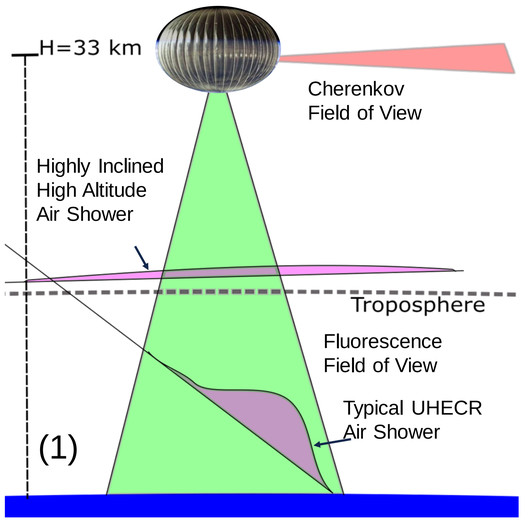
Expected Performance of the EUSO-SPB2 Fluorescence Telescope

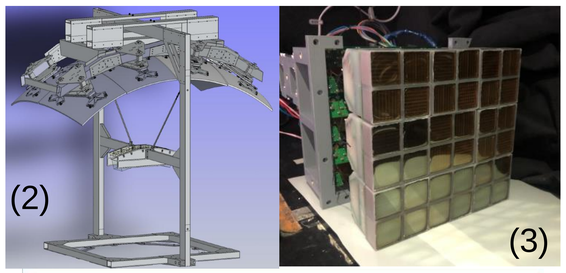
George Filippatos for the JEM-EUSO Collaboration

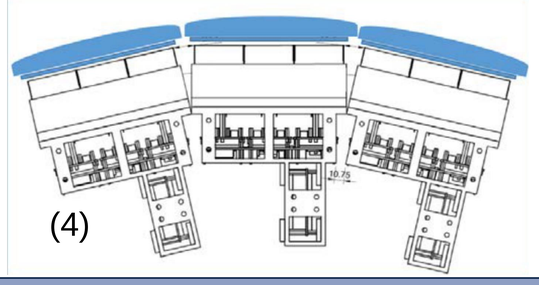
Colorado School of Mines

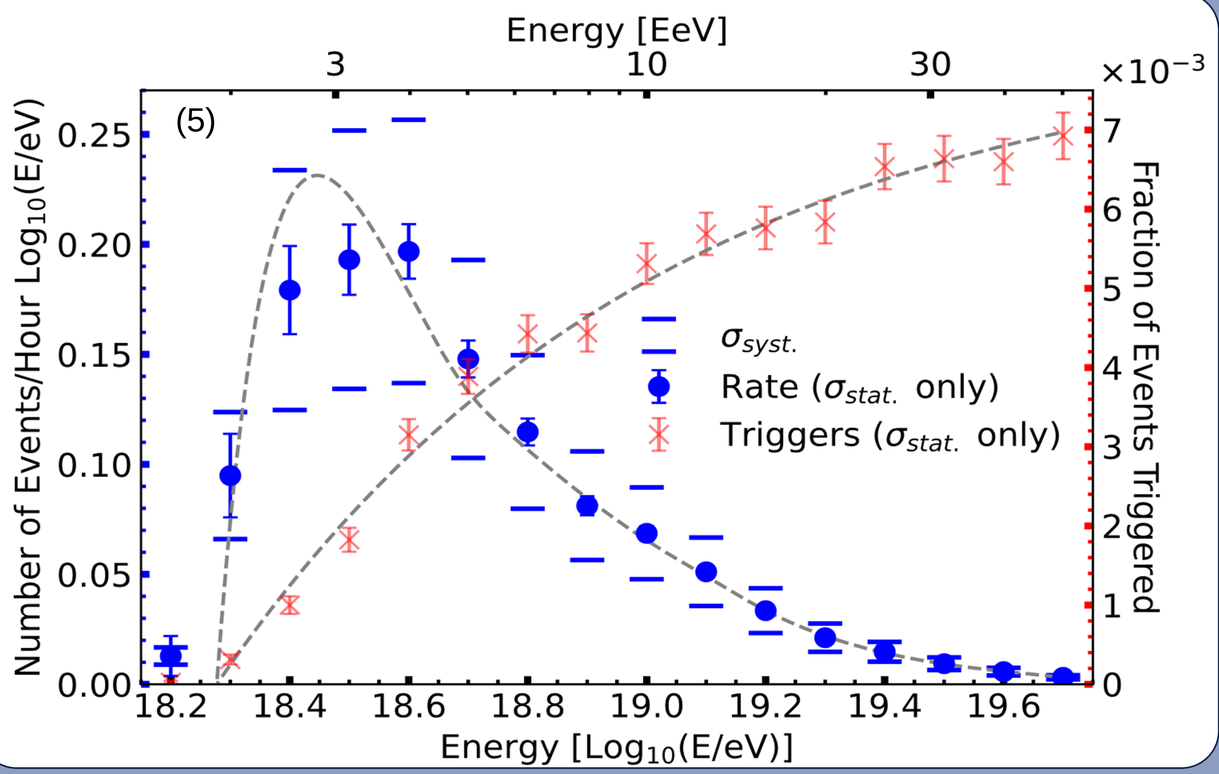
EUSO-SPB2



Pathfinder prototyping instrumentation for future space based missions, i.e. POEMMA [1]. Two scientific telescopes, a fluorescence (FT) and Cherenkov (CT). The FT will detect UHECRs as pictured above (1). Utilizing a Schmidt telescope (2) and consisting of 3 PDMs (3,4), with a total FoV of 36°x12° and 6,192 pixels. Flown on a NASA super pressure balloon [2], planned launch in 2023.



