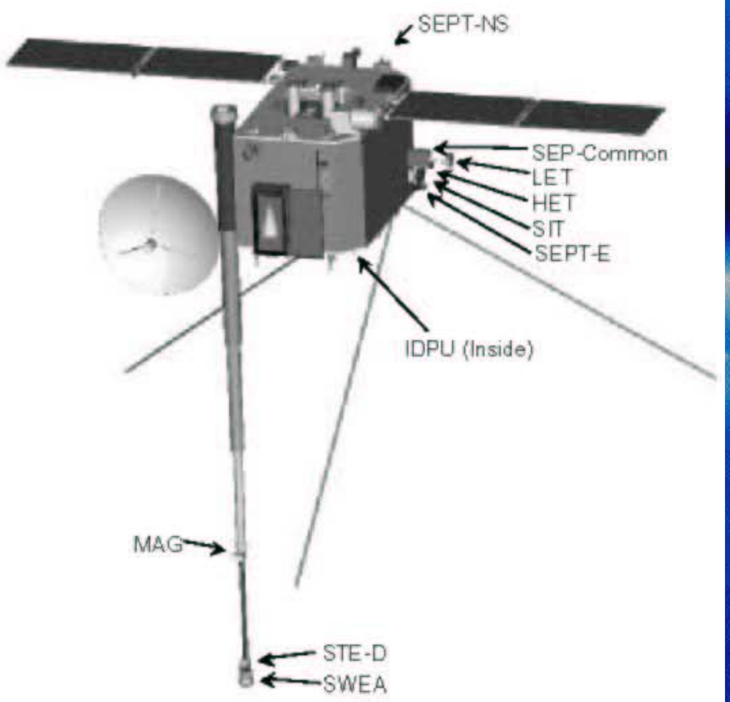

STEREO
IMPACT
UCB - NASA/GSFC- Caltech - U of MD - LANL - JPL - UCLA - SAIC - NOAA/SEC
U of MI - JHU/APL - MPAe - U of Kiel - CESR/CNRS - ESA/ESTEC -
DESPA/OBSPM - KFKI/RMKI

IMPACT (In-situ Measurements of Particles and CME Transients)

Instrument Overview

- **Boom Suite:**
  - Solar Wind Electron Analyzer (SWEA)
  - Suprathermal Electron Telescope (STE)
  - Magnetometer (MAG)

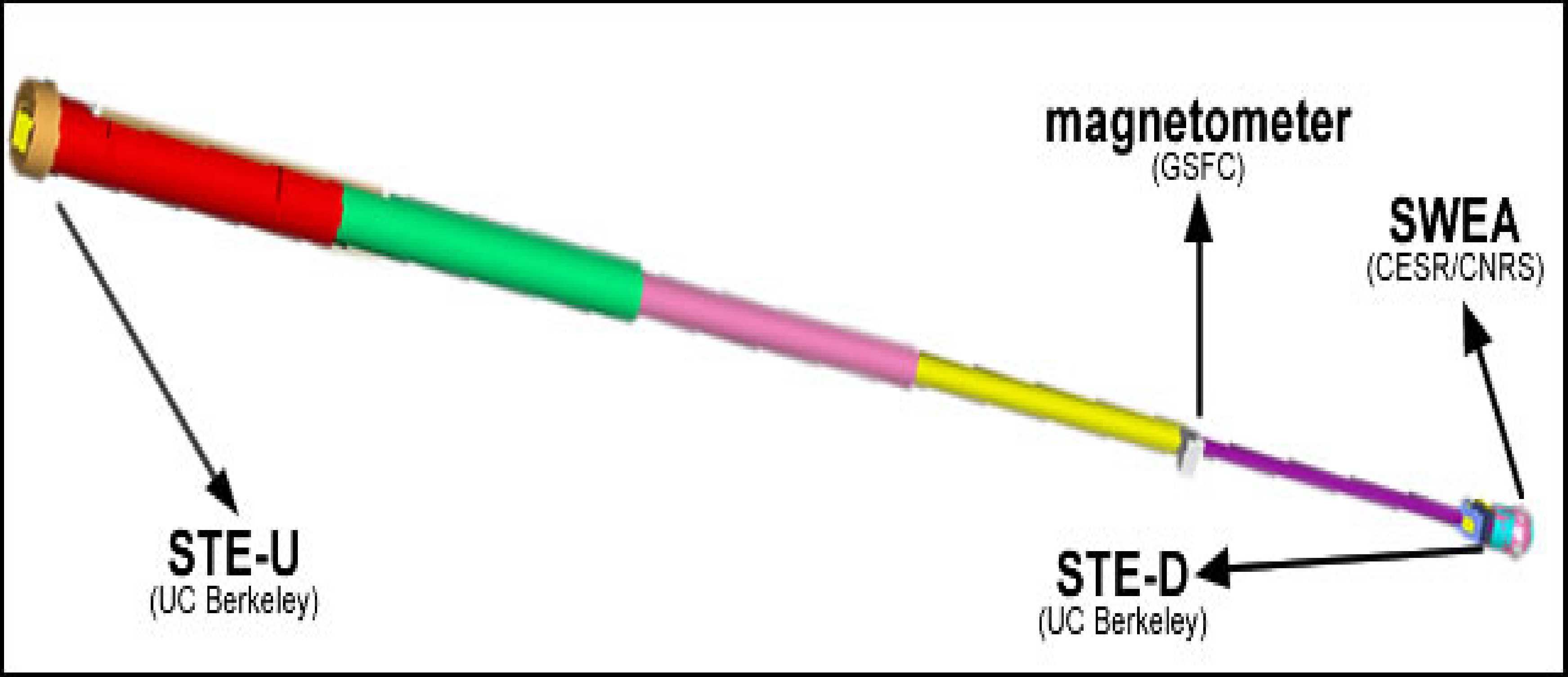
- **Solar Energetic Particles Package (SEP)**
  - Suprathermal Ion Telescope (SIT)
  - Solar Electron and Proton Telescope (SEPT)
  - Low Energy telescope (LET)
  - High Energy Telescope (HET)



IMPACT Team Member Institutions and Primary Roles

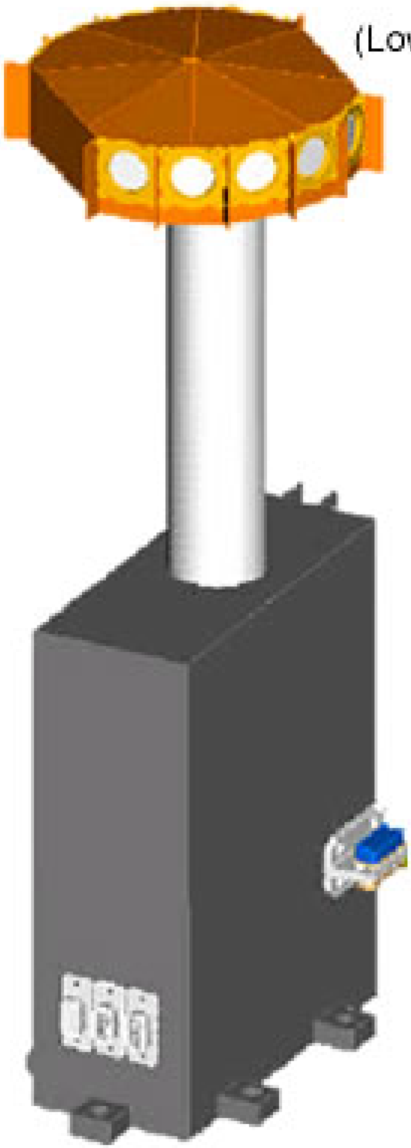
- University of California, Berkeley-Space Sciences Laboratory (IMPACT Management,SWEA,STE,IDPU)
- NASA Goddard Space Flight Center (MAG,SEP-LET,HET)
- California Institute of Technology (SEP-LET,HET)
- University of Maryland (SEP-SIT)
- *University of Kiel (SEP-SEPT)*
- *Centre d'Etude Spatiale des Rayonnements CESR (SWEA)*
- Los Alamos National Laboratory (Science Integration, SEP-SIT)
- *Max Planck Institut fur Aeronomie (SEP-SIT)*
- Jet Propulsion Laboratory (SEP-LET,HET)
- *ESTEC-European Space Agency (SEP-SEPT)*
- *DESPA Observatoire de Paris-Meudon (SWAVES/IMPACT coordination)*
- University of California, Los Angeles (MAG, IMPACT Data Web)
- SAIC-Science Applications International Corporation (IMPACT Modeling)
- NOAA Space Environment Center (IMPACT Modeling, Space Weather Applications)
- University of Michigan (IMPACT Modeling)
- *KFKI-Hungarian Research Institute for Particle and Nuclear Physics (SEP Modeling)*

Impact Boom Suite (Solar Wind Electrons and Magnetic Field)



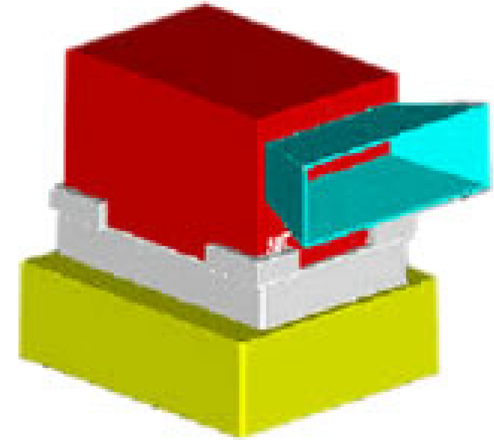
Impact SEP Package

(Solar Energetic Particles)

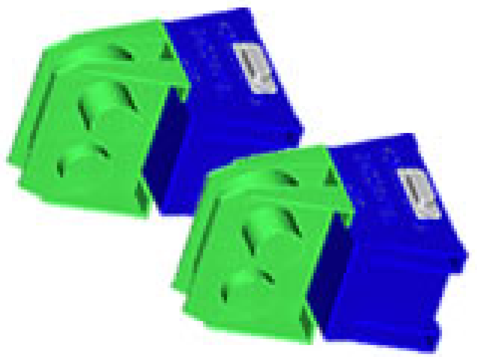


LET
(Low Energy Telescope)
Caltech/JPL

HET
(High Energy Telescope)
GSFC/Caltech



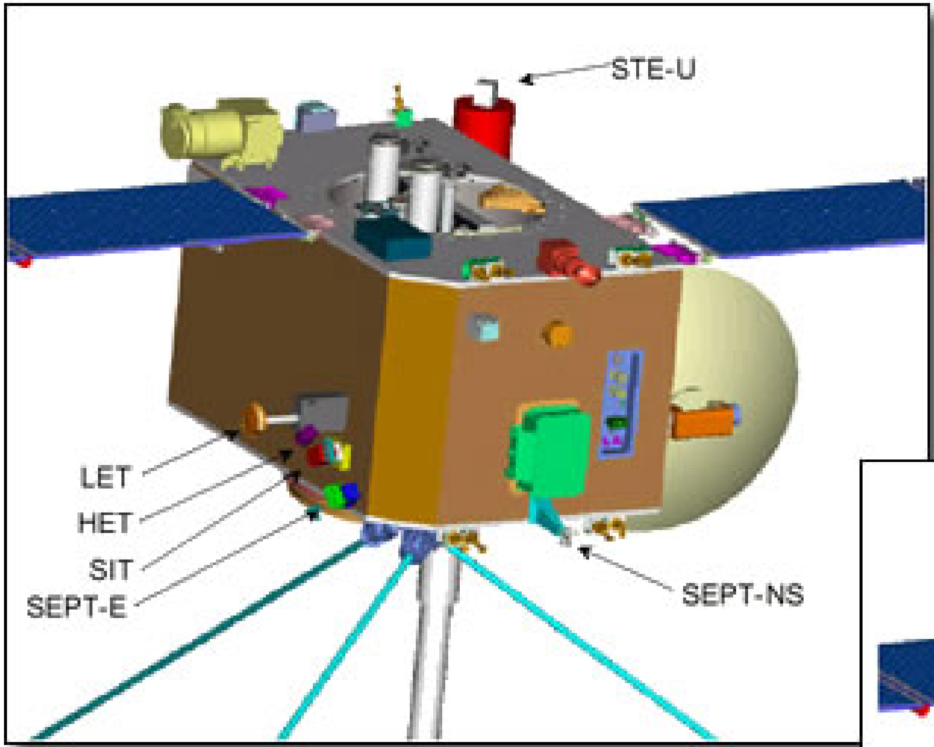
SIT
(Supra-Thermal Ion Telescope)
U of MD/MPAe



