VALIDATION OF MONTE CARLO YIELD FUNCTION OF A SEMI-LEADED NEUTRON MONITOR USING LATITUDE SURVEY DATA IN 2019 AND 2020

A. SERIPIENLERT, W. NUNTIYAKUL, S. KHAMPHAKDEE, P.-S. MANGEARD, A. SÁIZ, D.RUFFOLO, P. EVENSON, K. FONGSAMUT, P. JIANG, P. CHUANRAKSASAT, K. MUNAKATA, J. MADSEN, B. SOONTHORNTHUM AND S. KOMONJINDA

OUTLINE

- Introduction
- Atmospheric Simulation
- Detector Simulation
- Results
- Future Work

Latitude Survey Project

ATMOSPHERIC SIMULATION

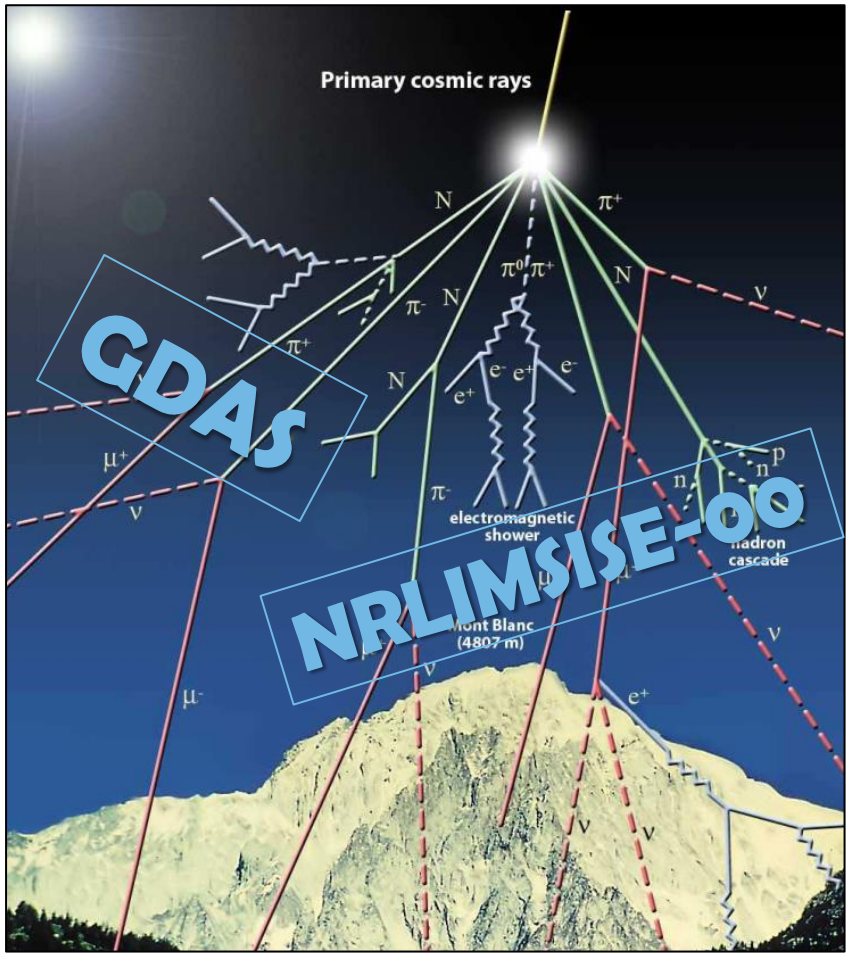
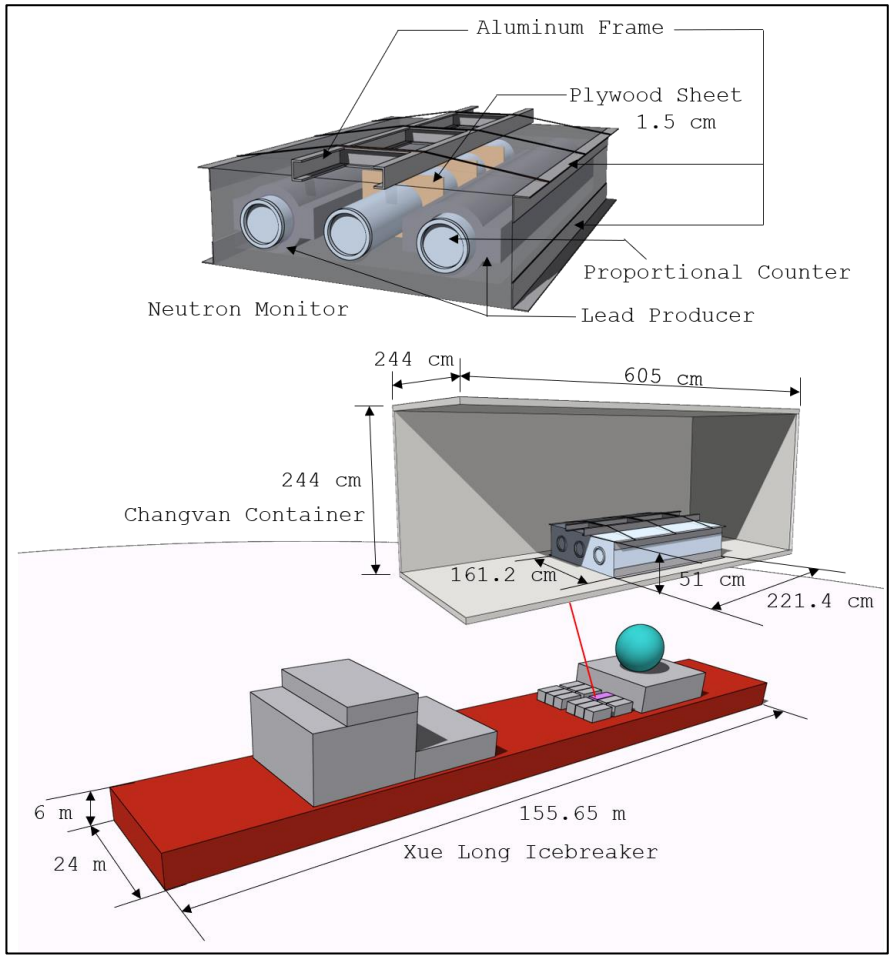
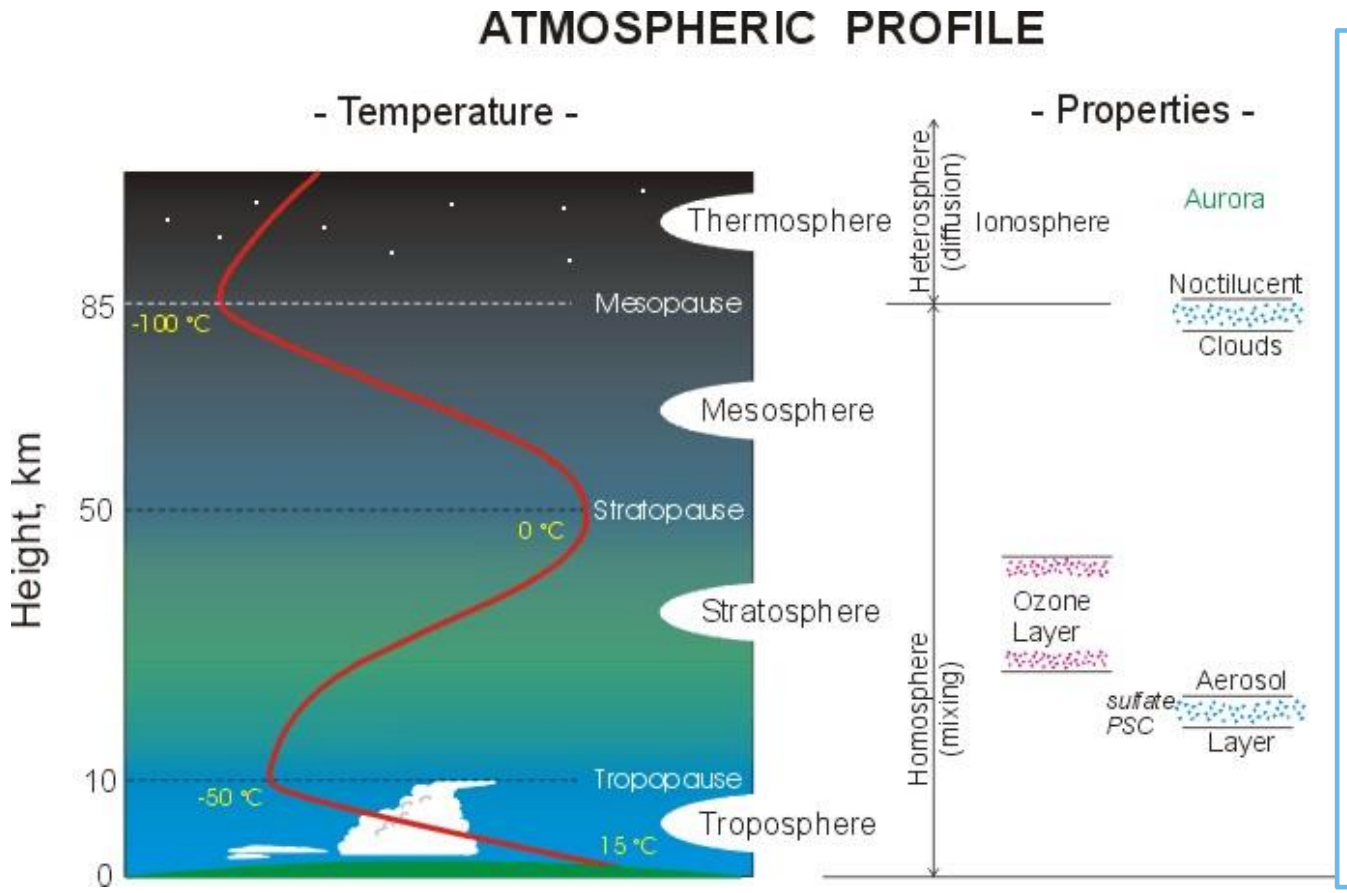


