

**R O S E T T A**  
**FLIGHT REPORTS**  
**of RPC-MAG**

**RO-IGEP-TR-0018**

**Issue: 2    Revision: 0**

**January 27, 2010**

**Report of the**  
**45P/Honda-Mrkos-Pajdusakova**  
**Tail Encounter**

**Time period: July 04. - July 08., 2006**

Ingo Richter  
Karl-Heinz Glassmeier

Institut für Geophysik und extraterrestrische Physik  
Technische Universität Braunschweig  
Mendelssohnstraße 3, 38106 Braunschweig  
Germany

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## 1 Overview

This document describes the observation of the tail of comet 45P/Honda-Mrkos-Pajdusakova. RPC-MAG was switched on at 00:02:43 on July 4, 2006 and switched off at 23:54 on July 8, 2006.

The magnetometer worked flawlessly. The operating temperature of the sensors was about  $-109^{\circ}\text{C}$ . For the first time during the ROSETTA mission the OB and IB sensor showed a nearly perfect synchronous run for 5 days after reaching the thermal equilibrium about 12 hours after switch on.

RPCMAG was operated in normal mode (SID2) for all the time. There is no impact of the reaction wheels to be seen in the magnetic field data.

The magnetic field data are highly structured. A first quick view analysis revealed many events that appeared also in the LAP data. Therefore, an in depth analysis of MAG and LAP data (or even more instruments) seems to be a promising task.

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**2 July 4, 2006**

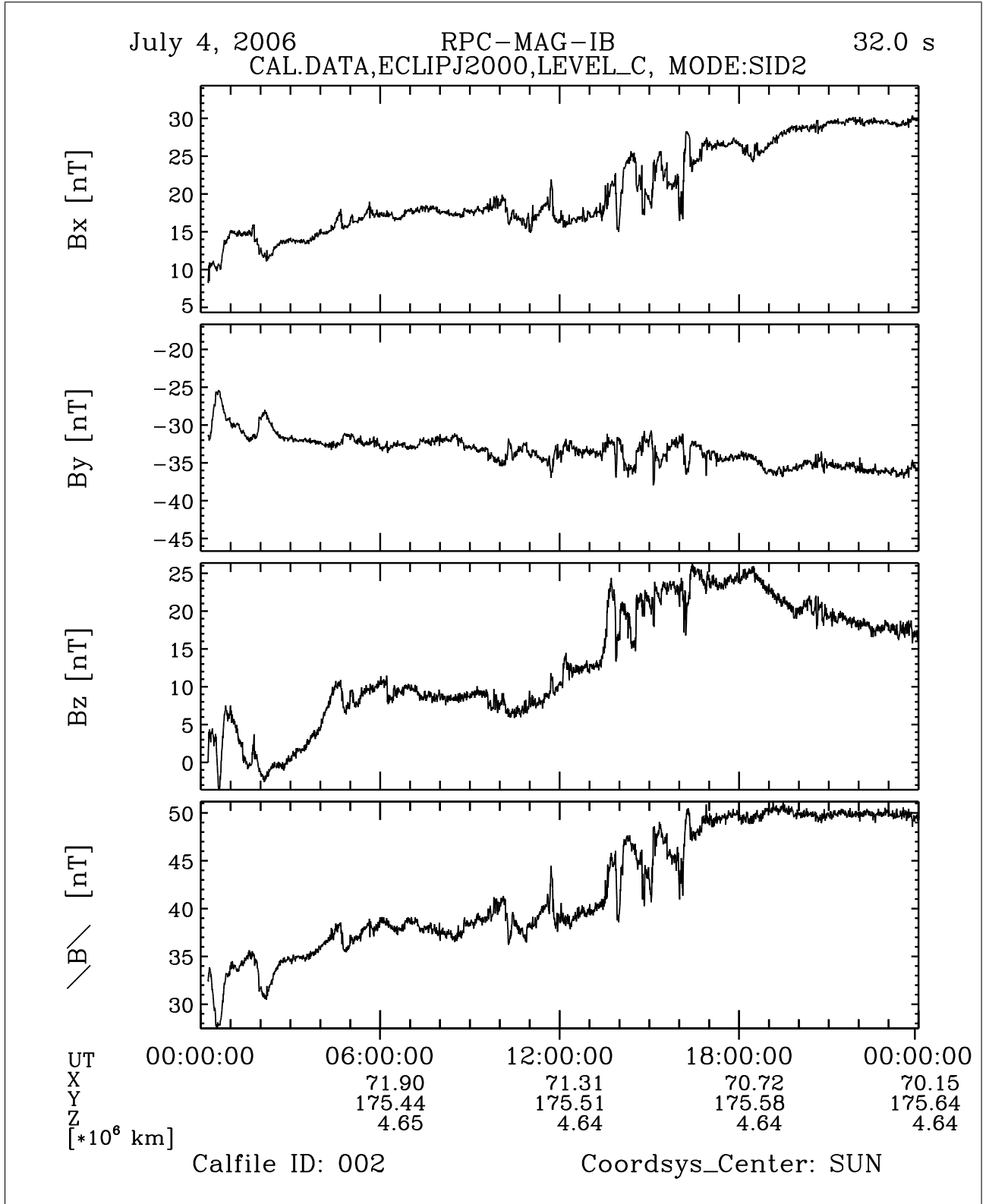


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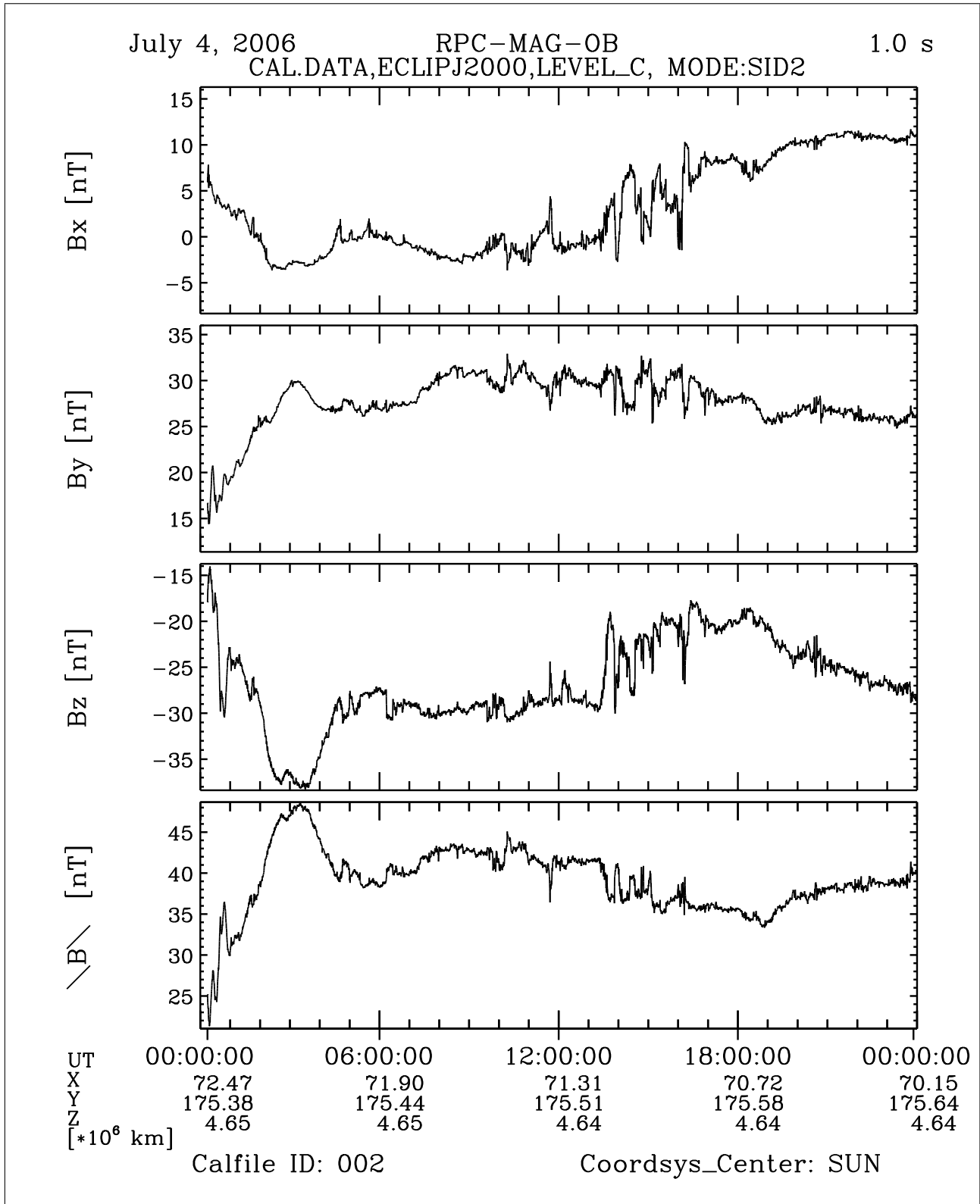


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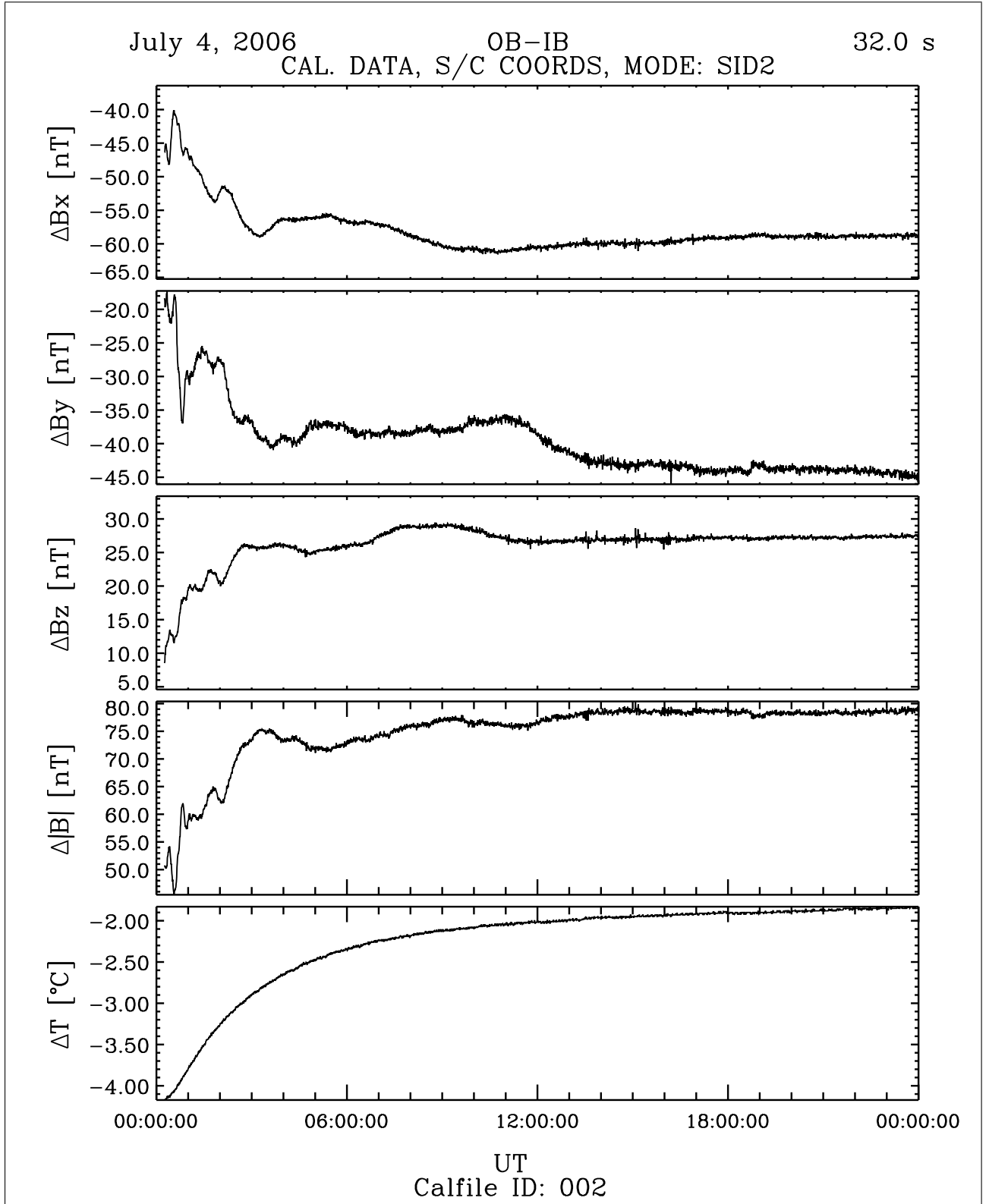


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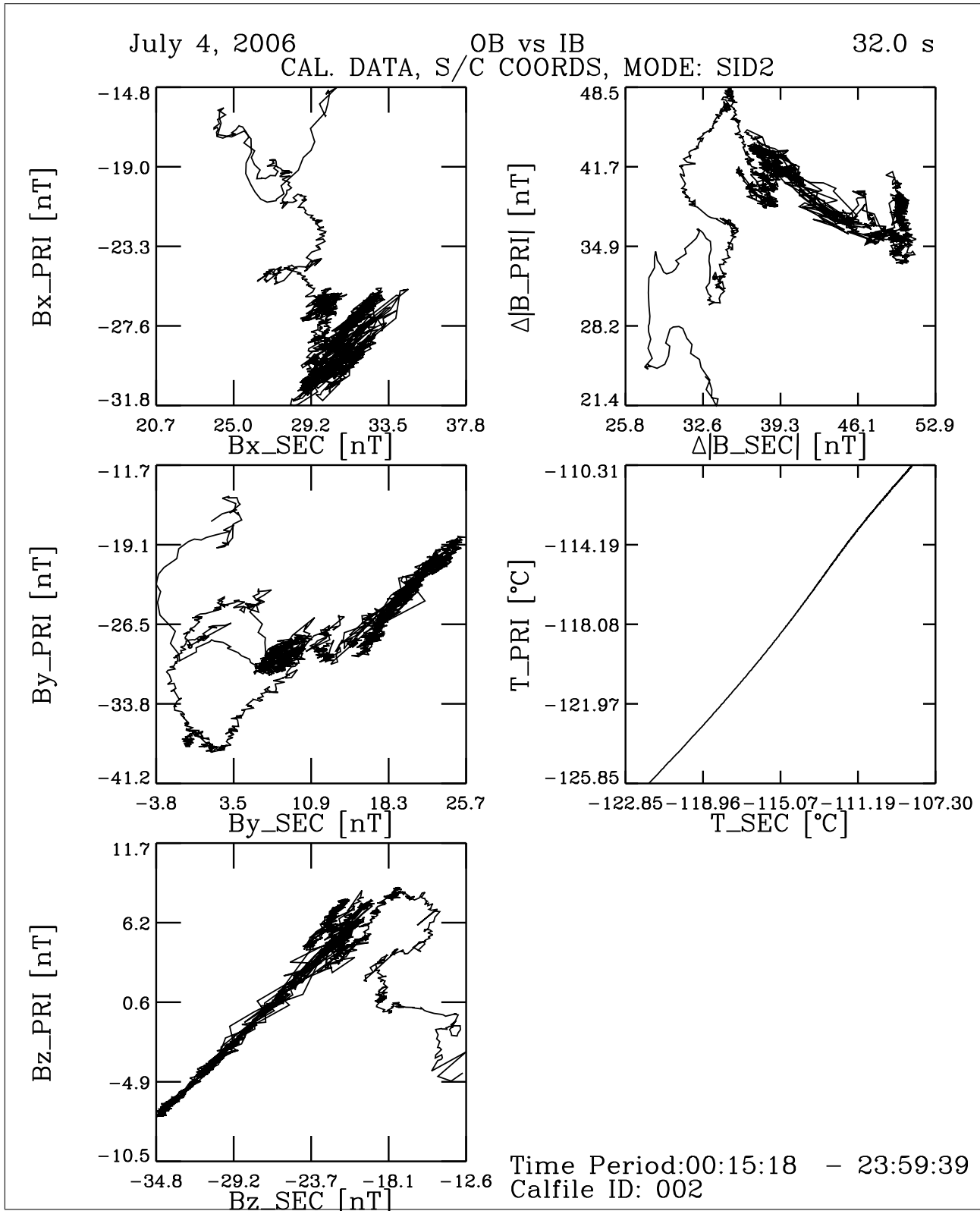


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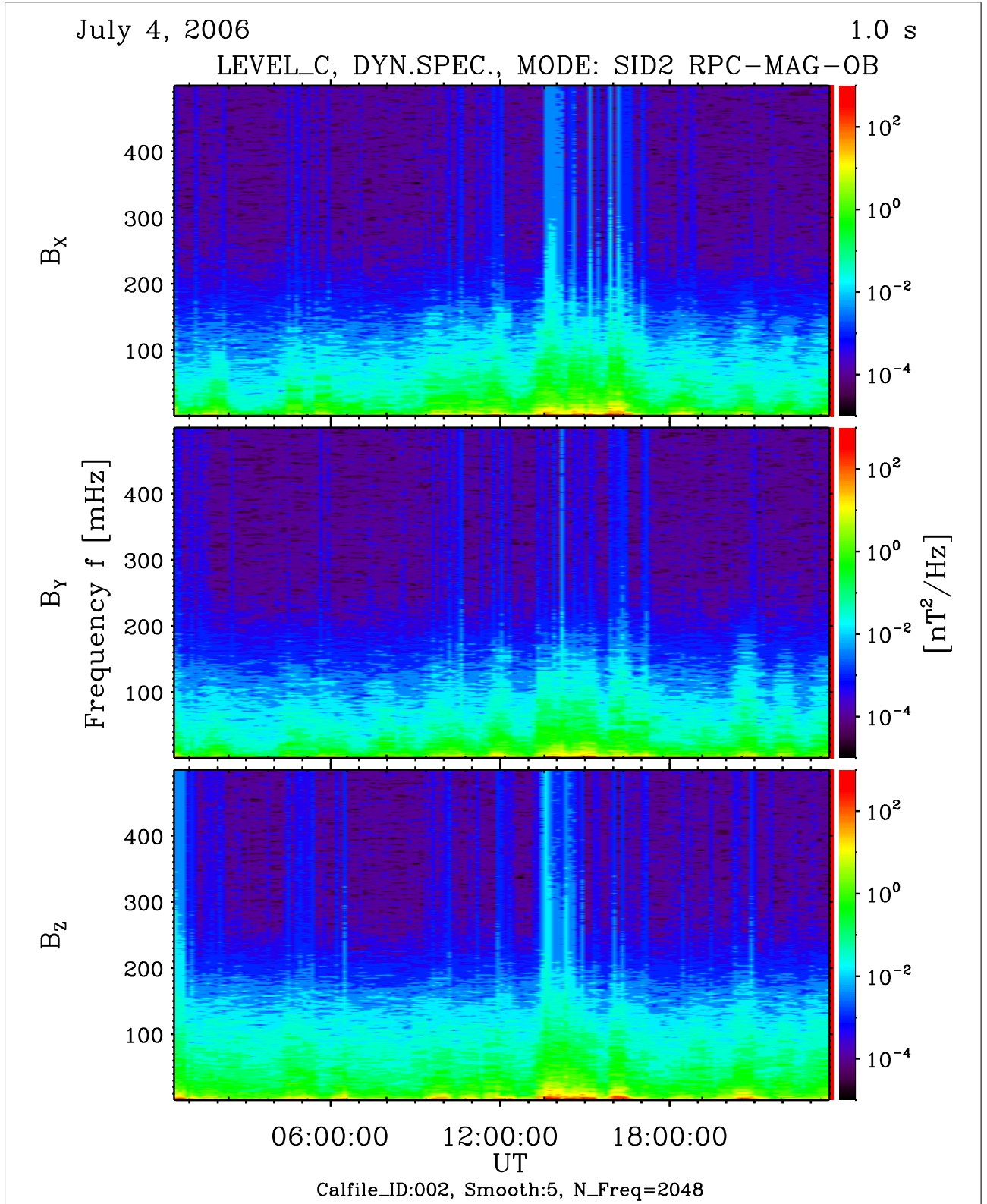


