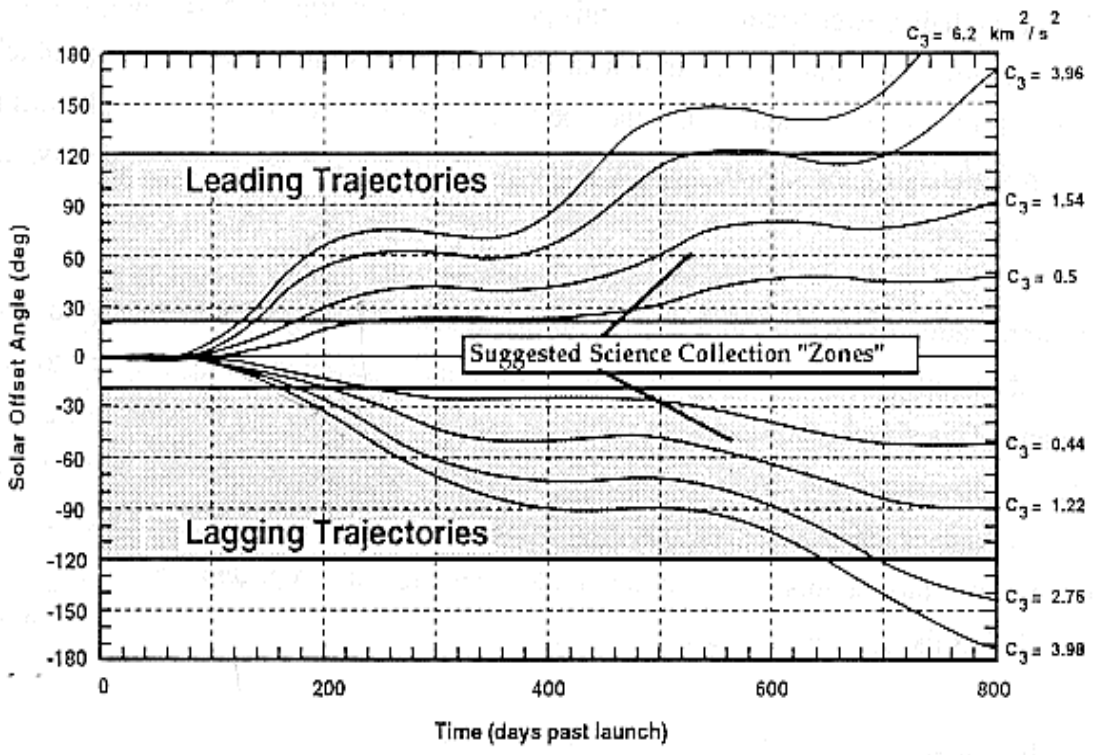
Solar Terrestrial Relations Observatory (STEREO)

Pre-Phase-A Presentation Feb 11, 1999

David Rust (SRP, x 5414)

Issues Addressed:

