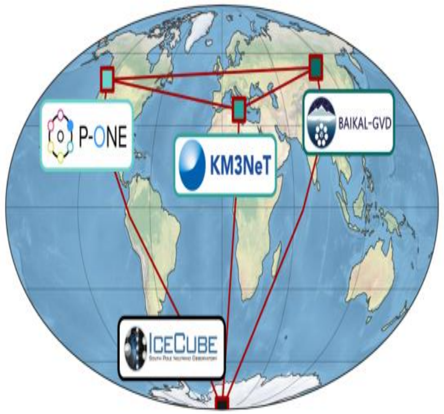
P-ONE

THE HENRYK NIEWODNICZAŃSKI
INSTITUTE OF NUCLEAR PHYSICS
POLISH ACADEMY OF SCIENCES

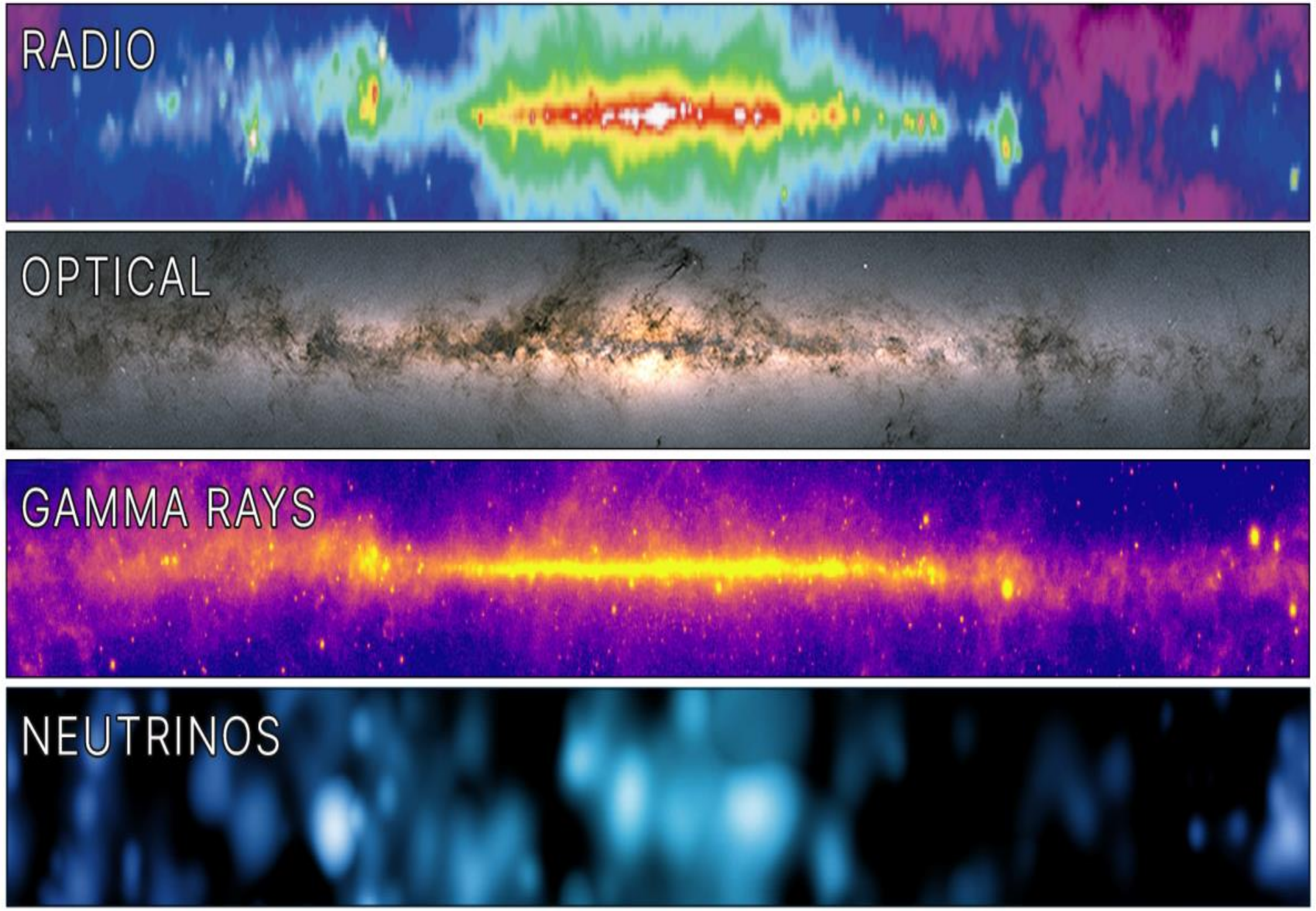
SIMULATION OF BACKGROUND MUONS FROM COSMIC RAYS



