



STEREO PLASTIC

The Plasma and Supra -Thermal Ion Composition Experiment

K.D.C. Simunac
University of New Hampshire
May 2007 NESSC Meeting

STEREO Orbit

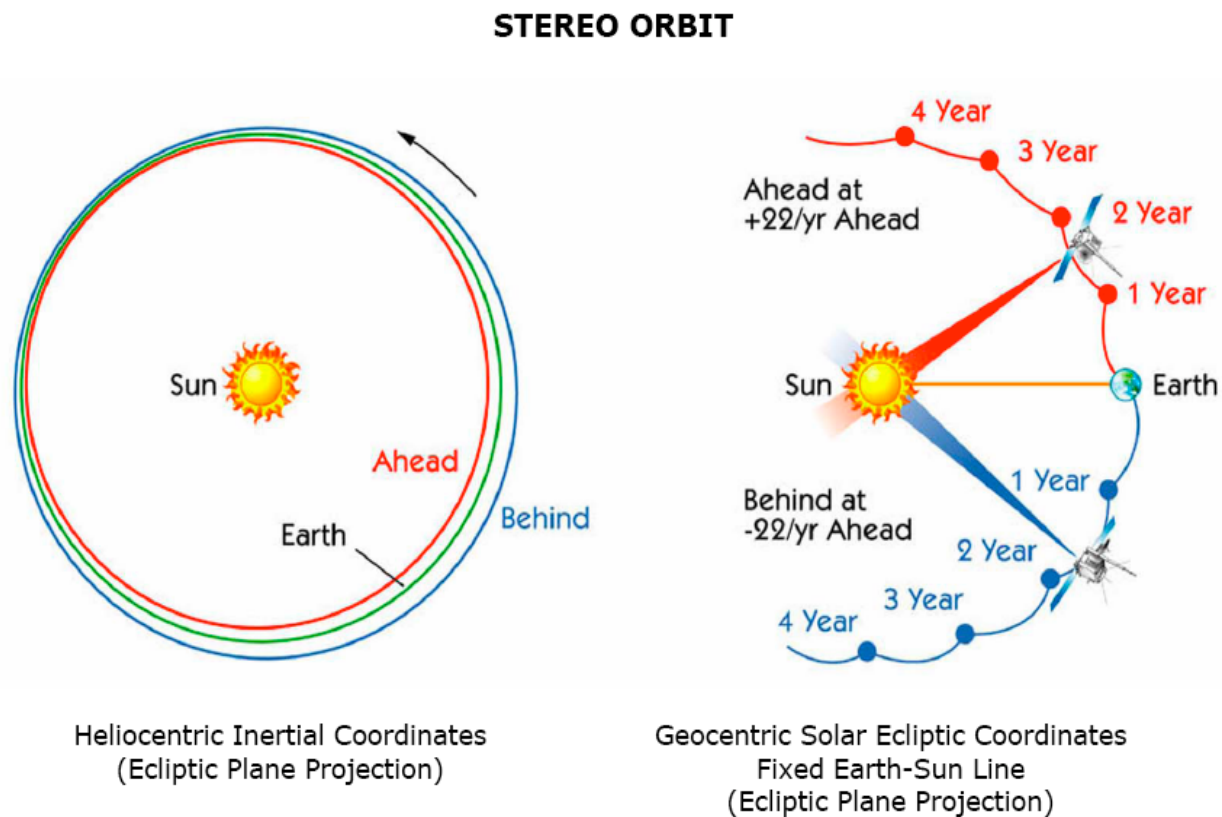
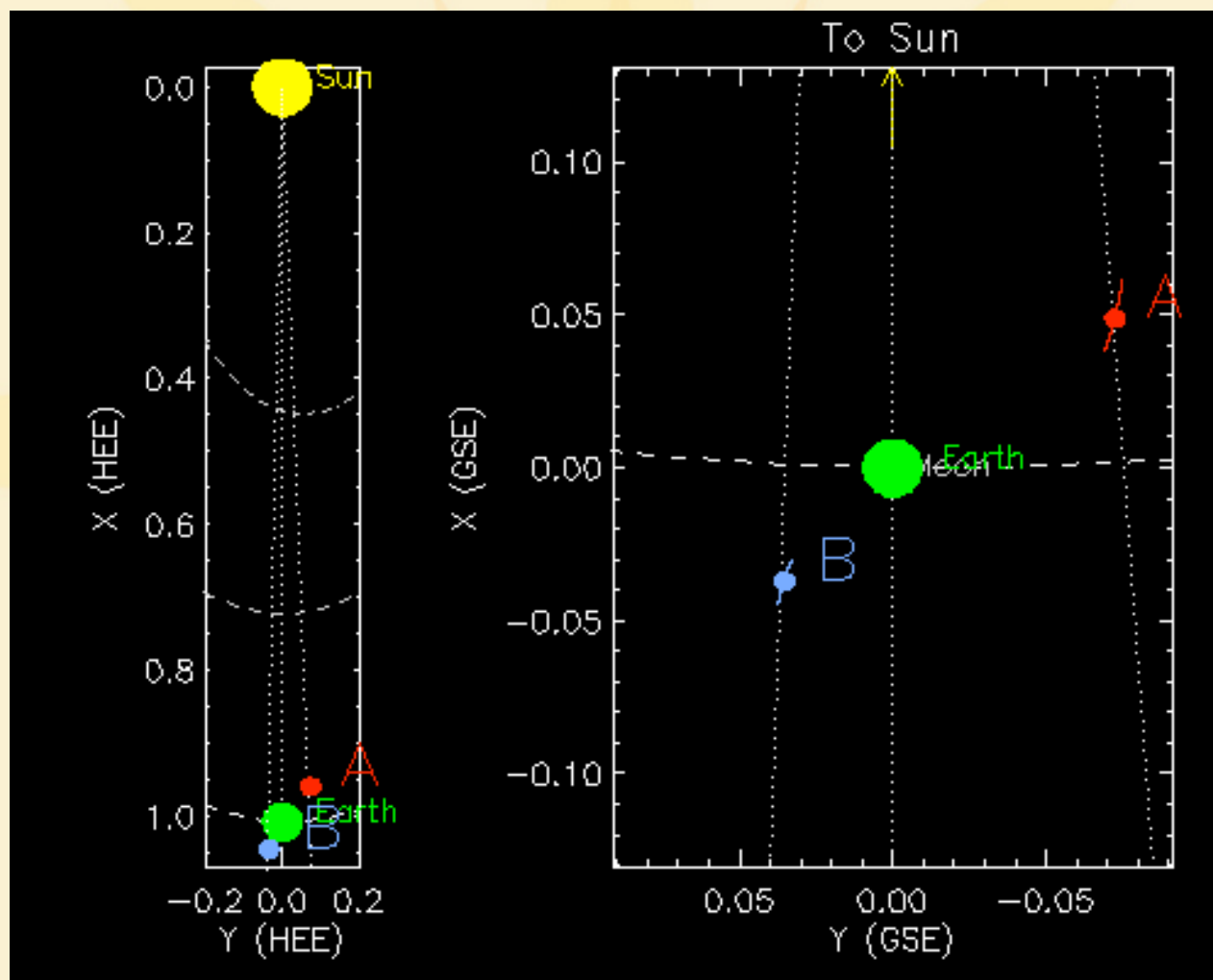


Image from the “STEREO booklet”, available from <http://stereo.gsfc.nasa.gov>

Where is STEREO today?