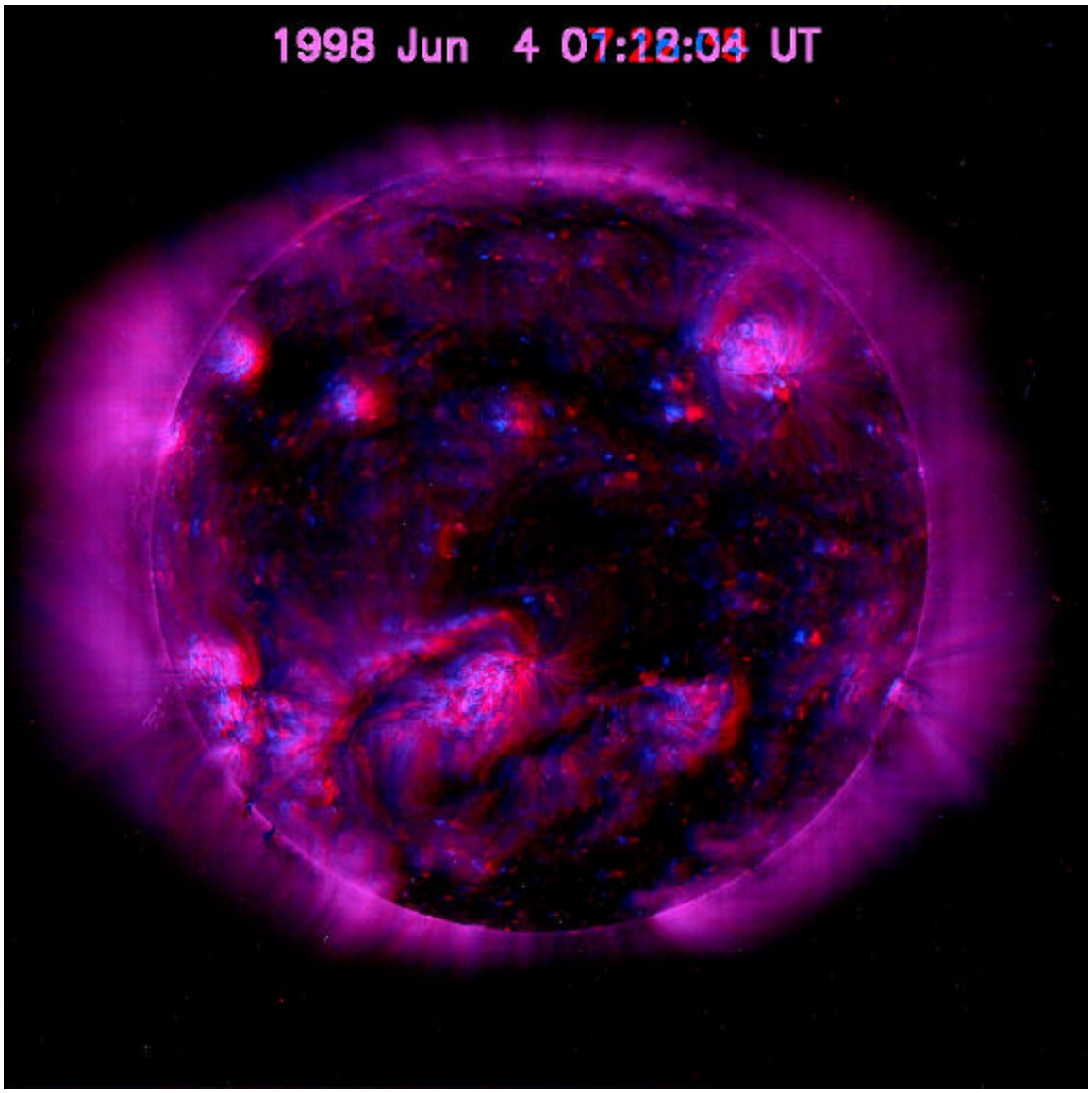
- **Orbit Selection**
  Leading/lagging vs. two lagging
- **Data Rate Requirement**
- **Launch Date: 2002 vs. 2004**



Solar Terrestrial Relations Observatory (STEREO)