SHREYA SHARMA

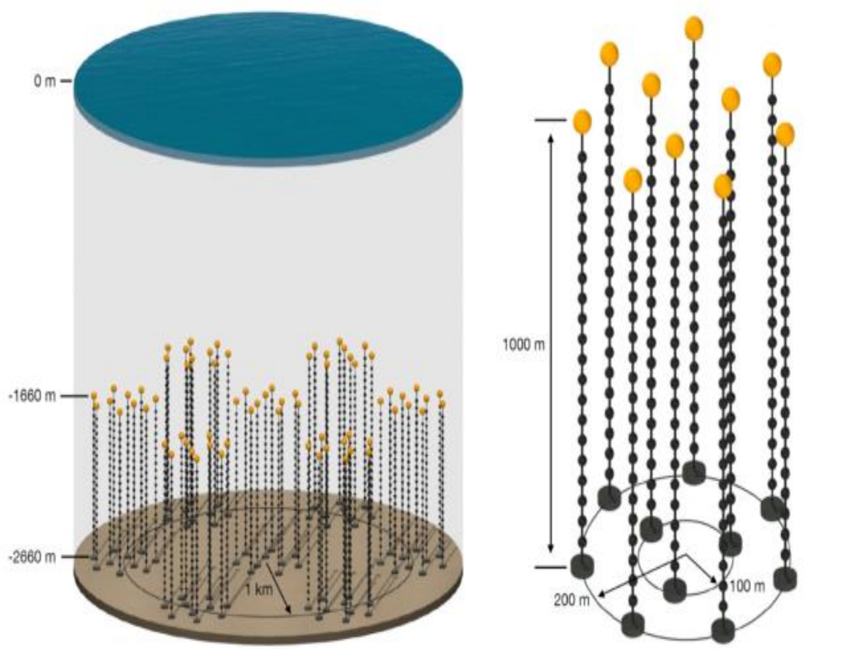
WHY NEUTRINOS?

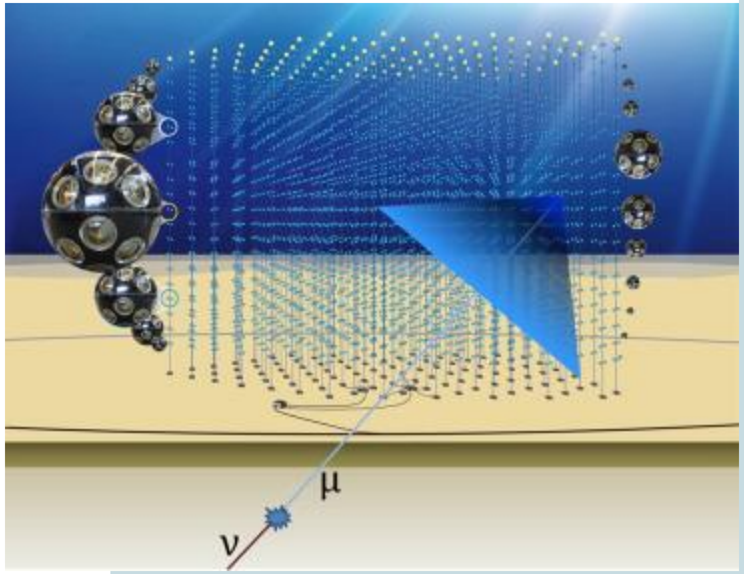
- Opens Up New Ways To Probe The Universe.
- Can Travel Several Light-years Without Interacting.
- Less Information Loss Than Photons.