Image credit: http://scifun.ed.ac.uk/card/images/left/cosmic-rays.jpg

DETECTOR SIMULATION



WHAT IS AN ATMOSPHERIC PROFILE?



www.ems.psu.edu/~lno/Meteo437/AtmProfile.jpg

- Variations of the characteristics of the atmosphere with **altitude**
  - Temperature
  - Composition
  - Pressure/Density
- Divided in multiple layers
- Depends strongly on latitude but also on time

ATMOSPHERIC MODEL INFORMATION

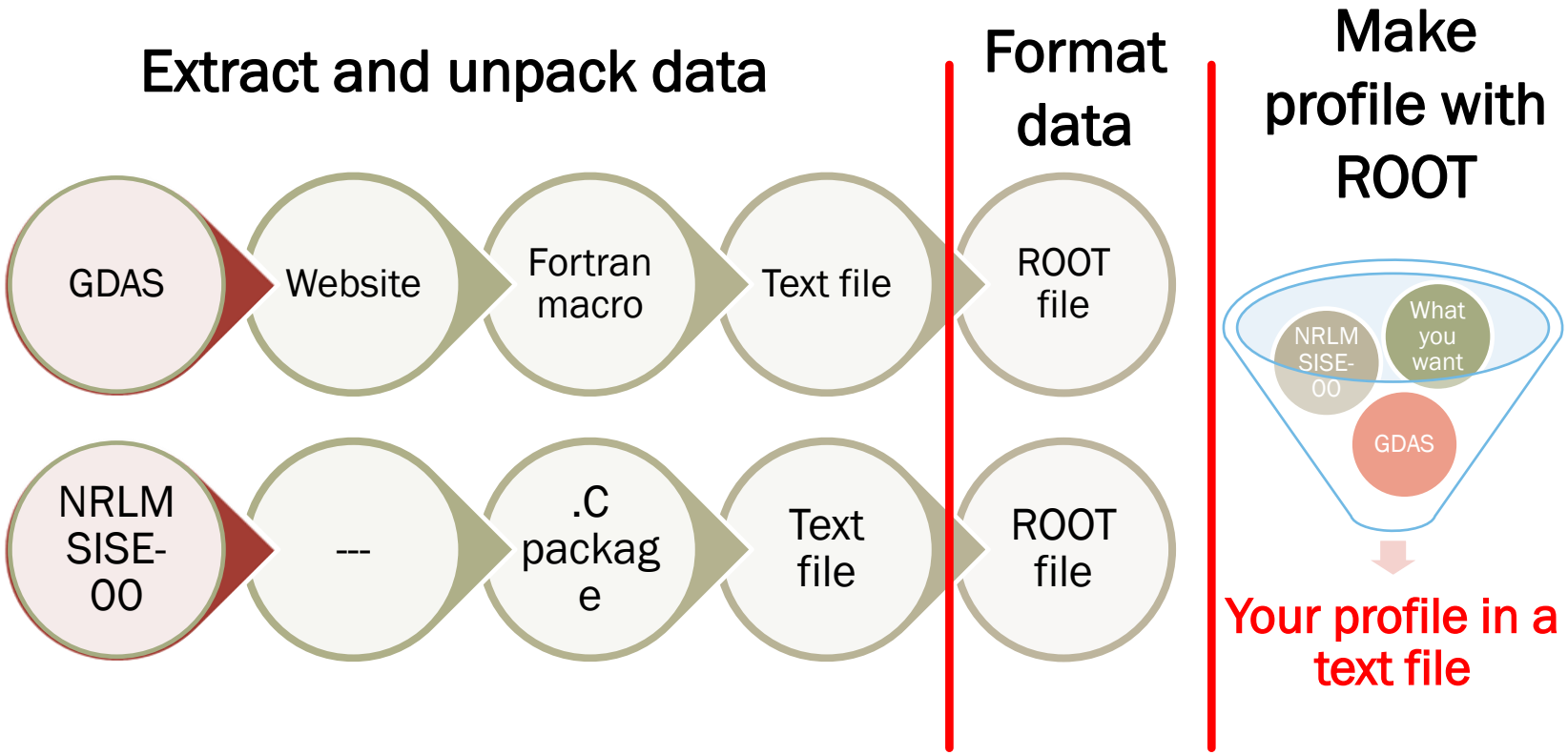
GDAS (P>20 hPa)

- Global Data Assimilation System
- It provides, every 6 hours, a worldwide grid (with a granularity of 1° in latitude and longitude) of meteorological parameters(from weather stations, balloons, satellites…). MOIST AIR
- Documentation: http://www.ready.noaa.gov/gdas1.php
- Extraction of data: http://www.ready.noaa.gov/ready2-bin/extract/extracta.pl
- Complex binary format: Fortran macro

NRLMSISE-00 (P<20 hPa)

- Naval Research Laboratory Mass Spectrometer, Incoherent Scatter Radar Extended model. DRY AIR
- http://ccmc.gsfc.nasa.gov/modelweb/models/nrlmsise00.php
- A .C package is available to extract air profiles at a given location and time into a text file.
- http://www.brodo.de/space/nrlmsise/

HOW TO CREATE THE ATMOSPHERIC PROFILES? THE PROCESS



ATMOSPHERIC SIMULATION FROM 3 LOCATIONS

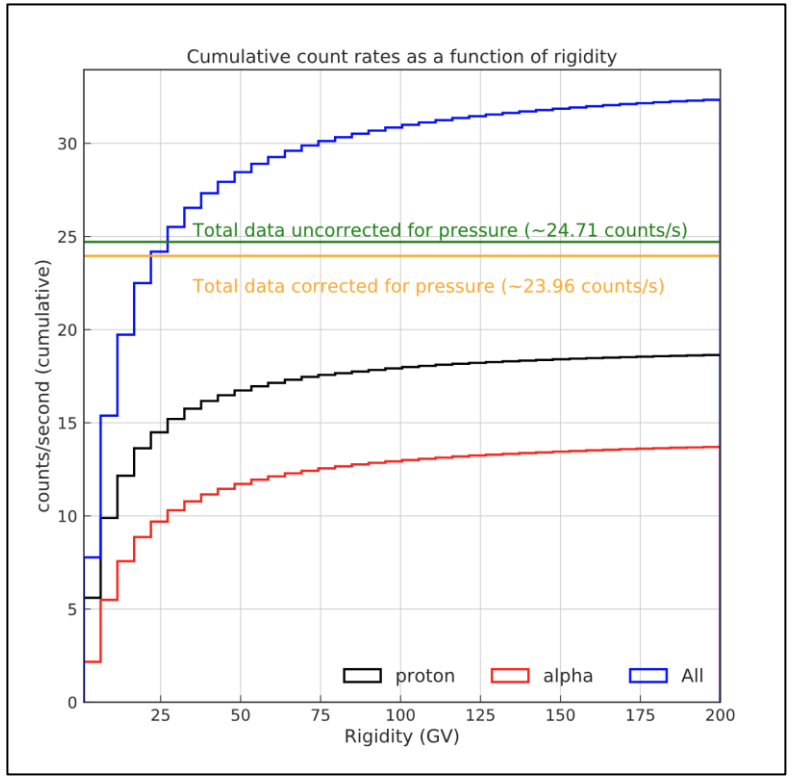
Port	Latitude	Longitude	Apparent / Vertical Cutoff (GV)	Time stay at the port
Hobart /Hob2019	-42.88	147.33	1.23 / 1.24	01:00 07-Nov-2019 to 08:00 08-Nov-2019 nov19.week1 nov19.week2 03:00 22-Dec-2019 to 08:00 24-Dec-2019 dec19.week4
Shanghai /Sha2019	31.317 [25,35] 31,32 ind 7,8	121.69 [115,125] 121,122 ind 7,8	13.6 /13.24	12:00 21-Oct-2019 to 02:00 22-Oct-2019 oct19.week3 oct19.week4 22:00-23:00 21-Apr-2020 apr20.week3
Zhongshan /Zho2019	-69.36 [-75,-65] -70,-69 ind 6,7	76.113 [70,80] 76,77 ind 7,8	0.10 / 0.10	17:00 11-Feb-2019 to 00:00 12-Feb-2019 feb19.week2 00:00 23-Nov-2019 to 06:00 5-Dec-2019 nov19.week4 dec19.week1