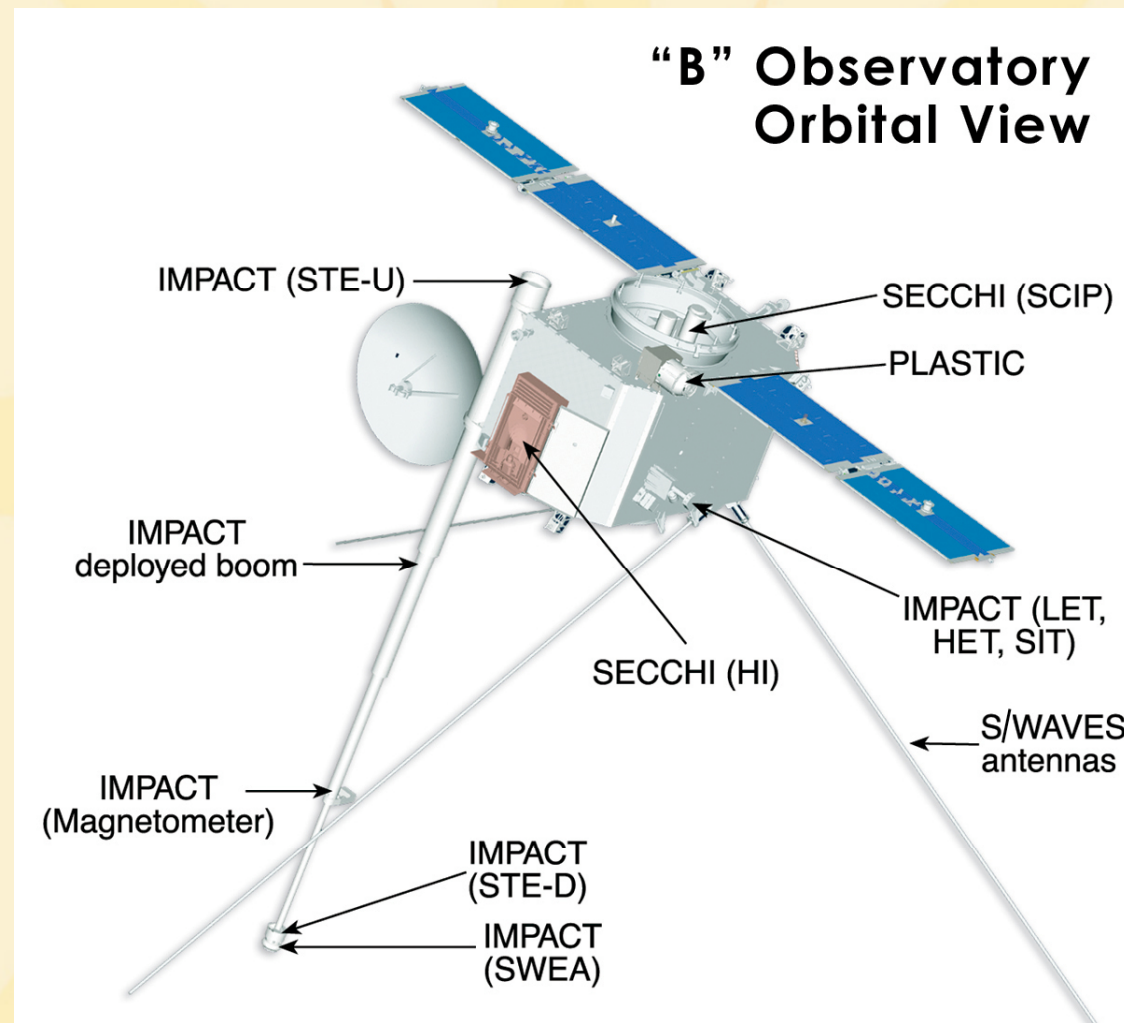


<http://stereo-ssc.nascom.nasa.gov/where/>

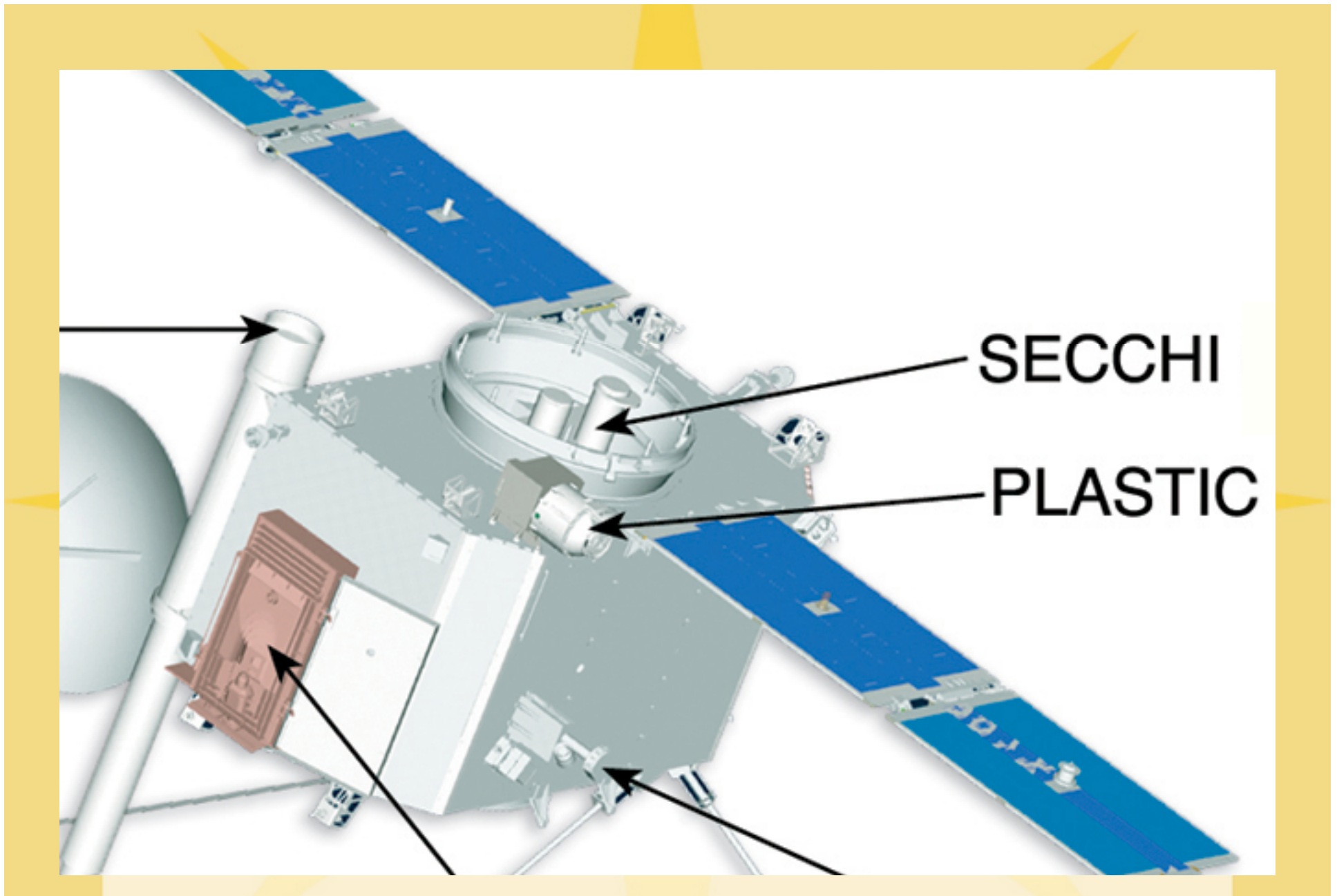
STEREO Instruments

- **SECCHI** Dr. Russell Howard (NRL)
solar and heliospheric imagers
- **IMPACT** Dr. Janet G. Luhmann (UC Berkeley)
electrons, energetic particles, and *in situ*
magnetic field
- **S/WAVES** Dr. Jean Louis H. Bougeret (Paris
Observatory) and Michael Kaiser (NASA GSFC)
radio burst tracker
- **PLASTIC** Dr. Antoinette Galvin (UNH)
solar wind plasma and supra-thermal ions

Instrument Placement



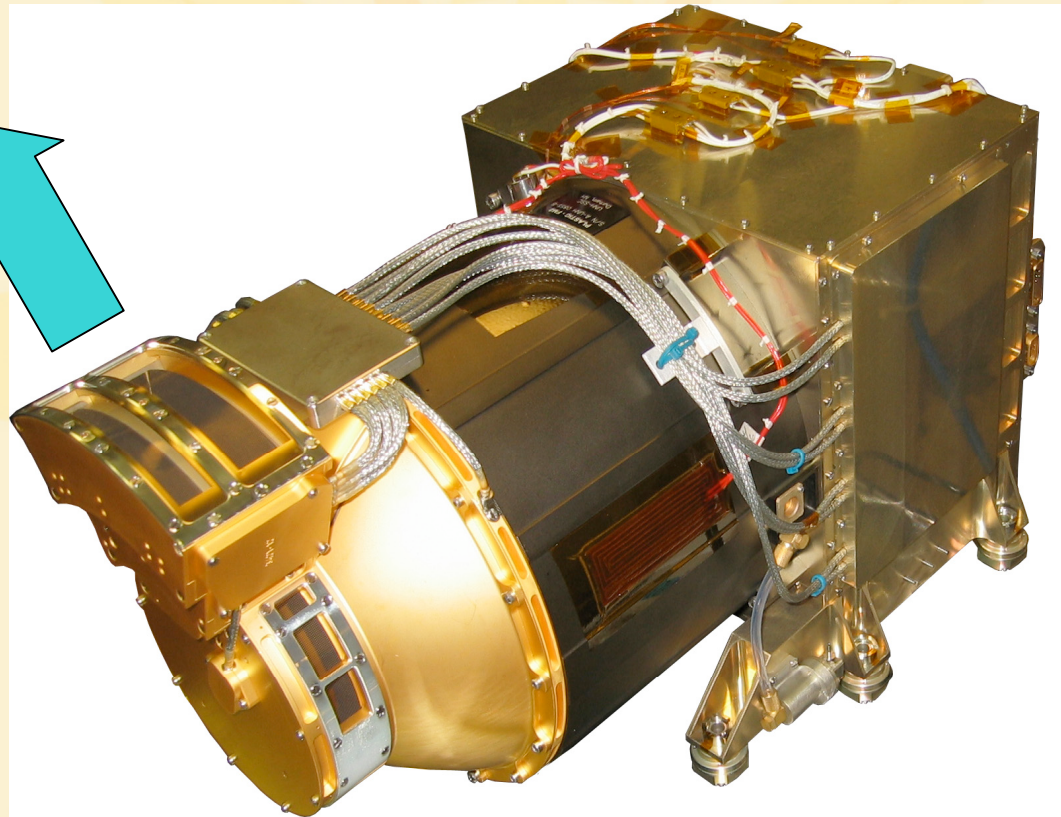
<http://stereo.jhuapl.edu/gallery/images/artistConcepts/pages/stereodiagram.php>