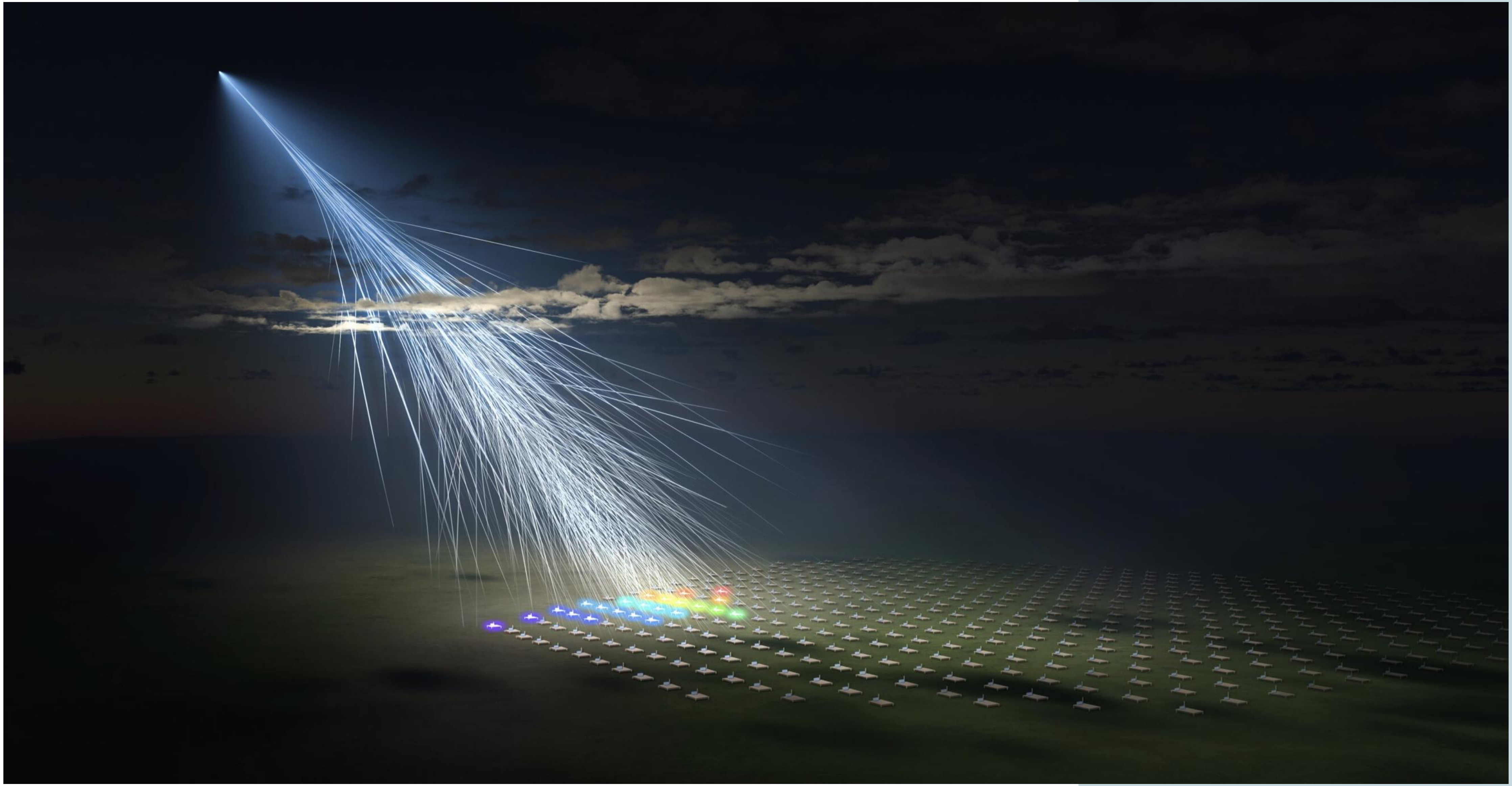


ABOUT NEUTRINO TELESCOPE

- Detects The Upward Going Neutrino Events.
- Observes The Part Of Universe That Is Opposite To Its Location.
- There Exists Many Backgrounds To Such Detectors, Majority Is From Cosmic Ray Muons.
- Downward Going CRs Muons Sometimes Mimic As Neutrino Signal.







CORSIKA

- Program package to do detailed MC simulation of the EAS generated from CRs.
- User can choose the primary particles their energy, zenith angles and other useful inputs according to requirements.
- There is also a thinning option to save computing time.

HADRONIC MODELS

High Energy Models (>80Gev)

- DPMJET
- EPOS
- HDPM
- NEXUS
- QGSJET
- SIBYLL
- VENUS

Low Energy Models (<80GeV)

- FLUKA
- GHEISHA
- UrQMD

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STEERING INPUT FILES

For Proton

```
RUNNR   17                            run number
EVTNR   1                             number of first shower event
NSHOW   50                            number of showers to generate
PRMPAR  14                            particle type of prim. particle
ESLOPE  -1                            slope of primary energy spectrum
ERANGE  1.E2  1.E6                    energy range of primary particle
THETAP  0.  70.                       range of zenith angle (degree)
PHIP    -180.  180.                   range of azimuth angle (degree)
SEED    1   0   0                     seed for 1. random number sequence
SEED    2   0   0                     seed for 2. random number sequence
OBSLEV  0.E1                          observation level (in cm)
FIXCHI  0.                            starting altitude (g/cm**2)
MAGNET  20.0  42.8                    magnetic field centr. Europe
HADFLG  0  0  0  0  0  2              flags hadr.interact.&fragmentation
ECUTS   0.3  0.3  0.003  0.003        energy cuts for particles
MUADDI  T                             additional info for muons
MUMULT  T                             muon multiple scattering angle
ELMFLG  T   T                         em. interaction flags (NKG,EGS)
STEPFC  1.0                           mult. scattering step length fact.
RADNKG  200.E2                        outer radius forNKGlat.dens.distr.
LONGI   T  10.  T  T                  longit.distr. & step size & fit &
out
MAXPRT  1                             max. number of printed events
DIRECT  ./                            output directory
USER    you                           user
DEBUG   F  6  F  1000000              debug flag and log.unit for out
EXIT                                  terminates input
```

