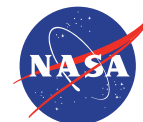




# **Radiation Environment Model of Protons and Heavier Ions at Jupiter**

Luz Maria Martinez Sierra, Henry B. Garrett,  
and Insoo Jun



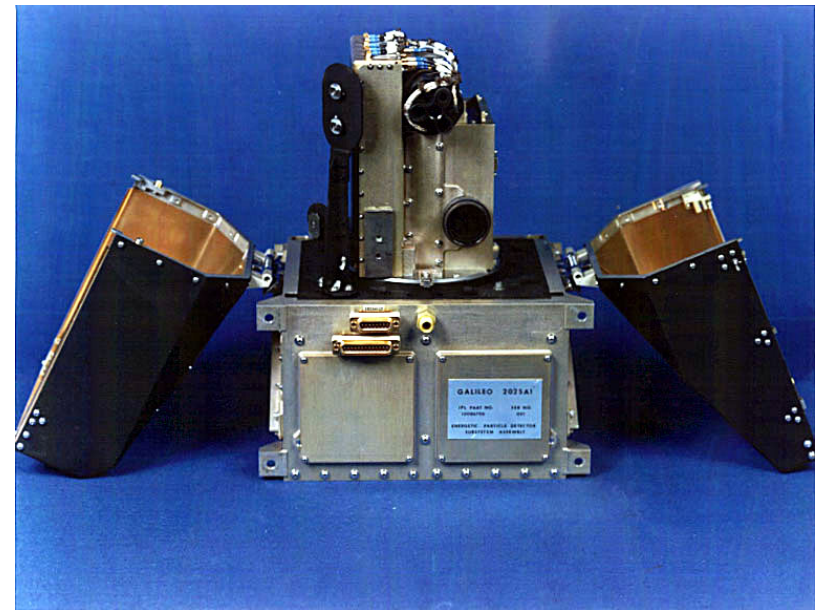
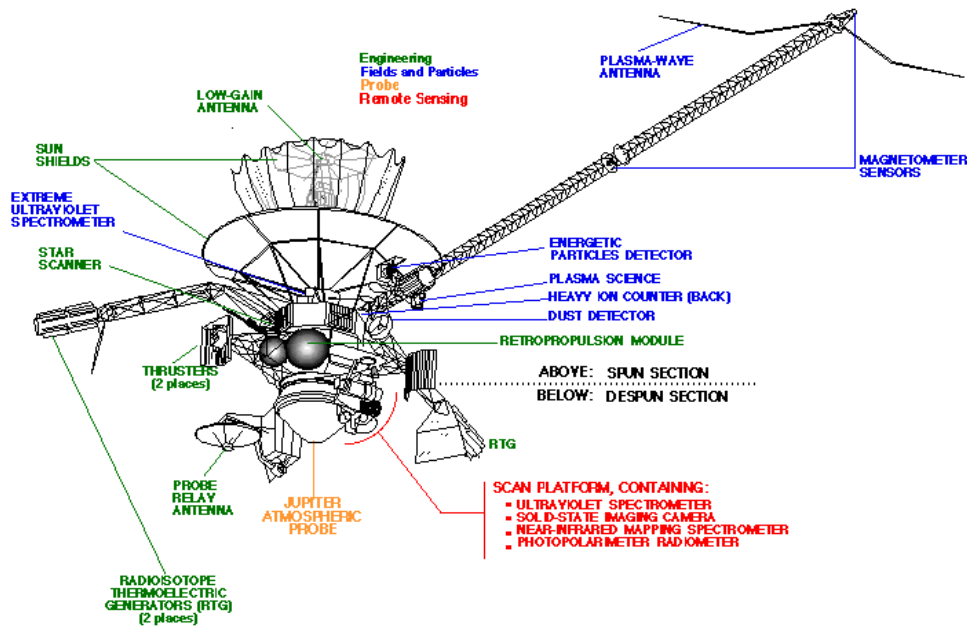
**Jet Propulsion Laboratory**  
California Institute of Technology