<http://stereo.jhuapl.edu/gallery/images/artistConcepts/pages/stereodiagram.php>

PLASTIC

to sun

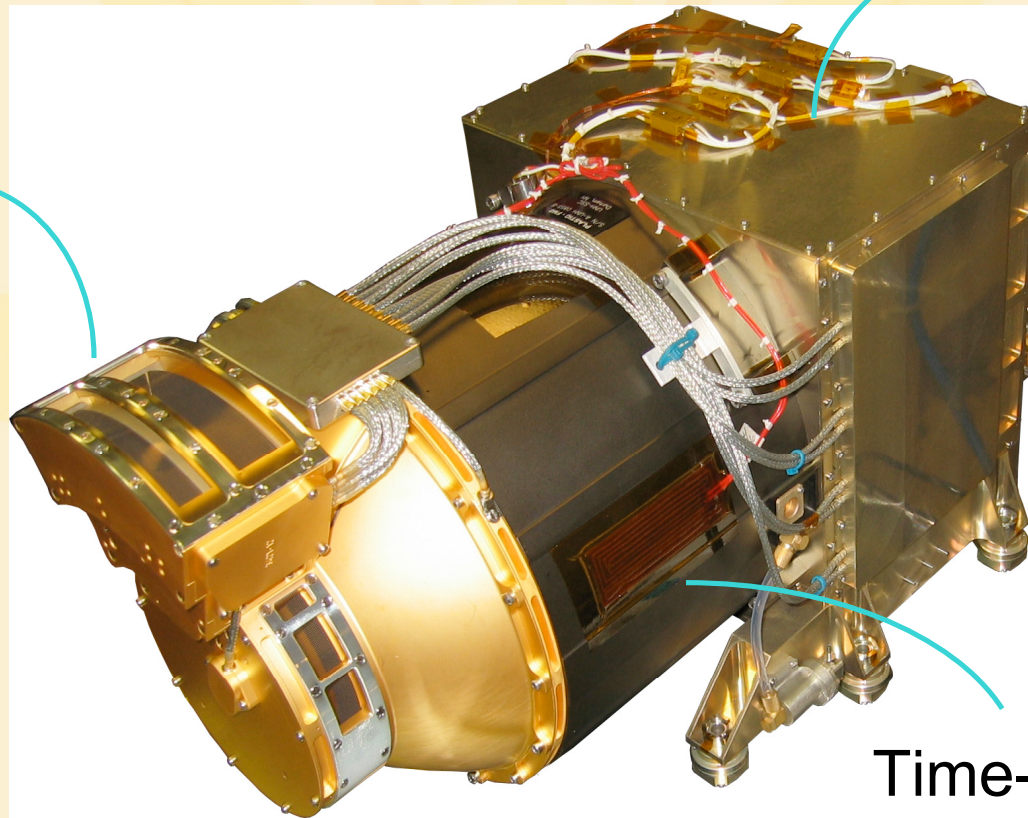


http://stereo.sr.unh.edu/gallery/imgs/instrumentation/FM1_clean_no_strap.jpg

PLASTIC

Entrance
System

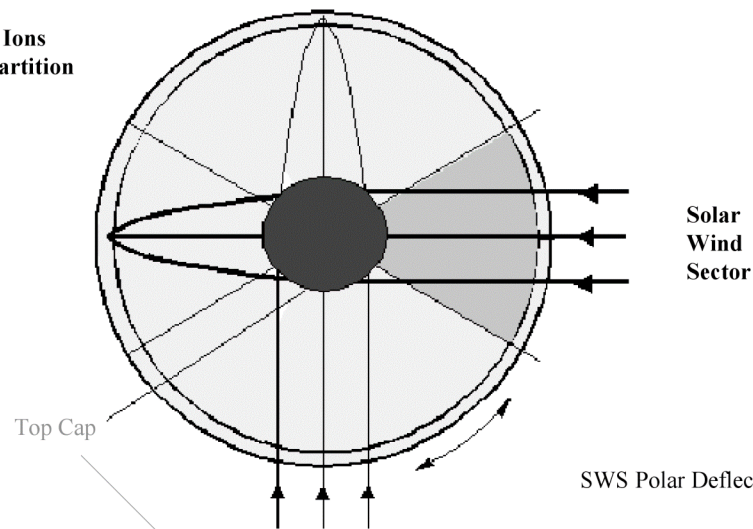
Electronics
Box



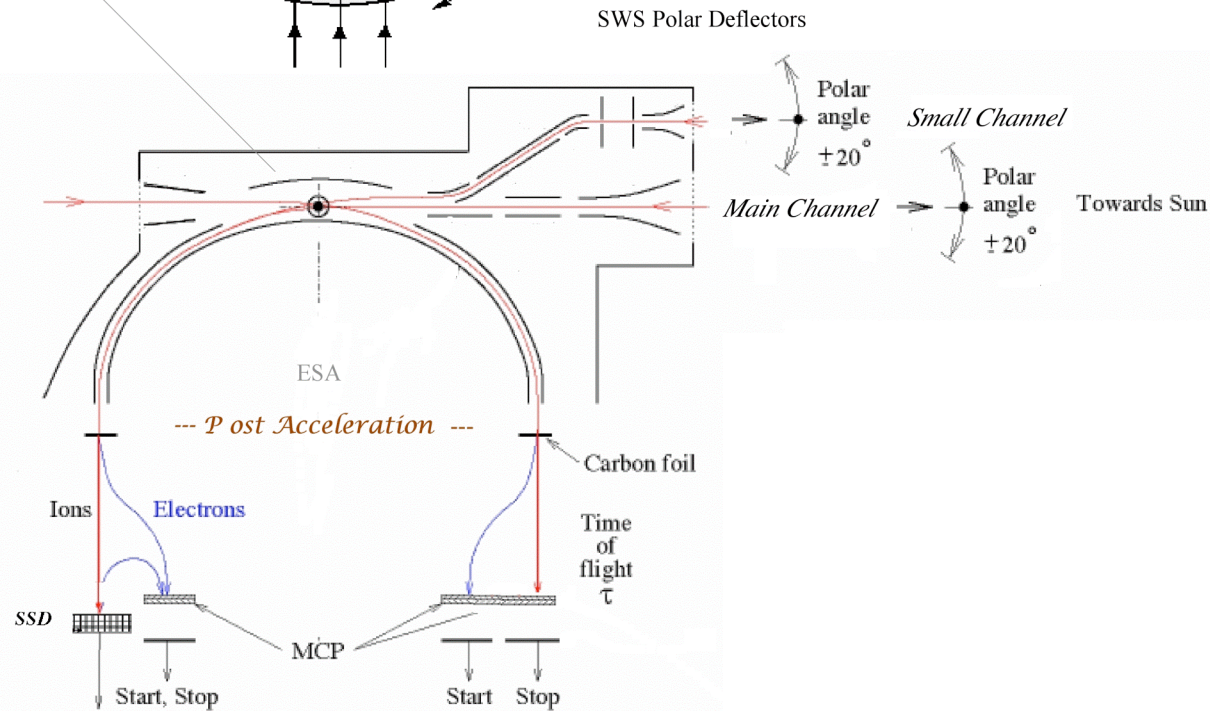
Time-of-Flight
Chamber

http://stereo.sr.unh.edu/gallery/imgs/instrumentation/FM1_clean_no_strap.jpg

Suprathermal Ions
Wide-Angle-Partition



PLASTIC Schematic Cross Sections

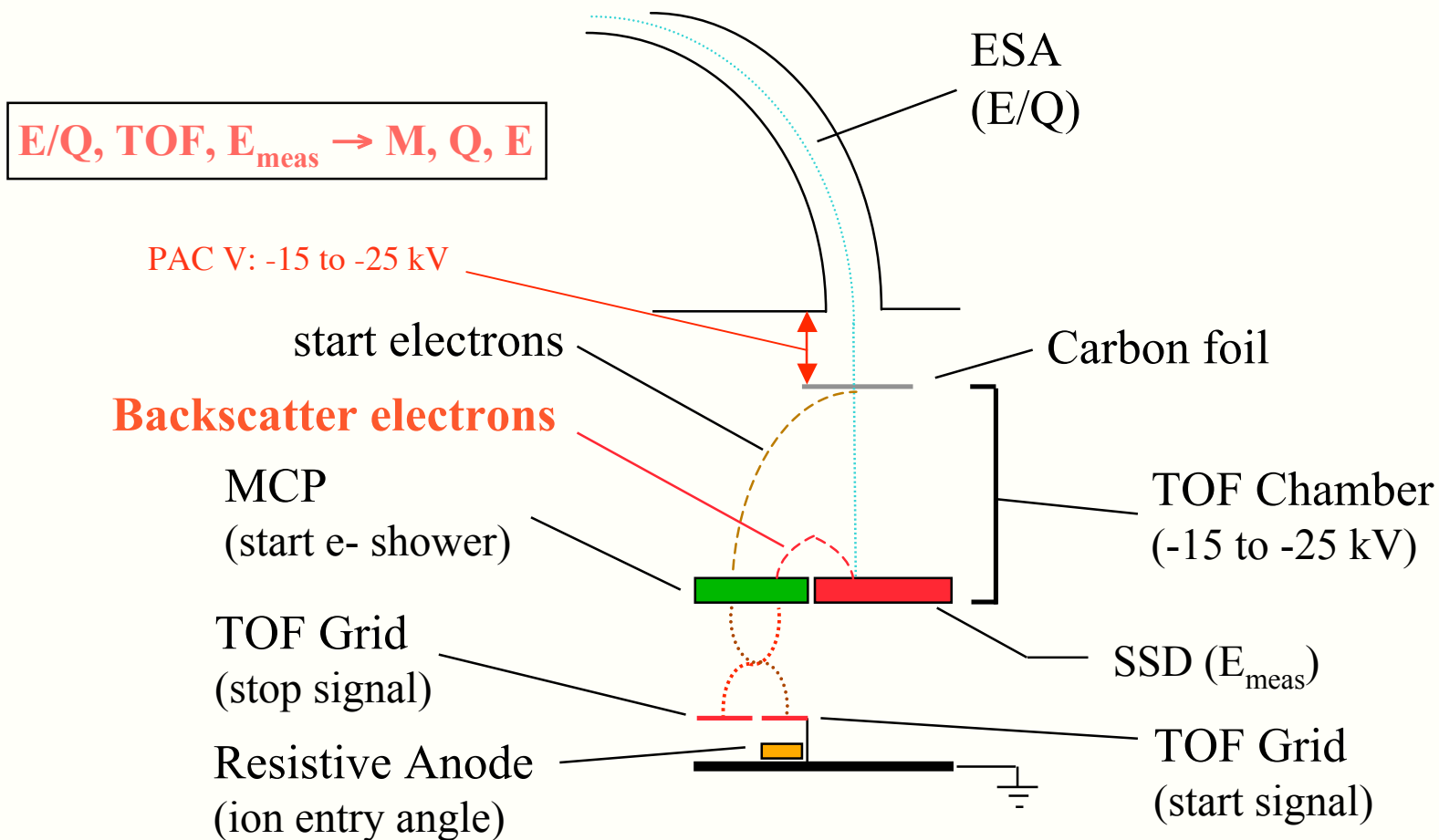


Slide courtesy of Toni Galvin

What do we measure?

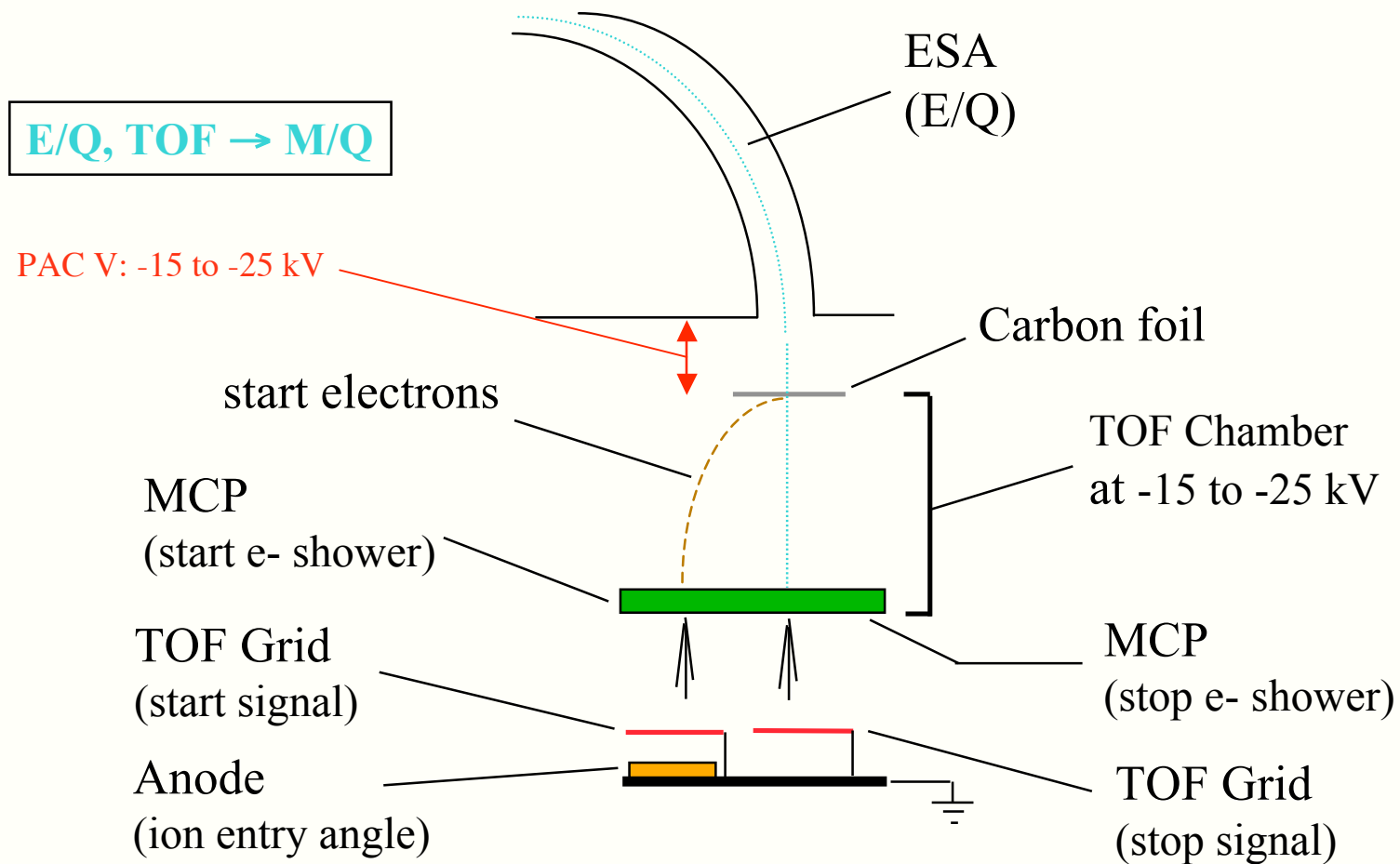
- Count rate
- Energy per Charge
- Time of Flight
- Incident Azimuth Angle (in-ecliptic)
- Incident Solar Wind Deflection Angle (out-of-ecliptic)
- Residual Energy (SSD Side only)