SEPT
(Solar Electron Proton Telescope)
U of Kiel/ESTEC

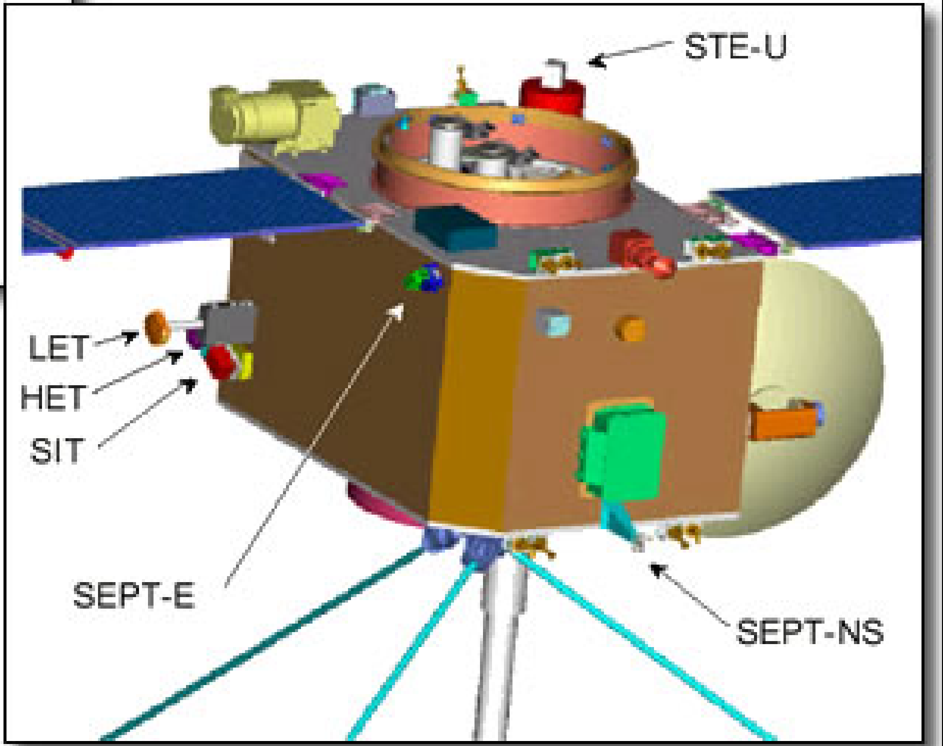
Impact Instruments Location

(Ahead and Behind Spacecraft)

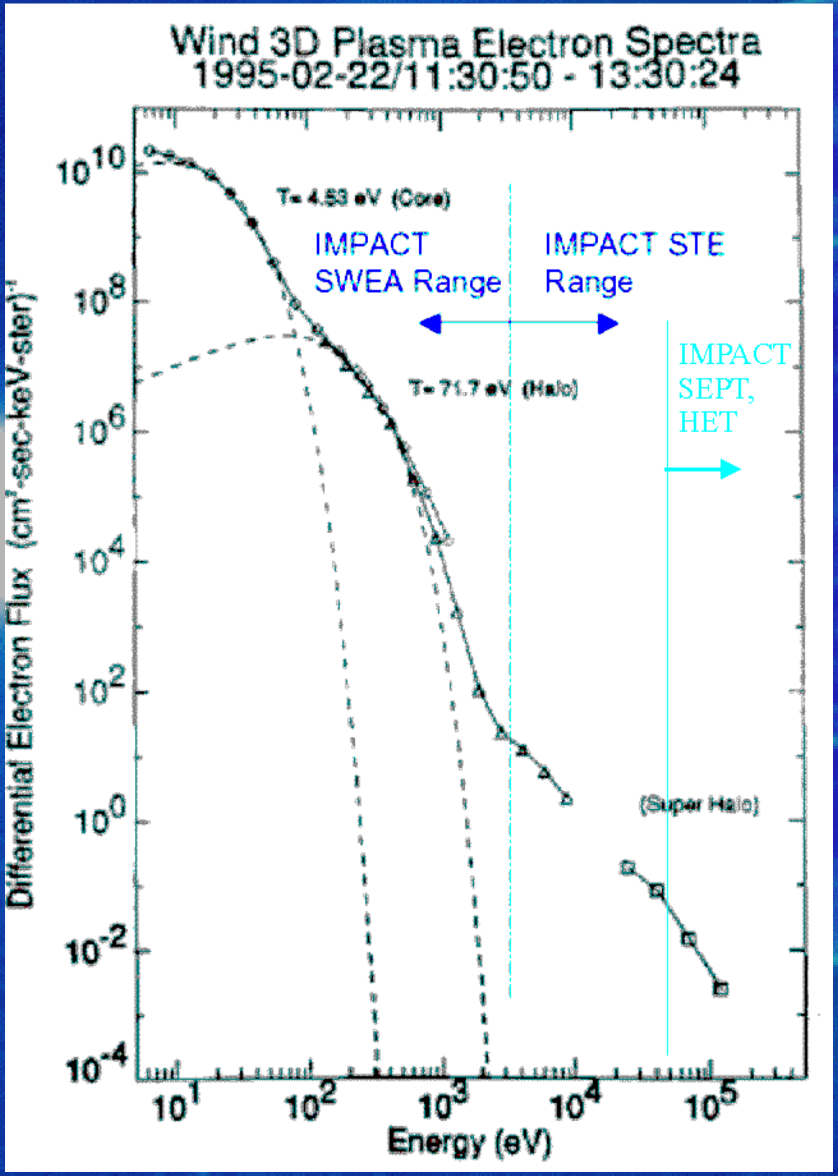


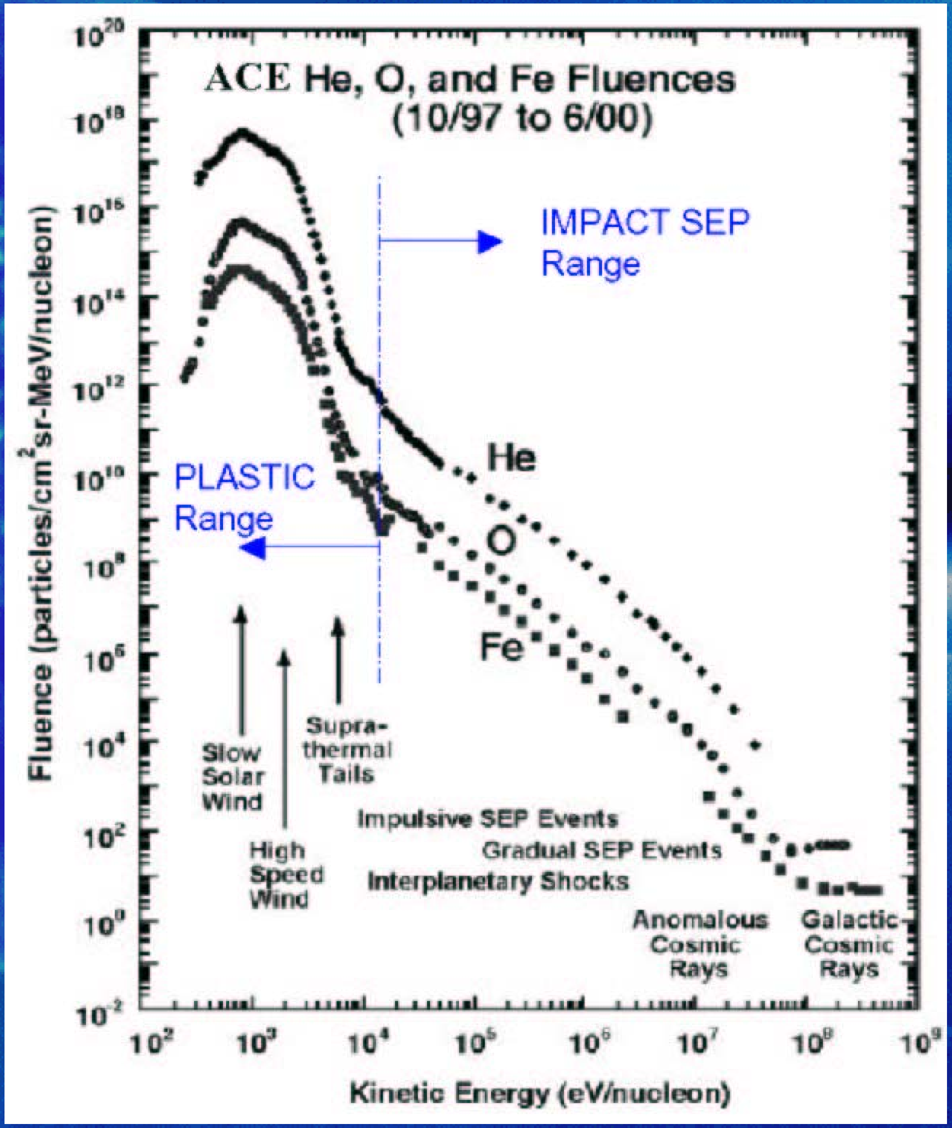
Ahead Spacecraft

Behind Spacecraft



IMPACT Electrons and Solar Energetic Particles (SEP)





(WIND data from Larson et al., 1996)

(adapted from the ACE science center news letters figure by Mewaldt, Gloeckler and Mason)

…aim for electrons is energy range, directionality, for SEP ions, also composition.

