ANALYZING TIME-DELAY HISTOGRAMS FROM 2019-2020 CHANGVAN LATITUDE SURVEY

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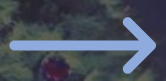
Outline



Introduction

Cosmic rays

Neutron monitor

Latitude survey

Data analysis

Time-delay histogram

Leader fraction

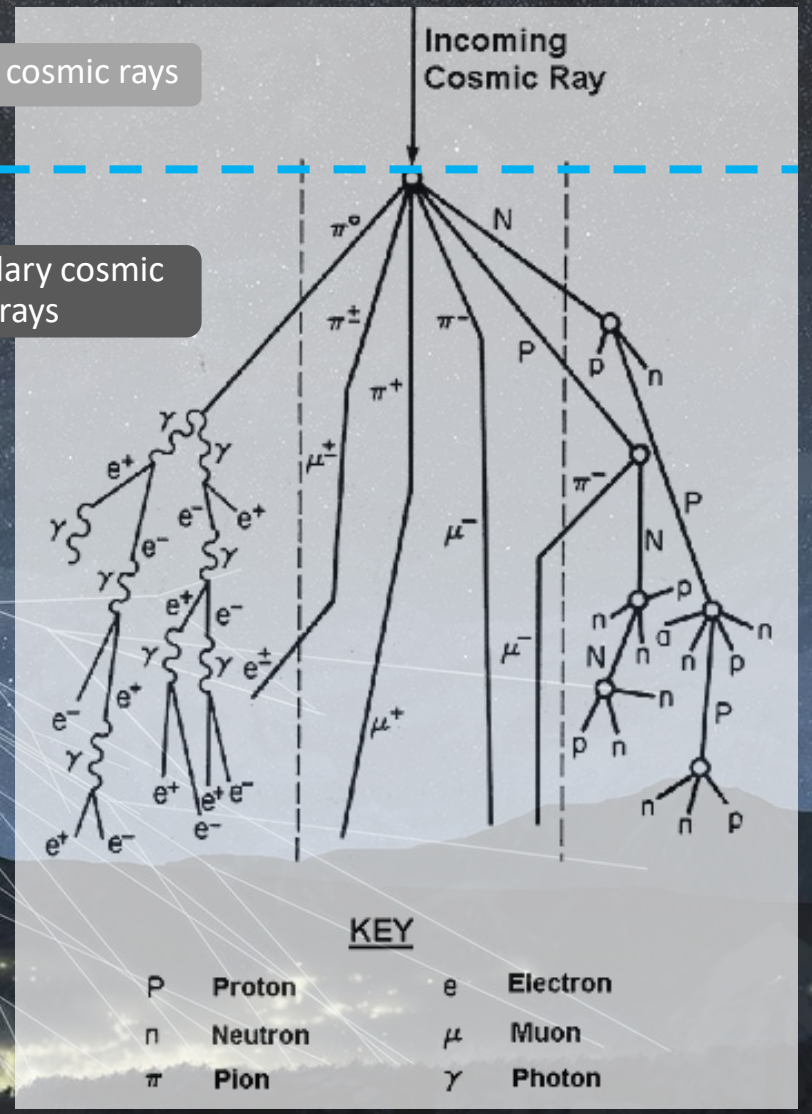
Results

Cosmic rays

The sun

Active galactic nuclei

Supernova

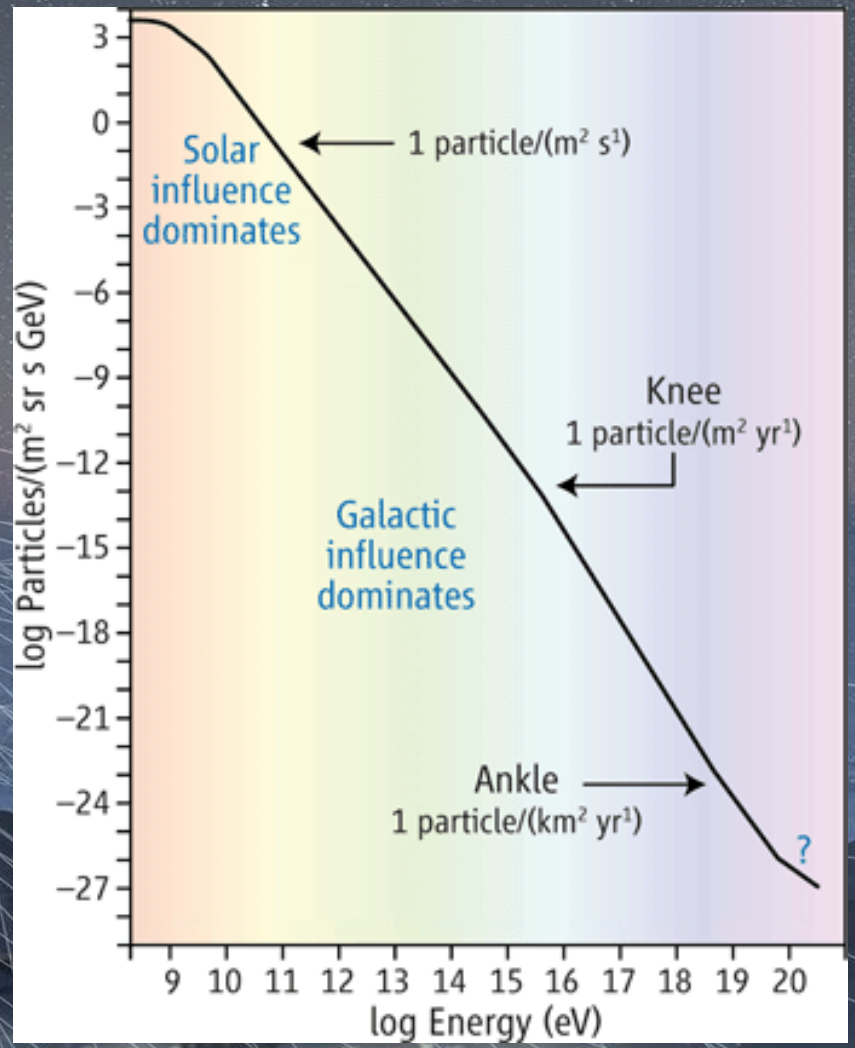


Cosmic ray spectrum

