



www.spacecollege.org



**Sternwarte
Bochum**



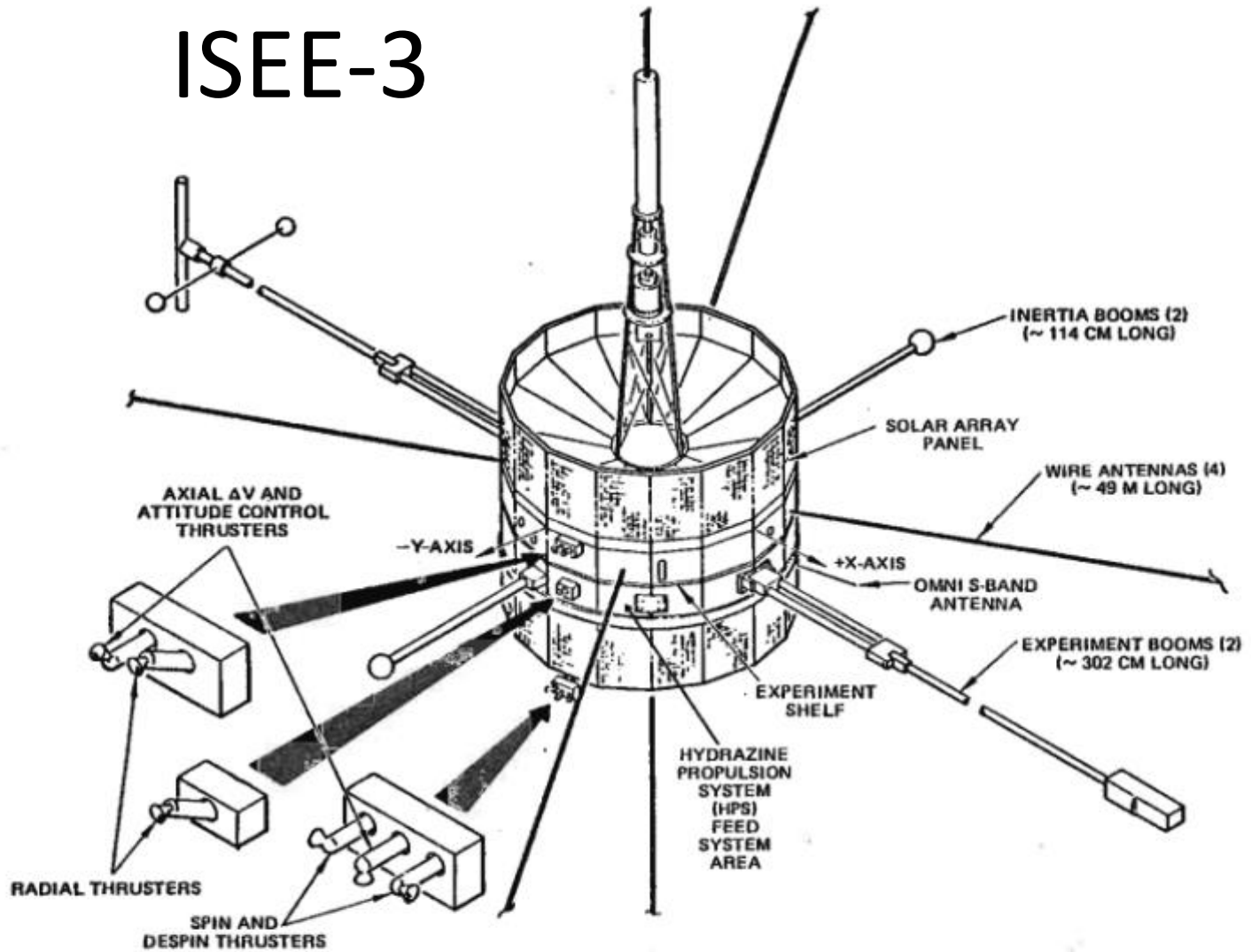
ISEE-3 Reboot Project

Dennis Ray Wingo

CEO

Skycorp Incorporated

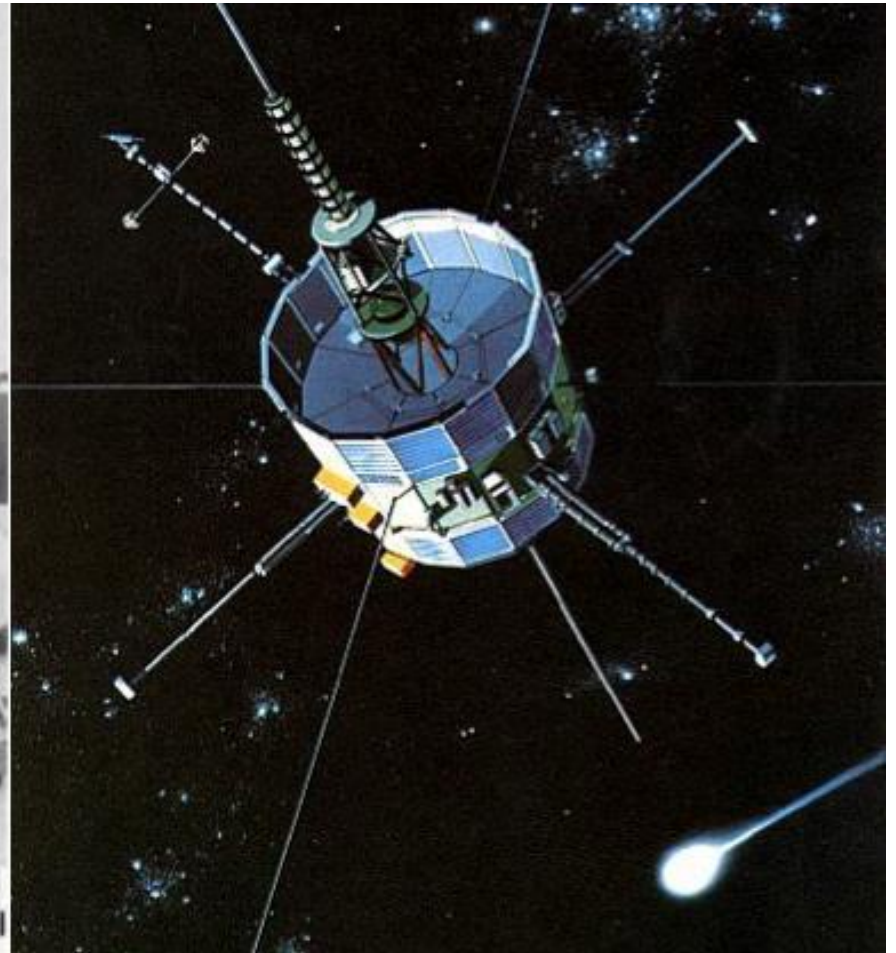
ISEE-3



2-2

Figure 2-1. ISEE-3 Spacecraft

Spacecraft

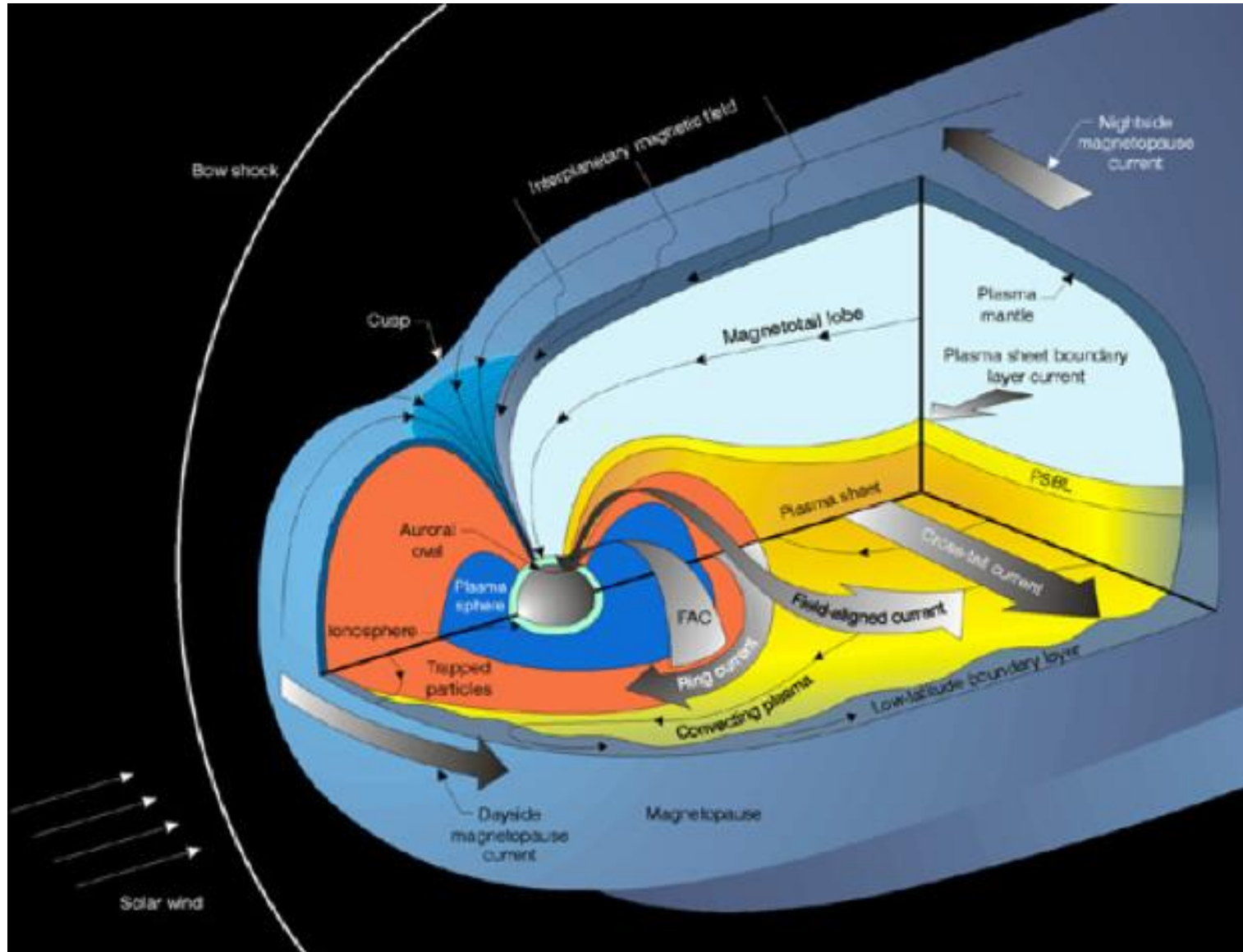


ICE achieved the first comet interception. It will

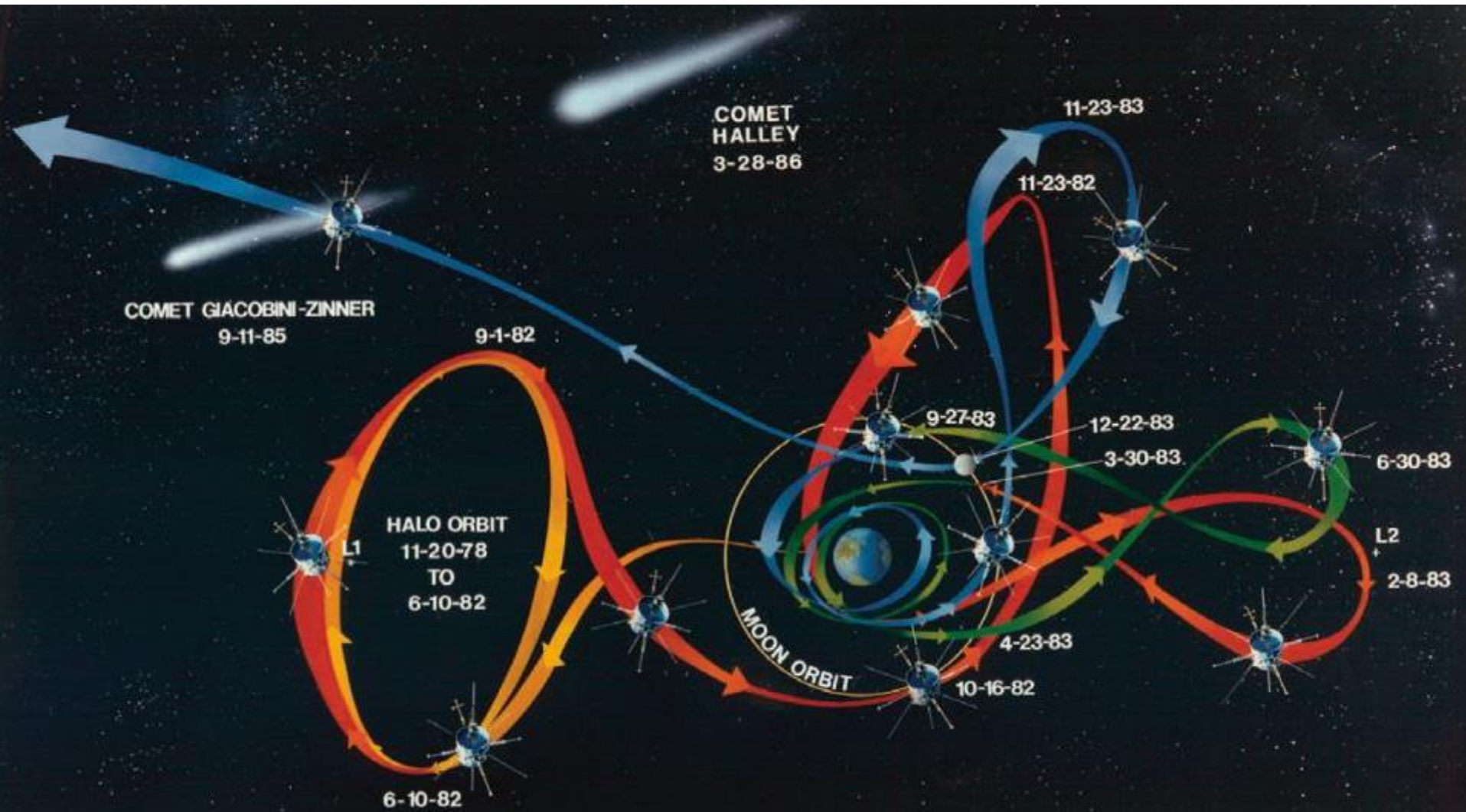
