C3 Meeting
Beam Background Studies

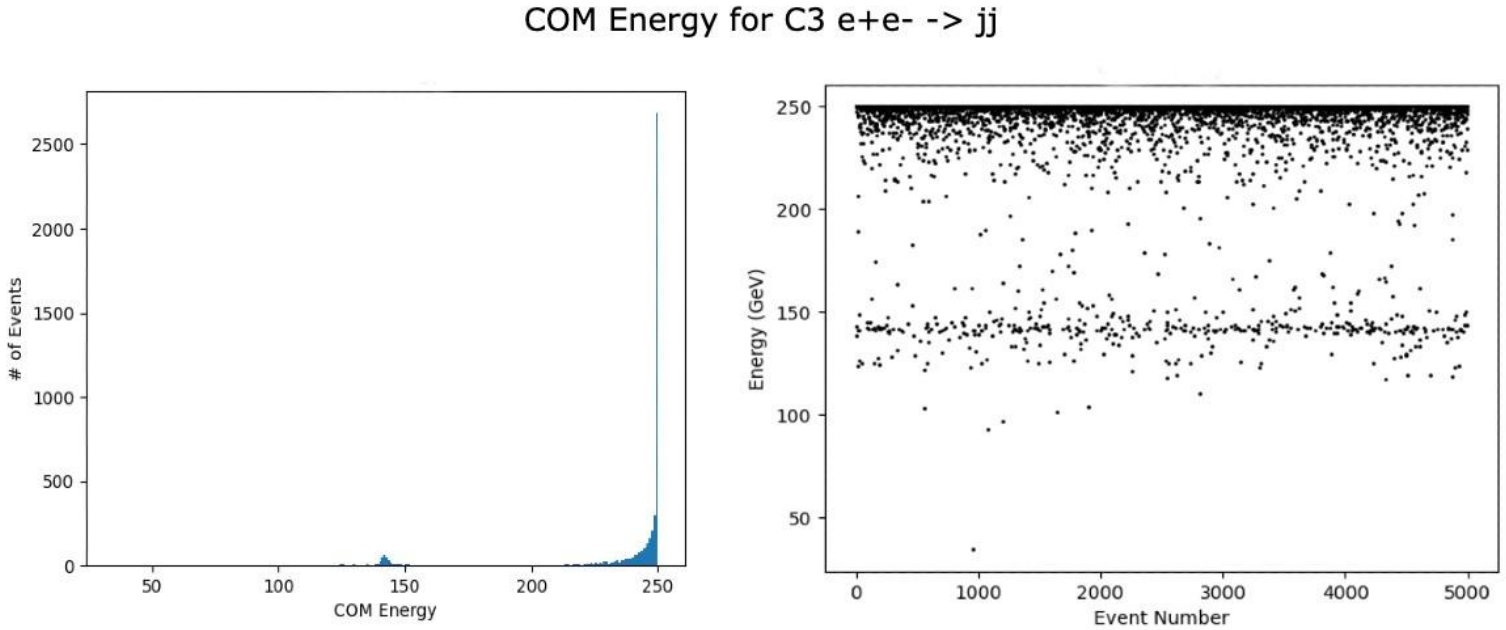
Elias Mettner -October 6, 2023

CIRCE/WHIZARD

- Produced output from CIRCE modified for C3
- Created WHIZARD script that runs a simple process but takes in our CIRCE output
- Outputs a hepmc file which we will then feed into Geant
- We have been running some tests on the hepmc output to trust its validity before we begin with modifying WHIZARD to better fit our needs for the hadron background

WHIZARD Output Issue

- Plotted the CoM Energy of 5000 simulated events (expecting ~250 GeV for all)
- Process: e+e- -> jj
- A small number of events hover around 150 GeV
- We were uncertain so we messaged Thorsten Ohl with hopes of an explanation

