DECEMBER 2006 SEP EVENTS: Ulysses, STEREO & ACE OBSERVATIONS

Olga E. Malandraki

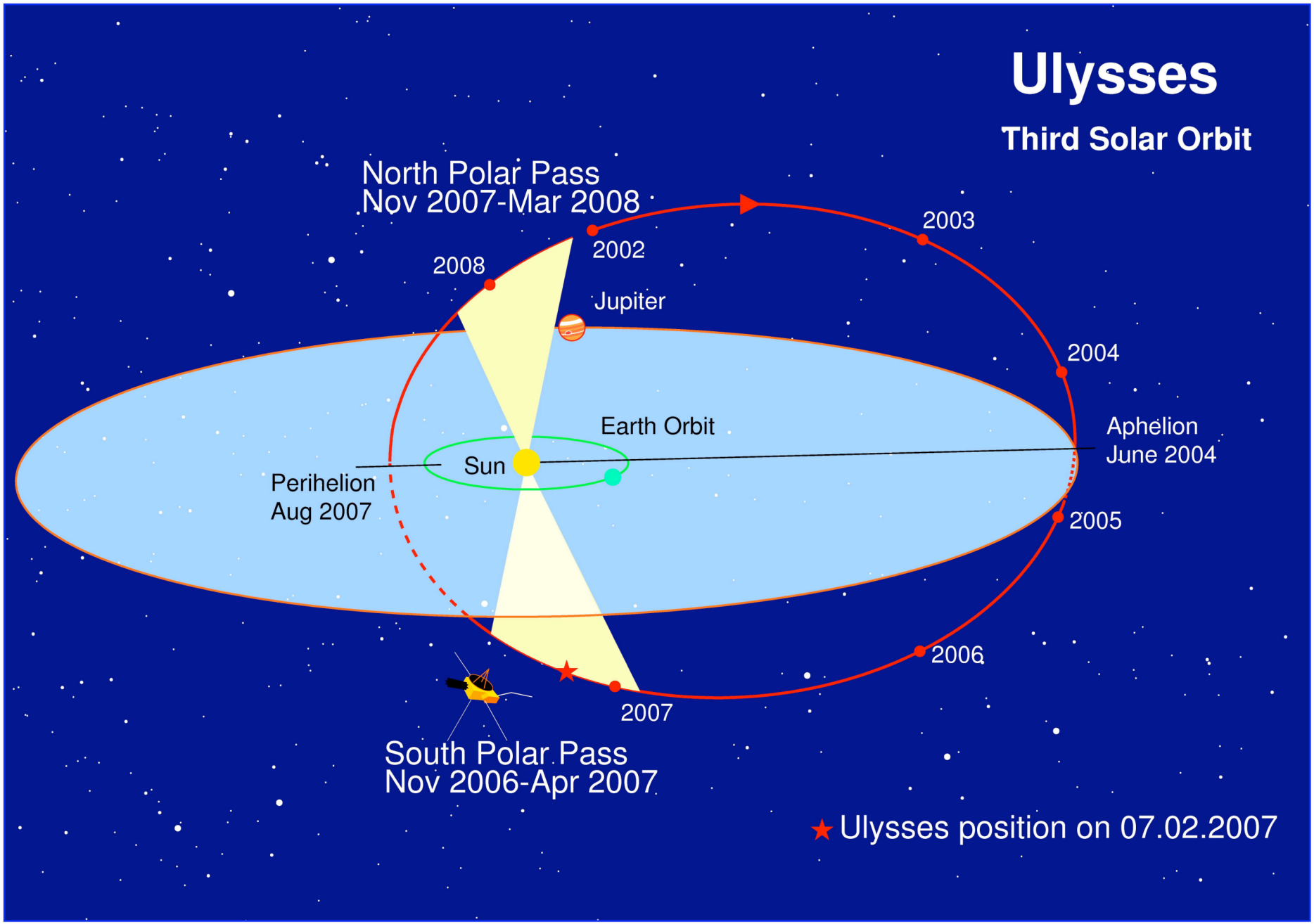
Institute for Astronomy and Astrophysics, Nat. Oservat. Athens, Greece

