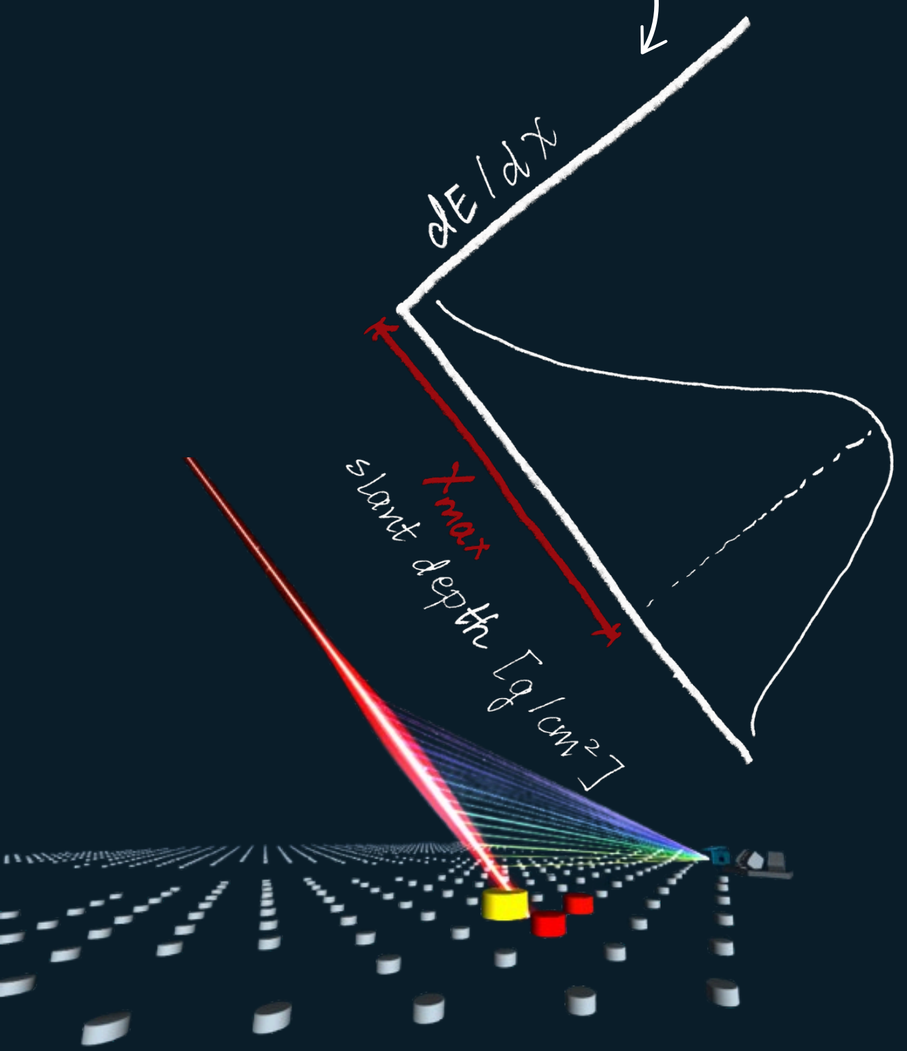
Reconstruction of the deep air shower using Top-Down reconstruction algorithm

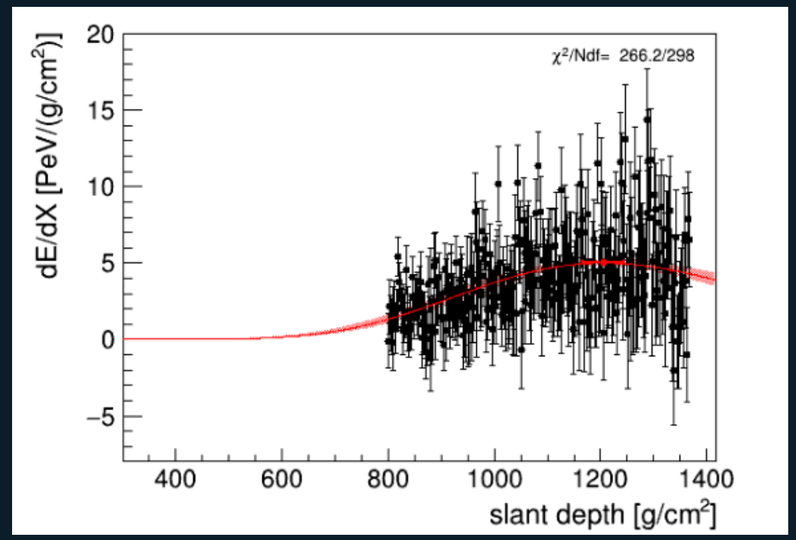
By: Megha Mogarkar
Institute of Nuclear Physics (IFJ, PAN)