The sun

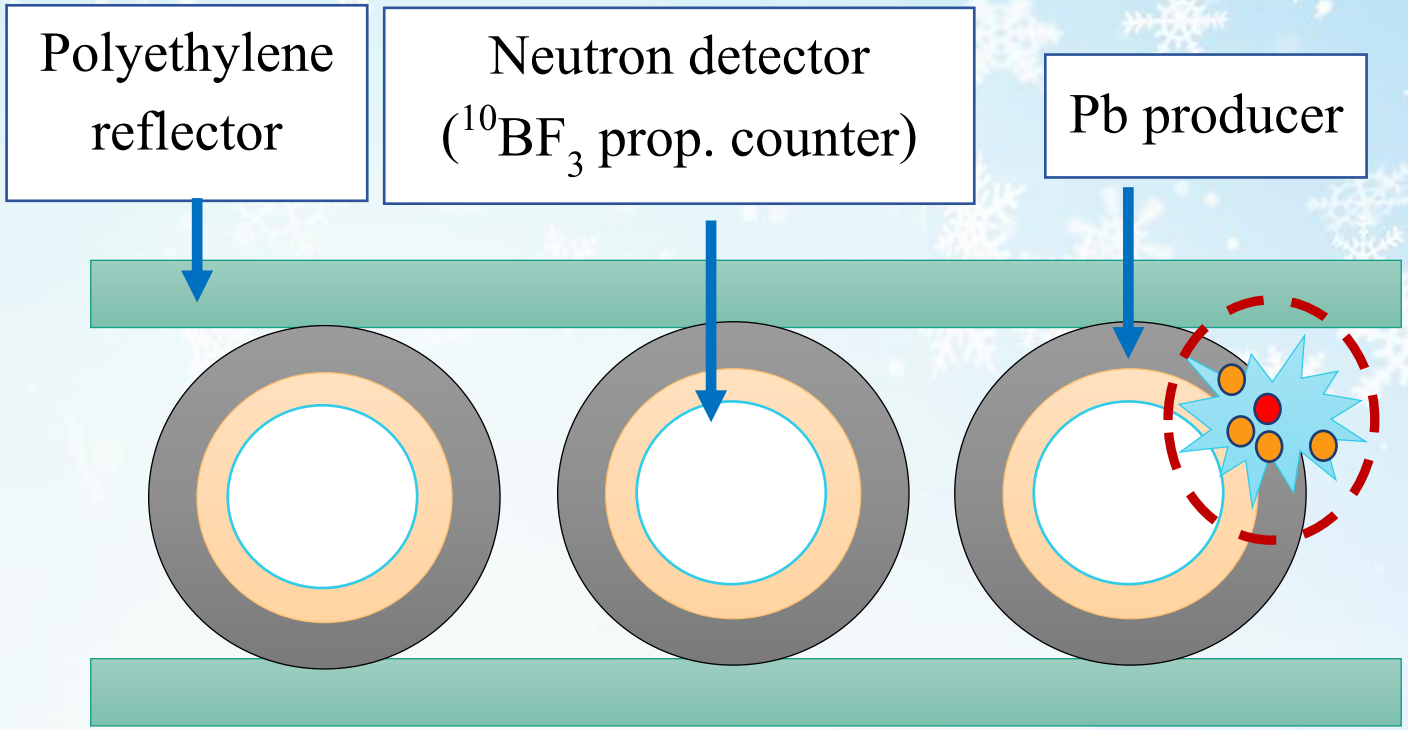
Active galactic nuclei

Supernova

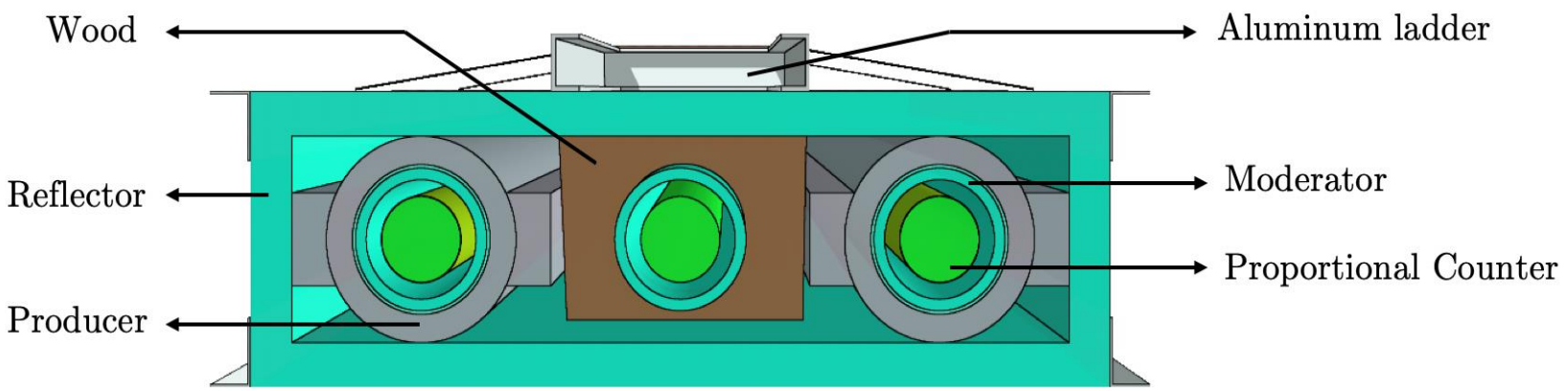


Picture from: https://science.sciencemag.org/content/314/5798/429/F1

Neutron monitor



CHANGVAN NEUTRON DETECTORS



The simulation of neutron monitor detector of Changvan by FLUKA simulation program.
Ref. Miss Kanokkarn Fongsamut

CHANGVAN LATITUDE SURVEY

The latitude surveys in 2018-2019 (CN35) and 2019-2020 (CN36)

