

Space Weather Investigations Enabled by Virtual Energetic Particle Observatory (VEPO)

John F. Cooper, Joseph H. King, Natalia E. Papitashvili,

Nand Lal, Tamara J. Kovalick, Rita C. Johnson

Heliophysics Science Division, NASA Goddard Space Flight Center

Thomas P. Armstrong, Jerry W. Manweiler, J. Douglas Patterson

Fundamental Technologies LLC, Lawrence, Kansas

Matthew E. Hill

Applied Physics Laboratory/JHU

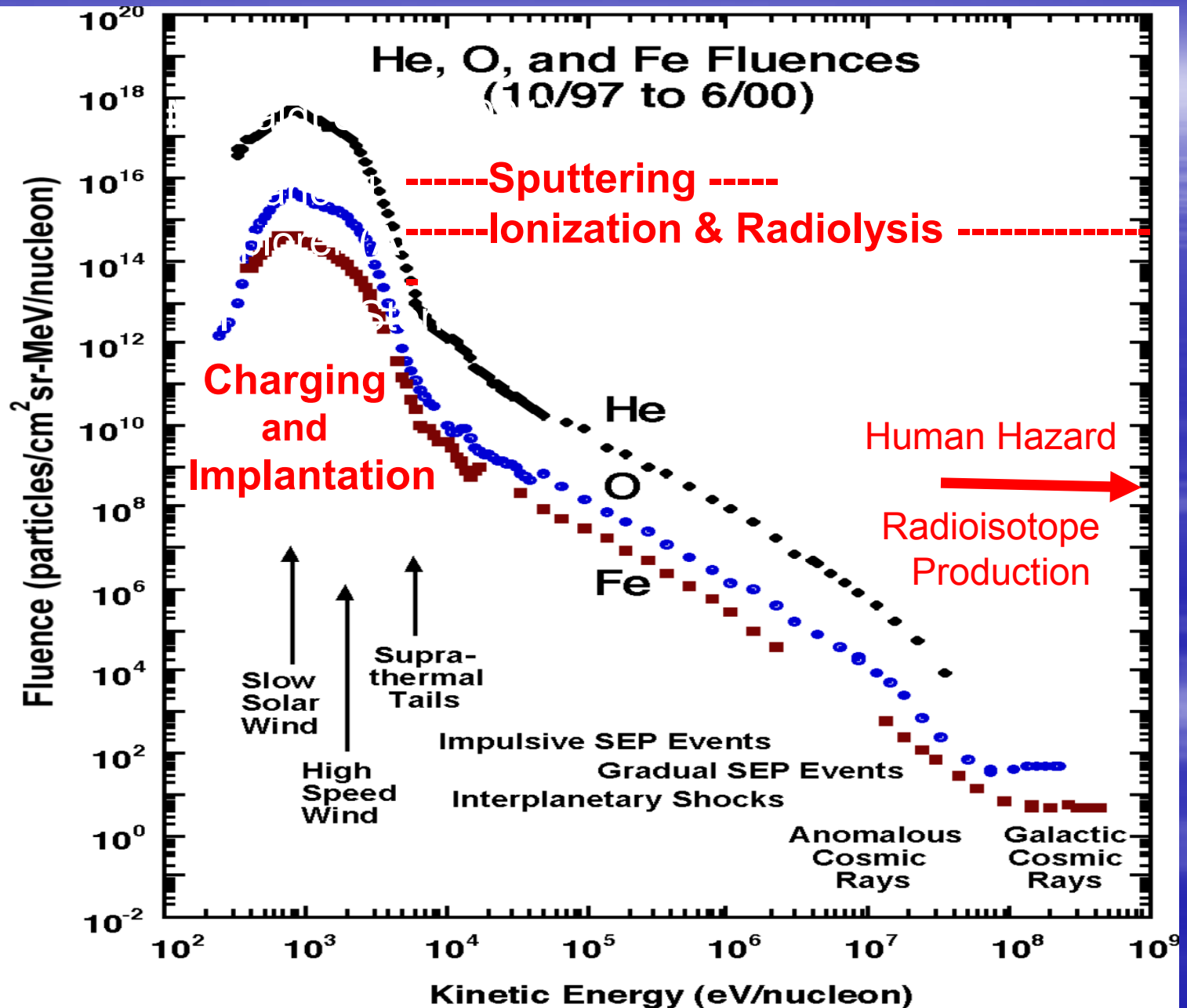
Robert B. McKibben

University of New Hampshire, Durham, New Hampshire

Cecil Tranquille

ESTEC, European Space Agency, Noordwijk, Netherlands

Spectral Dependence of Charged Particle Irradiation Effects





Virtual Heliospheric Observatory (VHO)

<http://vho.nasa.gov/>

Adam Szabo, Tom Narock, Jan Merka, Aaron Roberts, Jon Vandegriff, George Ho, Jim Raines, Peter Schroeder, Andrew Davis, Justin Kasper

VHO Focus Groups

Virtual Energetic Particle Observatory (VEPO)

<http://vepo.gsfc.nasa.gov/>

John Cooper, Tom Armstrong, Bruce McKibben, Matt Hill, Nand Lal, Joe King, Natasha Papitashvili, Cecil Tranquille