SIMULATIONS PARAMETERS

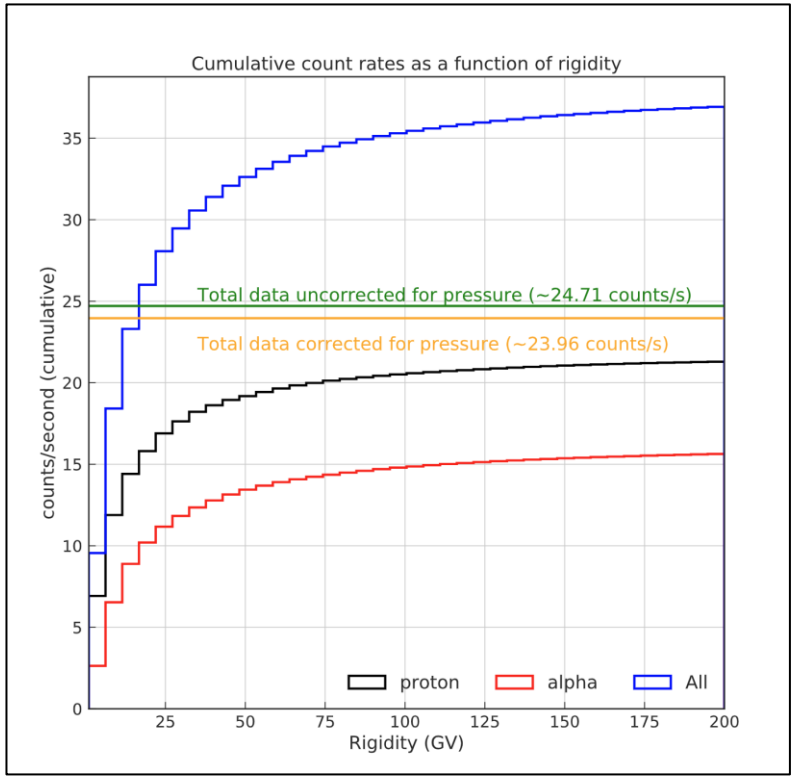
	Type	No. of simulated particles	No. of simulated particles	No. of simulated particles
Atmospheric simulation	p	1,000,000	1,000,000	1,000,000
	α	1,000,000	1,000,000	1,000,000
Library	n	136,508	125,494	155,272
	p	13,486	12,147	15,443
	μ	1,149,070	1,126,229	1,200,135
Detector simulation	n	100,000,000	100,000,000	100,000,000
	p	100,000,000	100,000,000	100,000,000
	μ	100,000,000	74,500,000	26,000,000