Spacecraft Prior to Launch



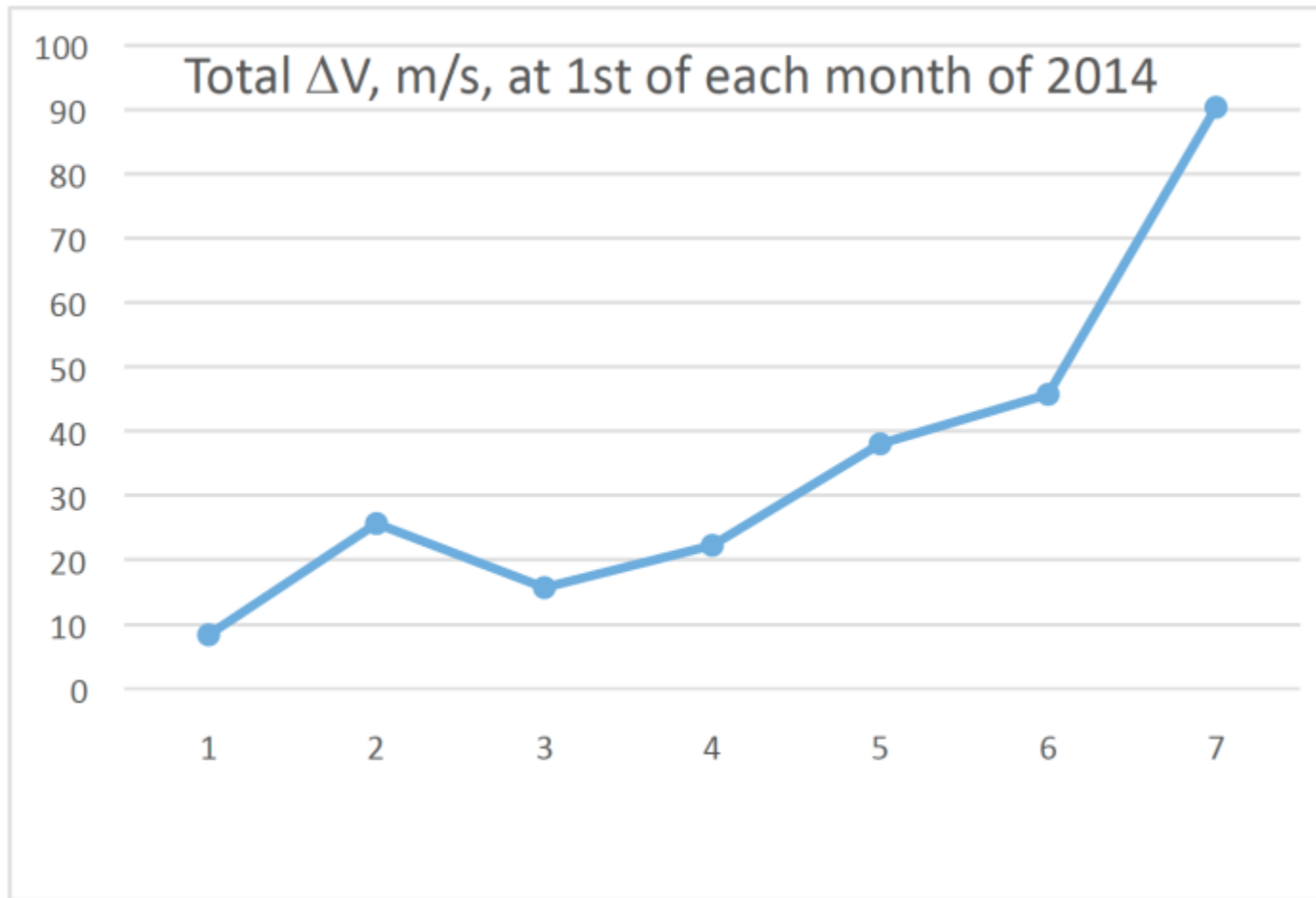
Original Mission



ISEE-3 Mission



Newton Hates Us, The Time Crunch



Project Milestones

- Project
 - Began 4-12-14
 - Crowd Funding Goal Met 5-18-14
 - Space Act Agreement Signed 5-21-14
 - ATP-E4.1 Completed and Approved 5-29-14
 - ATP E4.2 In Progress
- Technical
 - Document Acquisition 4-12-5-21