Lunar Solar Origins Exploration (LunaSOX)

<http://lunasox.gsfc.nasa.gov/>

John Cooper, Joe King, Natasha Papitashvili, Kent Hills, Alexander Lipatov

SPDF in the new Heliophysics Science Data Management Policy

- One of two (active) Final Archives
 - Ensure the long-term preservation and ongoing (online) access (with appropriate services) to non-solar NASA heliophysics science data
 - Serve and preserve data with metadata / software (with HQs)
 - Understand past / present / future mission data status (with HDMC)
 - May become a highly distributed long-term environment
 - **As Final Archive, allowed formats are NOT restricted to CDF**
- Critical infrastructure components to Heliophysics Data Environment
 - Heliophysics-wide dataset inventory (VSPO)
 - APIs (e.g. webservices) to SPDF system capabilities and data
- Center of Excellence for unique enabling science data services
 - I.e. CDAWeb, SSCWeb/4D Orbit Viewer, OMNIweb, CDF

Paths to [Magnetic field](#), [Plasma](#), [Energetic particle](#) data relevant to heliospheric studies and resident at Goddard's Space Physics Data Facility.

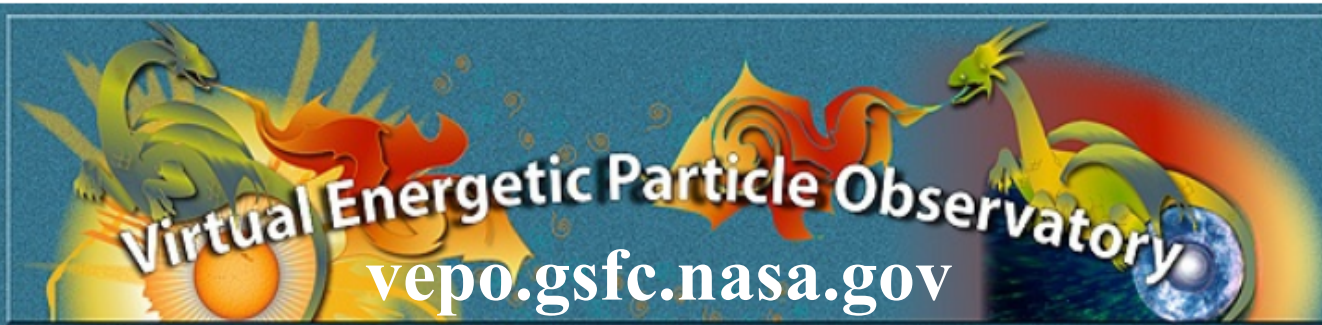
- OMNI data (spacecraft-interspersed, near-Earth solar wind data)
 - Low resolution OMNIWeb (1-hour, 1 and 27 days, 1963 - current)
 - High resolution OMNIWeb (1-min, 5-min, 1995 - current)
- Spacecraft-specific data sets (near 1 AU, including near-Earth)
 - + ACE
 - + Geotail
 - + IMP-8
 - + Wind
 - + Explorer 33&35, Genesis, ISEE 3, Prognoz, Apollo ALSEP, THEMIS-B&C
- Deep space data
 - COHOWeb-formatted hourly solar wind field and plasma
 - + Pioneer
 - + Ulysses
 - + Voyager
 - + Cassini, Helios, Mariner, STEREO
- Interfaces for comparing multi-source data
 - + Merged Magnetic field and Plasma
 - + Magnetic field
 - + Plasma
 - + Energetic particle fluxes (VEPO)

(LunaSOX)

**Multi-Source
Plot & List
Interfaces**

[Heliocentric Trajectories for Selected Spacecraft, Planets, and Comets](#)

If you have any questions/comments about OMNIWeb Plus data and service, contact: [Dr. Natalia Papitashvili](#), Space Physics Data Facility, Mail Code 672, NASA/Goddard Space Flight Center, Greenbelt, MD 20771



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Virtual Energetic Particle Observatory

+ Data Query (via VHO)

+ Introduction

+ Data Product Information

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+ News

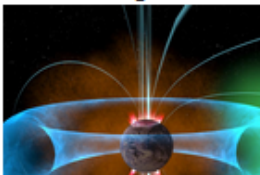
+ Education

+ Voyager at the Heliopause?

+ Discussion Documents

+ Feedback

Random Image



LATEST VEPO NEWS



+ Voyager 1 Apparently Attacked by Interstellar Dragon

D. L. Chenette, NASA Headquarters, Apr. 01, 2014

NASA's Director of Heliophysics announced that telemetry suddenly vanished today from Voyager 1, earlier reported to have emerged into local interstellar space, after a large thermal surge and the last message "Thar be Dragons!".

A competing interpretation of the puzzling loss of signal suggests that Voyager actually fell off the edge of the heliosphere and descended into the netherworld below. Support for this interpretation came not only from the thermal surge but also the detection of anomalous sulphur ions just before its demise. These ions could only be detected at high energies since the spacecraft's low-energy plasma instrument has long been inoperative.