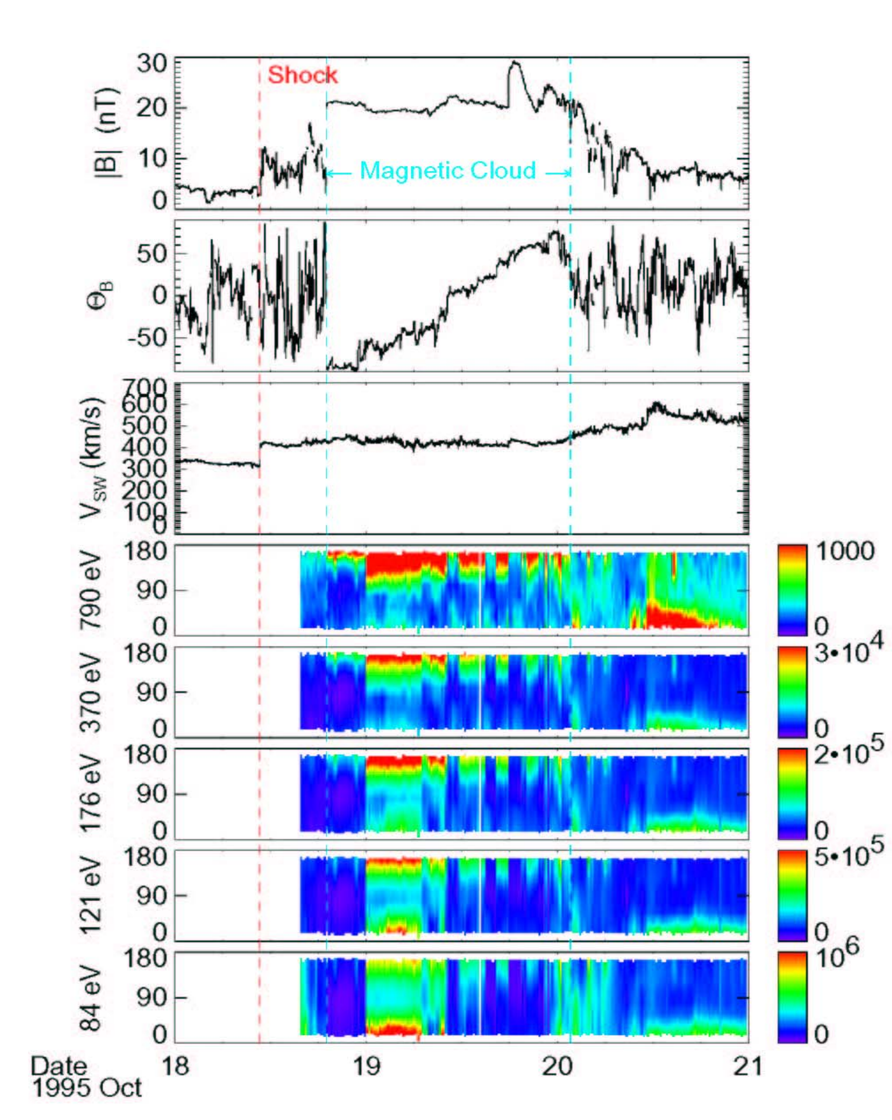
IMPACT Measurement Summary

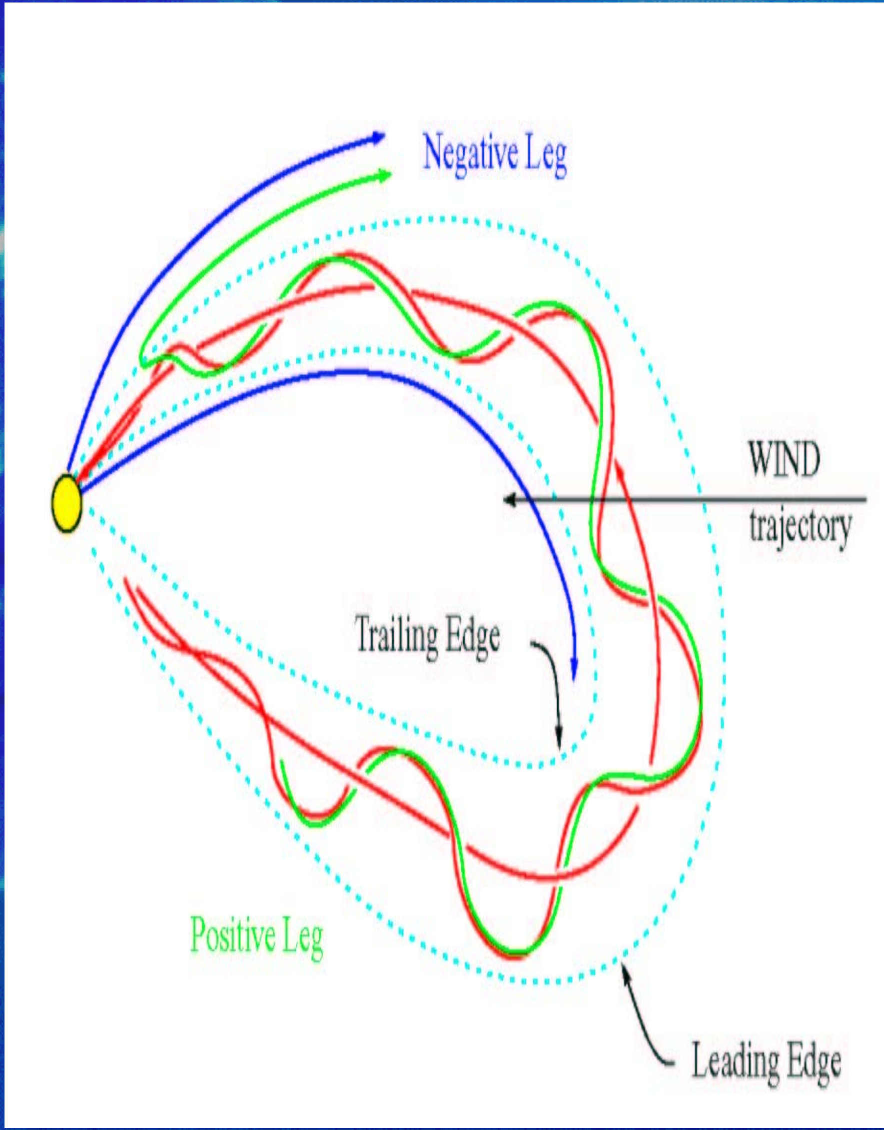
IMPACT Science Summary

Experiment	Instrument	Measurement	Energy or Mag. field range	Time Res.	Beacon Time Res. (*)	Instrument provider
SW	STE	Electron flux and anistropy	2-100 keV	16 s	2D x 3E, 60s	UCB (Lin)
	SWEA	3D electron distrib., core & halo density, temp. & anisotropy	~0-3 keV	3D=1 min 2D=8s Mom.=2s	Moments, 60s	CESR (Sauvaud) + UCB (Lin)
MAG	MAG	Vector field	±500nT, ±65536 nT	1/4 s	60s	GSFC (Acuna)
SEP	SIT	He to Fe ions	0.03-2 MeV/nuc	30 s	3S x 2E, 60s	U. of Md. (Mason) + MPAE (Korth) + GSFC (von Rosenvinge)
		^{3}He	0.15-0.25 MeV/nuc	30 s	----	
	SEPT	Diff. electron flux	20-400 keV	1 min	3E, 60s	U. of Kiel (Mueller-Mellin) + ESTEC (Sanderson)
		Diff. proton flux	20-7000 keV	1 min	3E, 60s	
		Anistropies of e,p	As above	15 min	----	
	LET	Ion mass 2-28 & anisotropy	1.5-40 MeV/nuc	1-15 min.	2S x 2E, 60s	Caltech (Mewaldt) + GSFC (von Rosenvinge) + JPL (Wiedenbeck)
		^{3}He ions flux & anistropy	1.5-1.6 MeV/nuc	15 min.	1E, 60s	
		H ions flux & anistropy	1.5-3.5 MeV	1-15 min.	1E, 60s	
	HET	Electrons flux	1-8 MeV	1-15 min.	1E, 60s	GSFC (von Rosenvinge) + Caltech (Mewaldt) + JPL (Wiedenbeck)
		H	13-100 MeV	1-15 min.	1E, 60s	
		He	13-100 MeV	1-15 min.	1E, 60s	
		^{3}He	15-60 MeV/nuc	15 min	----	
	SEP Common	----	----	----	----	Caltech (Mewaldt) + GSFC (von Rosenvinge)
IMPACT Common	IDPU (+Mag Analog)	----	----	----	----	UCB (Curtis)

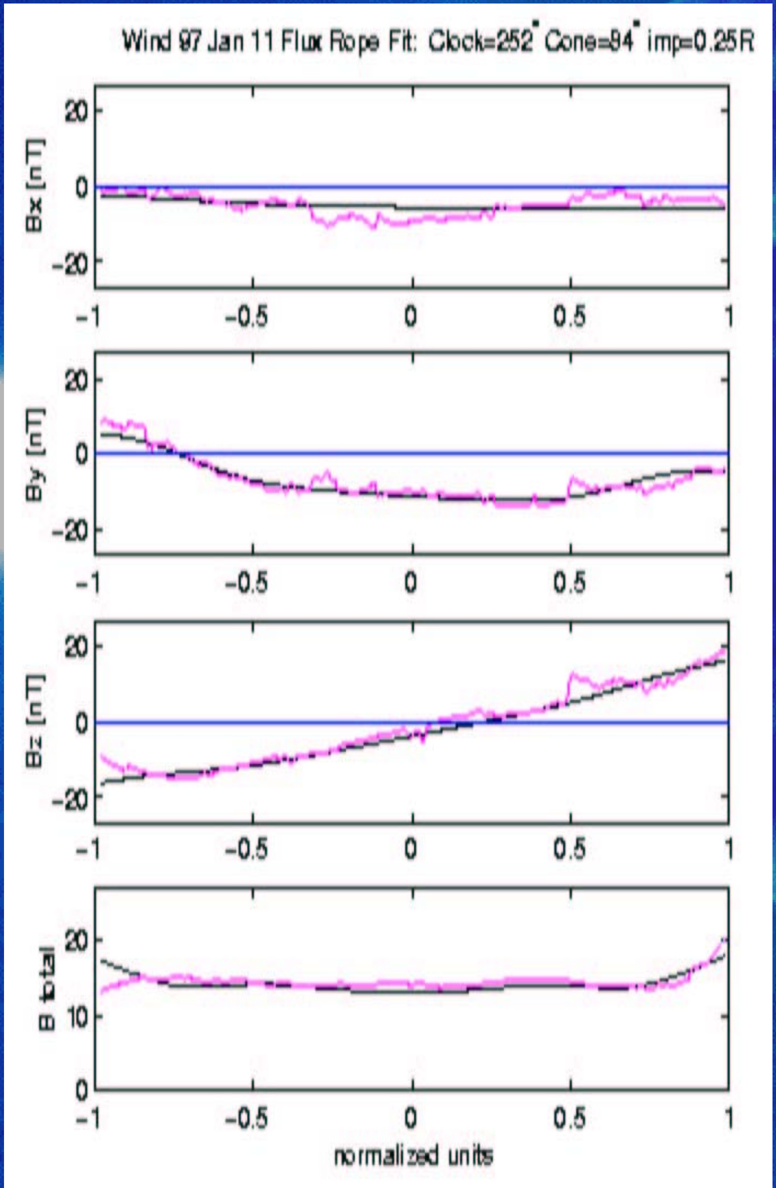
(*) E=Energies, S=Species, D=directions

IMPACT SWEA and STE electron measurements,with MAG, probe solar connection magnetic topology

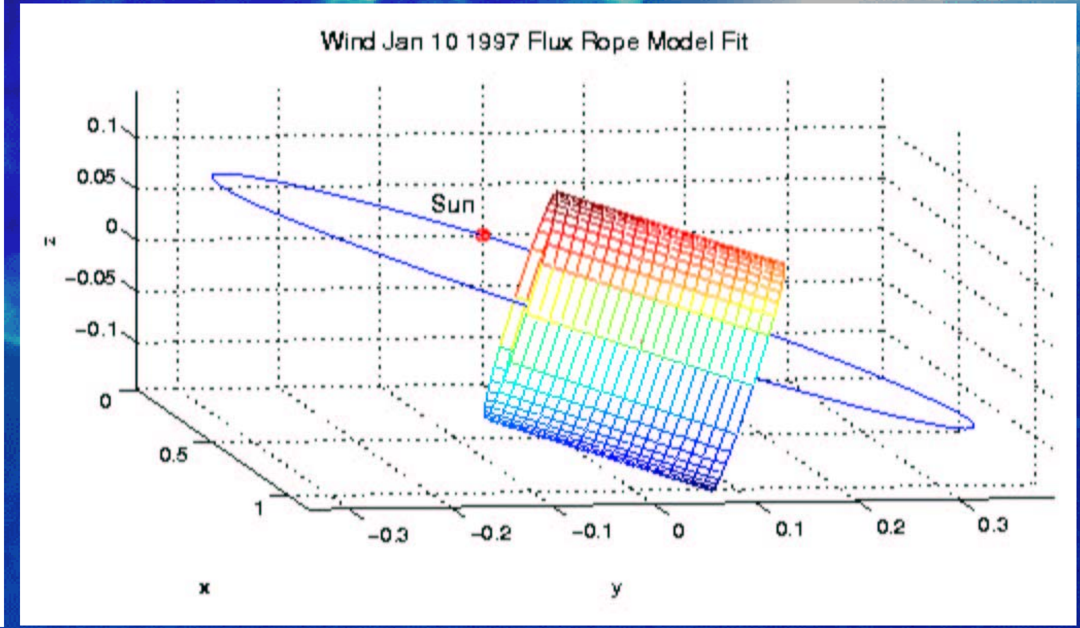




(figures from D. Larson)