 - Software Radio Delivered 5-05-14
 - Arecibo Trip 5-17-30
 - S Band Power Amp Delivered Arecibo 5-21-14
 - First Commanding Successful 5-29-14
 - Preliminary Telemetry Evaluation Complete
 - Maneuver Plan Development In Progress

Technical Approach | Software Radio

- Software Defined Radio (SDR) Used For Modulation and Demodulation of ISEE-3 Signals
- GNU Radio Software Used to Turn Bits into Signal
- Reduced Mod/Demod Development Time to Weeks

USRP™ N200/N210 NETWORKED SERIES



Technical Approach II Arecibo

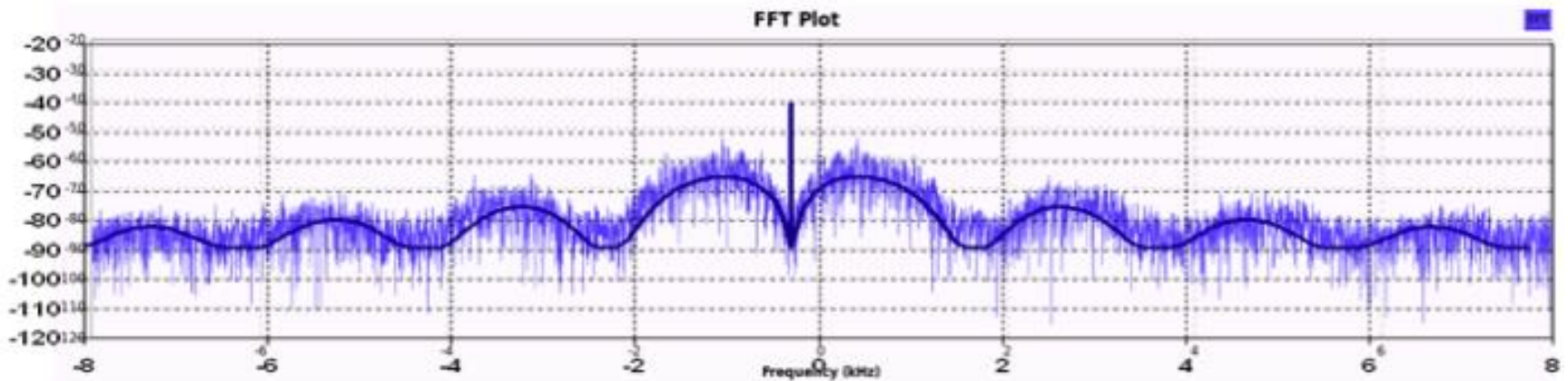
- Limited Availability of Ground Stations to Transmit S Band to Interplanetary Space
- No Time to Acquire High Power Amps
- Arecibo not back to full schedule after earthquake.
- Arecibo ideal for Project