For Iron

```
RUNNR   12                            run number
EVTNR   1                             number of first shower event
NSHOW   50                            number of showers to generate
PRMPAR  5626                          particle type of prim. particle
ESLOPE  -1                            slope of primary energy spectrum
ERANGE  1.E2  1.E6                    energy range of primary particle
THETAP  20.  70.                      range of zenith angle (degree)
PHIP    -180.  180.                   range of azimuth angle (degree)
SEED    1   0   0                     seed for 1. random number sequence
SEED    2   0   0                     seed for 2. random number sequence
OBSLEV  0.E1                          observation level (in cm)
FIXCHI  0.                            starting altitude (g/cm**2)
MAGNET  20.0  42.8                    magnetic field centr. Europe
HADFLG  0  0  0  0  0  2              flags hadr.interact.&fragmentation
ECUTS   0.3  0.3  0.003  0.003        energy cuts for particles
MUADDI  T                             additional info for muons
MUMULT  T                             muon multiple scattering angle
ELMFLG  T   T                         em. interaction flags (NKG,EGS)
STEPFC  1.0                           mult. scattering step length fact.
RADNKG  200.E2                        outer radius for NKG
lat.dens.distr.
LONGI   T  10.  T  T                  longit.distr. & step size & fit &
out
MAXPRT  1                             max. number of printed events
DIRECT  ./                            output directory
USER    you                           user
DEBUG   F  6  F  1000000              debug flag and log.unit for out
EXIT                                  terminates input
```

PLOTS

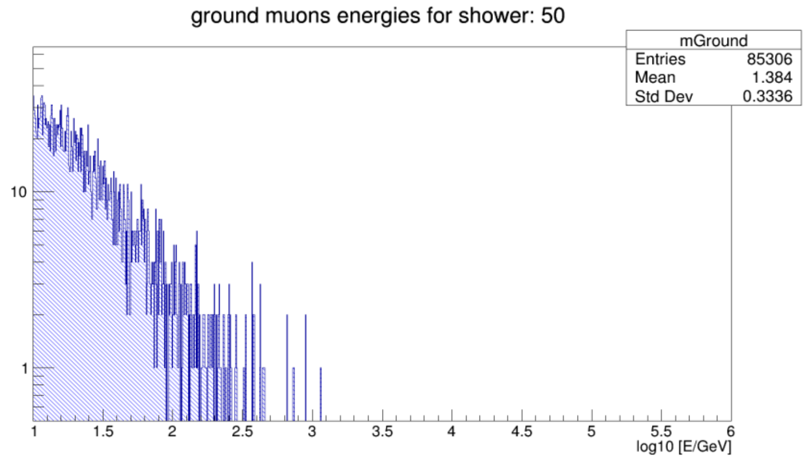
QGSJET(HE) + UrQMD(LE) (50 showers)

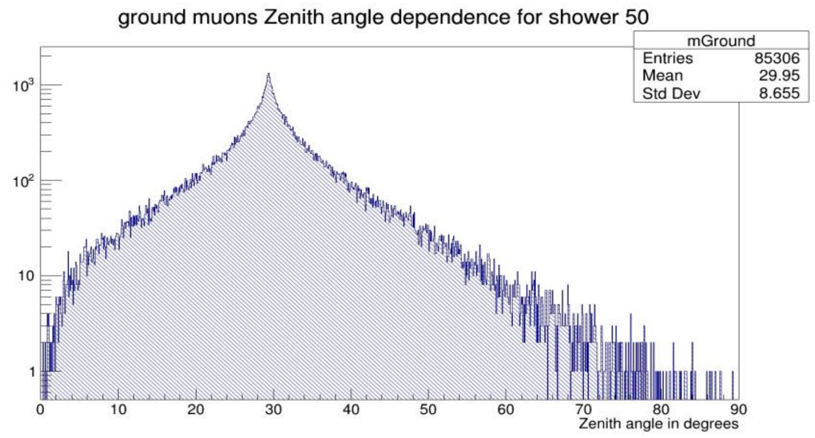
Primary Particles

Energy Spectrum

Zenith Angle Dependence

Proton





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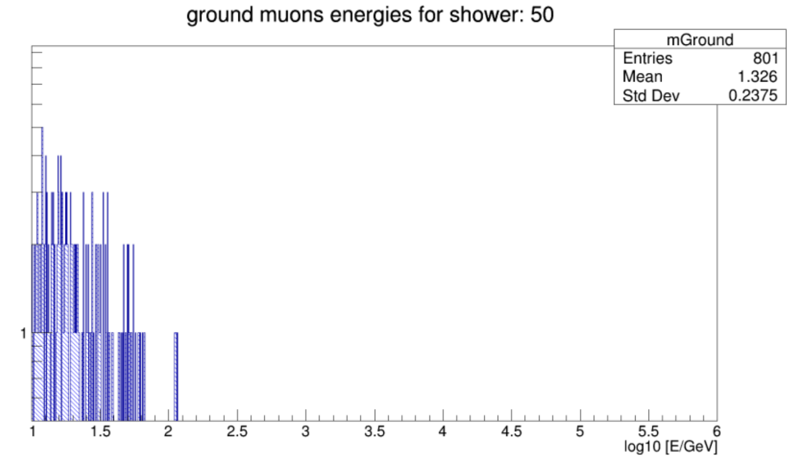
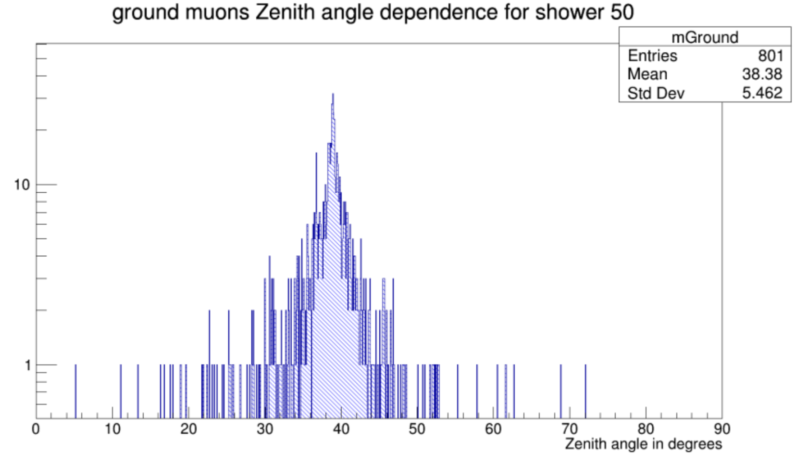