Science Objectives

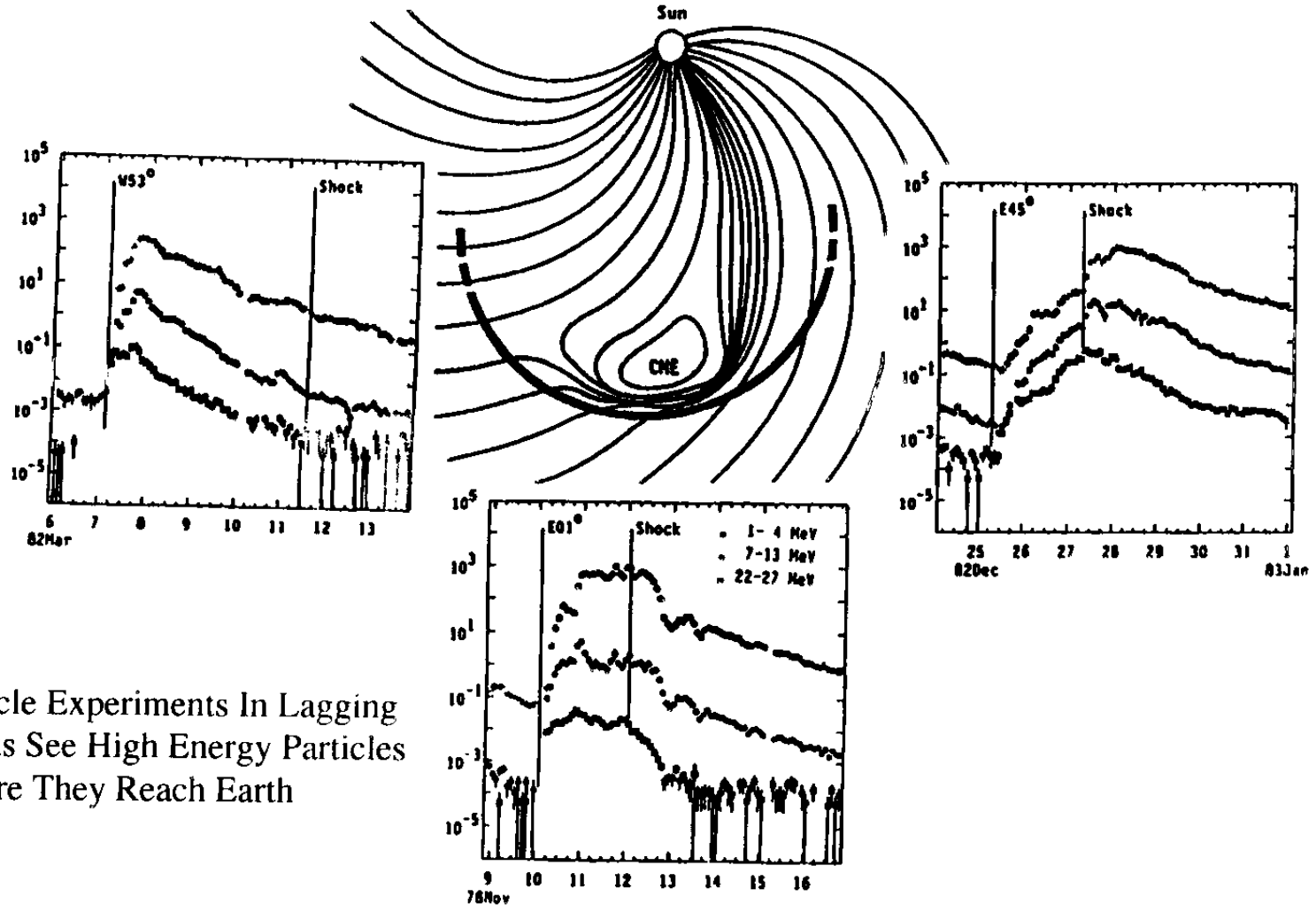
- **Different scientific and practical goals for different S/C separation angles 'α'**
  - **First year (α < 50°) : low corona, very fast phenomena, binocular stereoscopy**
  - **Second year (50°< α < 100°) : 3-D structure of CMEs, energetic particle distribution**
  - **Third and Fourth years (100°< α < 200°) : Earth-bound CMEs, Space Weather**
  - **Late in Mission (α > 180°) : Global solar evolution and Space Weather**



Binocular stereoscopy can be used for the first year of the baseline mission. Viewing image pairs with, e.g., red and blue glasses, may be the easiest way to deduce 3D structure and to infer the physical processes in the corona.
This image is composed of images taken 6 hours apart. View it with the red filter over the left eye and the blue filter over the right eye. The solar rotation allows one to simulate a stereo effect for those features that do not change in that interal. The sun rotates about 3.5 degrees in 6 h, so the view is similar to viewing something at arm's length.

