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AJMAN UNIVERSITY

Zenith Angle Dependence of Muons From Charm Particles – Simulation Study

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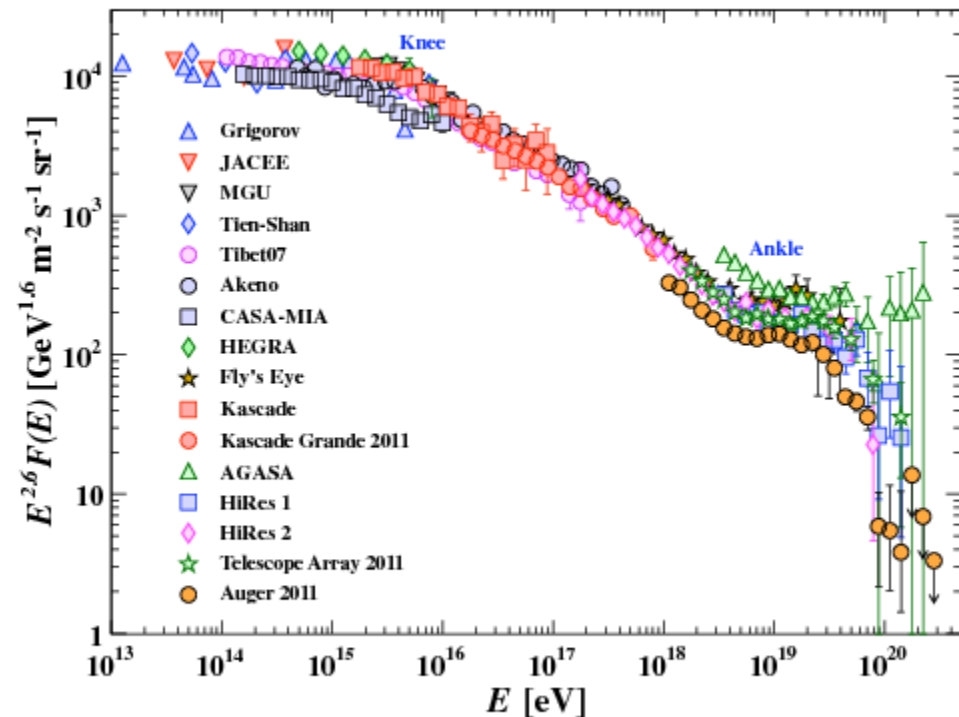
Outline:

- Introduction
- Muons in EAS
- Simulation
- Muon Charge Ratio
- Outlook



Introduction:

- Muons component is of the main components of EAS at the surface and underground
- Sensitive to primary mass and energy
- Heavy quarks are produced from some high energy EAS





Simulation:

CORSIKA:

- Simulation E^{-1} spectrum
 - 500 air shower for each bin
 - 10 PeV
 - 100 PeV
 - 1 EeV
 - 10 EeV
- QGSJET for high energy hadronic interactions
 - Zenith angle $[0 - 40^\circ]$ and $[40 - 60^\circ]$
 - With and without Charm



Muon Charge Ratio:

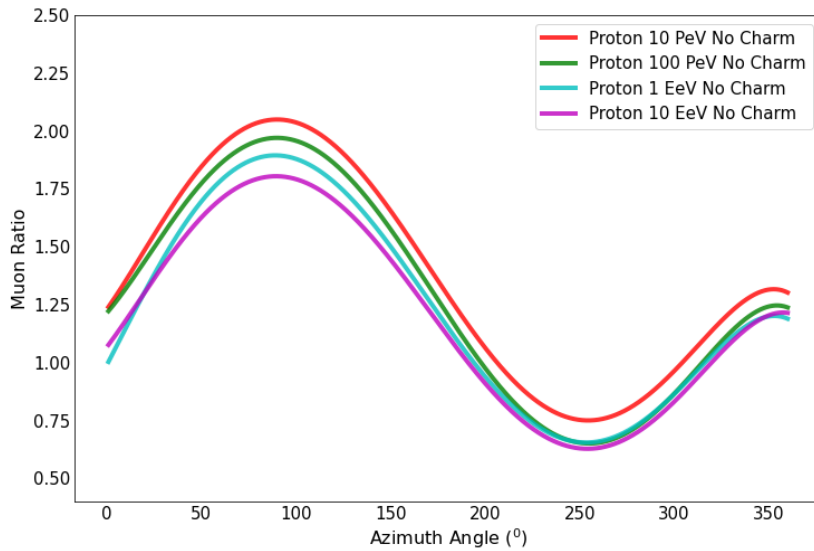
- Positive to negative muons
- Sensitive to mass and energy of primary cosmic ray
- Previous experiments expected the ratio to be around 1.27 at low energies

