Simulation of VDG gammas and surface muons

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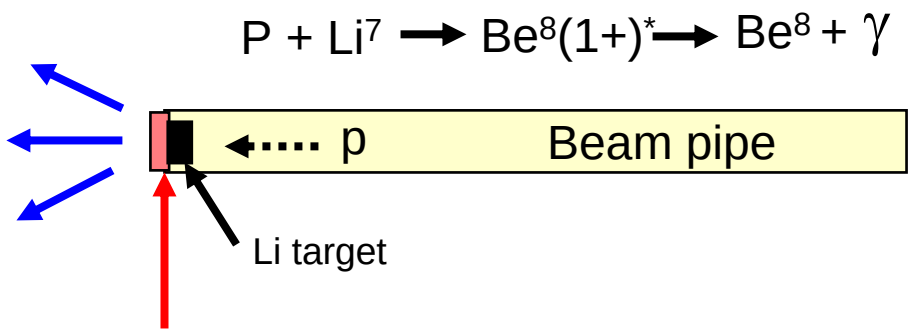
Introduction

- **Goal of this talk is to inform people:**
  - **How the sources are simulated for the workshop**
  - **How to use GlastRelease to simulate the sources**
  - **Where to look if people want to check how the sources are simulated**

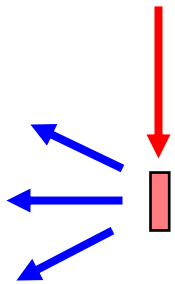
Simulation of VDG gammas

Reality:



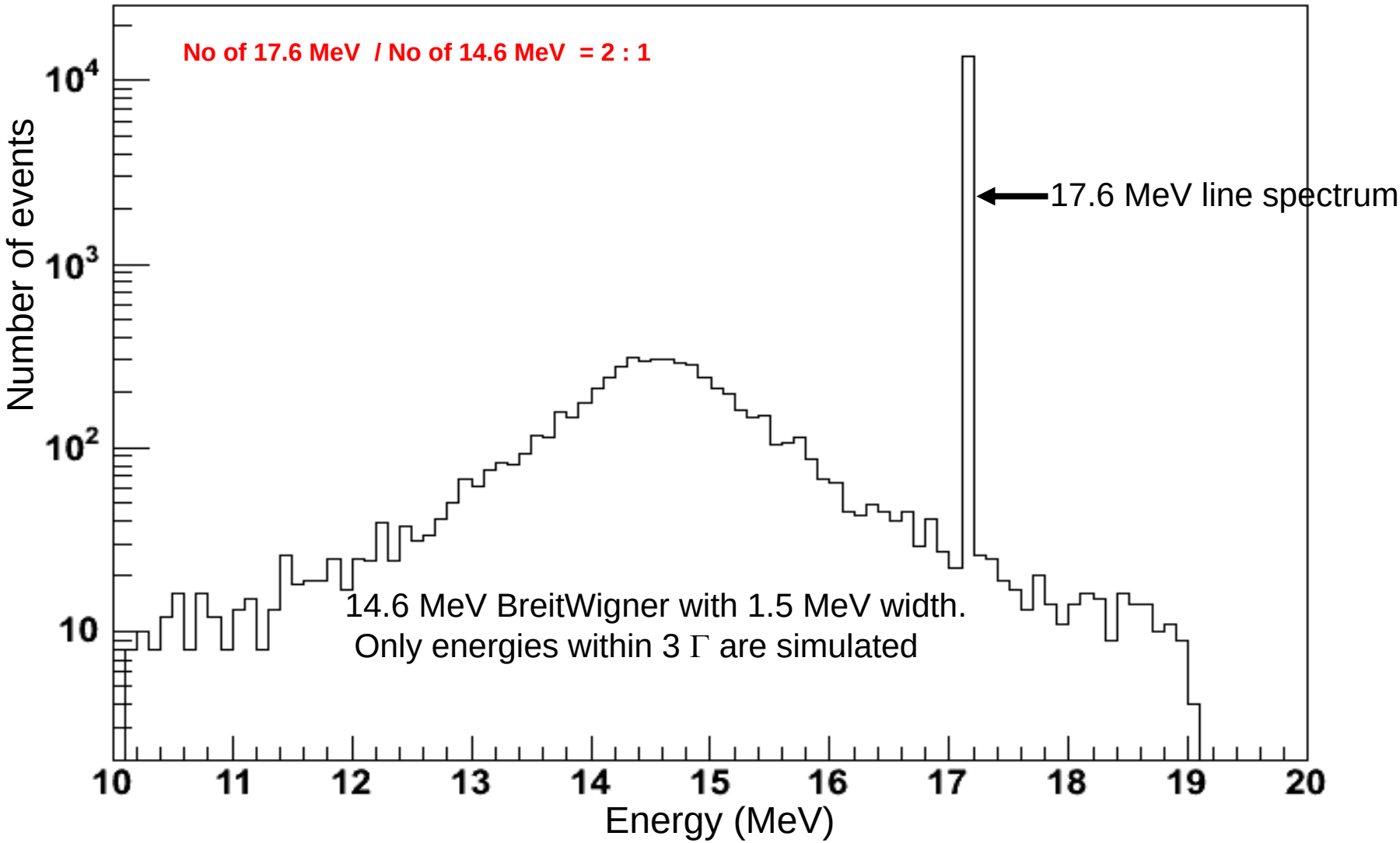
Electrons are produced by gamma conversions in the iron shield in front of the accelerator

