# CosmoGenic Backgrounds for Homestake 4850ft Level

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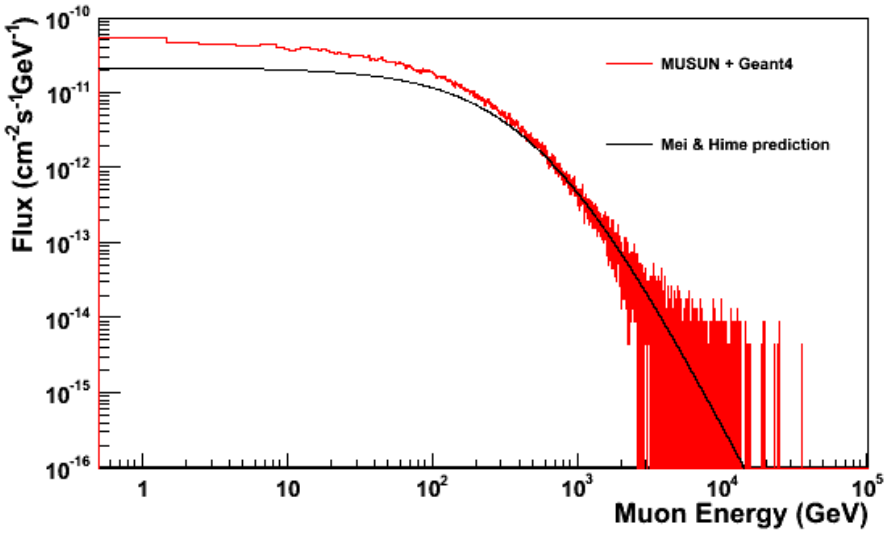
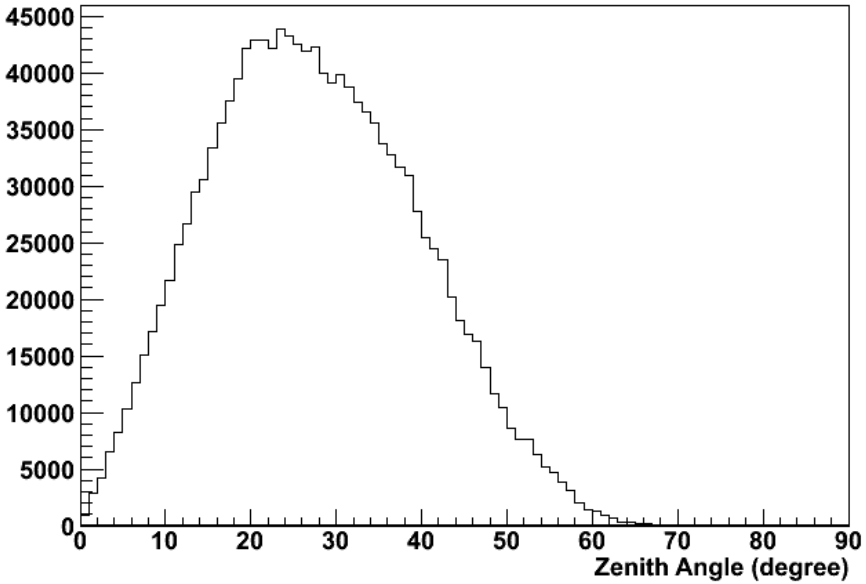
# Muon Shower Data File