# Outline

- Introduction
  - Background: mission and instrument
- Method
  - Monte Carlo simulations
- Results
  - Geometric Factors and contamination
- Conclusions
- Acknowledgements

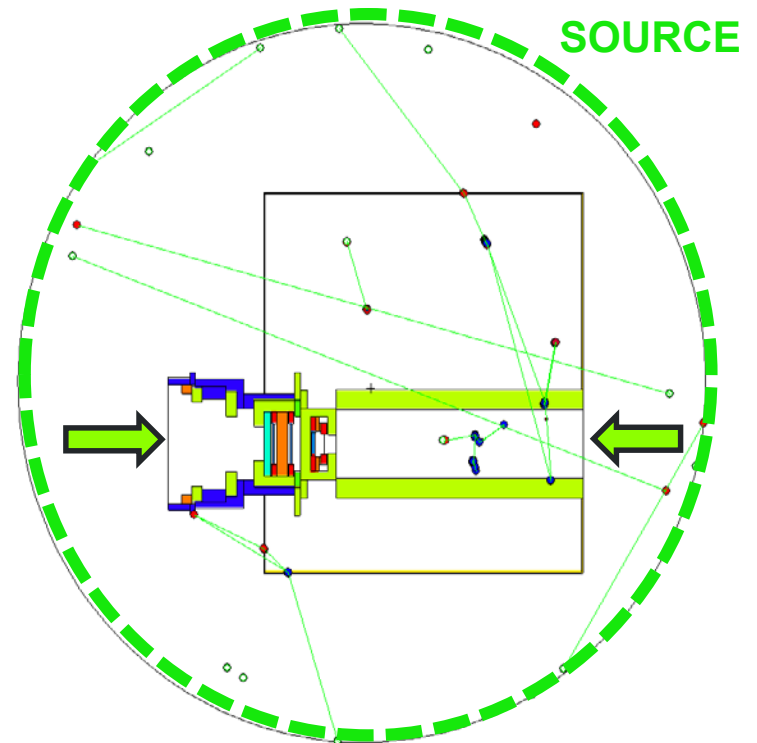
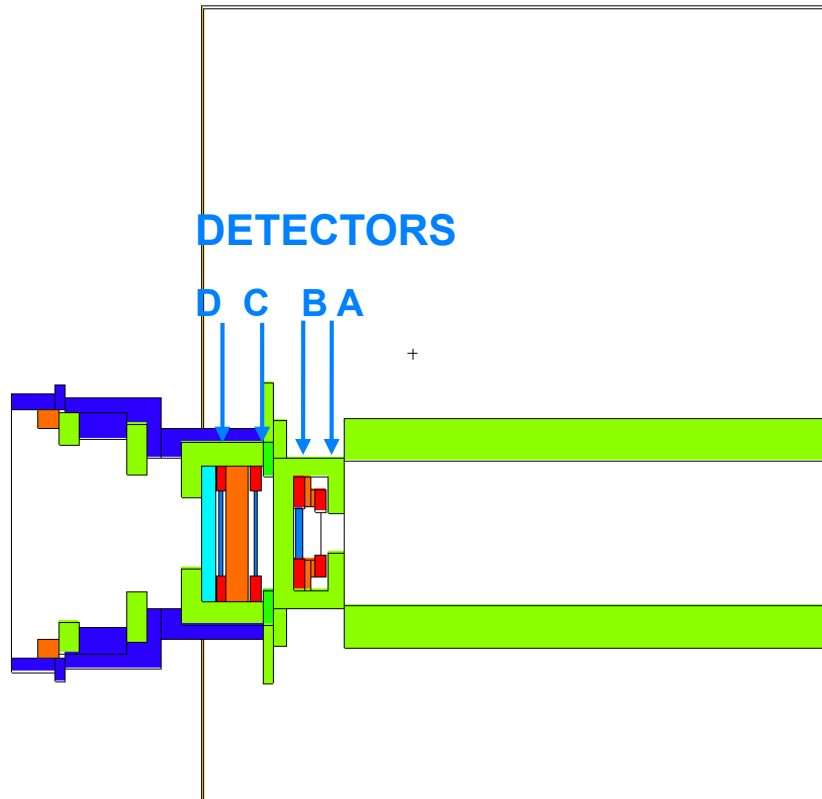
# Introduction - Background