DETECTOR SIMULATION RESULTS

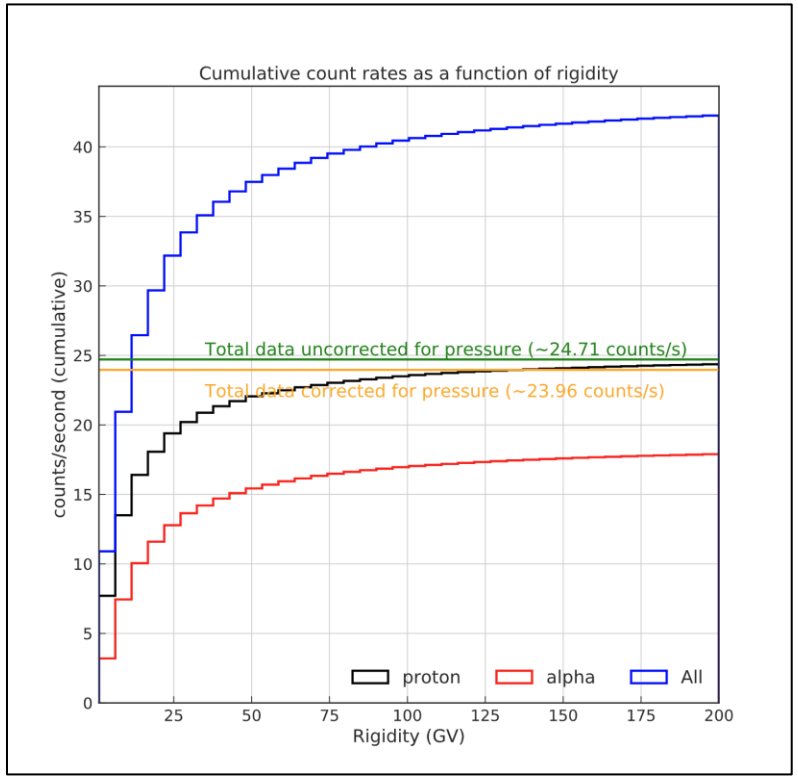
COUNT RATES



SHANGHAI

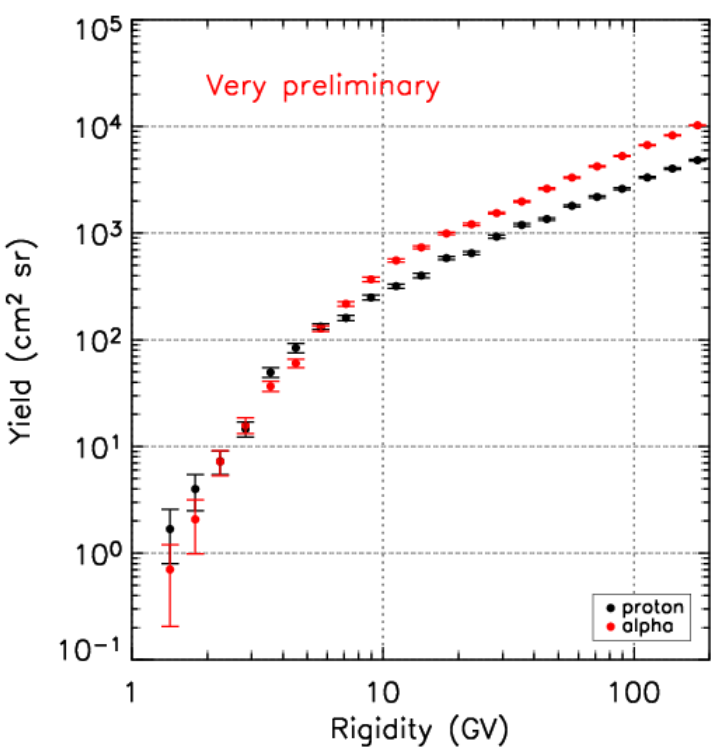


HOBART



ZHONGSHAN

YIELD FUNCTION



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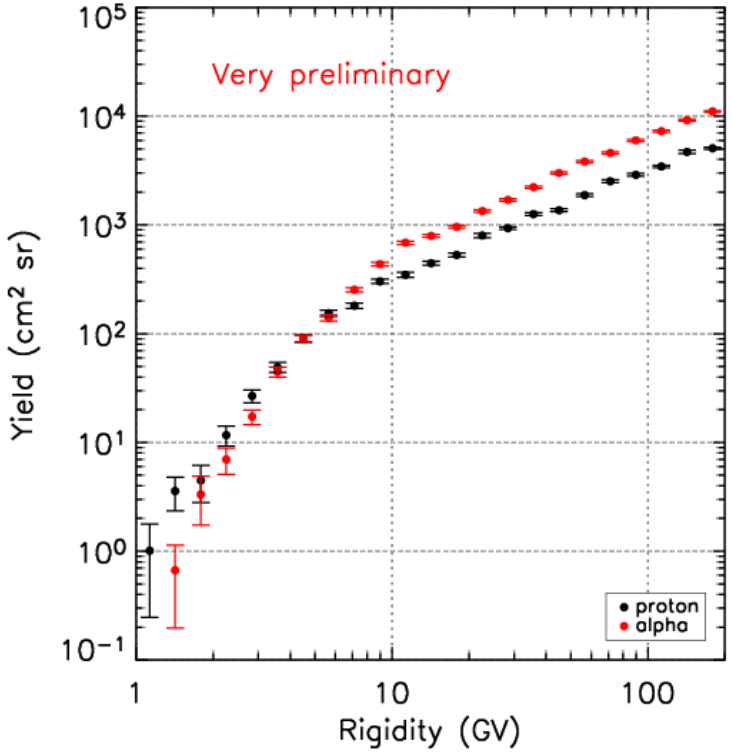

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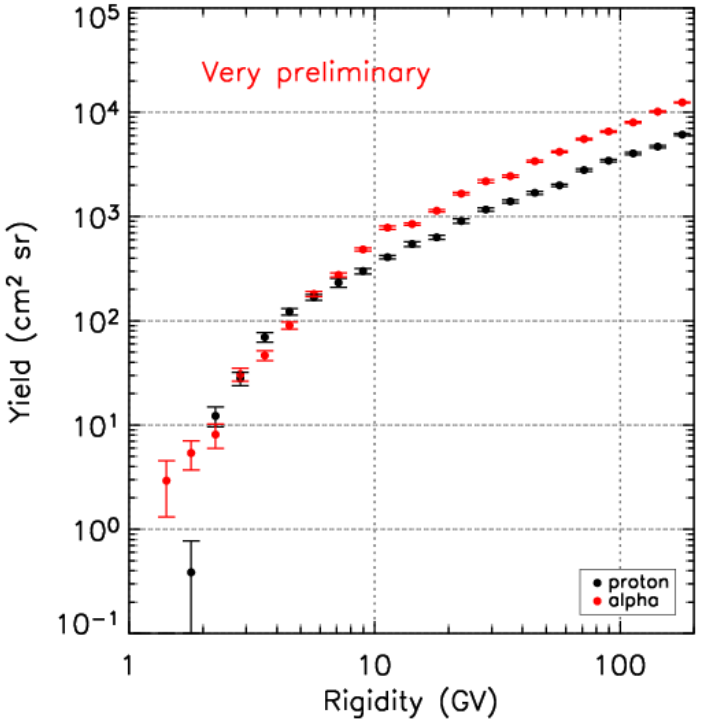