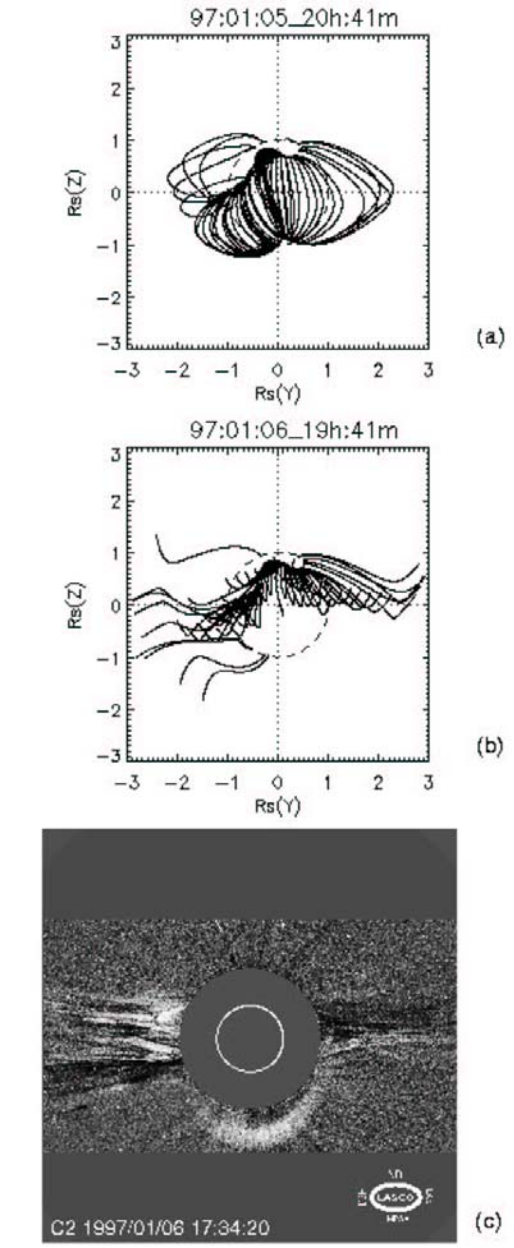


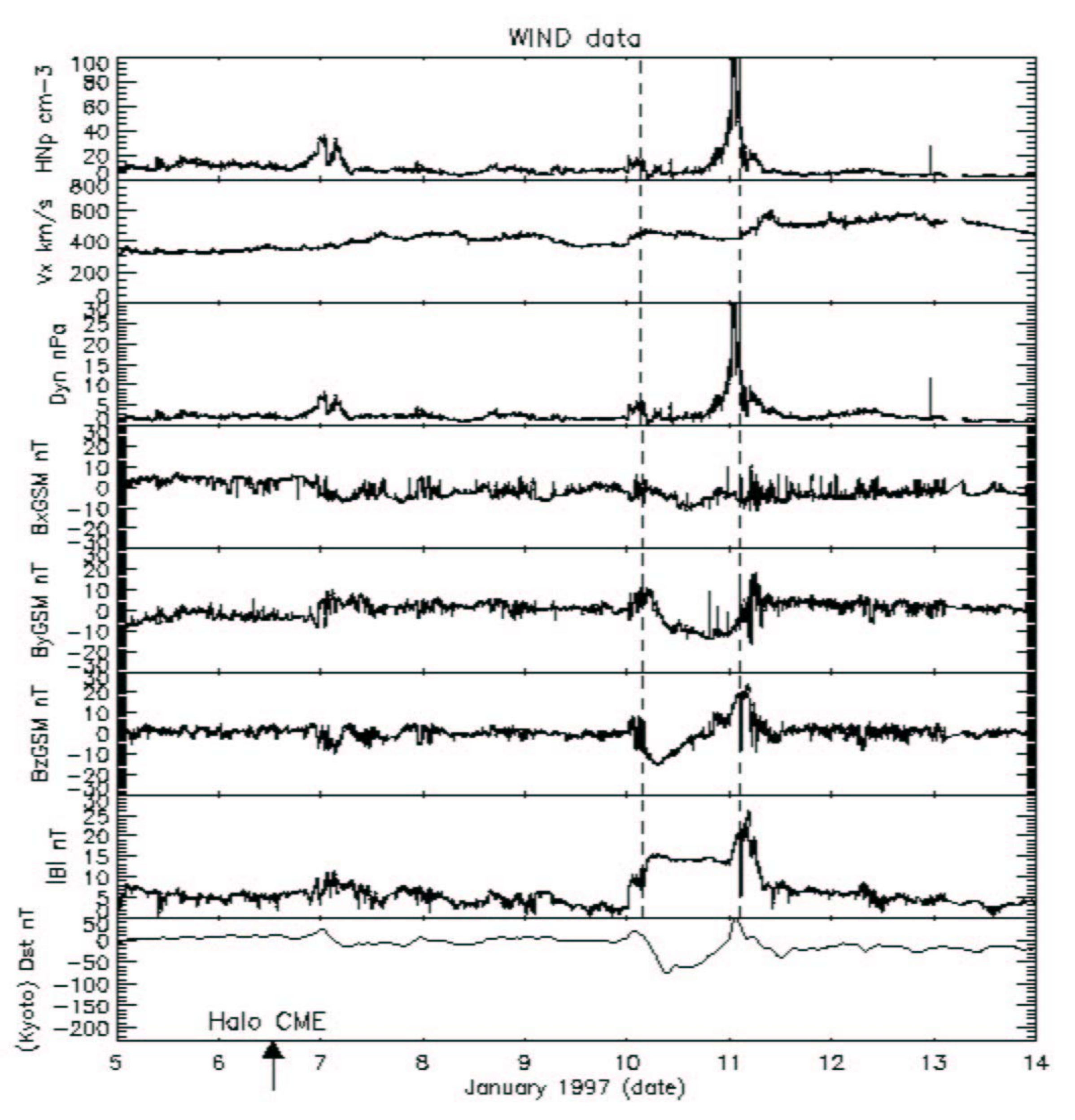
...and provide comparisons for modeling the ICME fields with magnetic flux ropes or other models



(flux rope fits by Tamitha Mulligan, from the paper by Yan Li et al., JGR 2001)

Coronal field models help relate the CME to the ICME magnetic signature





(figures from a paper by Yan Li et al., JGR 2001)

IMPACT SWEA and STE electron measurements combine with SWAVES radio burst data to diagnose ICME magnetic topology using flares

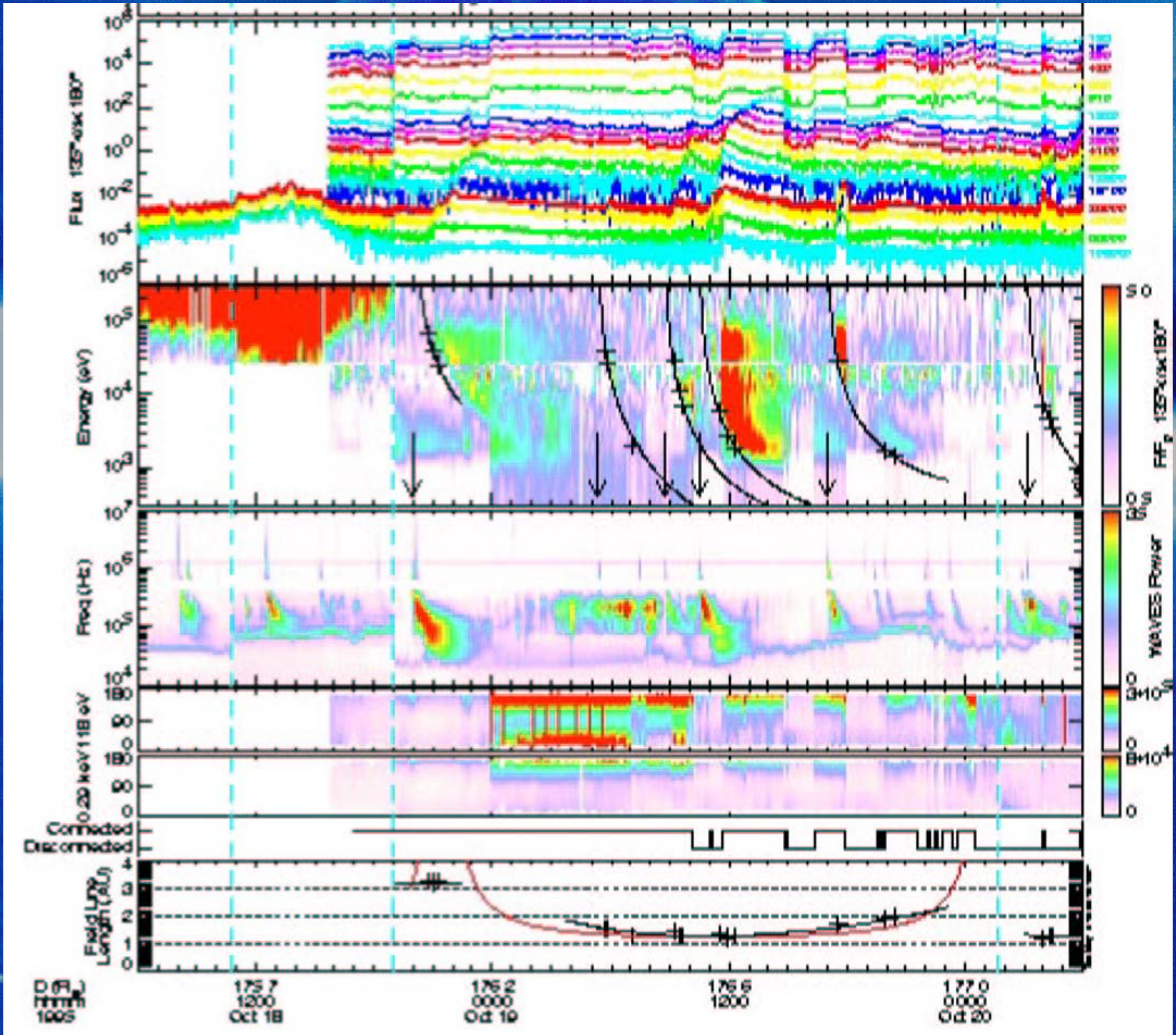
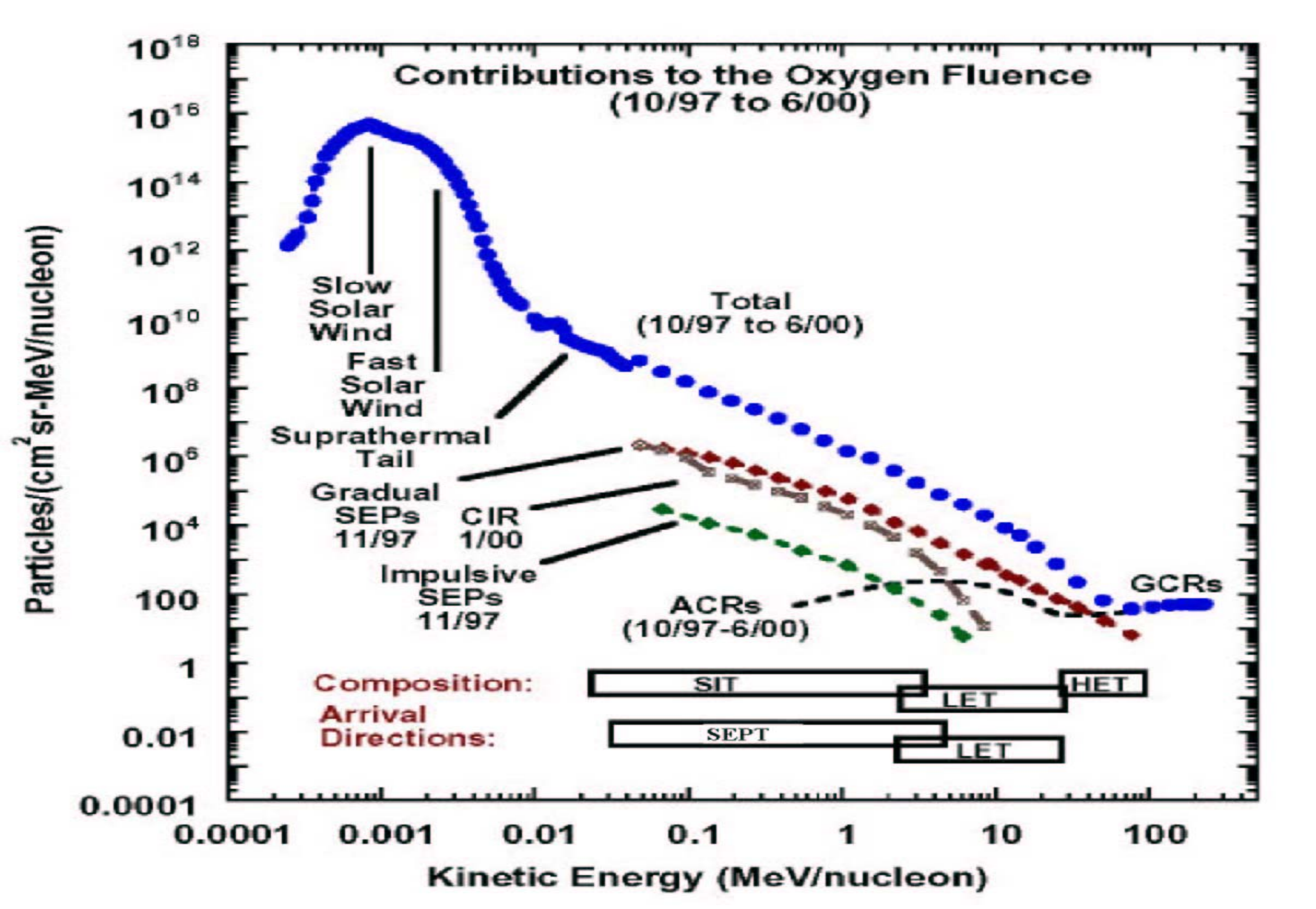
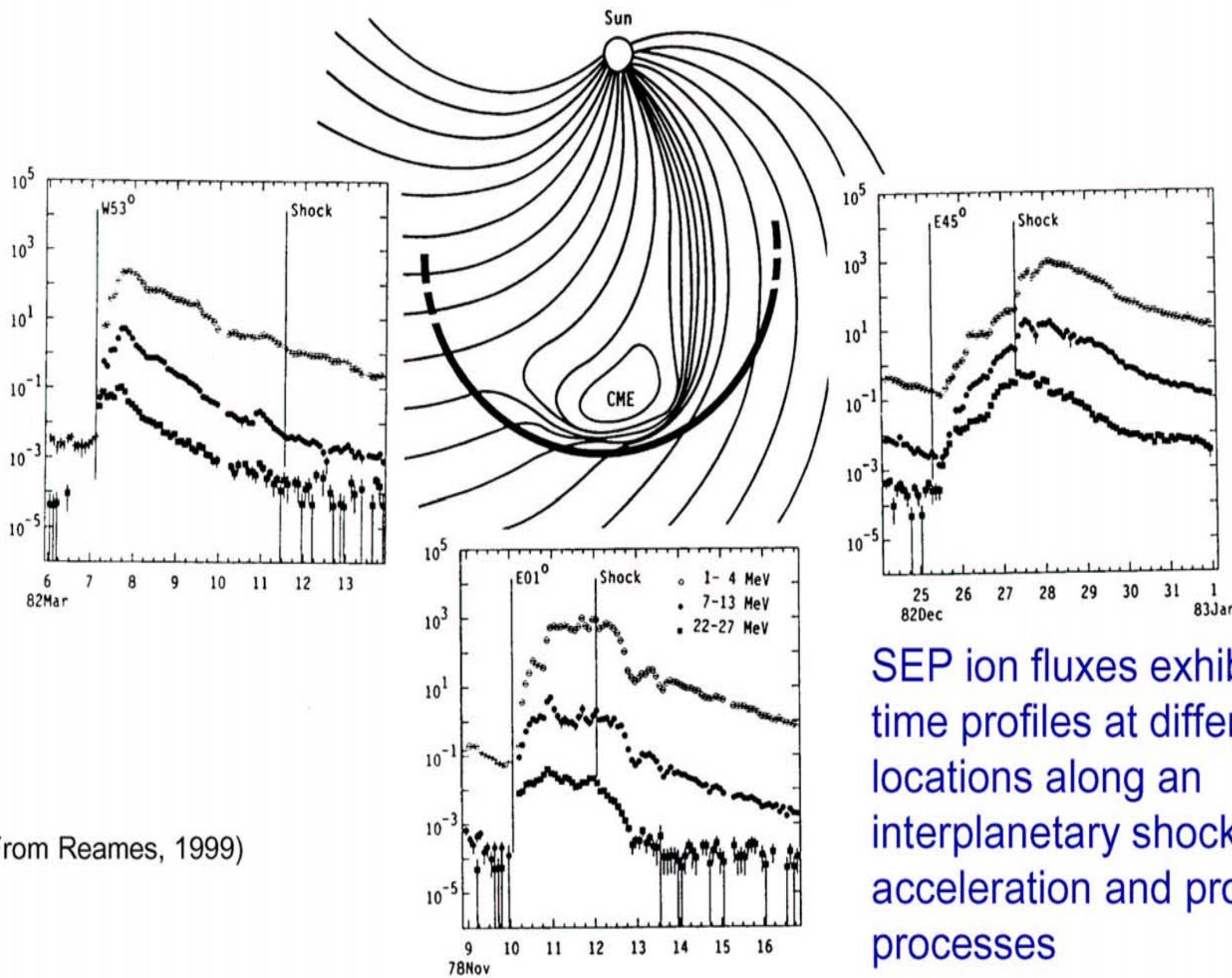