- Galileo at Jupiter: December 1995-September 2003
- GIRE2 model of the radiation environment



# MCNPX modeling of the instrument

3D geometric model and material distribution for the energetic particle detector (EPD)



# Instrument's detector / logic

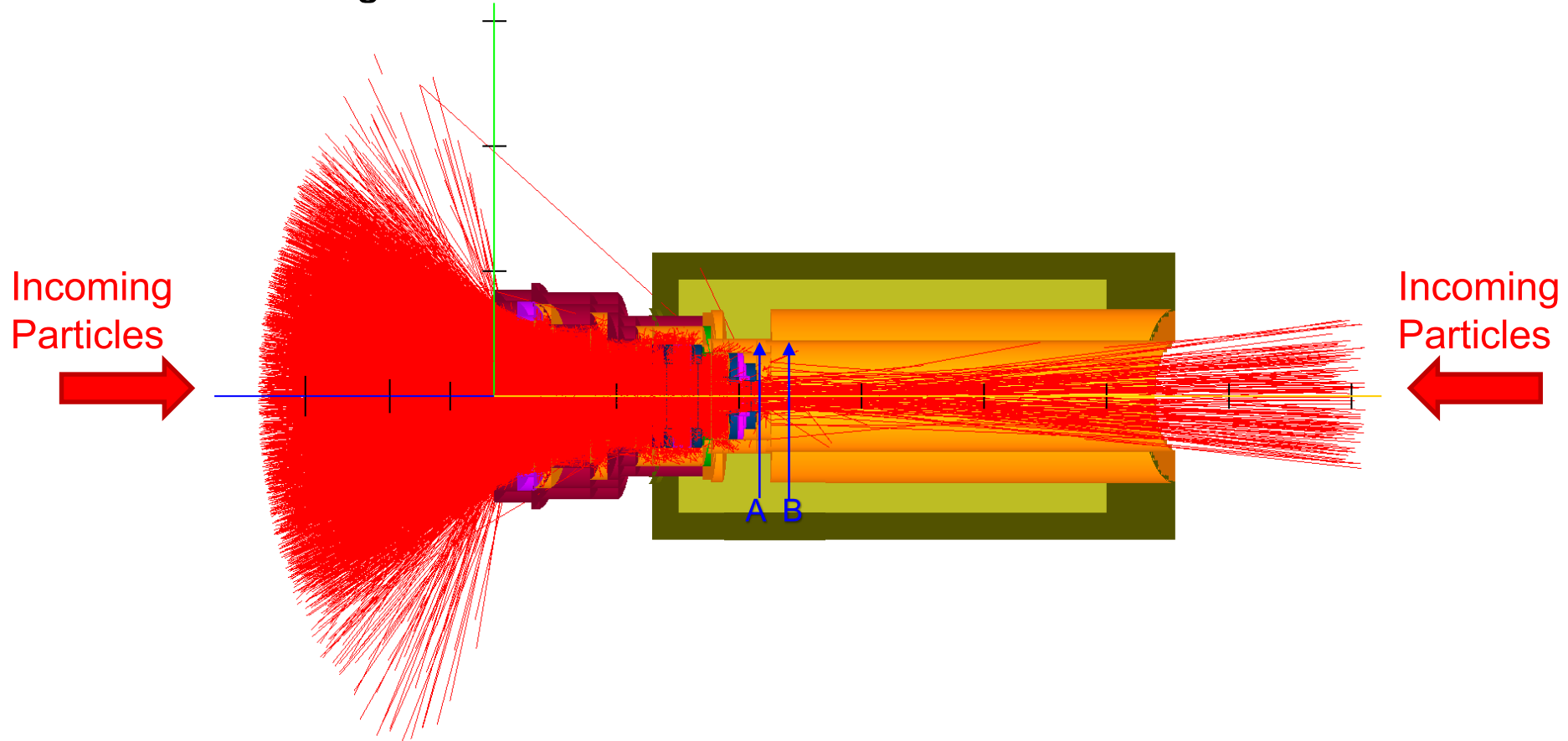
To register a count, different detectors are activated according to the following logic:

Detector Number	Energy Threshold MeV	Detector Number	Energy Threshold MeV
A1	0.018	B1	0.075
A2	0.034	B2	0.800
A3	0.055	B3	8.270
A4	0.110		
A5	0.272	C1	0.162
A6	0.510	C2	2.170
A7	0.820	D1	0.133
A8	1.65	D2	1.860

Channel	Channel Logic
B0	A7 B1 (C2)
B2	A8 B3 (C2)
DC0	(B1) D2 (C1)

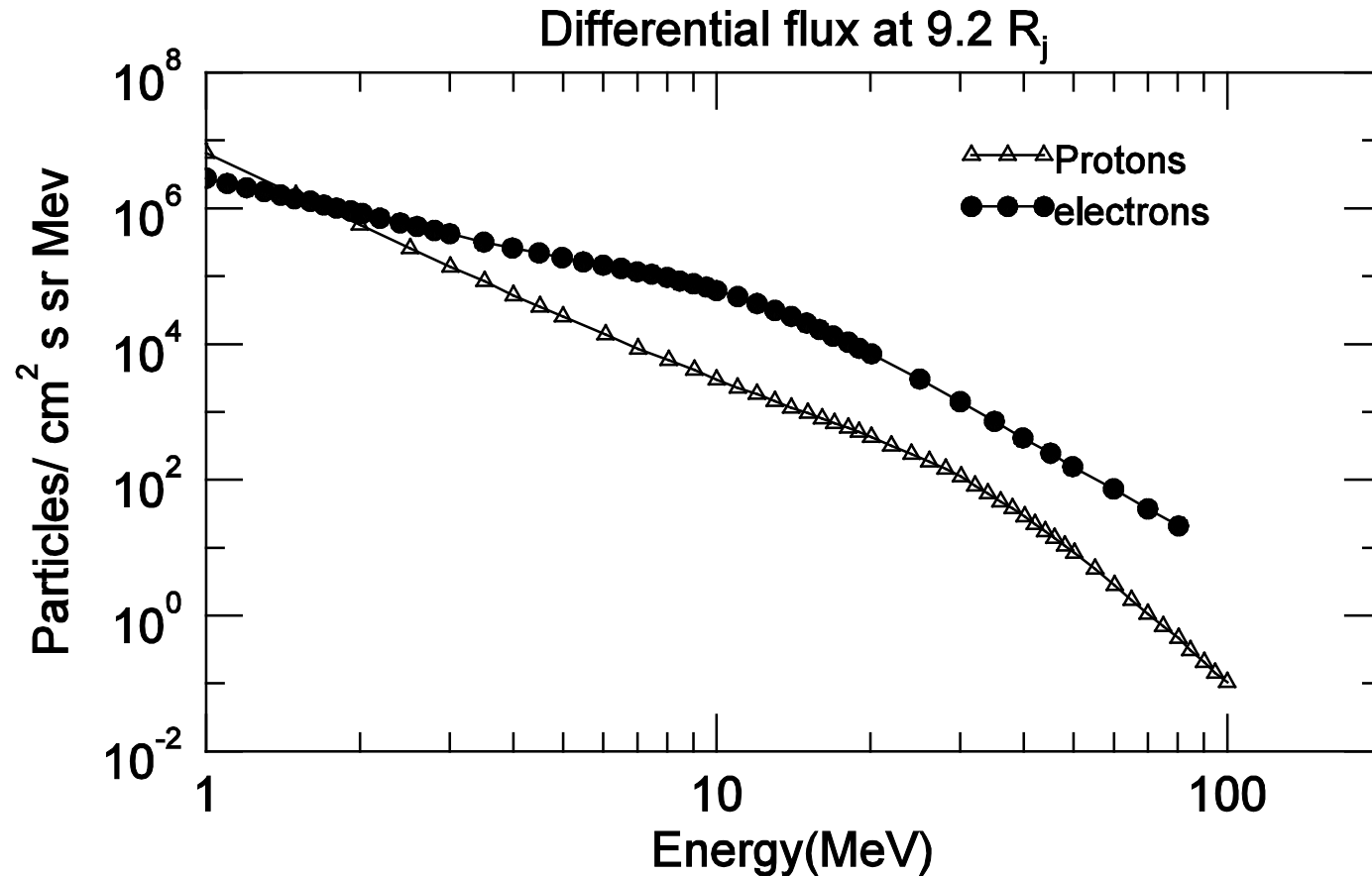
