FF radiation

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MDI meeting

Outline

- Final Focus radiation
  - Introduction
  - Layout
  - Top
    - Intensity
    - Plot
  - Giant Dipole Resonance
    - Plots
  - Higgs
  - Summary

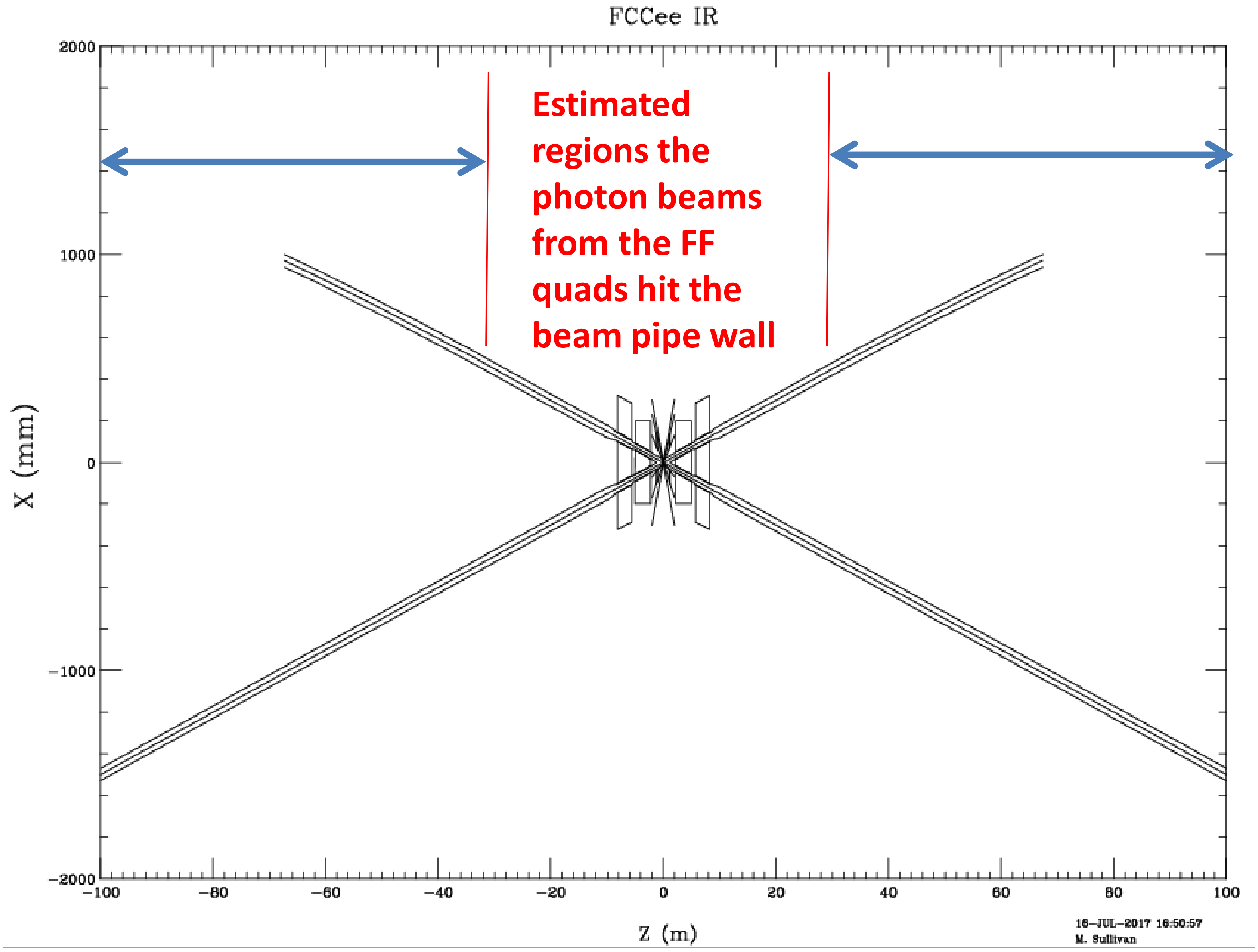
Introduction

- The final focus quads (Q1 and Q2) are very strong in the FCCee design
- The beam is also very big in these quads
- The combination generates a very high energy beam of SR photons that travel down the out going beam pipe
- Almost all of the radiation stays inside the beam pipe until the pipe turns to match the beam in the first downstream bend magnet