+ Global Anisotropies in TeV Cosmic Rays Related to the Sun's Local Galactic Environment from IBEX

N. A. Schwadron, Feb. 13, 2014

IBEX determinations of local interstellar velocity are consistent with interstellar modulation of high energy (TeV) cosmic rays.

+ Calculated Risks: How Radiation Rules Mars Exploration

S. E. Gifford, Astrobiology Magazine, Feb. 13, 2014

[more...](#)

INTRODUCTION

The Virtual Energetic Particle Observatory (VEPO) serves the heliophysics data user community as a focus group component operating within the domain of the Virtual Heliospheric Observatory (VHO) for improved discovery, access, understandability, and usability of energetic particle data products from selected spacecraft and sub-orbital instruments within the VEPO [Data Source](#) Environment.

[more...](#)



Paths to Magnetic field, Plasma, Energetic particle data relevant to heliospheric studies and resident at Goddard's Space Physics Data Facility.

- +> OMNI data (spacecraft-interspersed, near-Earth solar wind data)
- +> Spacecraft-specific data sets (near 1 AU, including near-Earth)
- > Deep space data
 - > **COHOWeb-formatted hourly solar wind field and plasma**
 - +> Pioneer
 - +> Ulysses
 - > Voyager
 - +> Voyager 1
 - +> Voyager 2
 - > Cassini, Helios, Mariner, STEREO
 - +> Cassini
 - > Helios 1
 - +> 1-hour; magnetic field and plasma, COHO-formatted
 - > **ASCII files via FTP**
 - +> 30-min fluxes from E7 (Trainor)
 - +> 1hr fluxes from E6 (U.Kiel)
 - +> Helios 2
 - +> Mariner 2
 - +> Mariner 10
 - +> STEREO-A
 - +> STEREO-B
- > Interfaces for comparing multi-source data
 - +> Merged Magnetic field and Plasma
 - +> Magnetic field
 - +> Plasma
 - > Energetic particle fluxes
 - > **Multi-source spectra of energetic particle fluxes**
 - > IMP8/CPME, GOES and ACE/SIS proton fluxes, 1-hour
 - > **Plots, listings, subsetted files**

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OMNIWeb- Plus Browser (VEPO Addition)

Multi-source spectral plots (MSSP) of energetic particle fluxes

Data source, Plot/List	Resolution	Species	Time span	Energy range Mev/n
<input checked="" type="checkbox"/> ACE EPAM, FunTech.	1day	He	1997-08-30 - 2013-05-26	0.4-3.9
<input checked="" type="checkbox"/> ACE SIS, Caltech	1hr	He	1997-08-29 - 2013-12-14	3.4-41.2
<input type="checkbox"/> ACE ULEIS, Caltech	1hr	H, He	1998-02-19 - 2014-03-05	0.06-8.7
<input type="checkbox"/> ACE SEPICA, Caltech	1hr	H, He	1997-10-07 - 2005-02-05	0.40-6.0
<input type="checkbox"/> GOES8&11 NOAA	1hr	H, He	1995-01-01- 2010-12-31	0.6-500.
<input type="checkbox"/> GOES13 NOAA	1hr	H, He	2010-05-01- 2014-01-30	0.7-500.
<input type="checkbox"/> Helios1 E6, U.Kiel	~1hr	H, He	1974-12-11 - 1983-12-31	4.0-51.0
<input type="checkbox"/> Helios1 E7, GSFC	30min.	H, He	1974-12-16 - 1982-12-31	3.4-206.5
<input type="checkbox"/> Helios2 E6, U.Kiel	~1hr	H, He	1976-01-16 - 1980-03-08	4.0-51.0
<input type="checkbox"/> Helios2 E7, GSFC	30min.	H, He	1976-01-19 - 1979-12-23	3.4-204.5
<input type="checkbox"/> IMP8 CRNC, U.Chi/UNH	1hr	H,He	1973-10-30 - 2001-10-26	10.9-95.0
<input type="checkbox"/> IMP8 GME, GSFC	30-min	H,He	1973-10-30 - 2001-10-26	0.9-237.0
<input type="checkbox"/> Pioneer10, CRT, GSFC	6hr	H,He	1972-03-06 - 1994-12-31	3.4-413.0
<input type="checkbox"/> Pioneer11, CRT, GSFC	6hr	H,He	1973-04-06 - 1994-12-31	3.4-413.0
<input type="checkbox"/> SOHO, ERNE	2hr	H,He	1996-02-13 - 2013-04-17	1.8-50.7
<input type="checkbox"/> STEREO-A IMPACT/HET	1hr	H	2006-12-01 - 2014-03-18	13.6-100.
<input type="checkbox"/> STEREO-A IMPACT/LET	1hr	H,He	2007-03-29 - 2013-11-30	1.8-15.0
<input type="checkbox"/> STEREO-A IMPACT/SIT	1hr	H,He	2007-01-01 - 2014-02-12	0.1-10.2
<input type="checkbox"/> STEREO-B IMPACT/HET	1hr	H	2006-12-01 - 2014-03-18	13.6-100.
<input type="checkbox"/> STEREO-B IMPACT/LET	1hr	H,He	2007-03-29 - 2013-11-30/td>	1.8-15.0
<input type="checkbox"/> STEREO-B IMPACT/SIT	1hr	H,He	2007-01-27 - 2014-02-12	0.1-10.2
<input type="checkbox"/> Ulysses COSPIN, LET&HET	1day	H,He	1990-10-23 - 2009-06-30	2.0-95.0
<input type="checkbox"/> Ulysses HISCALE, FunTech.	1day	He	1990-11-14 - 2009-06-09	0.3-3.9
<input type="checkbox"/> Voyager1 CRS, CIT/GSFC	6hr	H,He	1977-09-07 - 2013-12-03	1.9-480.5
<input type="checkbox"/> Voyager1 LECP, APL	1hr	H	1977-09-12 - 2014-02-06	0.5-31.0
<input type="checkbox"/> Voyager1 LECP_Ion, APL	1hr	H(Ion)	1977-09-12 - 2013-02-06	0.04-4.0
<input type="checkbox"/> Voyager2 CRS, CIT/GSFC	6hr	H,He	1977-08-24 - 2013-12-03	1.8-457.4
<input type="checkbox"/> Voyager2 LECP, APL	1hr	H	1977-09-12 - 2014-02-06	0.5-30.0
<input type="checkbox"/> Voyager2 LECP_Ion, APL	1hr	H(Ion)	1977-09-12 - 2014-02-06	0.028-3.5
<input checked="" type="checkbox"/> Wind EPACT, GSFC	1hr	He	1994-11-03 - 2014-01-26	2.0-7.4