SSD Side



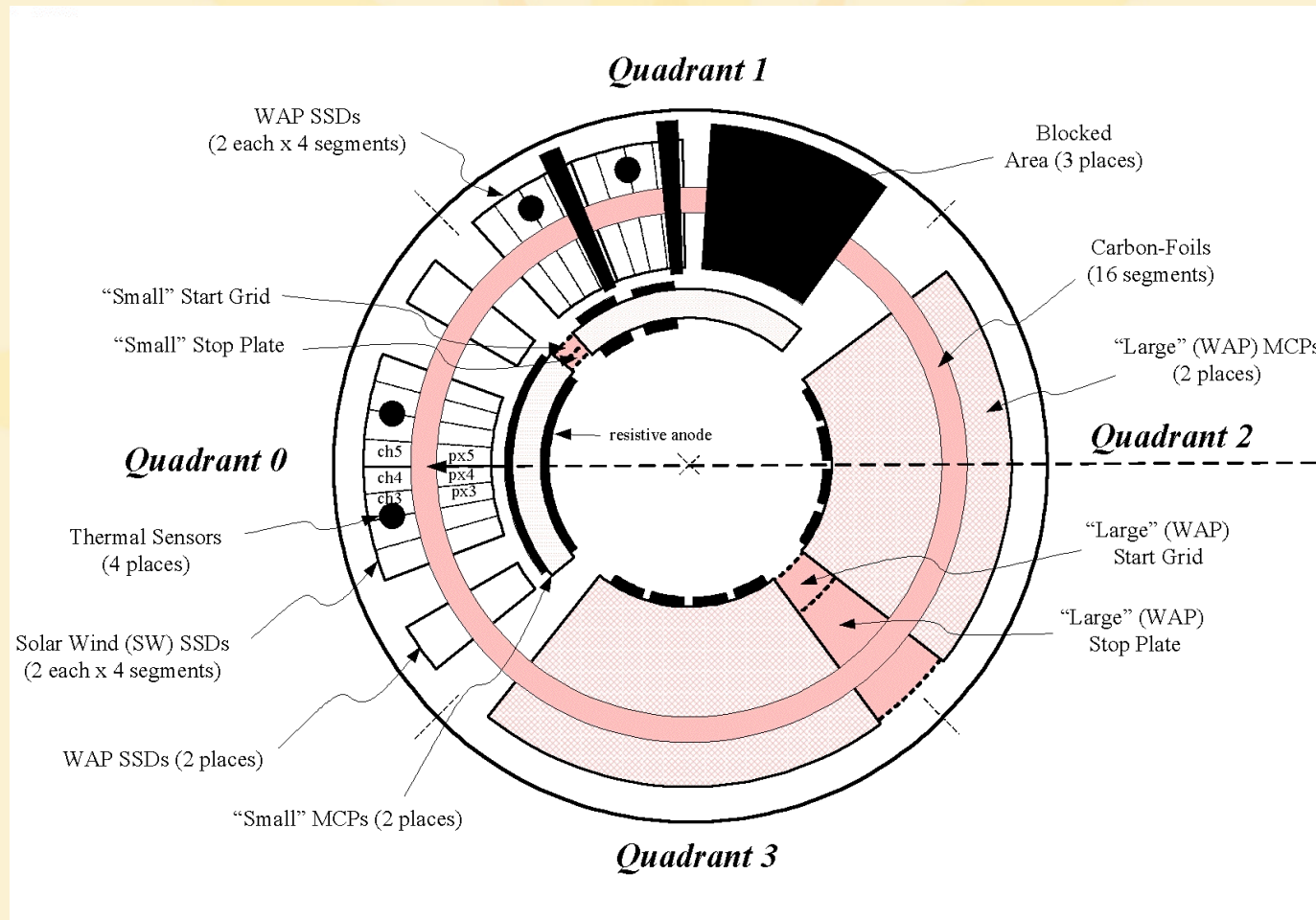
Slide courtesy of Mark Popecki

Non-SSD Side



Slide courtesy of Mark Popecki

Signal Board Sectors



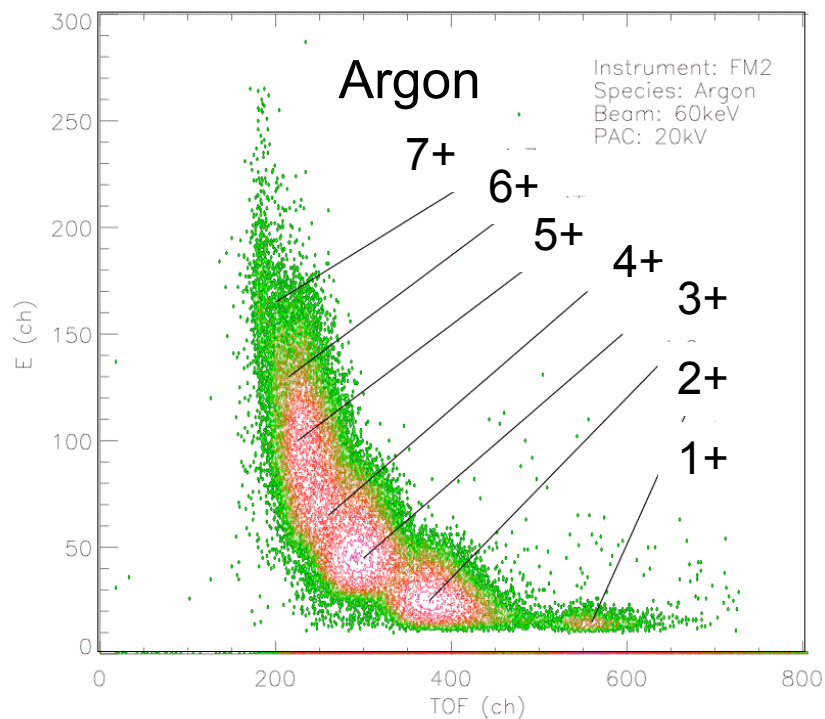
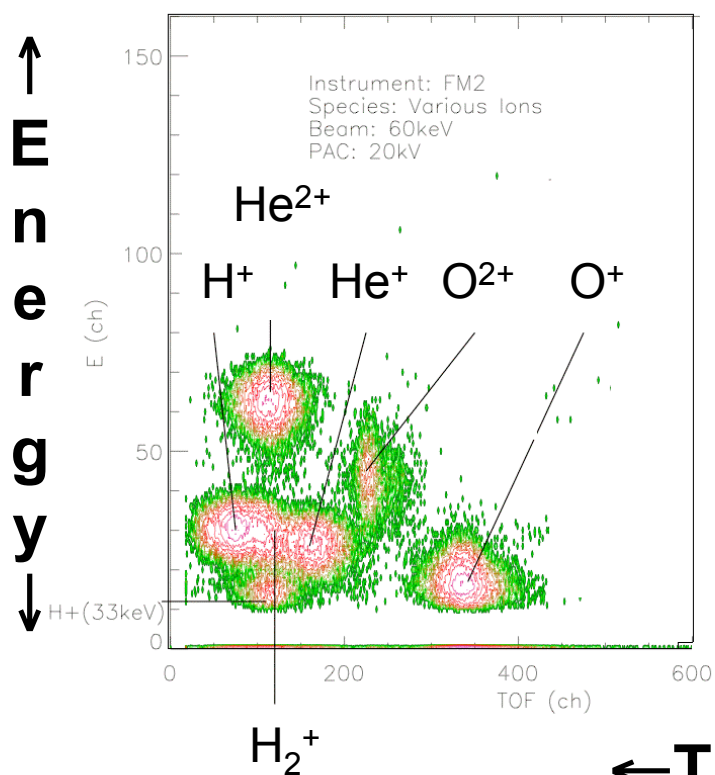
Slide courtesy of Toni Galvin

What we have $\Rightarrow$ What we want

- Energy per Charge
 - Time of Flight
 - Combine these to get mass/charge and energy/charge
 - Residual Energy (SSD Side)
 - Separate mass and charge if energy exceeds detector threshold
 - Count Rates
 - Angle Information
- Species
 - Charge State
 - Bulk Properties
 - Density
 - Velocity
 - Temperature

Prelaunch Calibrations - taken at CASYMS facility (U Bern)

