Galactic Cosmic Rays and Solar Flares

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LRO/CRaTER TIM
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Outline

• Background
• Radiation Sources
  – Galactic cosmic rays
  – Solar energetic particles
• Issues
• Simulations
• Questions
Background

• PhD Physics, MIT
• Currently
  – Research Scientist, MIT
  – Project Scientist, CRaTER
  – Visiting (BU)
• Design, calibration plasma Faraday cup for Triana
• Other work:
  – Calibration and analysis of Wind spacecraft data
  – Spacecraft formations for Solar Imaging Radio Array
  – Ground-based radio telescope arrays
Galactic Cosmic Rays

Crab Nebula (ESO)

Advanced Composition Explorer
January 15, 2005

- Solar minimum
  - Few sunspots
  - Few flares
  - Quiet corona
- Giant sunspot 720
  - Sudden appearance
  - Strong magnetic field
  - Very large
  - On west limb by January 20

Image credit: J. Koeman
January 20, 2005

dt < 30 minutes

2005/01/20 00:00

Graph showing the number of particles per square centimeter per steradian-second vs. time. The x-axis is labeled 'Day of 2005' with dates 'January 20' and 'January 21' indicated. The y-axis is labeled 'Particles (cm$^2$ sr$^{-1}$ s$^{-1}$)' with logarithmic scale, ranging from $10^{-4}$ to $10^4$. Two sets of data are plotted: >100 MeV Protons (GOES11) and >20 MeV/nuc Oxygen (ACE).
Issues

• What are the expected counting rates in the detectors under different conditions?
• What is the optimum trade between shielding the top detectors and maximizing the field of view of the lower detectors?
• How well can the instrument distinguish energy and species?
Observed peak spectrum
Modeled Flux

Proton Flux \([p \text{ s}^{-1} \text{ cm}^{-2} \text{ sr}^{-1} \text{ MeV}^{-1}]\)

Proton Energy \([\text{MeV}]\)
Predicted event rate

![Graph showing predicted event rate over time. The x-axis represents time from 15 to 20 with increments of 1, and the y-axis represents event rate ranging from $1 \times 10^0$ to $1 \times 10^4$. The graph includes a line labeled H_hi_SIS and a limit line.](image-url)
Predicted Deposition

Energy Deposited in D1 [MeV]

Energy Deposited in D1 [MeV]

Energy Deposited in D1 [MeV]
Questions for LRO

- Telemetry: Max event rate 1250 events/sec on 1553
- CRaTER (LRO) operational during flares
- Measurements during transit for calibration purposes?
- Occasional s/c roll for calibration