◆Species: ○Protons (H) ●Alpha particles (He) For higher Z go [HERE](#)

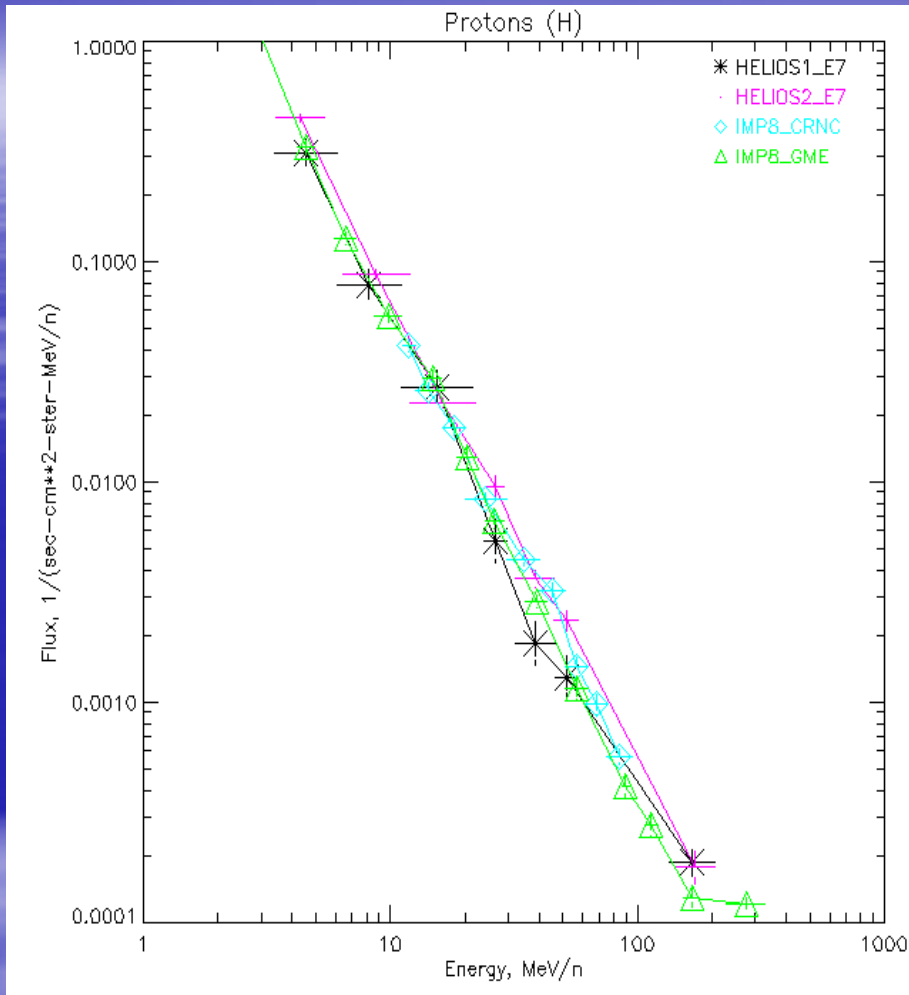


Figure 1. May 10, 1978 reservoir event with overall good agreement between proton flux spectra from IMP-8 GME and CRT, and from comparable GSFC instruments on Helios 1 and Helios 2.