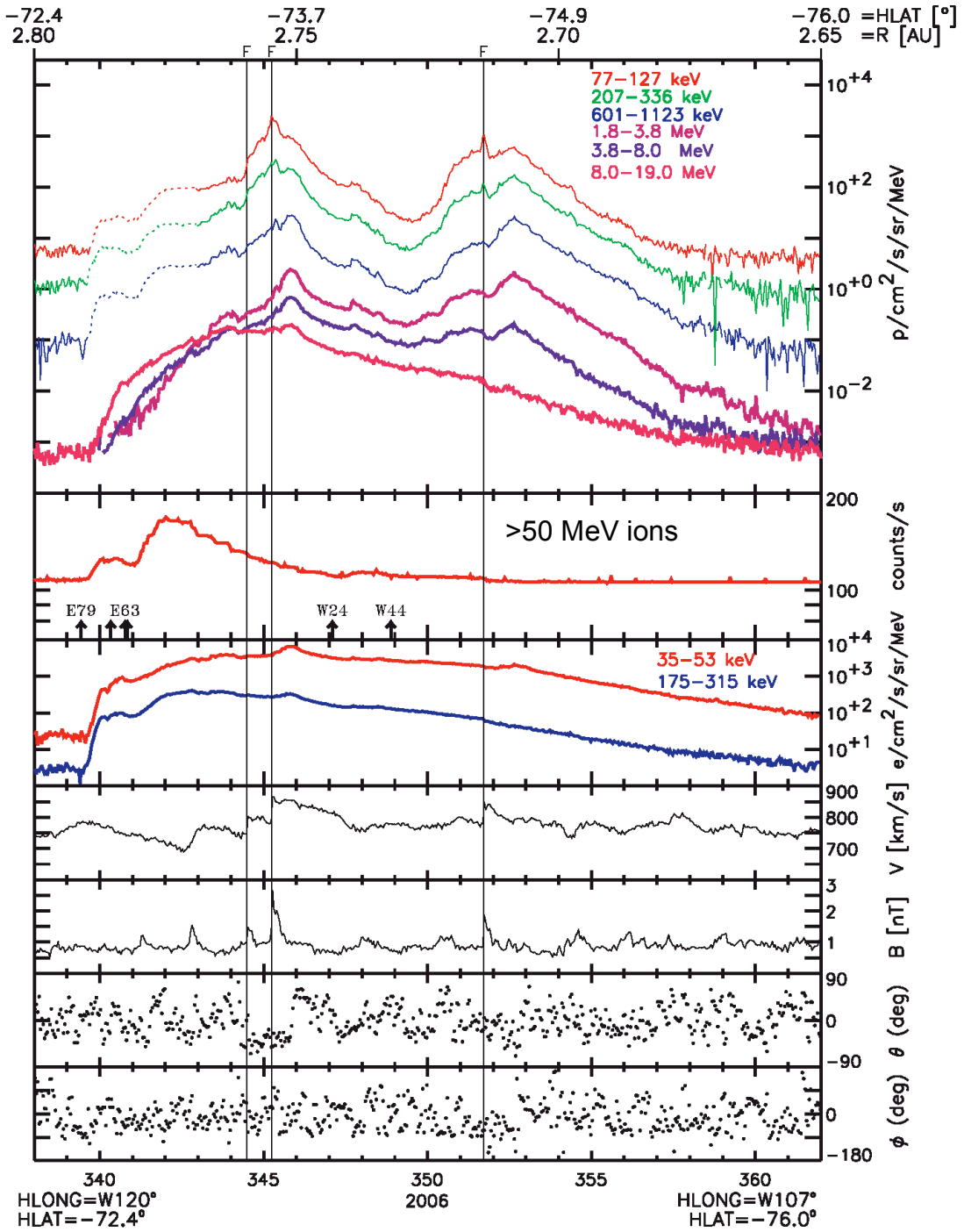
Collaborators:

R. Marsden, C. Tranquille, *ESTEC/ESA, The Netherlands*,
D. Lario, *APL/JHU, USA*,
B. Heber, *CAU, Kiel, Germany*, R. A. Mewaldt, C. M. S. Cohen, *SRL, Caltech*, USA, L. J. Lanzerotti, *NJIT, USA*, R. B. Forsyth, *IC, UK*,
H. A. Elliott, *SRI, USA*, A. Geranios, *UOA, Greece*