PLOTS

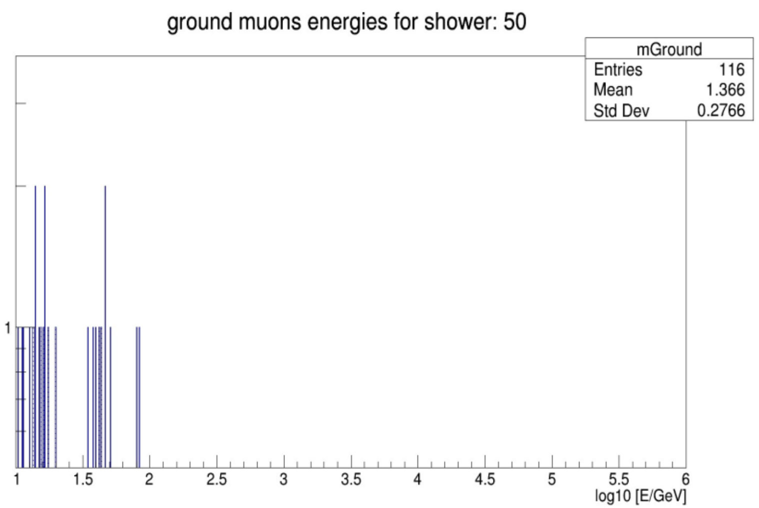
QGSJET (HE) +GHEISHA(LE)(50showers)