The Deep Event

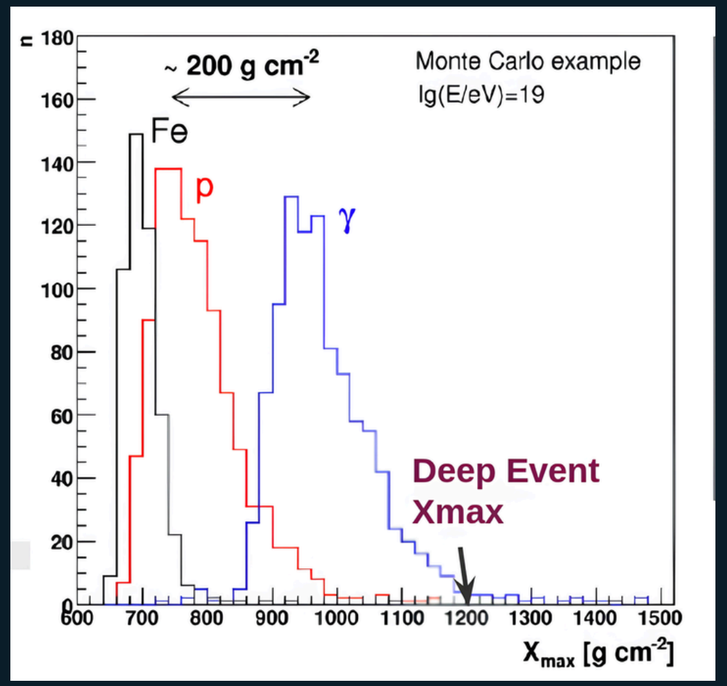
Longitudinal profile



Longitudinal profile of the deep event



$$X_{max} = 1205 \pm 38 g/cm^2$$



Distribution of Xmax for different primaries

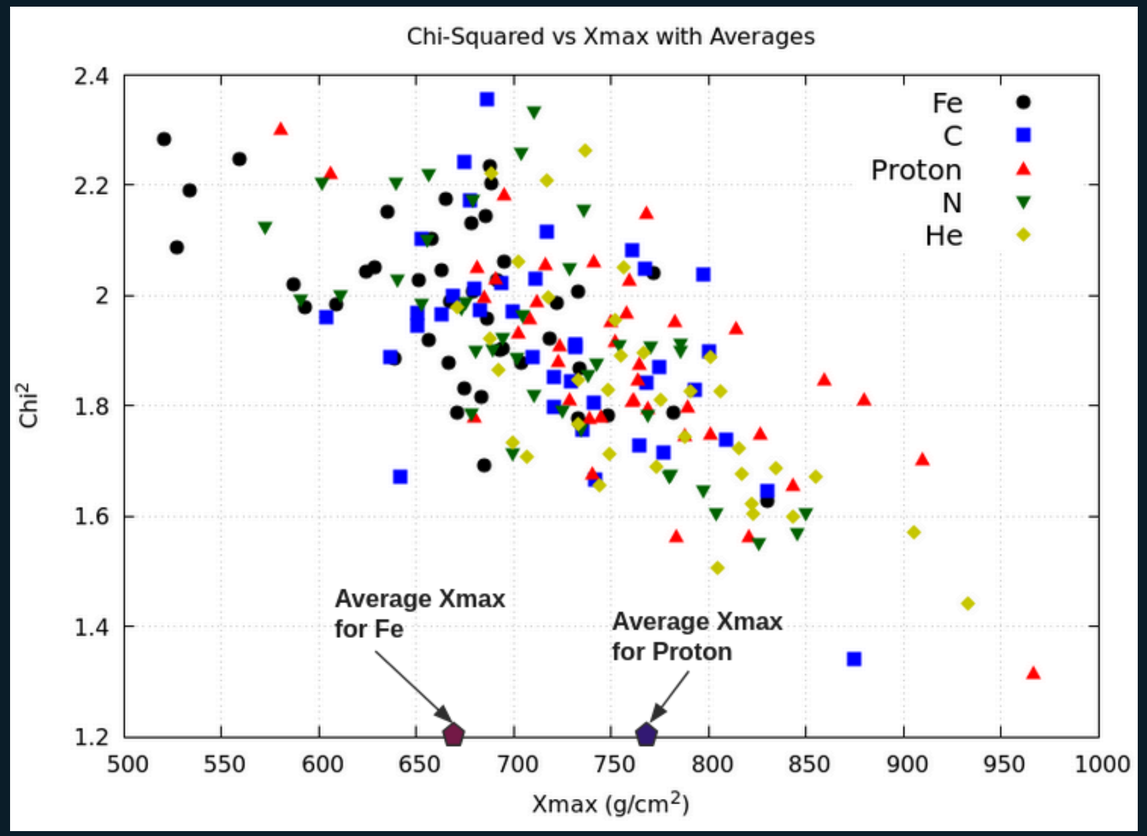
Unusually large Xmax: Xmax of the Event is larger than the expected range of hadronic showers