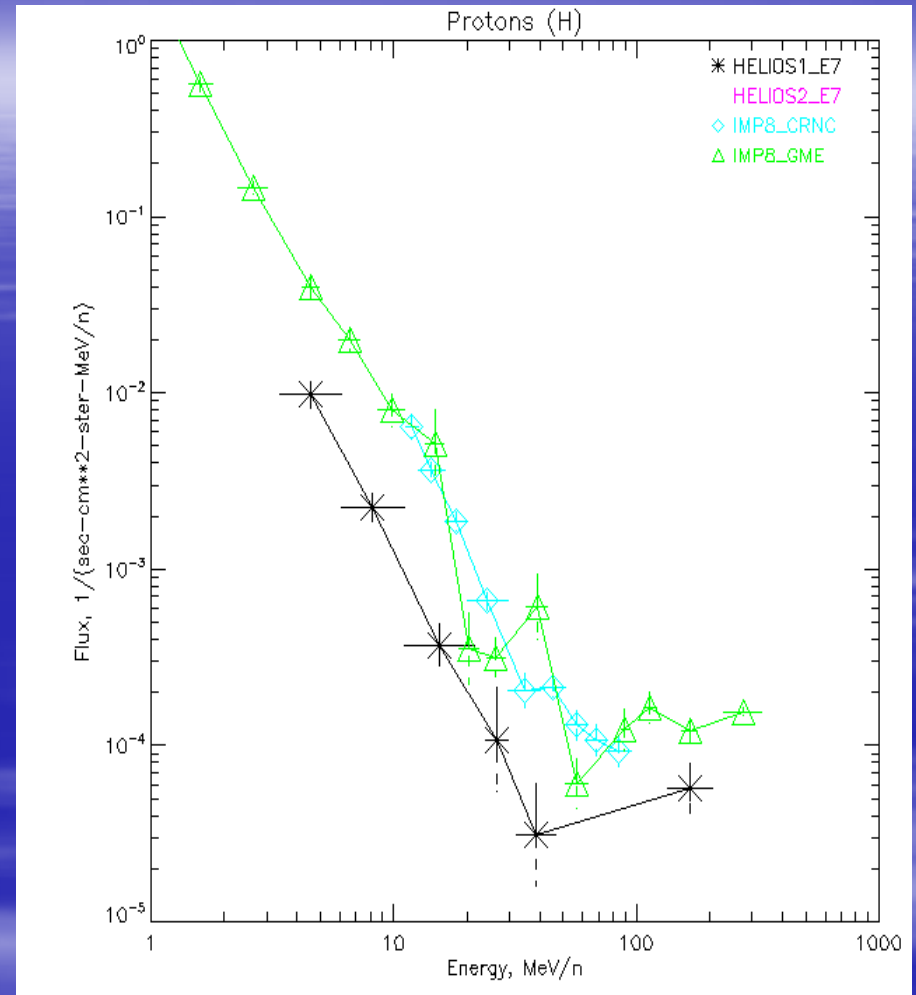
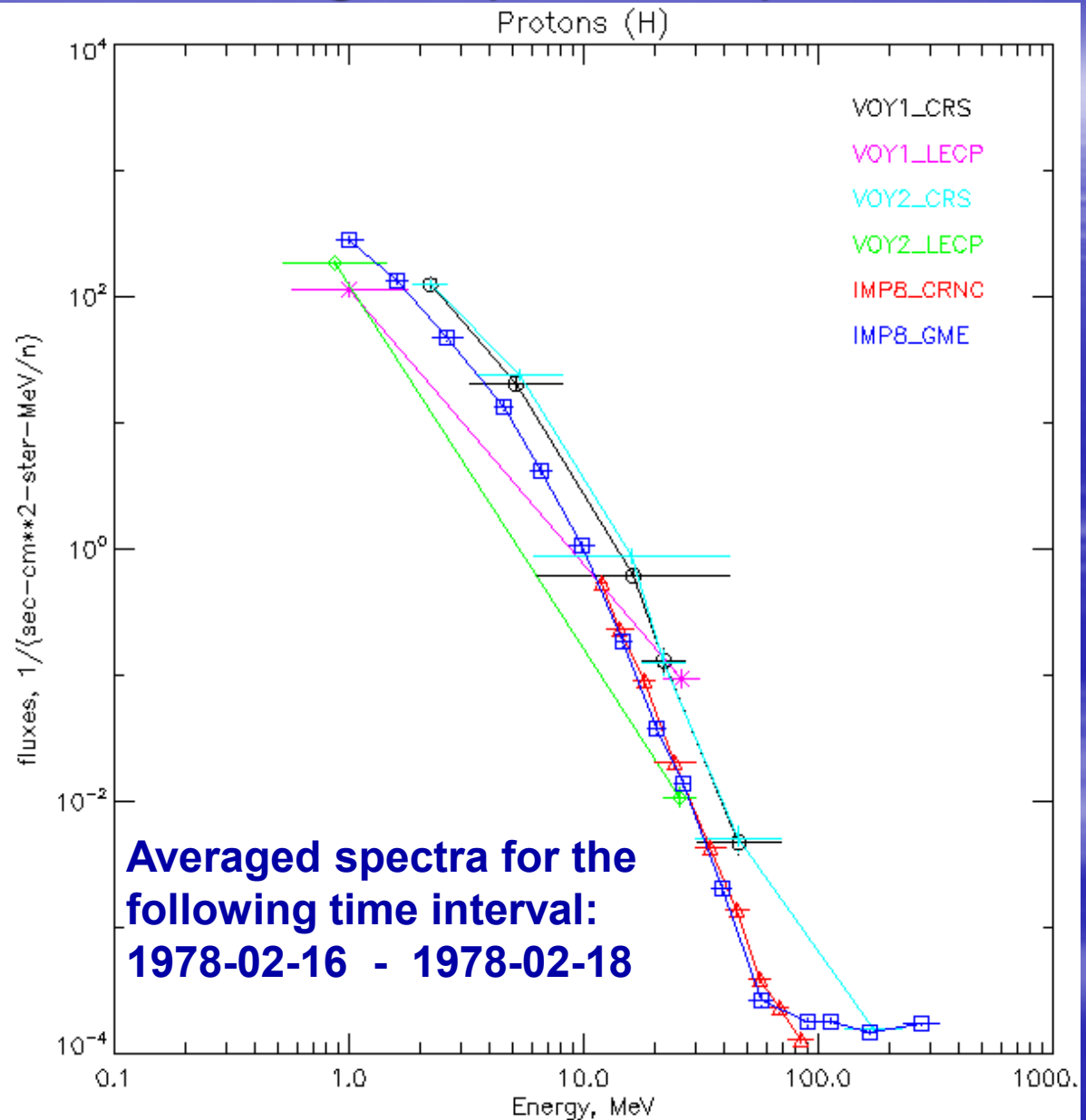