Comparison Of Two STEREO Mission Designs

Mission Design ------> Mission Feature	**One S/C lagging and one S/C leading**	**Two S/C trail Earth in its orbit**
S/C #1 leaves at	+20 degrees per year	-20 degrees per year
S/C #2 leaves at	-30 degrees per year	-40 degrees per year
Principal advantage	No change from SDT report	No problems with high gain antenna at any point in the mission
Principal disadvantage	Leading S/C cannot point high gain antenna at Earth for first 200 days	Triangulation on CMEs is best only after 1 yr
Binocular image pairs possible?	After first 300 days, S/C are too far apart	Good separation for entire 2 yr science mission
Triangulation on CMEs?	After 0.5 yr	After 1 yr
Energetic particle warning?	One S/C for 2 yrs	Two S/C provide event profiles for 3 yrs
Triangulation on Earth-directed CMEs?	Best from yr 1.5 to yr 5	Best from yr 1.5 to yr 3.75
Full heliosphere imaging?	Best between yr 1.2 and yr 2.4	Best between yr 3 and yr 6
Full Sun imaging?	After 3.6 years without help from Earth	None without help from telescopes at Earth



Particle Experiments In Lagging Orbits See High Energy Particles Before They Reach Earth

Solar Terrestrial Relations Observatory (STEREO)

