Energetic particle environment as seen by SphinX

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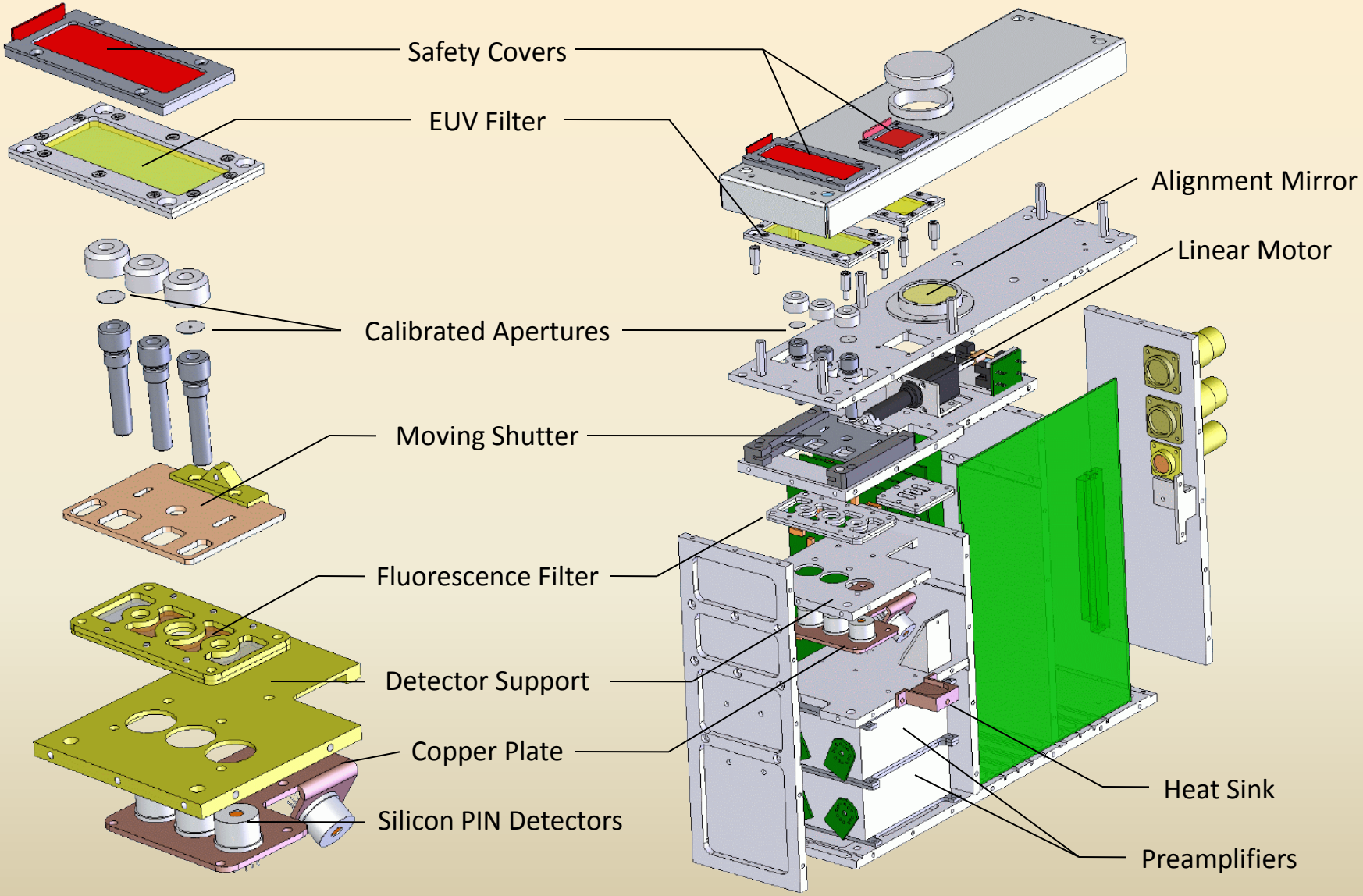
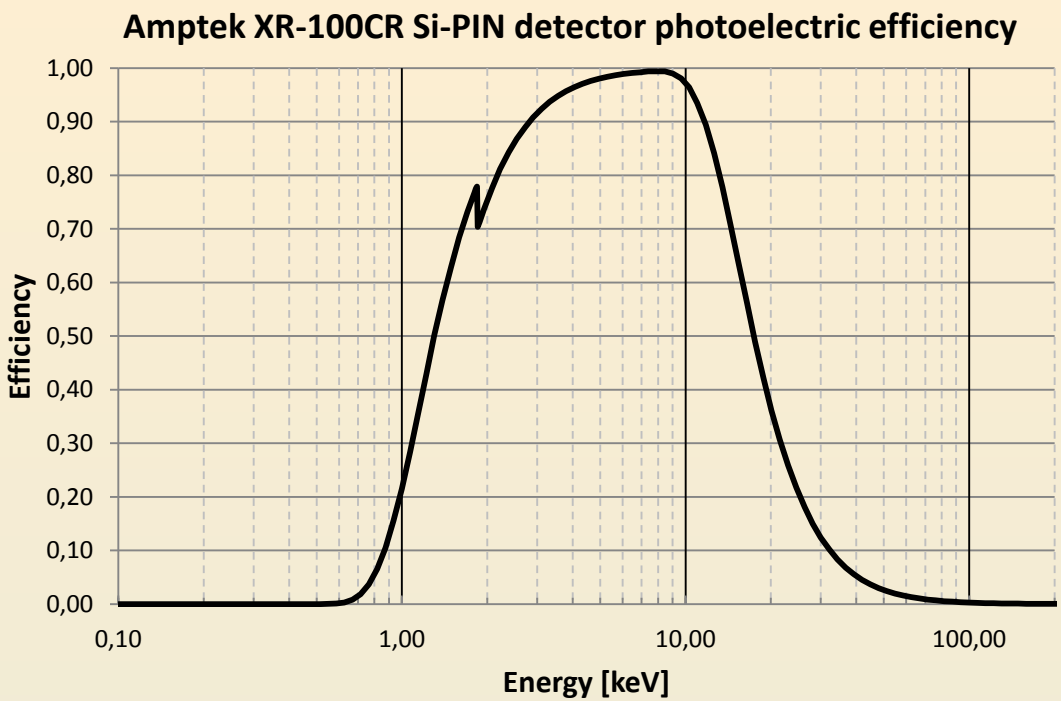
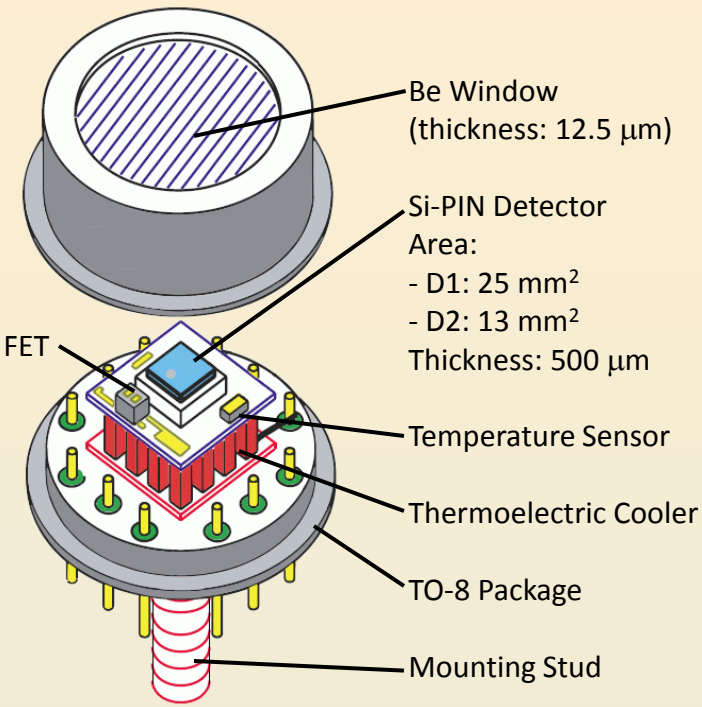
SphinX mechanical construction outline