Figure 2. Relatively poor GME-CRT proton flux agreement at 20 – 60 MeV due to limited GME count statistics on May 16, 1978 during reservoir event.

Multi-source plots of energetic particle spectra

Sources:

Voyager-1, CRS
Voyager-1, LECP
Voyager-2, CRS
Voyager-2, LECP
IMP-8, CRNC-UChic
IMP-8, GME-GSFC

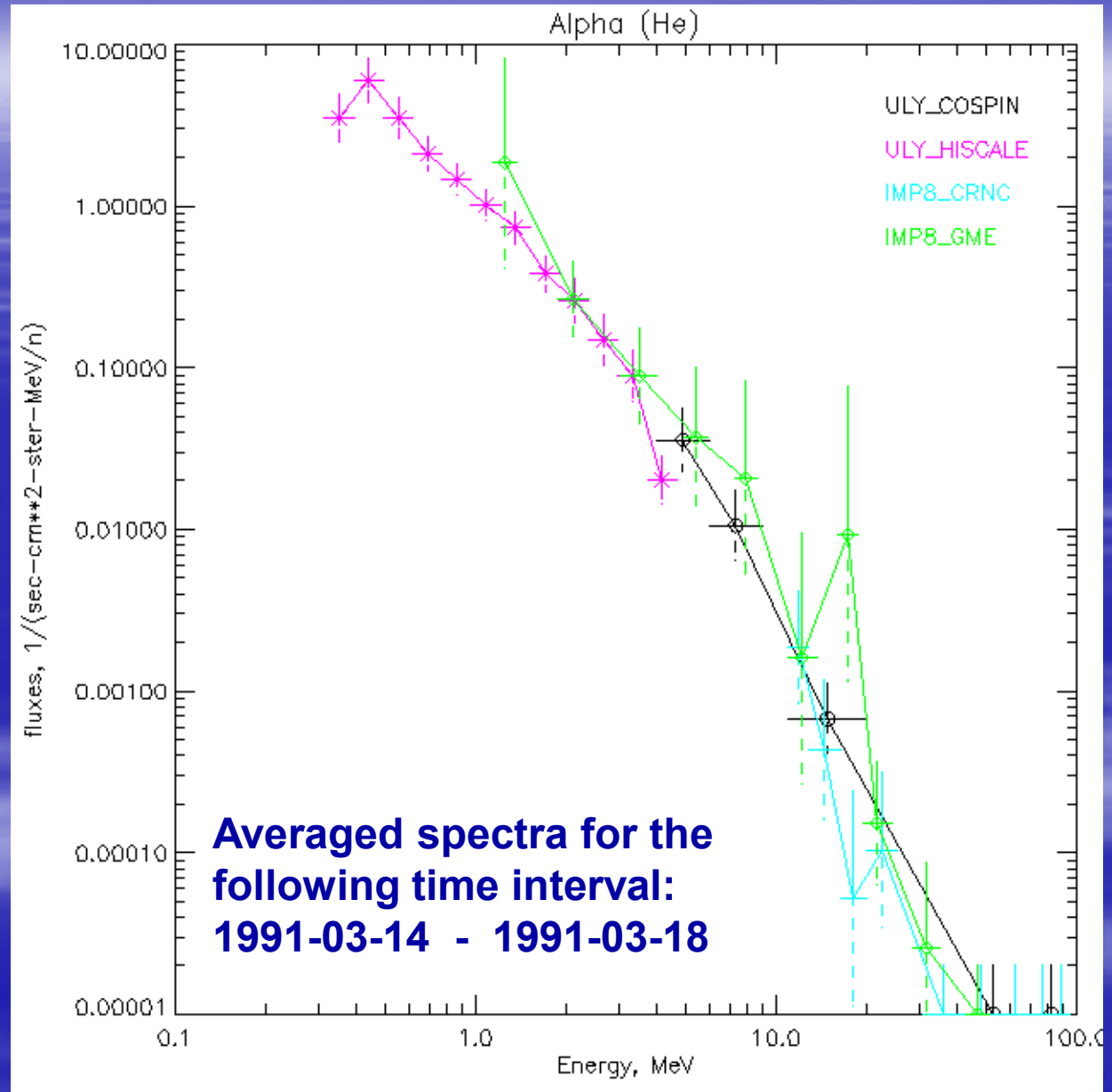


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Multi-source plots of energetic particle spectra