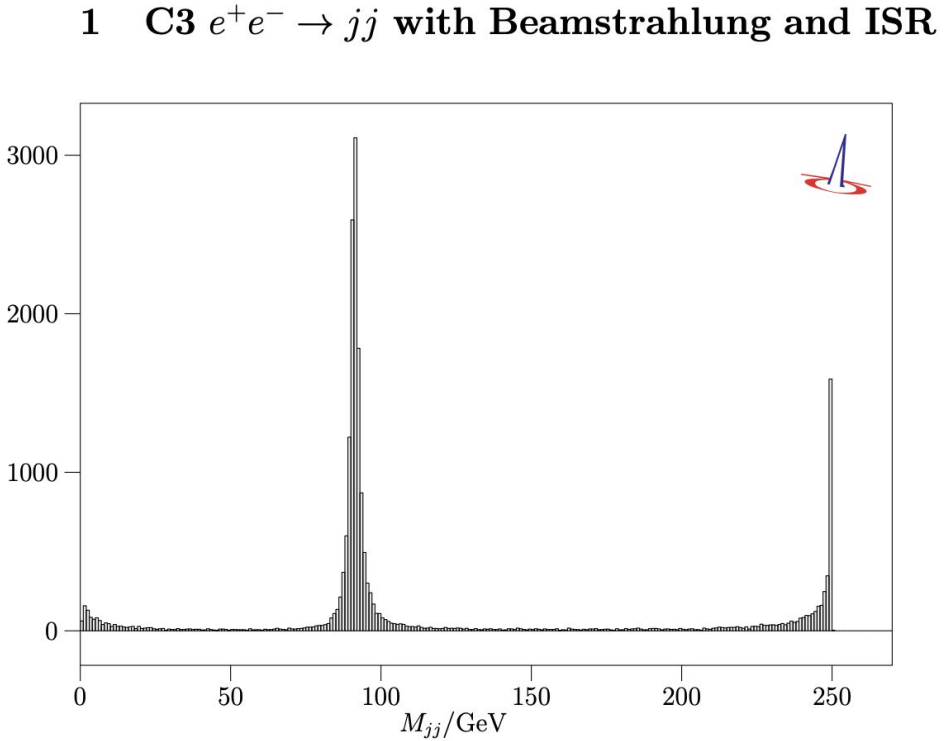


Correspondence With Thorsten

- Thorsten agreed something was odd with this bump and began to look into it with us
- As we noticed, these events are all heavily boosted with one beam having radiated most of its energy
  - Hard ISR photon assumed to go down the beampipe and doesn't appear in HepMC record
  - Events like this are expected, but they should be smoothly distributed - the bump is odd
- We ran some WHIZARD tests of various combinations with/without circe input, ISR, hadronization
  - Still no luck

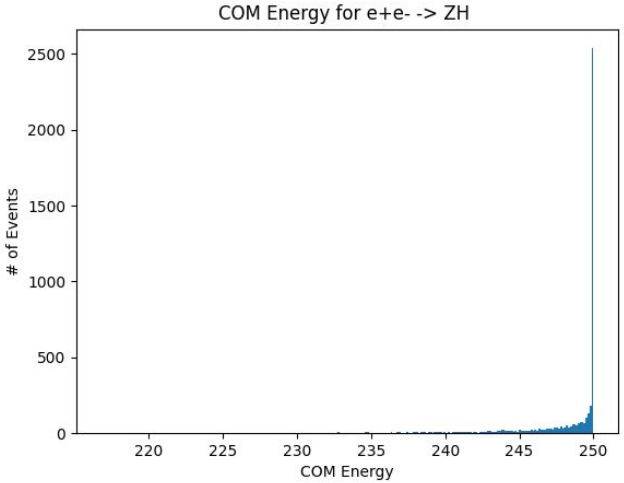
Correspondence With Thorsten

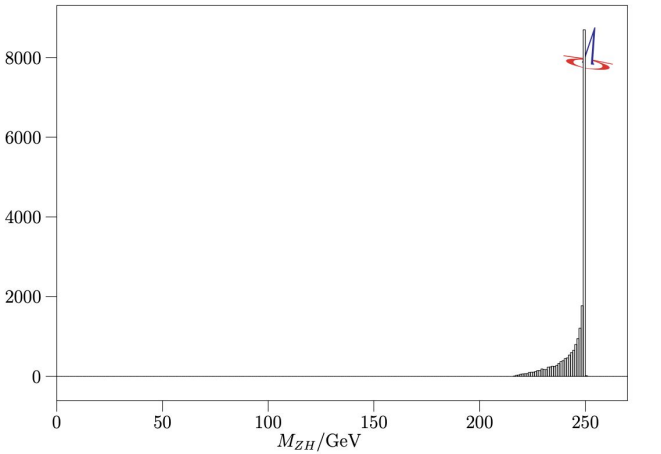
- After discussing more of our methods, we discovered the issue and explanation
- Our plots of the COM Energy are taken from the laboratory frame and not the actual COM frame
- In the correct center of mass frame, the plot has the peak of the Z Mass clearly visible



Correspondence With Thorsten

- This frame mixup would normally not be a big issue
  - This is specifically a resulting of simulating the e+e- -> hadrons process
  - We pick up some extra poles in the momentum structure since the beam energy is high
- The bump is the radiative return to the Z expressed lab frame
- To make sure this was the case, Thorsten and I plotted some ZH events with WHIZARD (expecting to see no bump this time)





Conclusion

- This error was the combination of a small mixup and a special case
- During this process, Thorsten also added a feature to Circe2 that will filter out certain regions where there are so few GPig events that they cannot be trusted
    - Gets rid of some the unrealistic radiative return from BS
- Now that we understand the workings of WHIZARD and CIRCE more, we are ready to begin configuring WHIZARD with instructions from Tim Barklow