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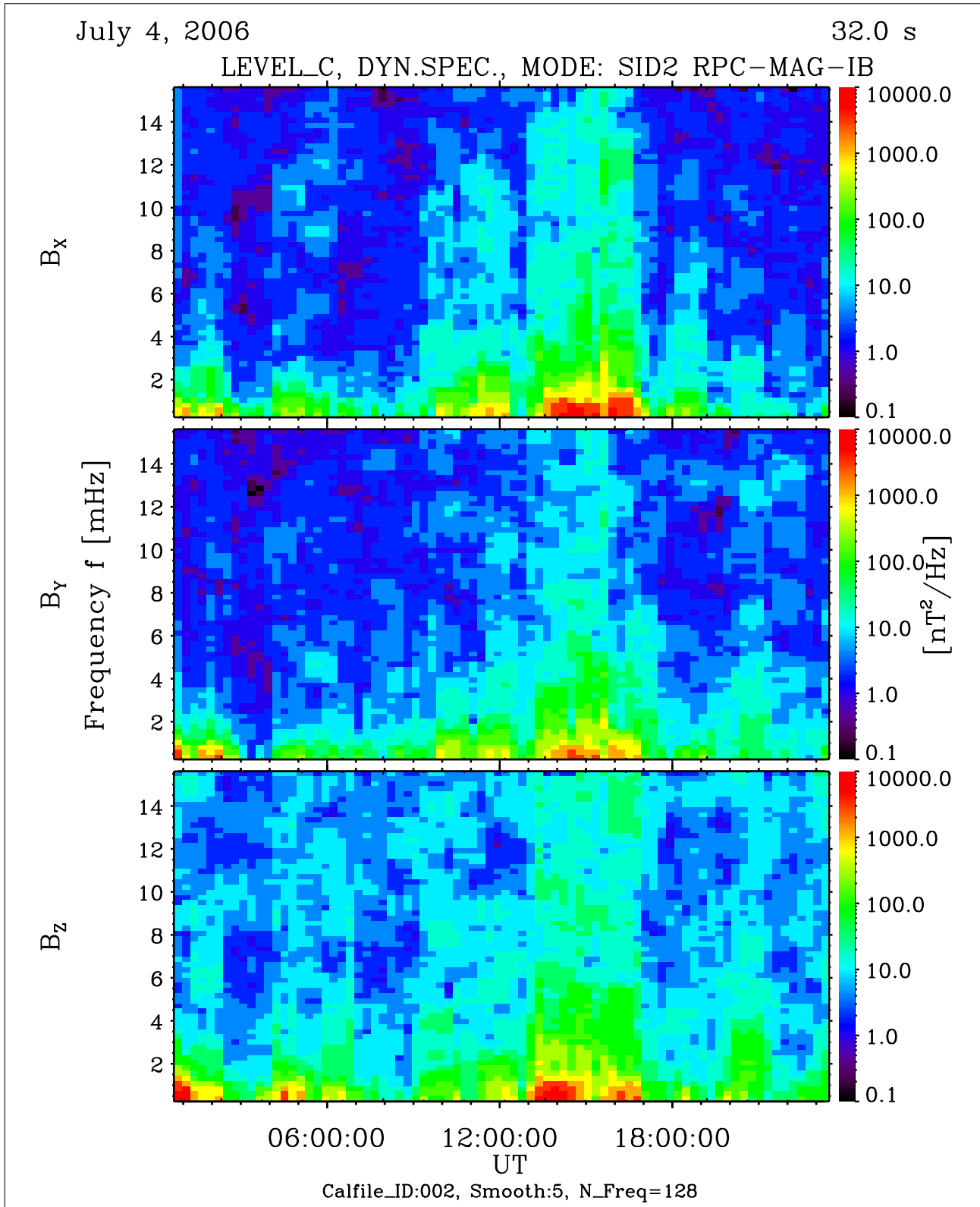


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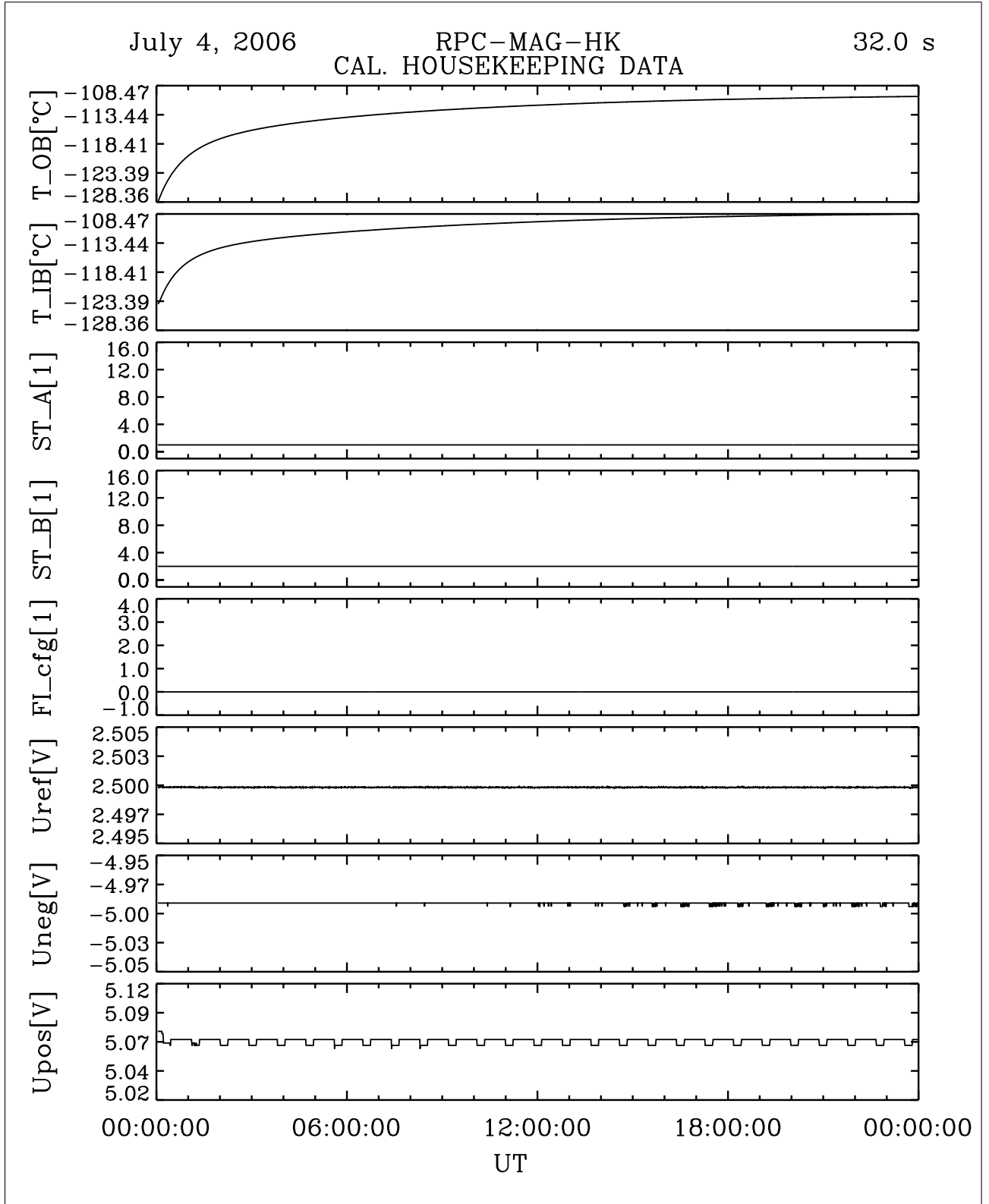


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**3 July 5, 2006**

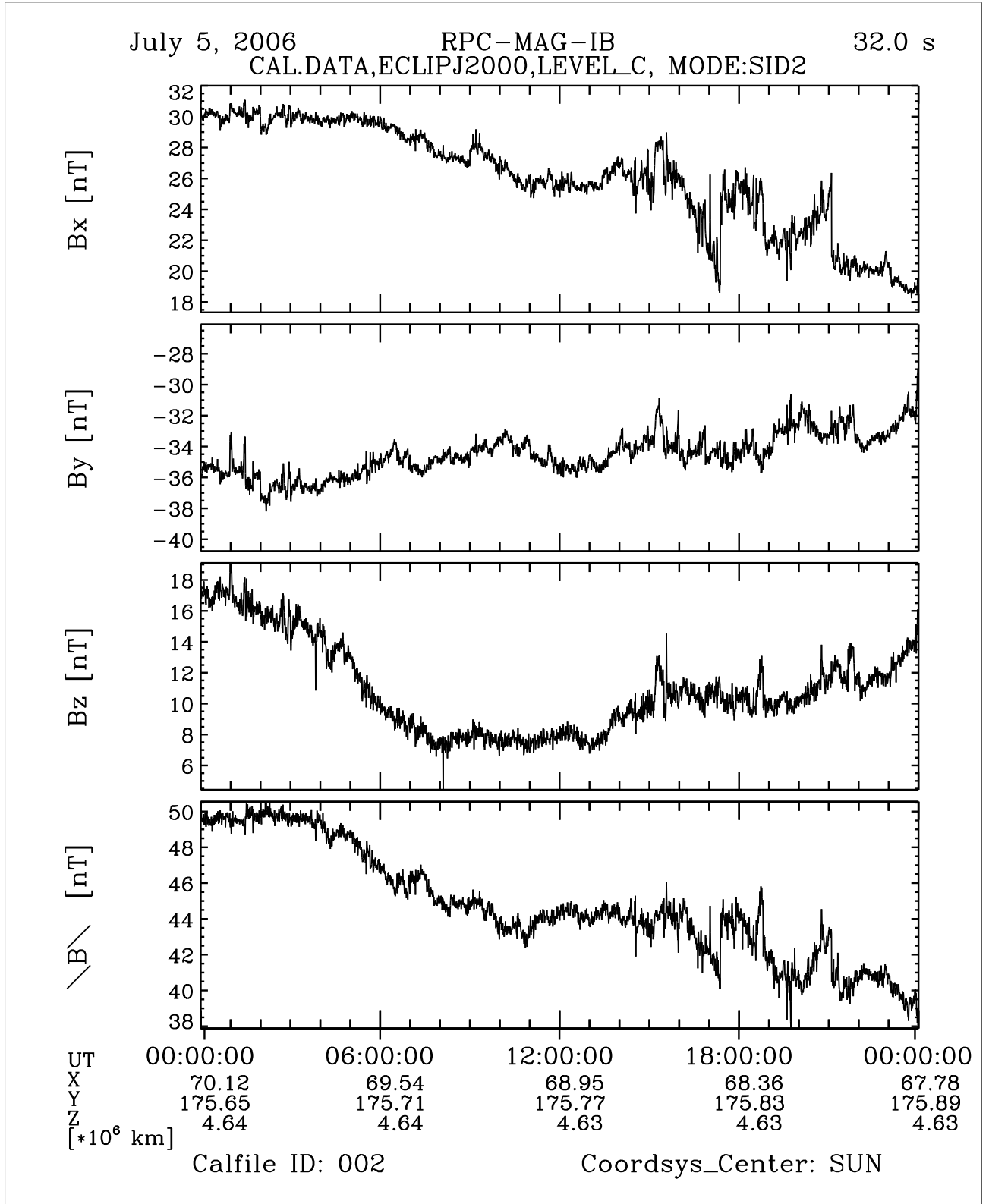


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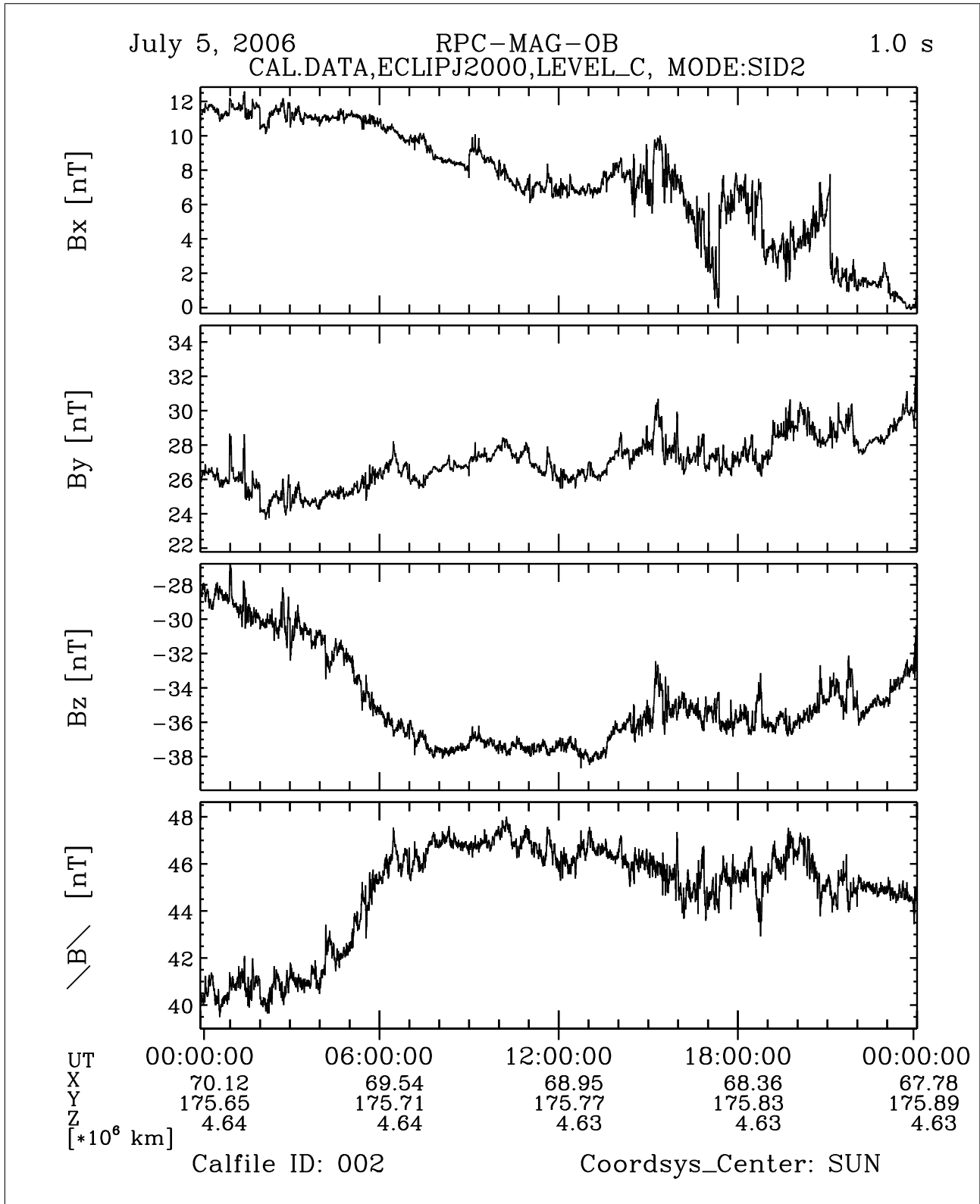


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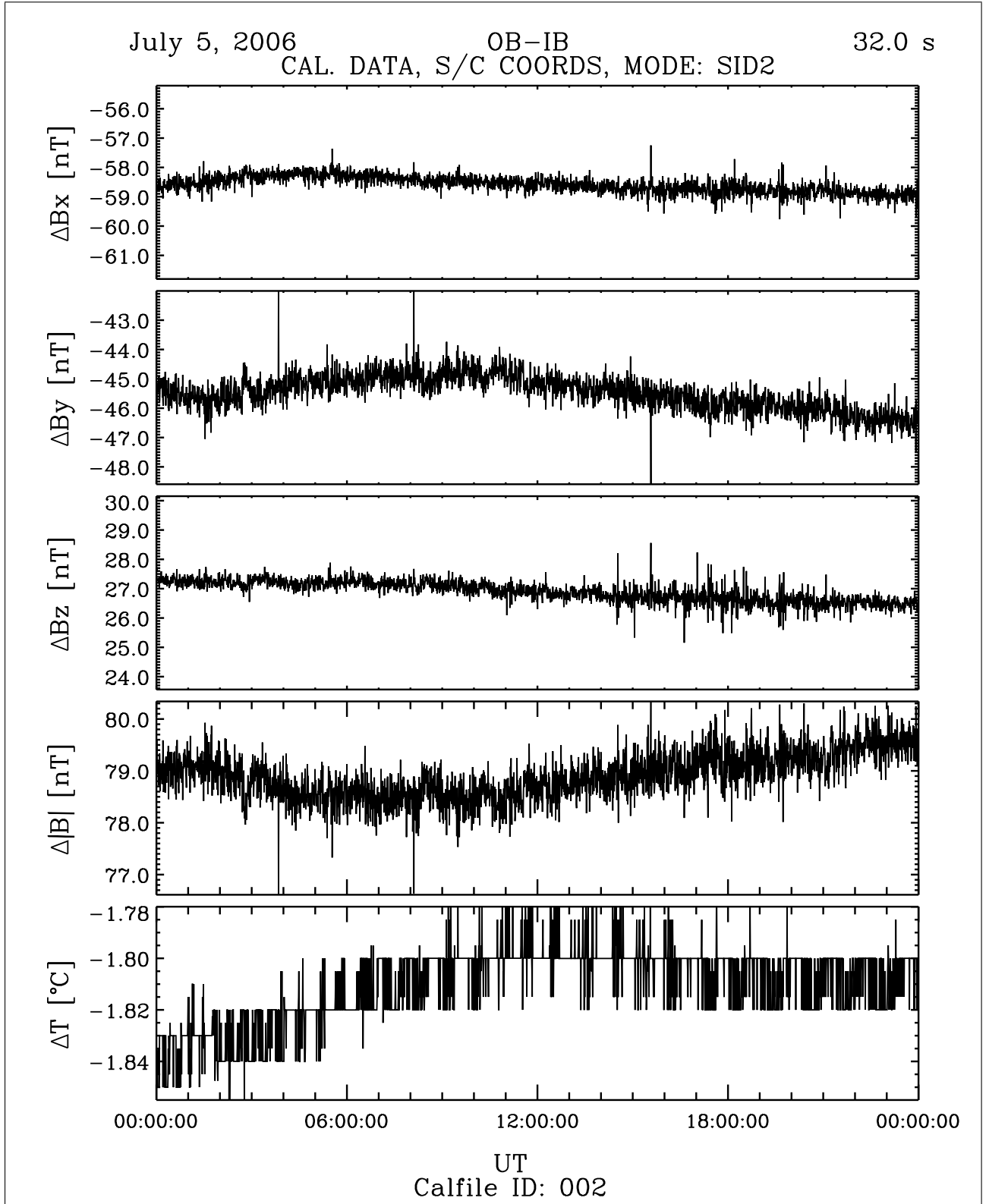