Plots provided by Jay Carroll and Andrew Gustafson



←Time-of-Flight→

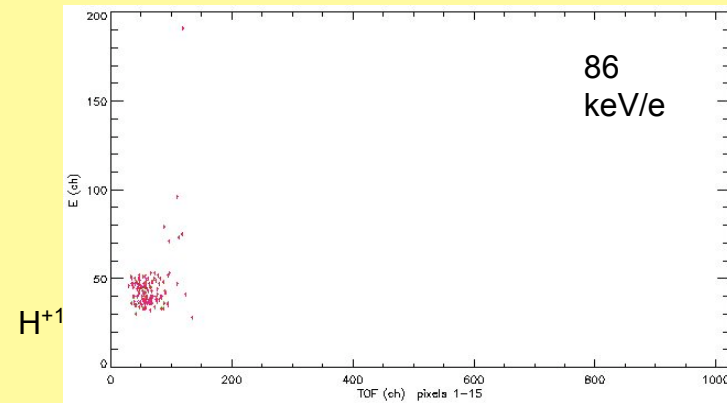
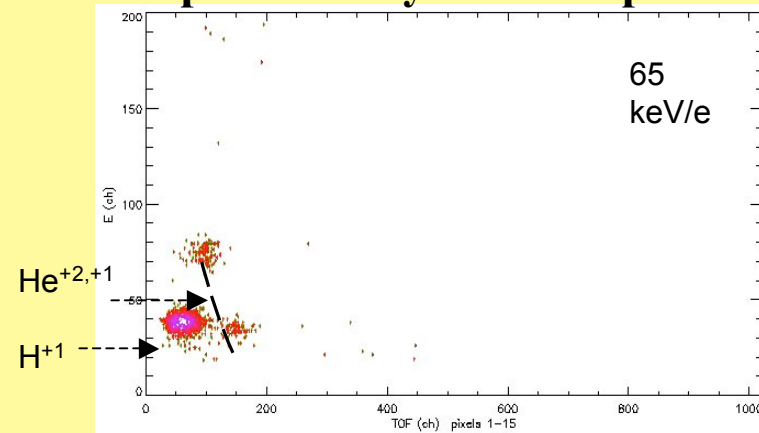
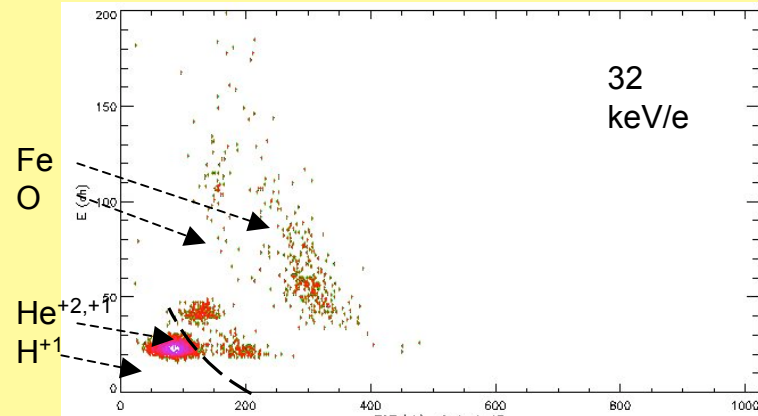
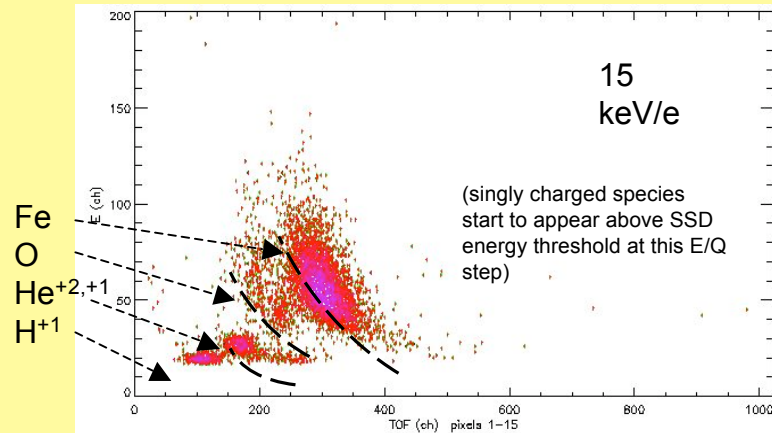
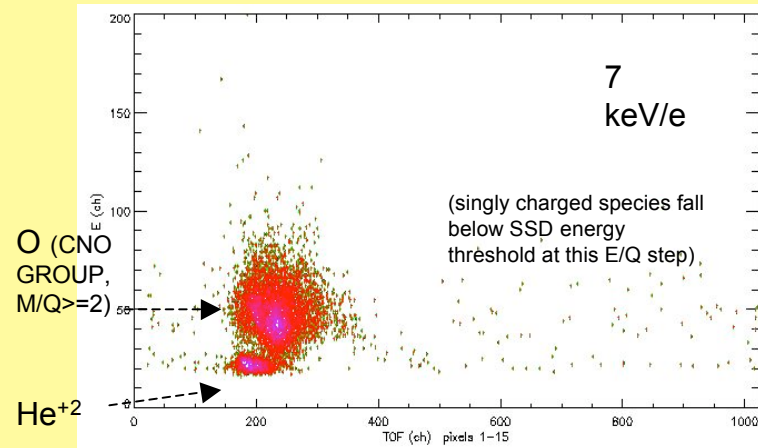
Slide courtesy of Toni Galvin

STEREO A Limited Entrance System Test

Dec 8, 2006

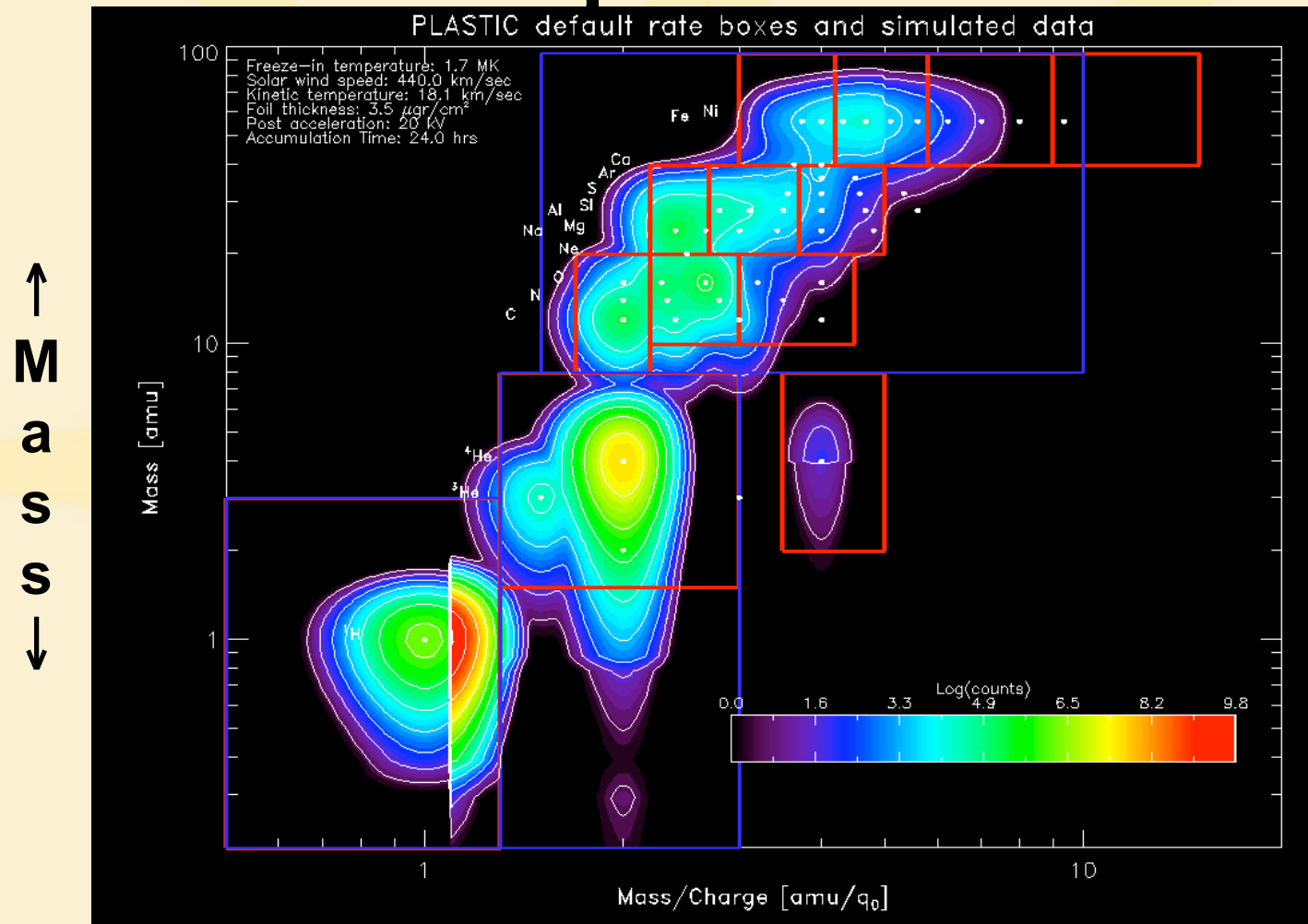
Static Voltage Test on ESA (E/Q) Energy vs Time-of-Flight

Species Identification Verification
Plots provided by Mark Popecki



Slide courtesy of Toni Galvin.