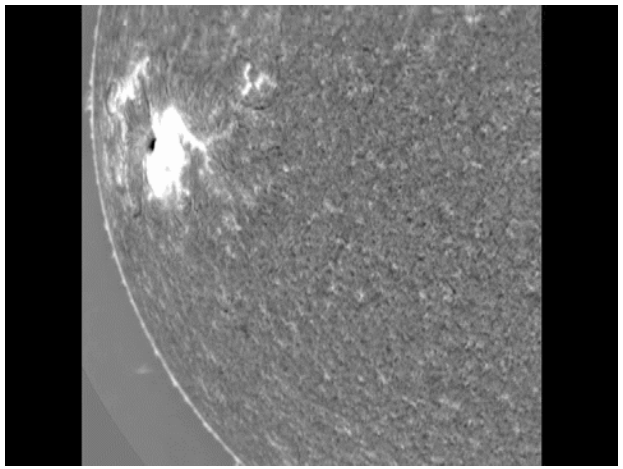
Objective

- Present unique energetic particle observations by Ulysses > 70ºS during intense solar activity in December 2006
- Compare with previous high latitude measurements obtained close to solar max
- Compare with simultaneous in ecliptic observations by STEREO, ACE at 1 AU


Ulysses
Third Solar Orbit
North Polar Pass
Nov 2007-Mar 2008
2002
2003
2004
2005
2006
2007
2008
Jupiter
Earth Orbit
Sun
Aphelion
June 2004
Perihelion
Aug 2007
South Polar Pass
Nov 2006-Apr 2007
Ulysses position on 07.02.2007

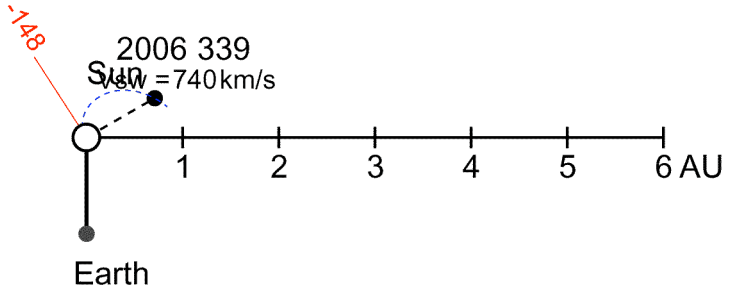


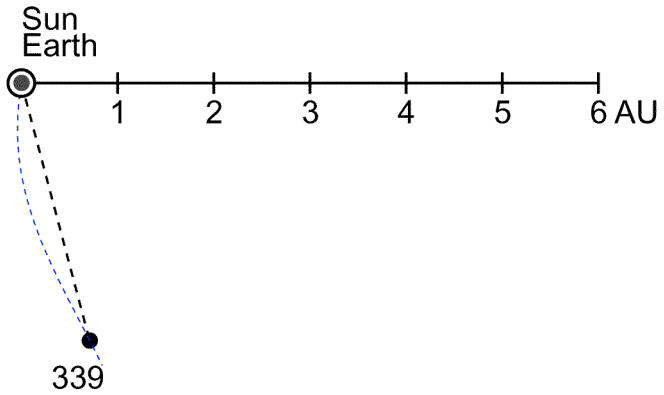
Unique Events of December 2006



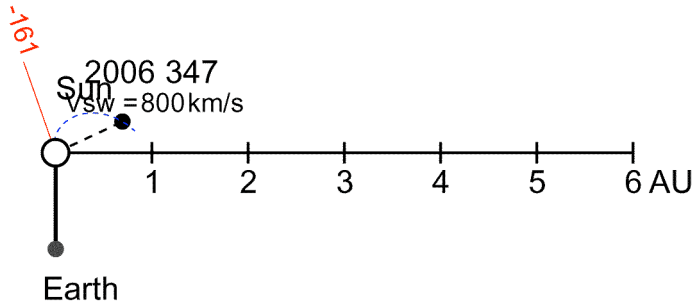
Credit: NSO/Optical Solar Patrol Network Telescope