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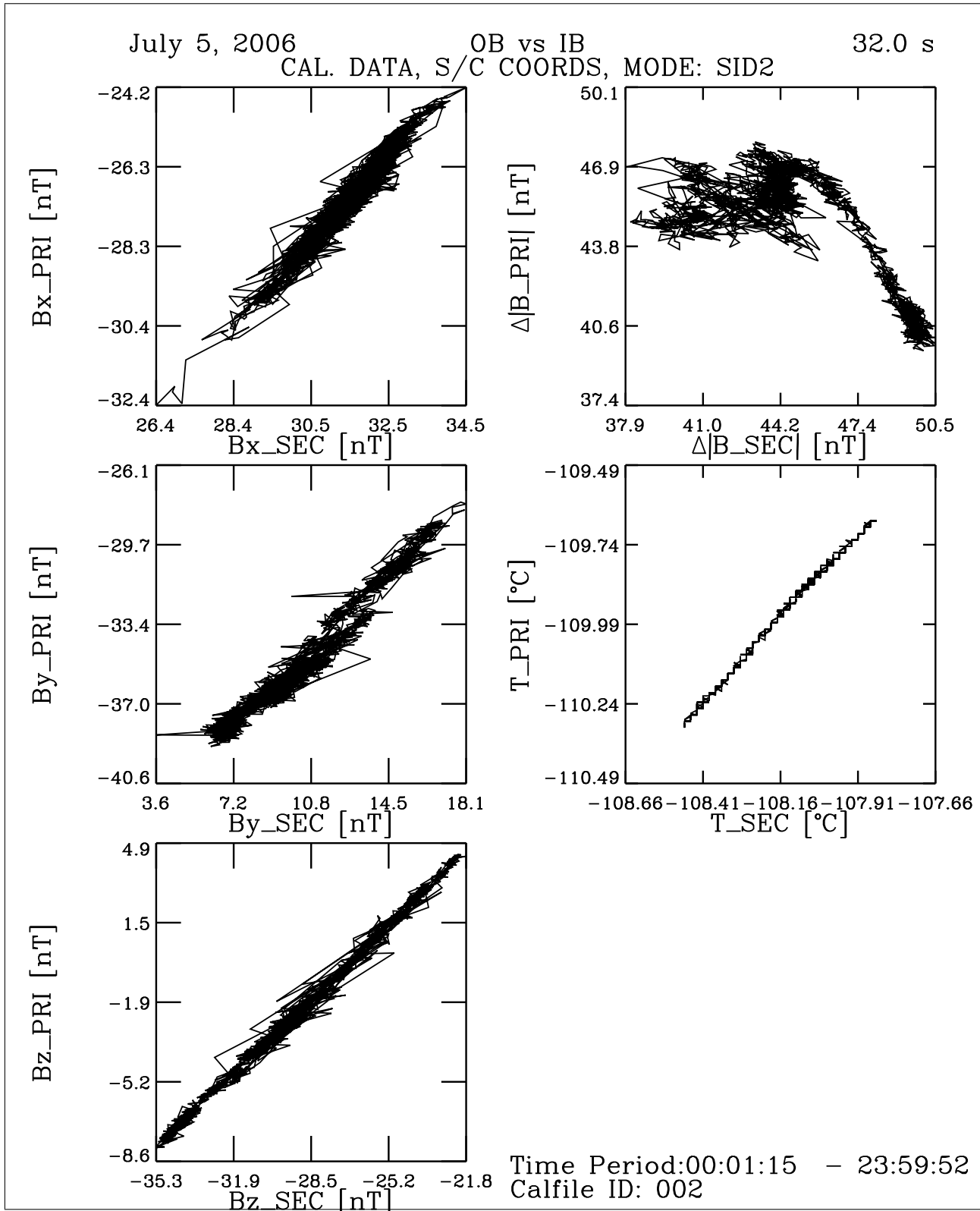


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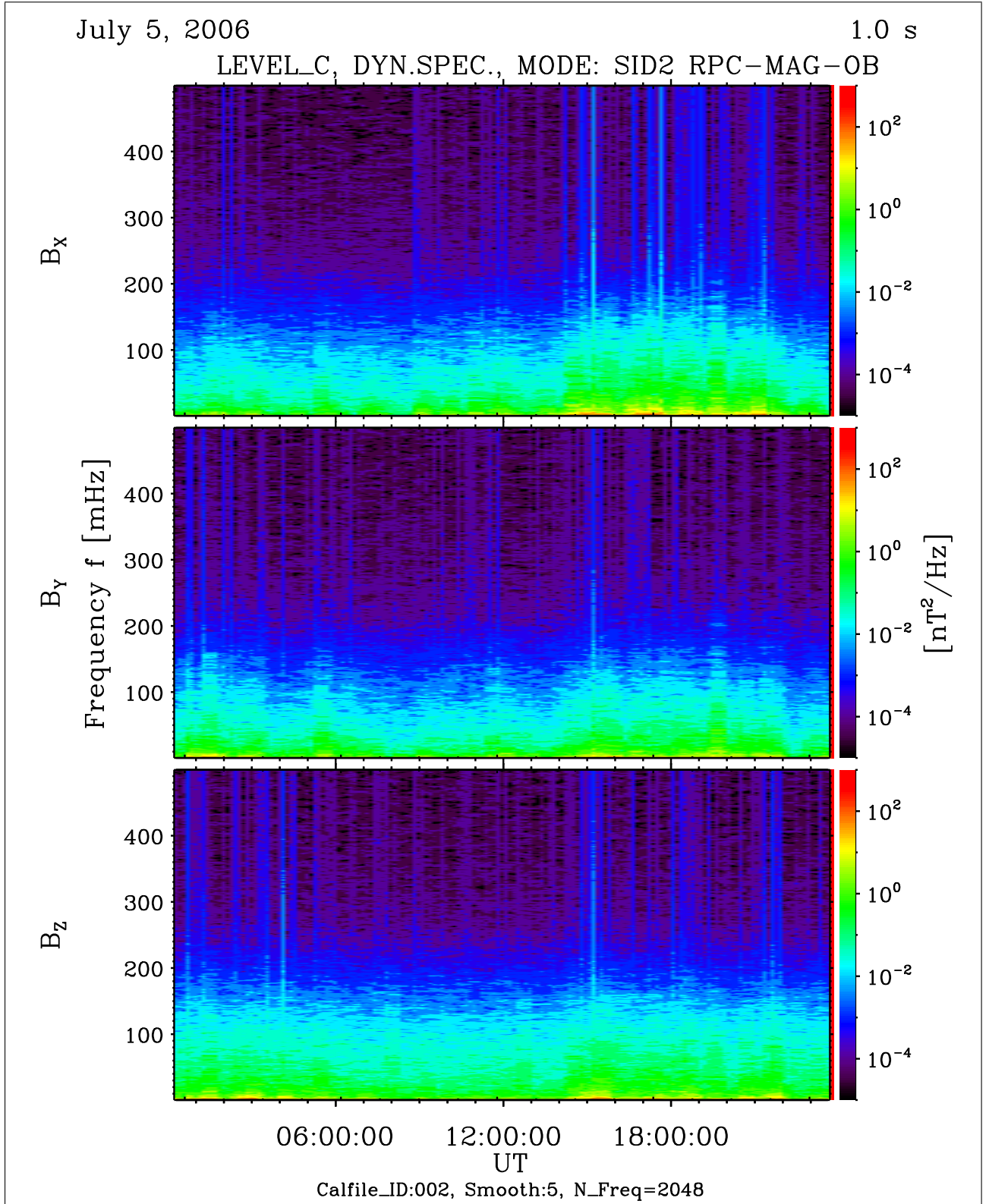


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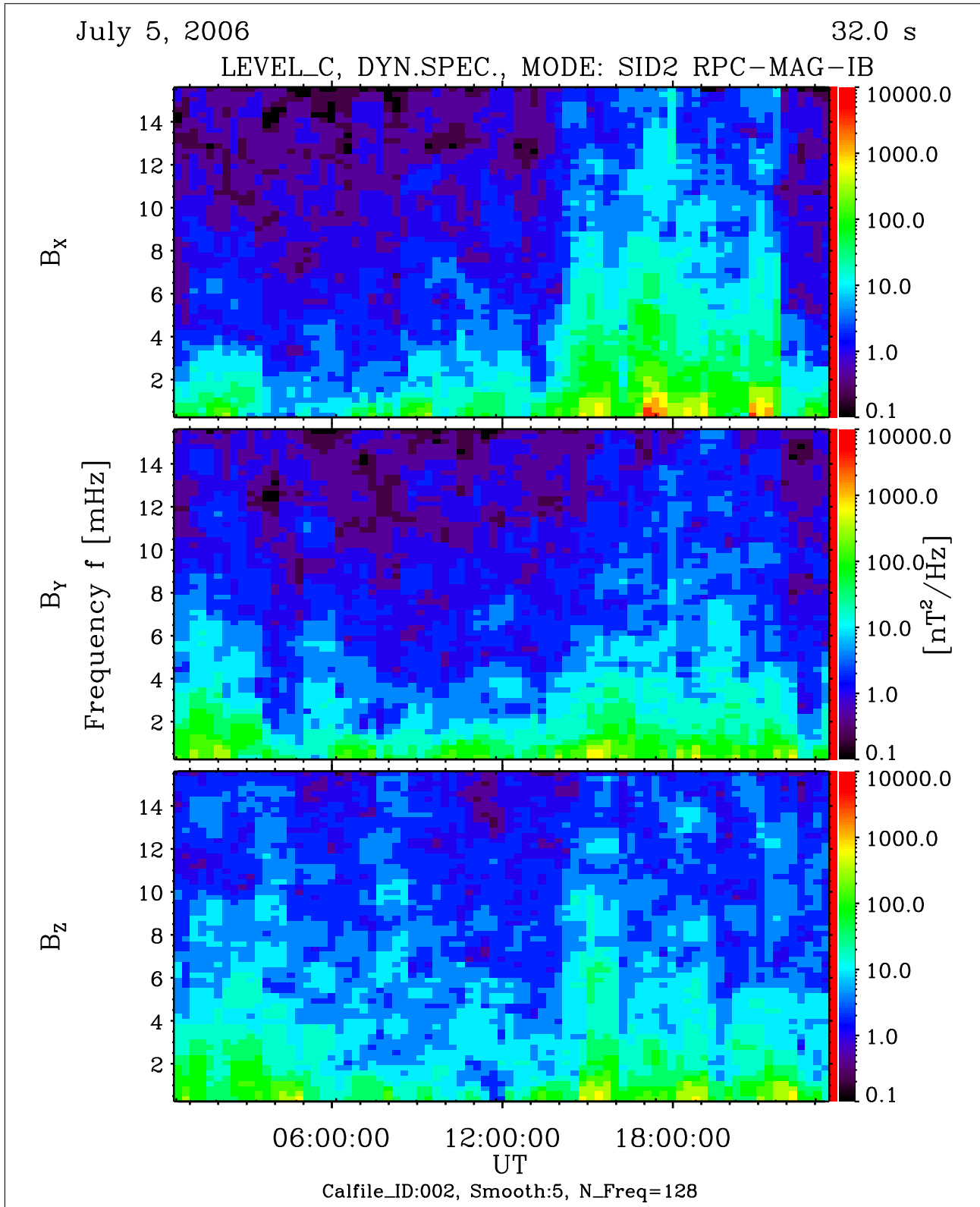


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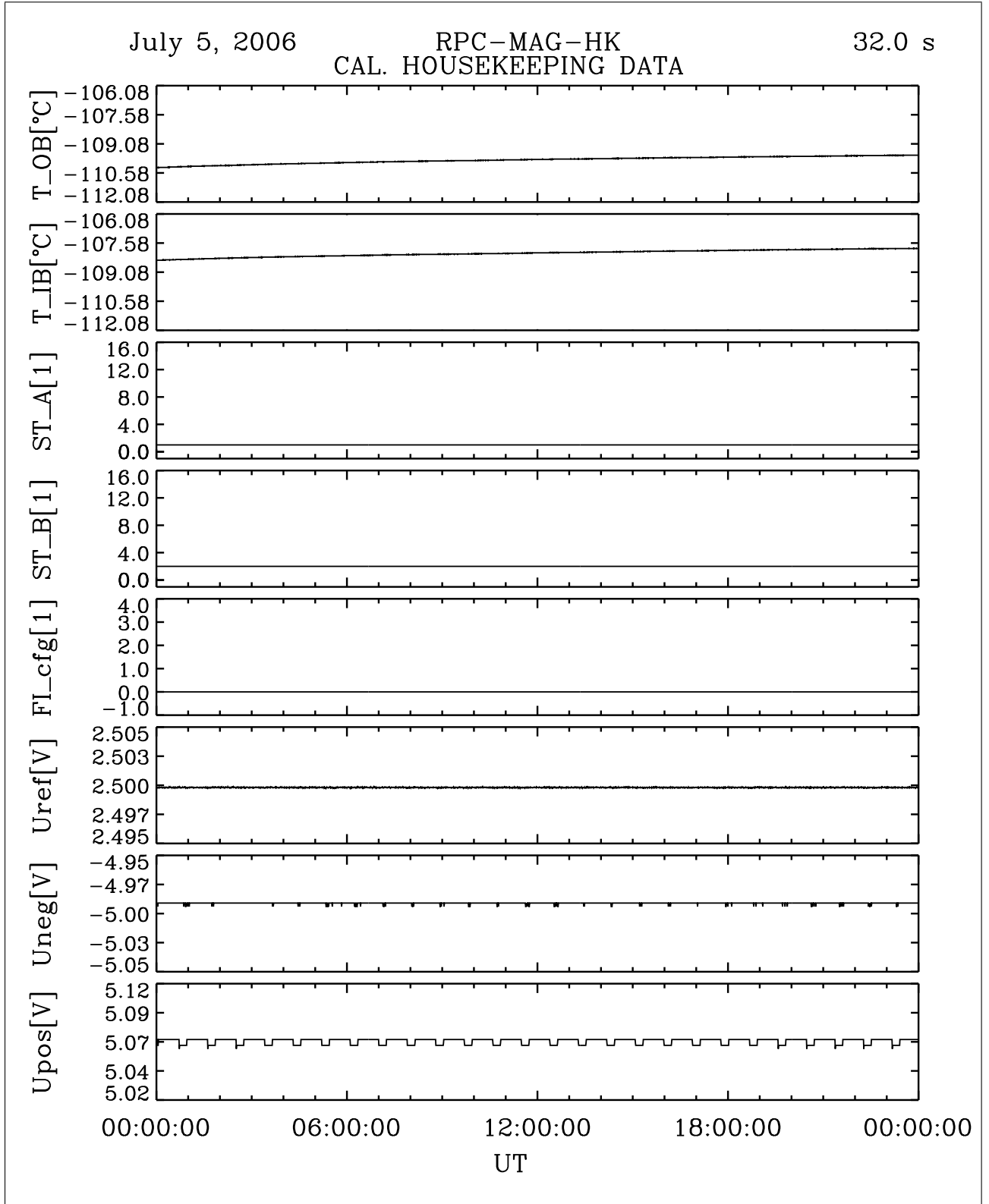