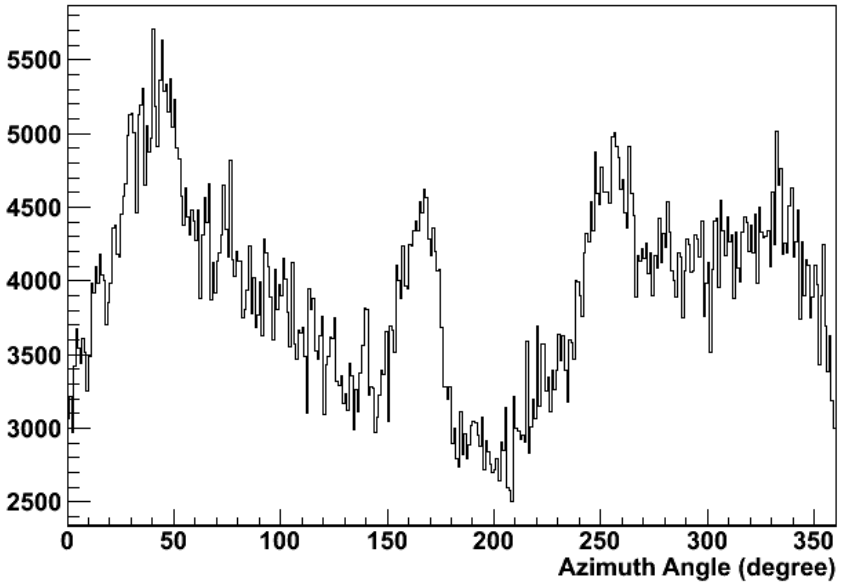
- The simulated shower information is stored in files online at http://people.usd.edu/~Chao.Zhang/
- In each folder there is a README file which tells the format and livetime information for each file.
- More files will be uploaded…

# Solo-Muon Defination

- Energy distribution from the right figure which is a collection of muons enter into the top sheet of cavern(MUSUN+G4).
- Angles are from below distribution.