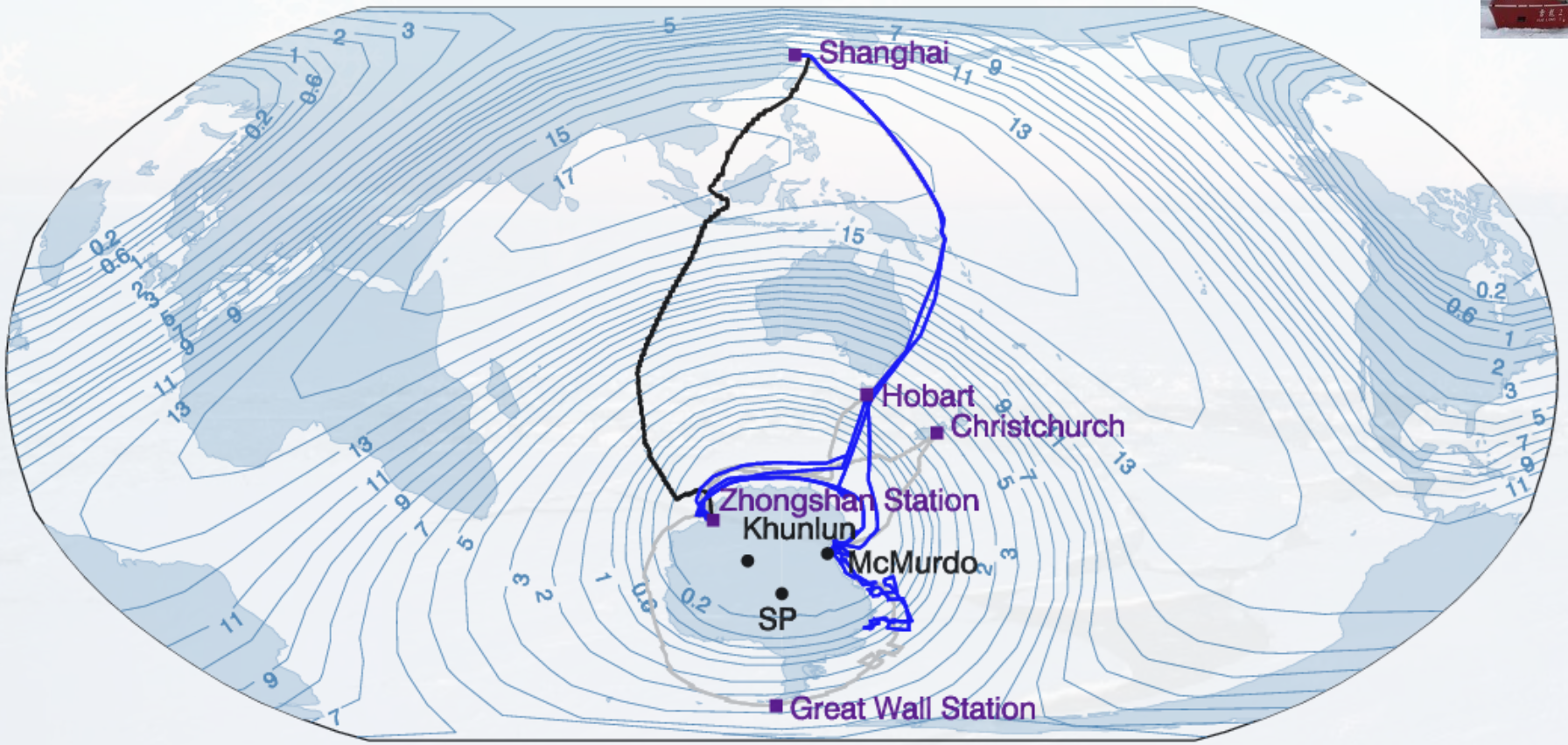
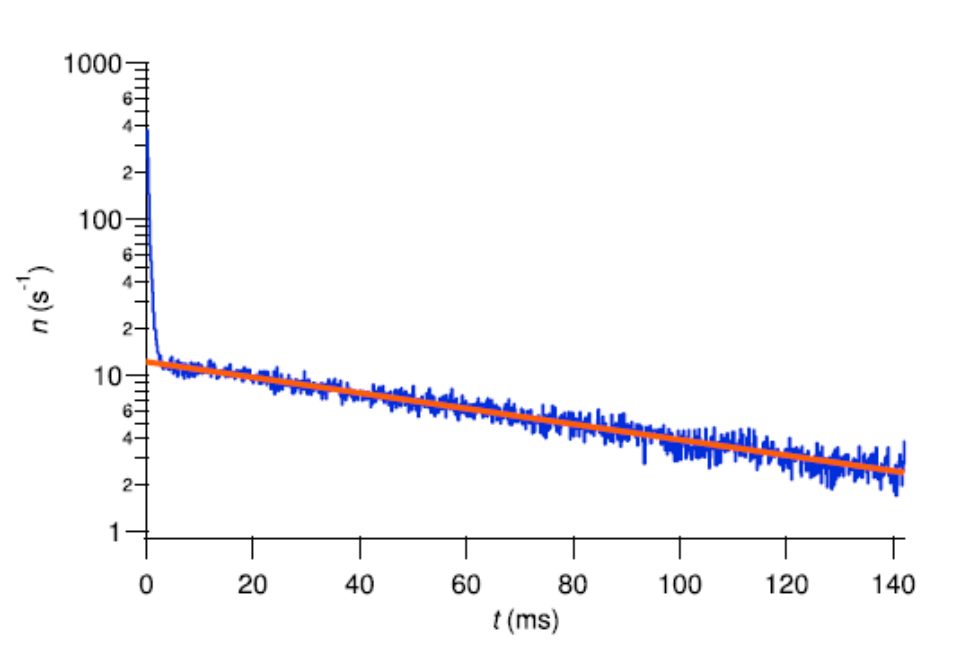
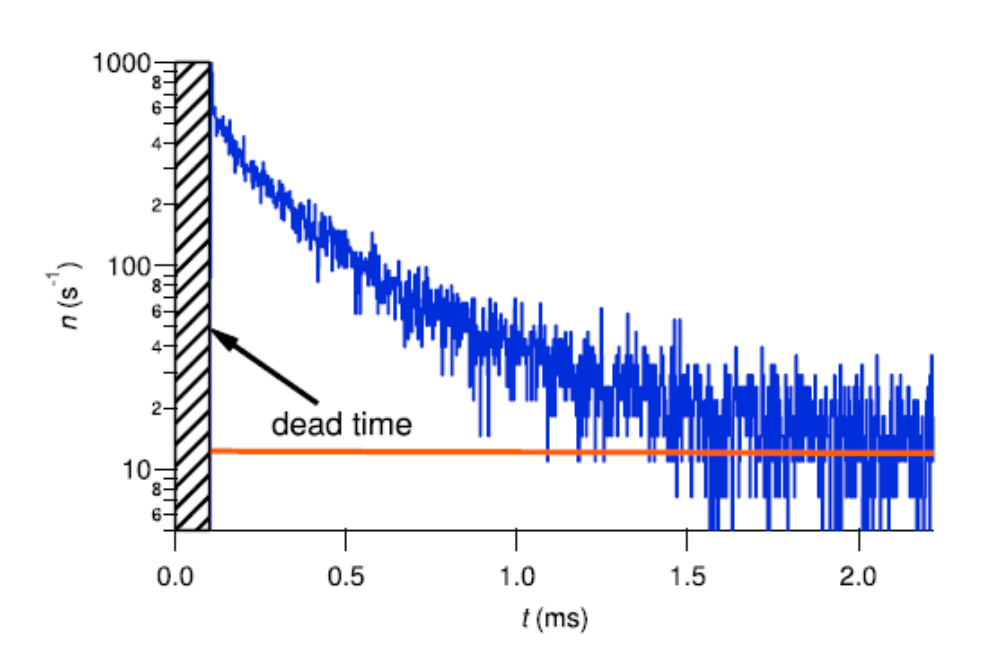


Figure from : Miss Sidarat Khamphakdee

TIME-DELAY HISTOGRAMS

- Distribution of the time delay between successive neutron counts at one counter tube recorded during one specific 1 h interval. (left) Long time delays show the exponential distribution typical of unrelated events, while (right) short time delays deviate substantially from the exponential function (red line). The electronic dead time is typically $t_d \sim 80 - 90$ µs.

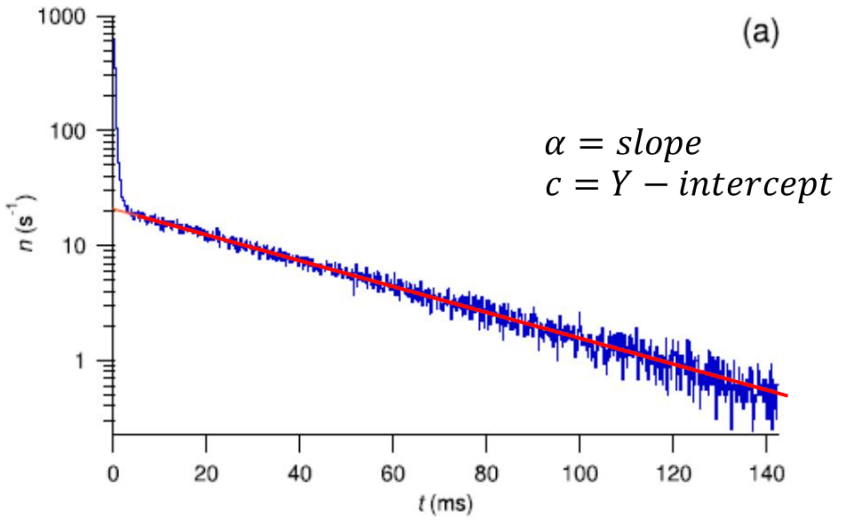




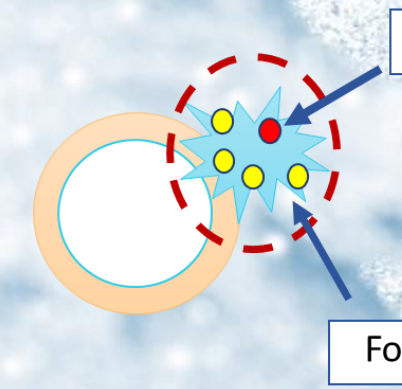
Ruffolo et al., 2016

Leader fraction

- Leader fraction (L) refers to neutron counts that do not follow a preceding neutron count in the same counter from the same atmospheric secondary particle
- We statistically calculate the leader fraction (L) from histograms of time delay that related to cosmic ray spectral index.
- Amplitude of exponential tail (red) indicates rate of "leaders" arriving by chance, not "following" in temporal association with preceding count.