At Arecibo



Success!



assumptions:

512 bps, R=1/2 convolutional code
biphase PSK, 60 deg mod index

free parameters:

noise power, total signal power, frequency offset

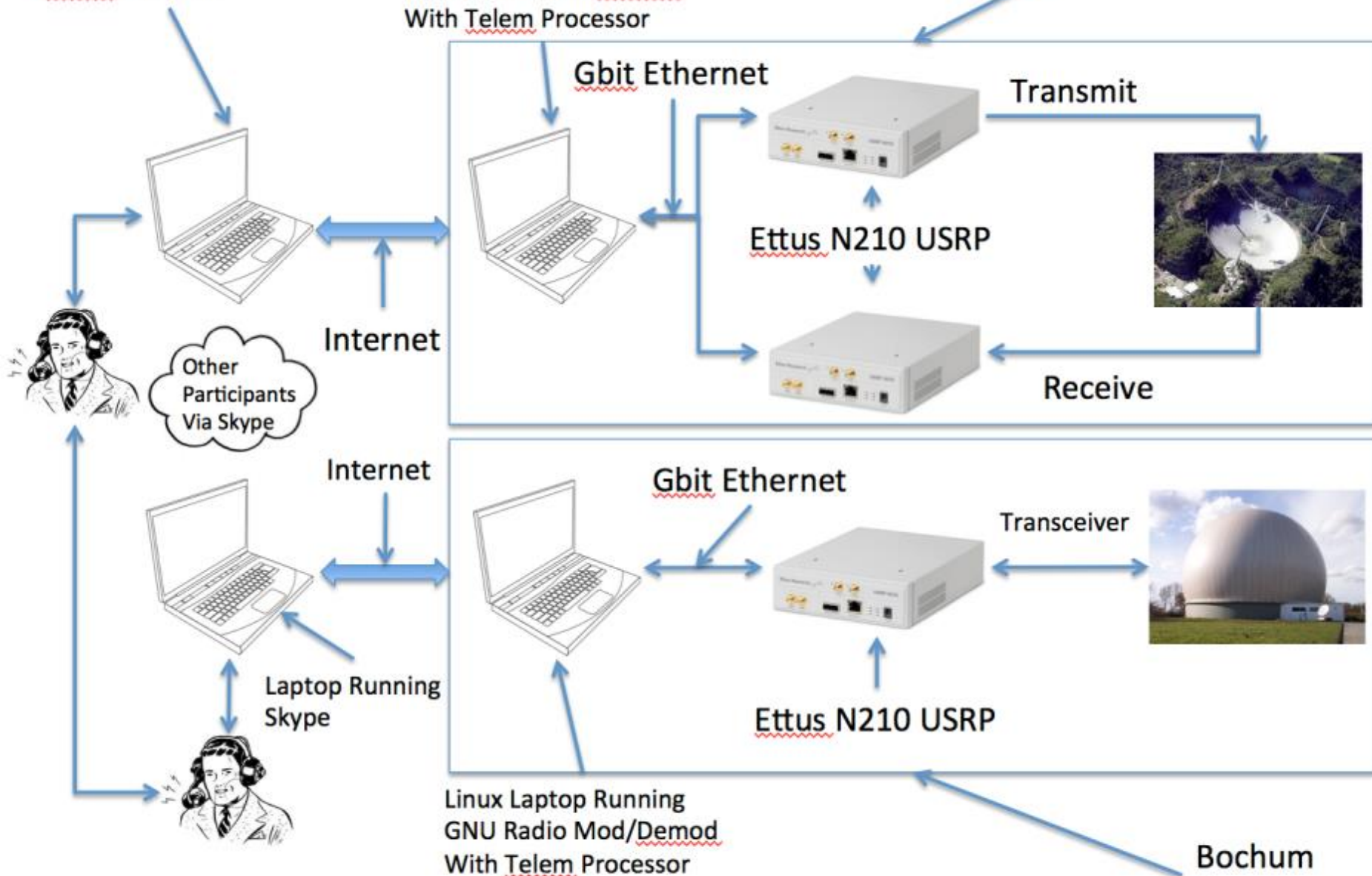
measured spectrum by ISEE-3 Reboot Project