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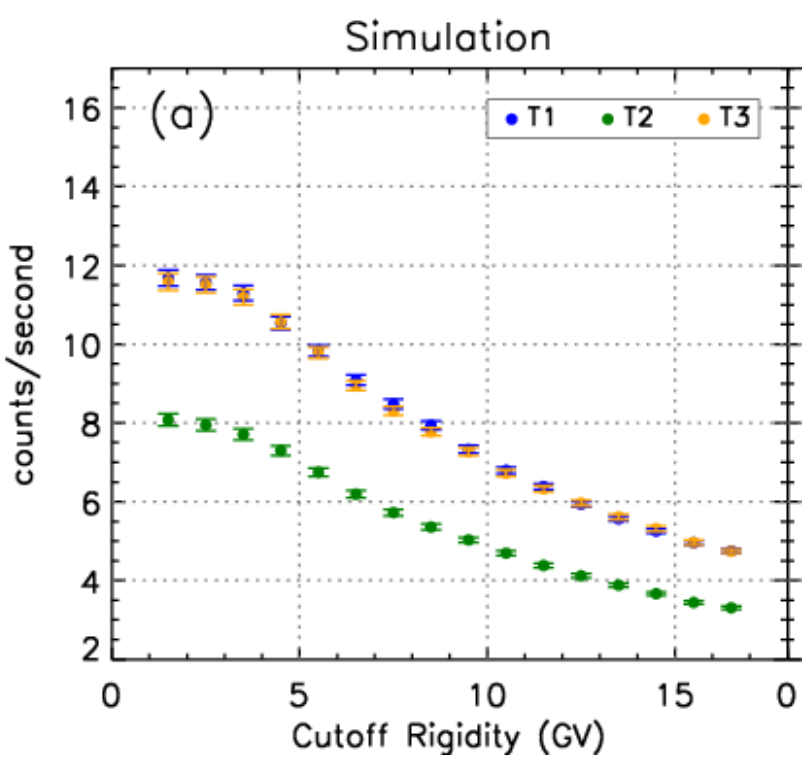
COUNT RATES VS CUTOFF RIGIDITY



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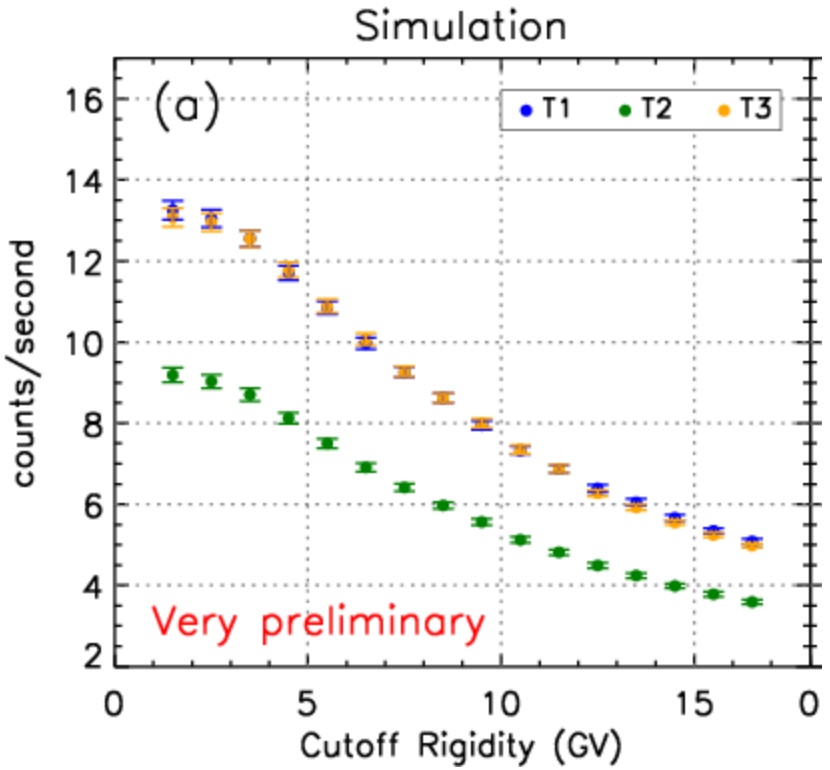

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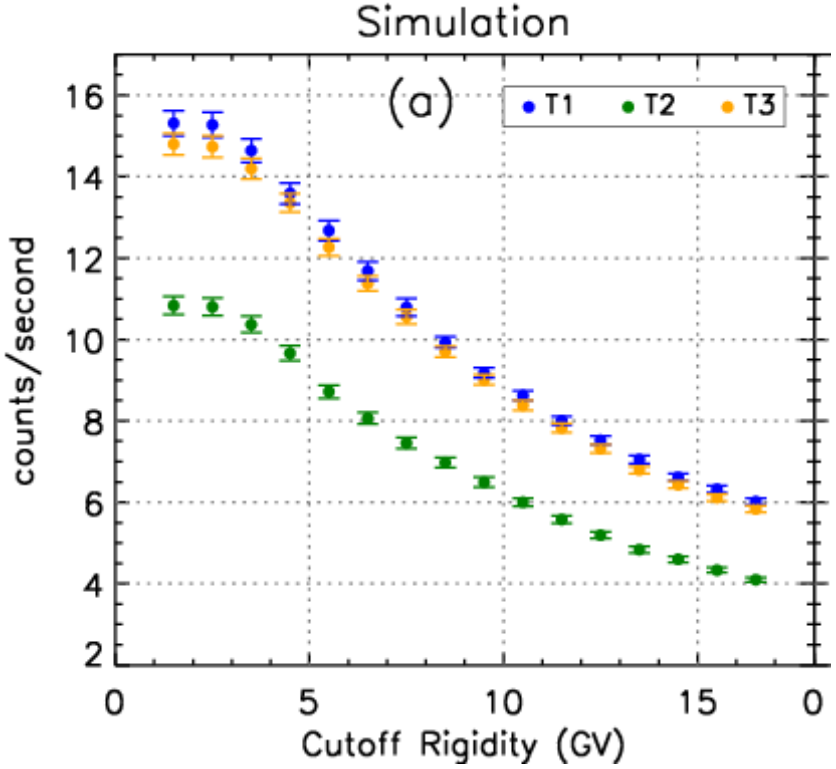