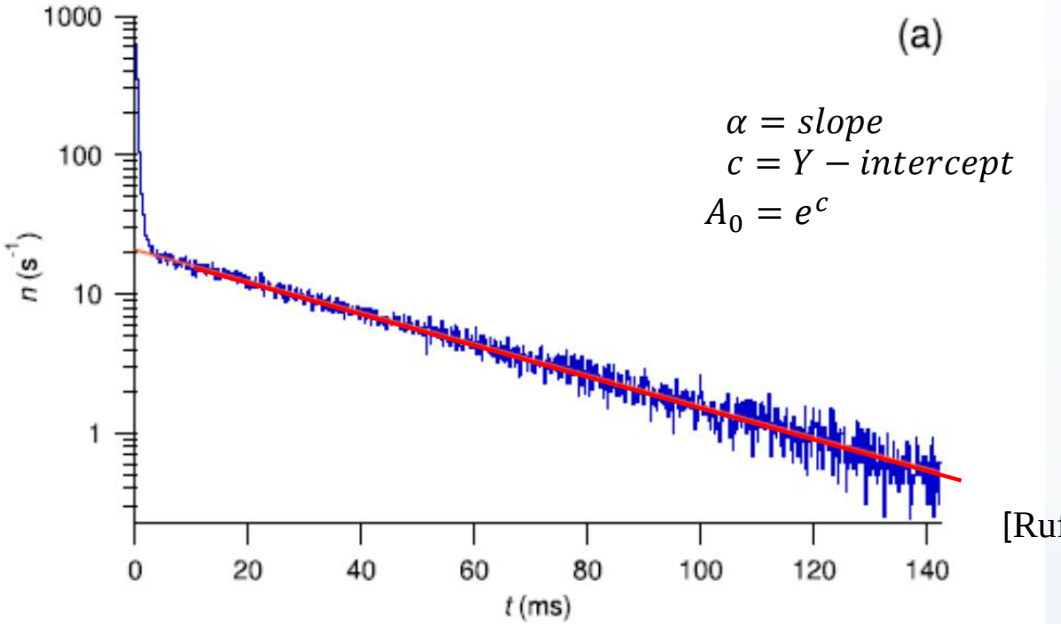


Ruffolo et al., 2016



$$\text{Leader Fraction} = \frac{\text{First count (Leader)}}{\text{All pulse (Leader + Followers)}}$$

Leader fraction calculation



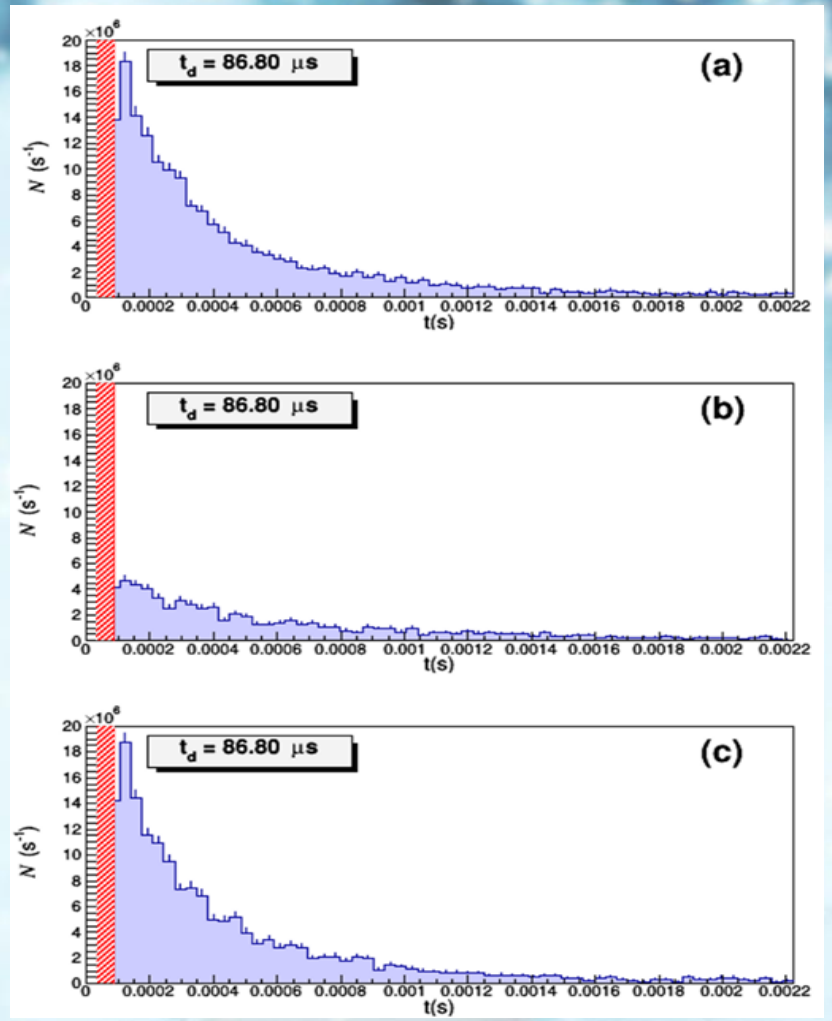
[Ruffolo et al., 2016]

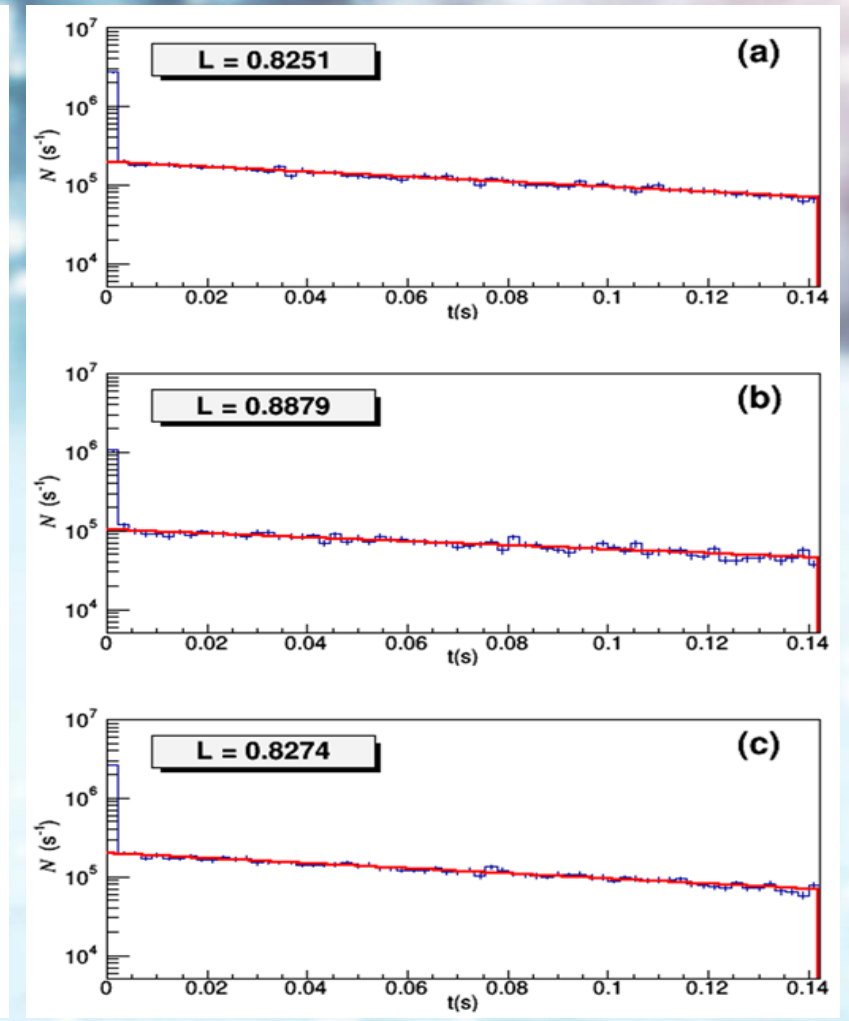
$$L = \frac{\frac{A_0}{\alpha} e^{-\alpha t_d}}{\sum_{t=t_d}^{t_0} N_t + \frac{A_0}{\alpha} e^{-\alpha t_0}}$$