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4 July 6, 2006

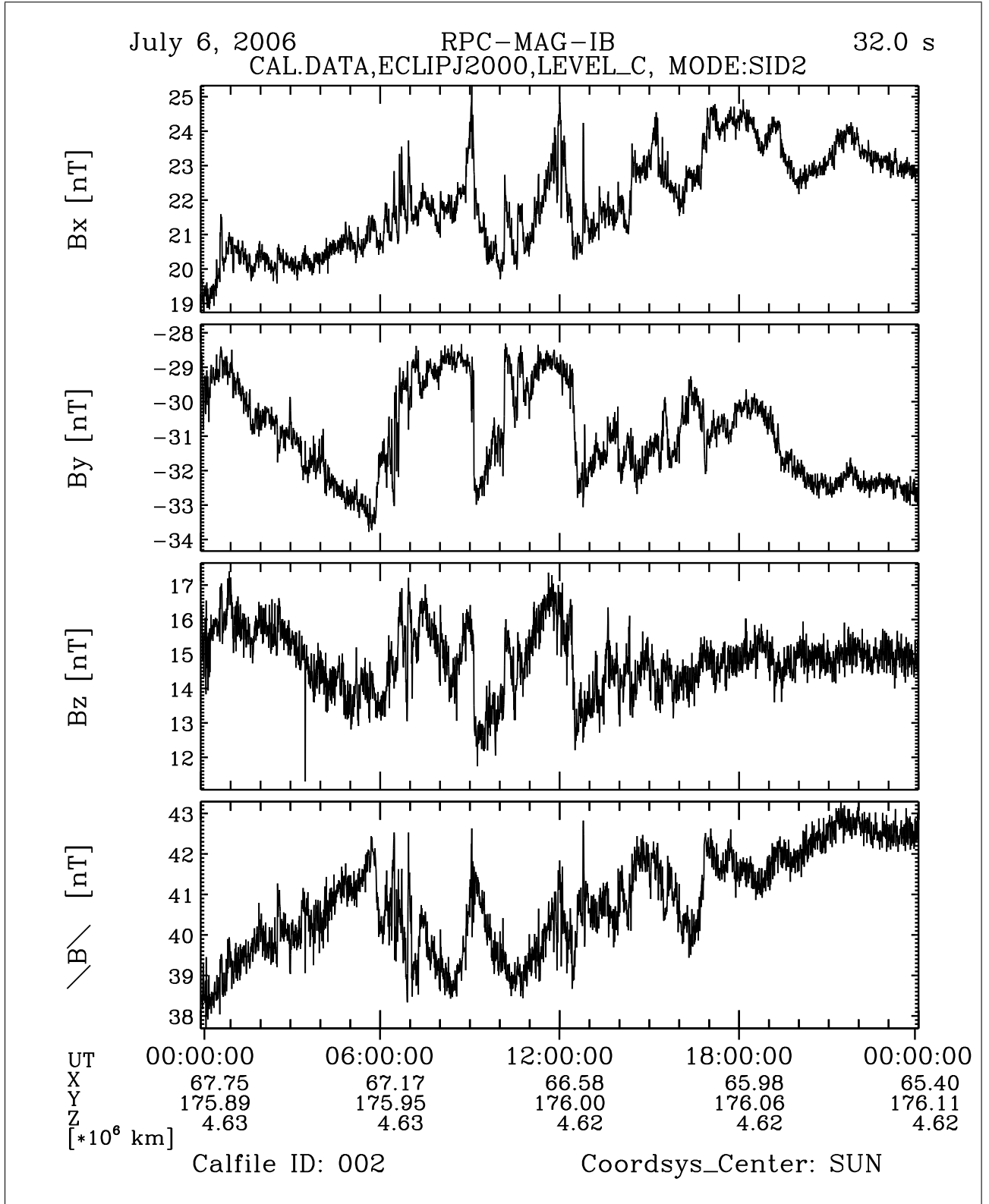


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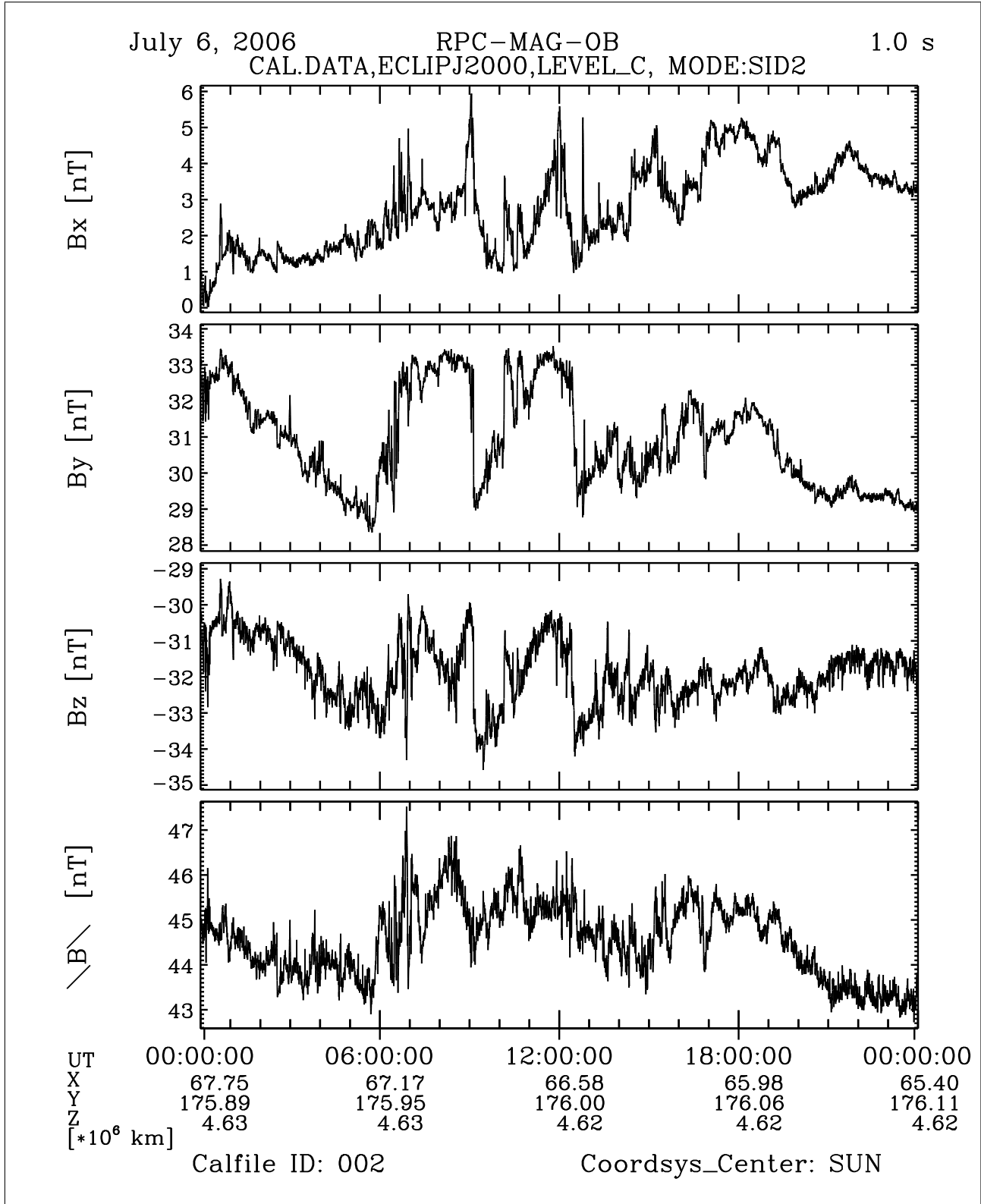


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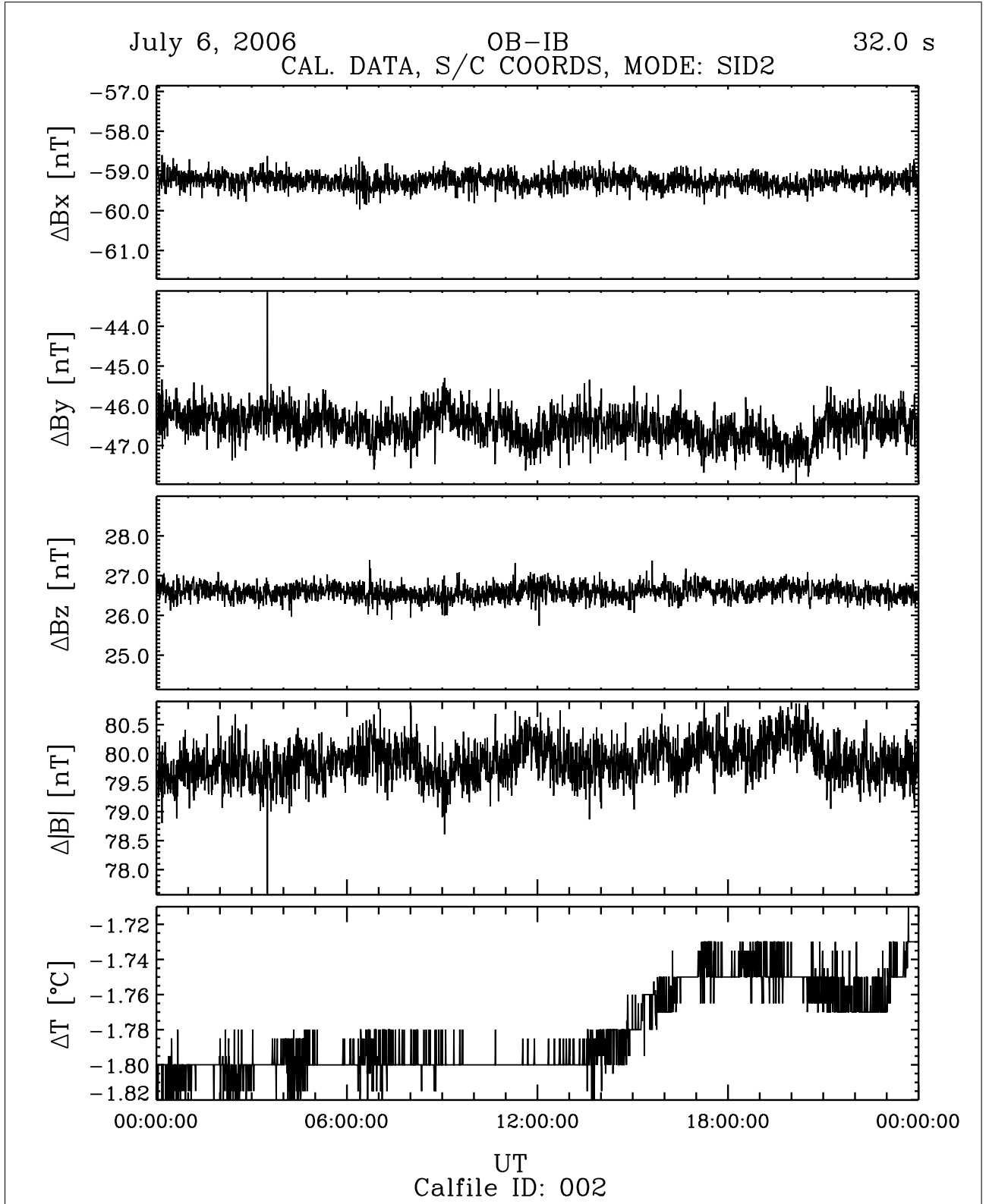


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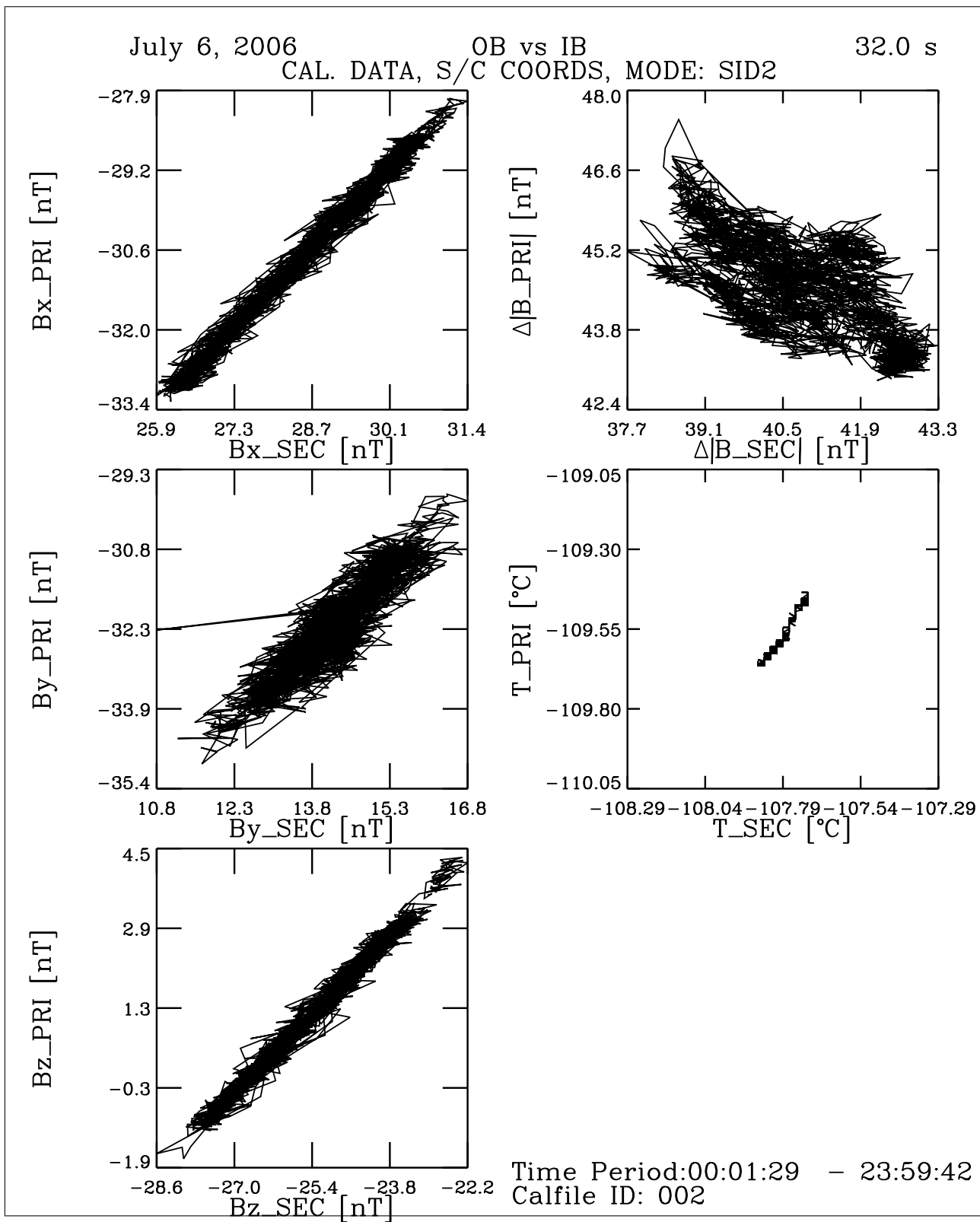


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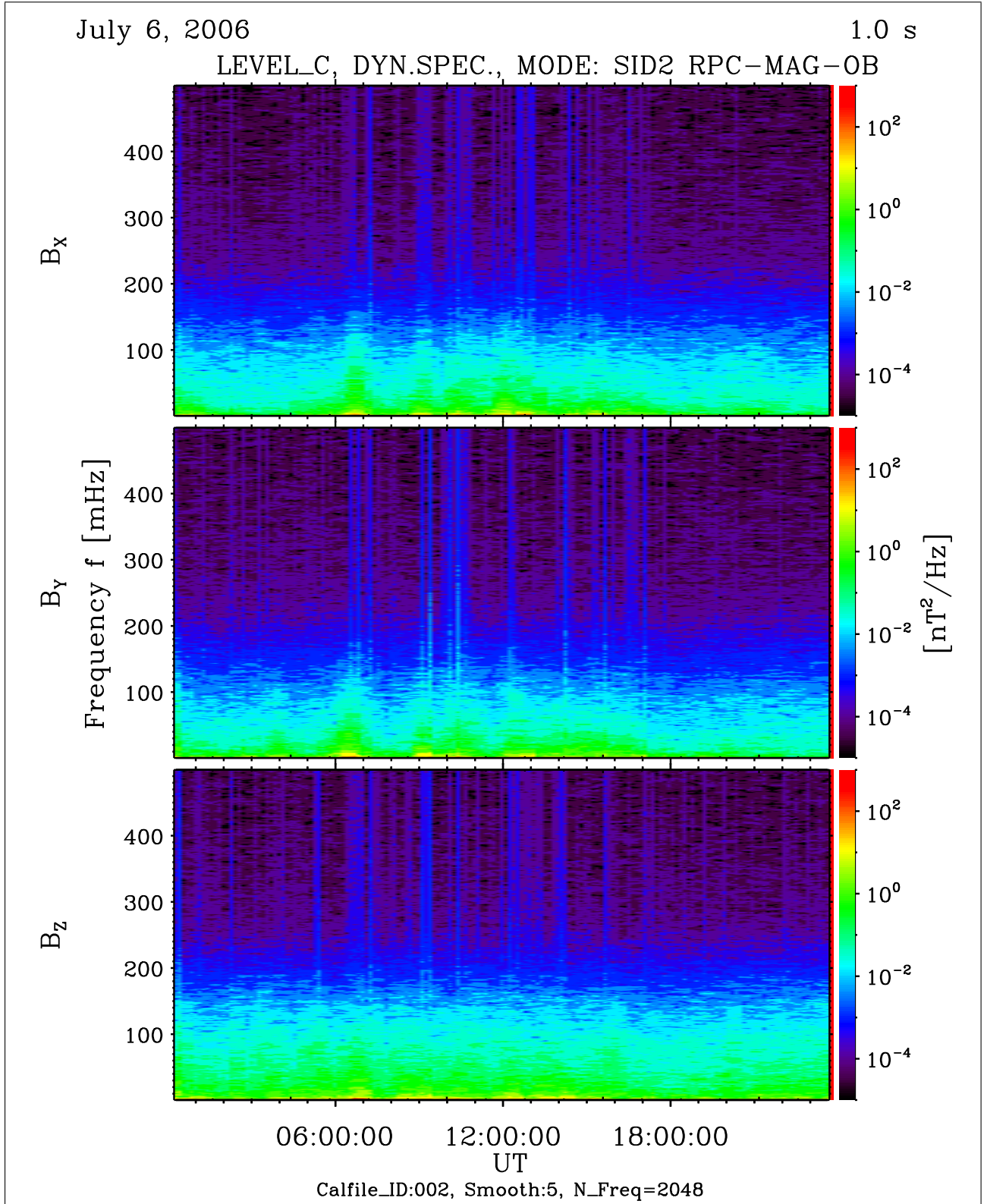


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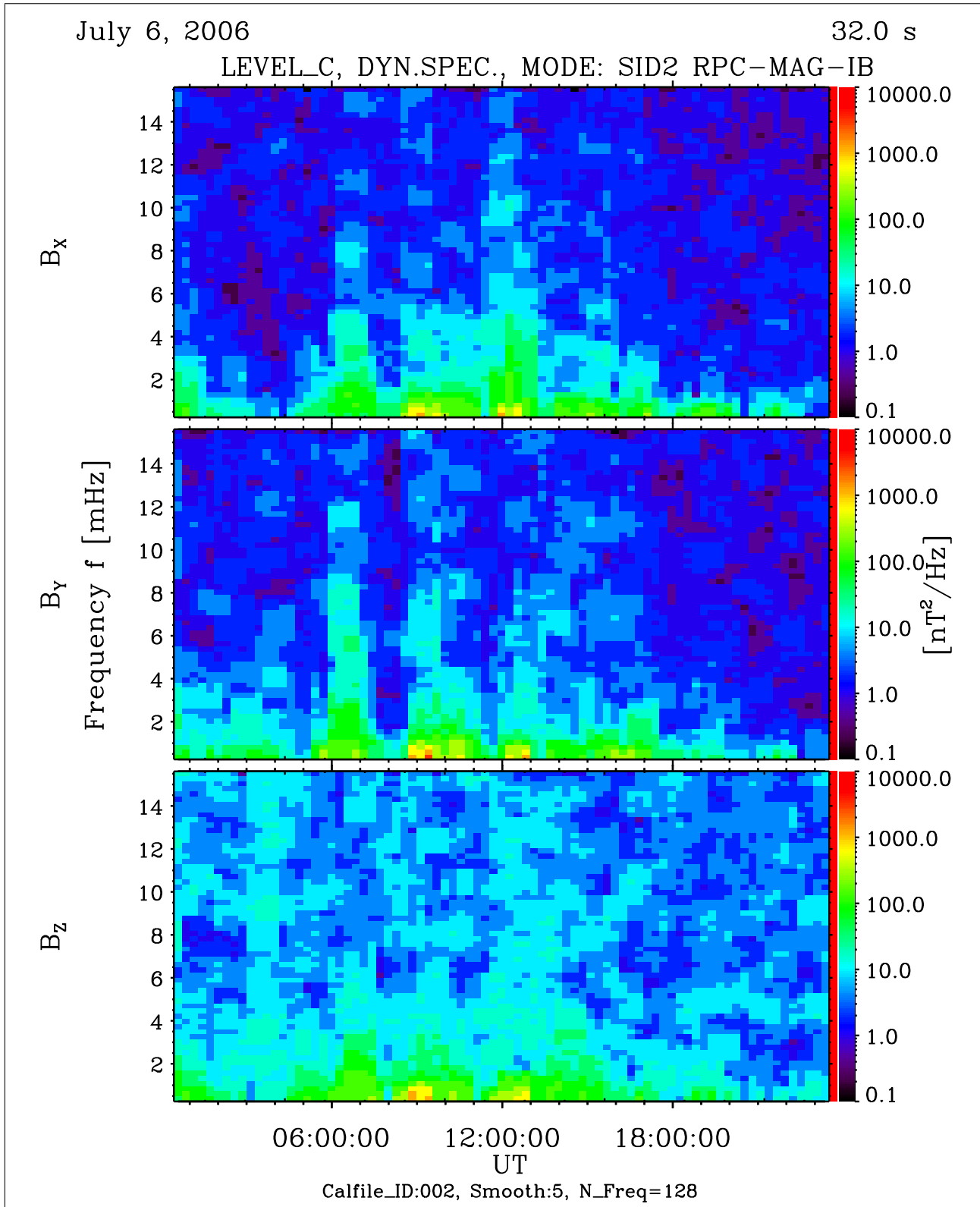