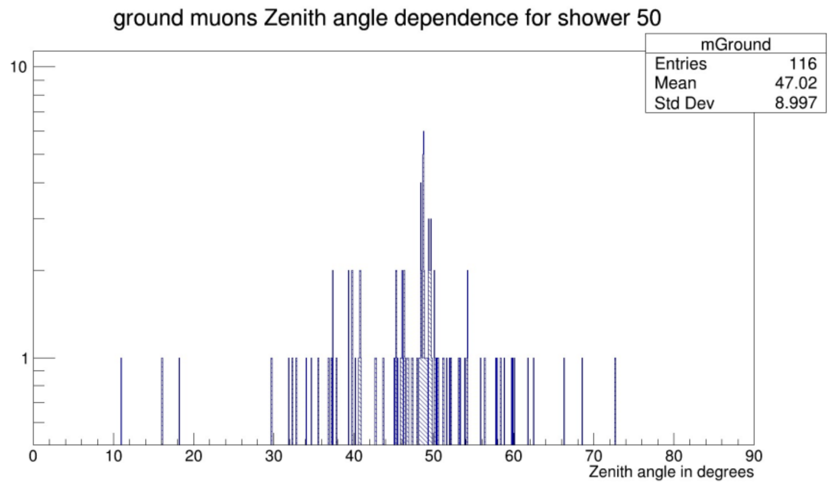
Primary Particles

Energy Spectrum

Zenith Angle Dependence

Proton





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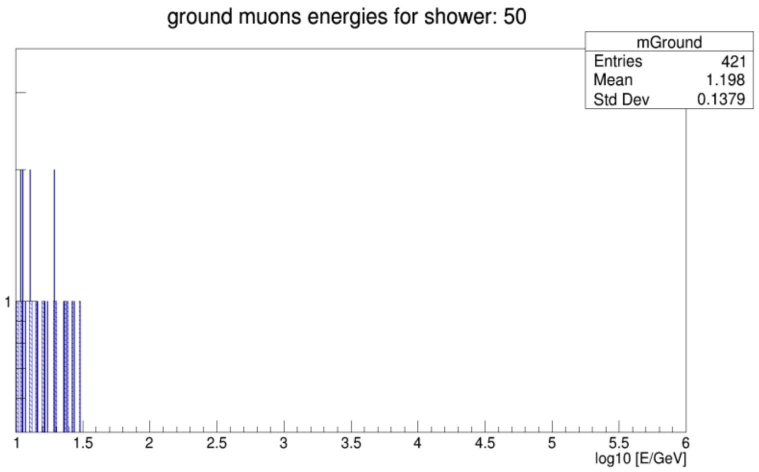
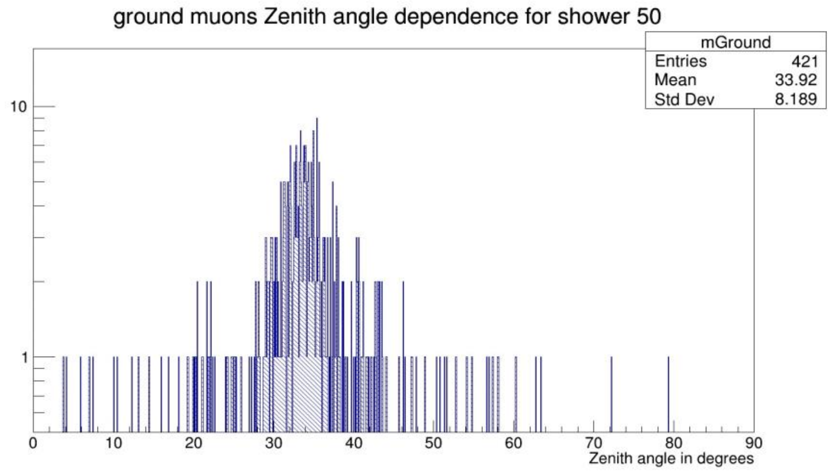




PLOTS

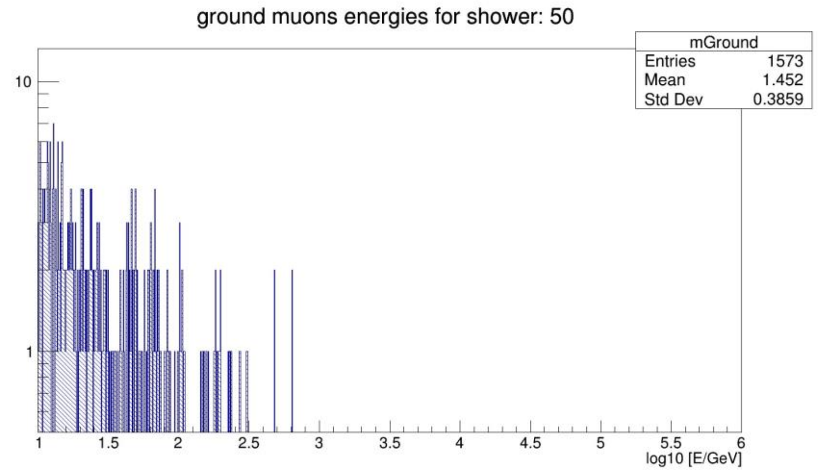
DPMJET(HE) + UrQMD(LE) (50 showers)