Intro. (2)

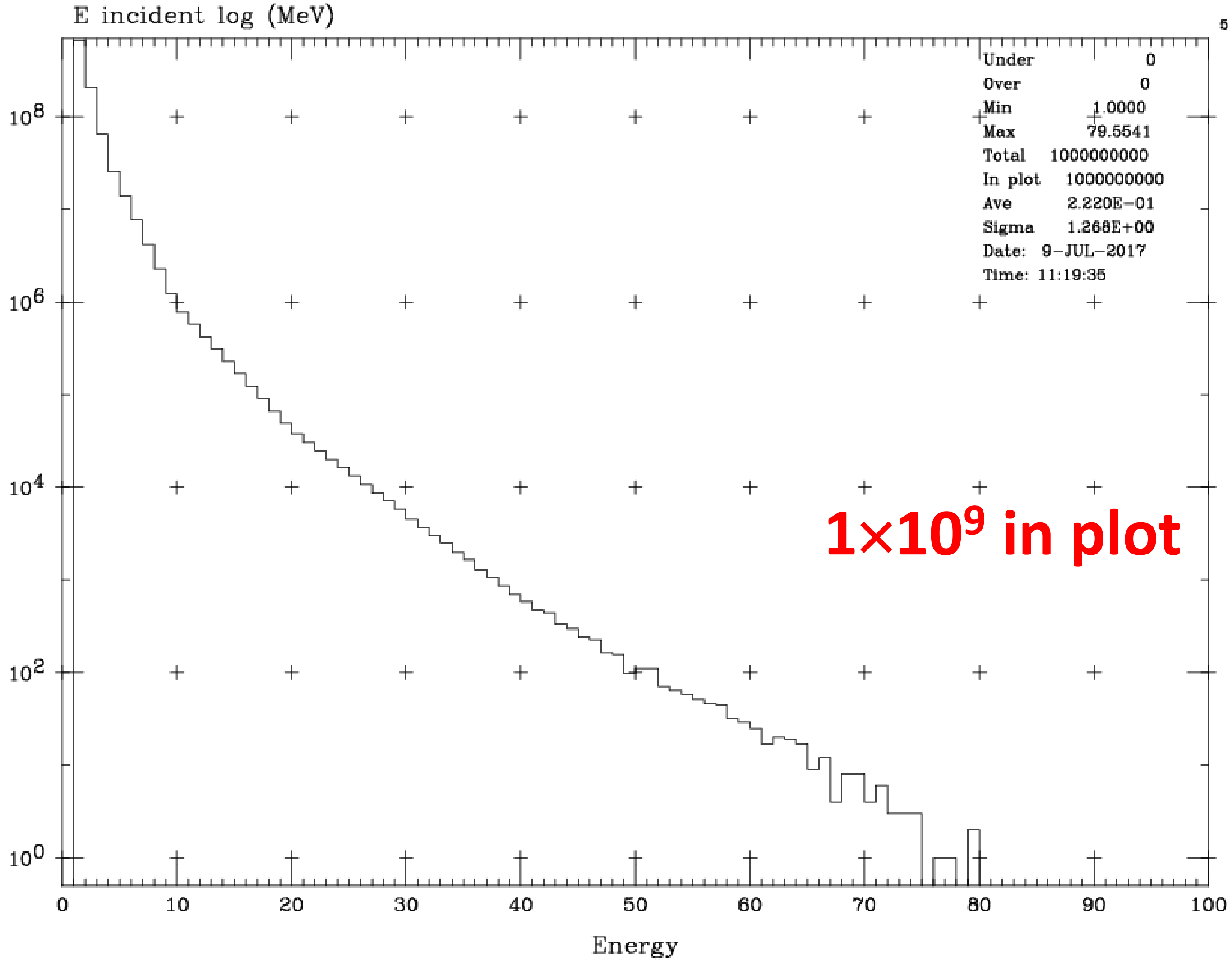
- The first downstream bend starts 29 m from the IP (fairly close)
- The photon spectrum from the FF quads has a high-energy tail that goes out to 10s of MeV
- I initially thought that the photon beam would be fairly localized but even the outgoing bends are so gentle that the photon beam from the ff quads is scrapped off over about 60 m of beam pipe