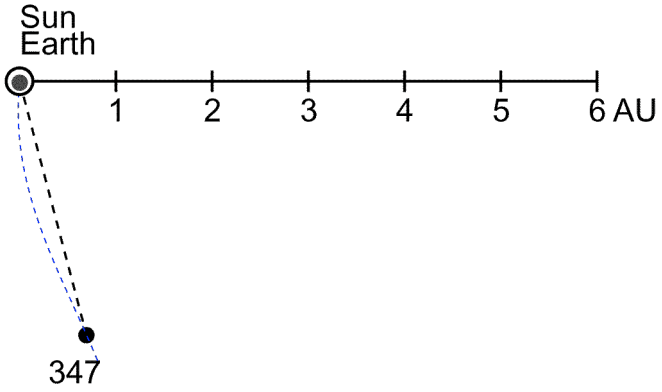
5 Dec





13 Dec

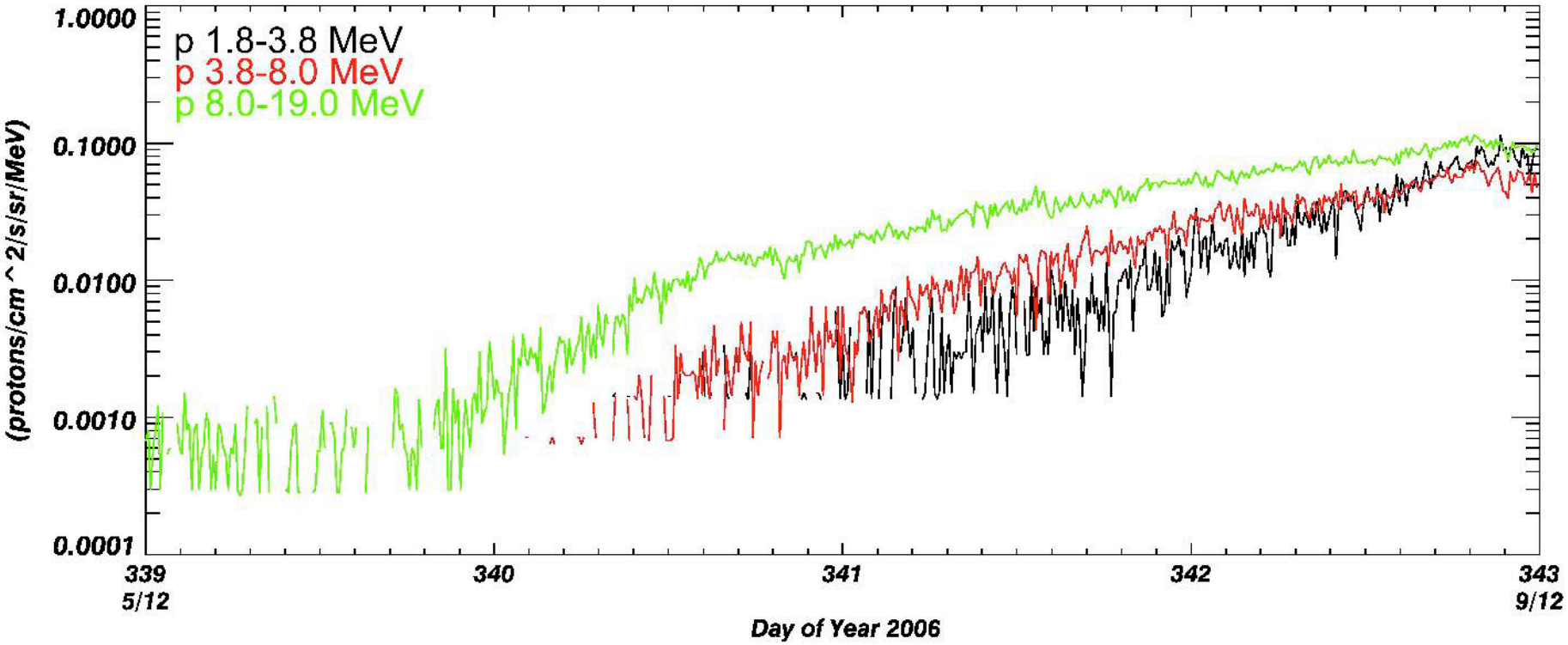