Solar Wind Species Classification

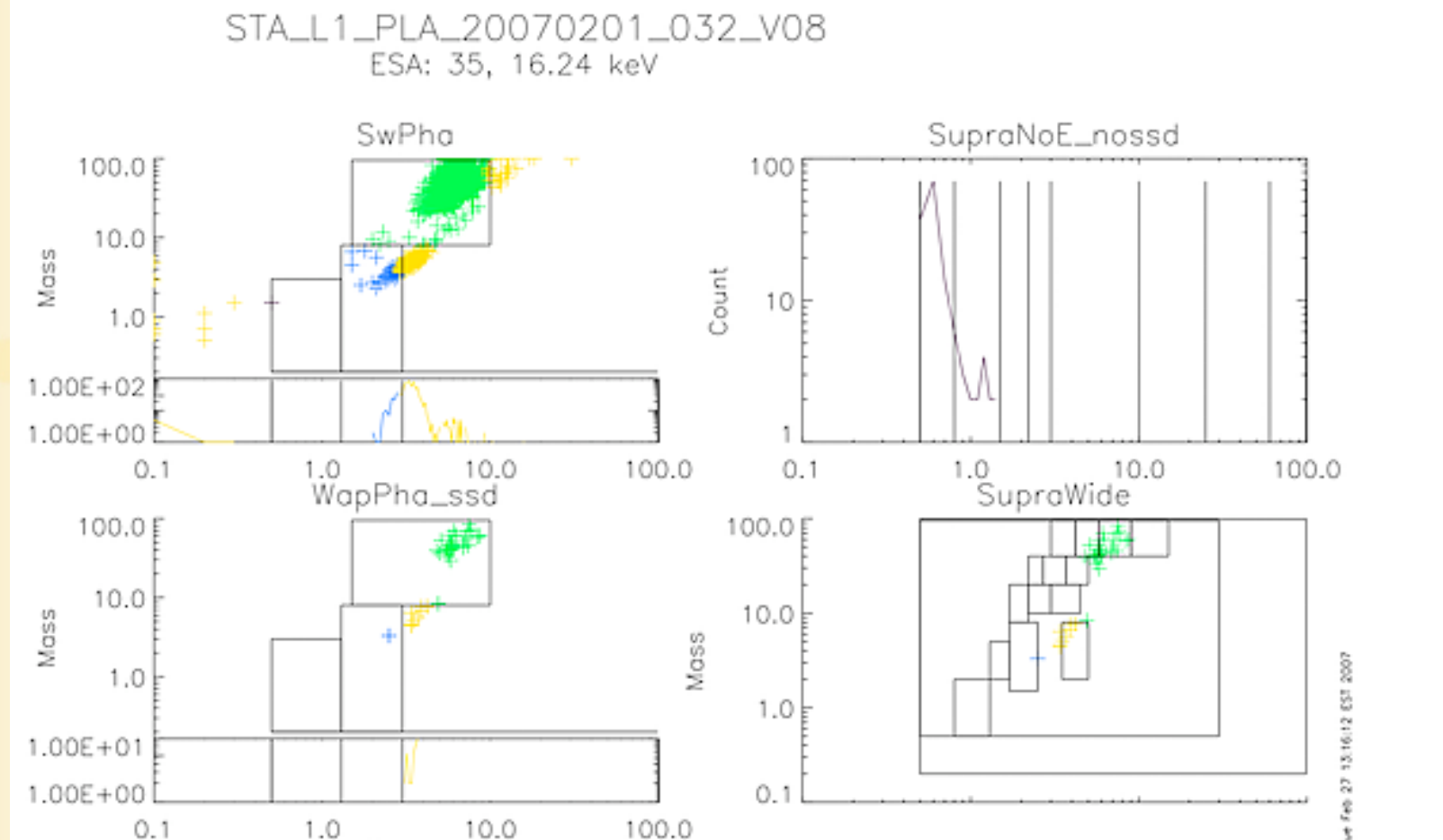


←Mass per Charge→

24 Hours of Simulated Data

Real Data

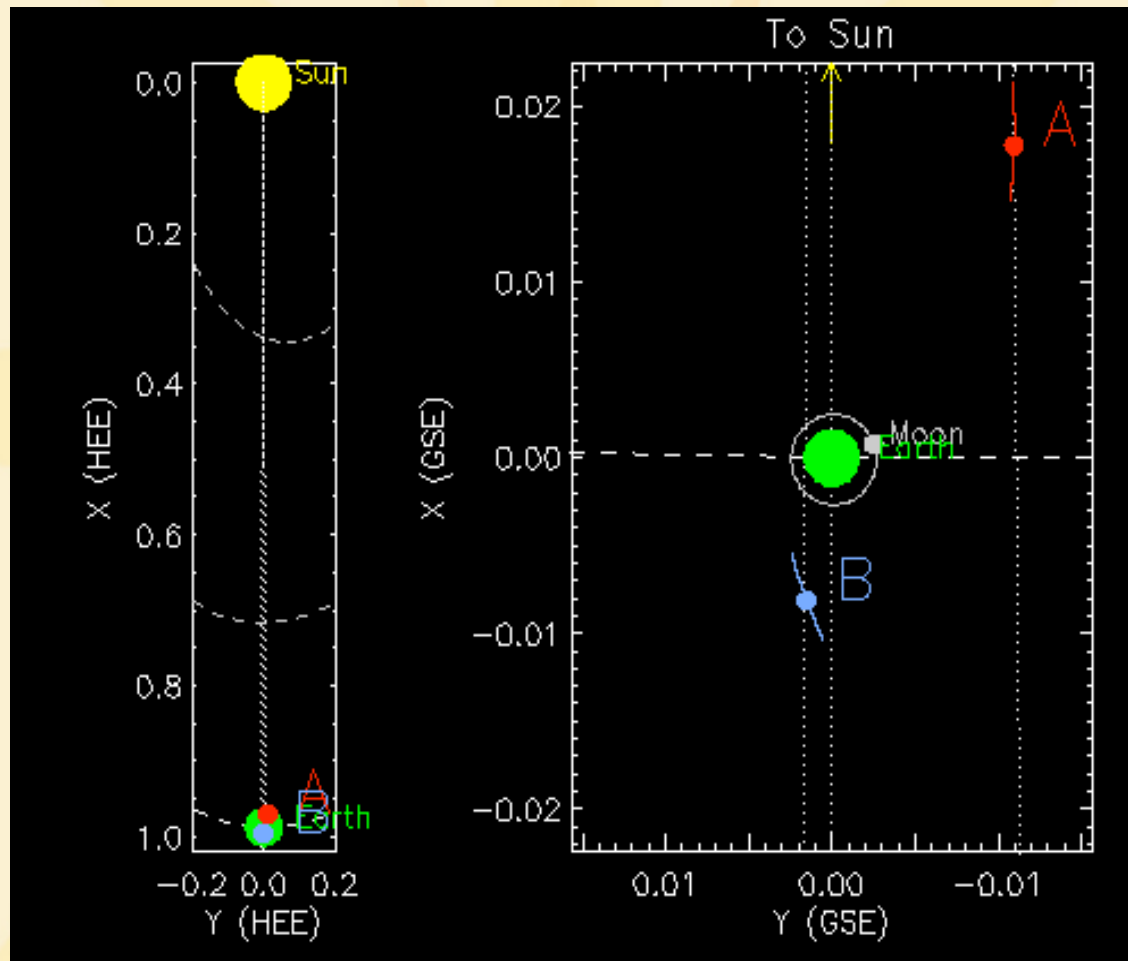
↑
M
a
s
↓



Bulk Properties of Protons

- Raw count rates give insight into trends over time
- The distribution of counts in energy and space can be fit to a distribution function, and velocity moments can be calculated including density, bulk speed, and temperature