Simulation:



No simulation of Li target, only gammas are simulated

VDG gammas energy spectrum (MC)



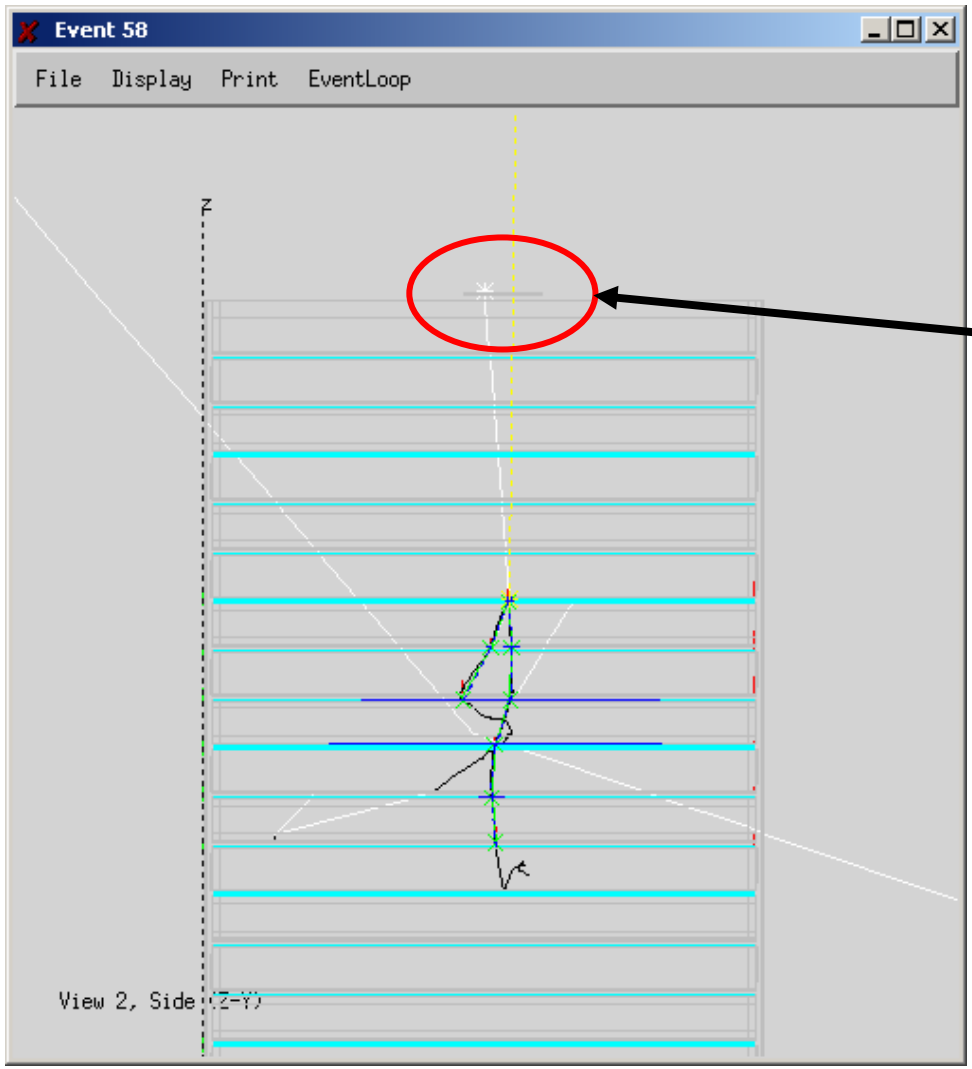
How to use the VDG source?