$$R_{\mu}^{atm} = \frac{N_{\mu^{+}}}{\mu^{-}}$$

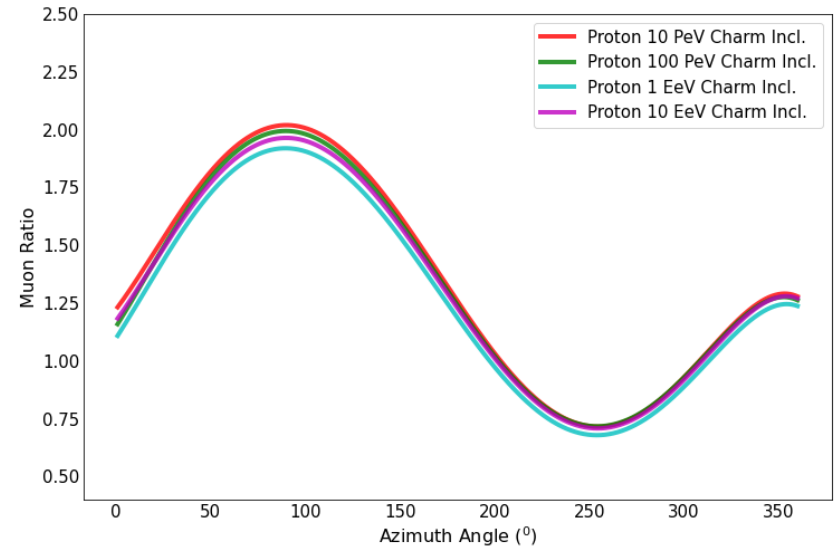


Muon Charge Ratio: [0 - 40°]

Proton Vertical No Charm



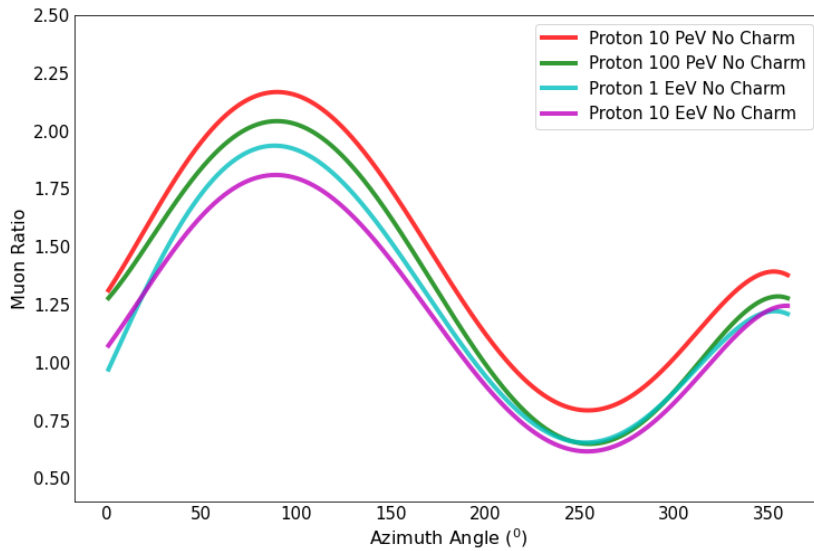
Proton Vertical Charm Incl.



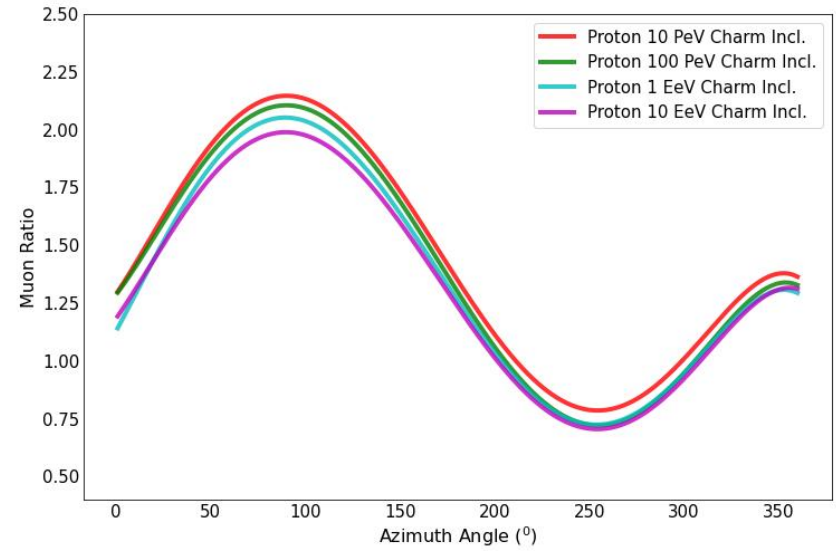


Muon Charge Ratio: [40 - 60°]