Picture of the downstream beam pipes



Top energy SR plot

- 5.17×10^{9} photons > 1 MeV per beam bunch
- 1.05×10^{7} photons > 10 MeV per beam bunch



Giant Dipole Resonance

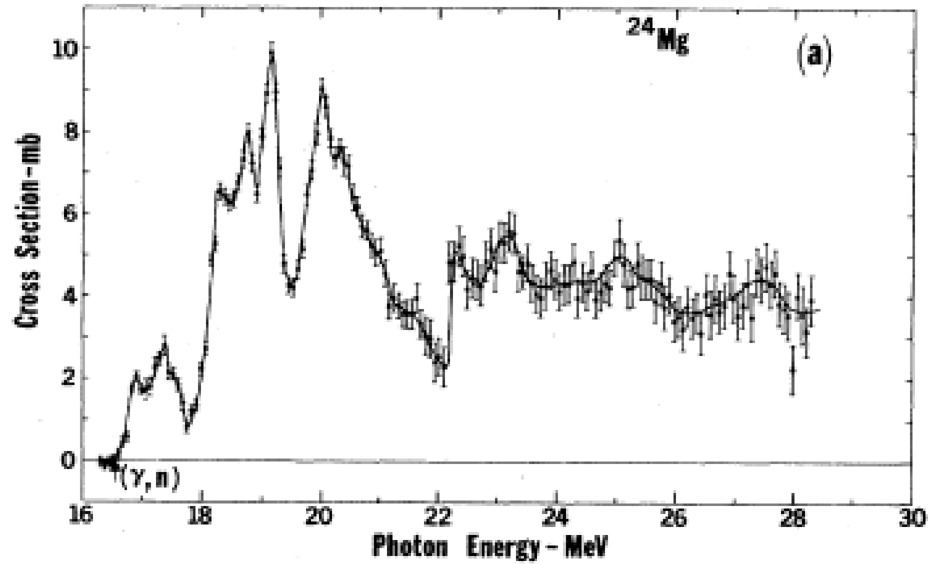
- The giant dipole resonance is a resonance in the photo production of neutrons
- It is a function of the element being struck by the photon beam
- Plots in next slides are from a reference:
  - "Measurement of the Giant Dipole Resonance with Monoenergenic Photons", Berman and Fultz, Rev. of Mod. Phys., 47, pg. 713 (1975)

GDR plots

Here are the cross-section plots for Mg and Si.

Al is between these two materials.

The resonance is at least 10x the cross-section value before the resonance.