simulated spectrum by A. Vollhardt (DH2VA), AMSAT-DL

Linux Laptop Real Time
Telem Software

Linux Laptop Running
GNU Radio Mod/Demod
With Telem Processor

Arecibo

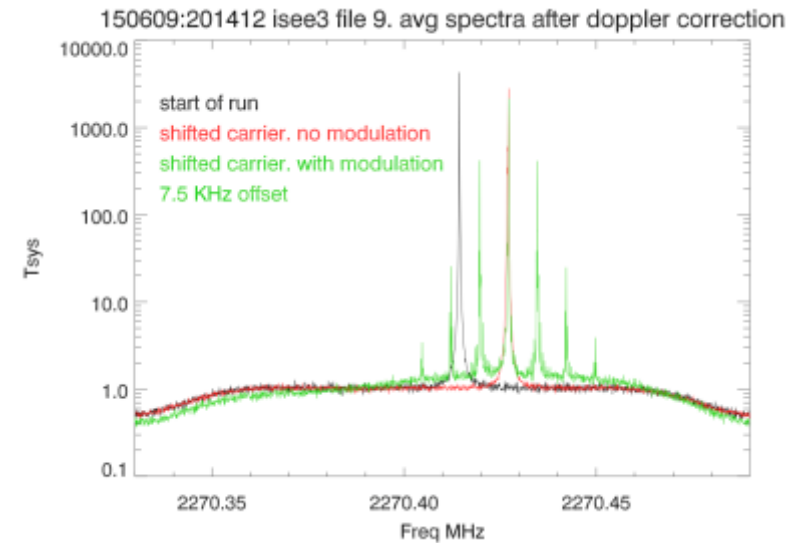
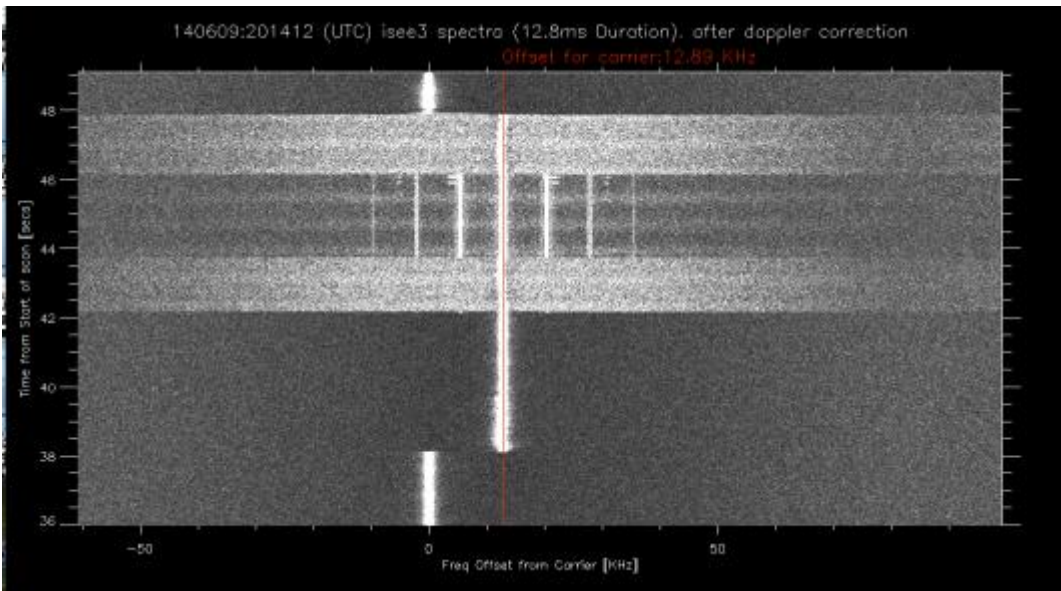


Voice Coordination In the Control Center, Ground Station Coordination via Skype & Phone

Bochum
Germany

Operational Communications Status

- 6-9-14
 - Testing Spacecraft Telecom, Commanding Different Data Rates (64, 512, 2048 bits/sec). Test Backup ROM Successful. Commanding ~50% Successful. Frequency Offset Between +-5-15 kHz. 9.4 and 7.5 kHz Successful. Test Coherent Ranging, First Thought Unsuccessful, Then.



Waveform Similar to 1978-02_compatibility_test_report_isee-c_flight_model (page 162)

Solar Array Temperatures (2014)

Solar Array Temps	27 PW
S/A Temp 1	13.3 c
S/A Temp 2	11.7 c
S/A Temp 3	15 c
S/A Temp 4	16.7 c
S/A Temp 5	16.7 c
S/A Temp 6	11.7 c