Proton Inclined No Charm



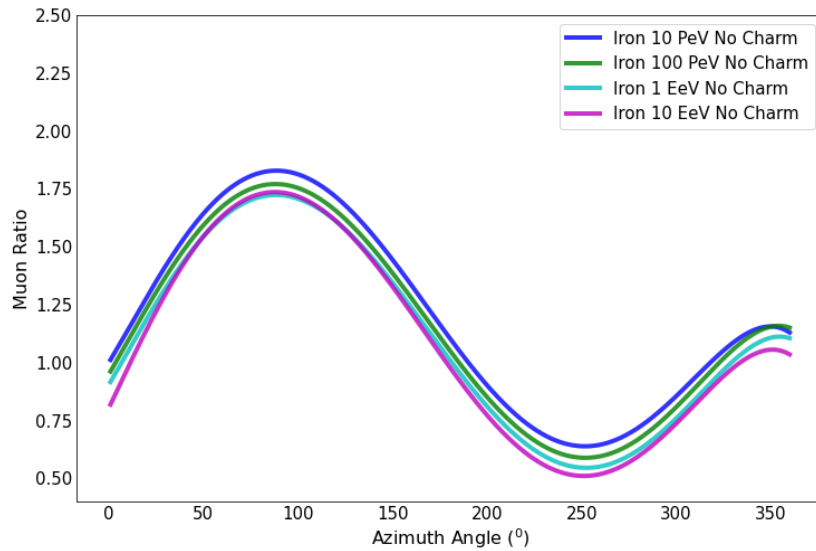
Proton Inclined Charm Incl.



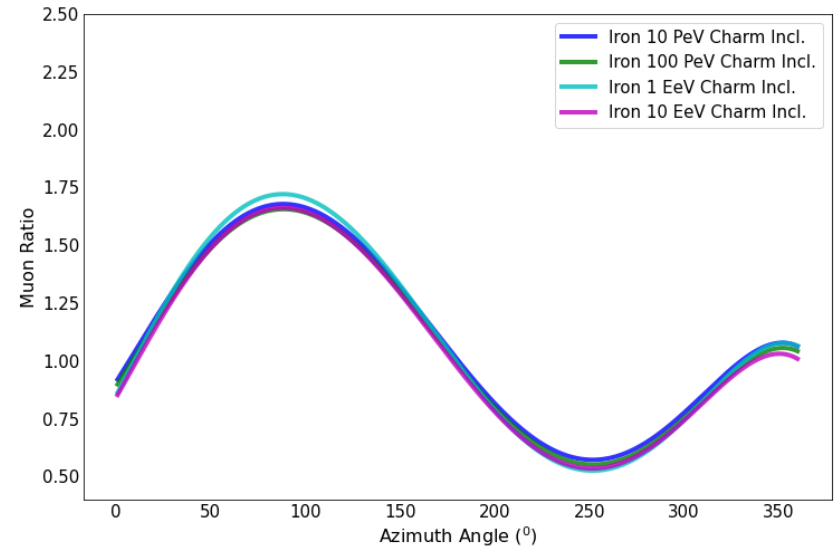


Muon Charge Ratio: [0 – 40°]