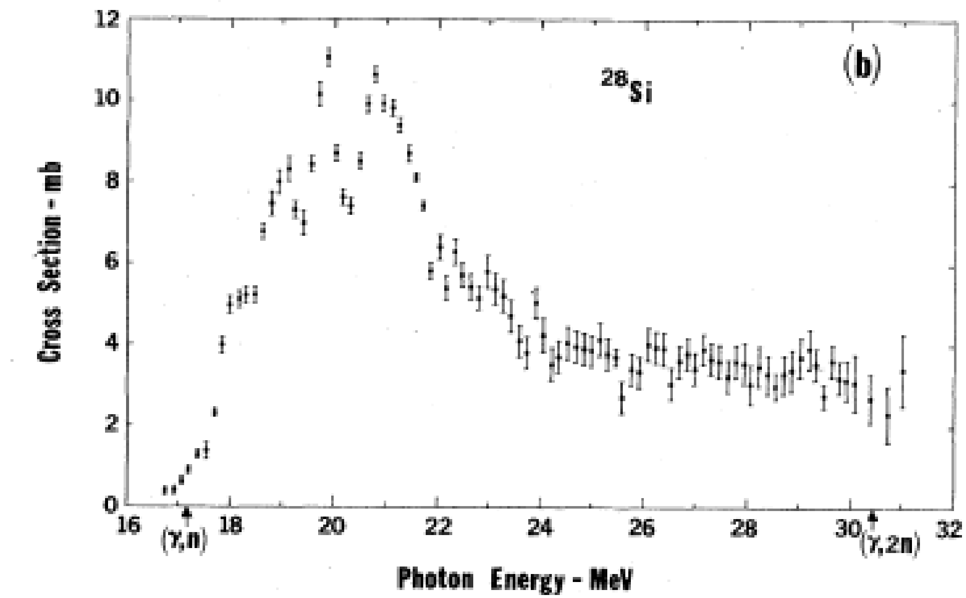
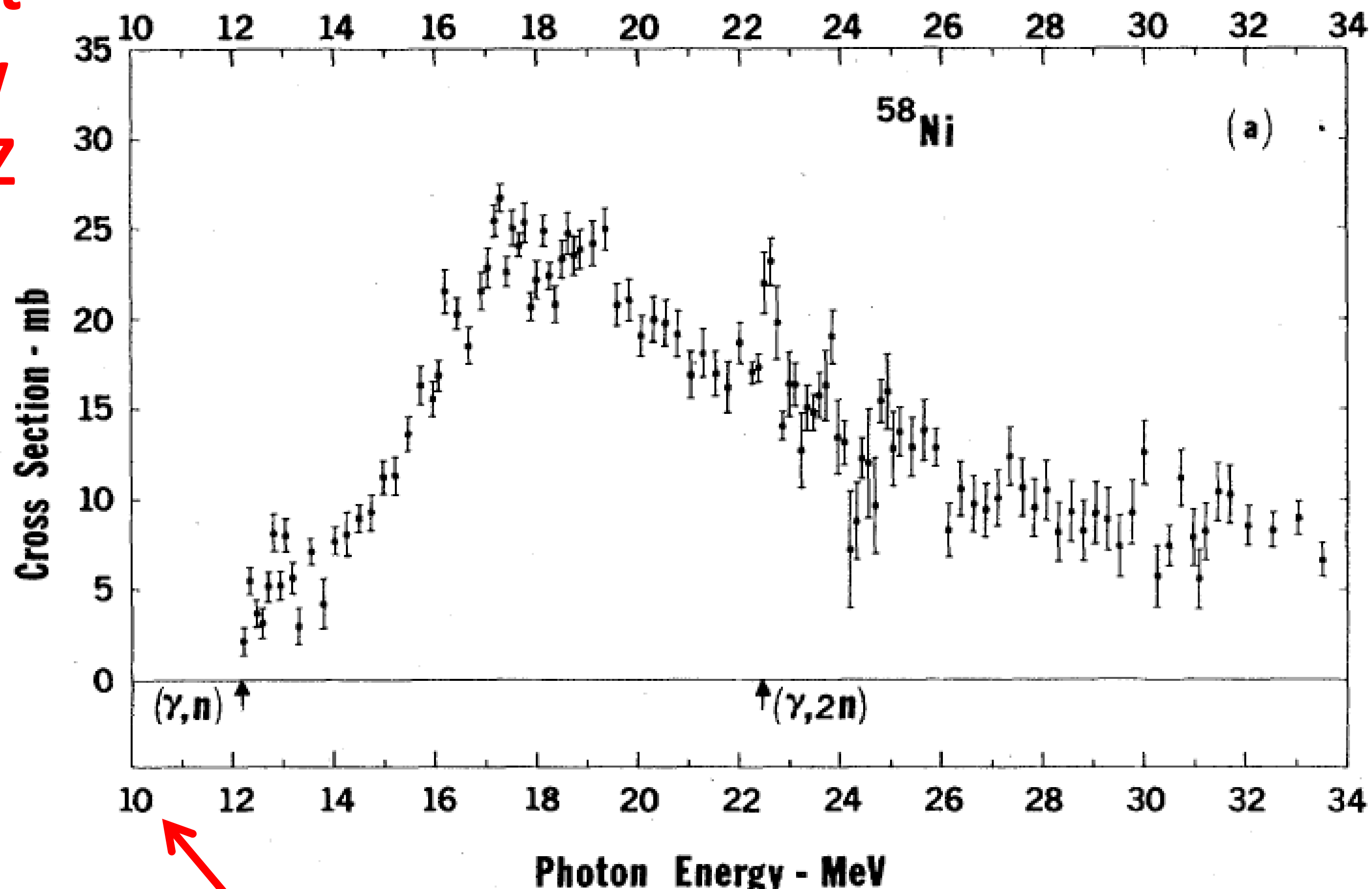


FIG. 15. (a) Photoneutron cross section for ^{24}Mg (Livermore). The curve is drawn to guide the eye. (b) Photoneutron cross section for ^{28}Si (Livermore).