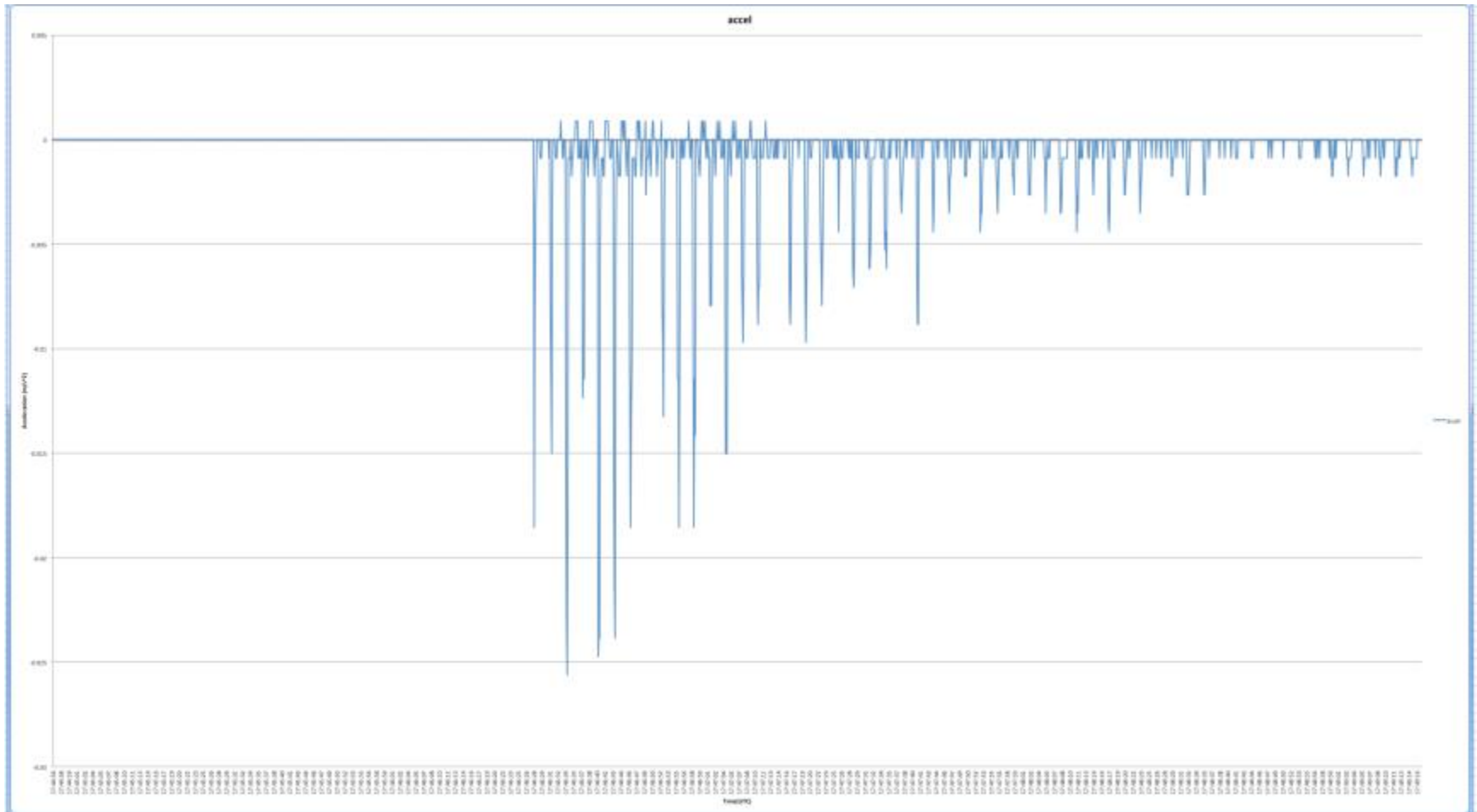
- Solar Array is Thermally Isolated from the Spacecraft
- Solar Array Thermal Design Nominal Value is 10-15c (conflicting sources)
- Solar Cell Test Nominal Temperature is 15 c.

AIAA 80-9207 "Design and Performance of the International Sun-Earth Explorer Power Systems" Obenschain, A.F, Ruitberg, A.P, NASA GSFC