Iron Vertical No Charm



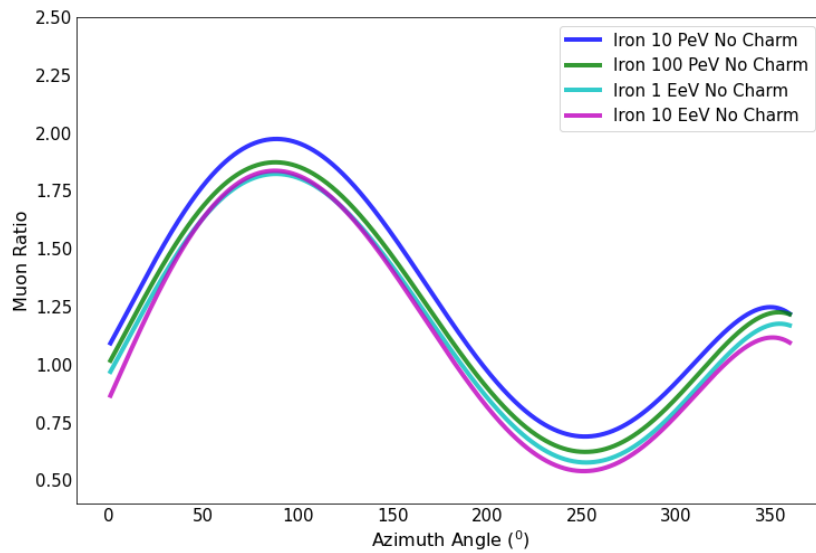
Iron Vertical Charm Incl.



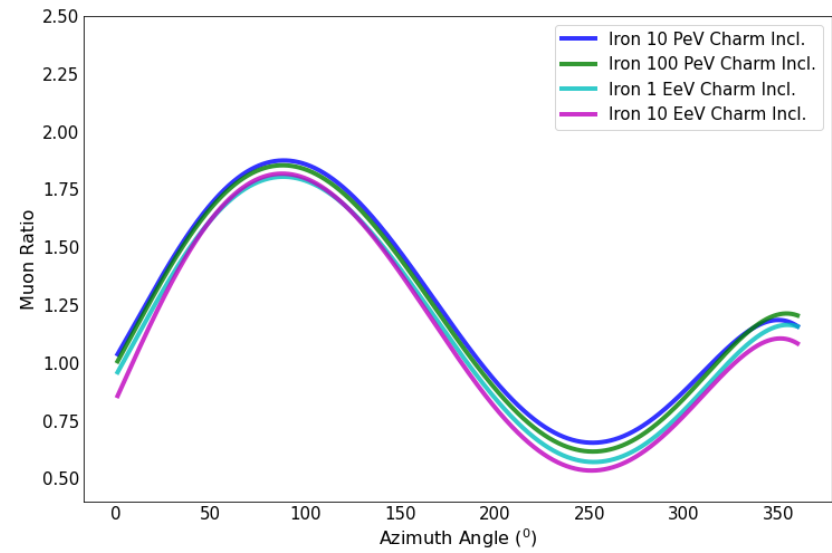


Muon Charge Ratio: [40 - 60°]

Iron Inclined No Charm



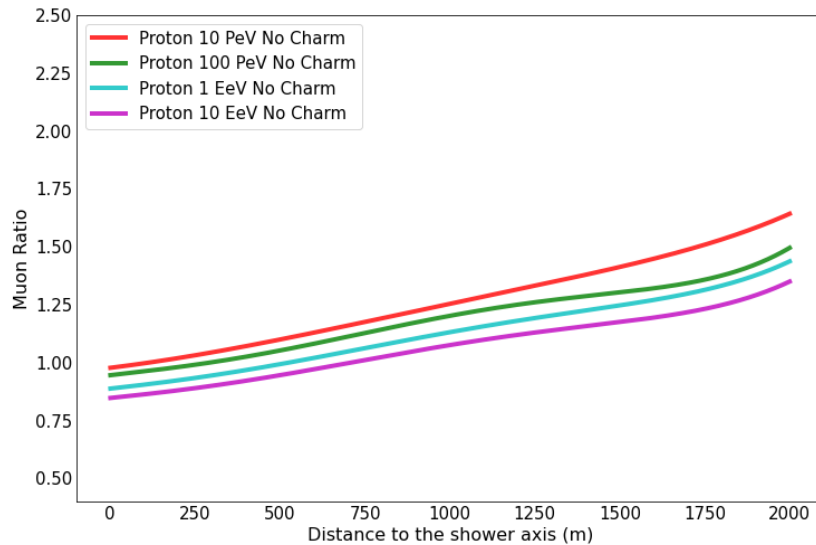
Iron Inclined Charm Incl.