Might indicate unusual interaction or exotic physics

Analysis using Top-Down

Step 1: Narrowing a primary

Compare chi-square values for different primaries with their Xmax



Implies that lighter primary is more probable: We take ***proton*** *as primary*

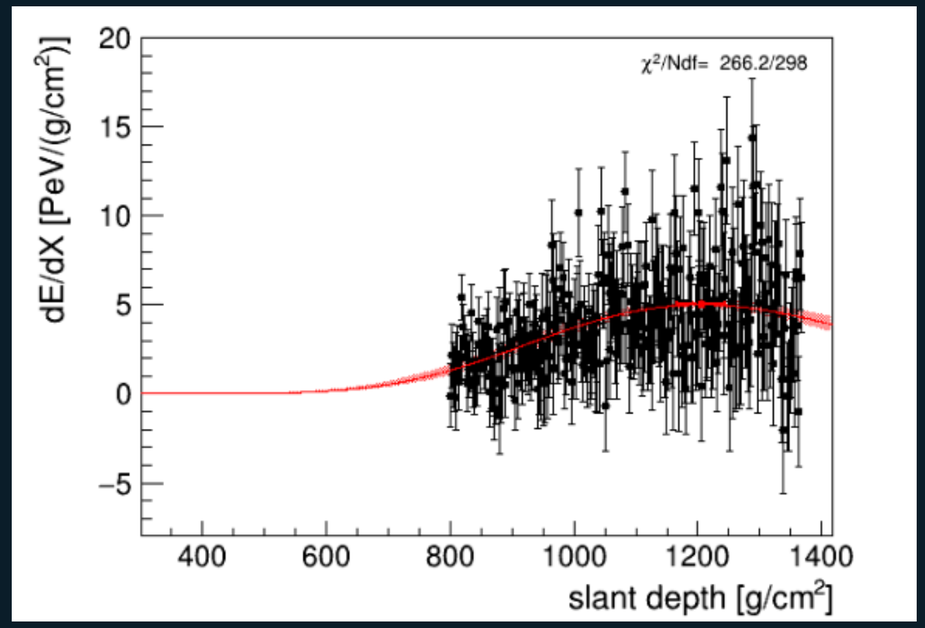
Step 2: Applying changes to Top-Down

Increased number of simulations- 500->100,000
Increased quality cuts: Xmax, dEdX, Ecal, chi-square etc.

Step 3: Longitudinal simulation match and full simulation

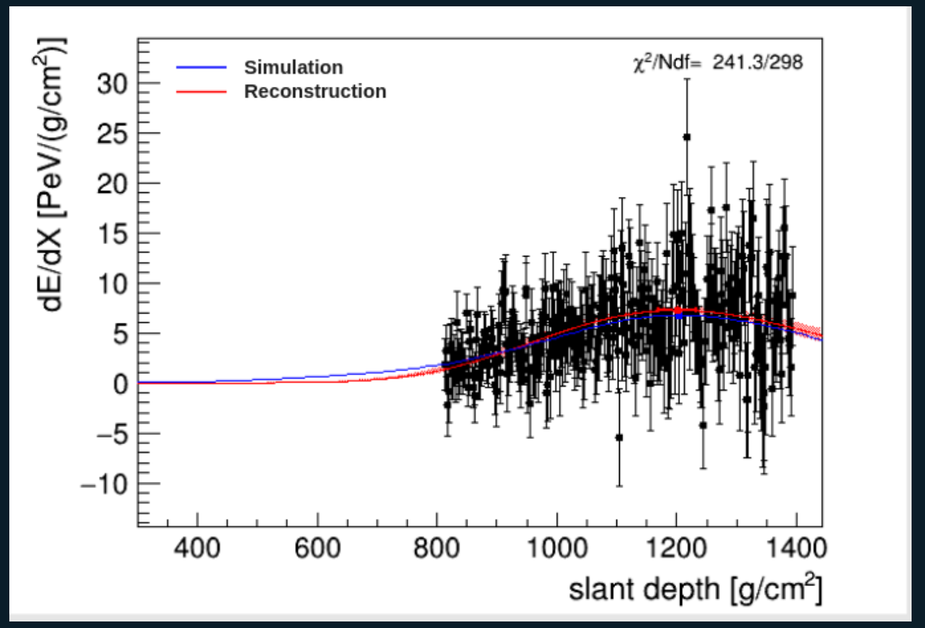
Simulate multiple longitudinal profiles of proton to get the best match. Then with the best match, further full simulation.

Result and Conclusions



Observed Longitudinal Profile

$$\mathbf{X_{max} = 1205 \pm 38 g/cm^2}$$



Top-down Reconstructed Longitudinal Profile

$$\mathbf{X_{max} = 1201 \pm 31 g/cm^2}$$

This unusual EAS being produced by a hadron (specificlly proton) is still a possibility
Further possibility of other hadrons would be interesting to see.