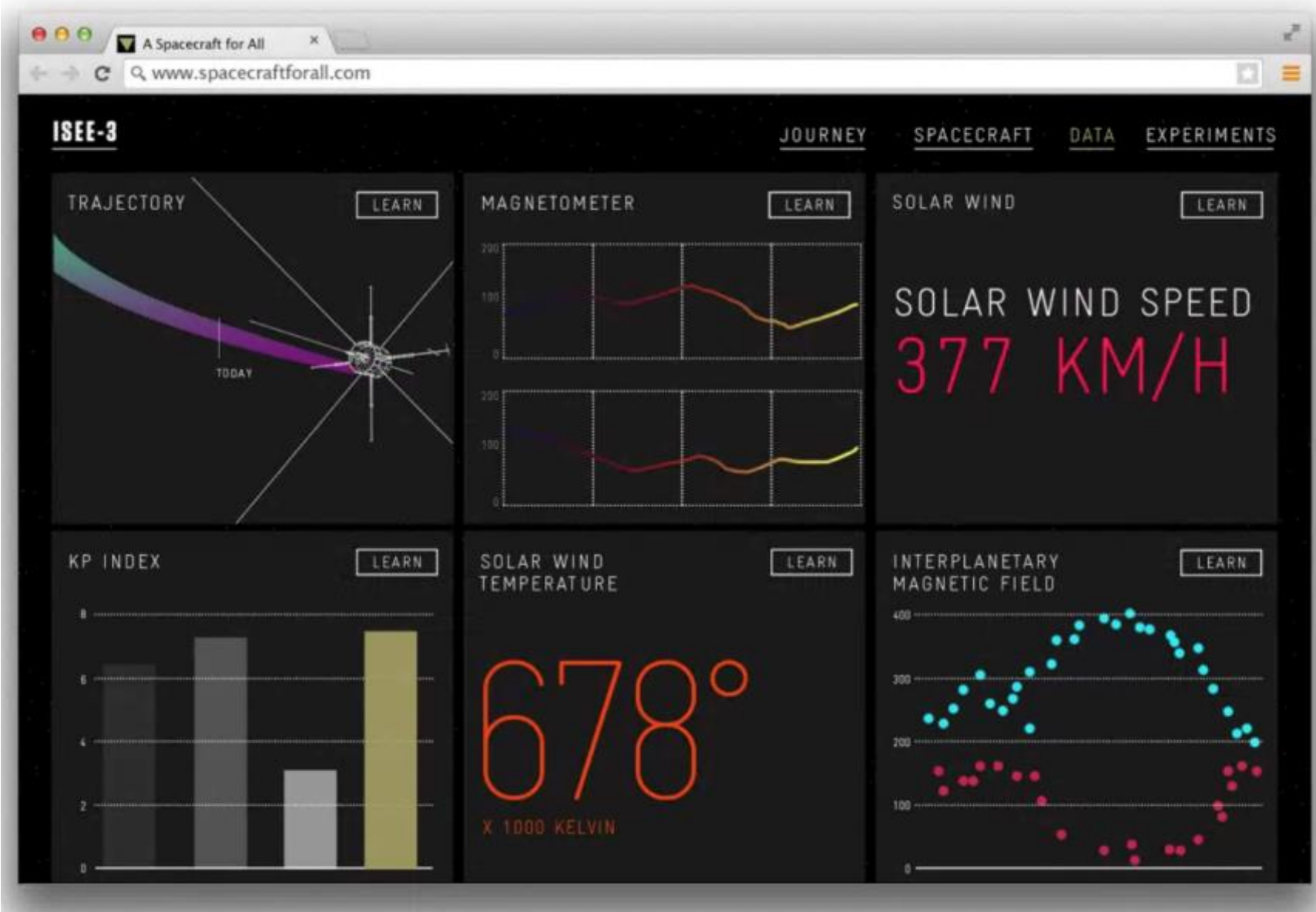
Operations at McMoons



The Agony of Defeat (temporary)

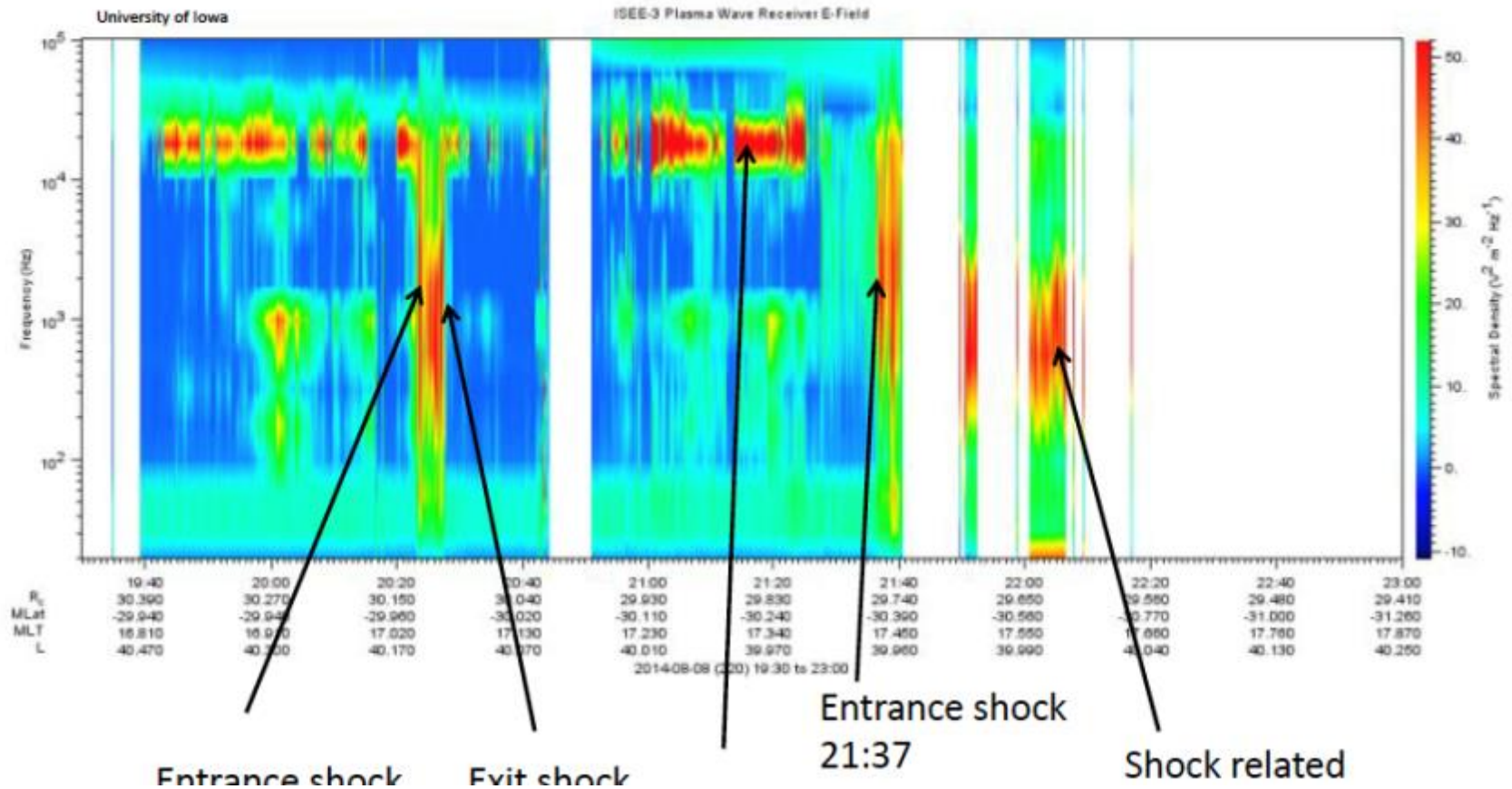


ISEE-3 Science



Data....

ISEE-3 at the bow shock of the Earth 8-8-2014



ISEE-3 Project Firsts

- First Private Entity to Recover and Successfully Command an Abandoned Spacecraft in Interplanetary Space
- First Use of Software Defined Radio in Real Time Spacecraft Command and Control
- First NASA Space Act Agreement To Utilize Abandoned NASA Assets

Where Next?