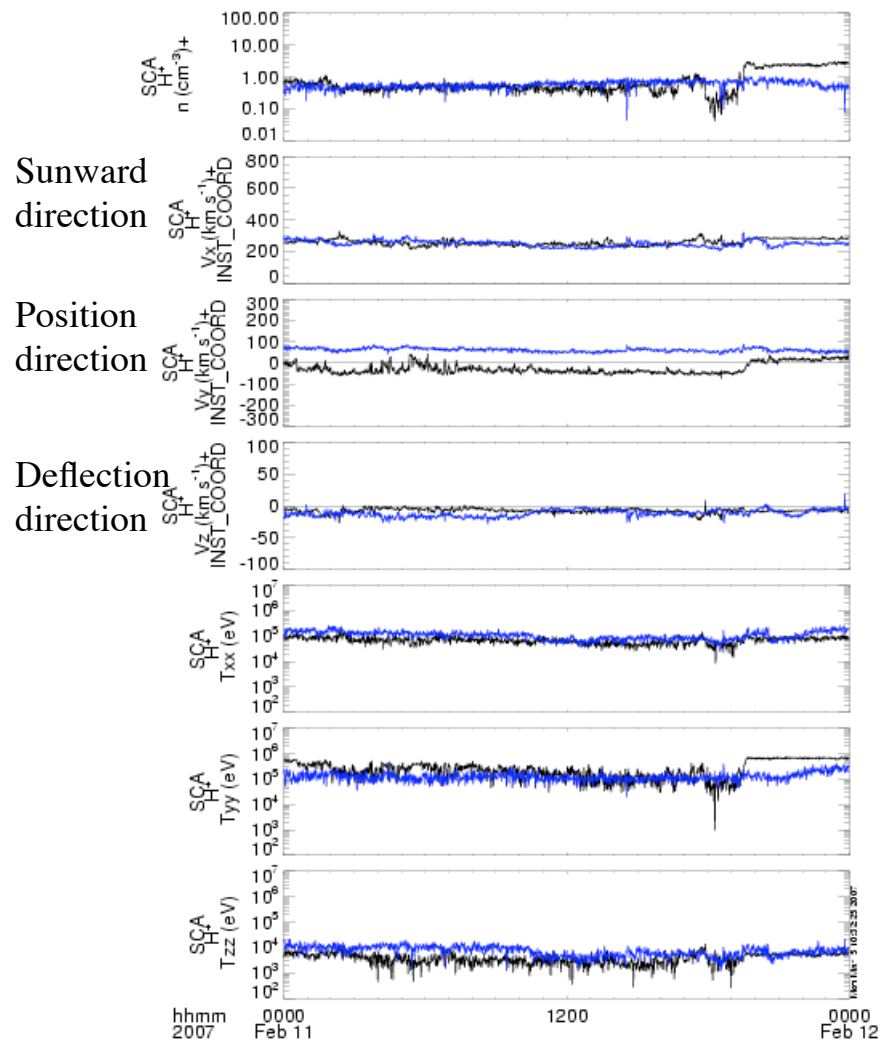
12 February, 2007



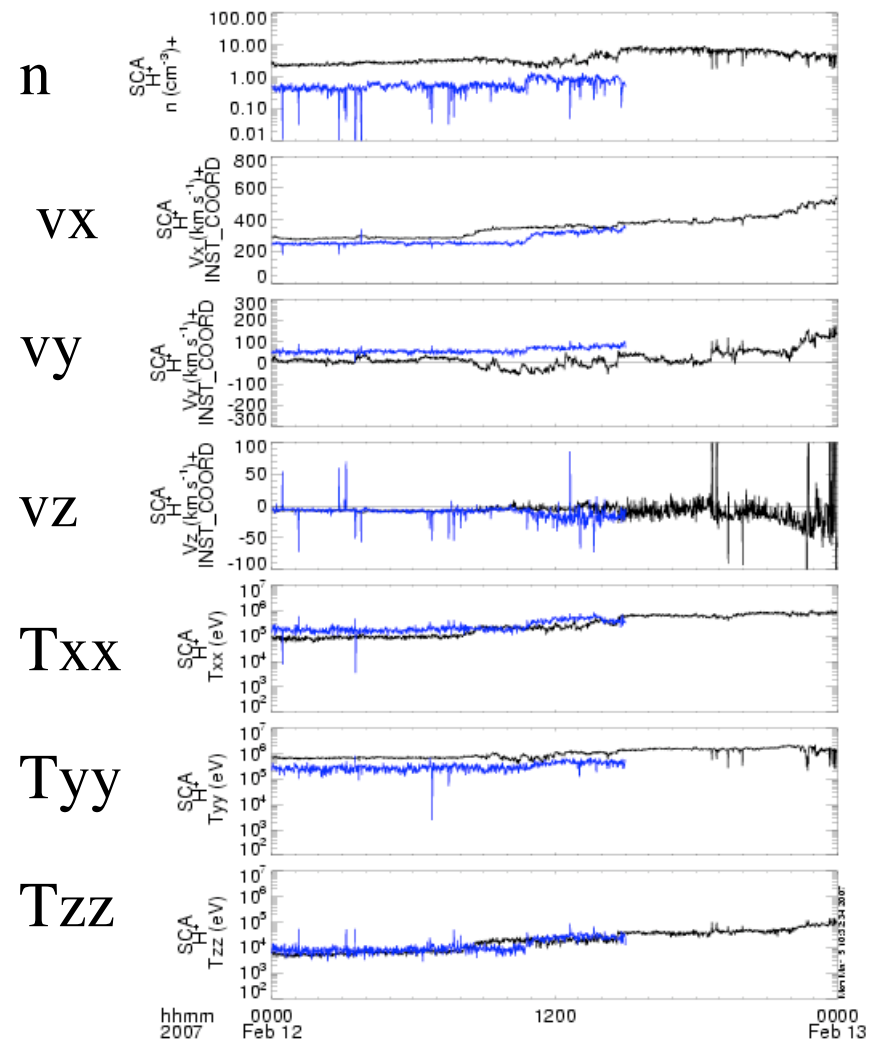
A - black

B - blue

On-board moments



Feb 11



Feb 12

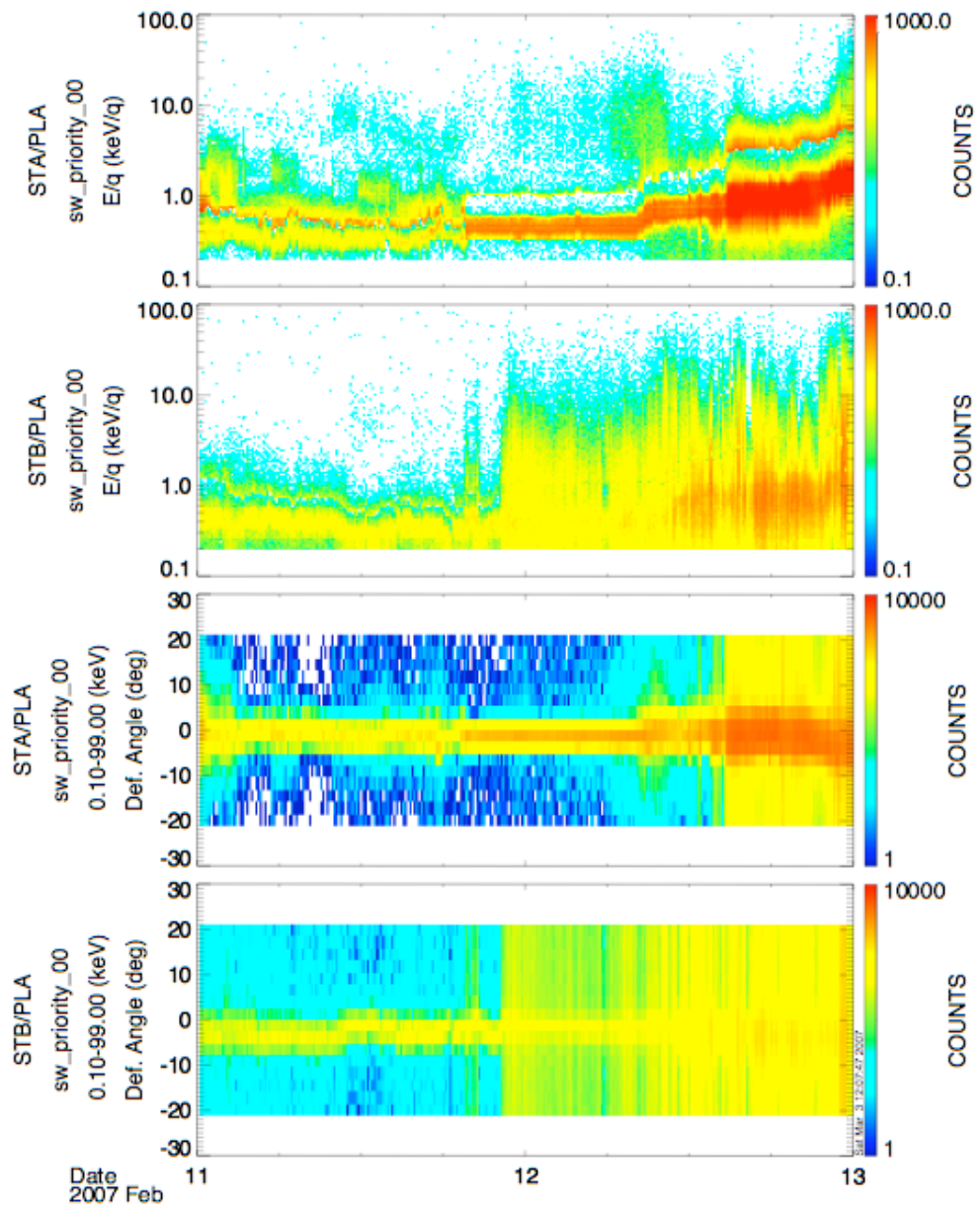
Slide courtesy of Lynn Kistler

SC/A Energy spec

SC/B Energy spec

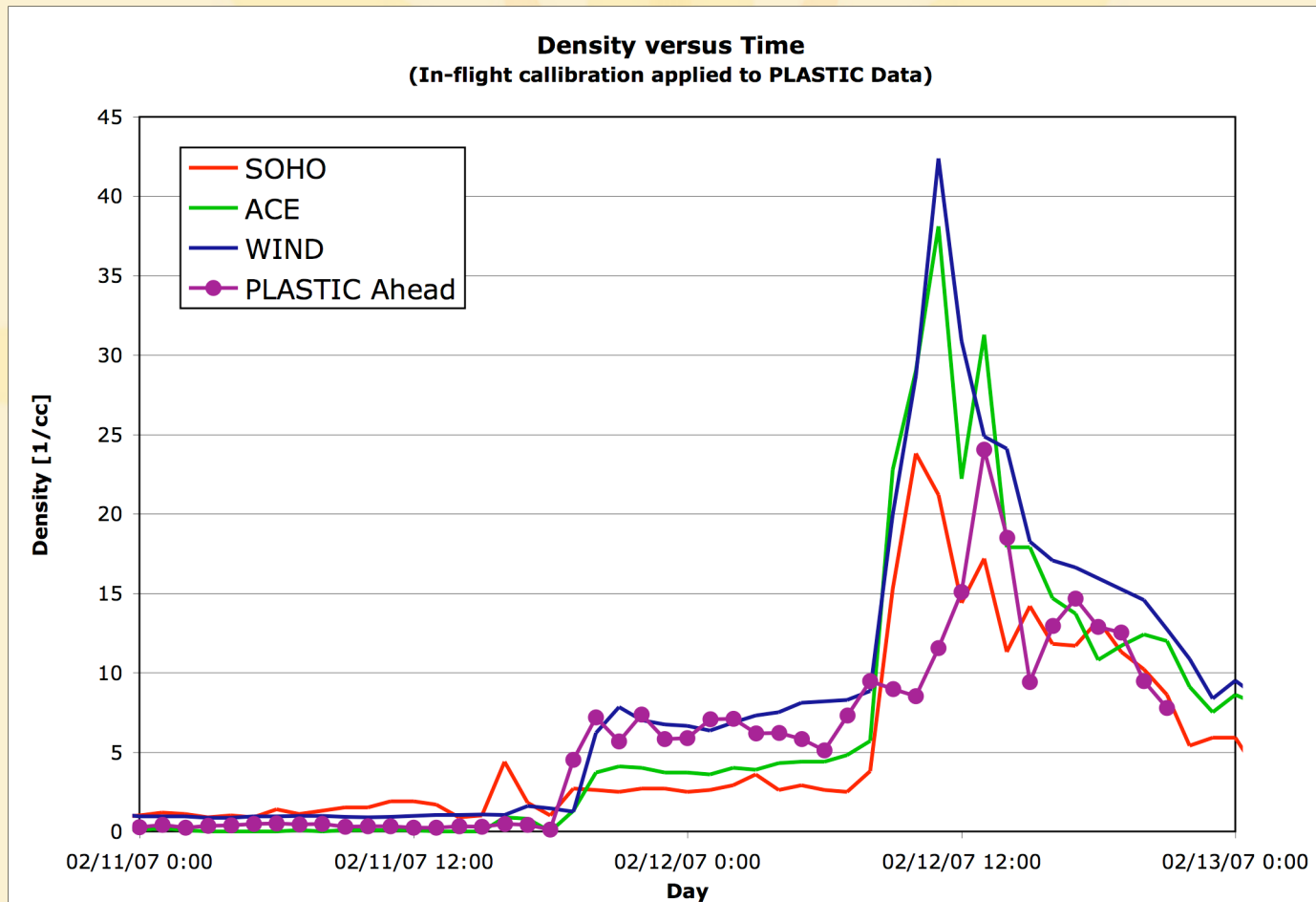
SC/A deflection

SC/B deflection

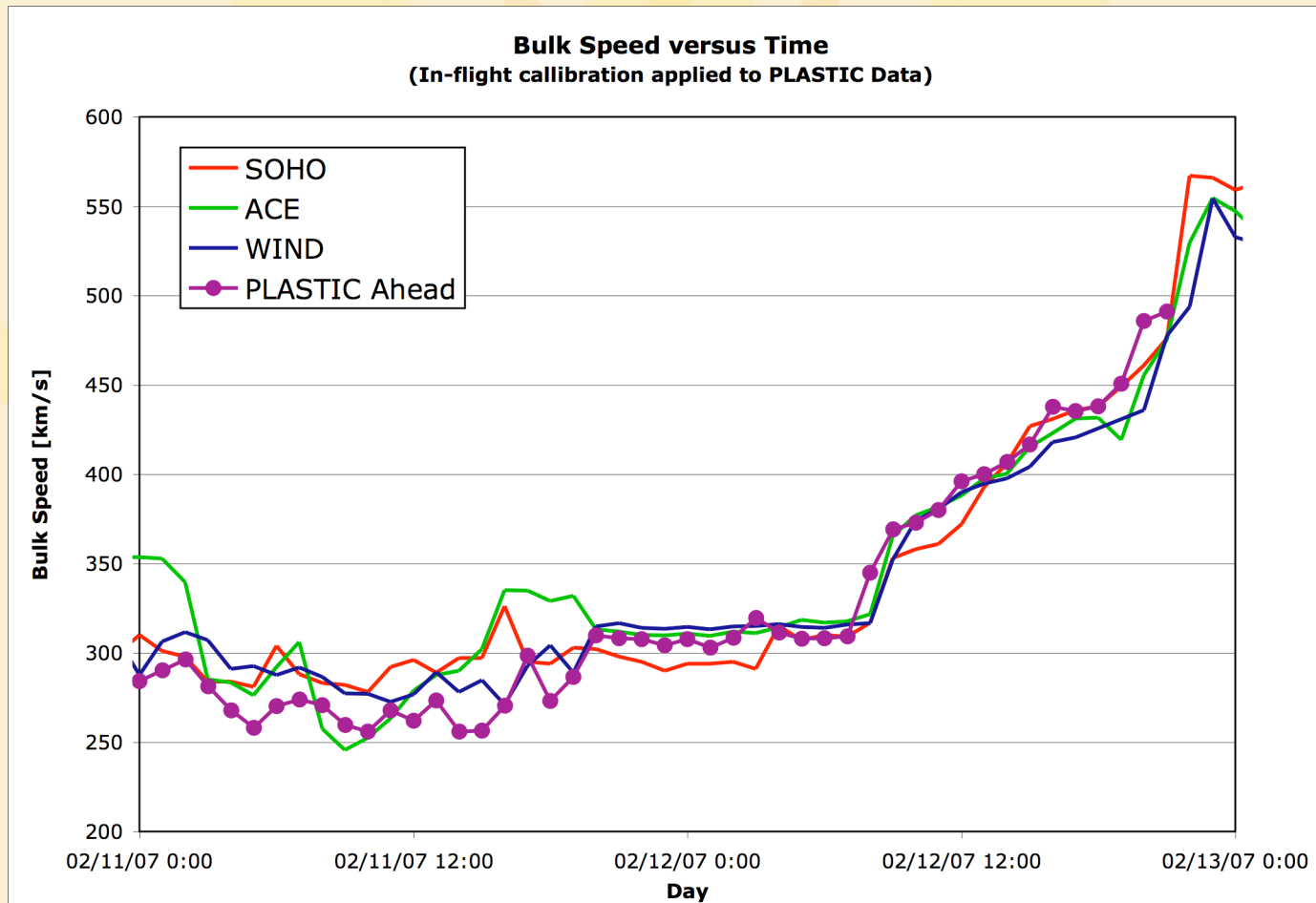


Slide courtesy of Lynn Kistler.

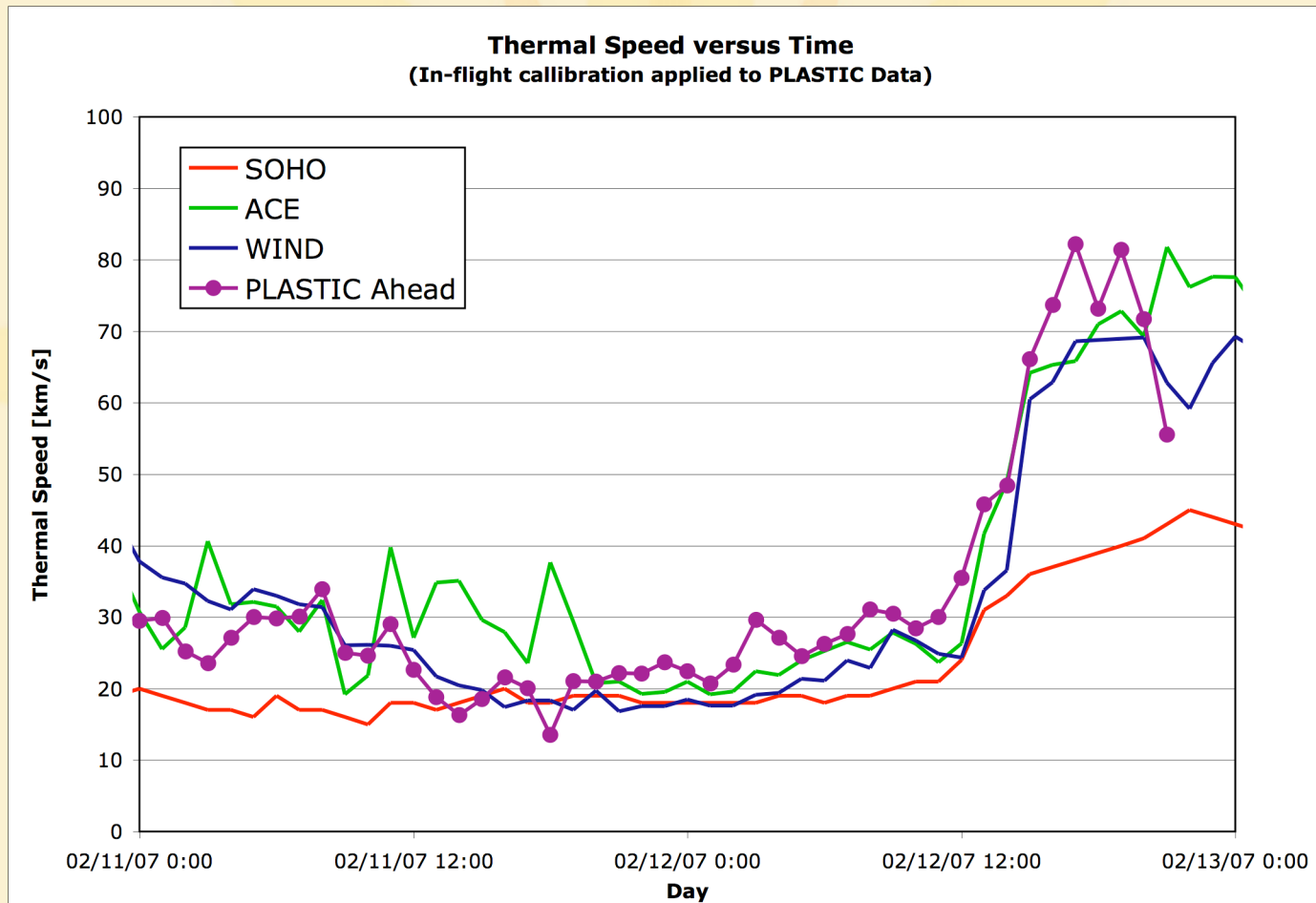
Bulk Properties from Maxwellian Fit to Velocity Distribution



Bulk Properties from Maxwellian Fit to Velocity Distribution



Bulk Properties from Maxwellian Fit to Velocity Distribution





PLASTIC Data is Available to the Public

CDF Files can be obtained from the
STEREO Science Center:

<http://stereo-ssc.nascom.nasa.gov/>

Acknowledgements

- ACE SWEPAM instrument team and ACE Science Center
- CELIAS/MTOF instrument on SOHO (SOHO is a joint ESA/NASA mission)
- WIND SWE team

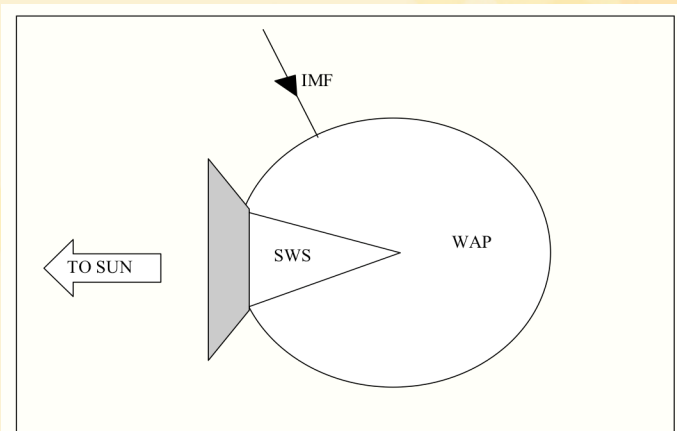
The STEREO/PLASTIC Institutions

- University of New Hampshire
- University of Bern, Switzerland
- Max Planck Institute for Extraterrestrial Physics, Germany
- University of Kiel, Germany
- NASA GSFC

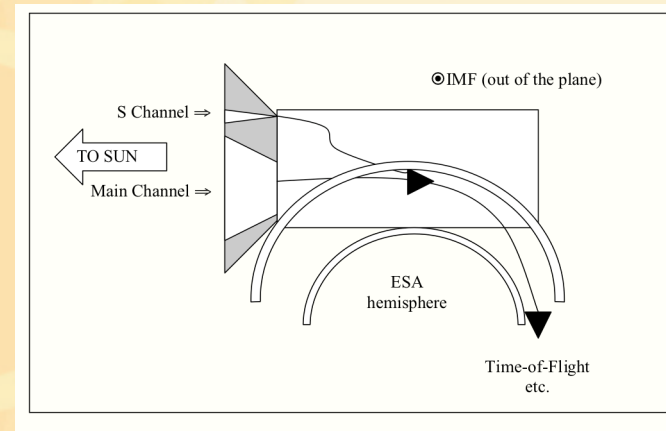


Thank you.

Most Extremely Simplified Views of Entrance System



Ecliptic



Out-of-Ecliptic

Energy per Charge and Deflection Angle

- Hemispherical Electrostatic Analyzer (ESA)
- 128 Voltage Steps, logarithmically spaced from about 80 keV/q to 0.3 keV/q
- “Duckbills” scan $\pm 20^\circ$ out of the ecliptic plane to determine declination of incident solar wind ions (instantaneous field-of-view is about 1.3°)
- 12.8 milliseconds for each voltage/angle combination -- about 1 minute for cycle

Note: No deflection angle information for Wide Angle Partition (WAP)

Aperture Switch

- ESA steps from high to low E/q
- When set (commandable) count rate threshold is encountered, main entrance is gated closed and small aperture is used for the rest of the cycle

Time of Flight and Azimuth Angle

- Ion is accelerated before passing through carbon foil
- Knocked-off electrons impact micro-channel plate (MCP)
- Shower from MCP is accelerated and hits grid giving “start” signal, and triggers anodes to give azimuth position

Time-of-Flight and Energy

- Depending on the instrument quadrant, ion hits stop grid or solid-state detector to give a “stop” signal
- Residual energy is measured with the solid state detector