SphinX detector

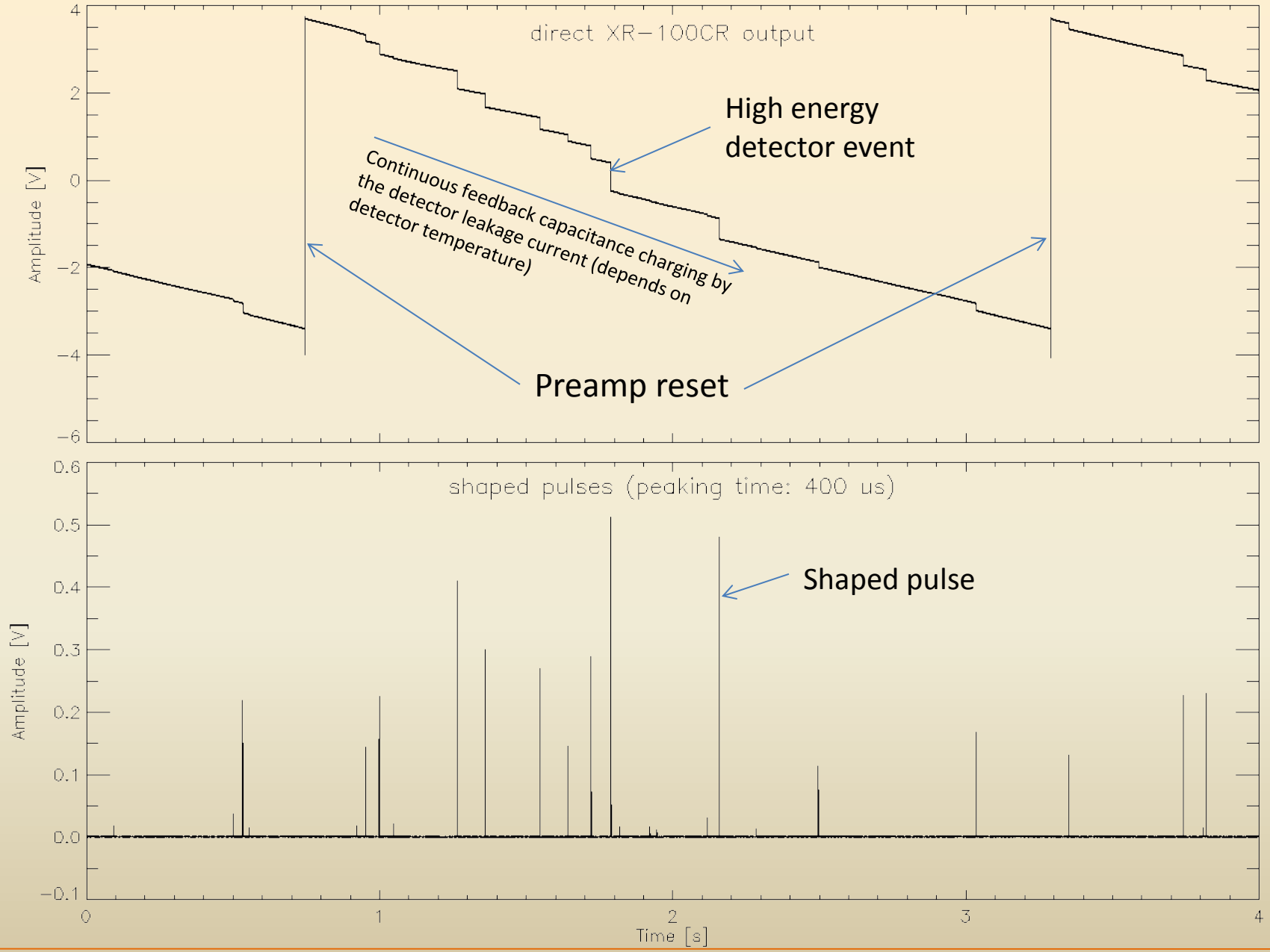




Preamplifier:

- Charge sensitive
- Sensitivity: 1 mV/keV (typical)
- Reset type
- Negative output

Detector response to particles

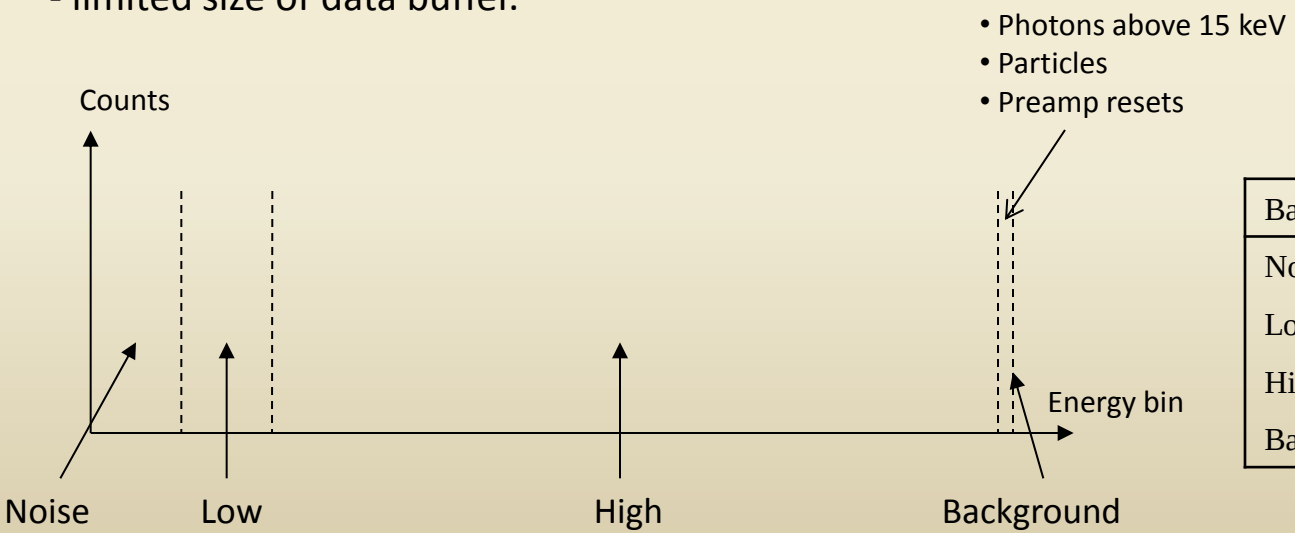


SphinX operation modes

Basic mode:
- provides only lightcurves in 4 energy bands,
- active all time while SphinX operated.

Spectral mode:
- provides spectra (256 channels),
- active only for selected time periods.

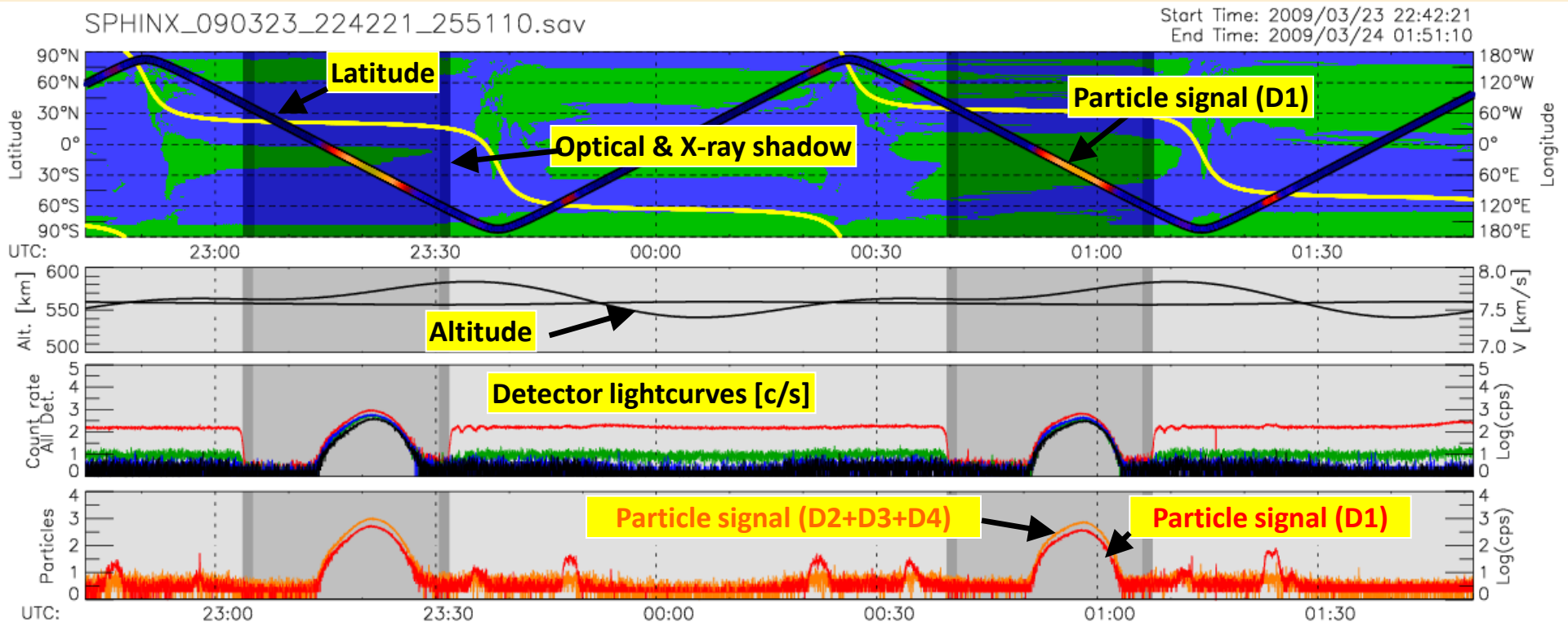
Sequence mode:
- provides full data – sequence of detector events recorded with their amplitudes and arrival times,
- active **most of the time,**
- allows for data reduction,
- limited size of data buffer.