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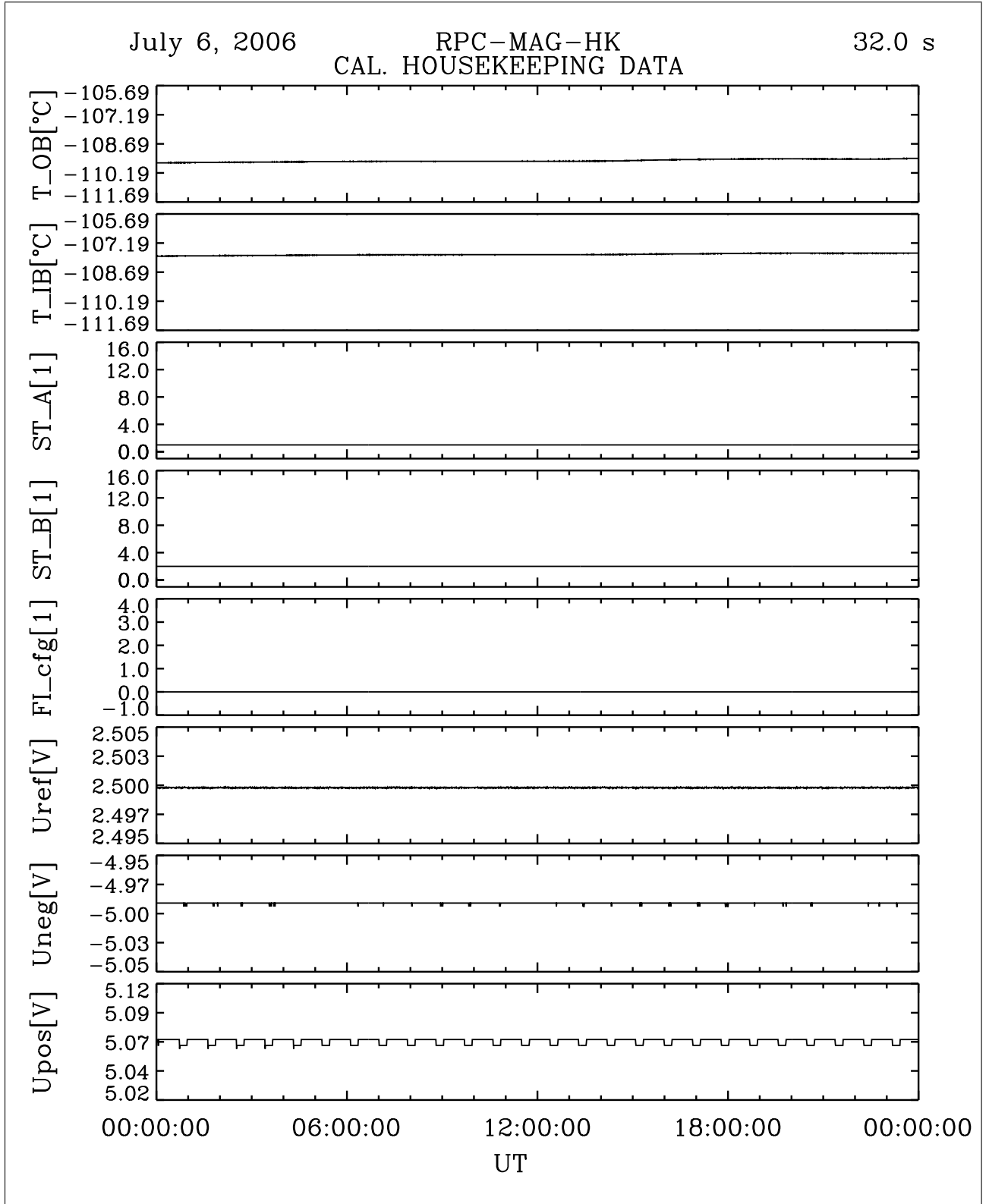


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5 July 7, 2006

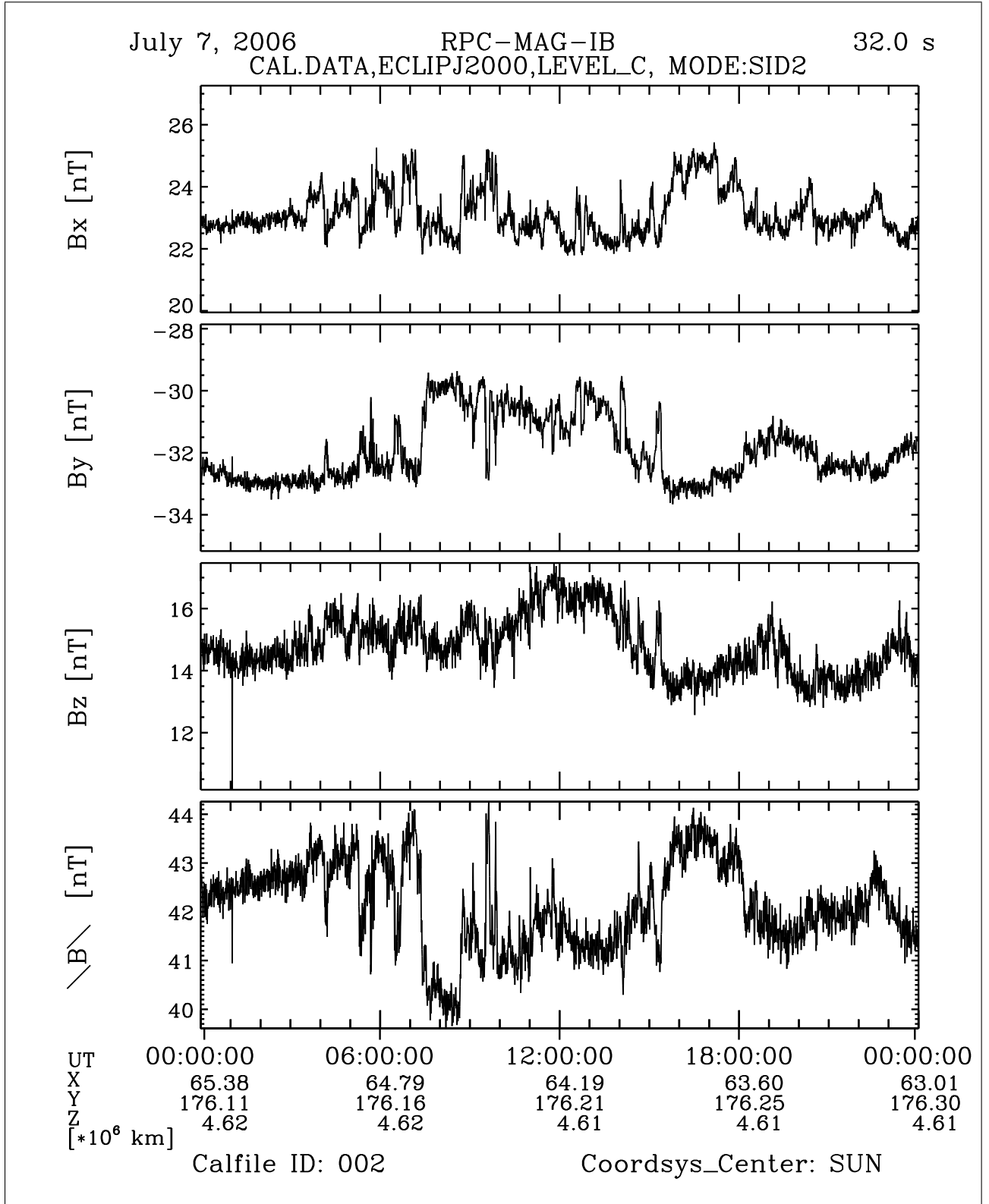


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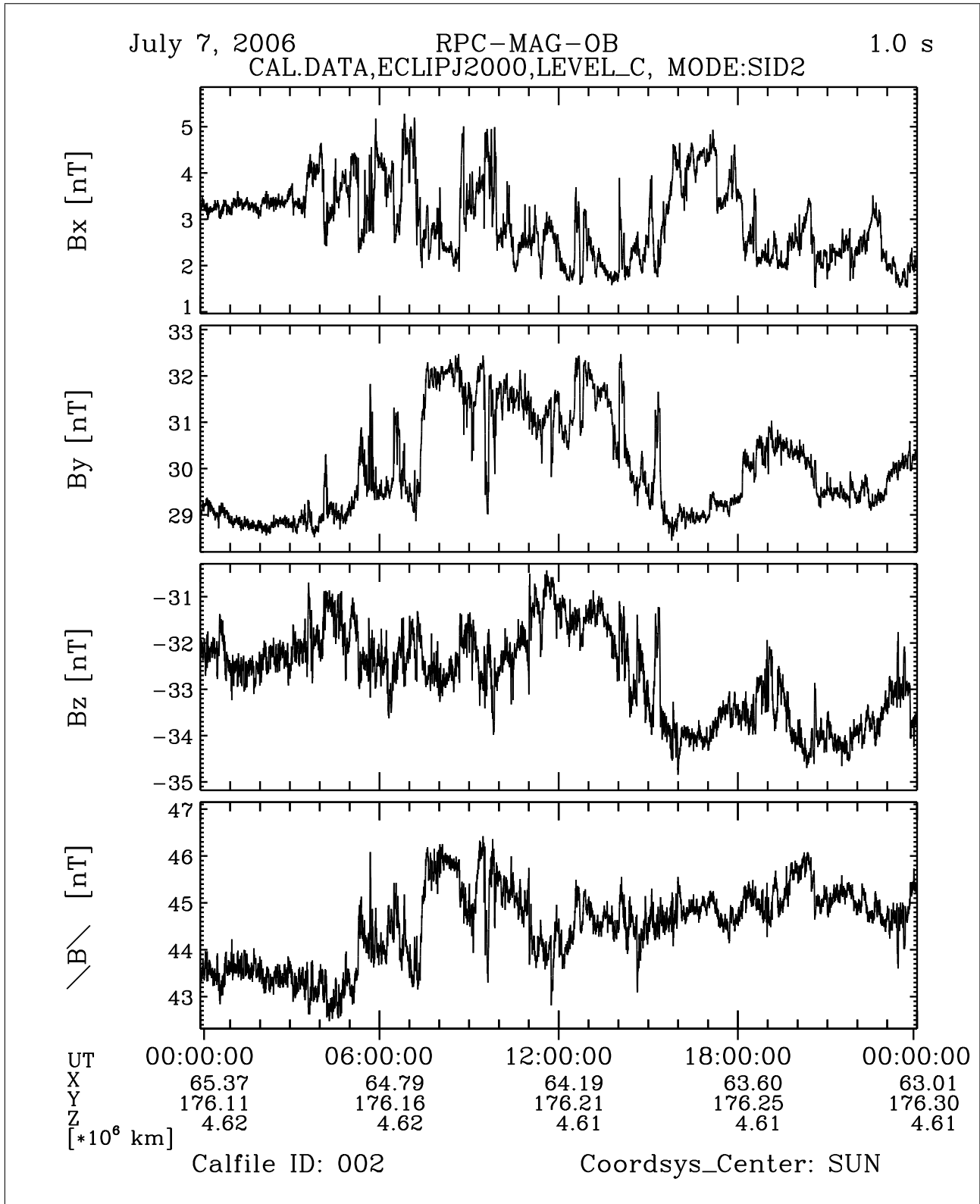


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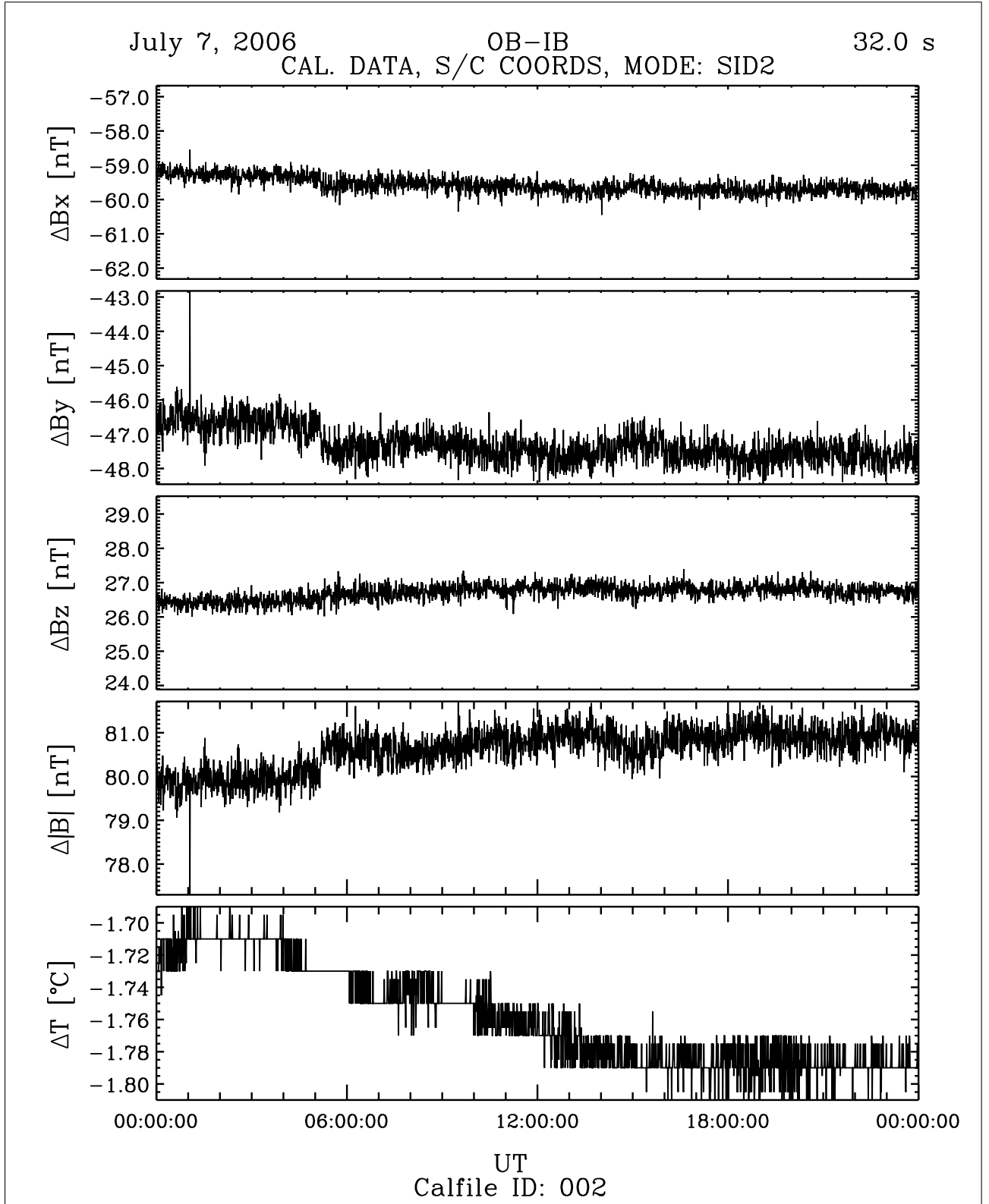


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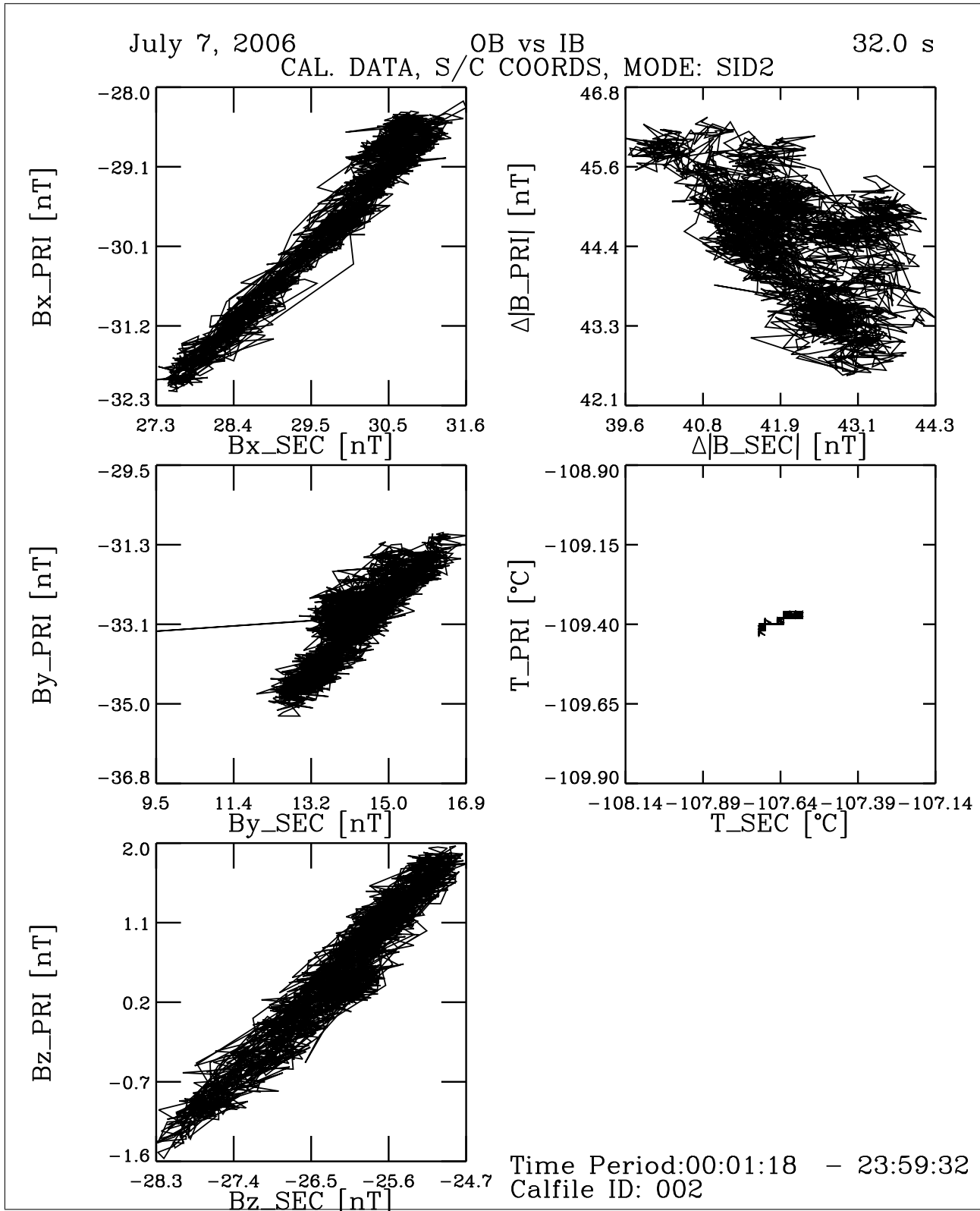