# Tracking the particles

- ~50M 11 MeV electrons are tracked into the instrument
- Geometric factor is determined by counting how many actually meet the counting criteria



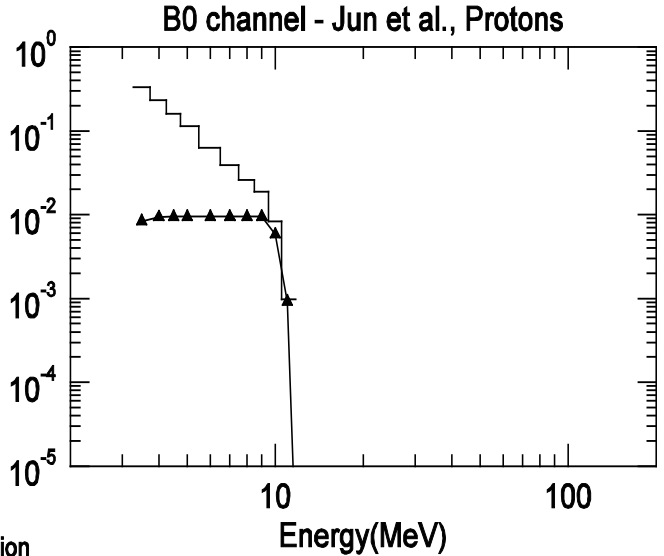
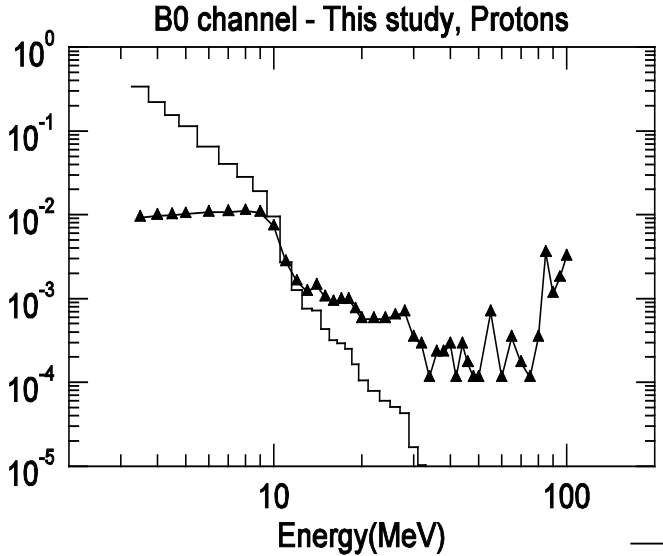
# Jovian Radiation Environment