energy bins

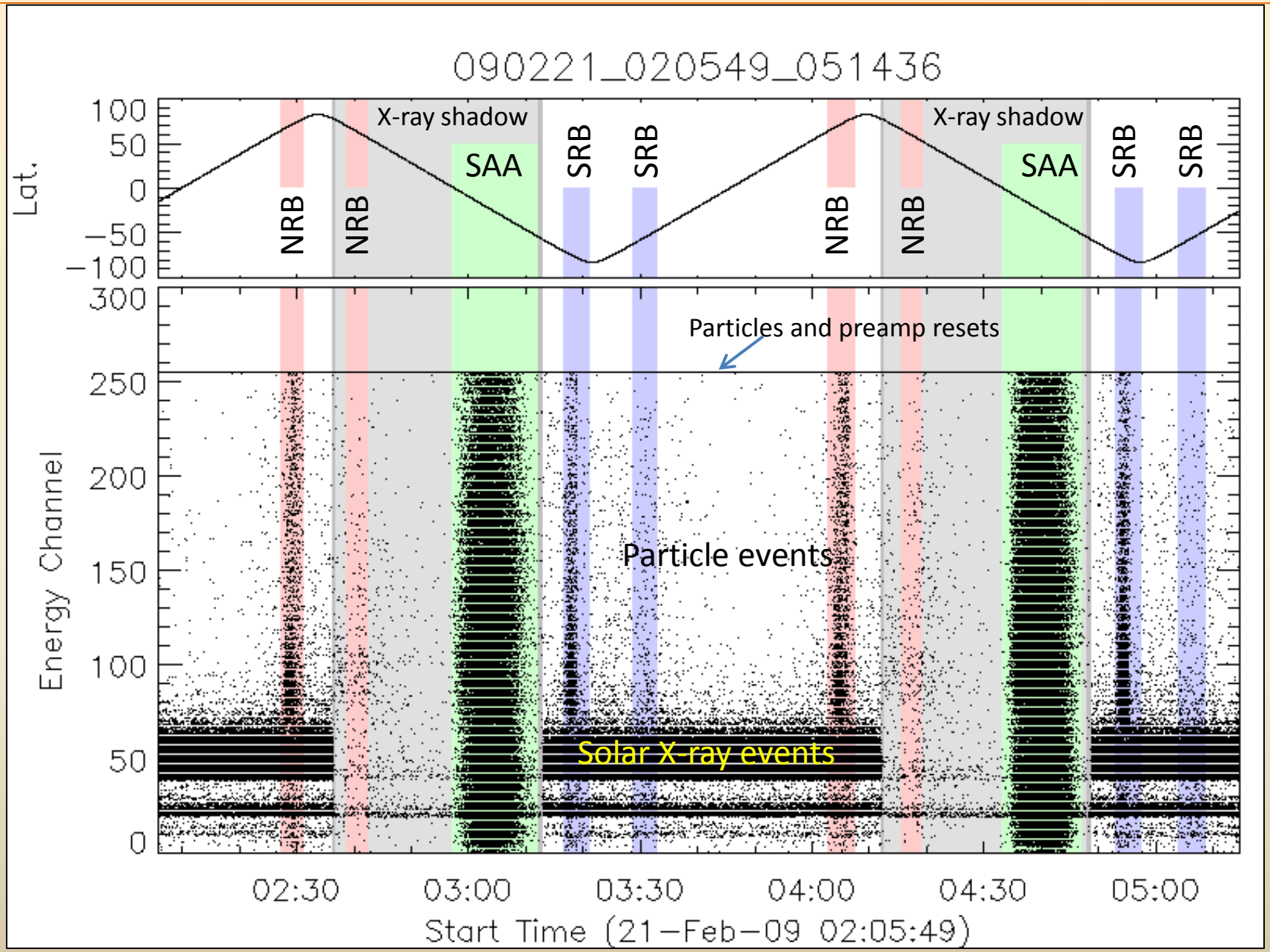
Band	D1	D2, D3
Noise	0 - 24	0 - 16
Low	25 - 50	17 - 50
High	51 - 253	51 - 253
Background	254 - 255	254 - 255

Example of SphinX particle signal (Level 0, basic mode)



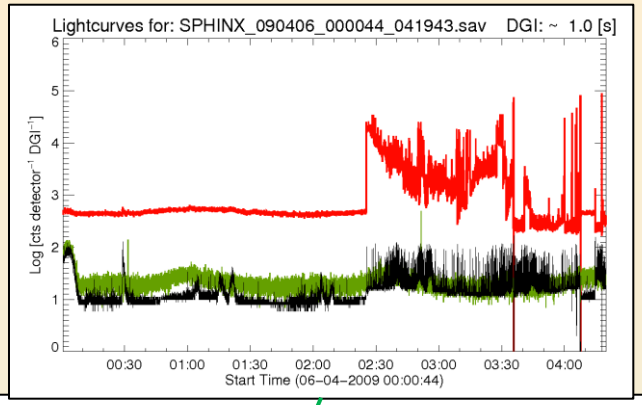
Detector D1 is sensitive to particles within SAA nad RB while D2 is sensitive mainly to particles within SAA.

Example of SphinX D1 particle signal (Level 0, sequence mode)