GDR plots (2)

Higher Z pushes up the resonance at least for low to medium Z

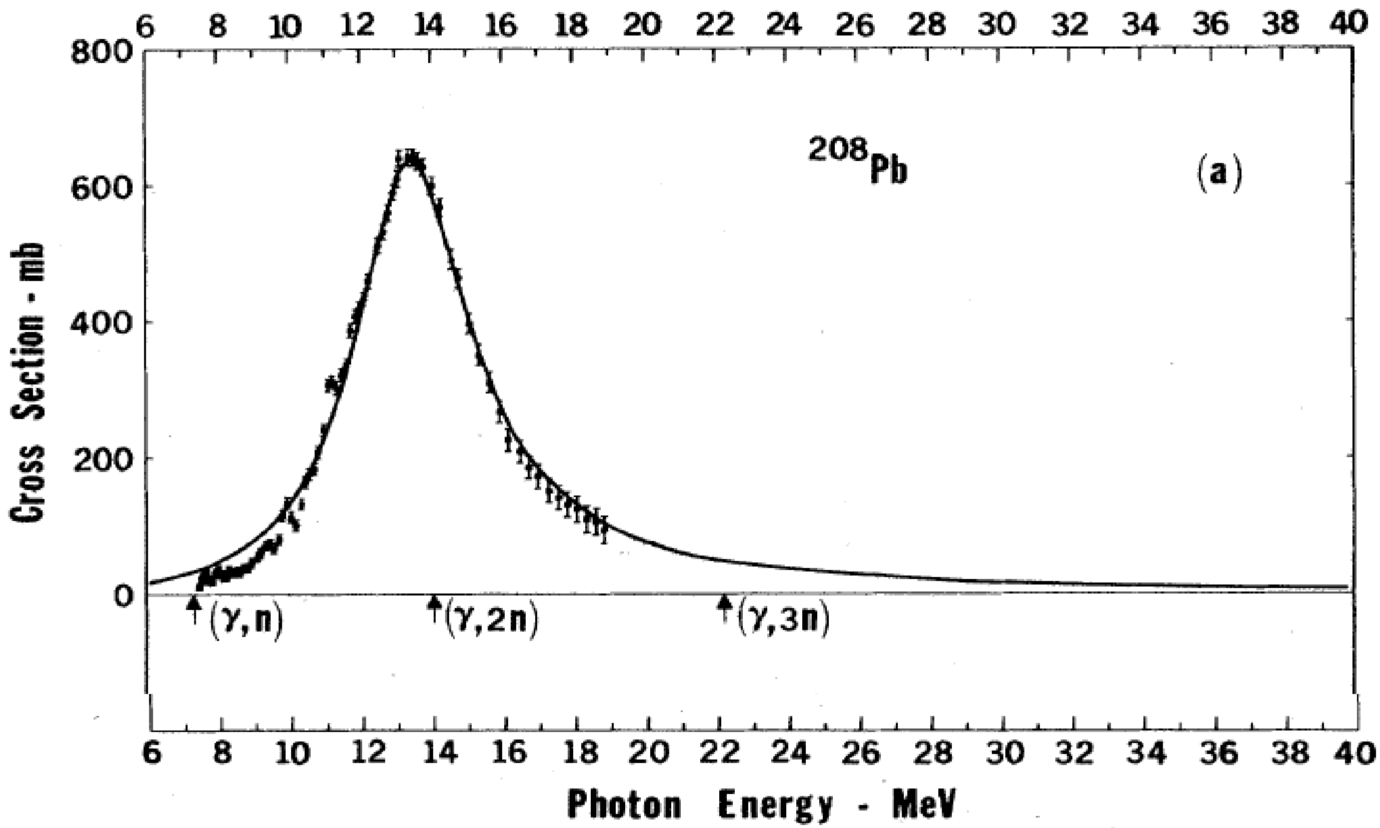


Note the scale offset

The resonance peak seems to reach a maximum value of about 18-20 MeV.

GDR plots (3)

Here we see the peak for Pb is lower – about 14 MeV.