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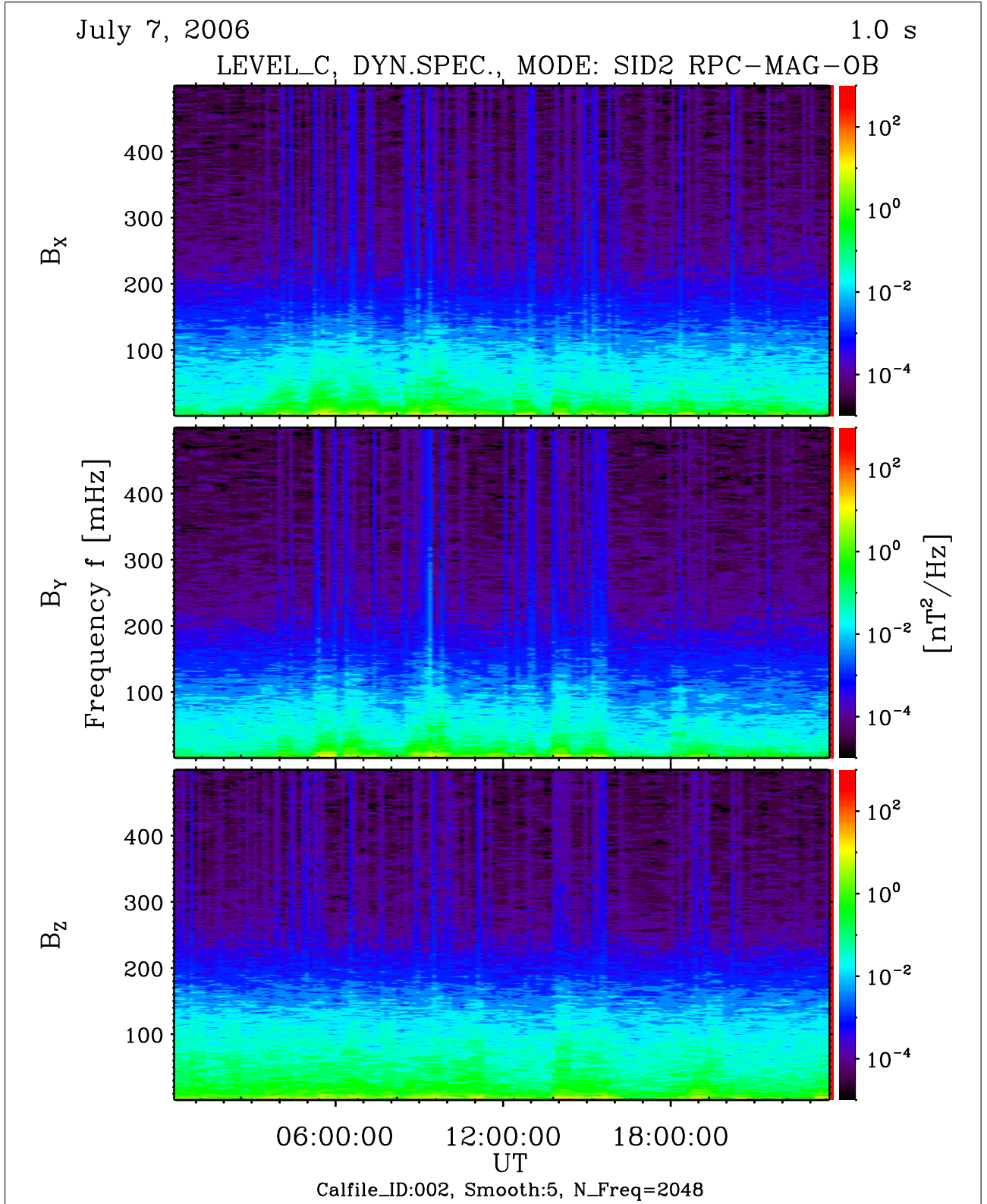


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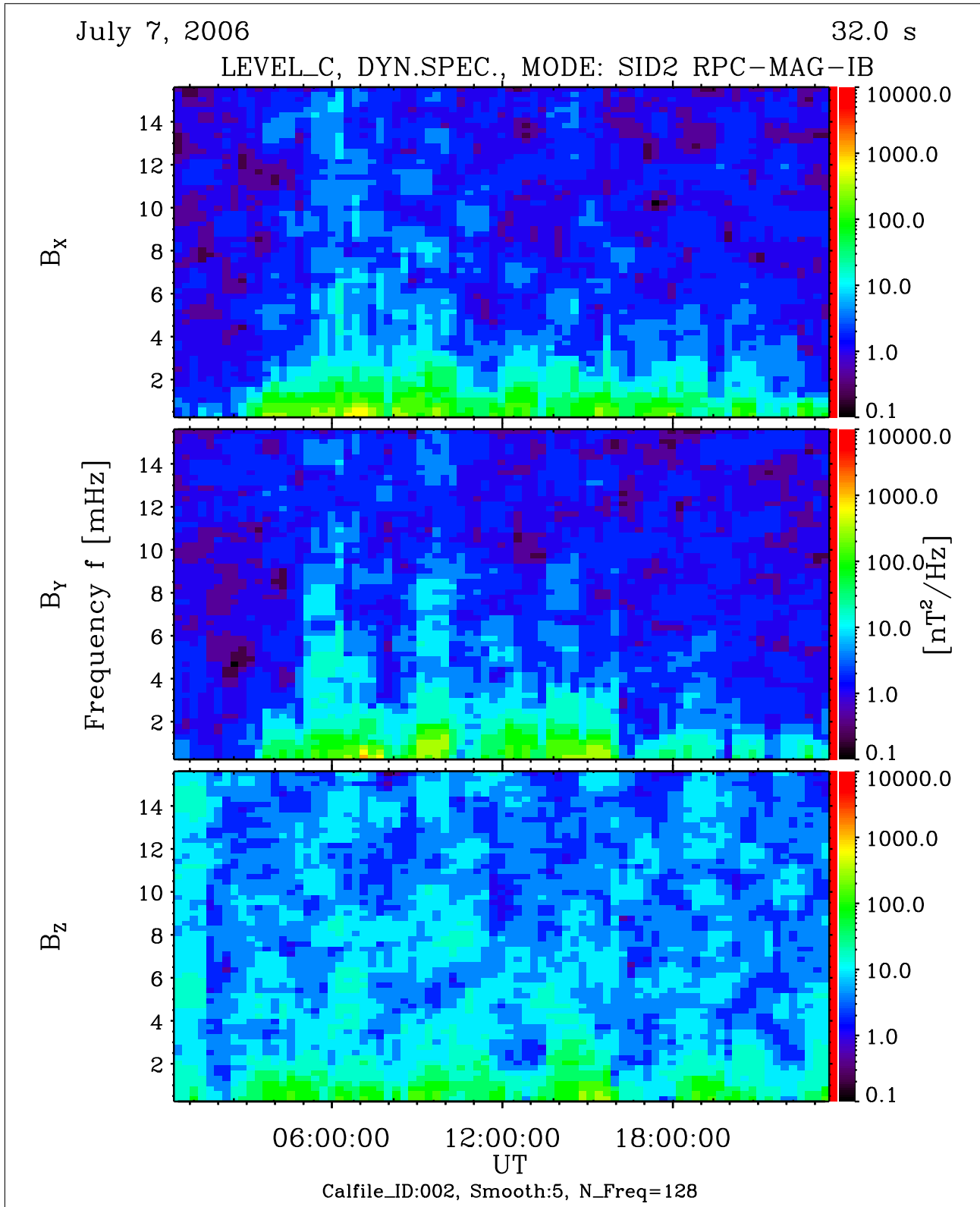


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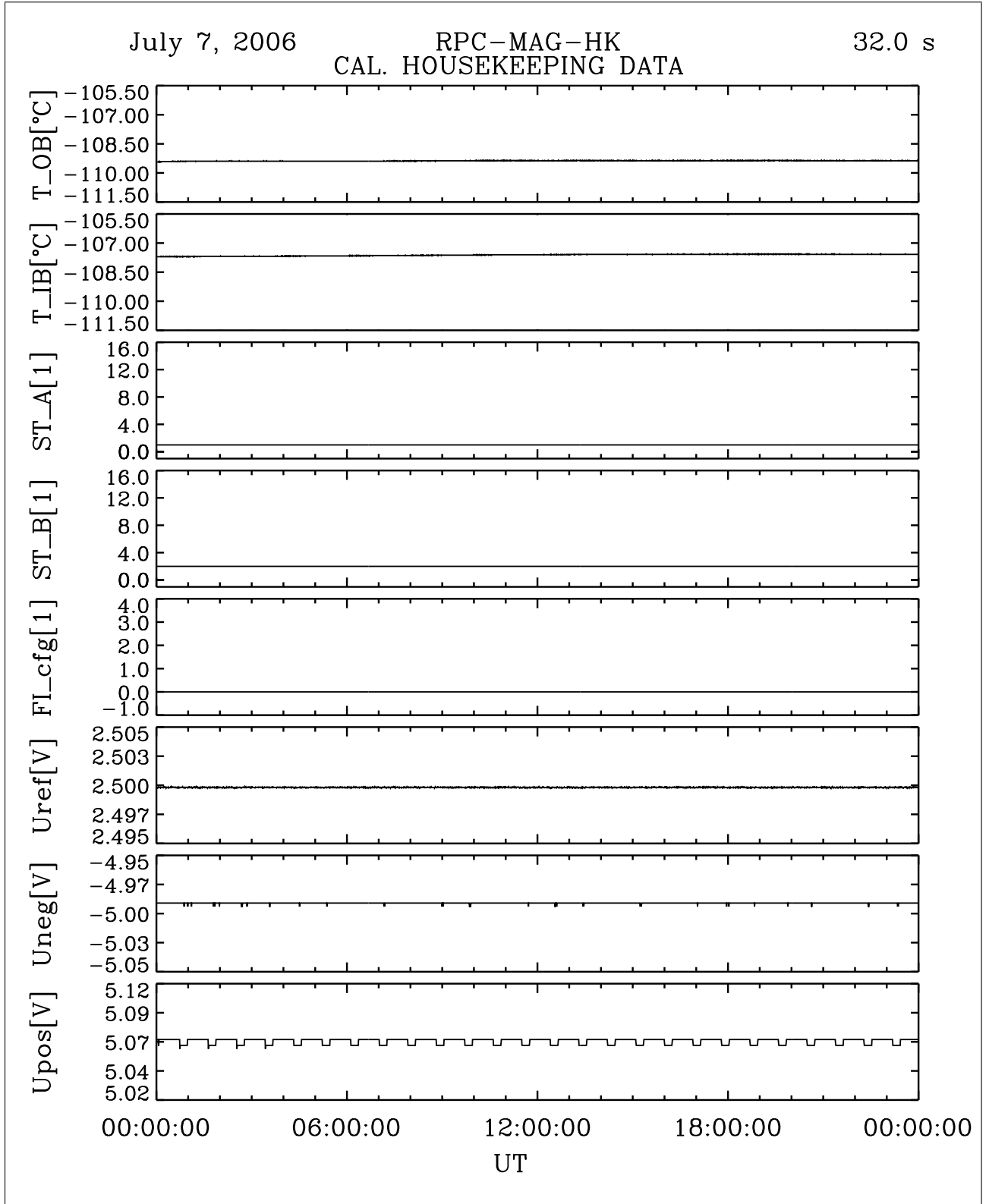


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**6 July 8, 2006**

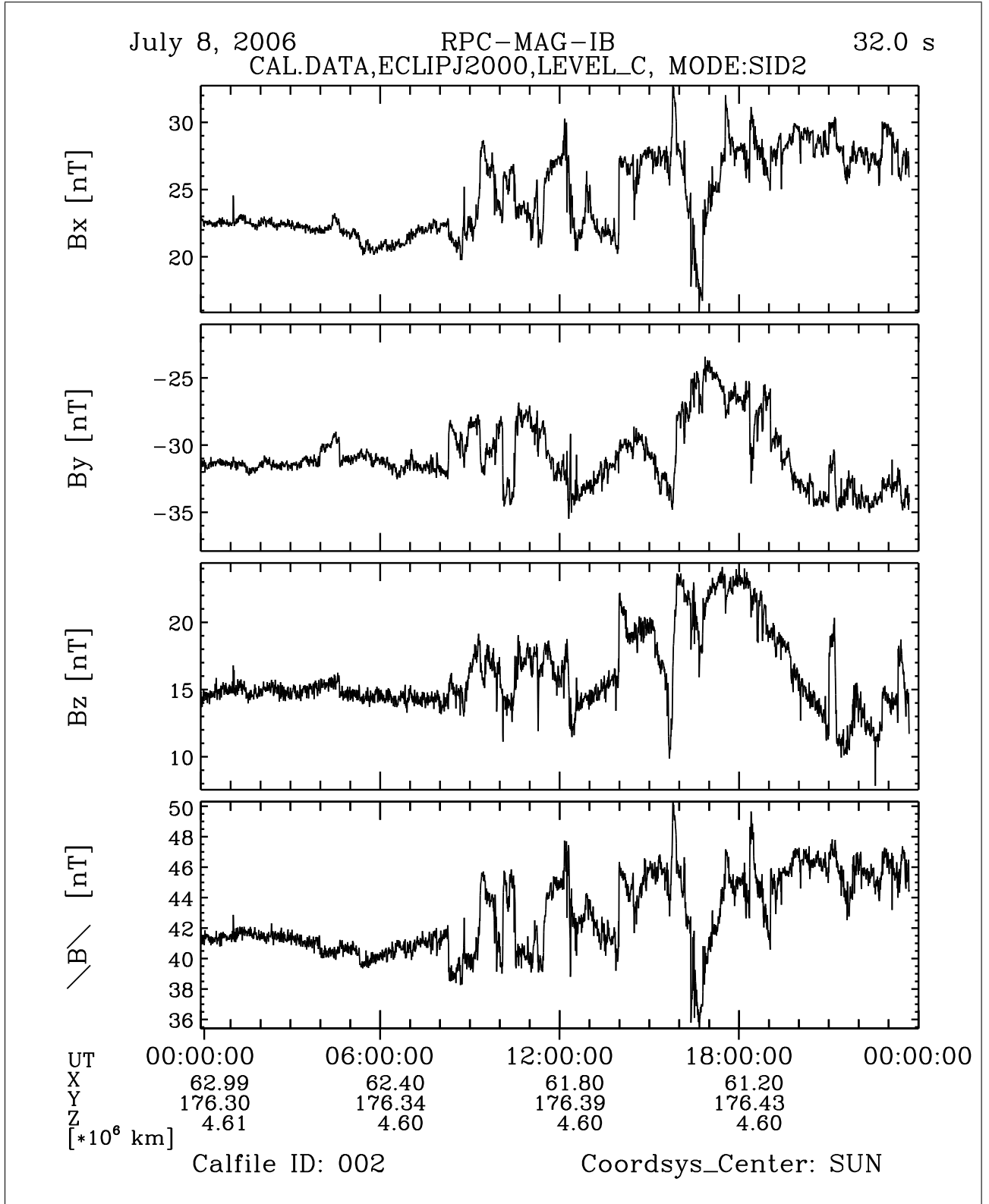


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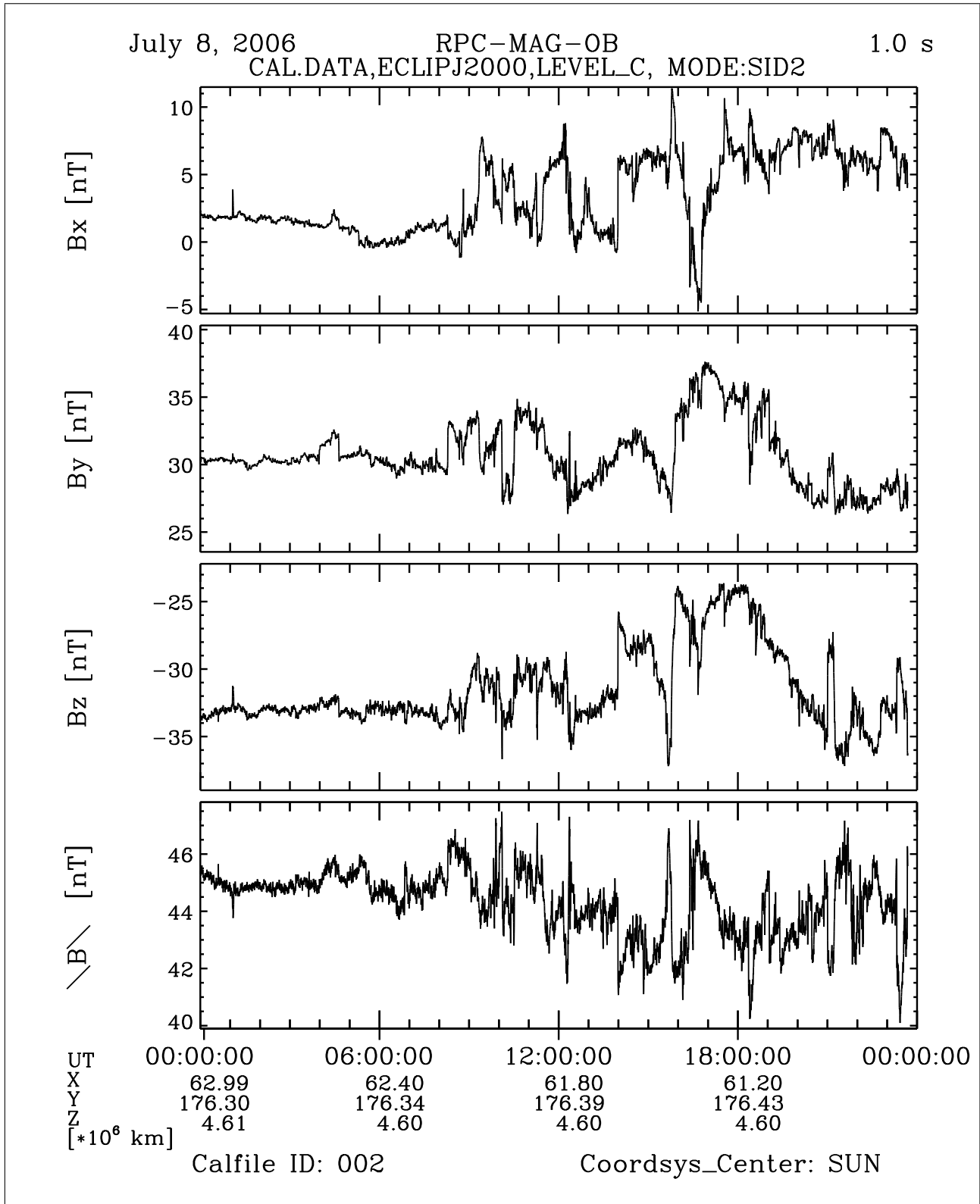