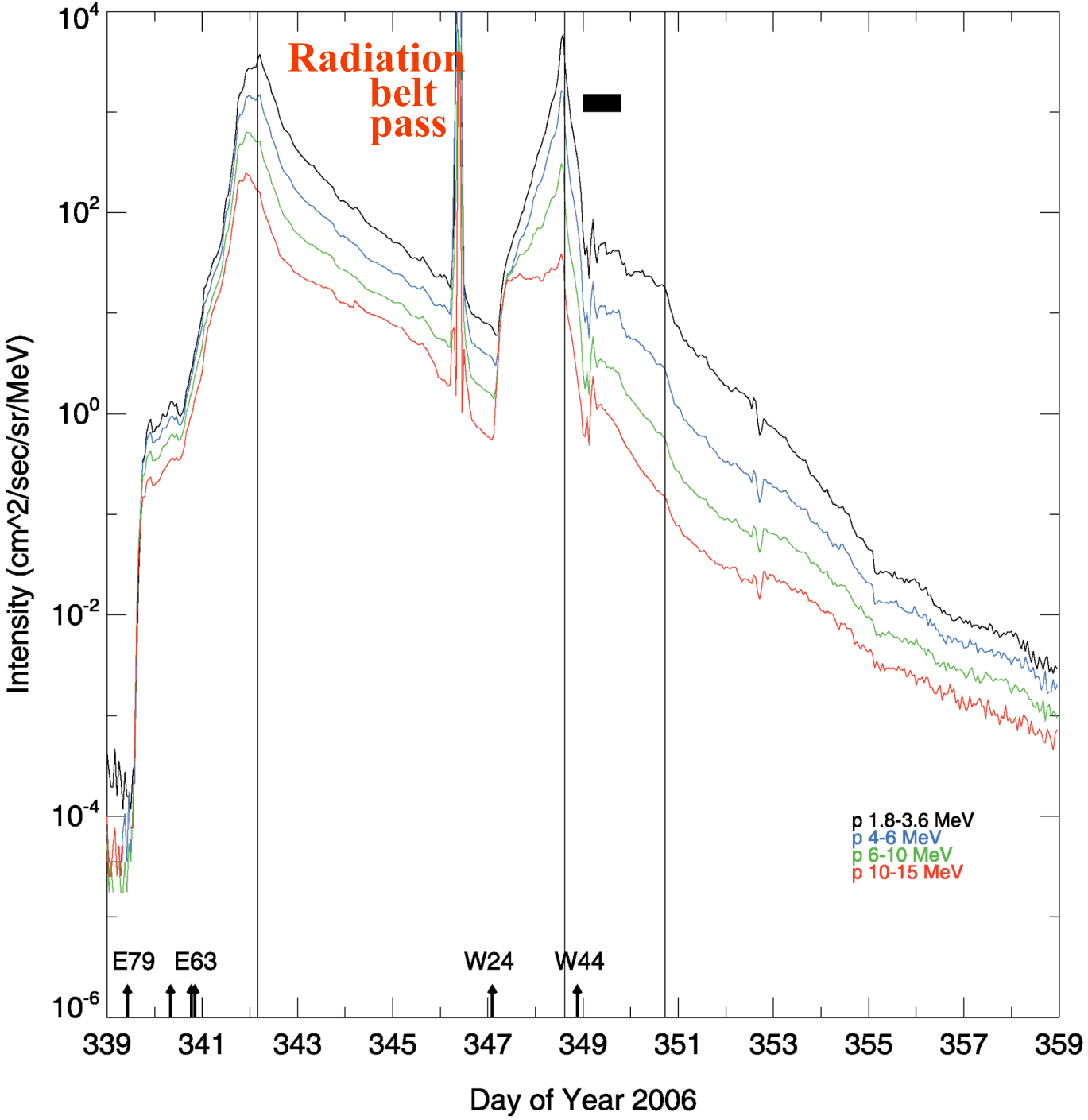
Angular separation with X9.0 flare location