figure from a study by Larson et al., 1997

IMPACT SEP Measurements Cover SEP Energy Range, Composition, and Directionality



IMPACT SEP instruments will take "snapshots" of SEP spatial distributions

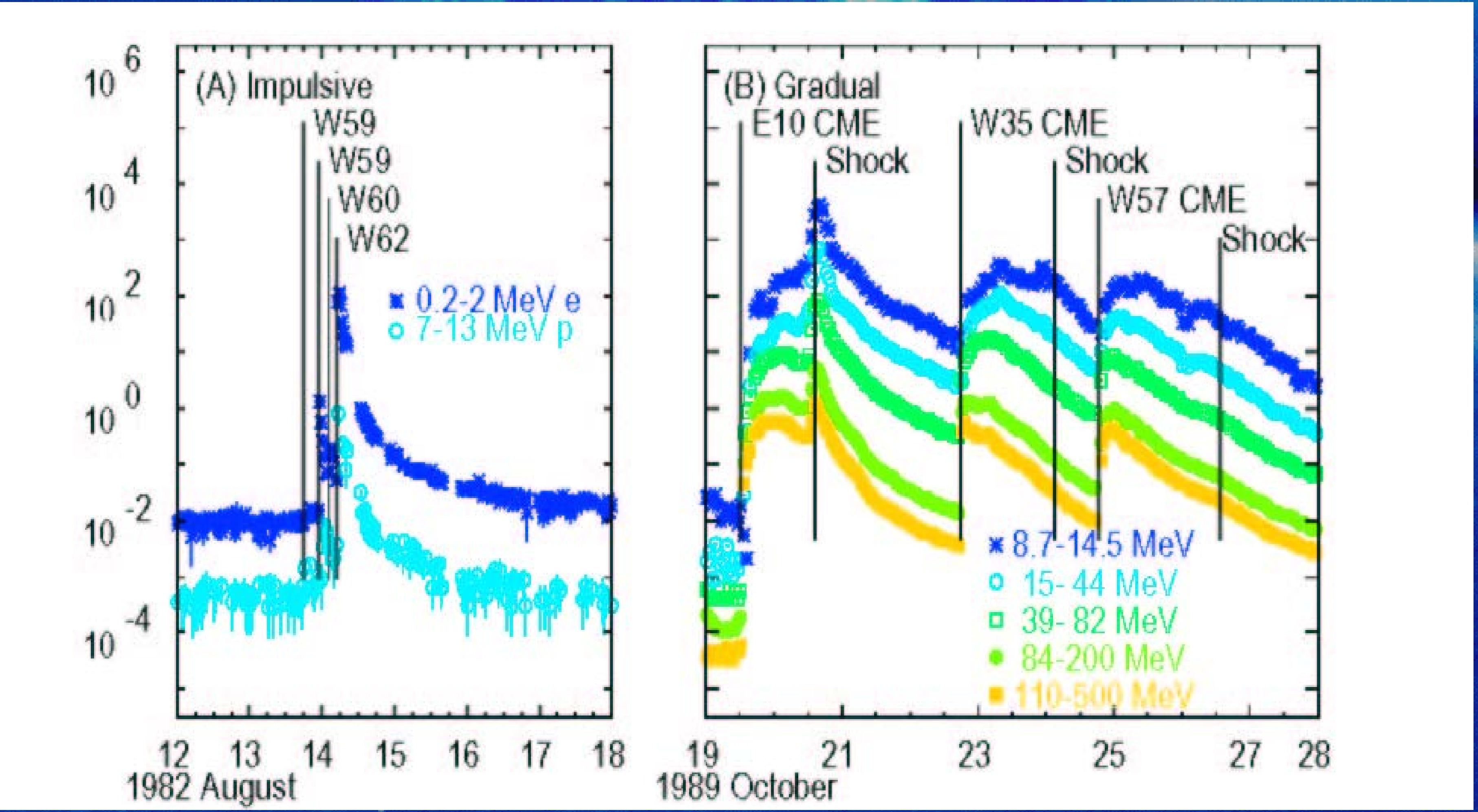


(From Reames, 1999)

SEP ion fluxes exhibit different time profiles at different locations along an interplanetary shock, related to acceleration and propagation processes

IMPACT SEP measurements…

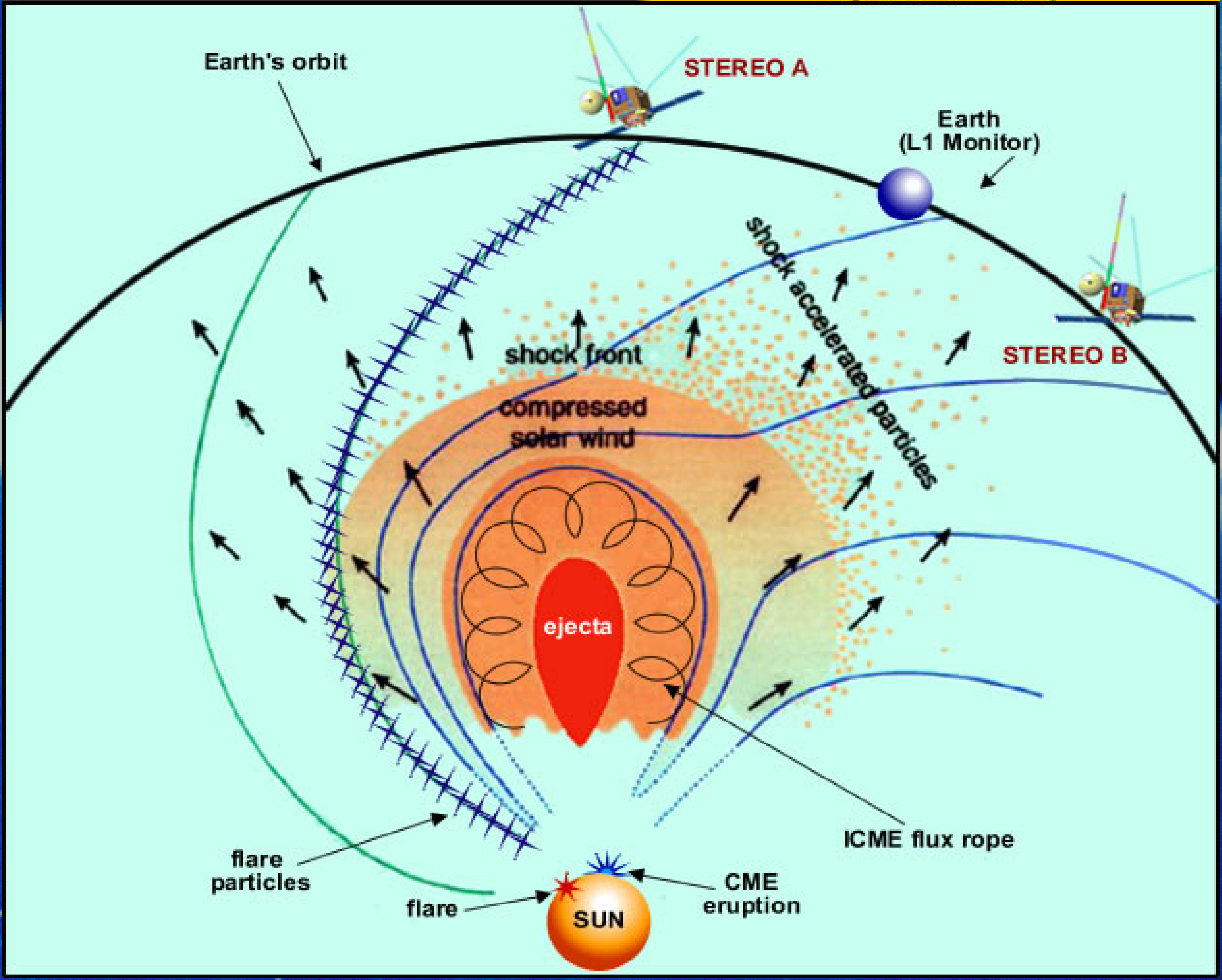
Will identify connections to flares … or ICME shocks



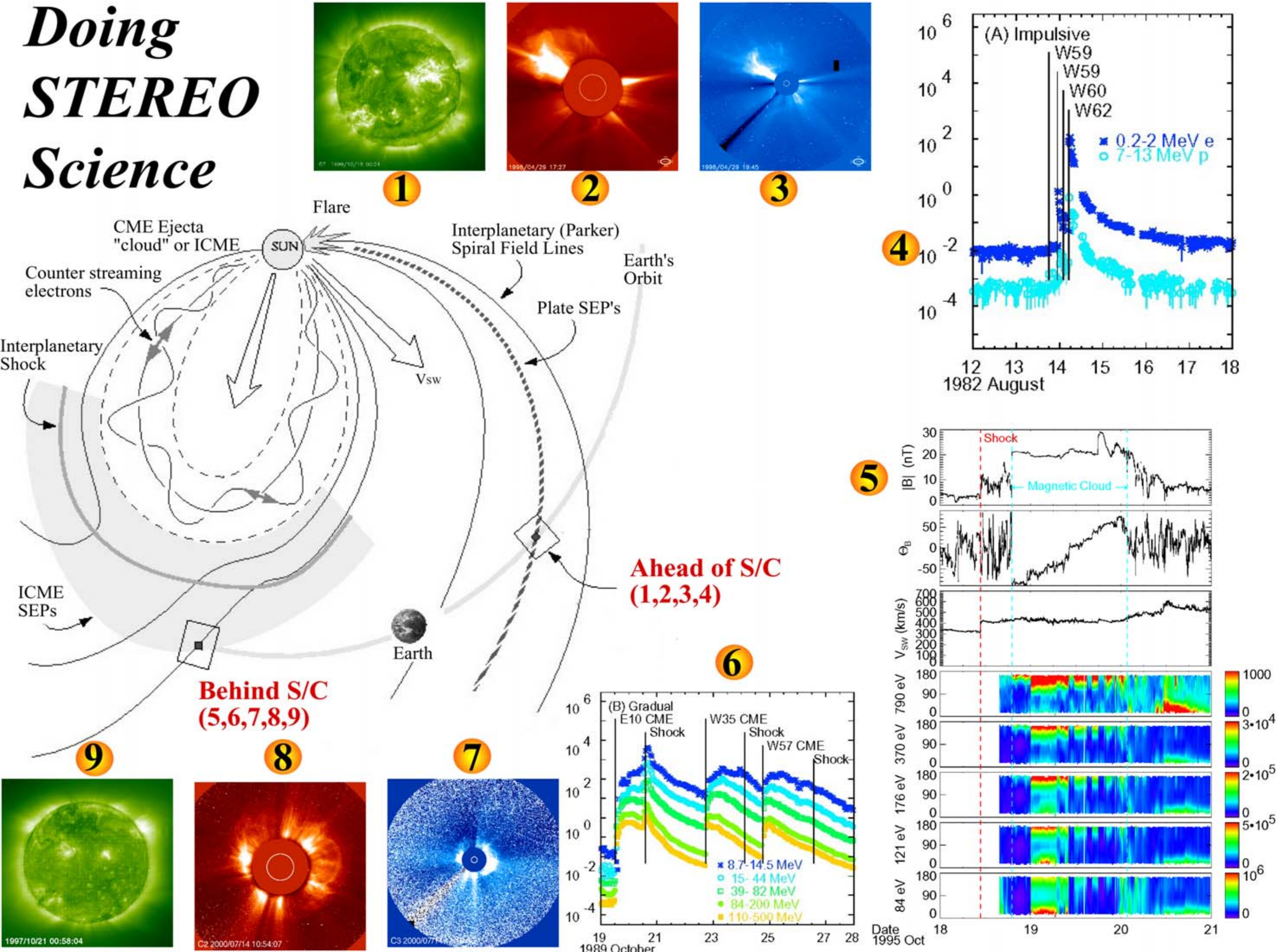
IMPACT Investigation Approaches:

- Multipoint interplanetary characterization of the imaged CMEs and their associated solar energetic particles (SEP) at increasing separations
- Quadrature measurements with imagers on STEREO and at Earth
- Space Weather detection, modeling and prediction

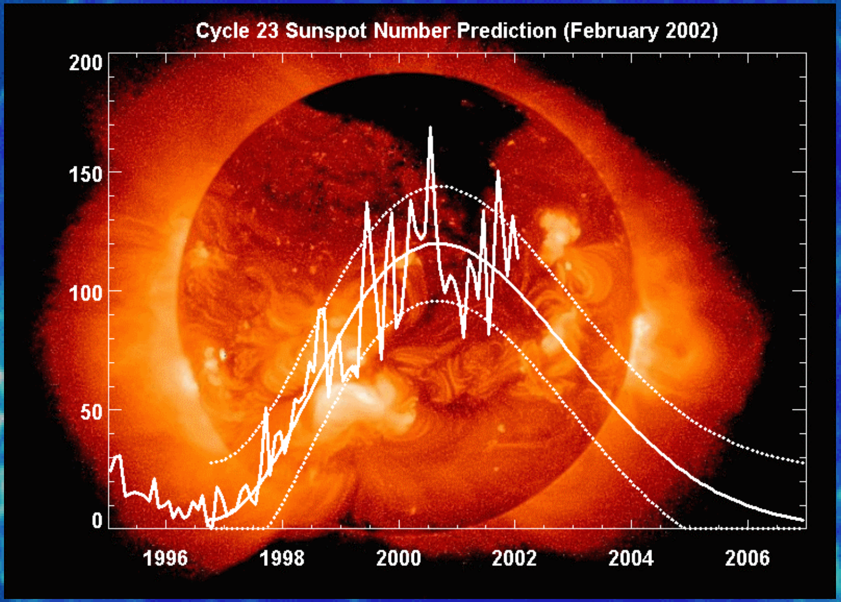
Stereo in-situ Science: Establishing Heliospheric Consequences of Imaged Solar Activity



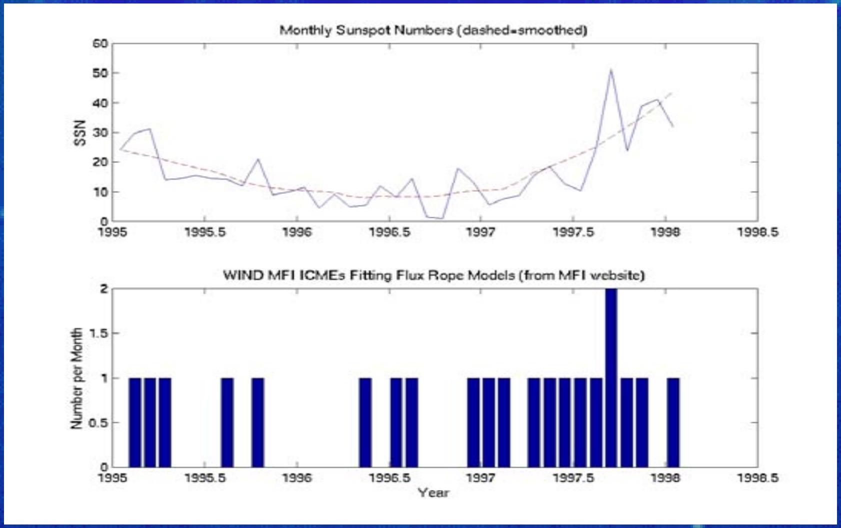
Doing STEREO Science



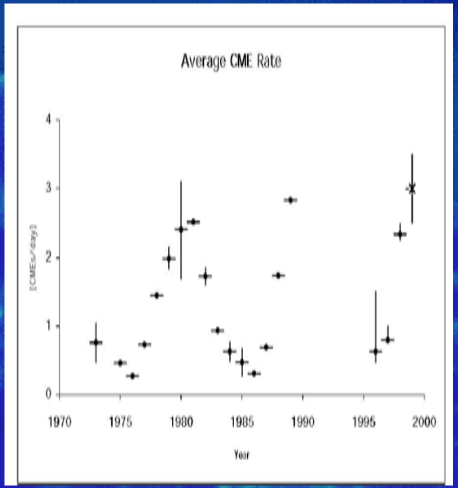
At the beginning of the STEREO mission, IMPACT should observe major ICMEs at each spacecraft approximately once per month. How often will both spacecraft detect the same one?



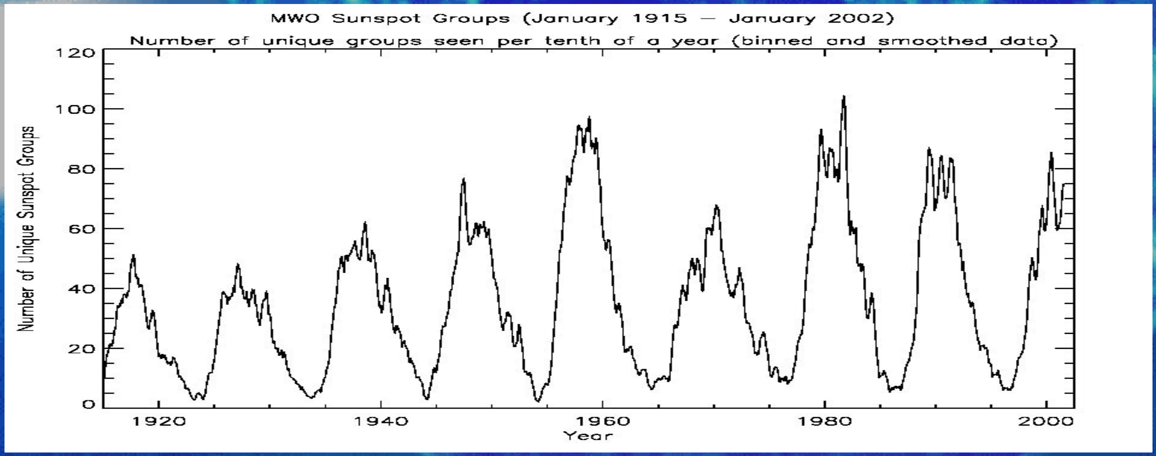
(figure from MSFC website)



Solar Cycle Influence on SEP

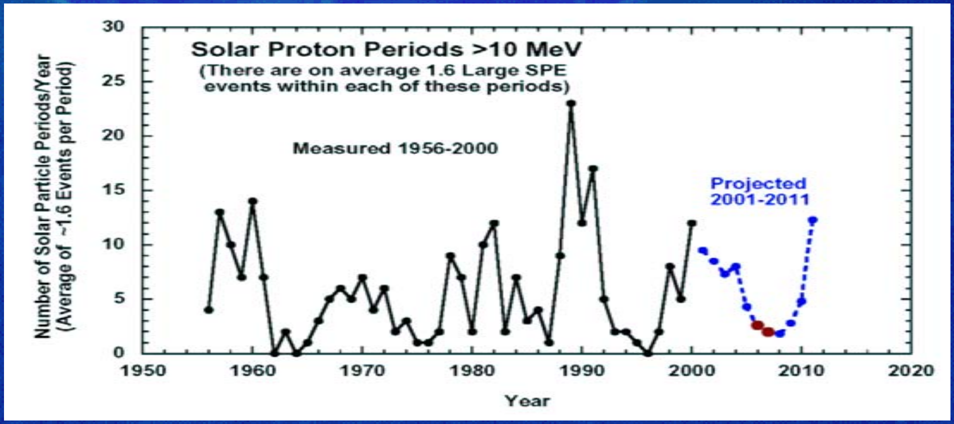


(CME cycle plot courtesy of Chris St. Cyr)



(figure from:

Mt. Wilson Observatory website)

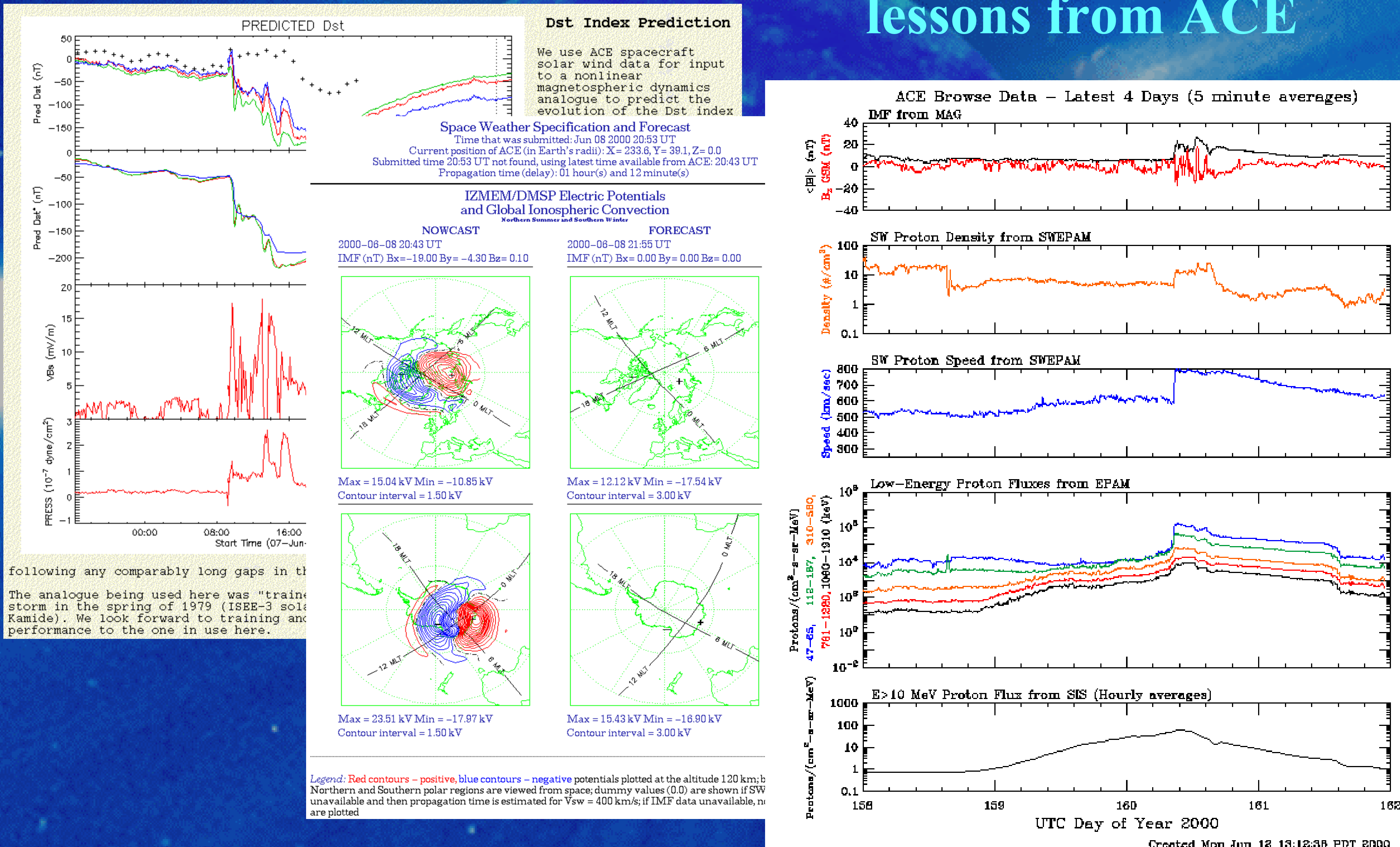


(figure from:

Dick Mewaldt)