where α and A_0 are the parameters from the hourly long-time histogram fit. t_o = 0.142 s is the overflow time in the electronic system, and dead time t_d = 87 μs . The term $\sum_{t=t_d}^{t_o} N_t$ is the sum of the neutron pulses for all time bins from t_d to t_o from the recorded histogram files

Result

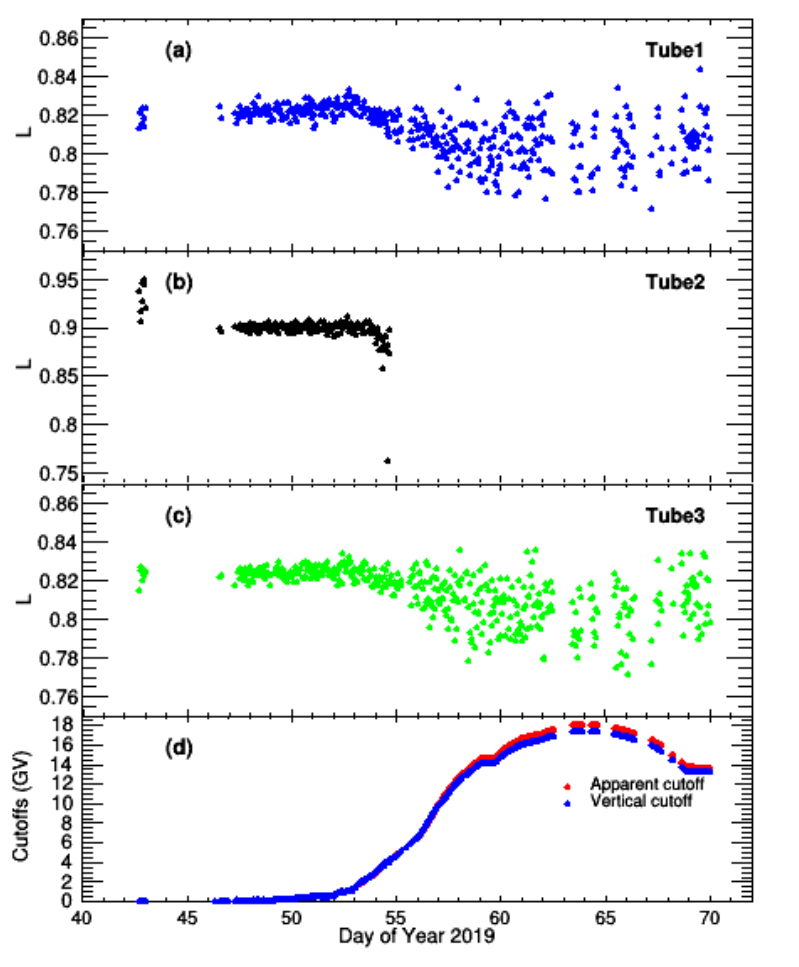
Time-delay histogram of 2nd hour UT on the 20th December 2019 of the survey year 2020