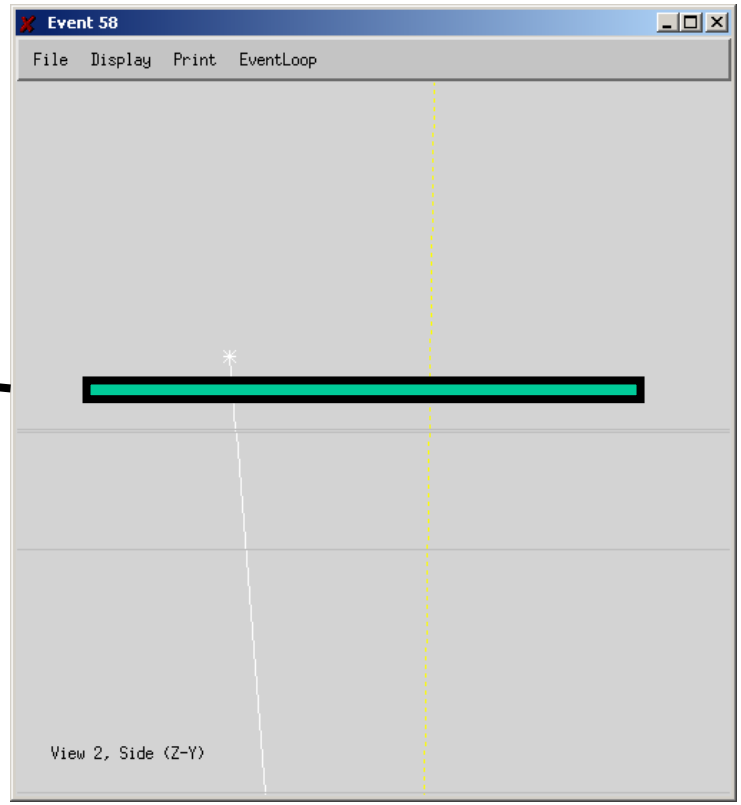
- Use EngineeringModel package (v2r0402p4 or later) and add following lines to the job option file:
  - FluxSvc.source_lib += {"$(LATINTEGRATIONROOT)/xml/source_library.xml"};
  - FluxAlg.source_name = "vdg_twoTowers";
  - GlastDetSvc.xmlfile = "$(XMLGEODBSROOT)/xml/latAssembly/2TowerSegVolsVDG.xml";
  - TkrInitSvc.TkrMinEnergy=4.; // default value is 30 MeV, need to lower it in order to enhance reconstruction efficiency of low energy gammas
- Source definition (implemented in LatIntegration/xml/source_library.xml)

```
<source name="vdg_twoTowers">
    <spectrum>
      <SpectrumClass name="VdgGamma" />
        <solid_angle mincos="0" maxcos="1" />
        <patch xmin="-225.4" xmax="-175.6" ymin="175.6" ymax="225.4" zmin="638" zmax="640" />
    </spectrum>
  </source>
```