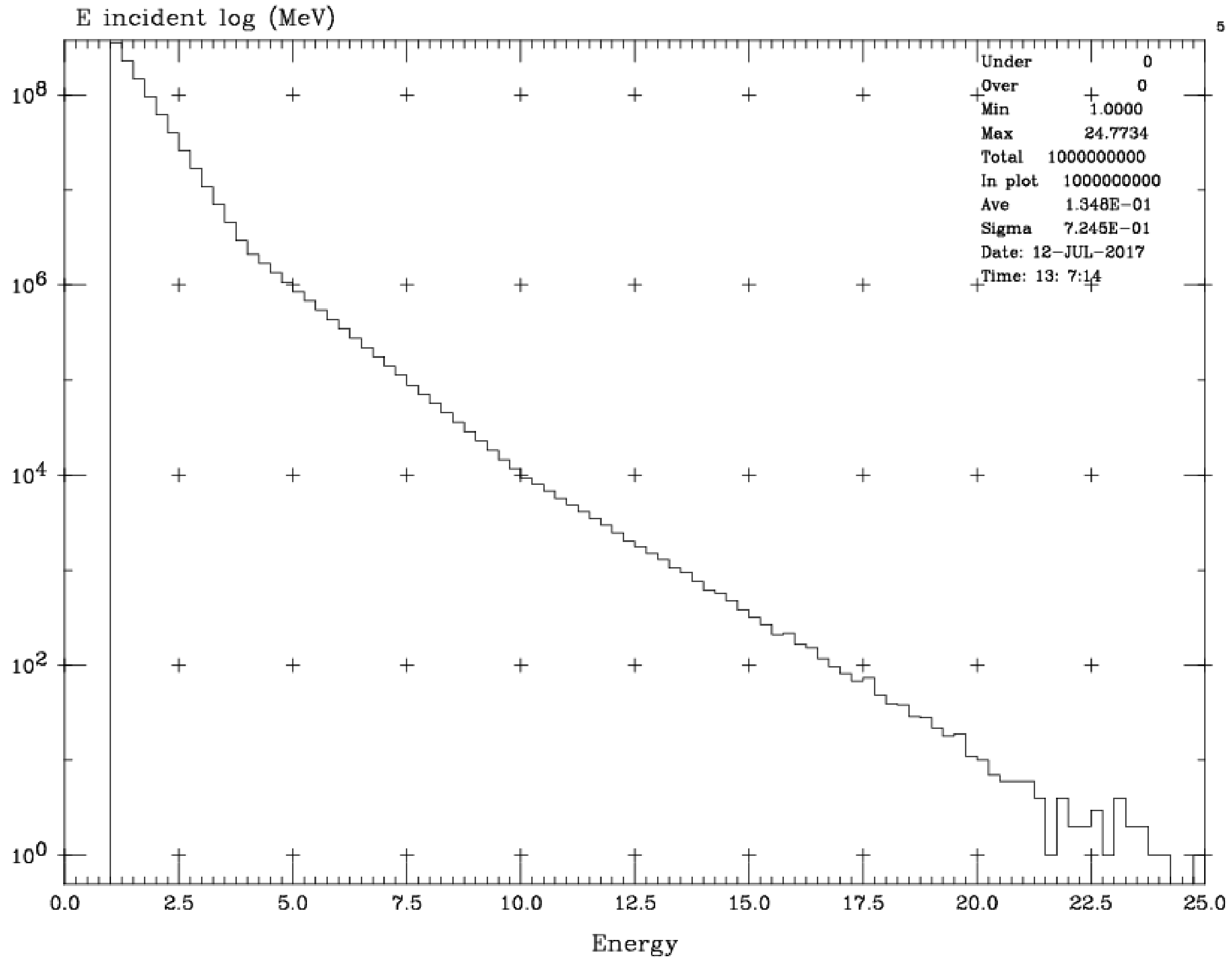


Higgs FF SR energy plot

- 3.6×10^7 photons > 1 MeV per beam bunch
- 1.5×10^3 photons > 10 MeV per beam bunch

Higgs energy may be OK?

Need to make sure.



Summary

- It looks like the Giant dipole resonance in the photo-neutron production cross-section could be a major source of neutrons for the detector
- It is outside of the detector unless very forward detectors come into the detector design
- In any case, this neutron source starts fairly close to the detector (30 m)

Summary (2)

- We will see if we can model this effect or at least get an estimate of how large a neutron source this photon dump will be
- More difficult to shield as it is distributed over 100 m
- This is work in progress obviously and it will take some modeling to get some estimates
- There are two of these locations (one on each side)
- As always, more to do….