Ulysses footpoint : 70 deg

ACE footpoint : 135 deg

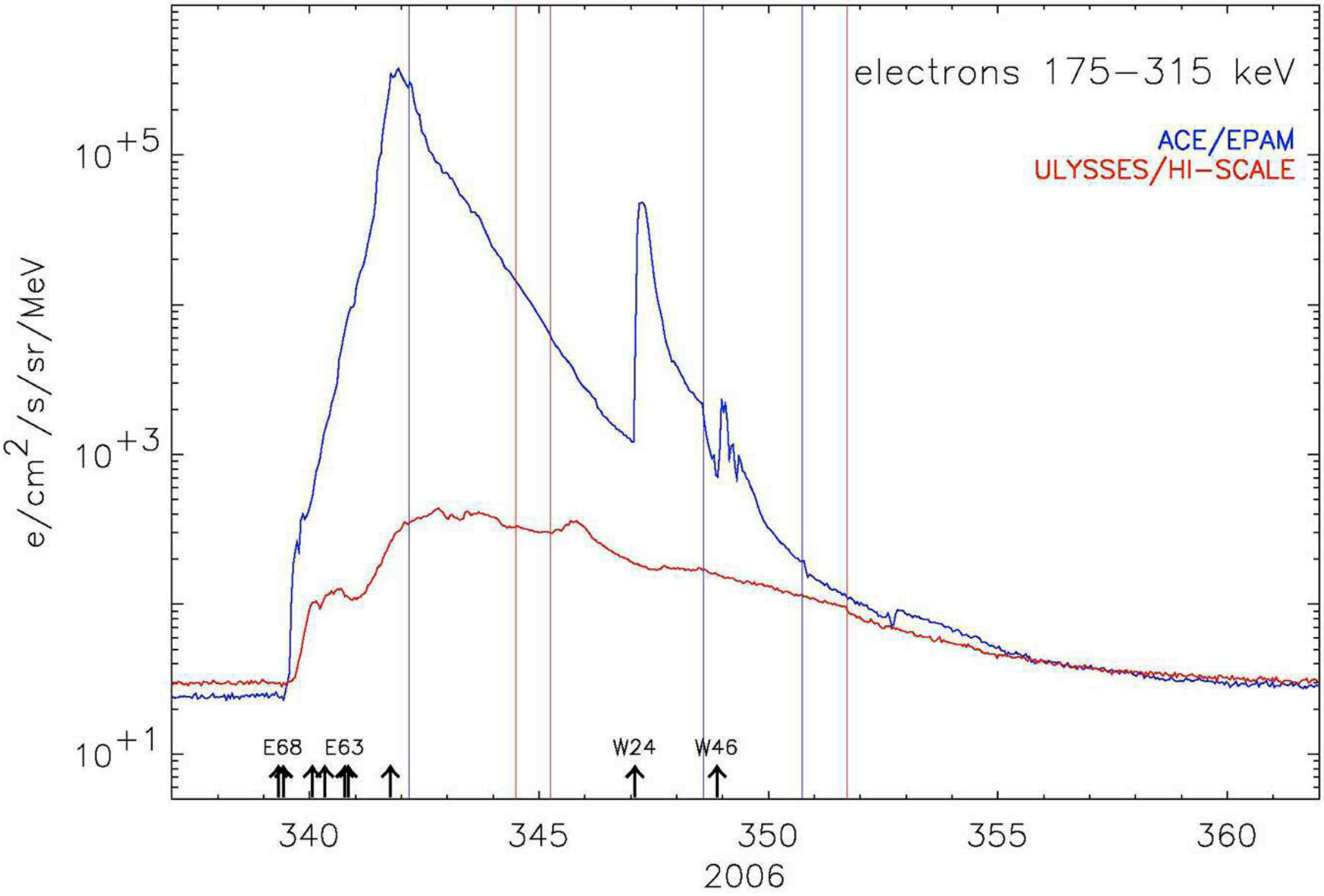


Velocity dispersion at Ulysses

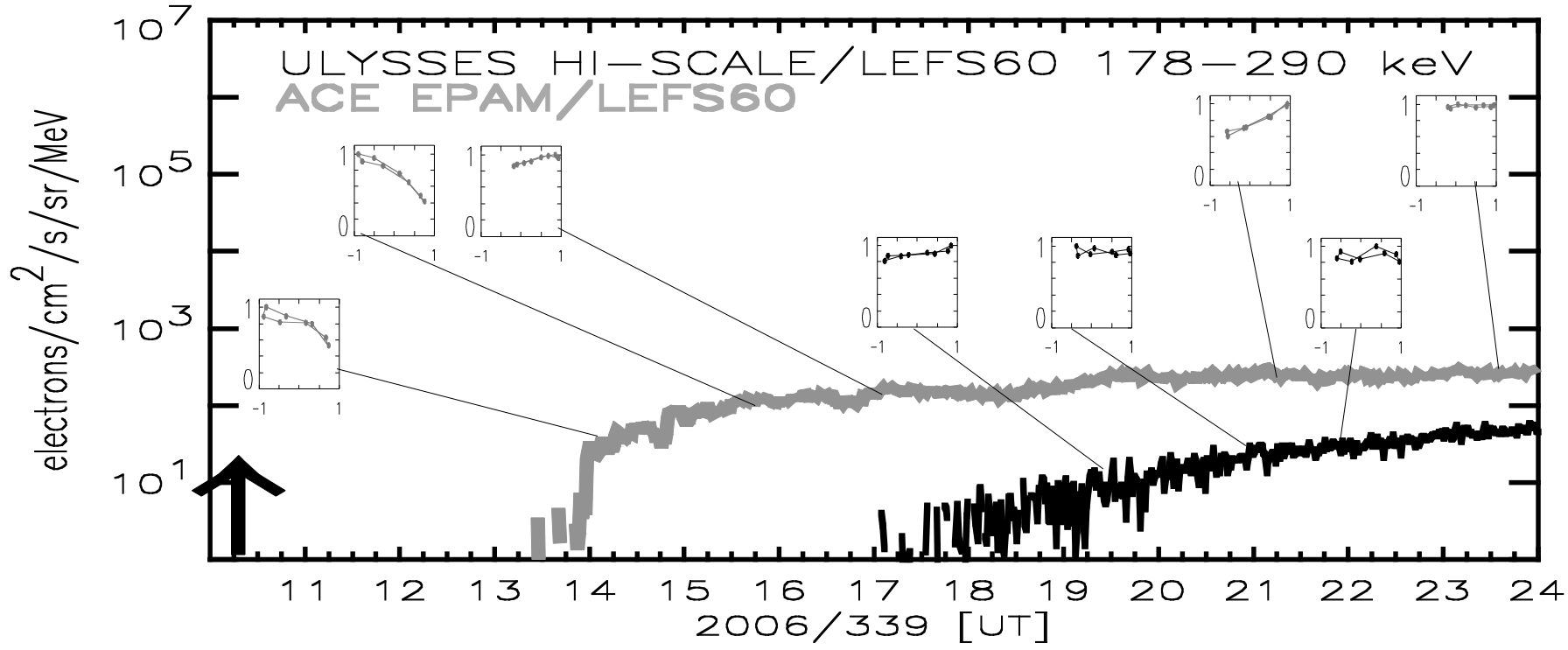

Radiation belt pass
Intensity (cm^2/sec/sr/MeV)
Day of Year 2006
p 1.8-3.6 MeV
p 4-6 MeV
p 6-10 MeV
p 10-15 MeV
E79
E63
W24
W44