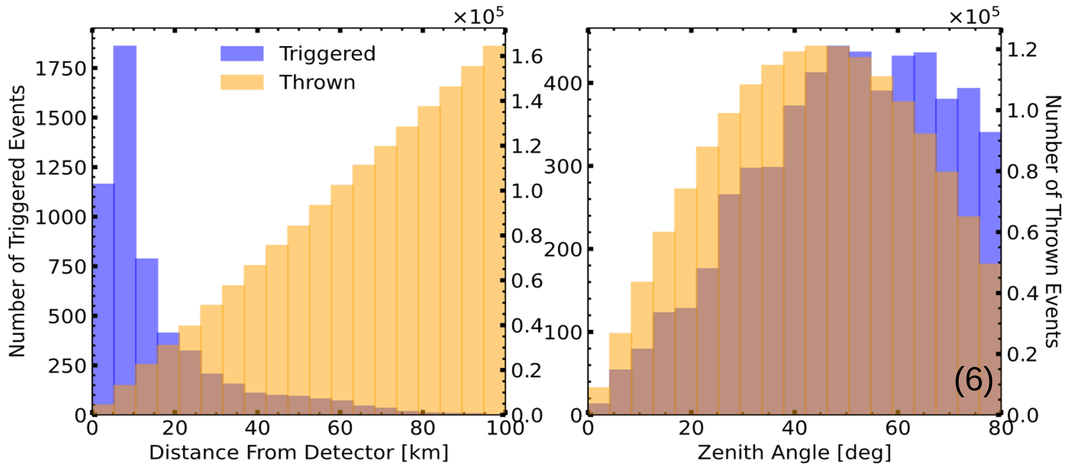




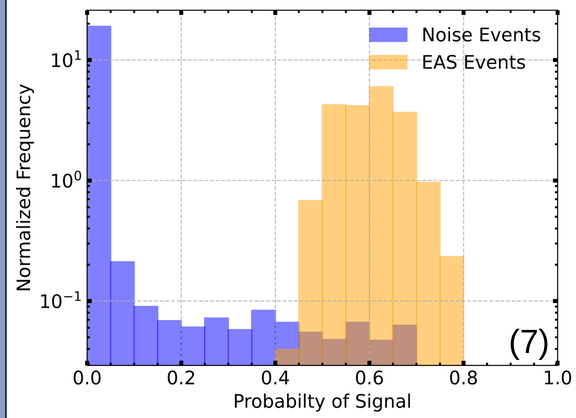
Event Rate Estimation

A large sample of simulated showers were generating using CONEX and the JEM-EUSO OffLine framework in order to gauge the expected performance of the EUSO-SPB2 FT. 1.6 million showers, broken into 20 energy bins. Only a small fraction of these events triggered as shown below in (6). The fraction of triggered events was converted to an expected event rate using the energy spectrum measured by Auger [3] by the equation to the right. The energy threshold was found to be $10^{18.2}$eV with a peak sensitivity at $10^{18.6}$eV. The event rate as a function of energy is shown above in (7). The expected event rate was found to be **0.12±0.01(stat.) 0.04(syst.)** events/hour.

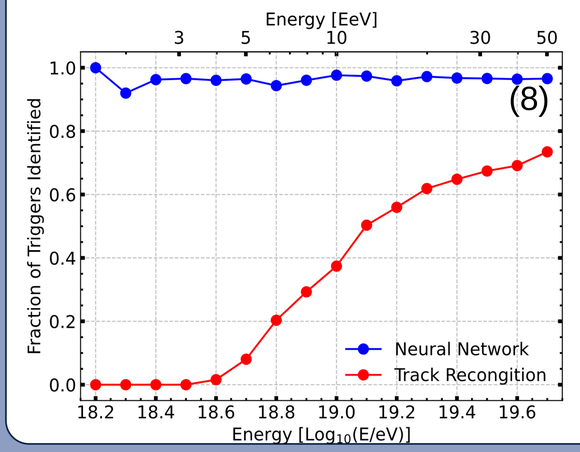
$$R(E_i) = \left(\frac{N_{Trigger}}{N_{Thrown}}\right) A\Omega \int_{E_i-\Delta E/2}^{E_i+\Delta E/2} J(E)dE$$



Neural Network Event Classification



Limit telemetry available to a super pressure balloon flight, require online data analysis techniques to prioritize data for download. A convolutional neural network [4] as been trained to identify events as extensive air showers. Simulated showers (signal), and simulated noise and real data from previous EUSO missions (noise) were used as the training data. The distributions of assigned probabilities for signal and noise events are shown above (7). Overall, >95% of signal was identified while >99% of noise was rejected. The model was trained without a bias to energy, so that it is energy independent, separating it from traditional track recognition algorithms, shown below (8).



References and Acknowledgements

[1] A. Olinto et al., The POEMMA (Probe of Extreme Multi-Messenger Astrophysics) Observatory, Journal of Cosmology and Astroparticle Physics (2020) [2012.07945].
[2] H. Zell, "Scientific balloons."https://www.nasa.gov/scientific-balloons/types-of-balloons, 2017.
[3] A. Aab et al., Measurement of the cosmic-ray energy spectrum above 2.5x10[18] eV using the Pierre Auger observatory, Physical Review D 102 (2020) .
[4] Y. LeCun, L. Bottou, Y. Bengio and P. Haffner, Gradient-based learning applied to document recognition, Proceedings of the IEEE 86 (1998) 2278.

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