- Source implementation: flux/src/VdgGamma.cxx

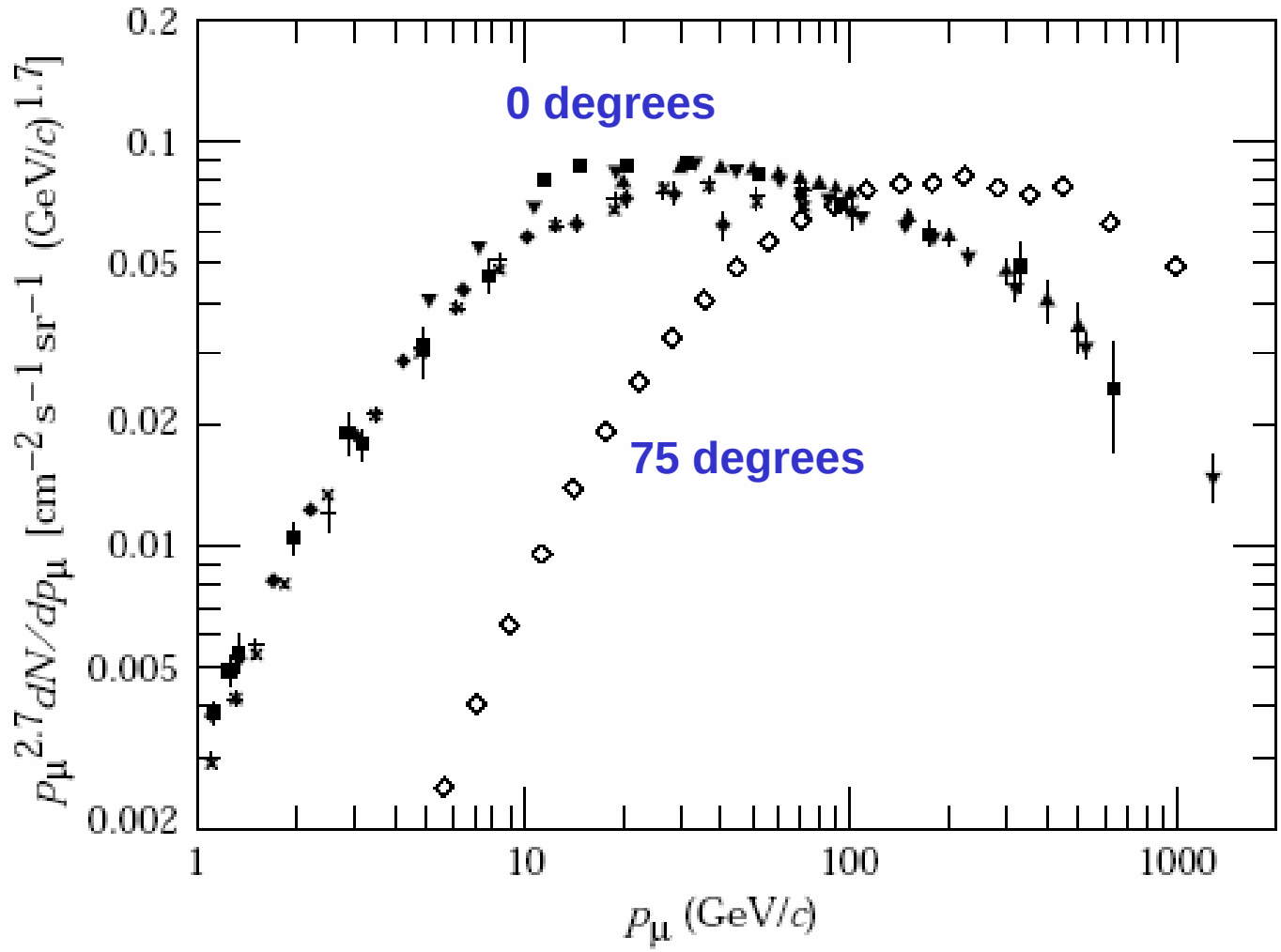
A gamma event display





- Shield is simulated as an iron cylinder with radius of 26 mm and thickness of 1.25 mm (7% X0)
- xPos=-200 mm, yPos=200 mm, zPos=636 mm, ~ 3mm above the tracker

Cosmic ray muon spectrum (PDG)