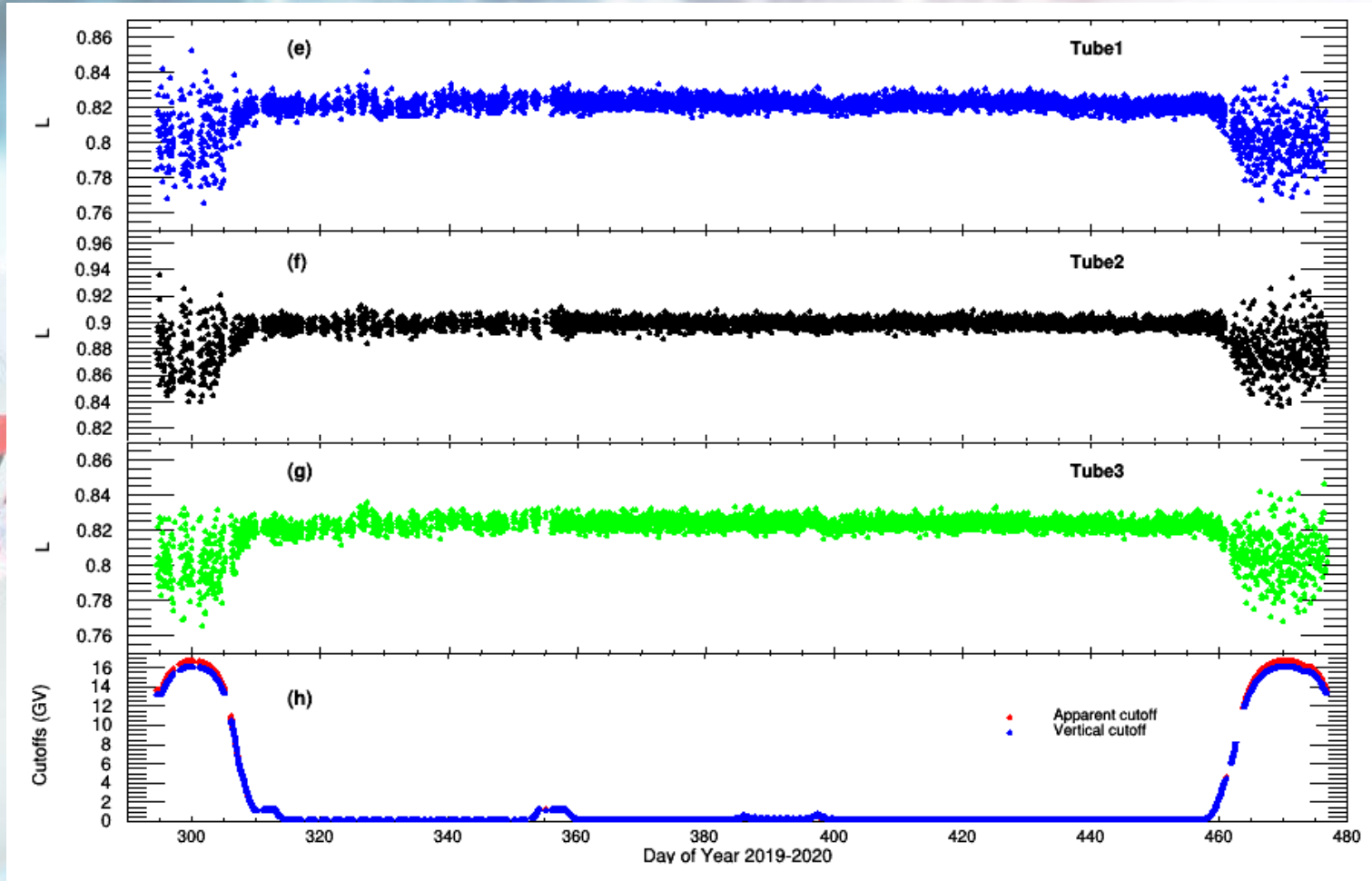


Result

Leader fraction of single-tube in the survey year 2018-2019

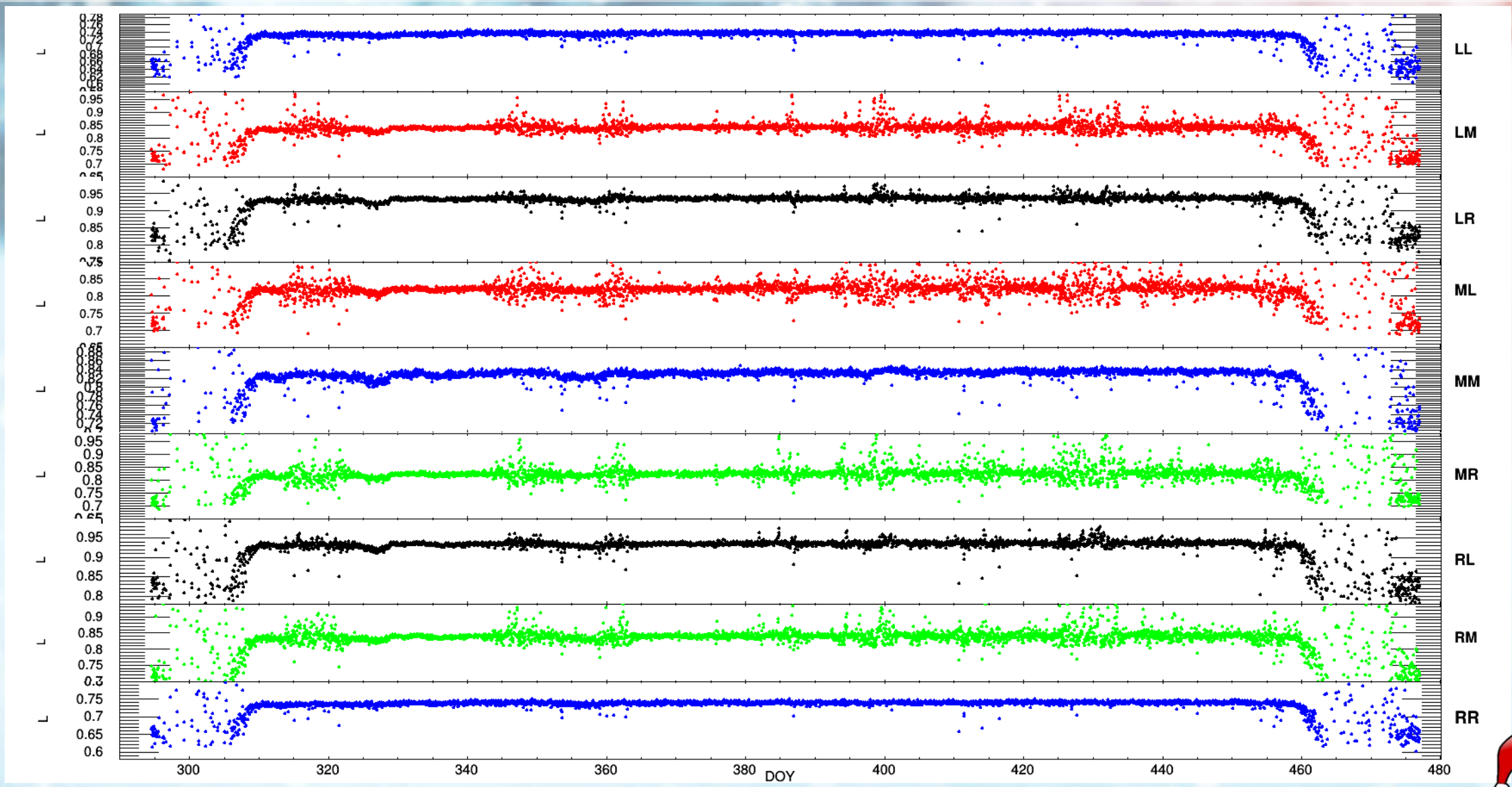


Leader fraction of single-tube in the survey year 2019-2020



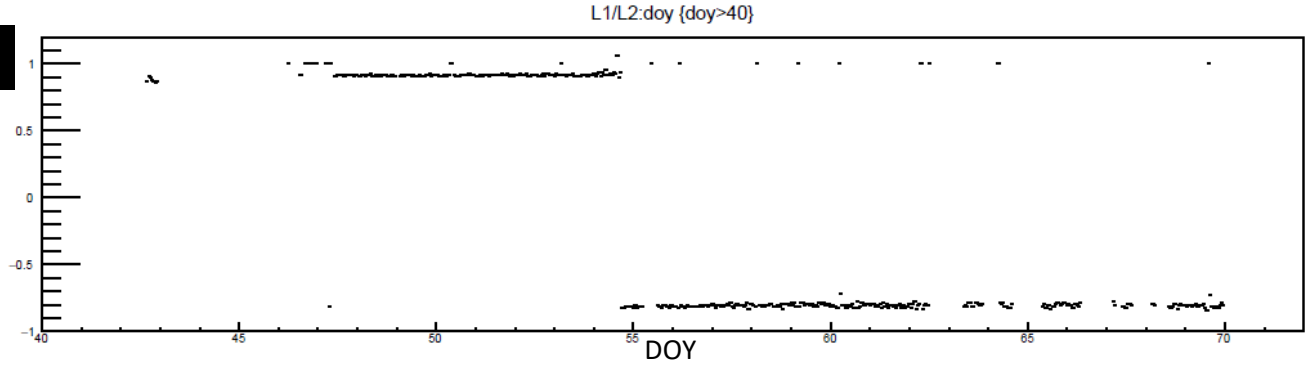
Result

Leader fraction of cross-tube in the survey year 2019-2020