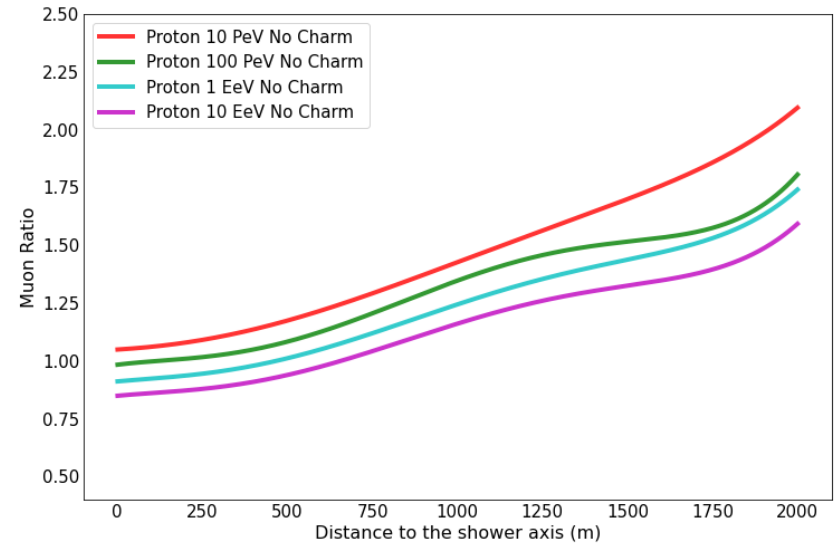


Muon Charge Ratio vs Distance:

Proton Vertical Charm/NoCharm



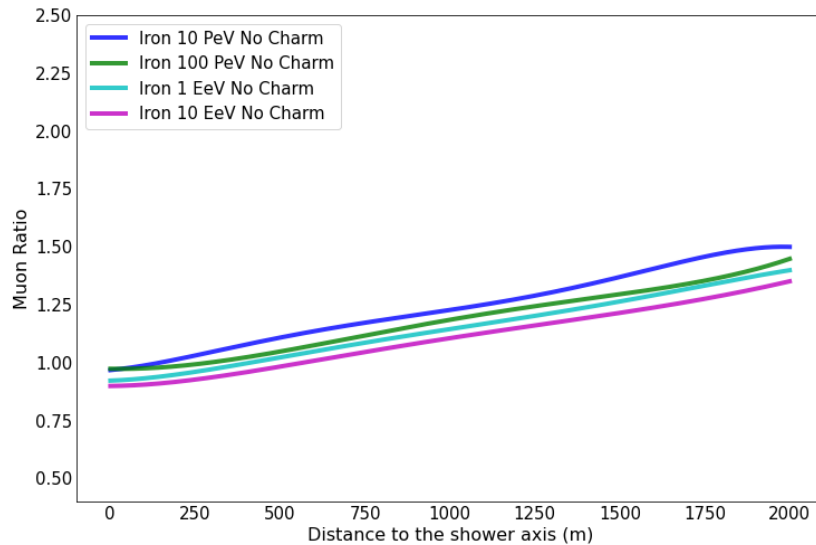
Proton Inclined Charm/NoCharm



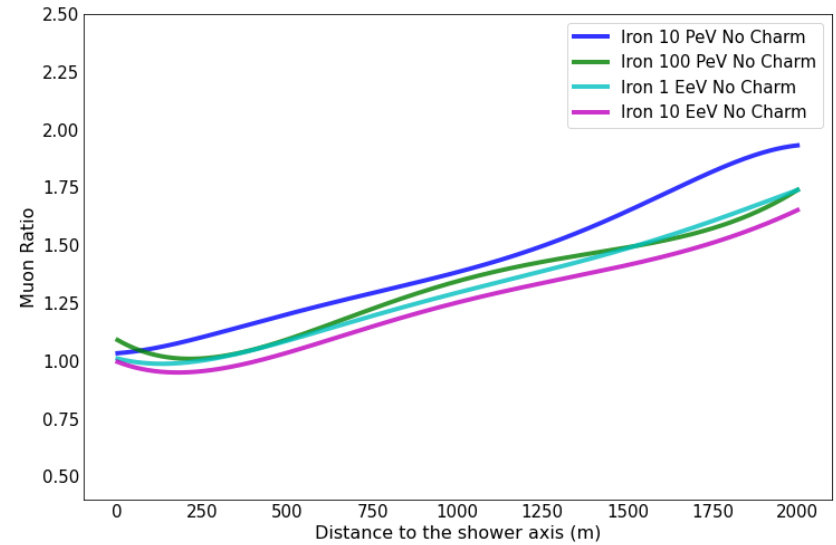


Muon Charge Ratio:

Iron Vertical Charm/NoCharm



Iron Inclined Charm/NoCharm





Outlook:

- Transverse momentum distribution of muons, electrons, protons, and neutrinos for different primaries and energies.
- Different atmosphere



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THANK YOU