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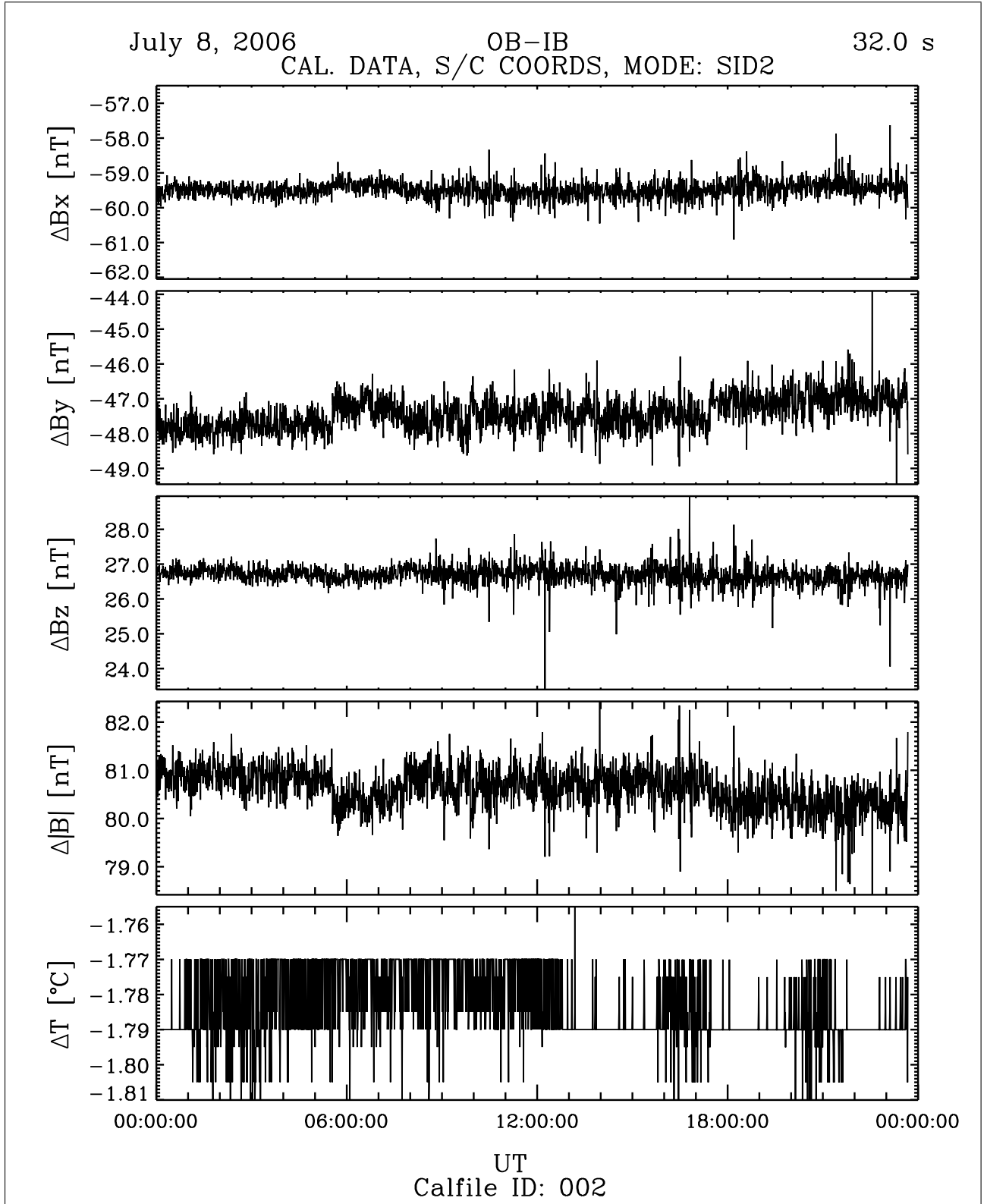


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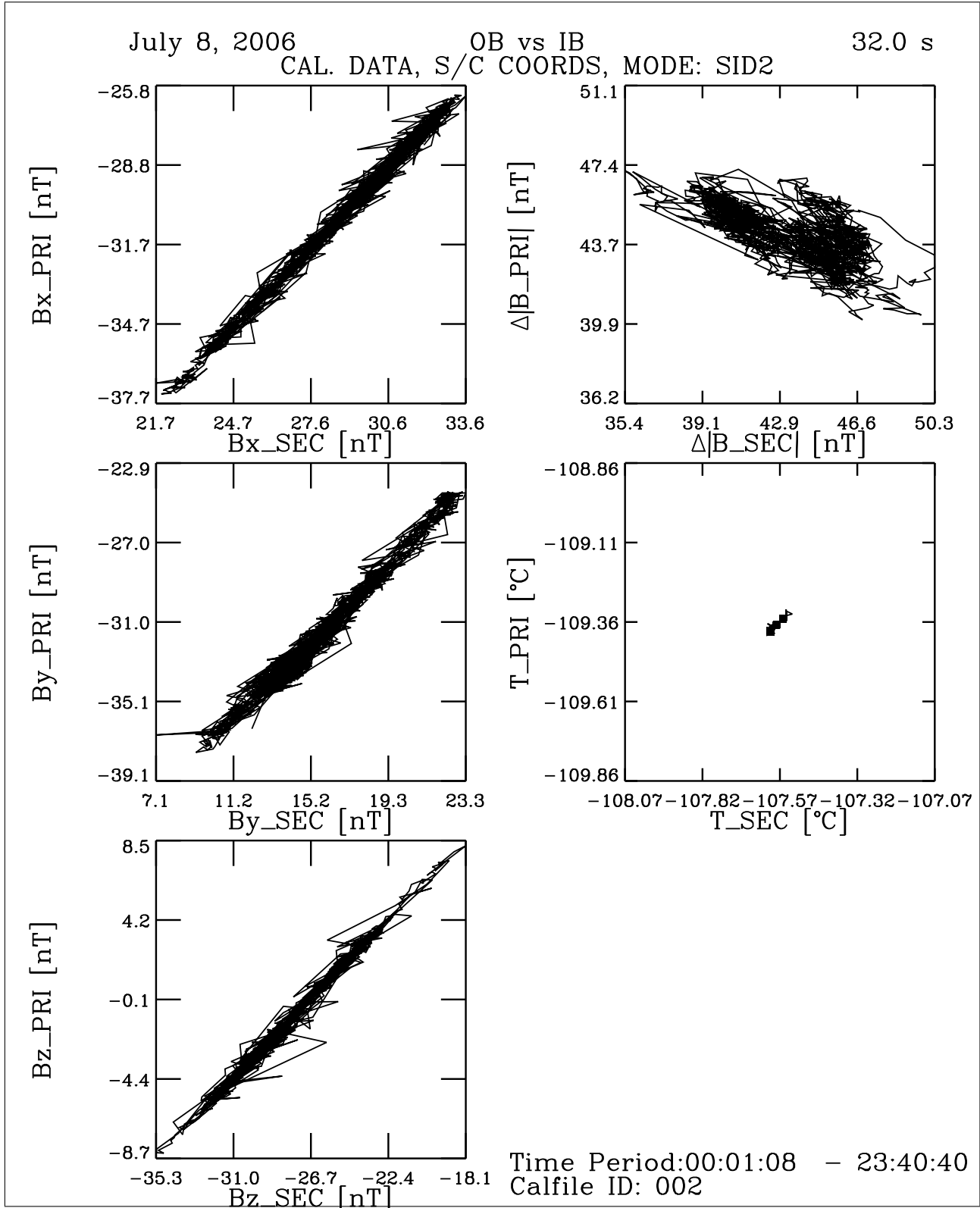


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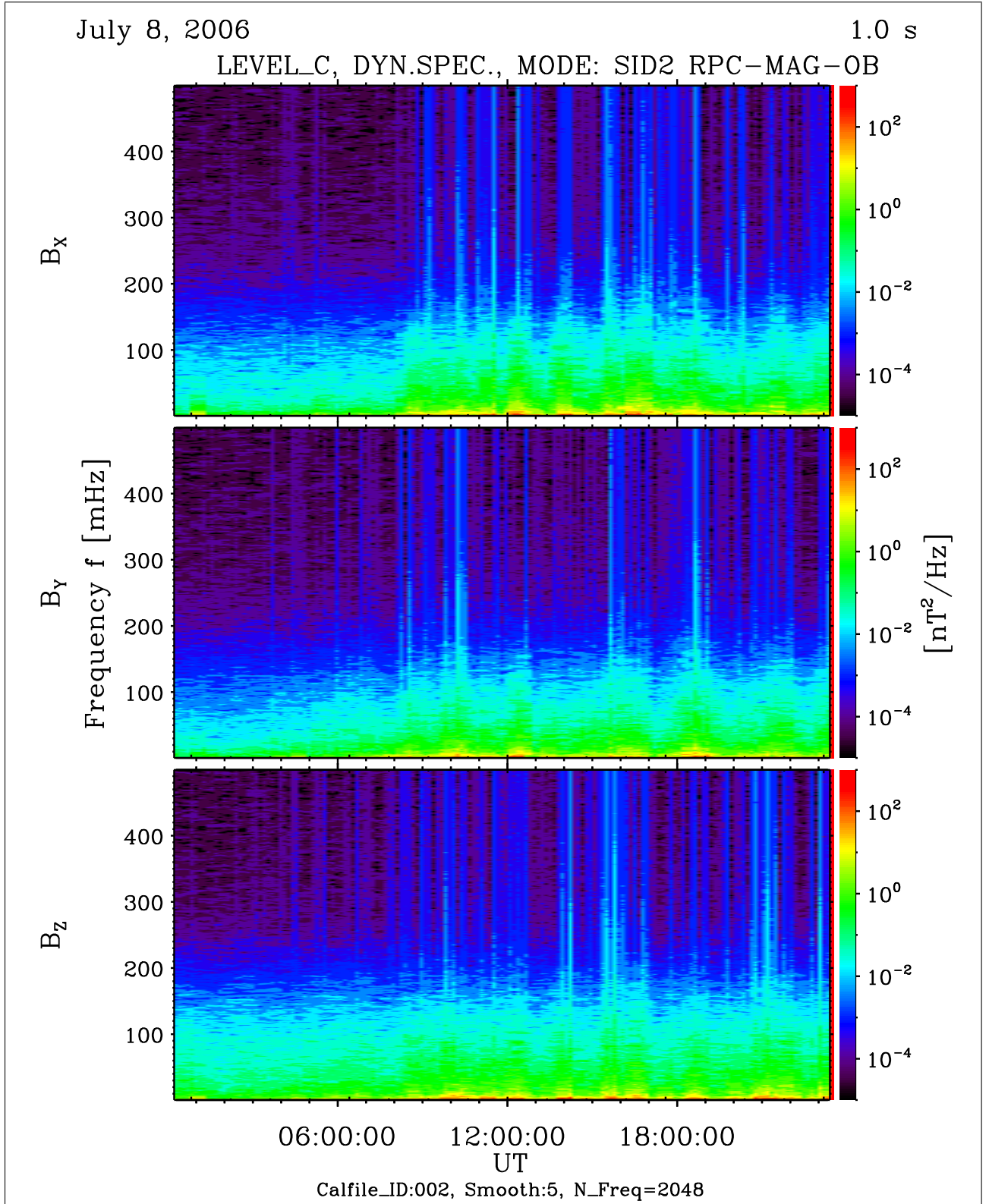


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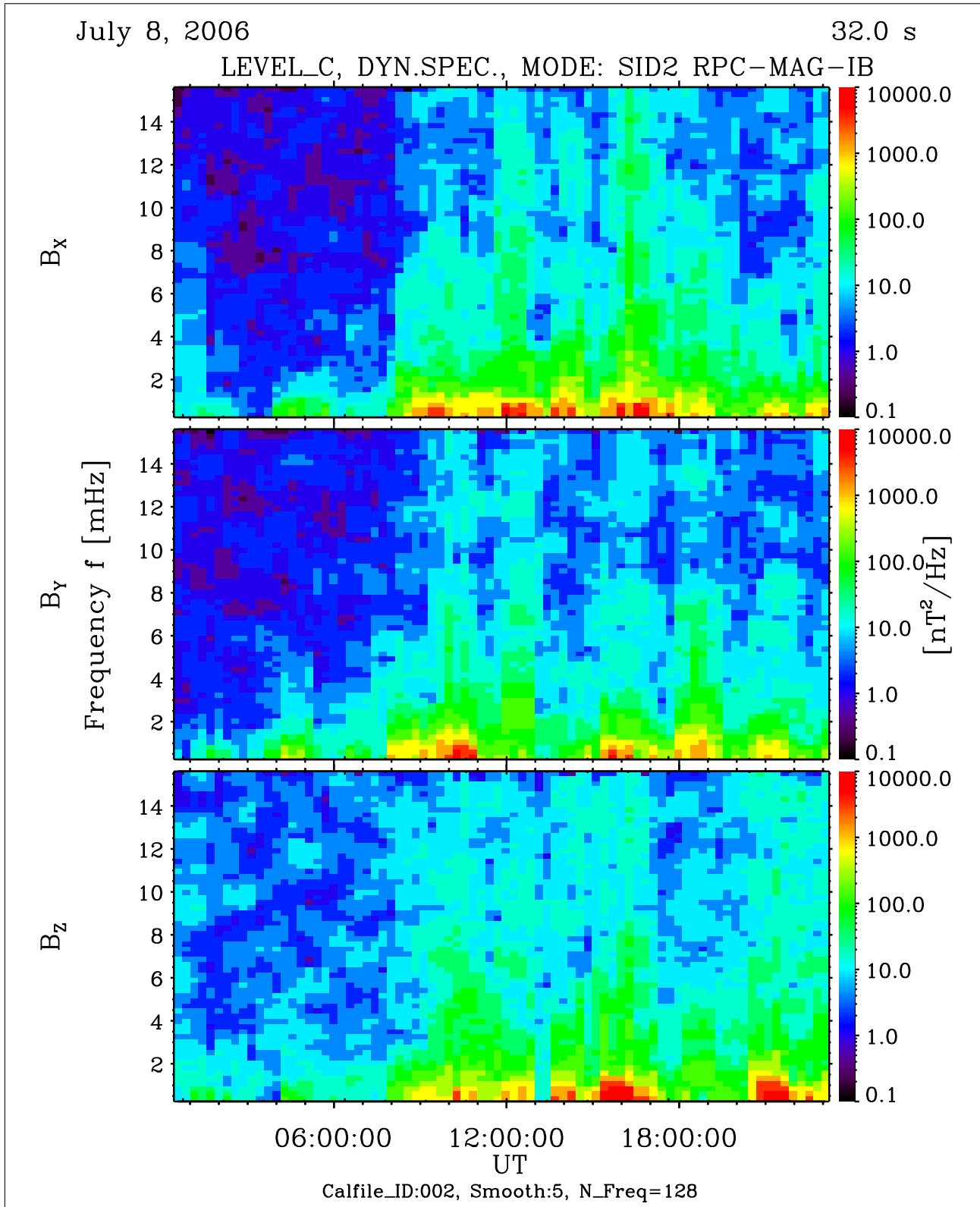


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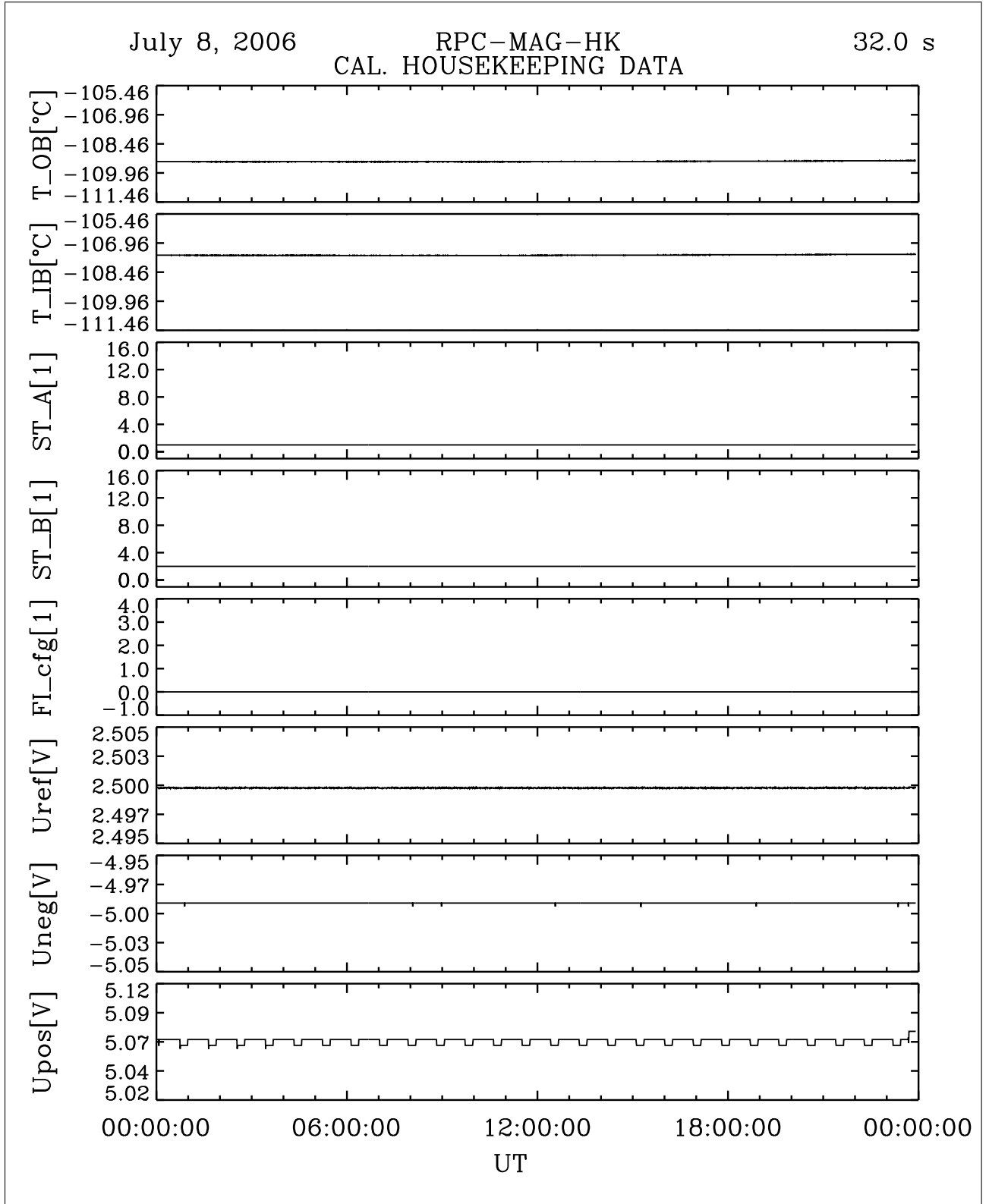


Figure 35: File: RPCMAG060708T0000\_CLA\_HK\_P0000\_2400

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## 7 Distance between HONDA and ROSETTA

The next two plots show the result of a distance calculation between HONDA's ion tail and ROSETTA. The calculations have been made using IDL and the right SPICE kernels. Assuming that the ion tail of Honda propagates with the solar wind speed of 450 km/s in a antisunward radial direction, the tail will cross ROSETTA's trajectory at a certain time. Evaluations of the distance between the tip of the tail and ROSETTA have been performed for ion tail travelling times between 2 and 4 days, represented by the displayed set of curves.

It can be seen that a possible encounter will happen on July 6, 2006 and 19:30 after an ion propagating time of 2.8 days.

This is only a very coarse model and shall just give an idea of possible event.