Sources:

Ulysses, COSPIN
Ulysses, HISCALE
ACE, EPAM
IMP-8, CRNC-UChic
IMP-8, GME-GSFC



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Hourly ACE EPAM MFSA Secteded Fluxes for Solar Wind Rest Frame (SWRF)

Links to Instrument Home pages	S p e c.	Polar angle range,deg.	Index number of Sector (1-8) for each cell: Azimuthal range (deg.)							
			1	2	3	4	5	6	7	8
LEMS30	H	7.5-52.5	0-90 <input checked="" type="checkbox"/>	90-180 <input type="checkbox"/>	180-270 <input type="checkbox"/>	270-360 <input type="checkbox"/>				
LEFS60	H	37.5-82.5	90-135 <input type="checkbox"/>	135-180 <input type="checkbox"/>	180-225 <input type="checkbox"/>	225-270 <input type="checkbox"/>	270-315 <input type="checkbox"/>	315-360 <input type="checkbox"/>	0-45 <input type="checkbox"/>	45-90 <input type="checkbox"/>
LEMS120	H	97.5 - 144.5	270-315 <input type="checkbox"/>	315-360 <input type="checkbox"/>	0-45 <input type="checkbox"/>	45-90 <input type="checkbox"/>	90-135 <input type="checkbox"/>	135-180 <input type="checkbox"/>	180-225 <input type="checkbox"/>	225-270 <input type="checkbox"/>
LEFS150	H	123.5-176.5	180-270 <input type="checkbox"/>	270-360 <input type="checkbox"/>	0-90 <input type="checkbox"/>	90-180 <input type="checkbox"/>				
LEMS30	I	7.5-52.5	0-90 <input type="checkbox"/>	90-180 <input type="checkbox"/>	180-270 <input type="checkbox"/>	270-360 <input type="checkbox"/>				
LEFS60	I	37.5-82.5	90-135 <input type="checkbox"/>	135-180 <input type="checkbox"/>	180-225 <input type="checkbox"/>	225-270 <input type="checkbox"/>	270-315 <input type="checkbox"/>	315-360 <input type="checkbox"/>	0-45 <input type="checkbox"/>	45-90 <input type="checkbox"/>
LEMS120	I	97.5 - 144.5	270-315 <input type="checkbox"/>	315-360 <input type="checkbox"/>	0-45 <input type="checkbox"/>	45-90 <input type="checkbox"/>	90-135 <input type="checkbox"/>	135-180 <input type="checkbox"/>	180-225 <input type="checkbox"/>	225-270 <input type="checkbox"/>
LEFS150	I	123.5-176.5	180-270 <input type="checkbox"/>	270-360 <input type="checkbox"/>	0-90 <input type="checkbox"/>	90-180 <input type="checkbox"/>				

Spin-Averaged Fluxes

H	LEMS30 <input type="checkbox"/>	LEFS60 <input type="checkbox"/>	LEMS120 <input type="checkbox"/>	LEFS150 <input type="checkbox"/>
I	LEMS30 <input type="checkbox"/>	LEFS60 <input type="checkbox"/>	LEMS120 <input type="checkbox"/>	LEFS150 <input type="checkbox"/>

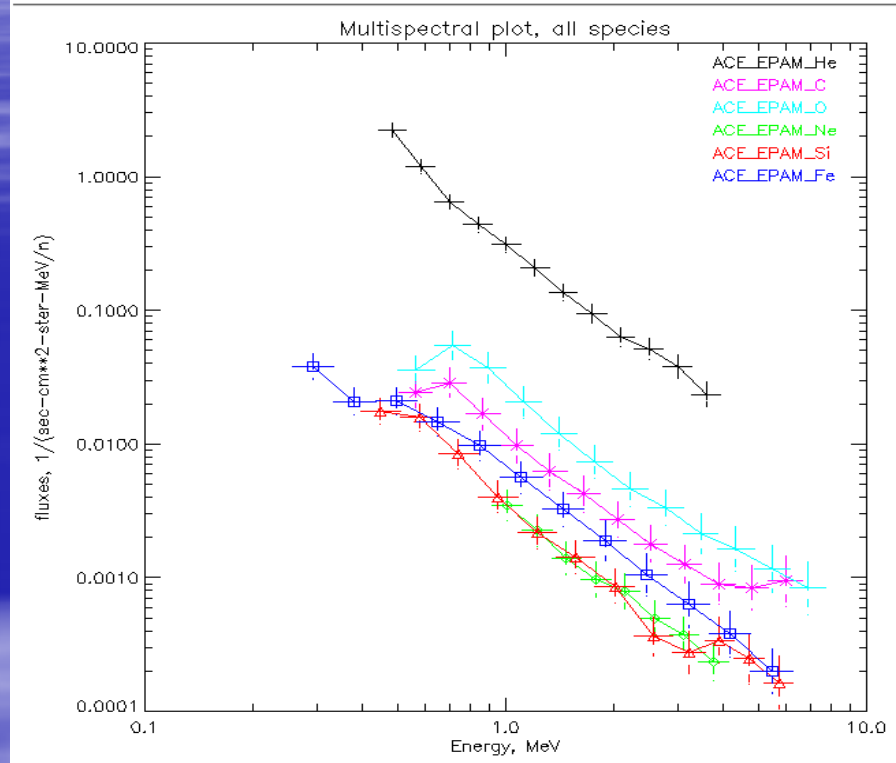
Multi-Source Spectral Plots (MSSP-4) of energetic electron particle fluxes

