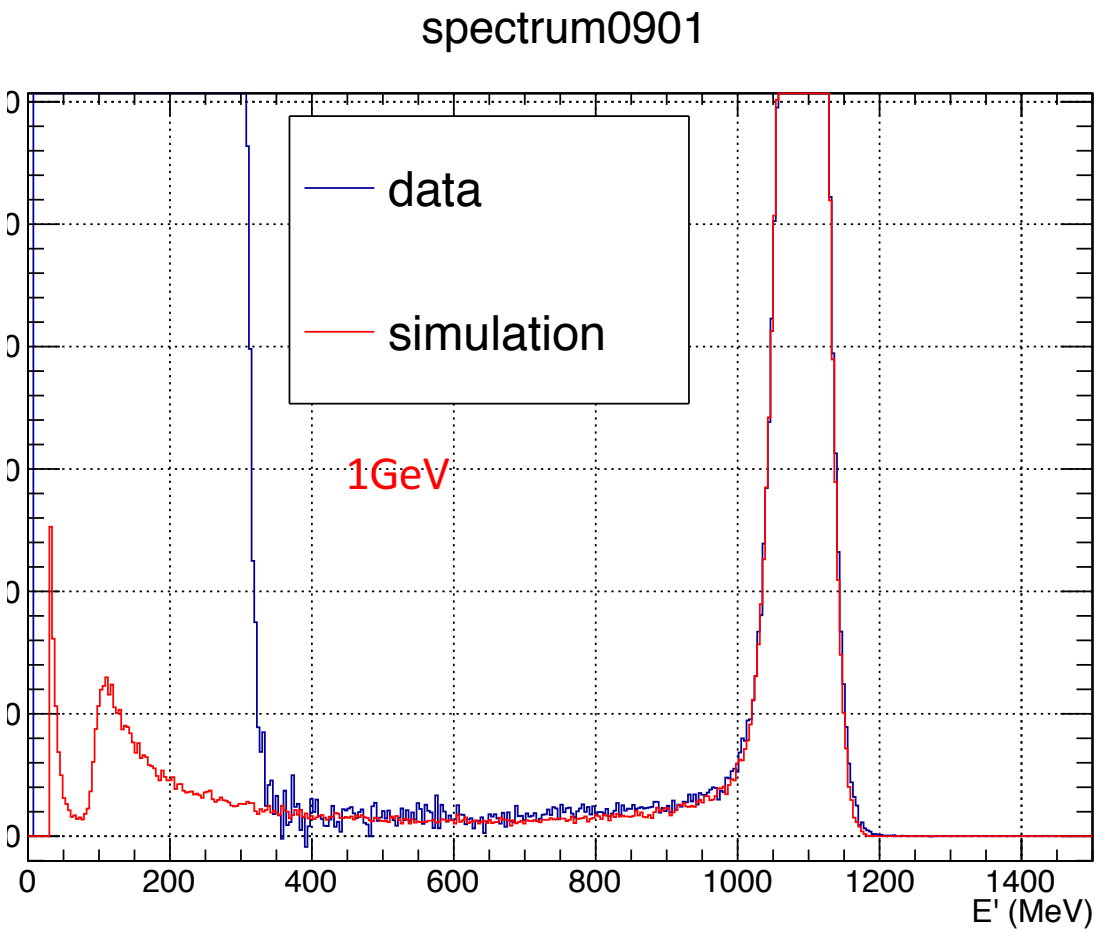




MC vs data near transition region

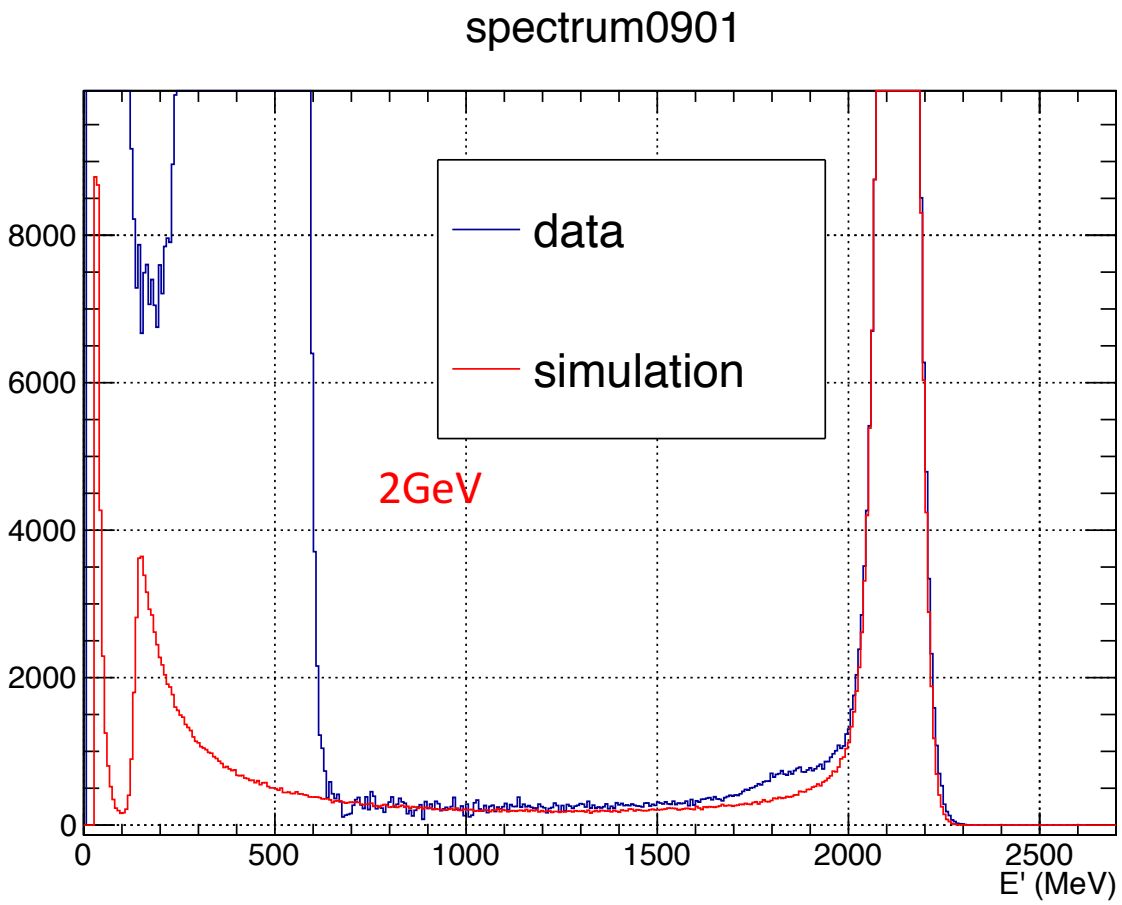
3rd Outermost PWO layer

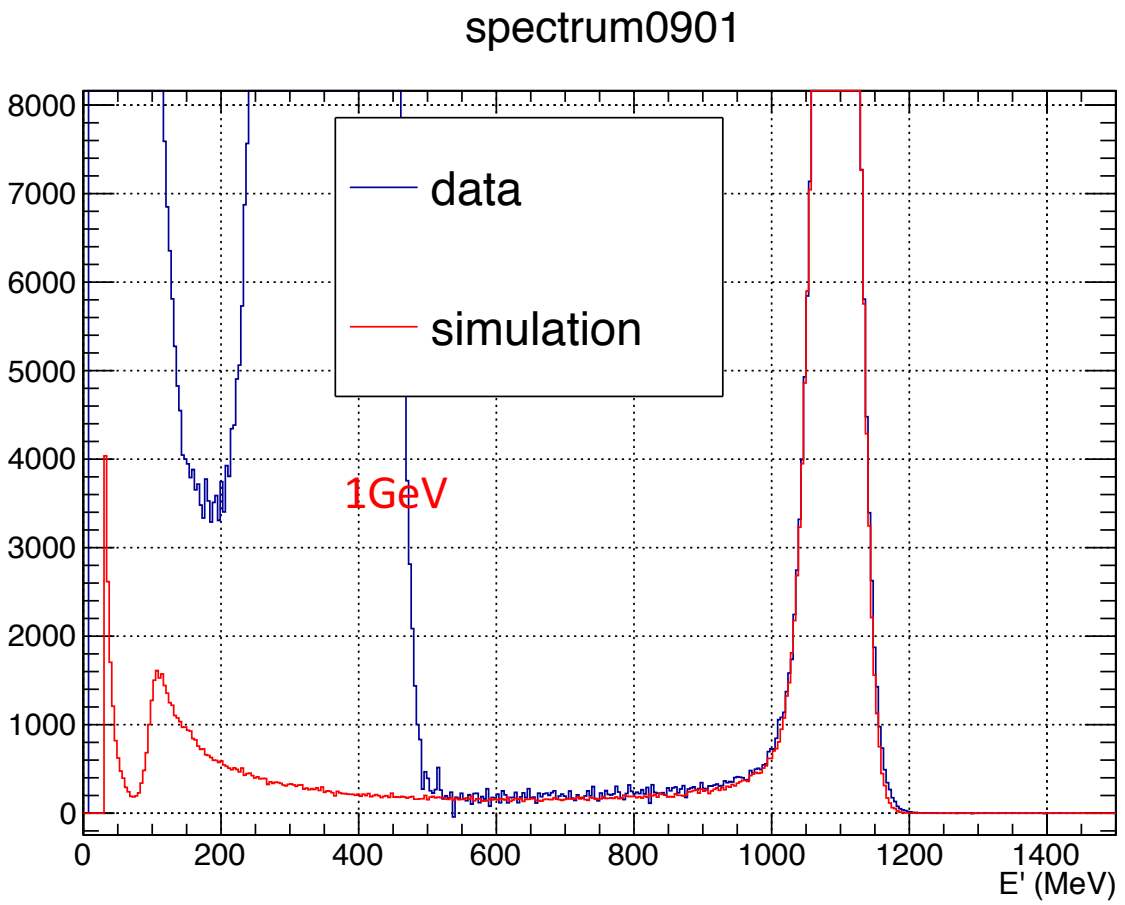




MC vs data near transition region