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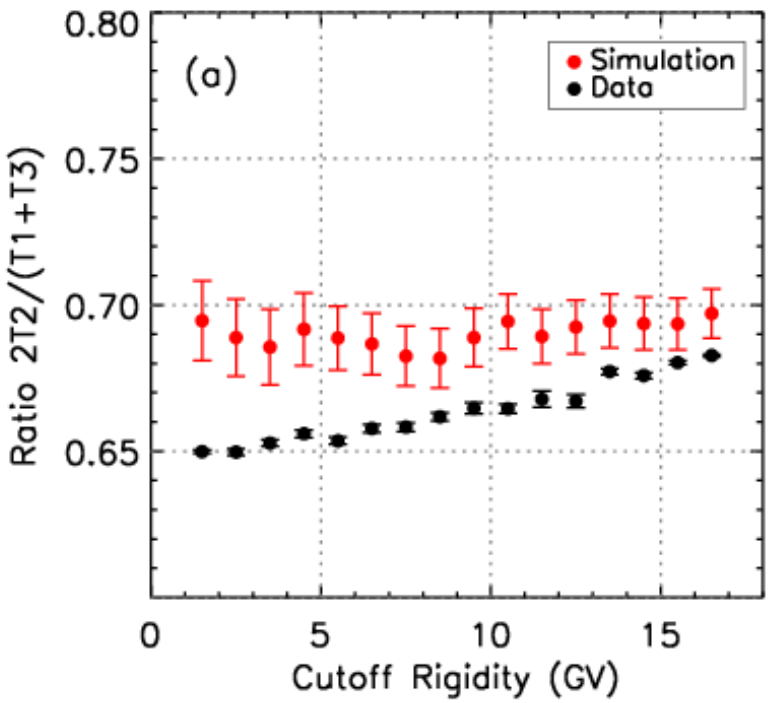
COUNT RATES RATIOS VS CUTOFF RIGIDITY



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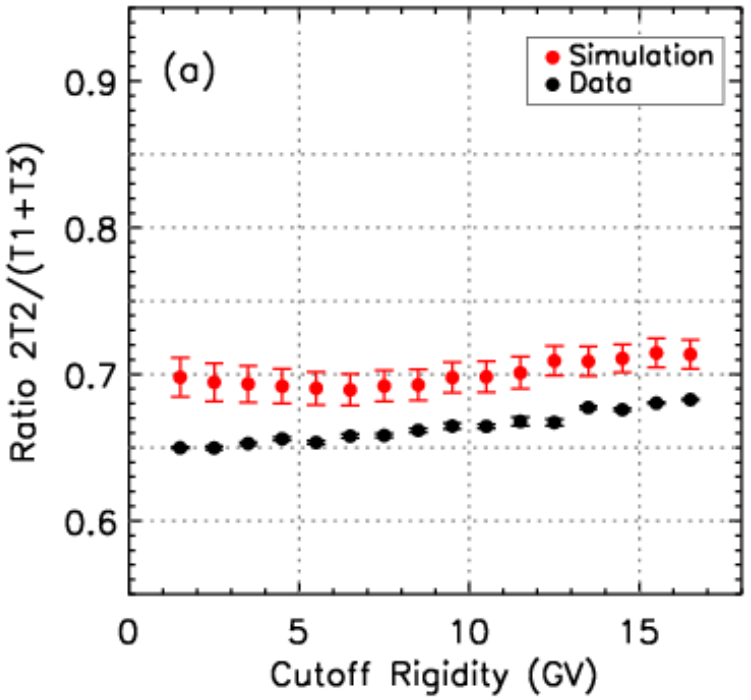

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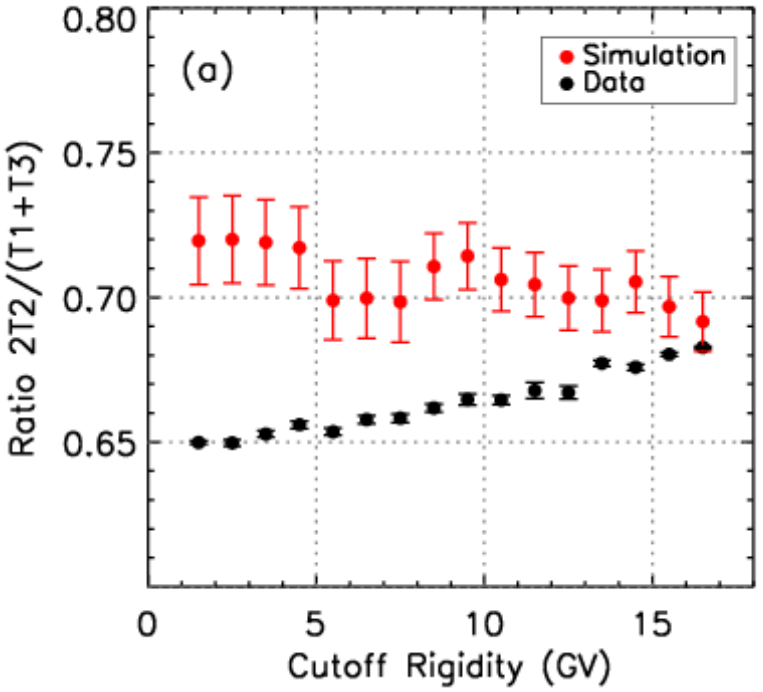