To estimate % electrons vs protons, use 9.2 R<sub>j</sub> characteristic spectra based on the Divine – Garrett model to compute relative counts



# MCNPX Geometric Factors and Spectral Contributions for this Study and Previous Jun Estimates

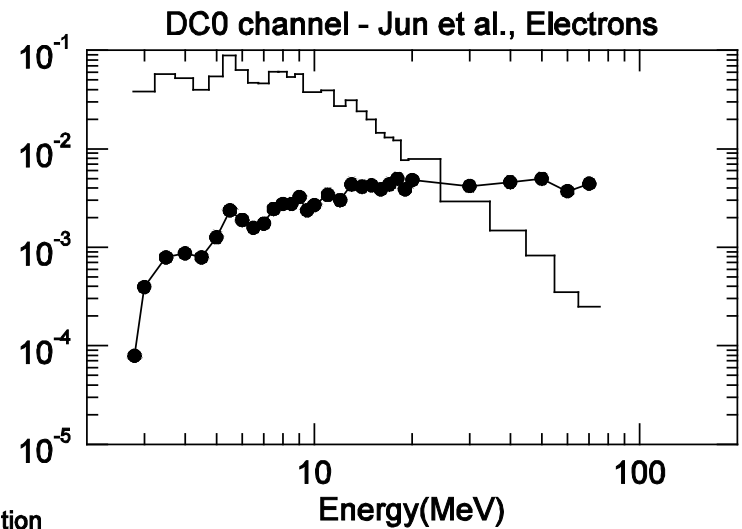
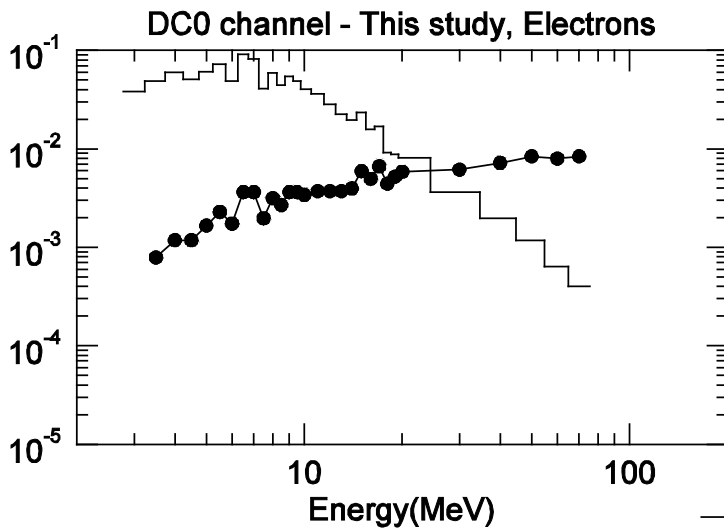
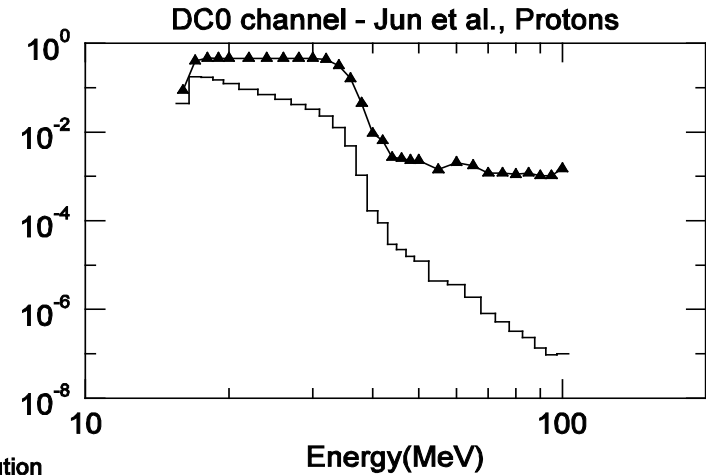
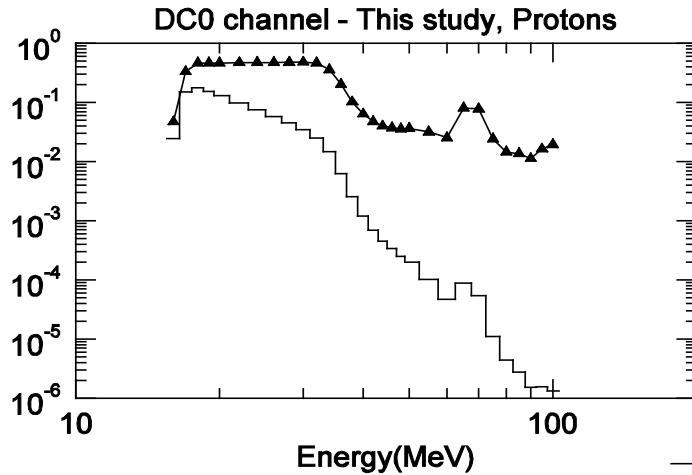
## B0 Channel



