THE QUEST FOR GALACTIC NOISE WITH RNO-GJethro Stoffels19th June 2023





Why?

- New detector => Need for verification procedures

Our Milky Way is a well known radio emitter
Use as standard candle



- Reference work: Antony Escudie. From the observation of UHECR signal in [1-200] MHz to the composition with the CODALEMA and EXTASIS experiments.



Transit curves

ms

- V_{RMS} of timetraces VS Local Sidereal Time
- LST instead of LT => General noise averages
- For RNO-G:
 - Visibility from Summit Station
 - Limited time spreading(2 months => 4 hour spread)
 - Use the three upwards facing surface antennas with background data





View of Gal(I,b)=(0,0) View of Gal(I,b)=(180,0) deg. Altitude (deg.) Altitude (deg.) ۰. • • - • • -20 -20 -40 -40 • • • -60 -60 -80 -80 Local Siderial Time (hrs) Local Siderial Time (hrs) View of Gal(I,b)=(270,0) deg. View of Gal(I,b)=(90,0) deg. Altitude (deg.) Altitude (deg.) . 60 -. 40 · . 0⊢ -20 -20 -40 -40 -60 -60 • -80 -80 Local Siderial Time (hrs) Local Siderial Time (hrs)

Galactic visibility

Nick van Eijndhoven. Search for Galactic noise in RNO-G



Constructing a transit curve



- Extract time of event (convert to LST) and timetrace for antenna under study
- Calculate the average V_{RMS} in finite period with multiple traces





TRANSIT CURVES RNO-G



Data cleaning

- Use data from new station

- Filtering galactic dominant region (<110MHz)

- Two quality cuts @ 3σ

- LST smearing effect?



50

0

100

150

200

Frequency (MHz)

250

300

350

400

TRANSIT CURVES RNO-G





TRANSIT CURVES RNO-G



Results

Clear oscillatory behaviour



SIMULATION



Expected VRMS values

- Total noise = Thermal noise + Galactic noise
- Thermal noise at antenna (T=290,14K):

 $P = k_b T \Delta v = V^2 / R \Leftrightarrow V_{RMS} = \sqrt{Rk_b T \Delta v}$ so for the full frequency range: $V_{RMS} = 0.0179 \ mV$ and for the reduced range: $V_{RMS} = 0.00469 \ mV$

- Galactic noise: via NuRadioMC open source simulation software
 - https://github.com/nu-radio/NuRadioMC
 - One on one simulation with data

COMPARISON



11



COMP&RISON



Conclusion

- Use Milky Way as standard candle

- Indication of a galactic signal

- Could be improved:
 - Limited smearing effect
 - More data
- Absolute amplitude discrepancy data VS simulation needs to be solved



QUEST FOR G&L&CTIC NOISE