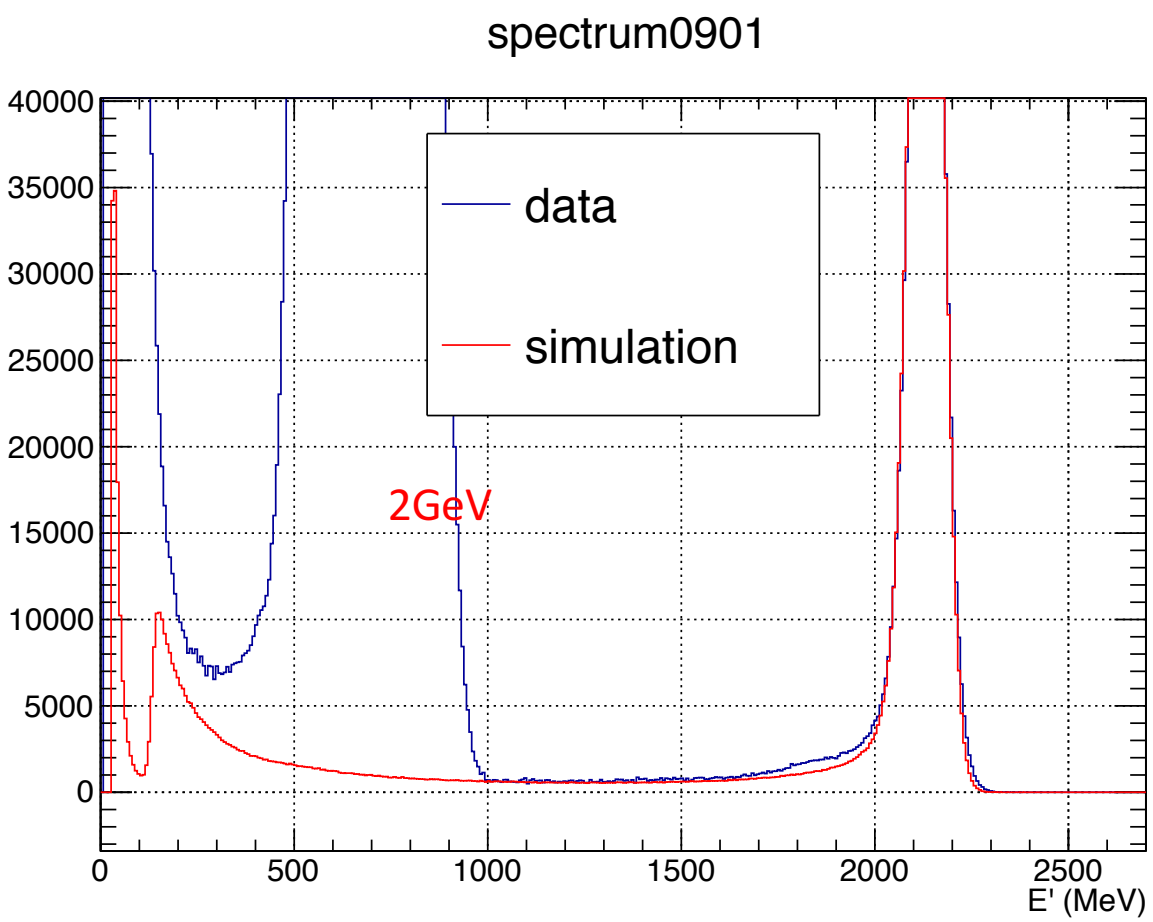
7th Outermost PWO layer

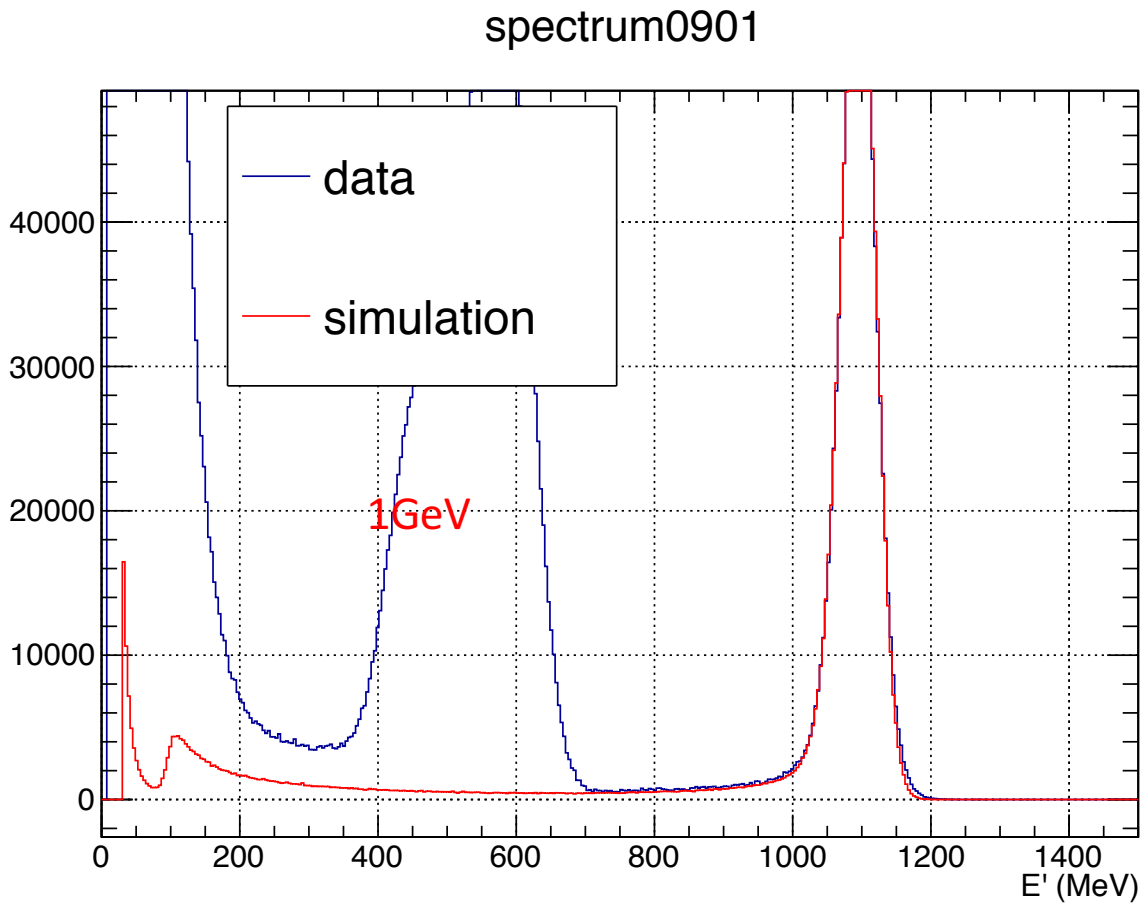




MC vs data near transition region

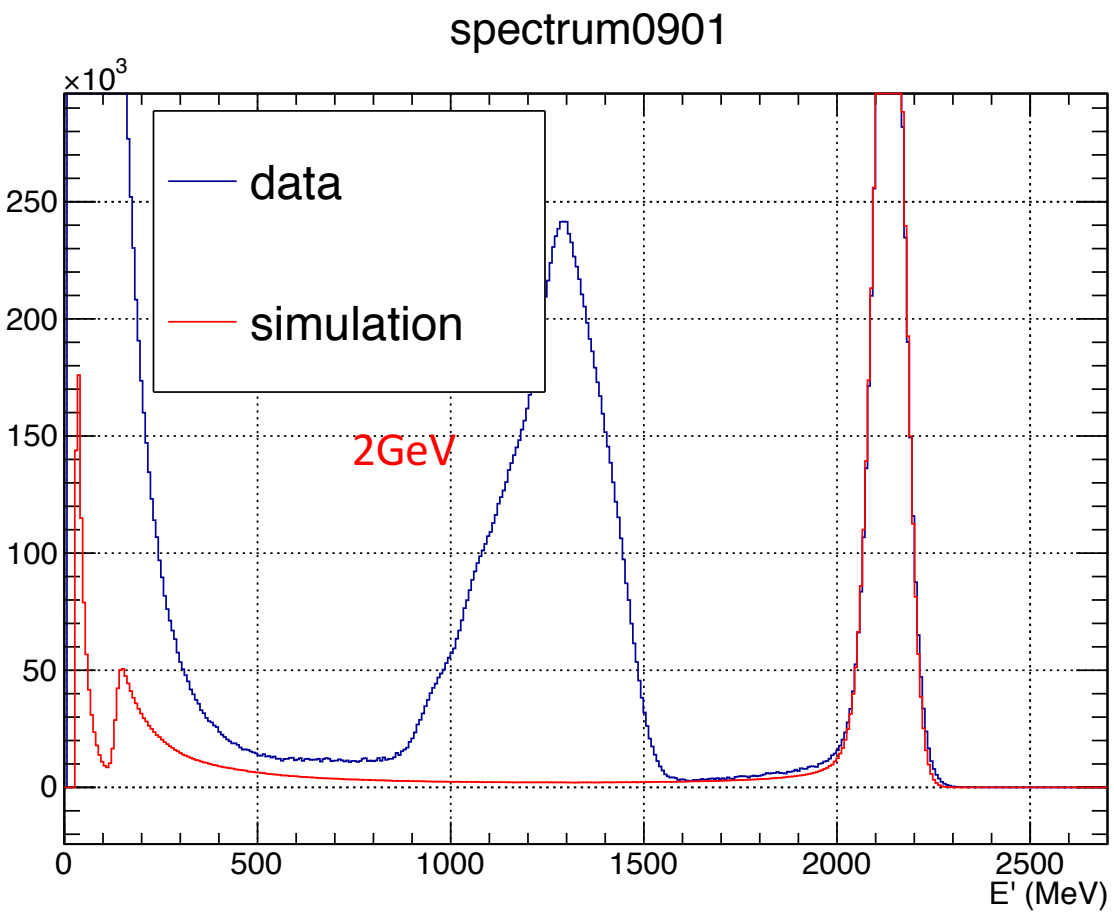
10th Outermost PWO layer