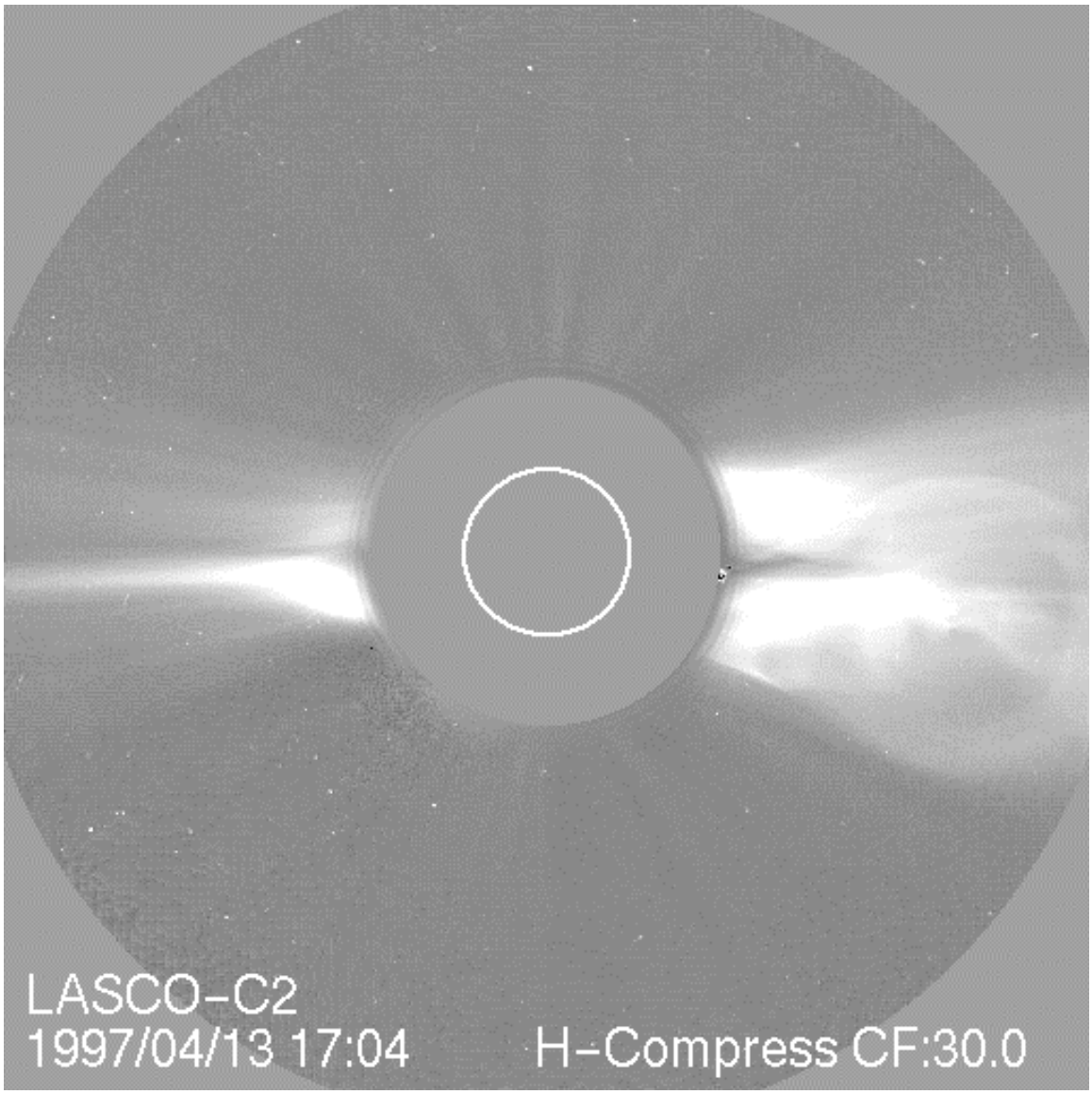
Data Rate and Data Compression

Acceptable rate varies from imager to imager.

- **30 X is acceptable for the coronagraph during some parts of the mission**
- **Chromospheric imager requires no more than 5 - 10 X compression.**
- **Science teams will want to do it themselves.**

How did data rates grow from the science team report?

- **Chromospheric imager (CI) accounts for 85 - 90 % of the bandpass.**
- **Larger detectors now available: 2K vs. 1 K**
- **We better understand the need to study fast phenomena, so…**
- **CI will often want 1400 2048 x 2048 x 16 bit images per day.**
- **CI could generate 90 Gbits/day before compression.**
- **With a compression of 10 you get about 8 Gb/day.**



Even at the highest compression, CME images show no obvious degradation. 30X Compression can be used at least part of the time with coronagraph images.

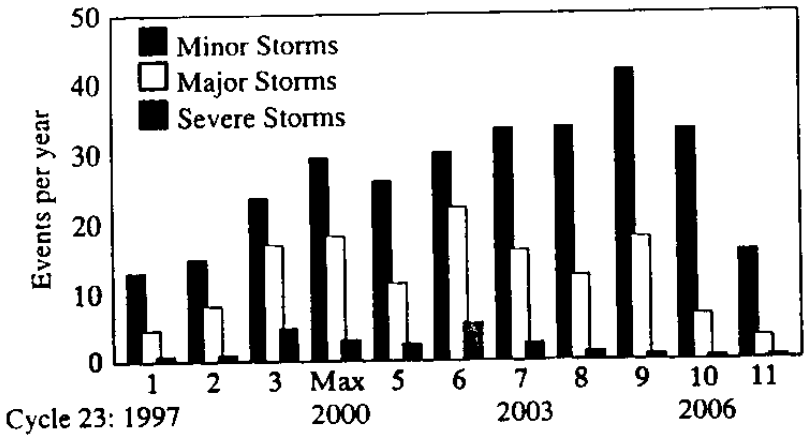


Fig. 5.—Average Geomagnetic Activity for Cycles 17–22.

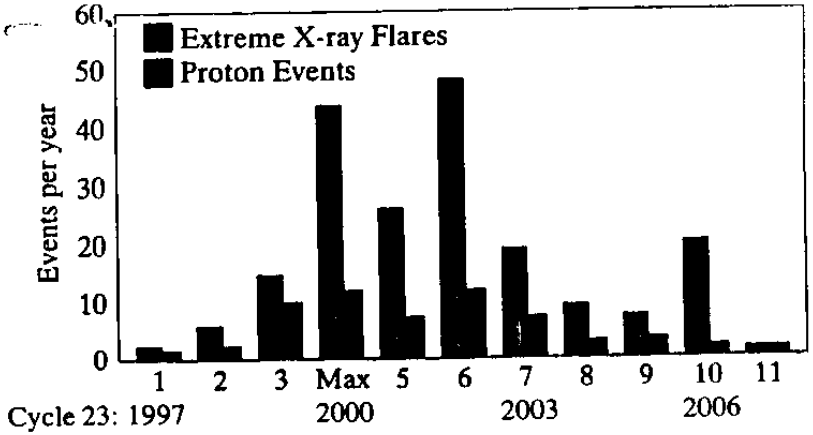


Fig. 6.—Average Solar-Geophysical Activity for Cycle 21 and 22.

2002 Launch	2004 Launch
Big CMEs still frequent in year 3	Big CME rate down by 4X
10 proton events in year 1	3 proton events in year 1