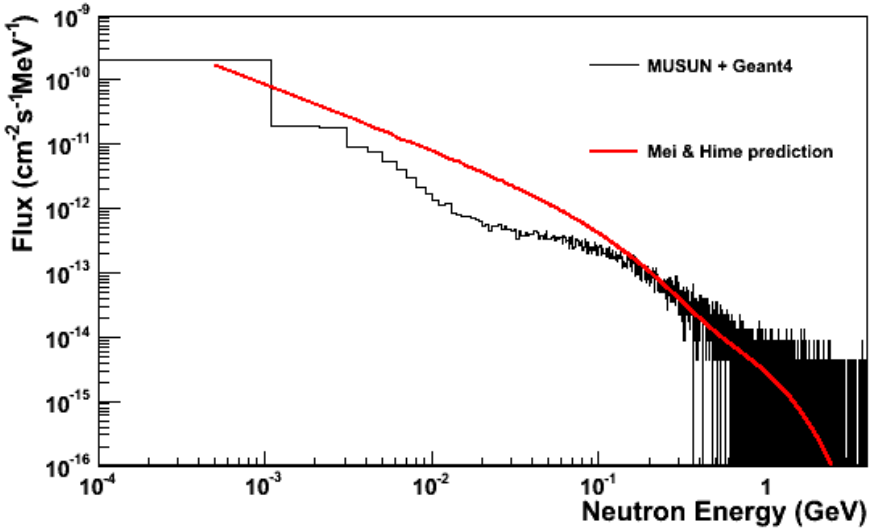



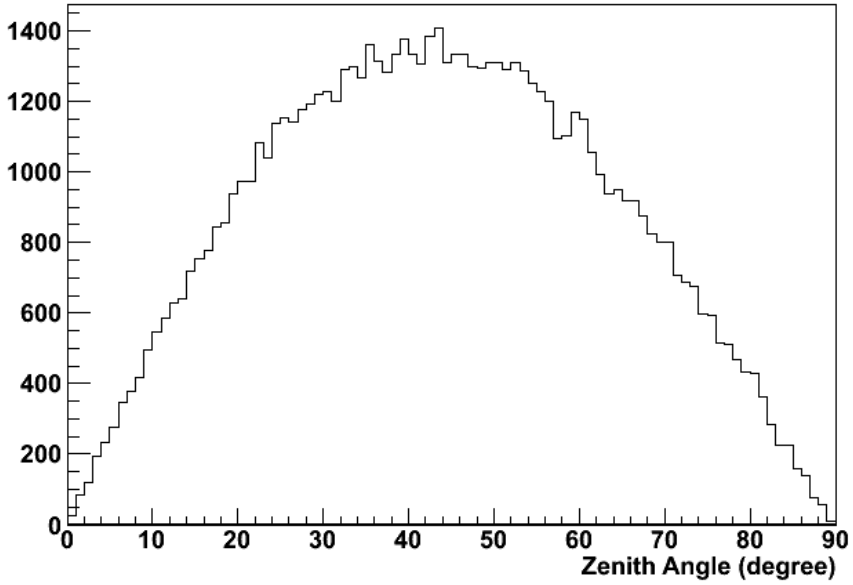
# How to generate solo muon

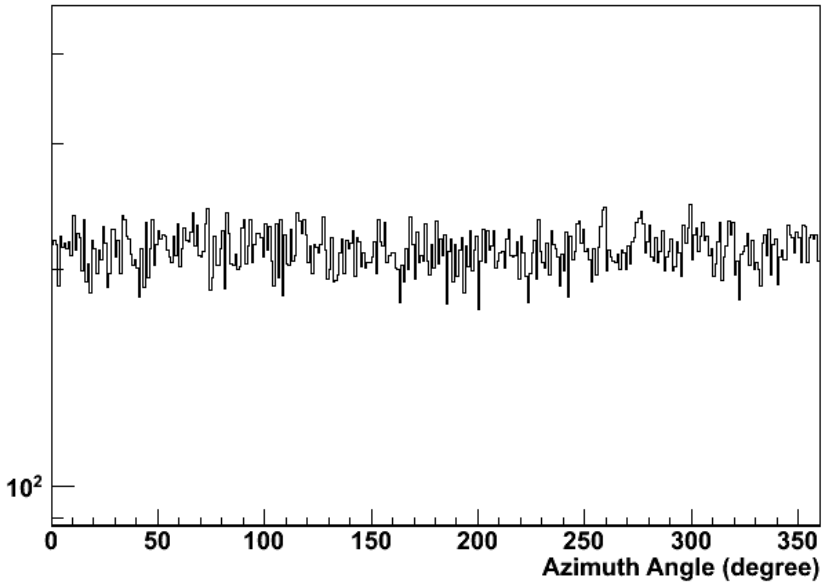
- In the generator, energy is randomly generated from the histogram provided in previous page. All muons are treated as single. The total flux is normalized to 6.46e-9 $cm^{-2}s^{-1}$(Mei&Hime 4.40e-9 $cm^{-2}s^{-1}$).
- They are uniformly generated on a sheet right above the detector with the size 50m*50m(there is no rock surrounded the water tank).The angle is generated from the histogram provided in previous page.

# Solo-Neutron Defination

- Energy distribution from the right figure which is a collection of neutrons enter into the top sheet of cavern(MUSUN+G4).
- Angles are from below distribution.



# How to generate solo neutron

- In the generator, energy is randomly generated from the histogram provided in previous page. All neutrons are treated as single. The total flux is normalized to 3.41e-10 $cm^{-2}s^{-1}$(Mei&Hime 5.39e-10 $cm^{-2}s^{-1}$).
- They are uniformly generated on a sheet right above the detector with the size 50m*50m(there is no rock surrounded the water tank).The angle is generated from the histogram provided in previous page.
- Different from this, Monica's sim used energy spectrum in Mei&Hime with uniform position surrounded the water tank with uniform angle.