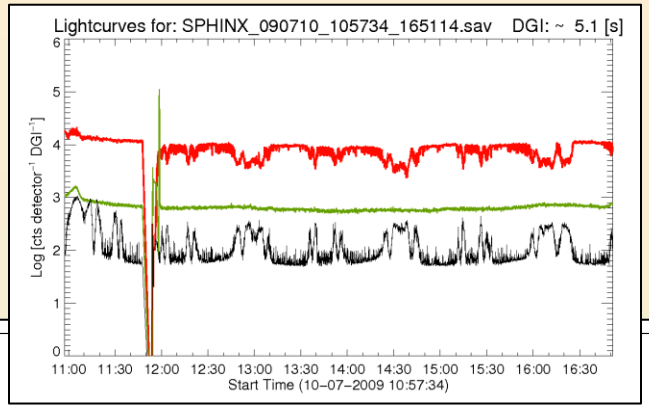


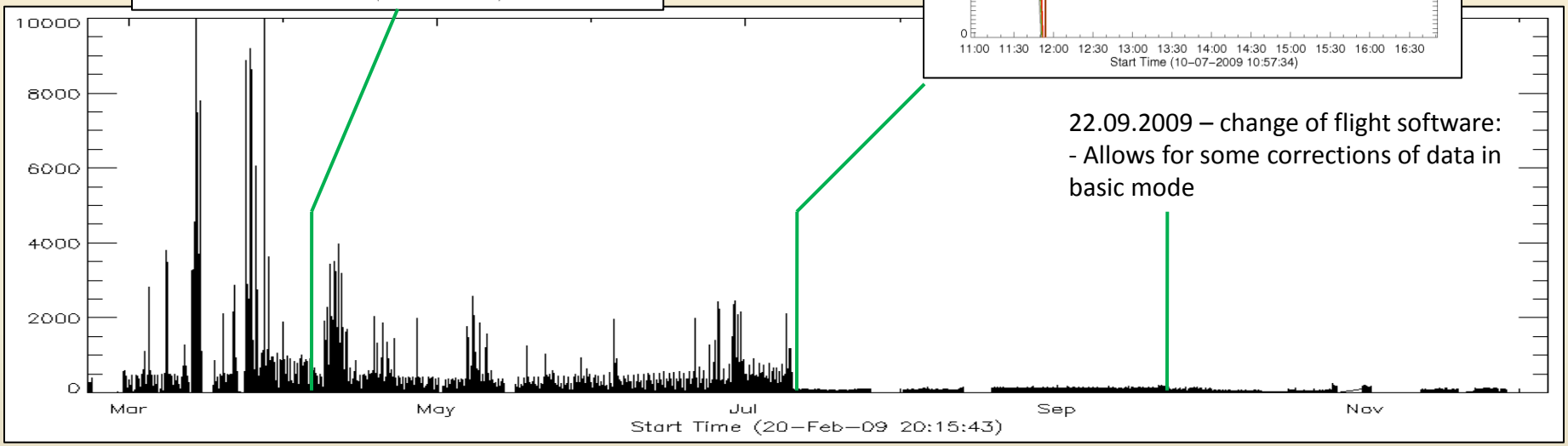
SphinX D1 particle signal

06.04.2009 – permanent D1 preamp malfunction



10.07.2009 – change of flight software:
- Improvement of data quality in sequence mode
- degradation of data quality in basic mode





22.09.2009 – change of flight software:
- Allows for some corrections of data in basic mode

Condition of SphinX D1 particle signal:

20.02.2009 - 06.04.2009 – excellent D1 data quality (sequence mode allows for further improvements)

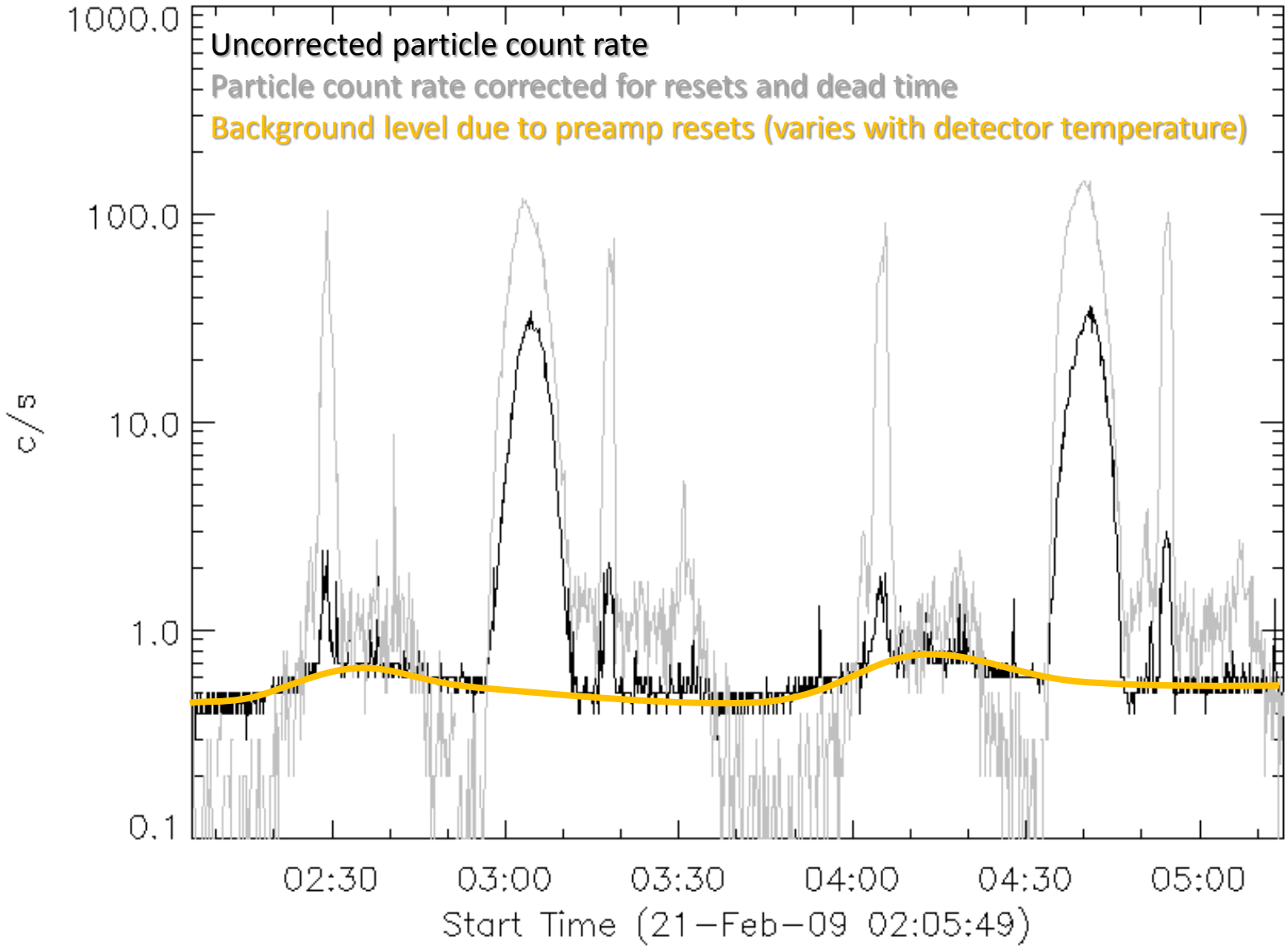
06.04.2009 - 10.07.2009 – deteriorated D1 data quality. The data may be useful for analysis after some corrections.

10.07.2009 - 22.09.2009 – insufficient D1 data quality for any analysis

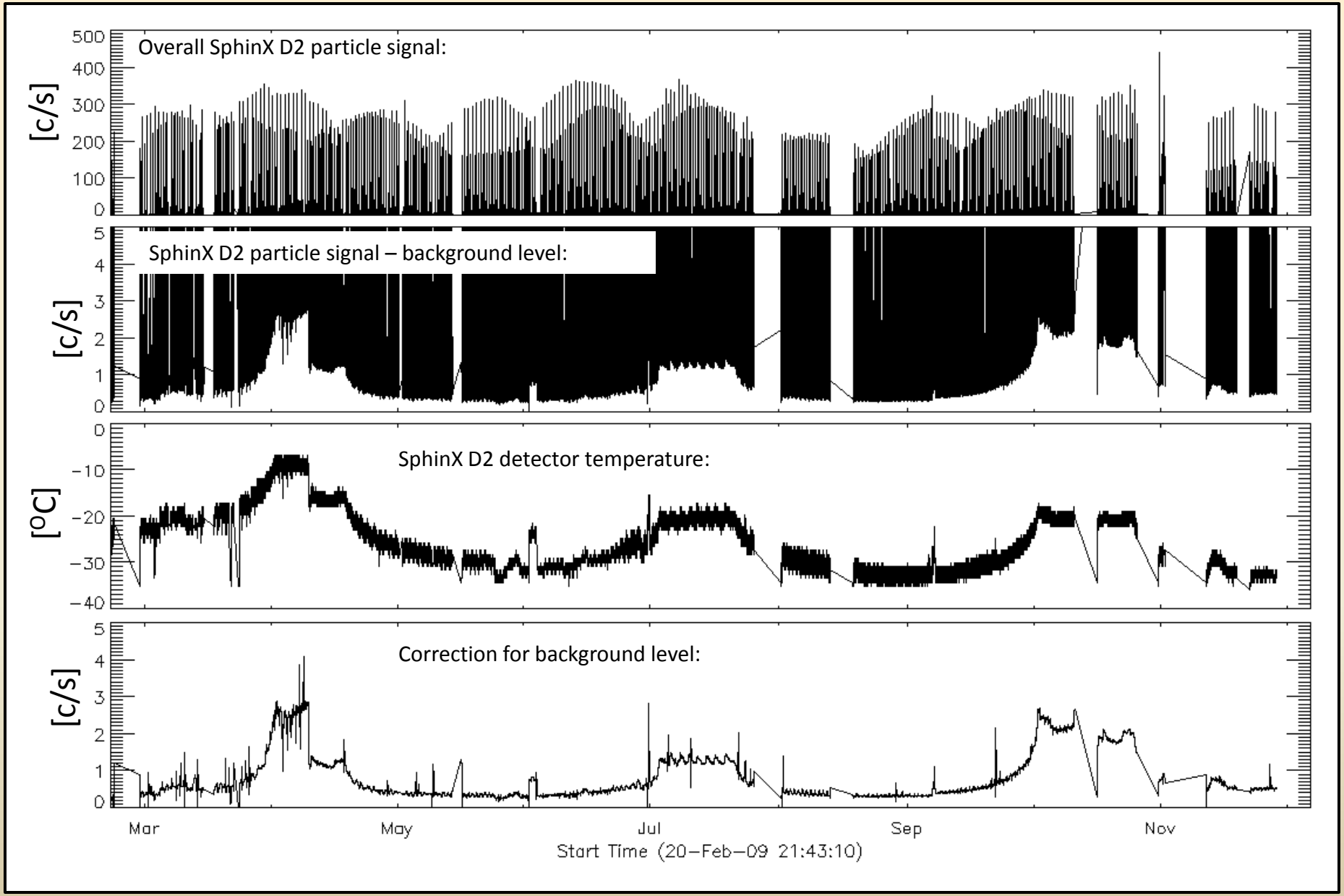
22.09.2009 - 29.11.2009 – insufficient D1 data quality for any analysis (may be useful after some corrections).