— Relative Contribution  
▲▲▲ Geometric Factors



# Geometric Factors and Spectral Contributions (Continued) DC0 Channel



— Relative Contribution  
▲▲ Geometric Factors

— Relative Contribution  
●● Geometric Factors

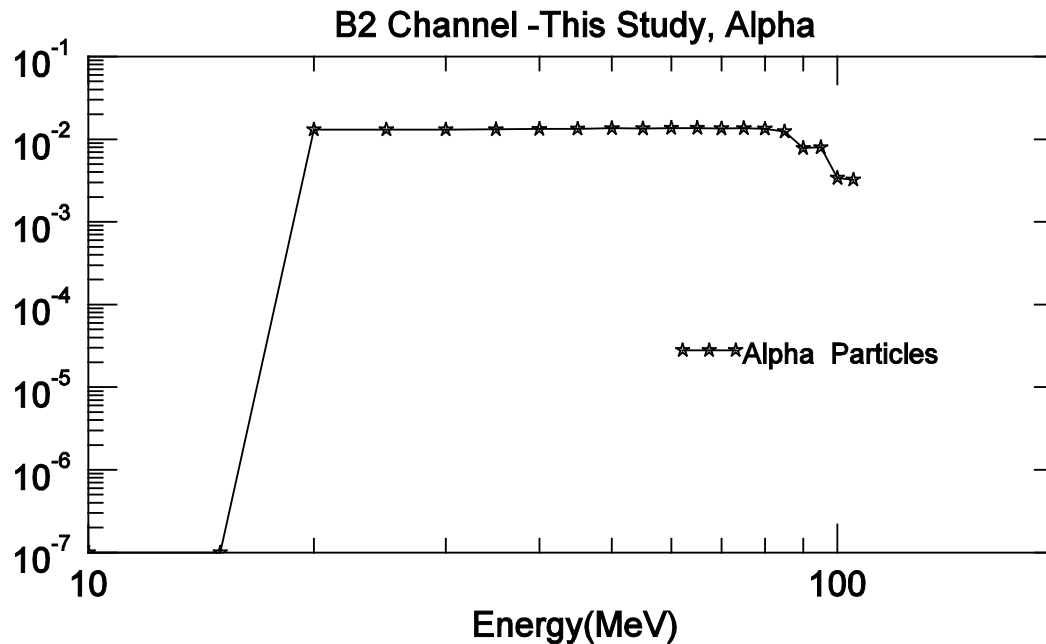
# Contamination – DC0 channel: Estimated Counts