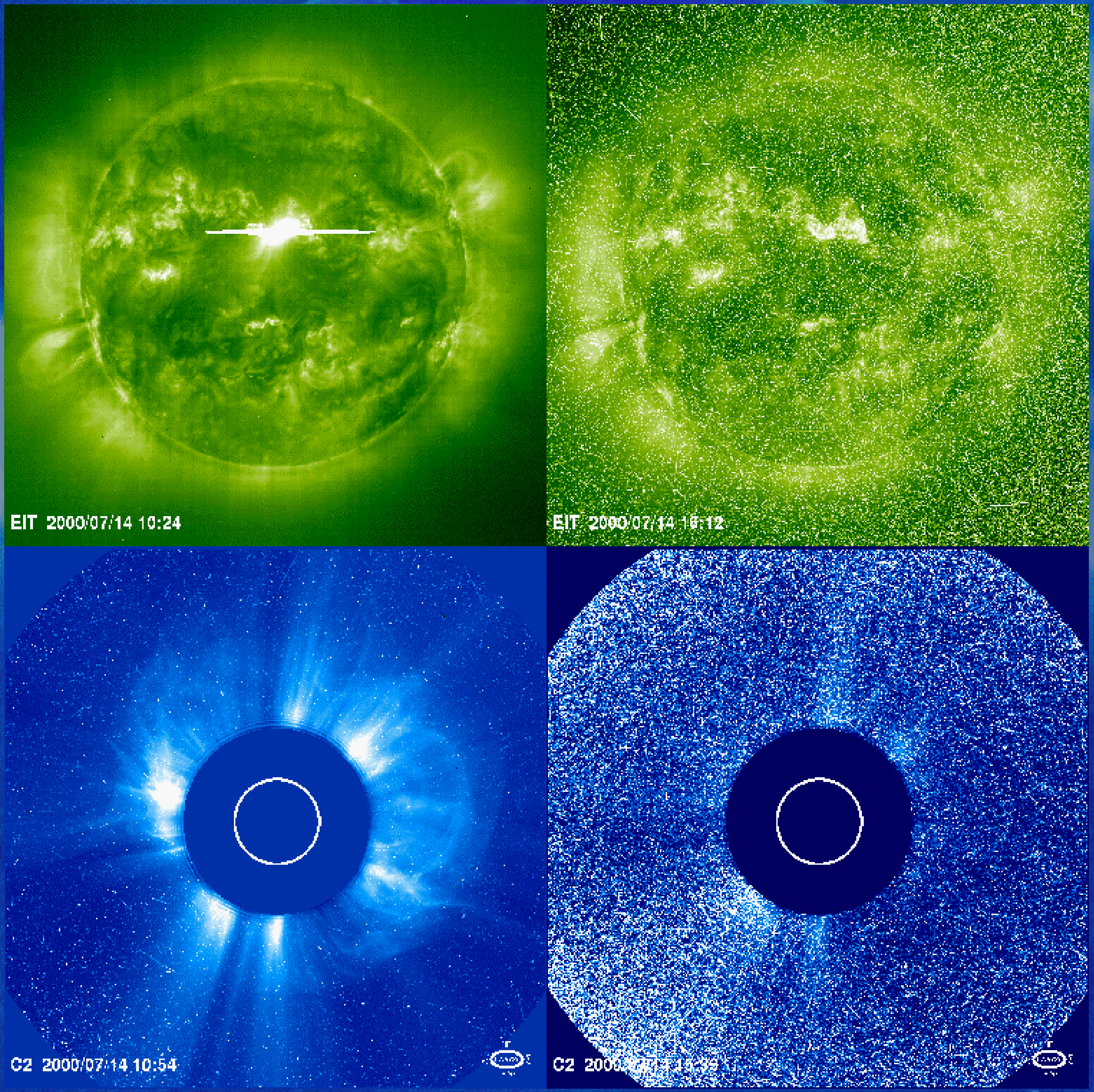
IMPACT Space Weather:

lessons from ACE



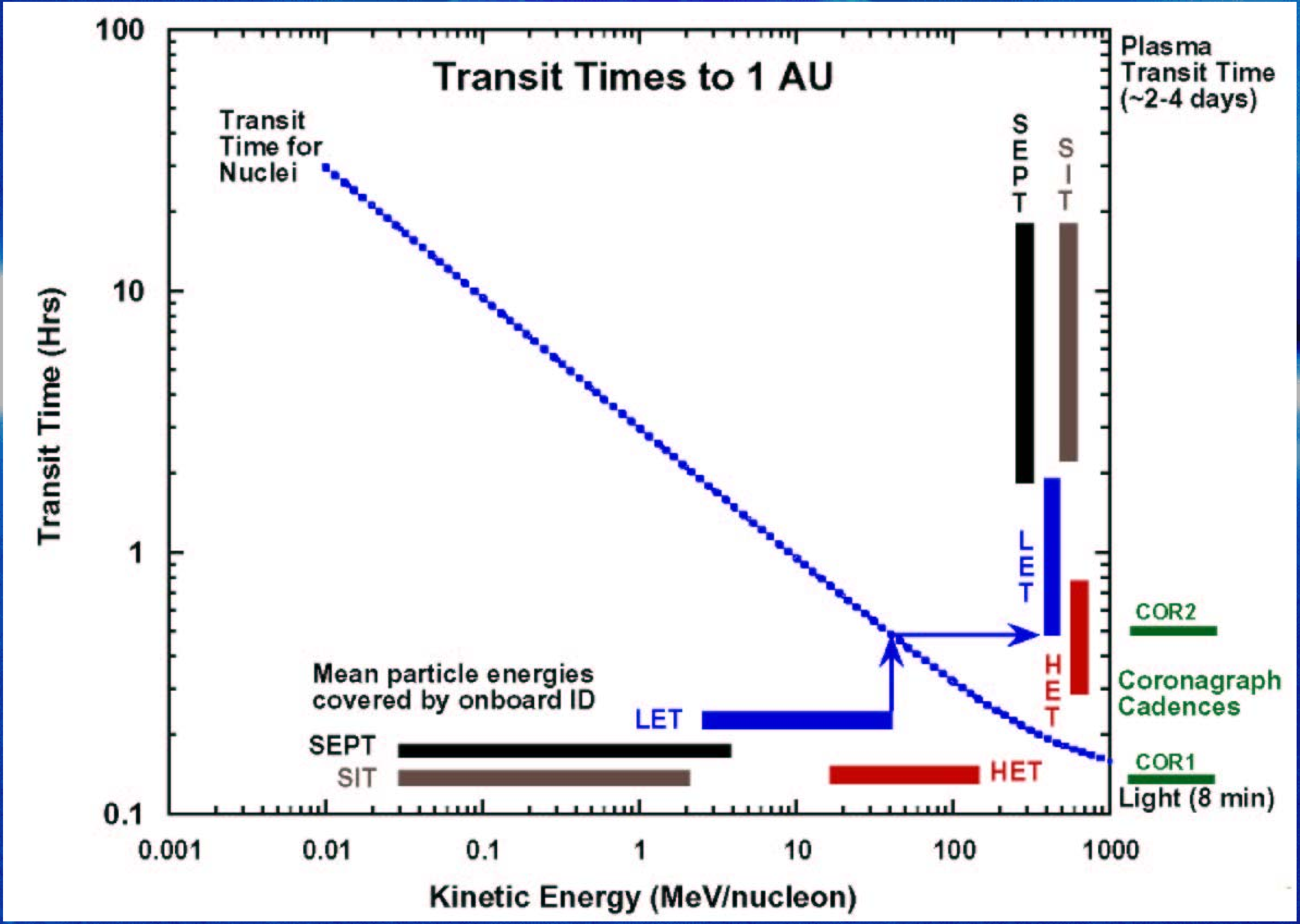
(examples from ACE Real Time Space Weather data user websites)

Imagers can detect SEPs but…

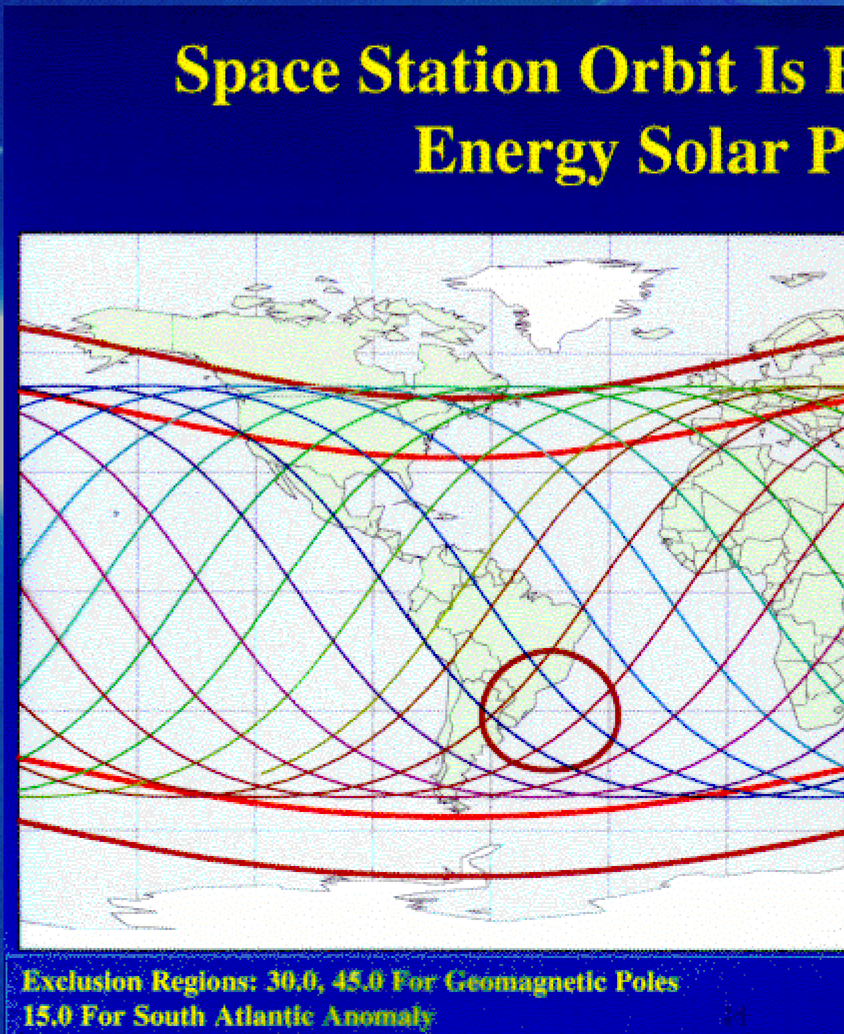


… the information is limited. *(images from SOHO, EIT and LASCO)*

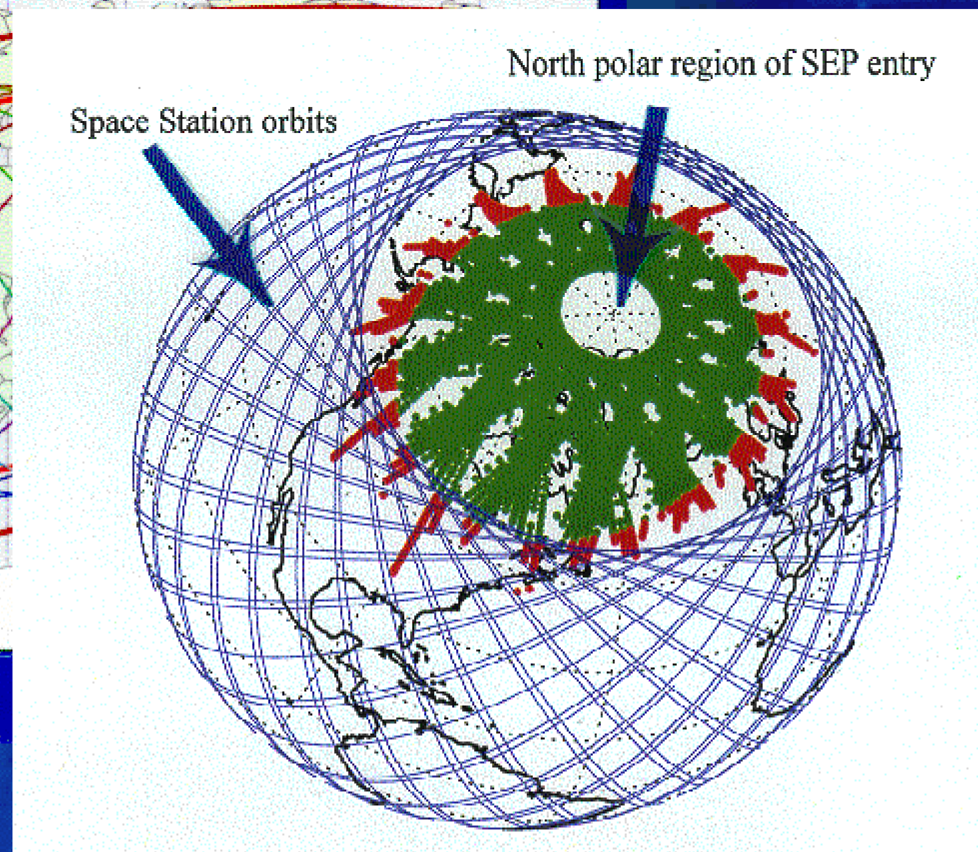
IMPACT SEPs give advance warning of an approaching ICME shock