Improvement of D1 particle signal quality

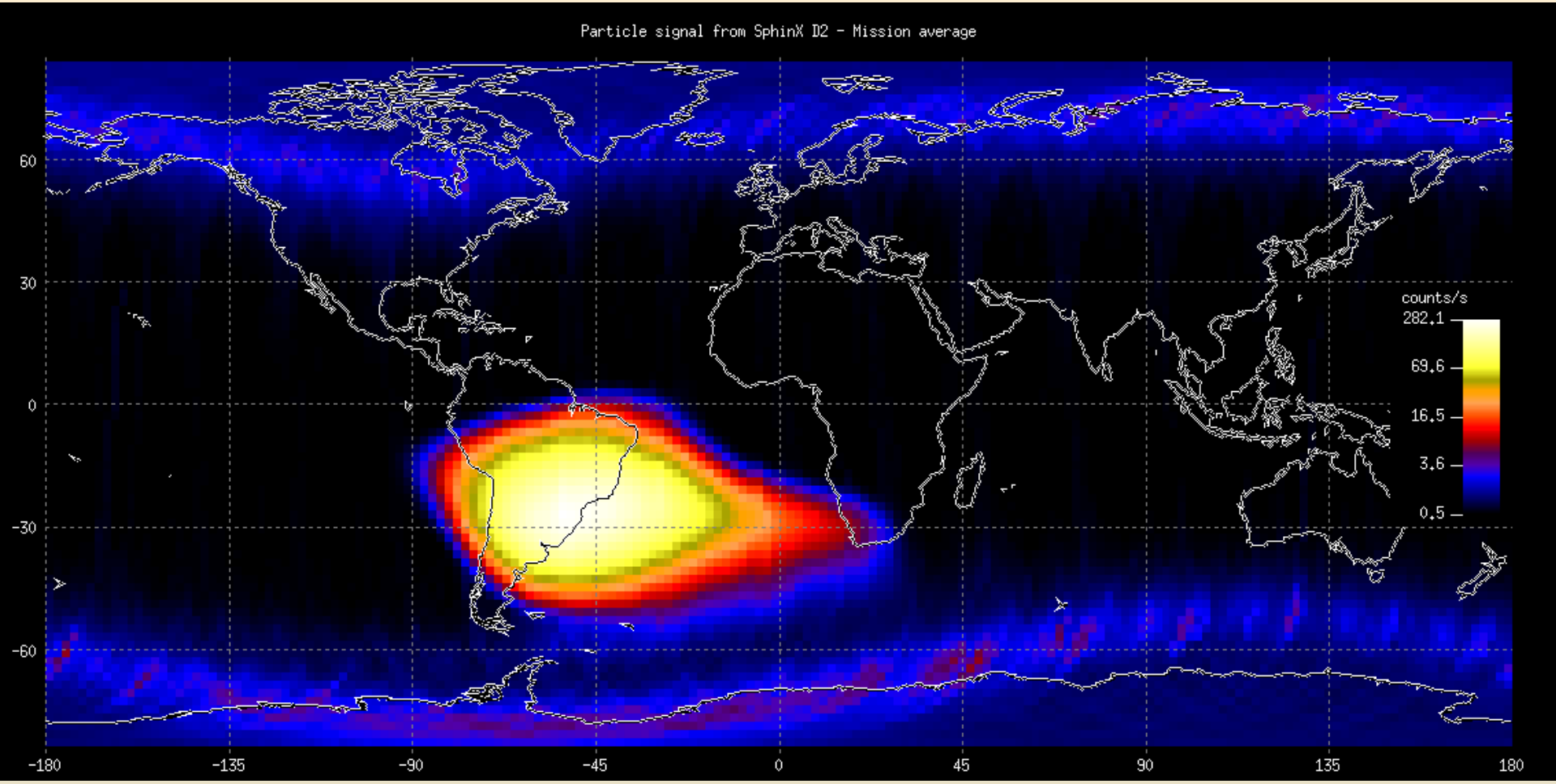
(Possible only for time period from 20.02.2009 to 06.04.2009)