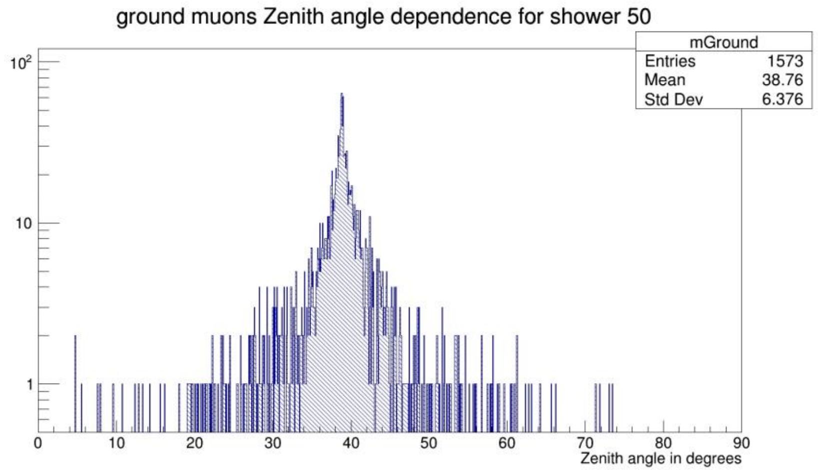
Primary Particles

Energy Spectrum

Zenith Angle Dependence

Proton





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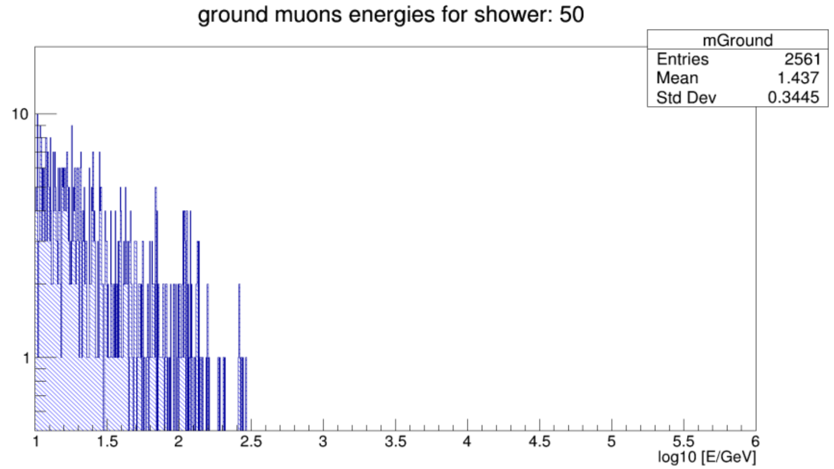
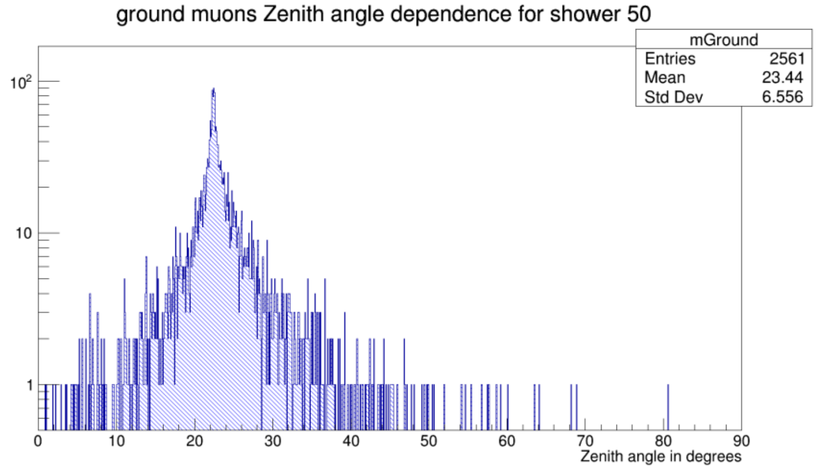




PLOTS

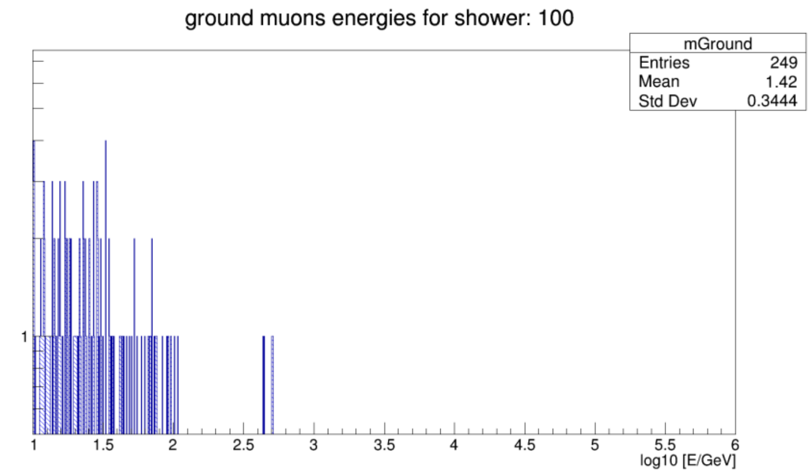
QGSJET(HE) + UrQMD(LE) (100 showers)