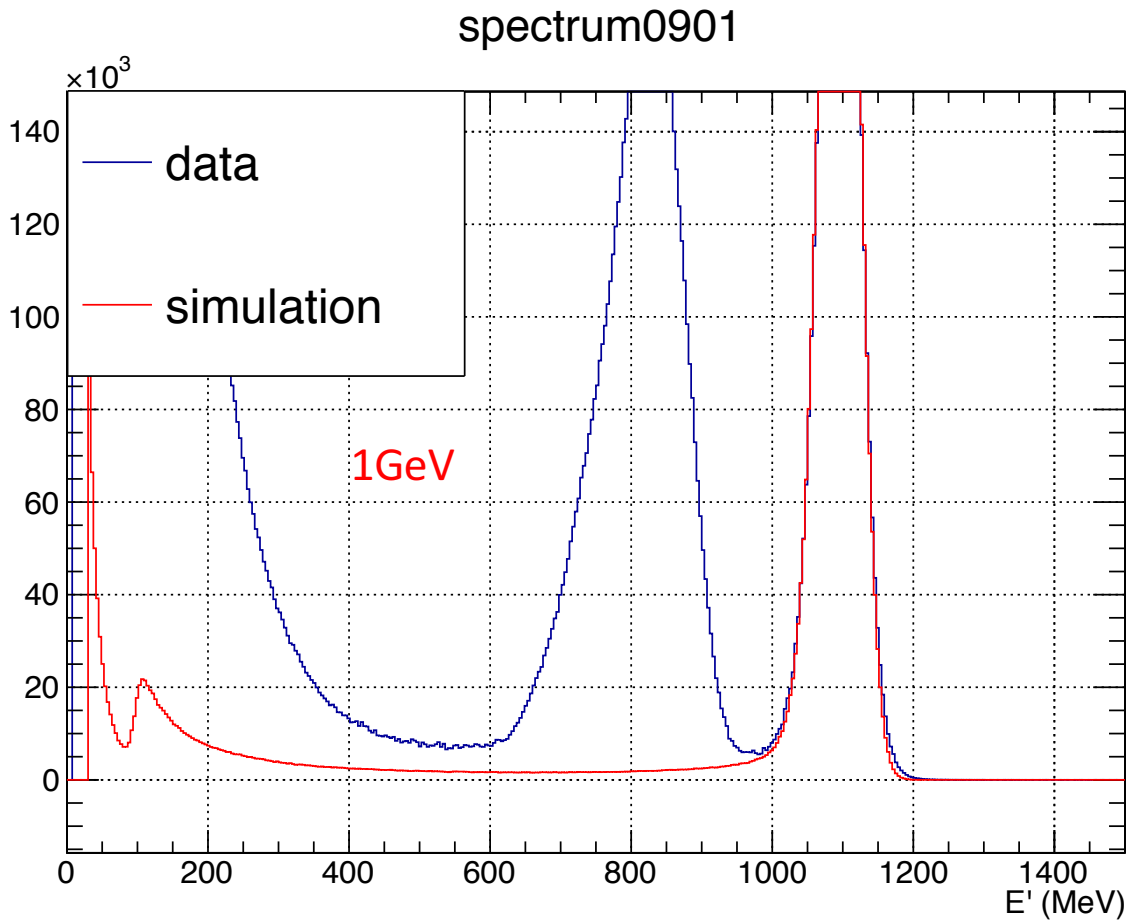




MC vs data near transition region

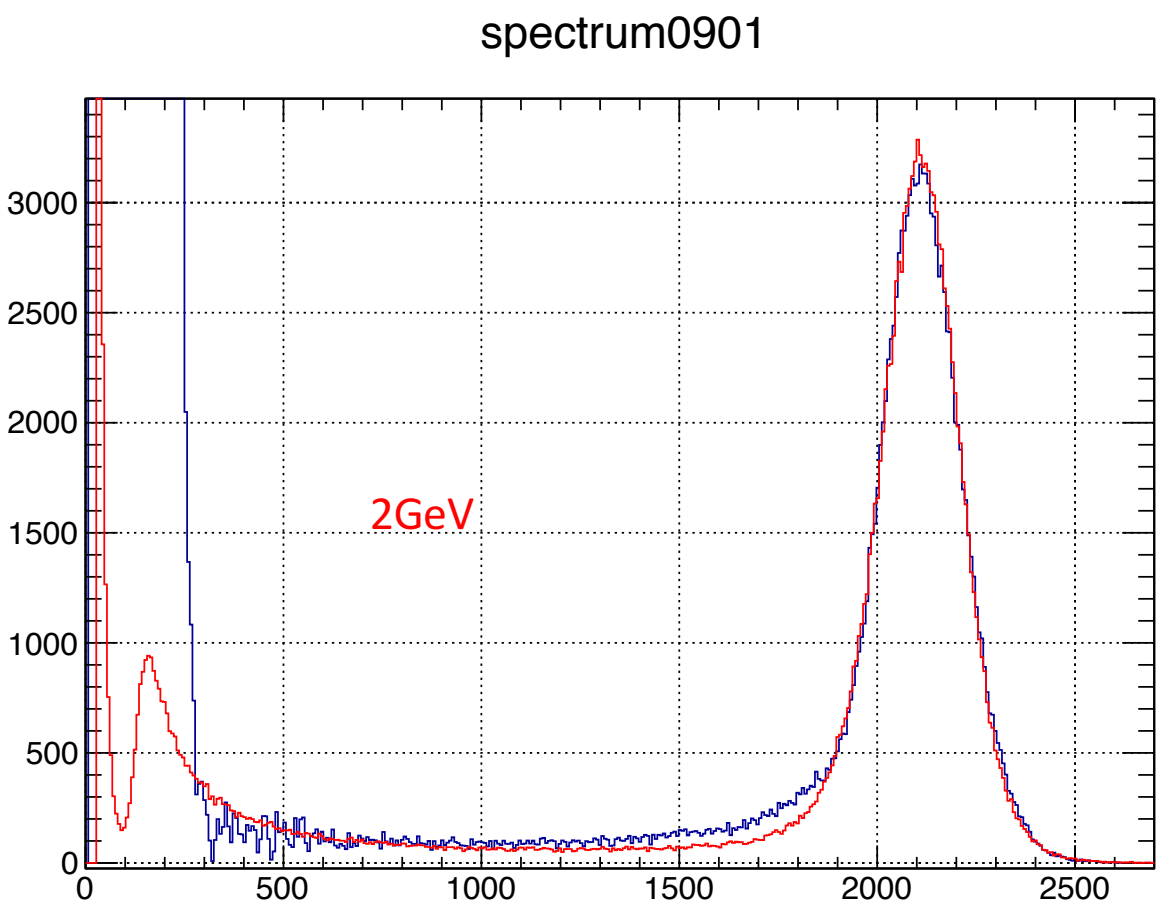
13th Outermost PWO layer

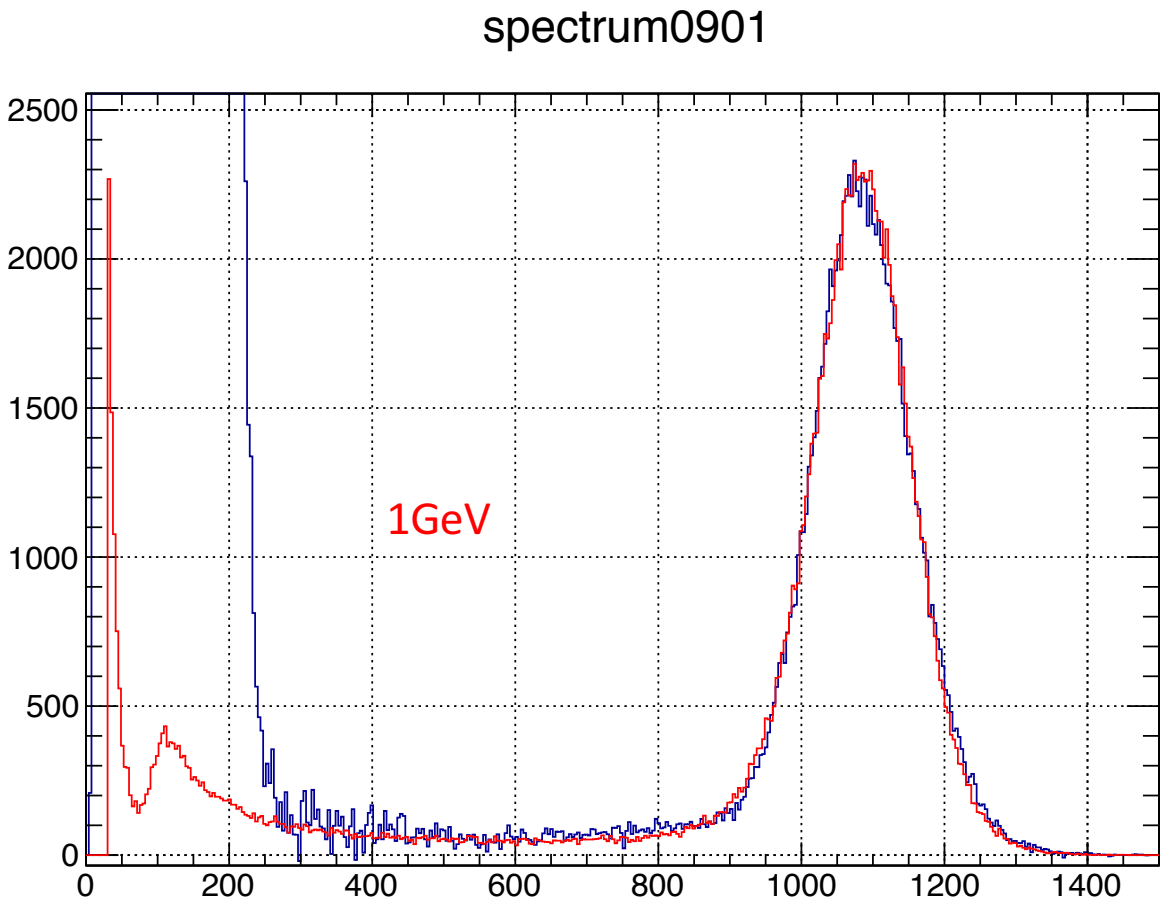




MC vs data near transition region