SphinX D2 particle signal

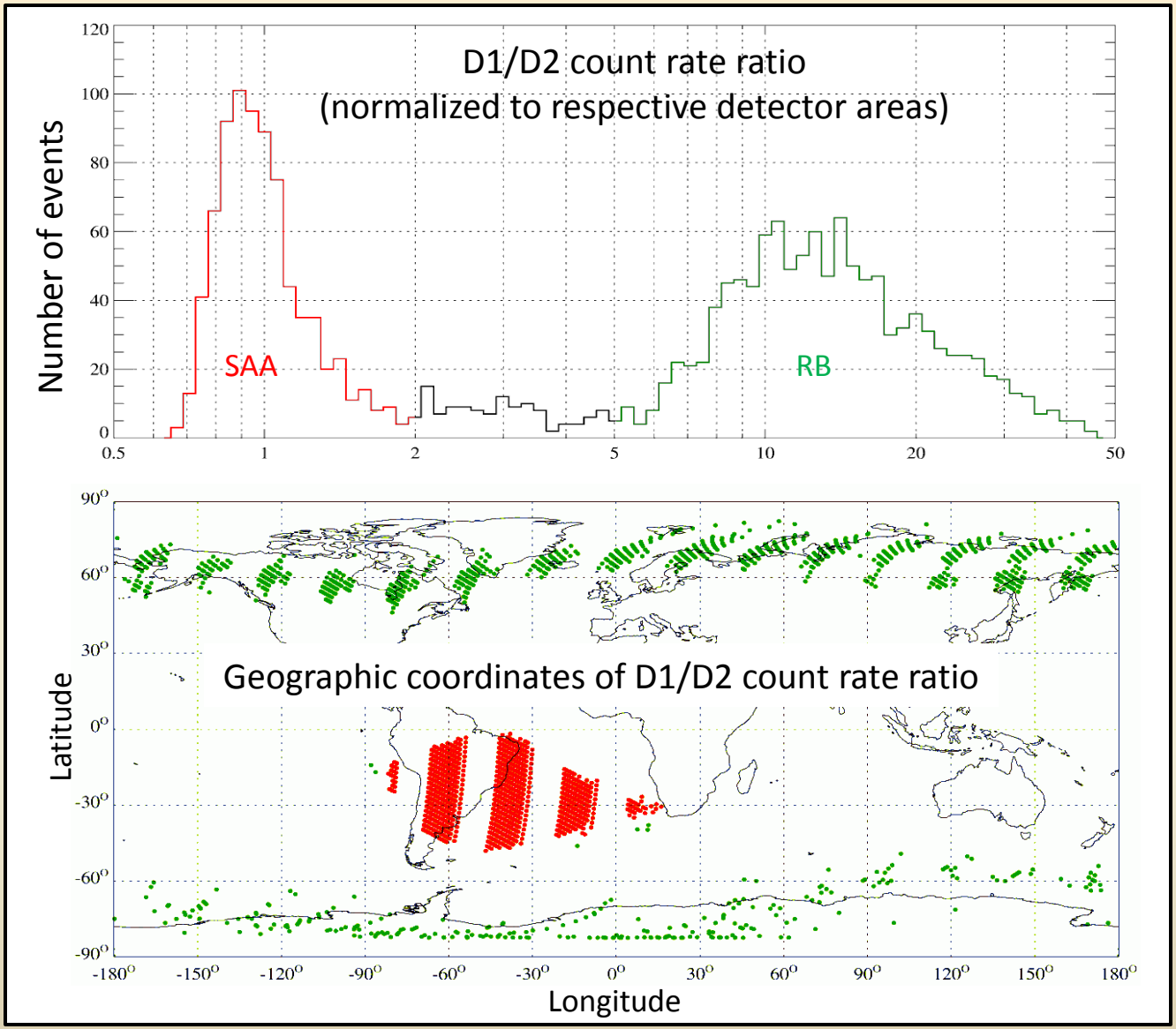


Reconstruction of Earth's particle environment



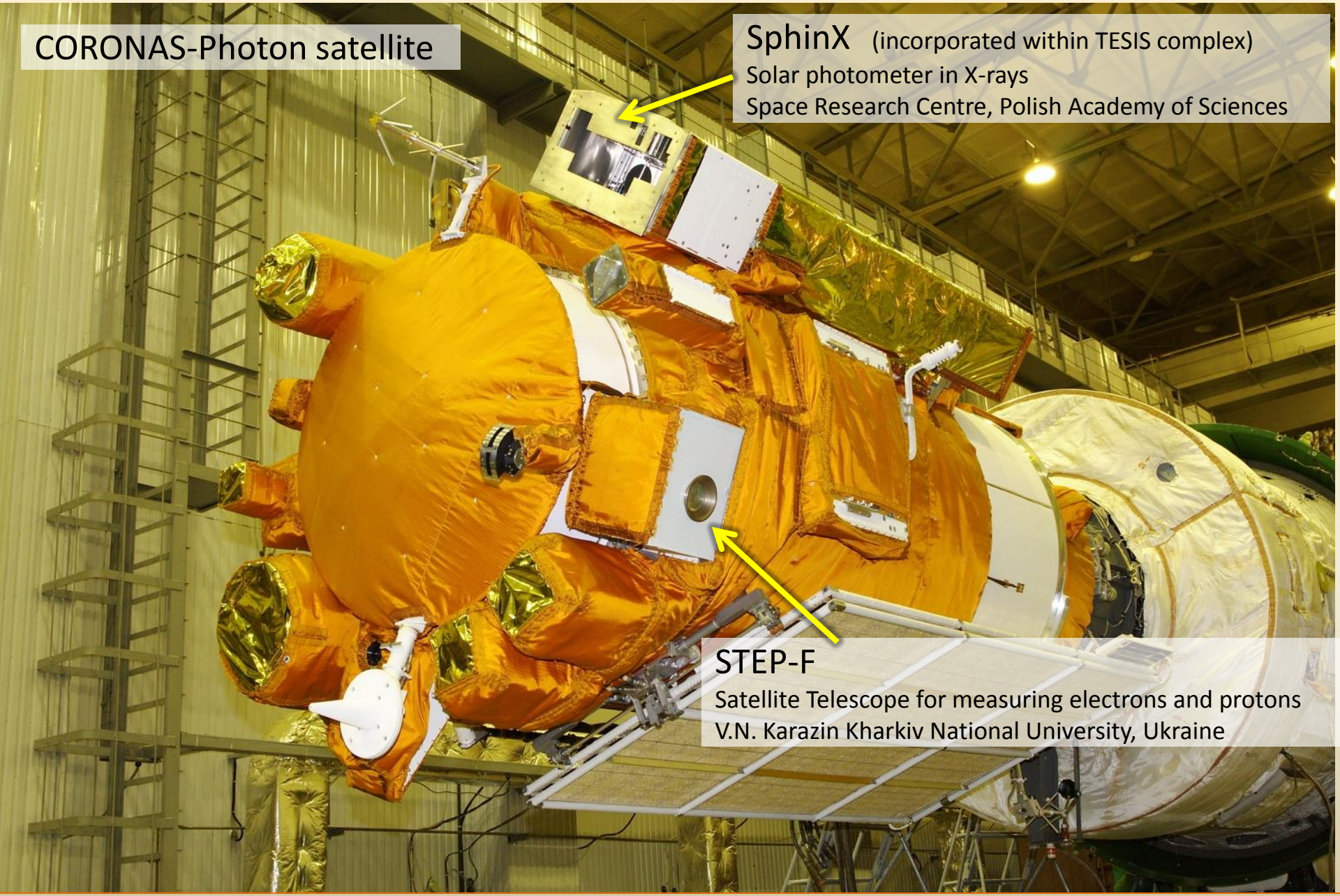
Count rate distribution in geographic coordinates obtained from SphinX D2 detector (basic mode) after background level correction. The map is averaged over whole observation period from February 20 to November 29, 2009.

SphinX sensitivity to particles



[O. V. Dudnik et al.
X-RAY SPECTROPHOTOMETER SPHINX AND PARTICLE SPECTROMETER STEP-F OF THE SATELLITE EXPERIMENT CORONAS-PHOTON – PRELIMINARY RESULTS OF JOINT DATA ANALYSIS, Solar System Research, 2012, Vol. 46, No. 2, pp. 160–169]

SphinX – STEP-F joint data analysis



SphinX – STEP-F joint data analysis

STEP-F is a telescope for measuring electron and proton fluxes aboard CORONAS-Photon satellite.

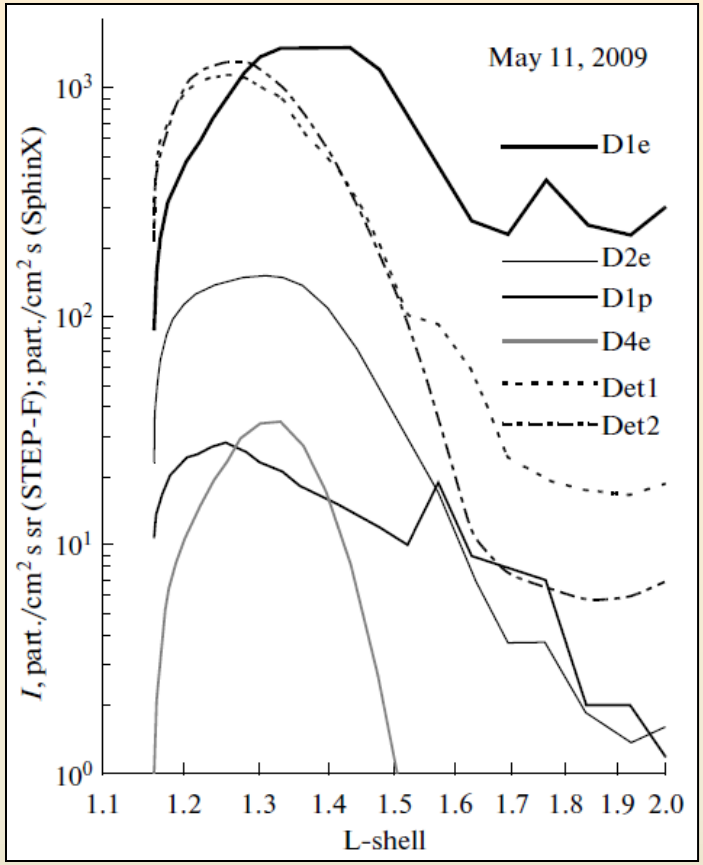
The STEP-F instrument provides registration of:

- electron fluxes and energy spectra in the energy range Ee = 0.18 – 2.3 MeV,
- electron fluxes in integral range Ee > 2.3 MeV,
- proton fluxes and energy spectra in the energy range Ep = 3.5 - 55.2 MeV,
- proton fluxes in integral range Ep > 55.2 MeV,
- alpha-particle fluxes and energy spectra in the energy range Ea = 15.9 - 160.0 MeV.