# Combined Shower Defination

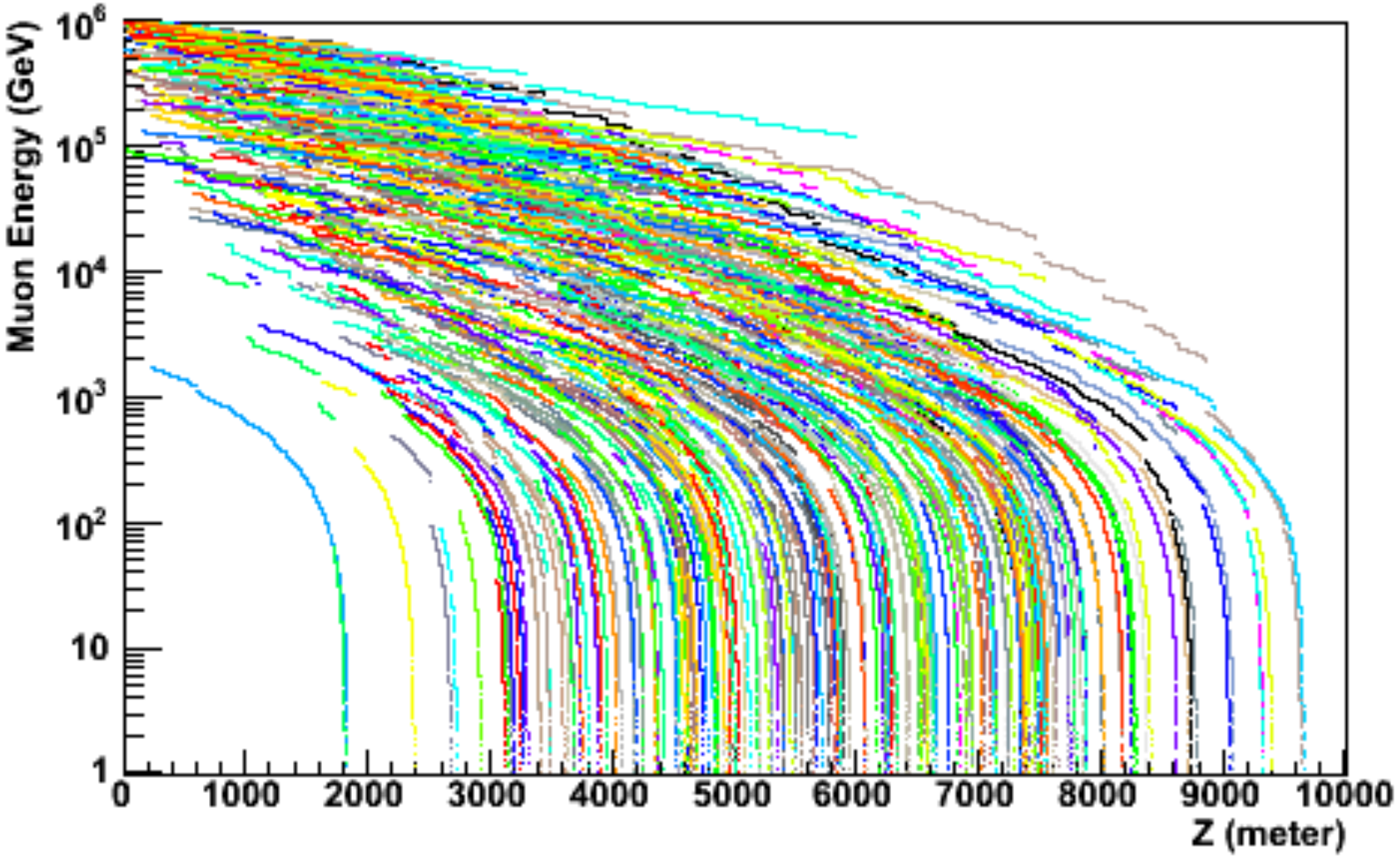
- They are from the shower information in http://people.usd.edu/~Chao.Zhang/ please refer the exactly direction from the README.txt file in the link. The LZ20ton detector locate in the middle of $20m^3$ cavern with 10cm rock surrounded.
- The solo muon and neutron information are collected from those files though, they are parameterized into some sort of functions in order to compare with that in Mei&Hime's. So they have no any multiplicity information in them.

# Results

| | Solo muon | Solo neutron | Combined shower |
|---|---|---|---|
| Mu_wat_top(/m2/s) | 6.46e-5 | - | 6.46e-5 |
| Mu_wat_all(/m2/s) | 1.84e-5 | - | 1.85e-5 |
| Neu_wat_top (>100keV /m2/s) | - | 2.91e-6 | 1.55e-6 |
| Neu_wat_all (>100keV /m2/s) | - | 1.13e-6 | 1.08e-6 |
| Neu_Xe_all (>100keV /m2/s) | 2.38e-6 | 1.00e-8 | 2.40e-6 |
| At least one NR/s (5 keV_r<E<25 keV_r) | 1.32e-5 | 2.56e-9 | 1.31e-5 |
| Single NR/s | 7.26e-9 (8evts) | <4.26e-12 | 3.12e-9 (1evt) |

Short of statistics…

# Geant4 Simulation for Muons From Surface



# Summary

- For LZ20ton Detector, solo-muon produced background is 3 order of magnitude higher than solo-neutron does(regardless of veto). Even with 99% of muon veto, solo-muon still contribute dominant background.
- We try to use full geant4 simulation to replace the MUSUN result. A muon shower database is proposed for Homestake and Soudan mine.