2nd layer LG near transition

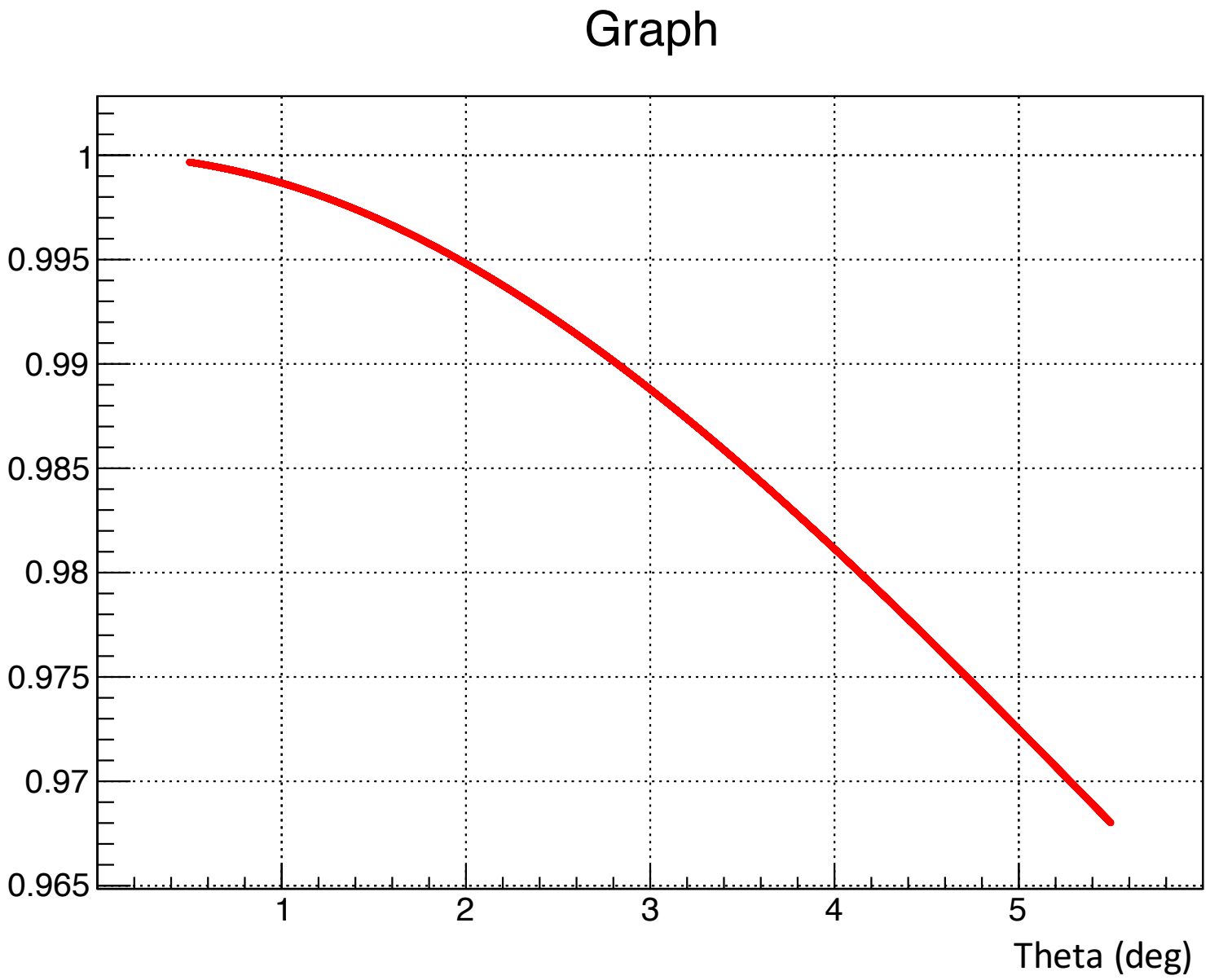




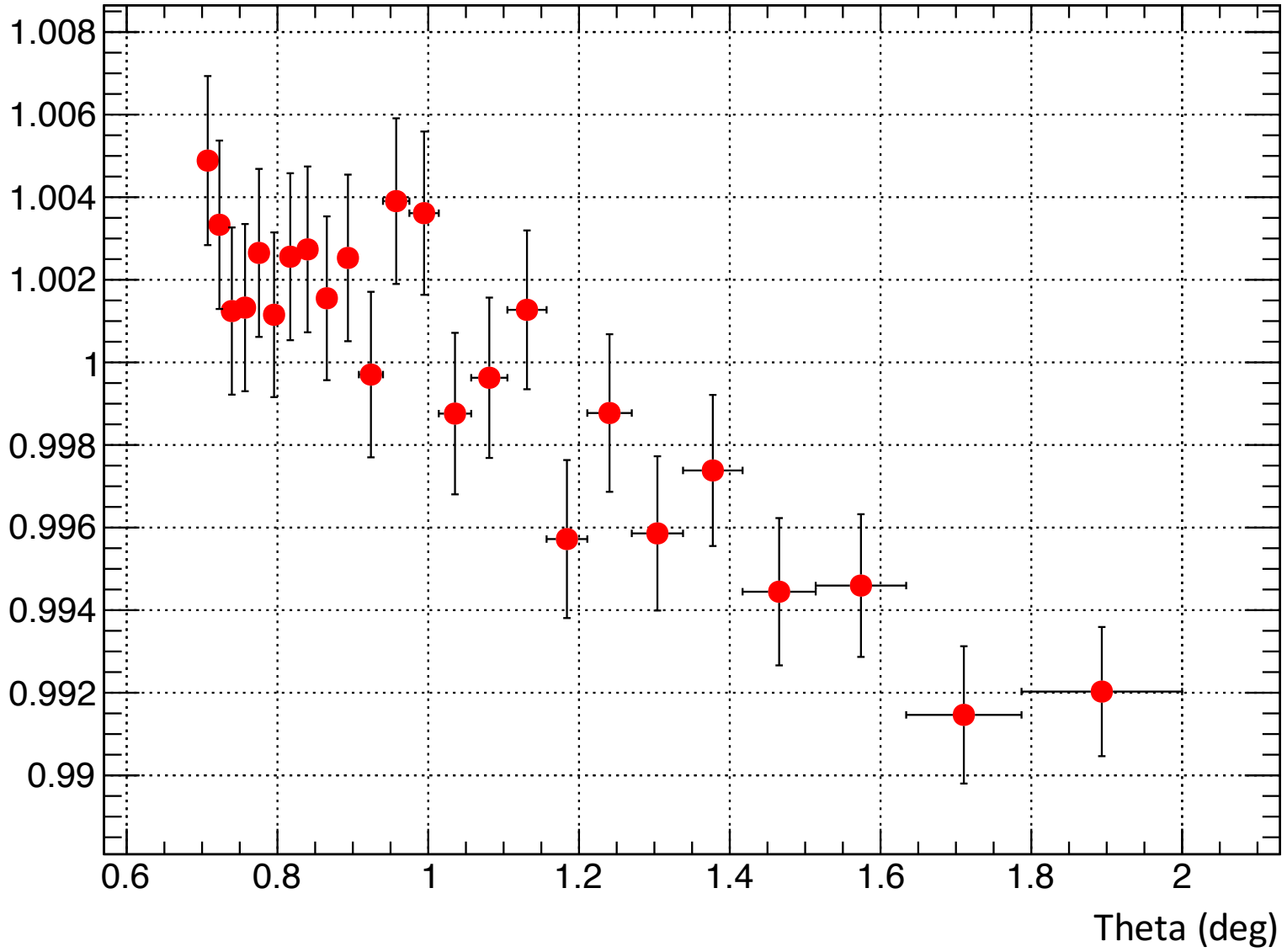
Summary

- A strange bump is observed near the 2GeV ep elastic peak
  - Doesn’t seem to come from a particular module
  - Doesn’t seem to come from a particular run period
  - Doesn’t appear for the 1GeV data
  - More obvious as scattering angle increases
  - For the LG part it is not visible, but this could just due to bad energy resolution
  - If it is a type of background, then it will increase the ep count from the data, which might very well be the cause why the ep/ee ratio from the data diverge from the simulation at large angle