Energy (MeV)	Protons		Electrons		Total		
	cm <sup>2</sup> -sr	Flux	cm <sup>2</sup> -sr	Flux	Proton	Electron	Counts
3.00	0.00E+00	1.37E+05	0.00E+00	4.22E+05			
3.50	0.00E+00	8.36E+04	7.90E-04	3.18E+05	0.00E+00	1.26E+02	1.26E+02
4.00	0.00E+00	5.22E+04	1.18E-03	2.60E+05	0.00E+00	1.54E+02	1.54E+02
4.50	0.00E+00	3.56E+04	1.18E-03	2.20E+05	0.00E+00	1.30E+02	1.30E+02
5.00	0.00E+00	2.54E+04	1.66E-03	1.88E+05	0.00E+00	1.56E+02	1.56E+02
6.00	0.00E+00	1.39E+04	1.74E-03	1.45E+05	0.00E+00	2.52E+02	2.52E+02
7.00	0.00E+00	8.55E+03	3.63E-03	1.16E+05	0.00E+00	4.21E+02	4.21E+02
8.00	0.00E+00	5.77E+03	3.16E-03	9.59E+04	0.00E+00	3.03E+02	3.03E+02
9.00	0.00E+00	4.17E+03	3.63E-03	7.74E+04	0.00E+00	2.81E+02	2.81E+02
10.00	0.00E+00	2.98E+03	3.40E-03	6.12E+04	0.00E+00	2.08E+02	2.08E+02
11.00	0.00E+00	2.25E+03	3.71E-03	5.00E+04	0.00E+00	1.85E+02	1.85E+02
12.00	0.00E+00	1.82E+03	3.71E-03	3.95E+04	0.00E+00	1.47E+02	1.47E+02
13.00	0.00E+00	1.43E+03	3.71E-03	3.12E+04	0.00E+00	1.16E+02	1.16E+02
14.00	0.00E+00	1.15E+03	3.95E-03	2.55E+04	0.00E+00	1.01E+02	1.01E+02
15.00	0.00E+00	9.68E+02	5.92E-03	2.04E+04	0.00E+00	1.21E+02	1.21E+02
16.00	4.71E-02	7.91E+02	4.97E-03	1.63E+04	3.72E+01	8.09E+01	1.18E+02
17.00	3.34E-01	6.84E+02	6.63E-03	1.31E+04	2.28E+02	8.71E+01	3.15E+02
18.00	4.66E-01	5.84E+02	4.42E-03	1.06E+04	2.72E+02	4.69E+01	3.19E+02
19.00	4.68E-01	5.05E+02	5.21E-03	8.67E+03	2.36E+02	4.52E+01	2.81E+02
20.00	4.68E-01	4.22E+02	5.84E-03	7.16E+03	1.98E+02	4.19E+01	2.39E+02
30.00	4.82E-01	1.11E+02	6.16E-03	3.05E+03	5.34E+02	1.88E+02	7.22E+02
40.00	6.38E-02	2.85E+01	7.19E-03	1.41E+03	1.82E+01	1.01E+02	1.19E+02
50.00	3.64E-02	8.37E+00	8.37E-03	7.25E+02	3.05E+00	6.06E+01	6.37E+01
60.00	2.54E-02	2.78E+00	7.97E-03	4.13E+02	7.08E-01	3.30E+01	3.37E+01
70.00	7.82E-02	1.06E+00	8.37E-03	2.46E+02	8.29E-01	2.06E+01	2.15E+01
					1.53E+03	3.40E+03	4.93E+03
					30.98%	69.02%	100%

# Geometric Factors – B2 channel

- Alpha response evaluation for the B2 channel logic

## B2 Channel



# Conclusions

- For the DC0 channel for energies higher than 16 MeV, the electron contributions to the counts on the detector were higher compared to the proton contributions in certain energy ranges. An average of roughly 70% of the DC0 count rates measured is estimated to be from electron contamination.
- B0 channel presented a very clean response for protons without any contamination due to electrons.
- The alpha channel, B2, presented a clean response over the energy range expected.

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