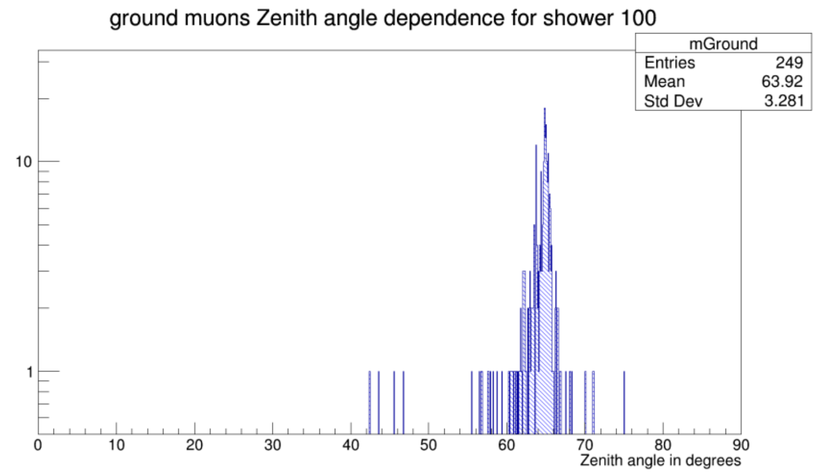
Primary Particles

Energy Spectrum

Zenith Angle Dependence

Proton





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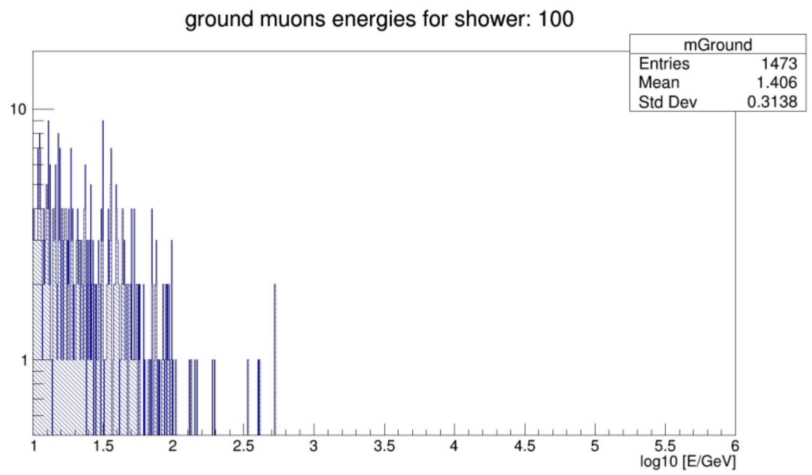
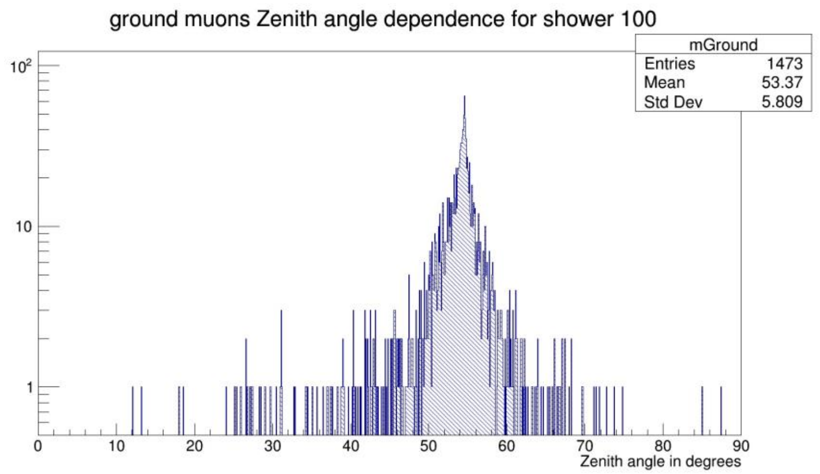
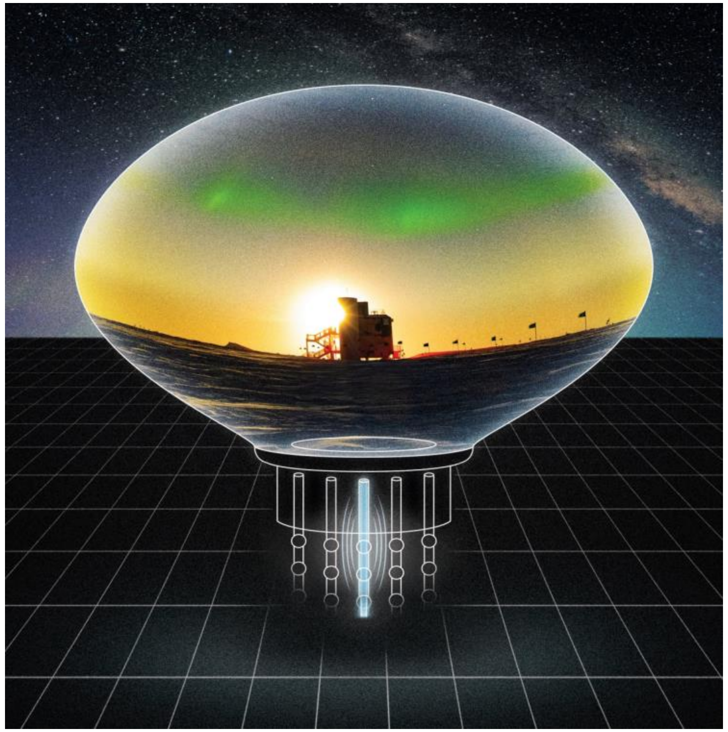
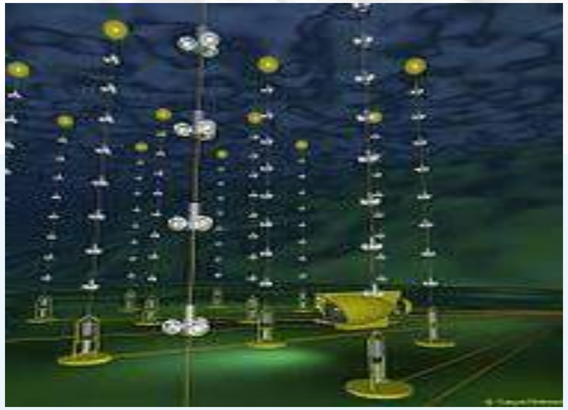




CONCLUSIONS

- The cosmic muons coming at the ground are more sensitive to low energy interactions rather than high energy interactions.
- As shower no increases the cosmic muons shifted to higher zenith angles (which is not understood why?).
- The next step to this simulation would be propagating these muons to the level of detector location via lepton propagator codes.





THANK YOU

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