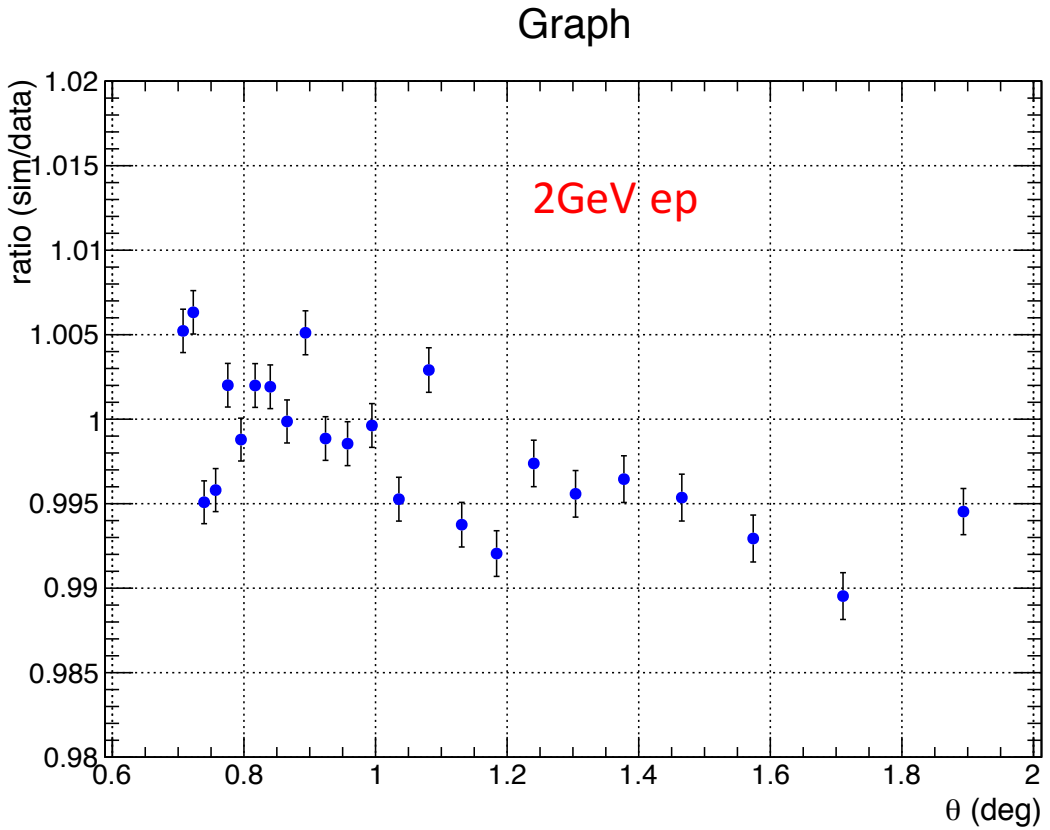
Cross section with Zhan's FF vs Cross section with dipole FF

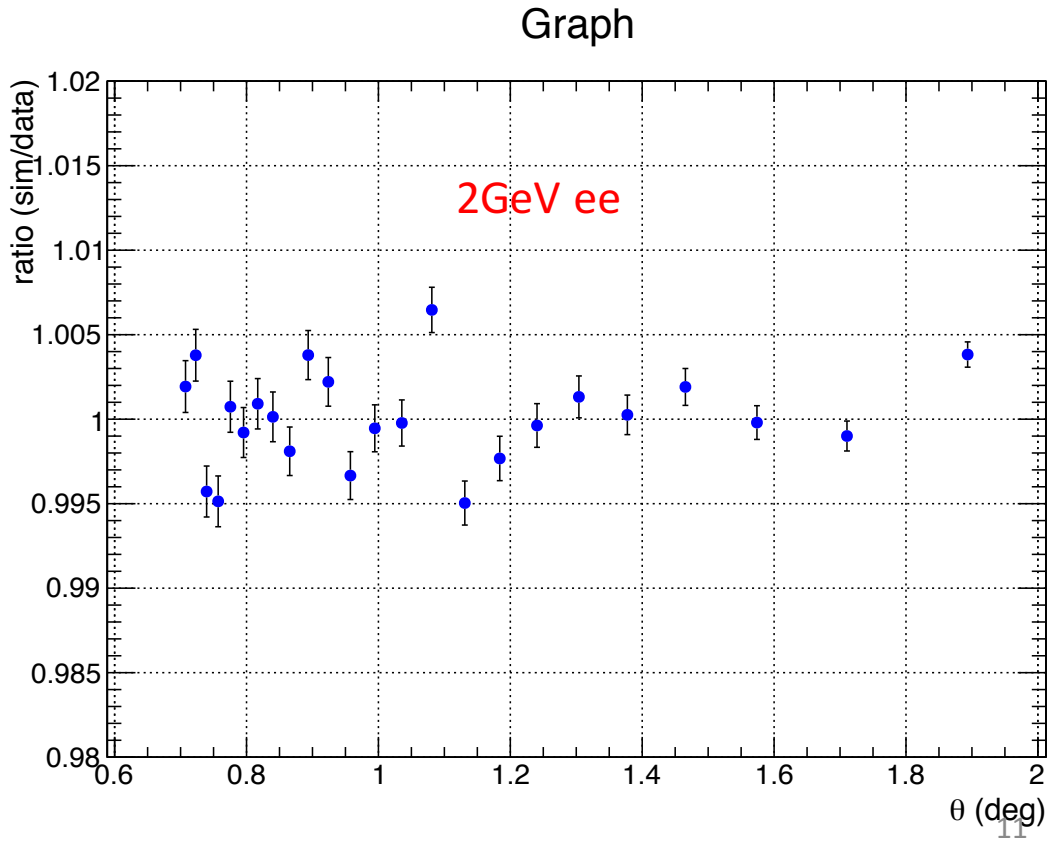


Simulation ep/ee vs data ep/ee in all quadrants



- To understand where is strong angular dependency comes from, instead of looking directly at the ep/ee ratio, look at the ep and ee comparison with the data separately
  - Firstly, do the GEM efficiency correction to the data for ep and ee separately
  - Scale the the total count in the theta range from the simulation to be the same as data (since we don't know really well the luminosity)
  - Lastly look at the ratio between simulation and data for each theta bin