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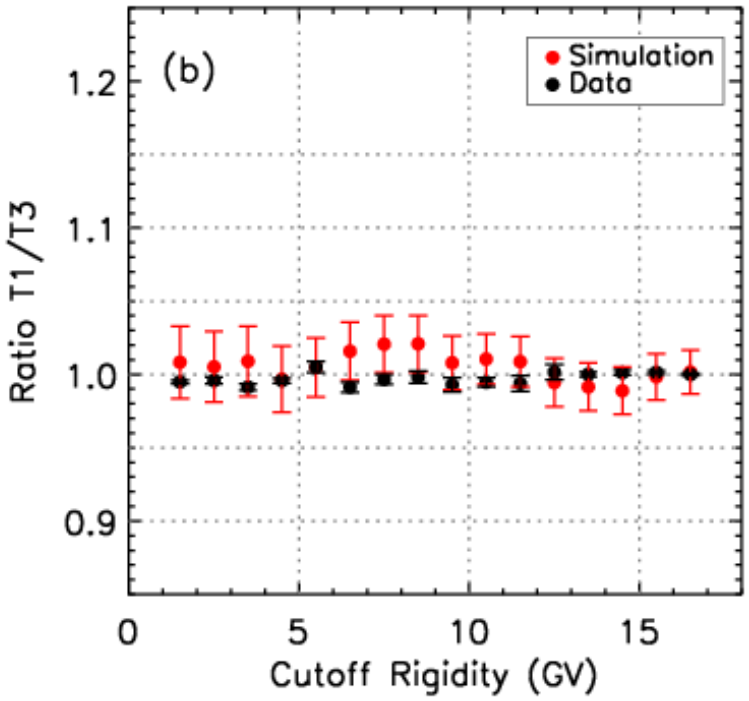

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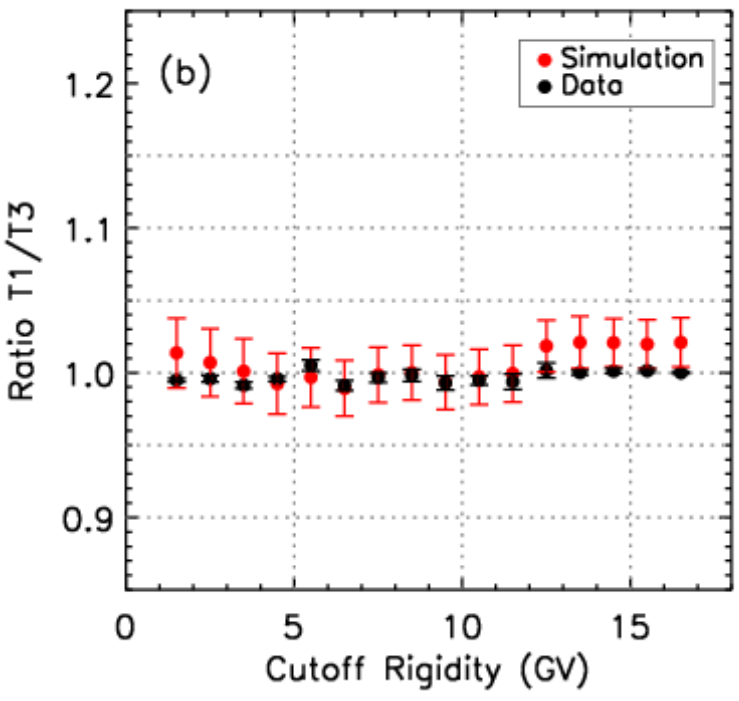

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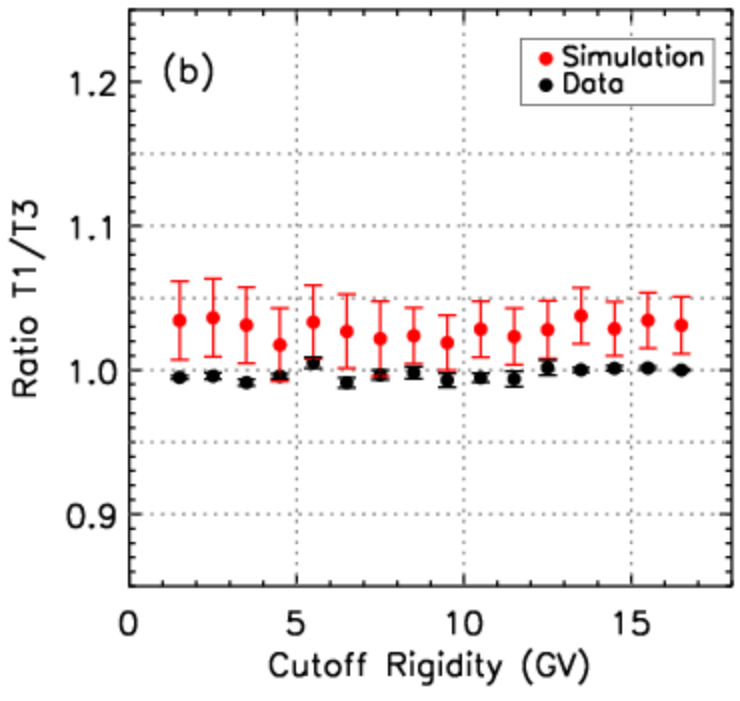

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FUTURE WORK

- Run more simulation at different locations to complete all rigidity.