STEREO-B

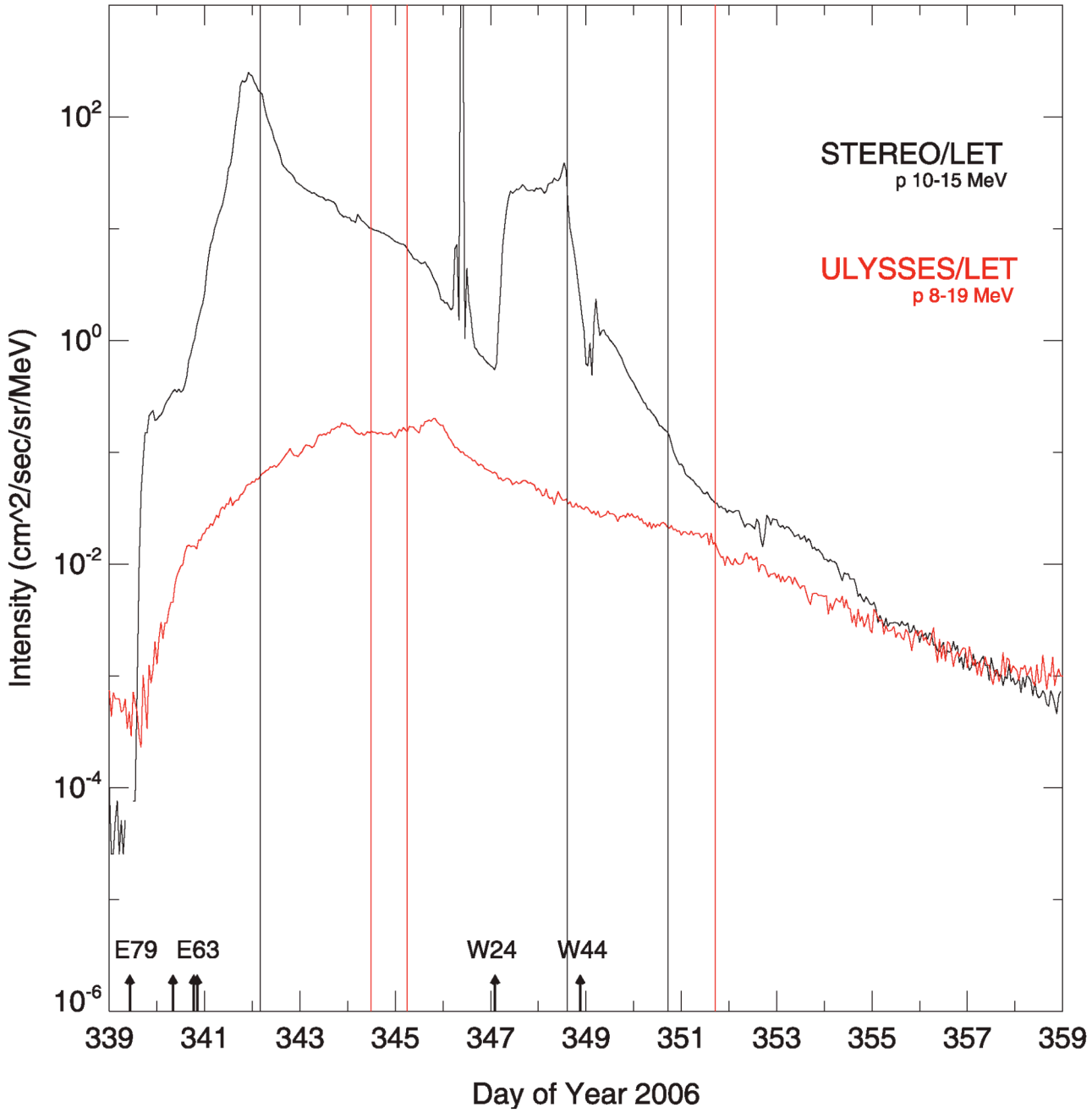
ULYSSES/ACE OBSERVATIONS



Near-isotropic angular distributions at the onset (*Ulysses*)



ULYSSES/STEREO-B OBSERVATIONS



December 2006 SEP events

- Unique observation of a high latitude event in the history of Ulysses mission during a period of relatively quiet and stable conditions in the heliosphere
- Simple structure of the heliosphere and Ulysses in high-speed coronal hole flow exclude the possibility that low latitudes magnetic fields lines reached Ulysses
- EP released when the propagating coronal waves reached high latitude magnetic field lines connected to Ulysses/ EP underwent perpendicular diffusion
- Risephase of the event at STEREO & ACE in response to the X9.0 flare faster than at Ulysses ⇒ more diffusive transport to high latitudes and to 3 AU than to STEREO, ACE
- 'Reservoir effect' observed late in the decay phase of the particle events

✓ **Malandraki et al., *Astrophys. J., 704*, 469, 2009**

EGU 2010, 2-7 May Vienna

- "ST1.1: Open session on the Sun and heliosphere (including Hannes Alfvén Medal Lecture)"

  Volker Bothmer, Bernd Heber, Olga Malandraki

- "ST1.4: Magnetic topology and energetic particles in the solar system“

  Claire Foullon, Harald Kucharek, Olga Malandraki