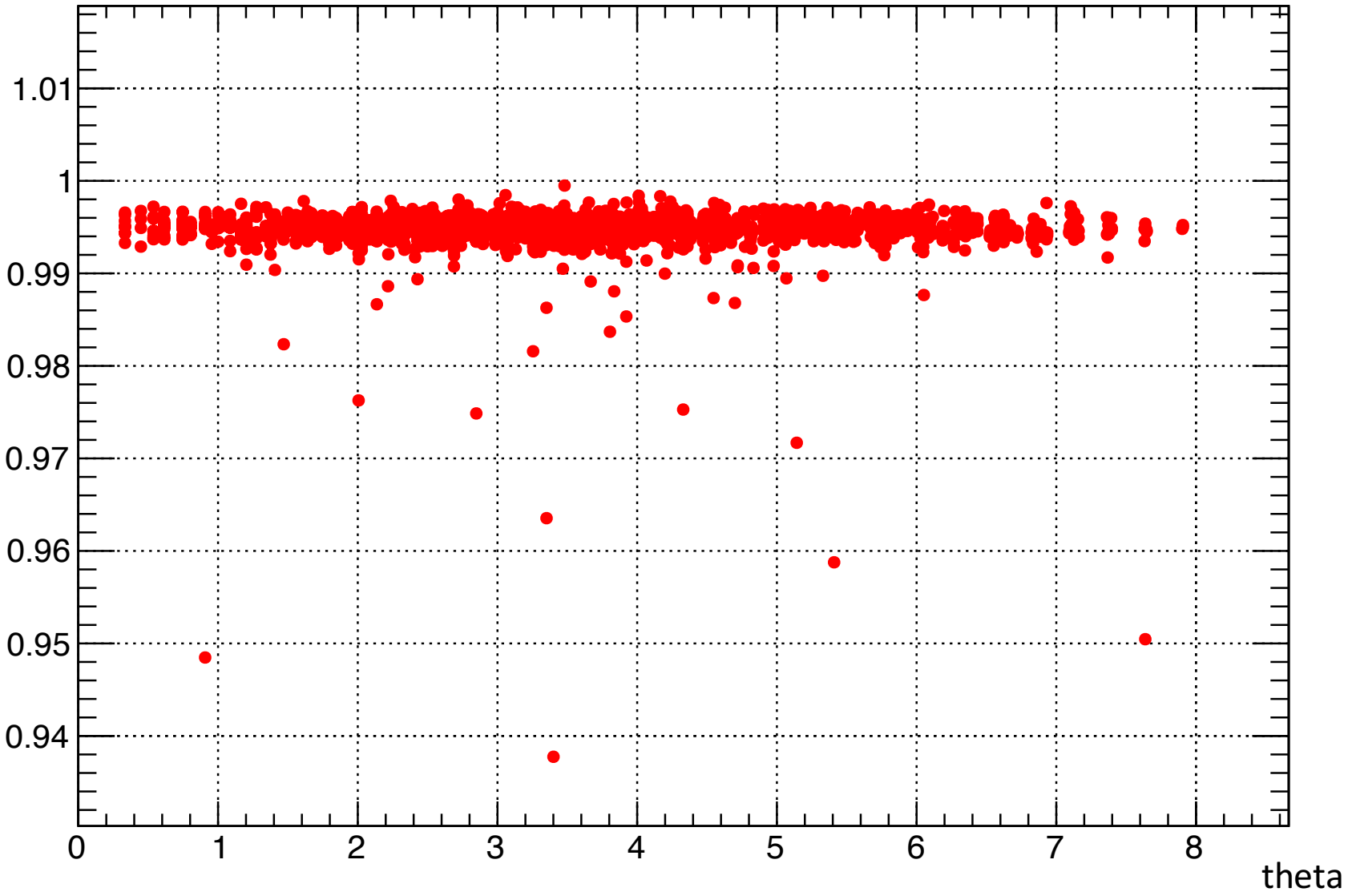




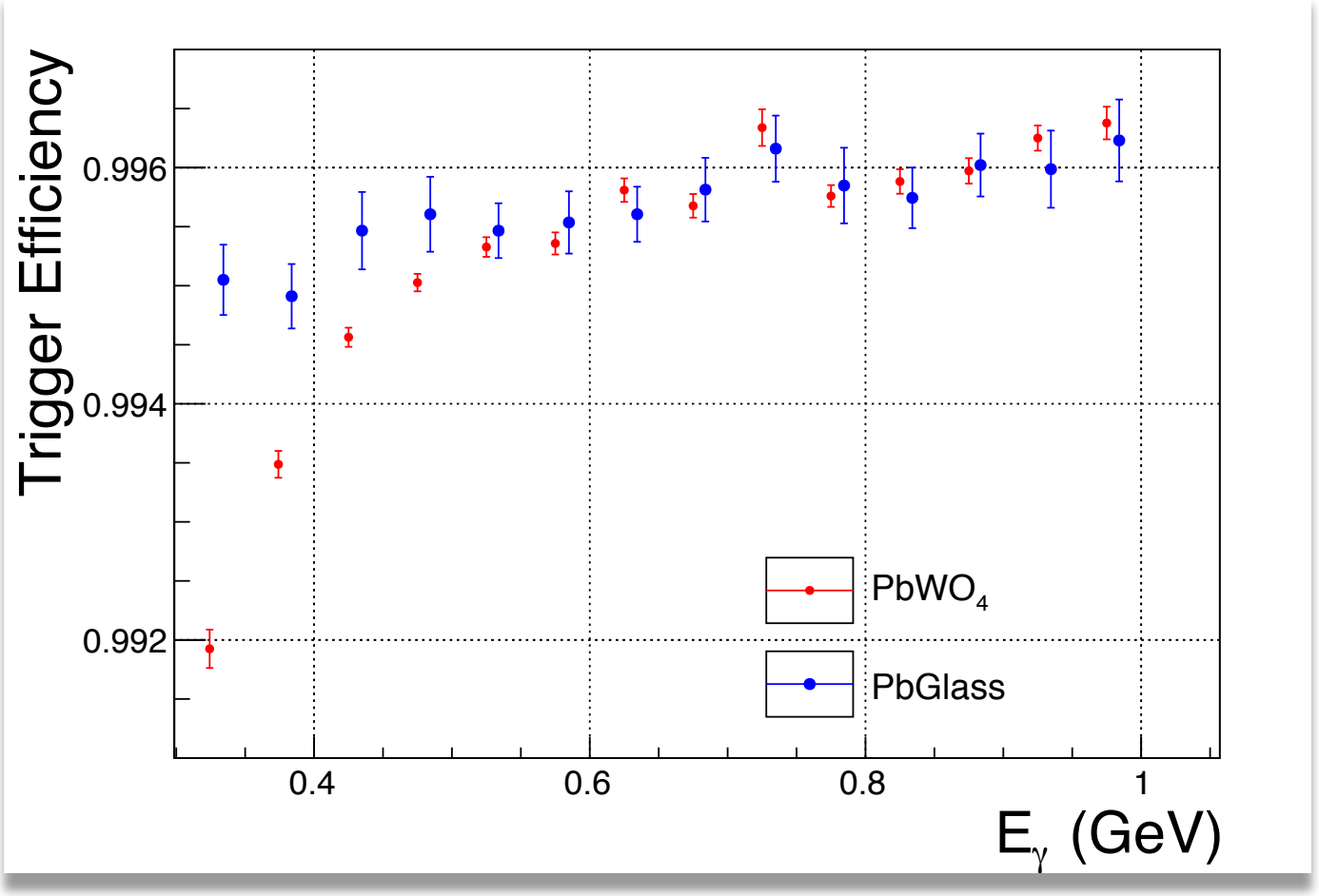
- Seems like the strong angular dependency comes solely from the ep side

- Possible causes:
  - Background subtraction?
    - So far we can say the ep yield after subtraction is quite stable within all 2GeV runs. Similar angular dependency exist in different quadrants.
  - ep event generator?
  - Trigger efficiency?
  - …

Trigger efficiency as a function of scattering angle theta



- How to correct for the trigger efficiency?
  - For ep this is trivial, we use the trigger efficiency of the module that the ep cluster center is on
  - For ee, the trigger efficiency “maybe” 1 – (both cluster not triggered)
  - In addition, the trigger efficiency we have in the table is just a constant, it doesn’t describe the low energy drop



Simulation ep/ee vs data ep/ee in all quadrants