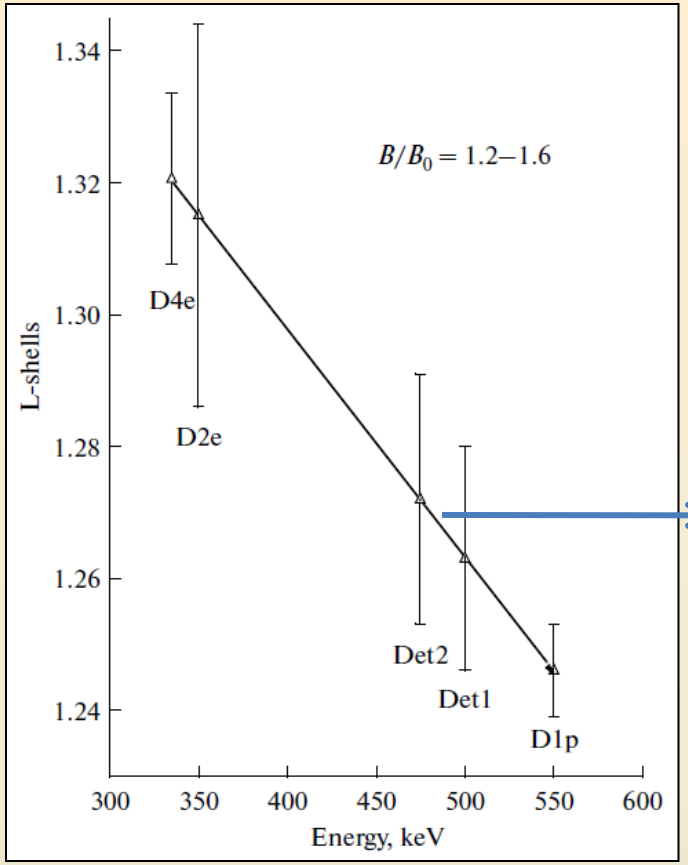
Registration channels used for common analysis:

	SphinX		STEP-F			
Detector/channel name	Det1	Det2	D1e	D1p	D2e	D4e
Recorded energy range, MeV	–	–	electrons $\Delta E_e = 0.18–0.51$ + protons $\Delta E_p = 3.5–3.7$	protons $\Delta E_p = 3.7–7.4$ + electrons $\Delta E_e = 0.55–0.95$	electrons $\Delta E_e = 0.35–0.95$	Secondary γ-radiation from electrons with $E_e \geq 0.6–0.8$
Detector type	Si PIN	Si PIN	Si PIN	Si PIN	Si PIN	CsI(Tl) + vacuum photomultiplier
Detector thickness, μm	500	500	380	380	380	5000
Active area, cm^2	0.215*	0.111*	17	17	17	49

Distribution of particle intensities by L-shells within SAA



An example of SAA particle flux in L-shell domain for four channels of STEP-F instrument and two SphinX channels.



dependence of L-shell positions at which maximum particle fluxes within SAA were observed on energy of electrons bound to the channels D2e and D1p of the STEP-F instrument.

Averaged energy thresholds for SphinX detectors in SAA:

$E_{thr1} \approx 500$keV (D1)
$E_{thr2} \approx 475$keV (D2)

(the values are not strictly fixed)

[O. V. Dudnik et al.
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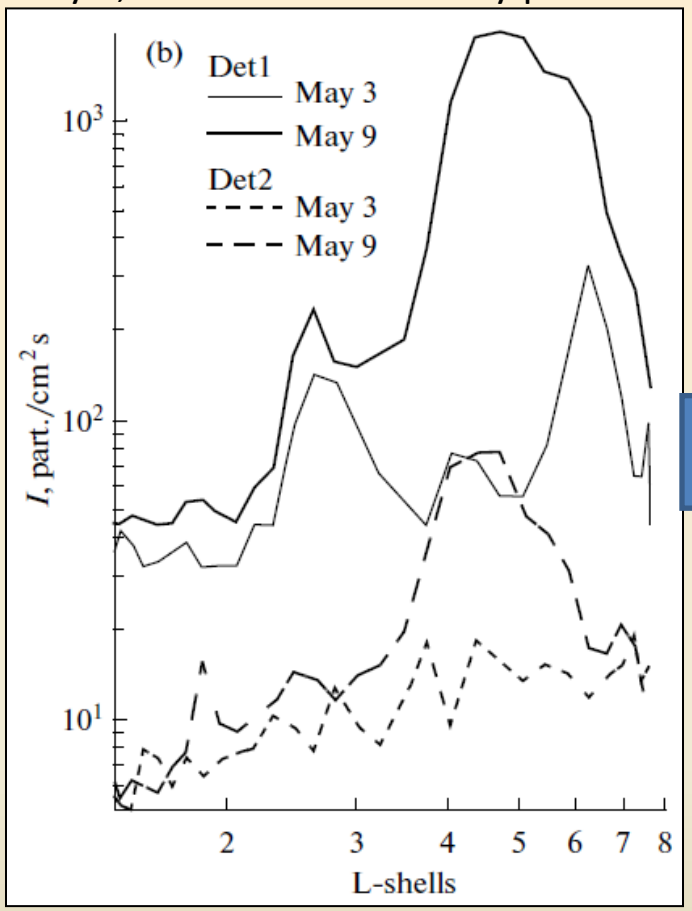
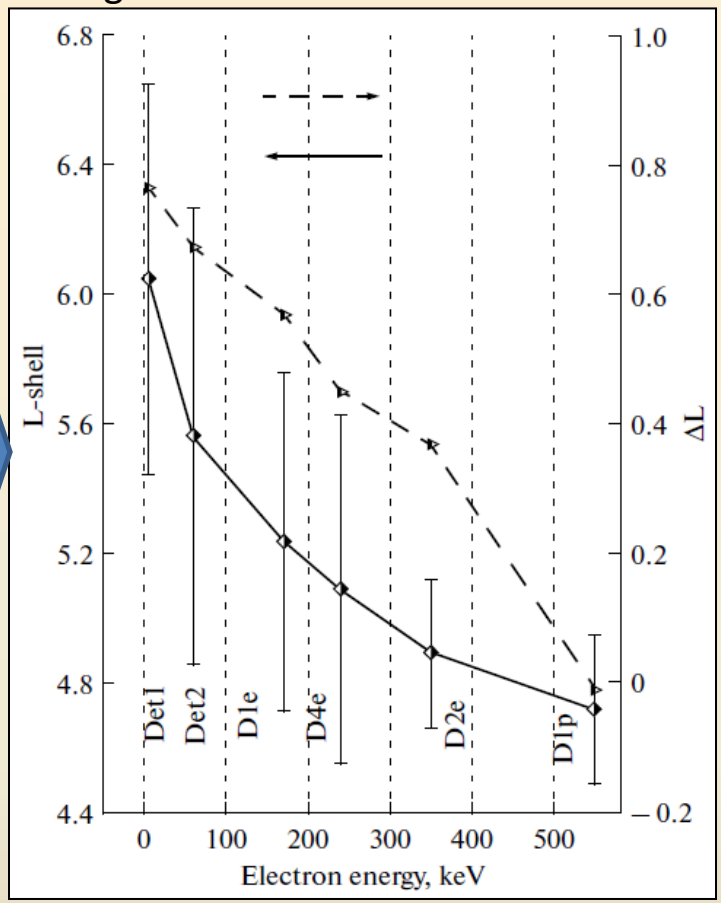
Distribution of particle intensities by L-shells within RB

May 3, 2009 - quiet conditions before geomagnetic storm,
May 9, 2009 - initial recovery phase from the magnetic storm



Changes of particle intensity distribution in nothern hemisphere due to geomagnetic storm as seen by SphinX



Initial values of L-shell positions of fluxes maxima in north hemisphere and ΔL displacement due to geomagnetic storm in dependency of electron energy

Averaged energy thresholds for SphinX detectors in RB:

$E_{thr1} \approx 5$keV (D1)
$E_{thr2} \approx 60$keV (D2)

(the values are not strictly fixed)

[O. V. Dudnik et al.
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Comparison of SphinX and STEP-F daily particle maps

04.05.2009

SphinX

SPEP-F

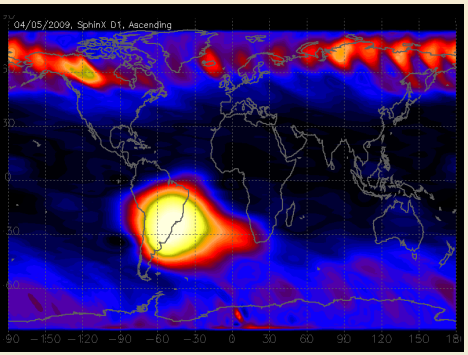
D1:

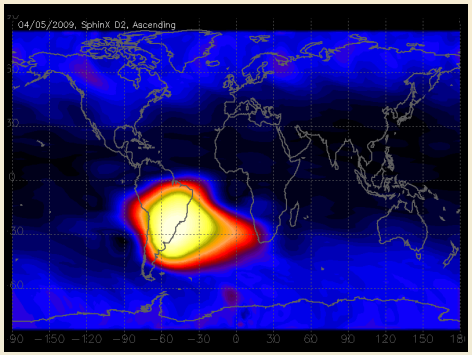
D2:

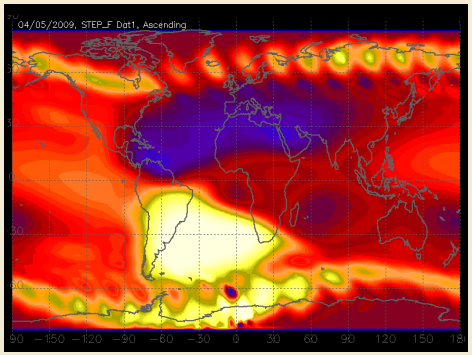
D1-e:

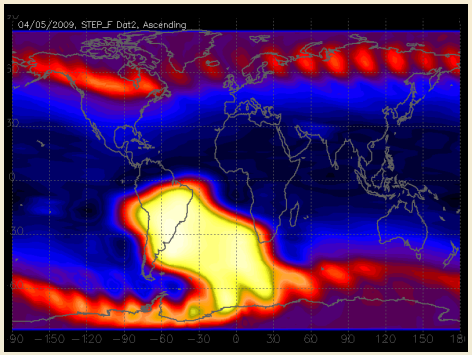
D1-p:

ascending:

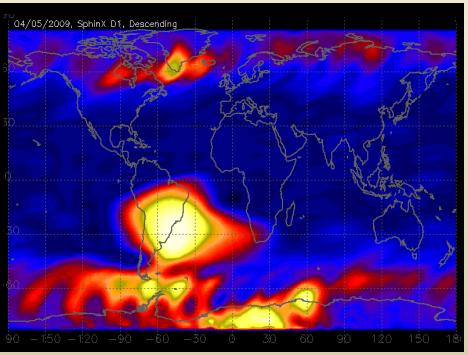


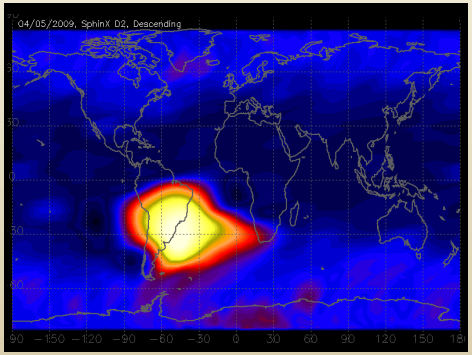


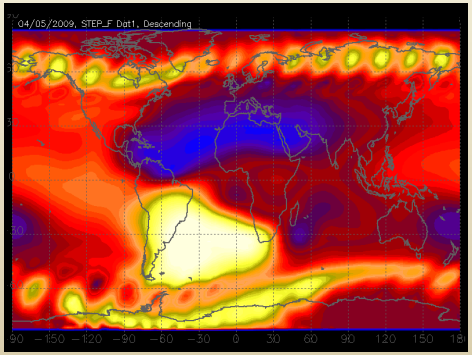


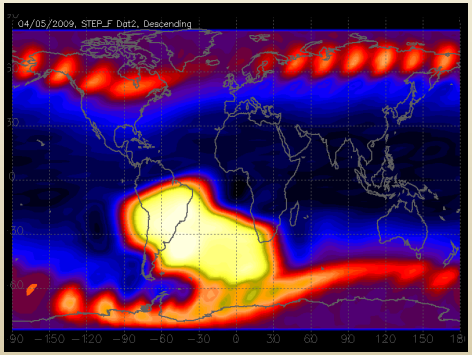


descending:









Comparison of SphinX and STEP-F daily particle maps

11.05.2009

SphinX

SPEP-F

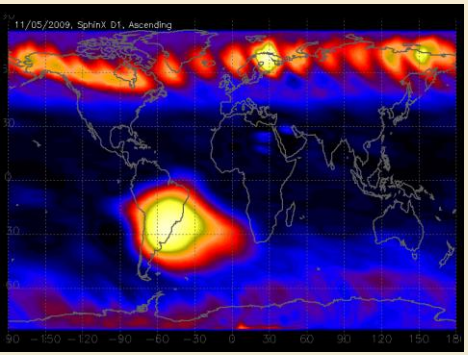
D1:

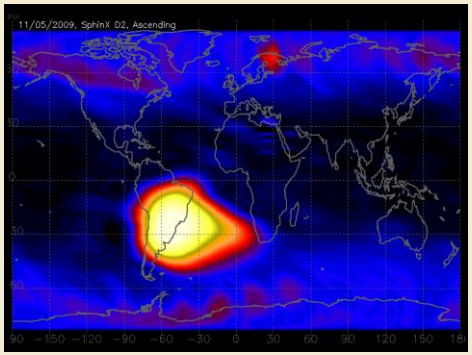
D2:

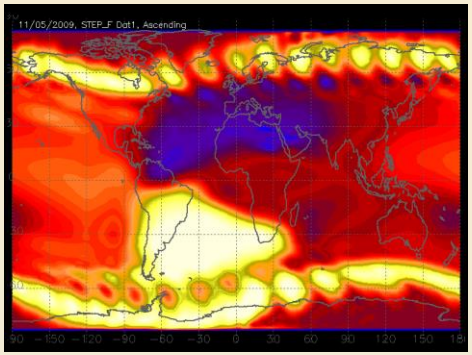
D1-e:

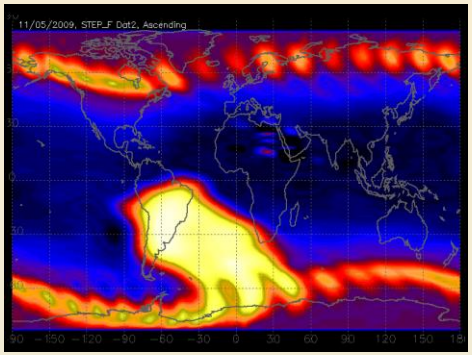
D1-p:

ascending:

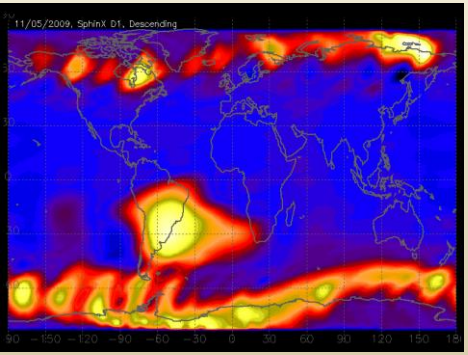


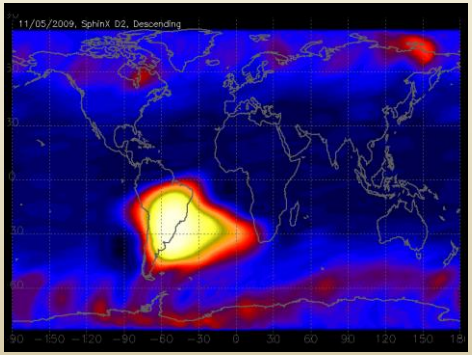


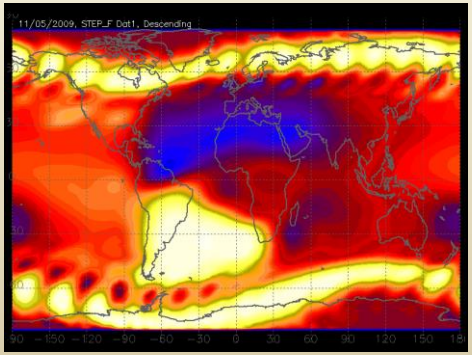


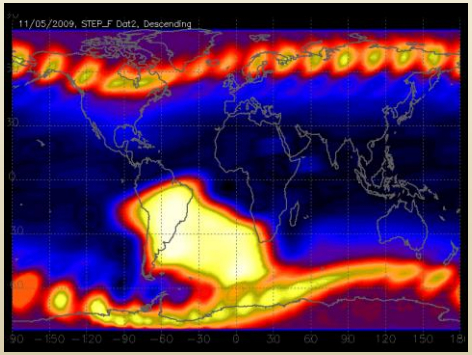


descending:









Thank you