SEP Hazard Predictions Depend on both: Polar Cap Size and SEP Fluxes

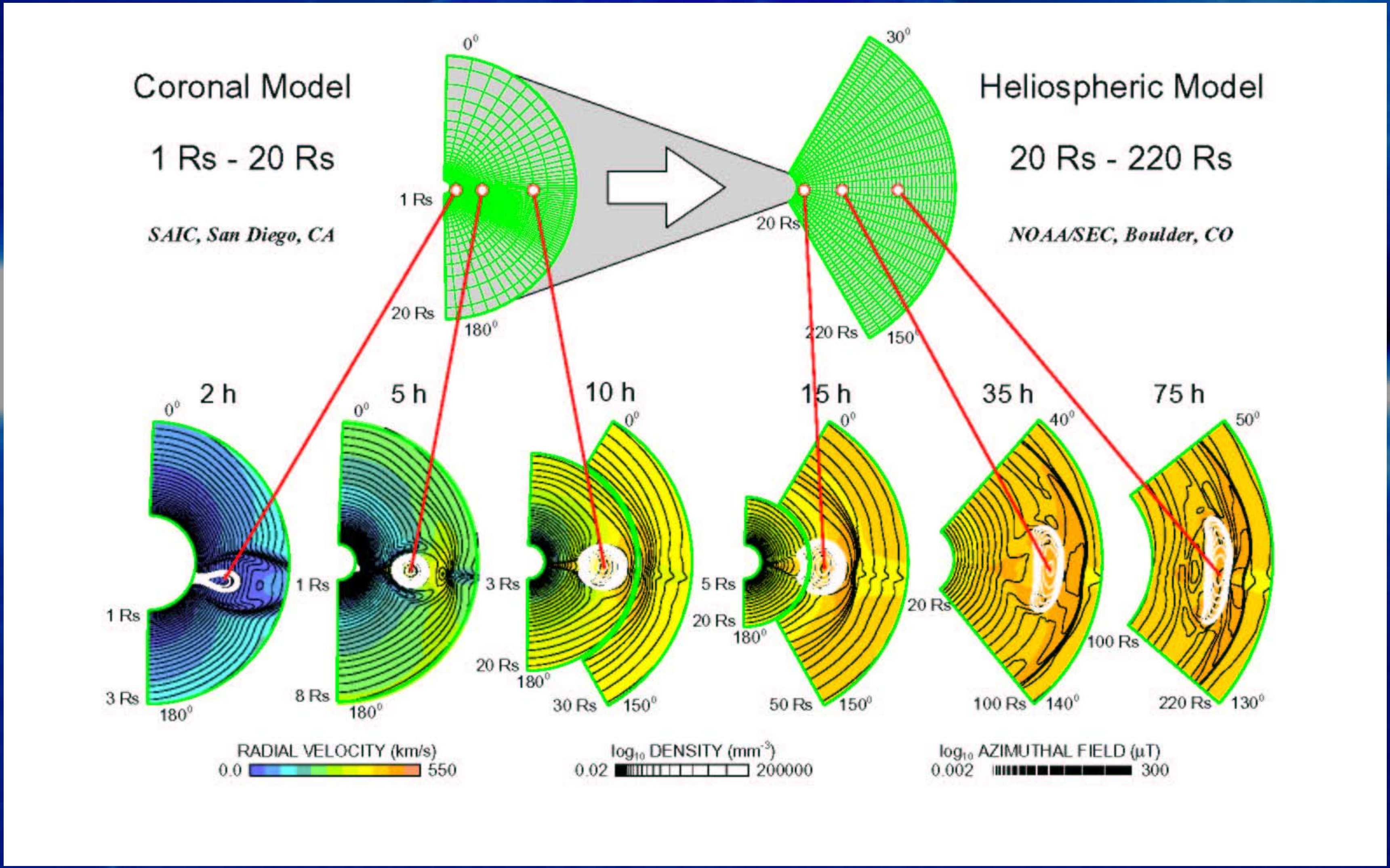


From R. Turner et al. Report on SEP Hazards, 1996



July 14, 2000 SEP event detected at SAMPEX (*figure from R. Leske, Caltech*)

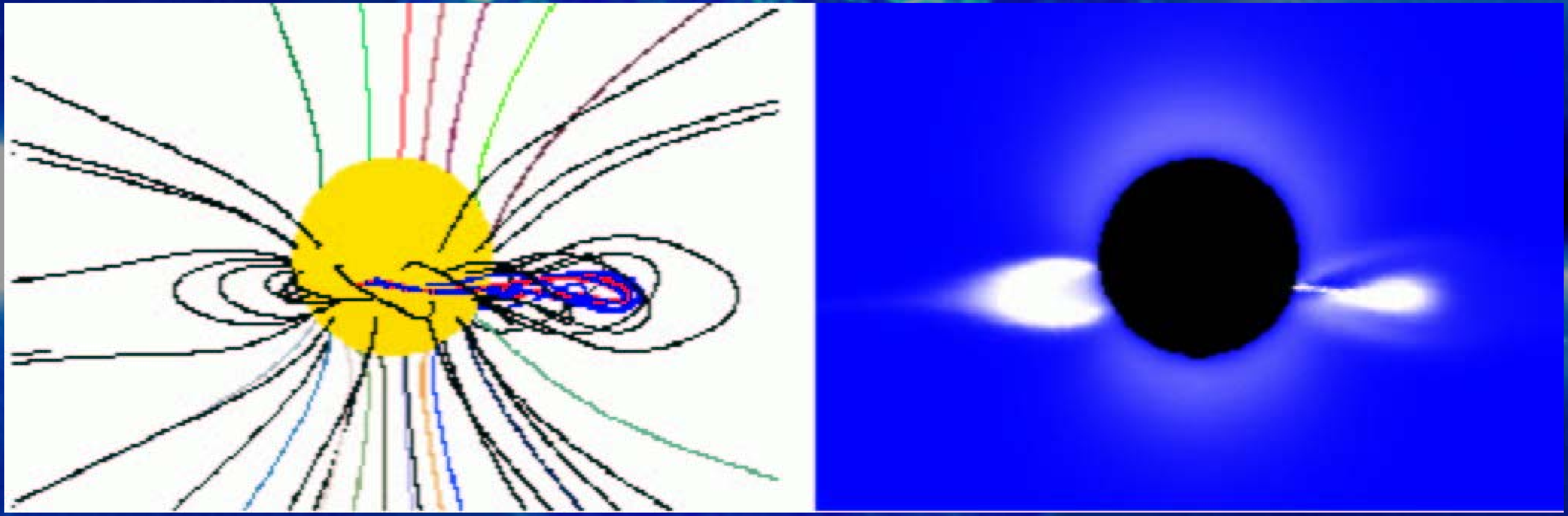
IMPACT Team Modeling



...will be critical for interpreting the solar activity connection.

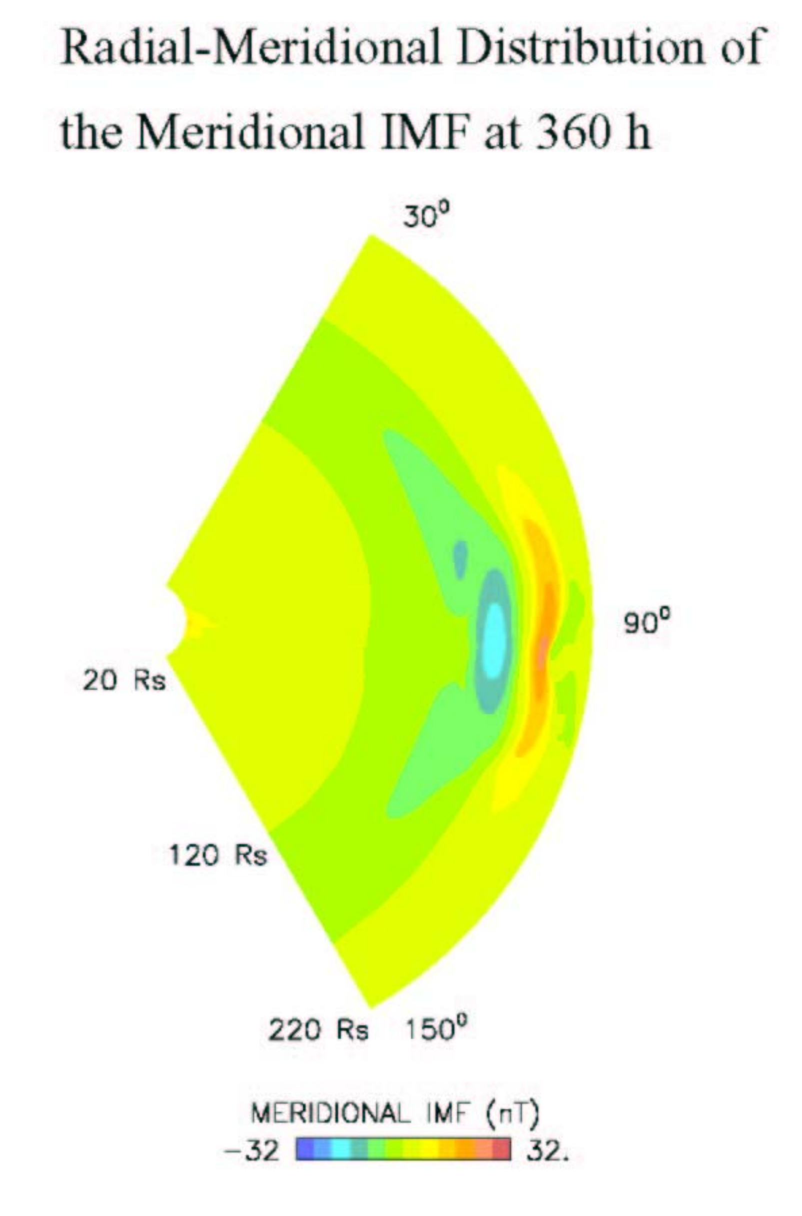
(figure courtesy of Dusan Odstrcil from work supported by NSF Space Weather Program)

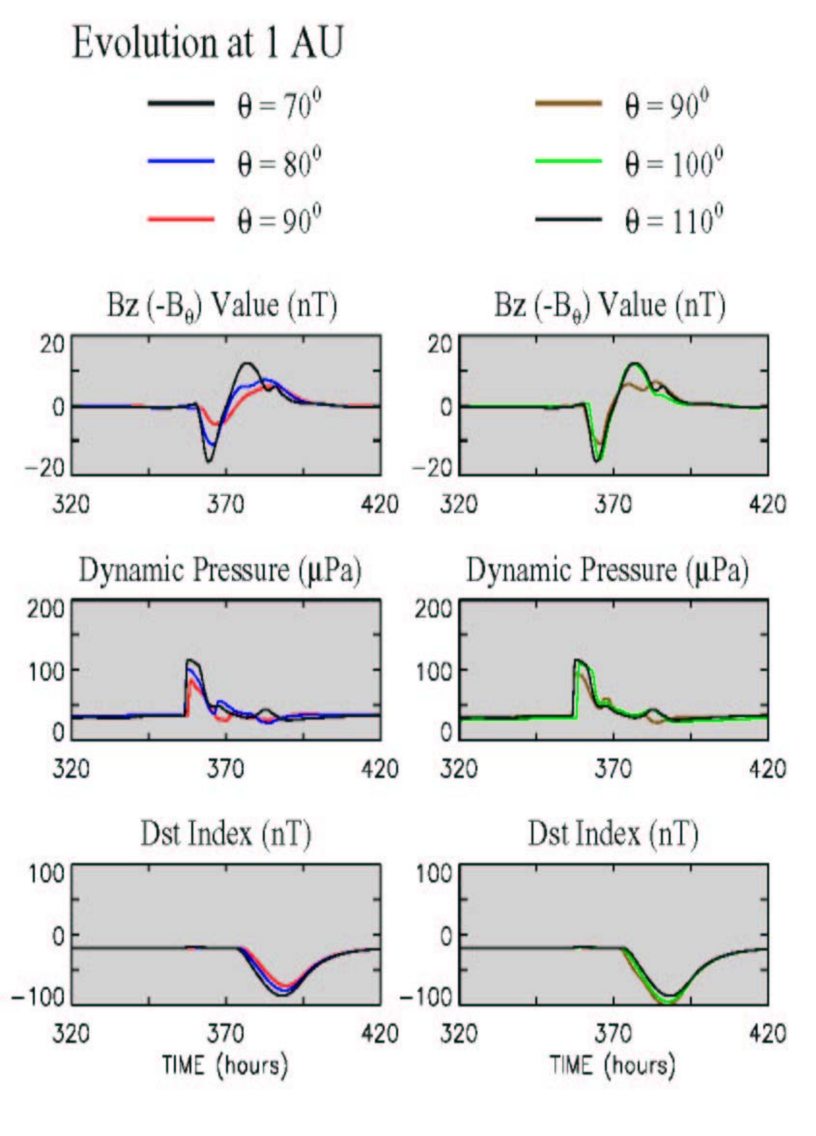
Models can simulate both solar signatures:



(Results from the SAIC coronal model, figure courtesy of Jon Linker. Figure adapted from Linker and Mikik, SAIC, San Diego, CA)

…as well as in-situ (1 AU) signatures:





(figures courtesy of Dusan Odstrcil from work supported by NSF Space Weather Program)

Science with IMPACT