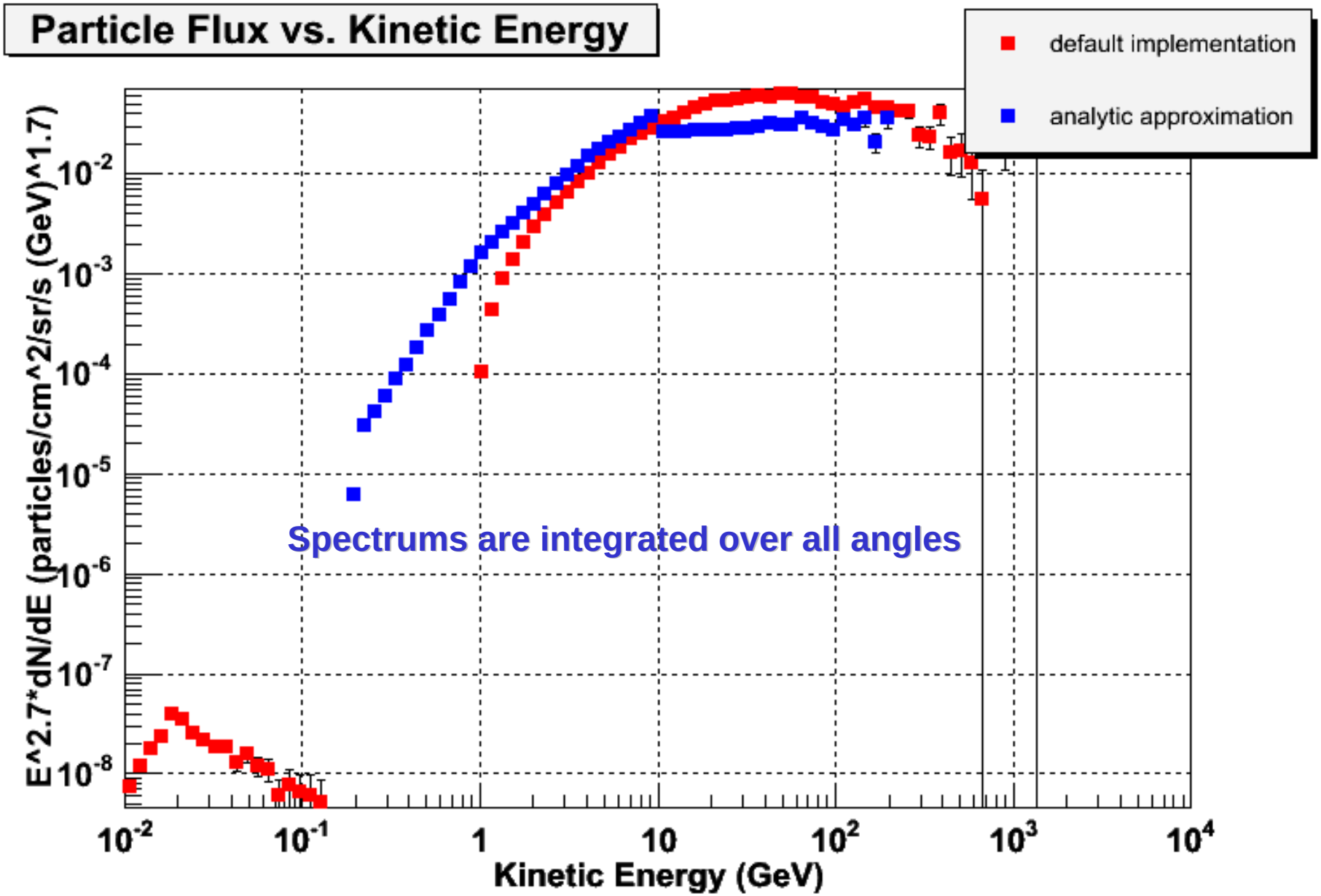


Energy spectrum
Is angular dependent

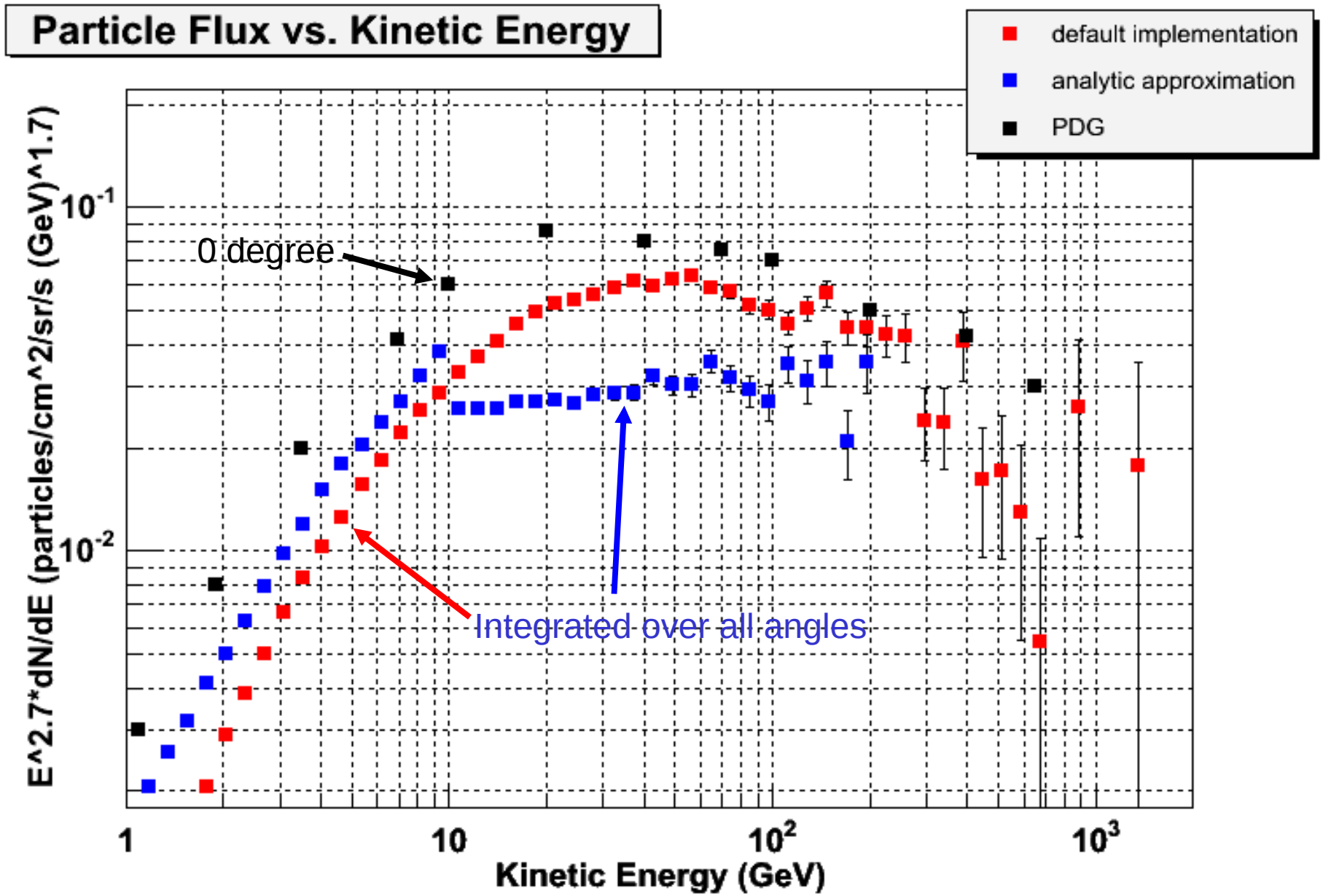
Simulation of sea level (surface) muons

- **Two implementations in GlastRelease (flux/src/SurfaceMuons.cxx):**
  - **Default (surface_muons)**
    - **empirically models plot from PDG**
    - **models correlation between angle and energy**
    - **produces an energy spectrum with few events below 1GeV**
    - **small number of unphysical low energy events (platform dependent)**
  - **Analytic approximation (surface_muons1)**
    - **Simplified analytic formula:**
      - **Flat energy spectrum (0.2 GeV < E < 1. GeV)**
      - **E^(-1.1) (1 GeV < E < 4 GeV)**
      - **E^(-1.6) (4 GeV < E < 10 GeV)**
      - **E^(-2.6) (10 GeV < E < 200 GeV)**
    - **produces a more reasonable energy spectrum for low energy events (<1 GeV)**
    - **does not model correlation between angle and energy**