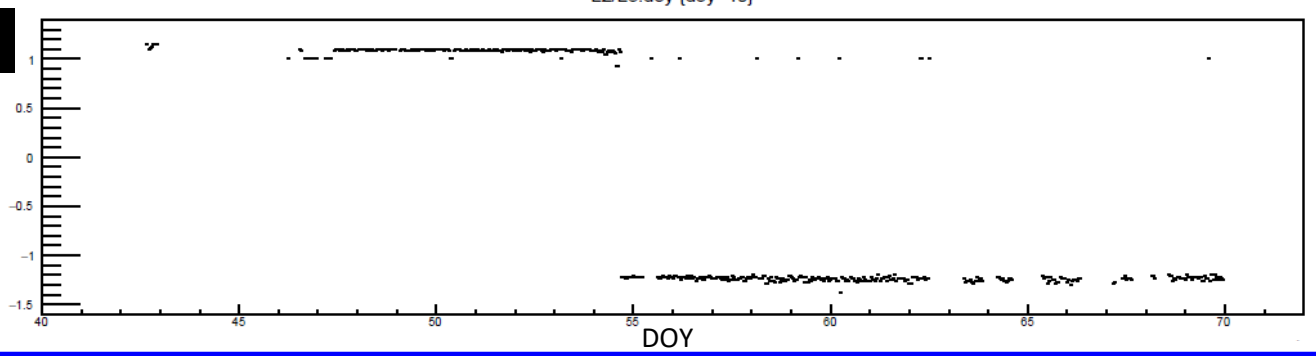


Tube ratio of the leader fraction of single-tube in the survey year 2018-2019

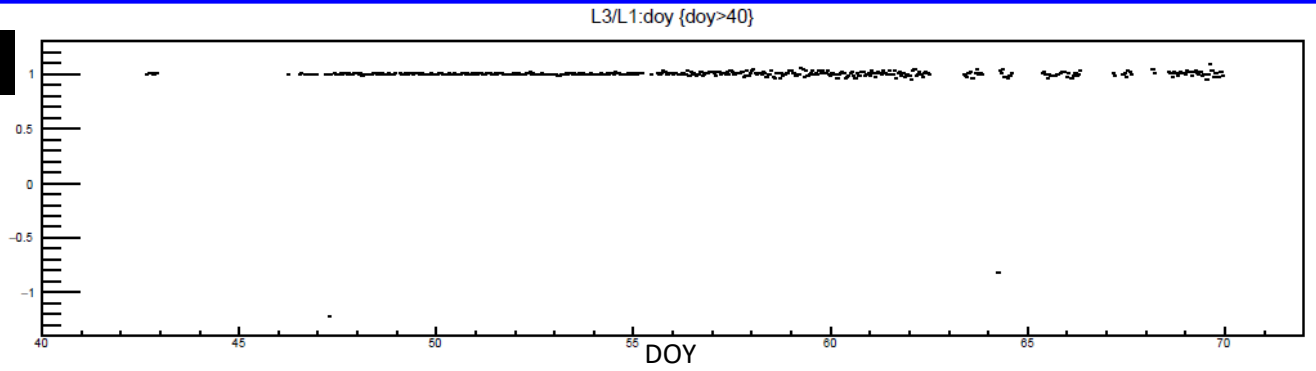
L1/L2



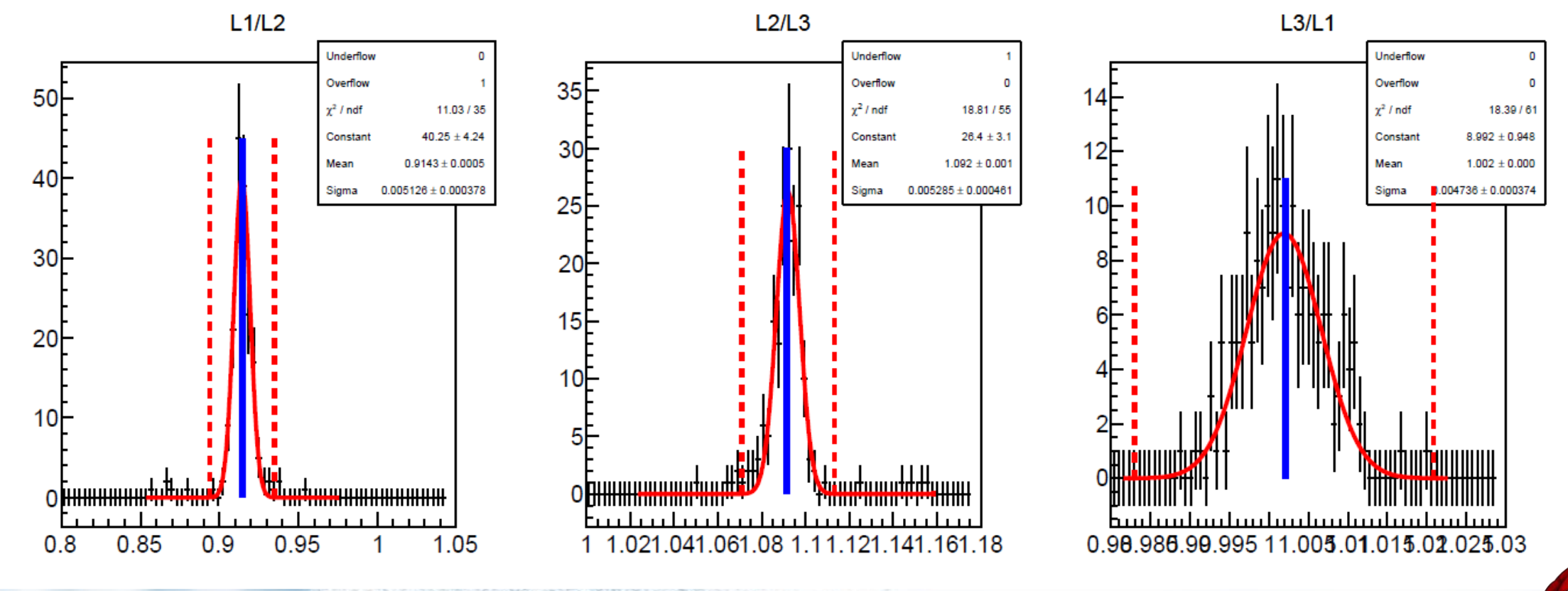
L2/L3



L3/L1

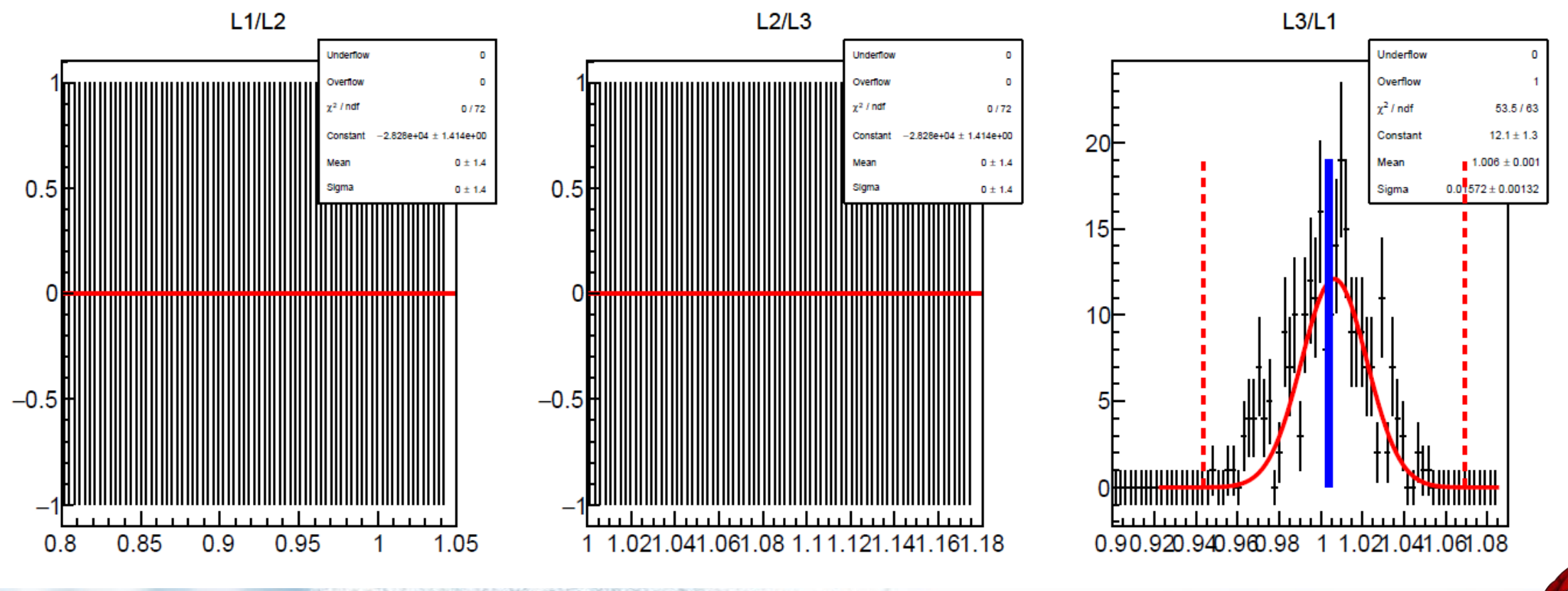


Gaussian fits of the survey year 2018-2019
(DOY 42.708 – 55.77)