Data source, Plot/List	Resolution	Time span	Energy range Mev/n
<input type="checkbox"/> Helios1 E6, U.Kiel	~1hr	1974-12-11 - 1983-12-31	0.3 - 2.0
<input type="checkbox"/> Helios2 E6, U.Kiel	~1hr	1976-01-16 - 1980-03-08	0.3 - 2.0
<input type="checkbox"/> IMP8 CRNC, U.Chi/UNH	1hr	1973-10-30 - 2001-10-26	0.7 - 50.0
<input type="checkbox"/> STEREO-A IMPACT/HET	1hr	2006-12-01 - 2014-03-18	0.7 - 4.0
<input type="checkbox"/> STEREO-B IMPACT/HET	1hr	2006-12-01 - 2014-03-18	0.7 - 4.0

ACE EPAM Flux for He, C, O, Ne, Si, Fe

Averaged Spectra from 19970831 to 19980830

 [Listing of spectral function points and power law fit](#)

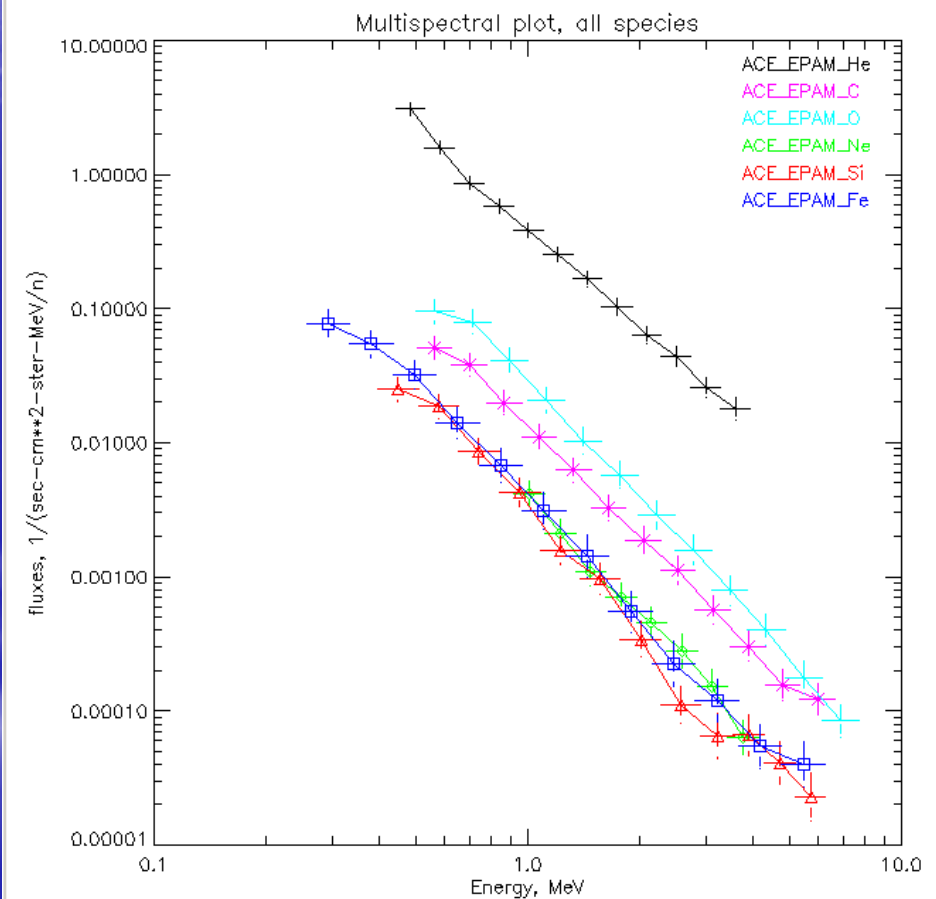


Aug. 31, 1997 – Aug. 30, 1998

VEPO

Averaged Spectra from 20110101 to 20111231

 [Listing of spectral function points and power law fit](#)



Jan. 1 – Dec. 31, 2011