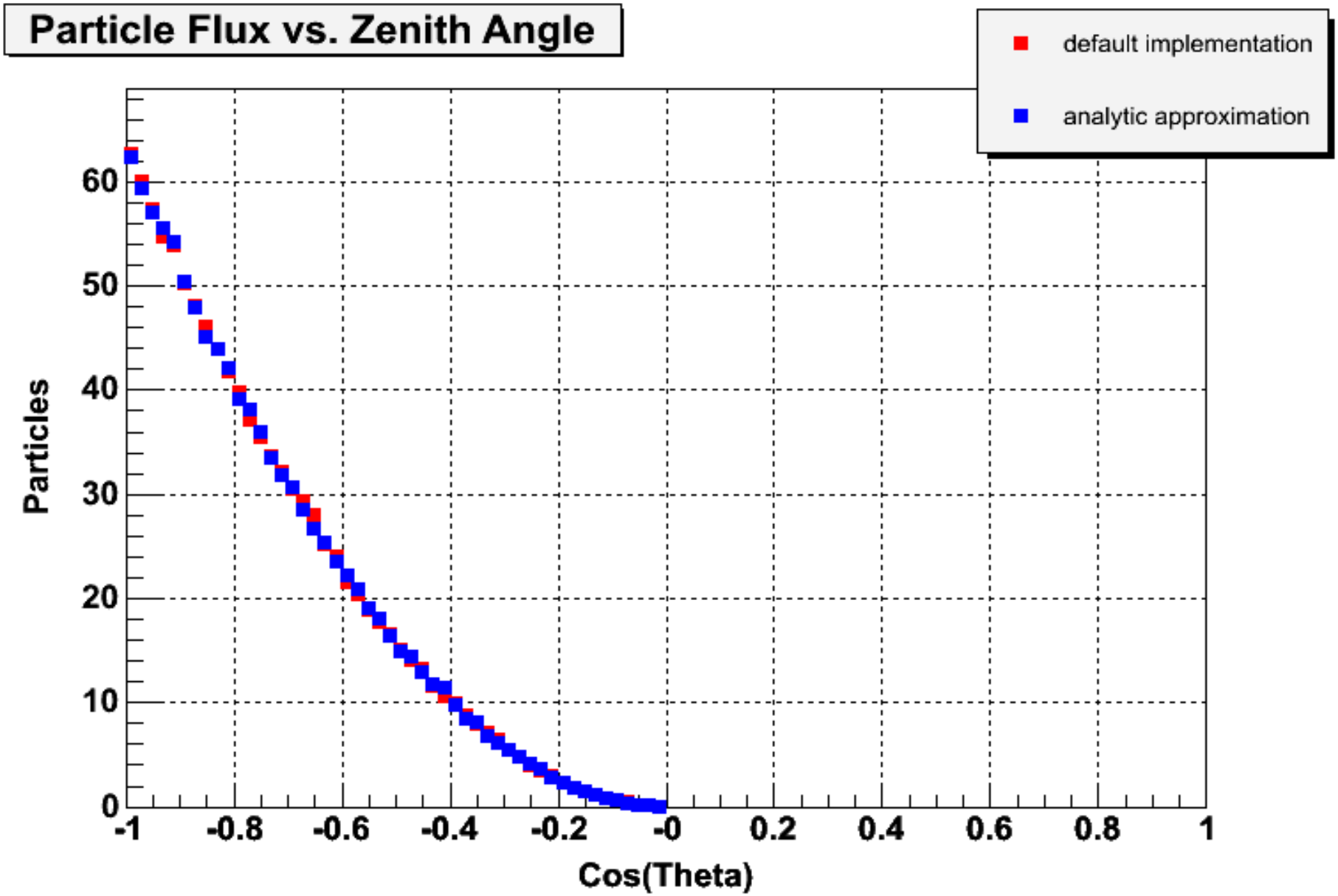
Simulated cosmic ray muon spectrum



Simulated cosmic ray muon spectrum compared with PDG plot



Surface muon angular distribution



How to use surface muons source

- Use EngineeringModel package (v2r0402p4 or later) and add following lines to the job option files:
  - FluxAlg.source_name = “surface_muons"; OR FluxAlg.source_name = “surface_muons1";
  - GlastDetSvc.xmlfile = "$(XMLGEODBSROOT)/xml/latAssembly/2TowerSegVols.xml“
- Source definition (add following to source_library.xml):
  - Default implementation
    - <source name="surface_muons">
    - <spectrum>
    - <SpectrumClass name="SurfaceMuons" params="0.0,1.0, 0.0"/>
    - <use_spectrum/>
    - </spectrum>
    - </source>
  - Analytic approximation implementation
    - <source name="surface_muons1">
    - <spectrum>
    - <SpectrumClass name="SurfaceMuons" params="0.0,1.0, 1.0"/>
    - <use_spectrum/>
    - </spectrum>
    - </source>

Conclusion

- Neither implementation is perfect, for the workshop, we produced two files using each implementation respectively
  - Default implementation
    - Surface_muons_2M_merit.root
  - Second implementation
    - Surface_muons1_2M_merit.root
- We need to produce a better implementation of surface muon simulations
  - Toby is working on extending the spectrum to below 1GeV
  - Can we use some tabulated data from Julie?
  - Can we have a discussion on this during the workshop?