Gaussian fits of the survey year 2018-2019

(DOY 55.77 – 70.00)

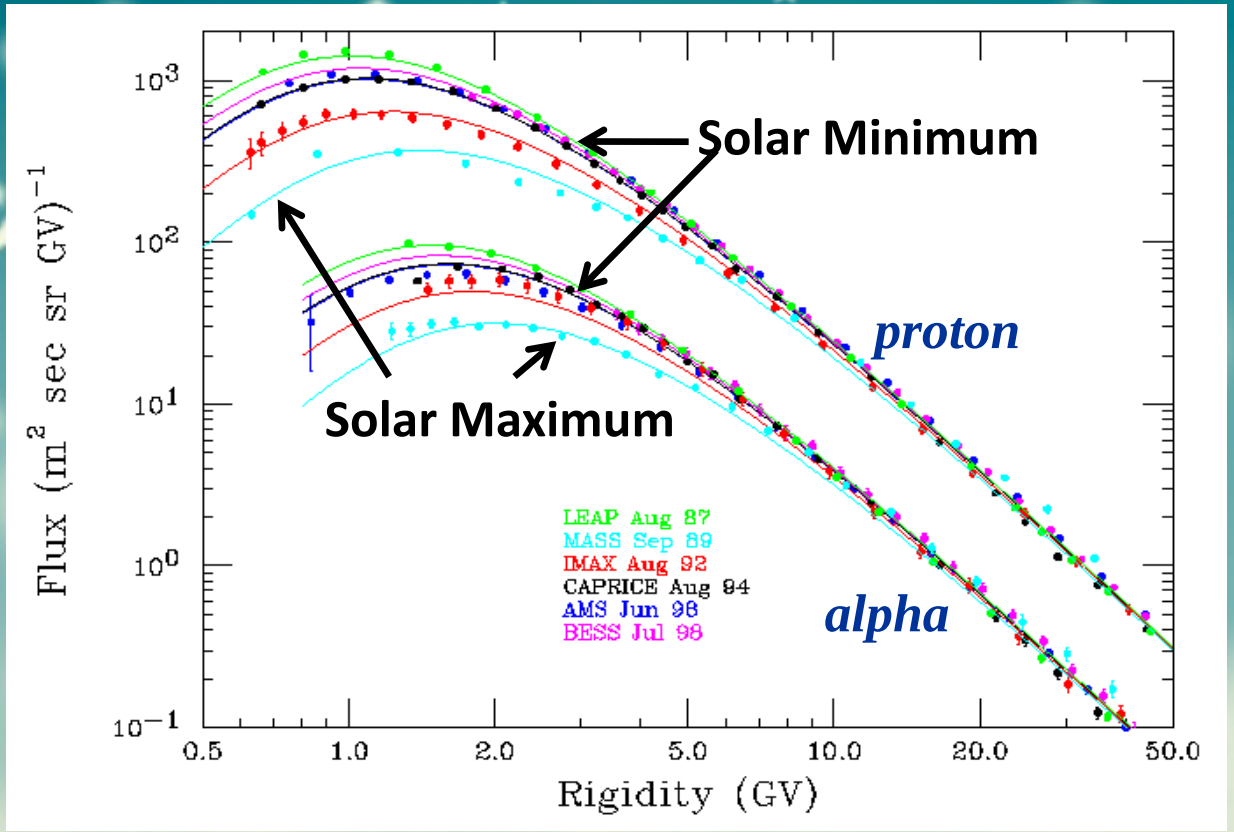


Next work

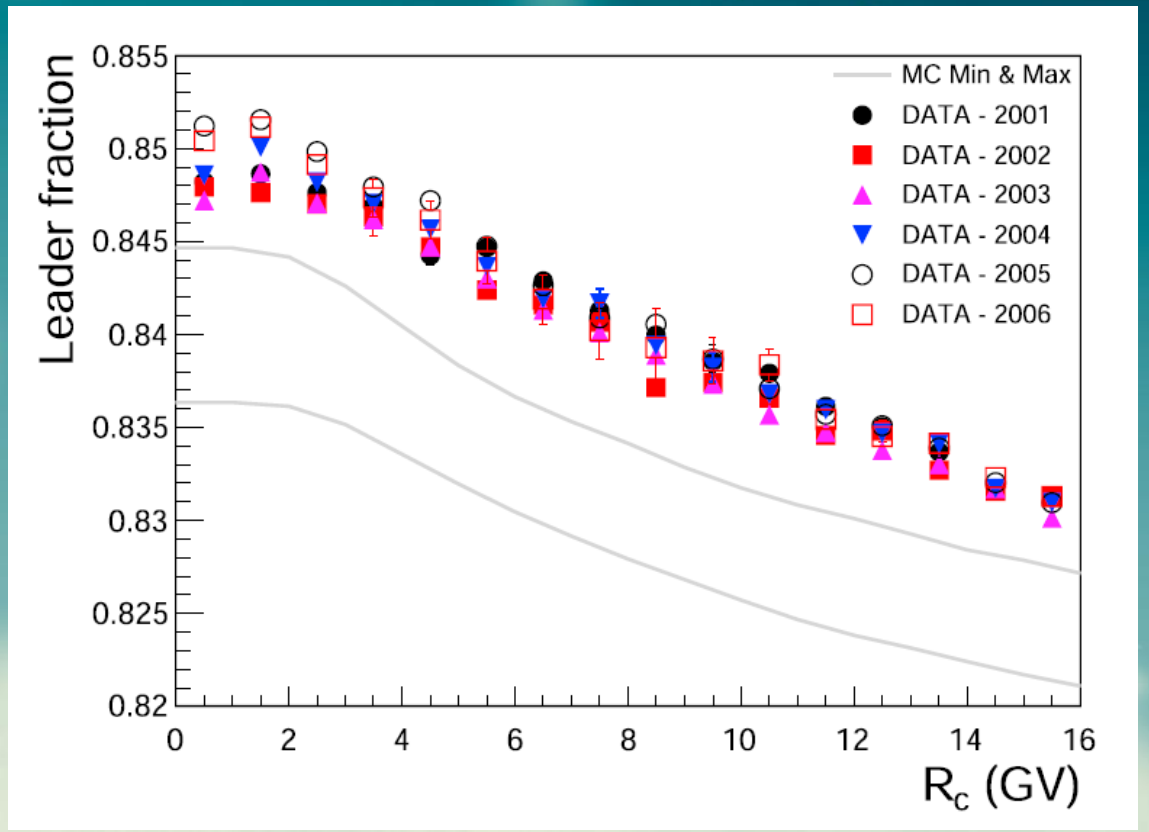
- Eliminate outliers
- Data set for further analysis
  - Pressure Correction
  - Short-term Moduration Correction
  - Temperature Correction
- Integral Response function / Differential Response function

GALACTIC COSMIC RAY FLUX

Distribution of cosmic-ray flux as a function of particle energy.



Dependence of the leader fraction L measured by the mobile neutron monitor on the apparent cutoff rigidity R_c for the six surveys.



Mangeard et al., 2016


THANK YOU FOR
YOUR ATTENTION