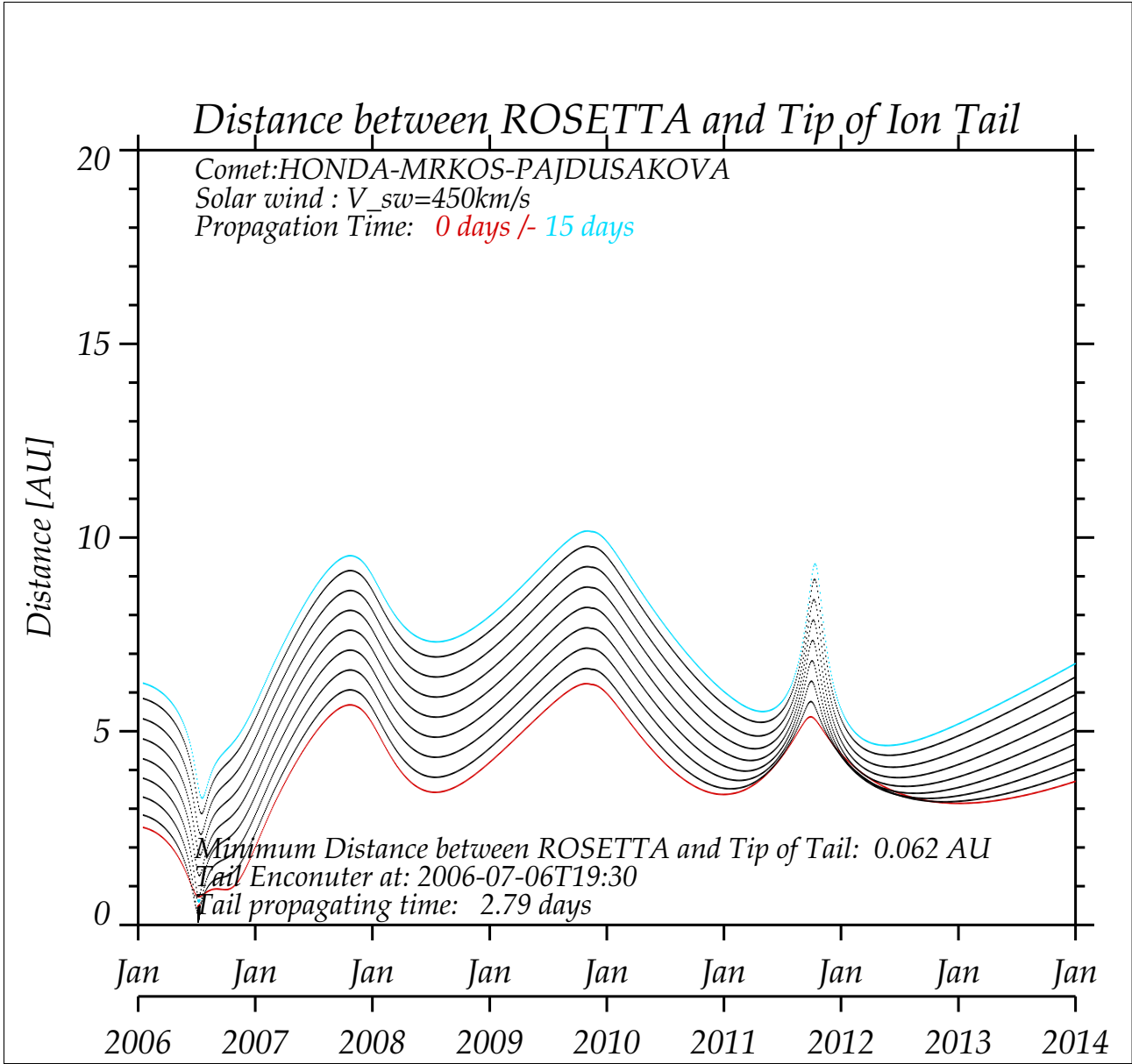


Figure 36: Distance between ROSETTA and Tip of Honda's anticipated Ion Tail - long term overview

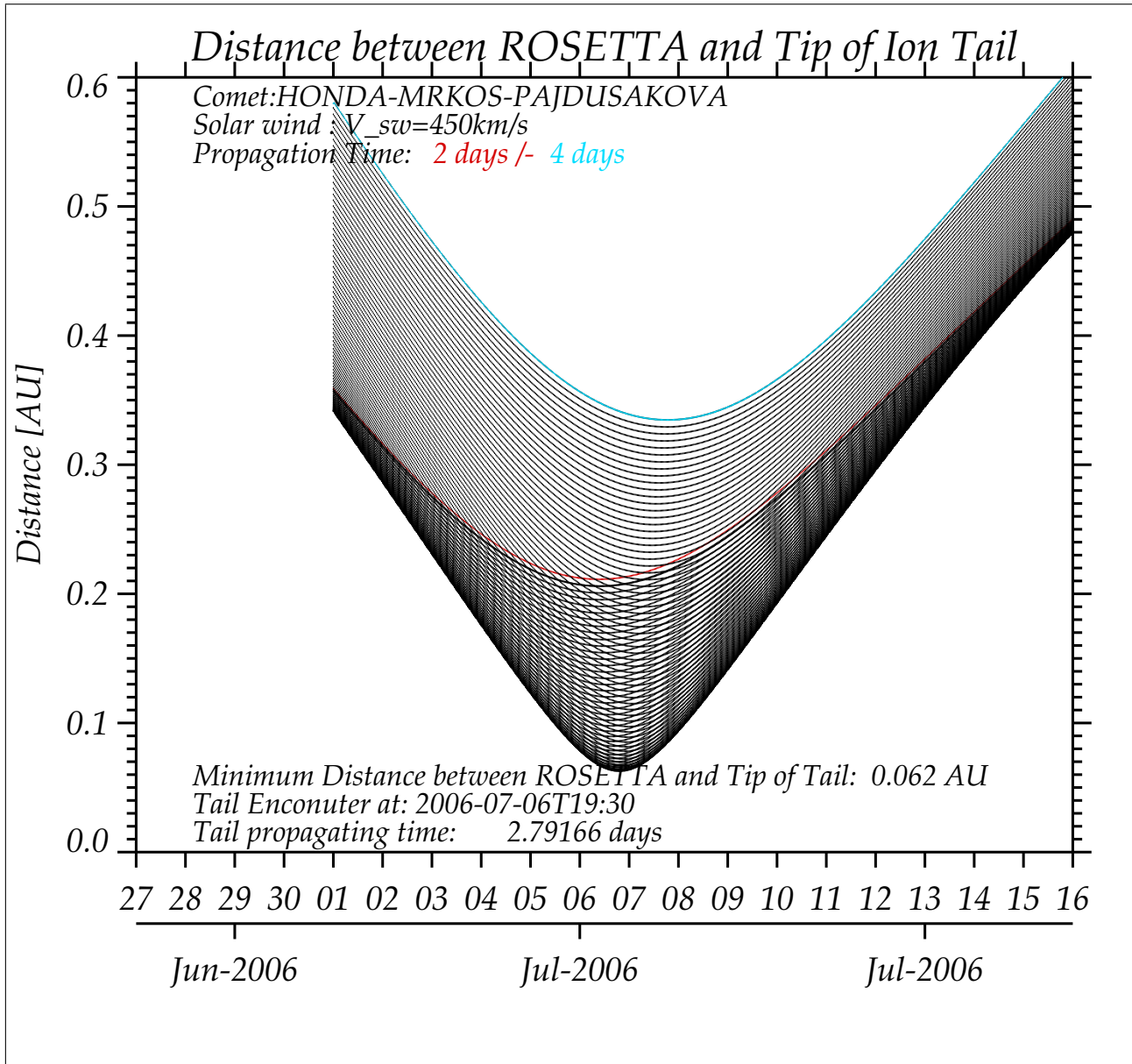


Figure 37: Distance between ROSETTA and Tip of Honda's anticipated Ion Tail - zoomed view

## 8 Geometry of the Encounter

The following three plots show the celestial situation during the ROSETTA – HONDA-tail encounter. Estimated ion tail direction and a magnetic field direction of a standard Parker spiral have been added.

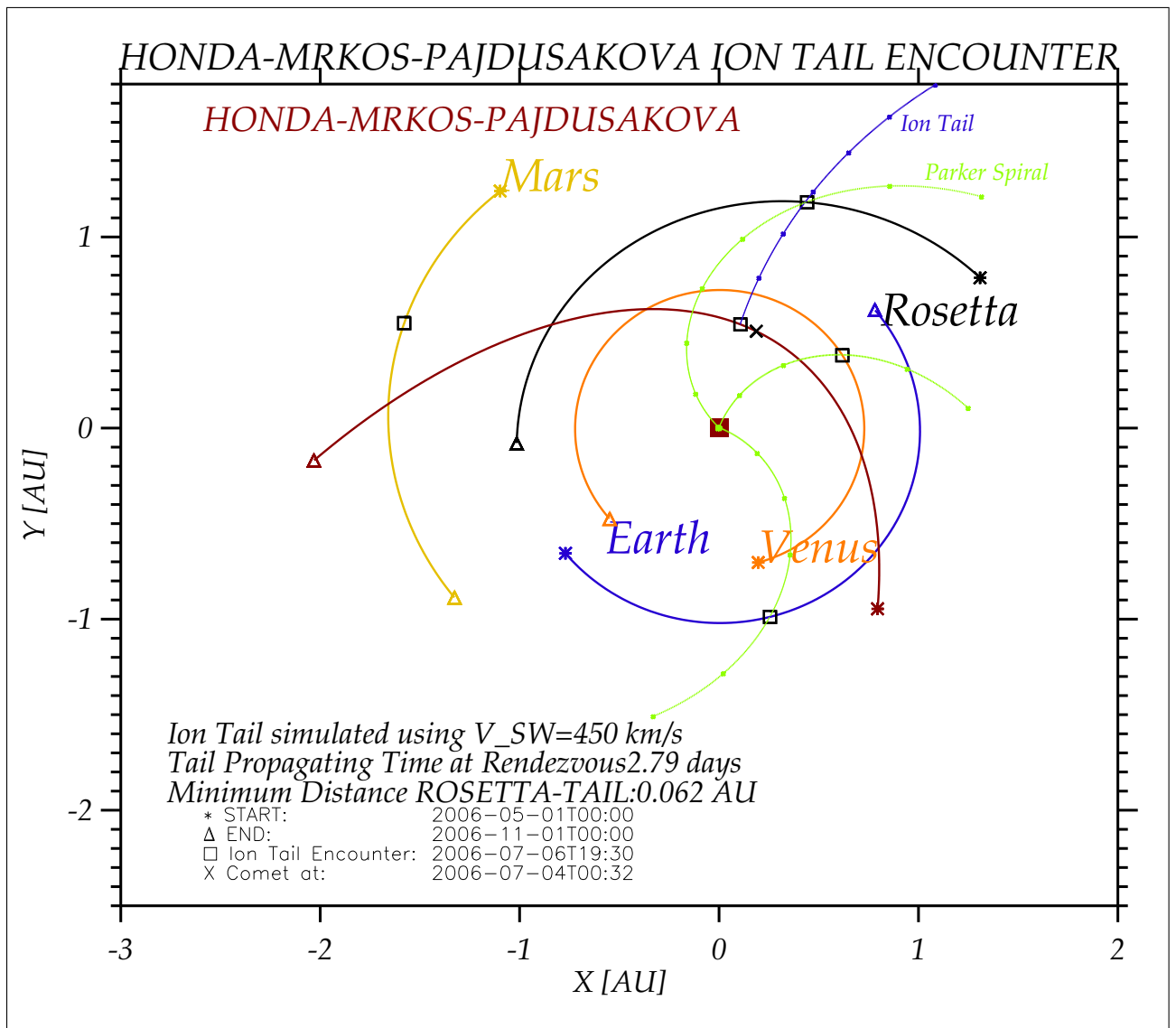


Figure 38: The geometrical encounter situation in the xy-plane (ECLIPJ2000)

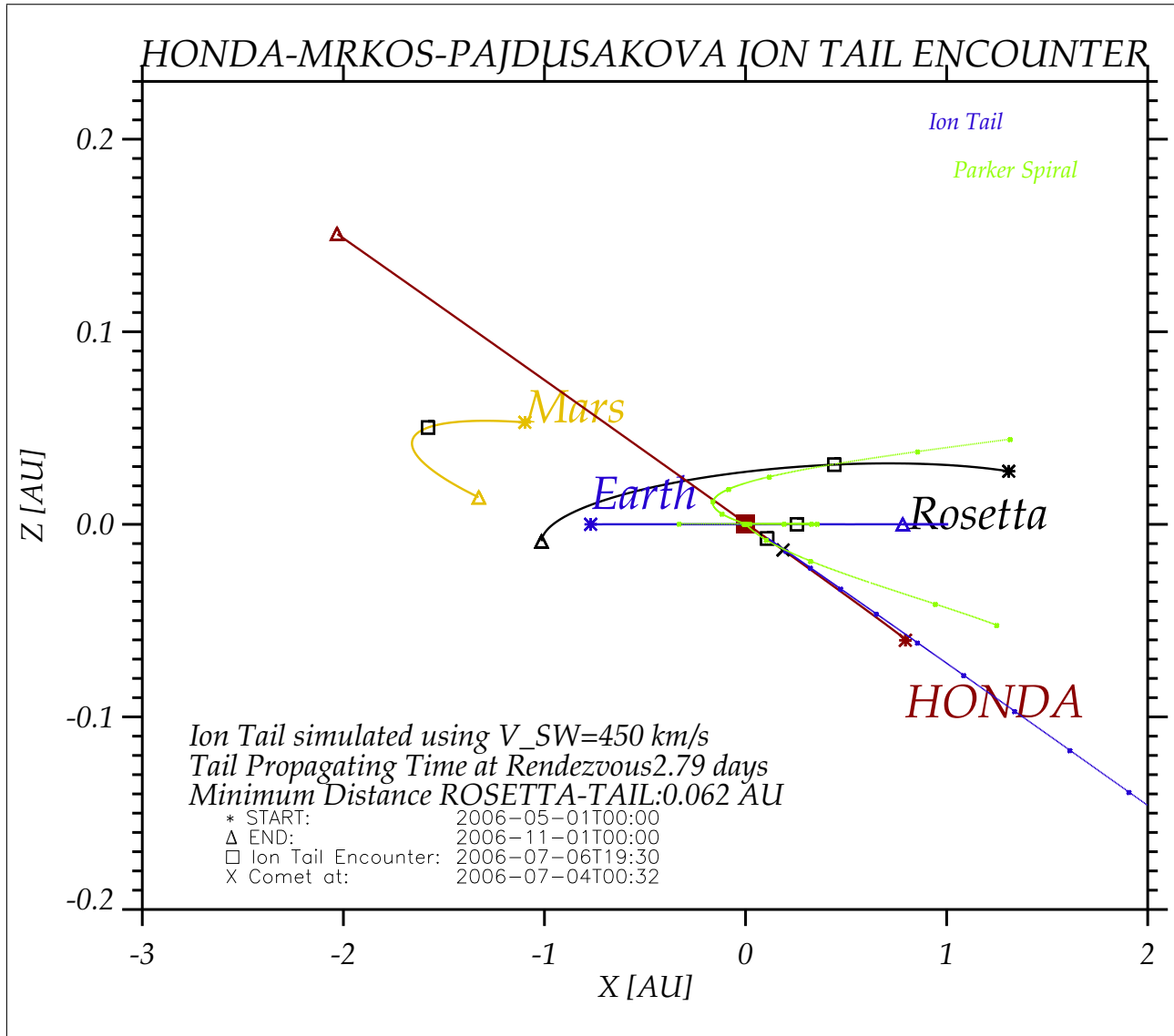


Figure 39: The geometrical encounter situation in the xz-plane (ECLIPJ2000)



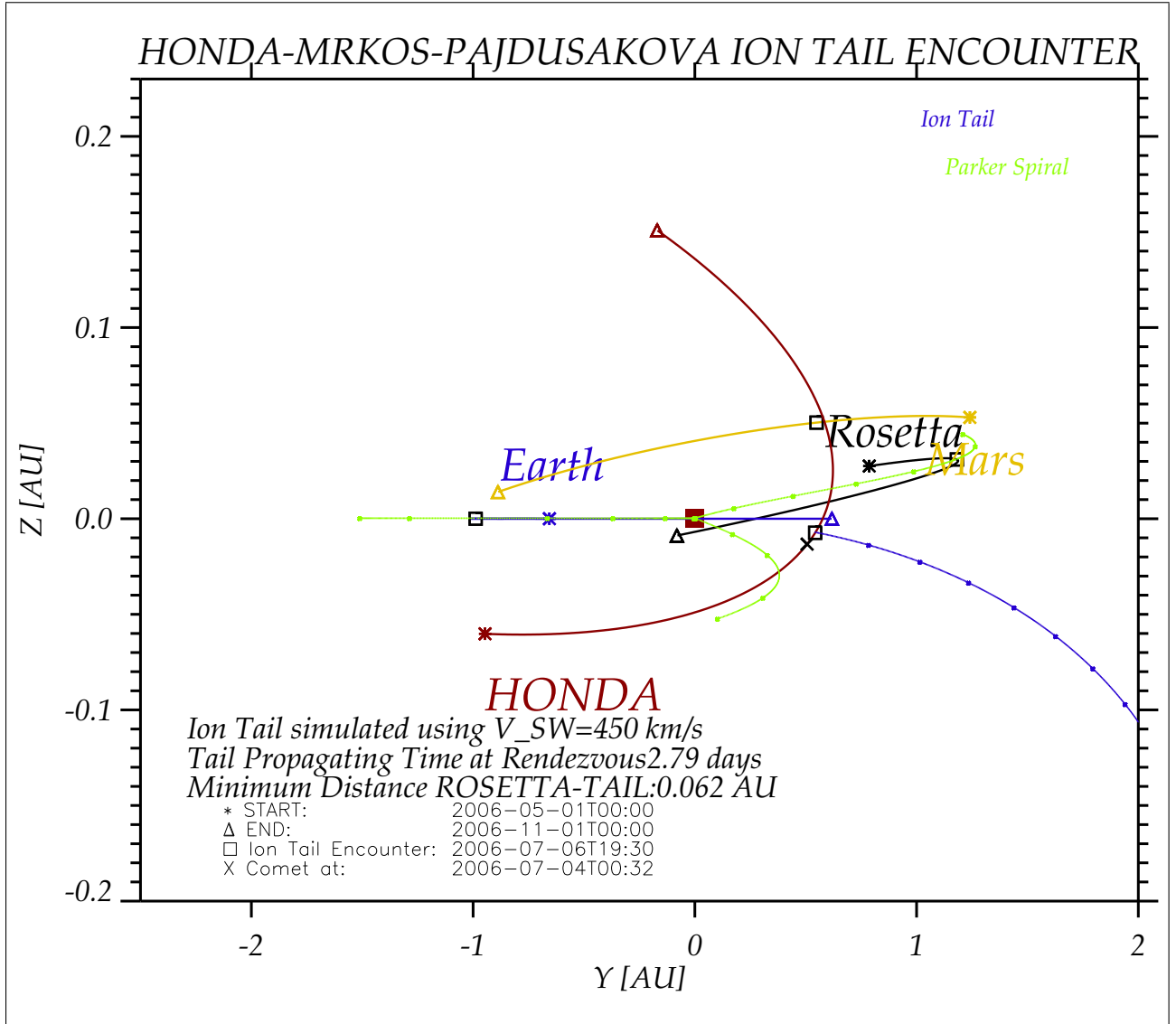


Figure 40: The geometrical encounter situation in the yz-plane (ECLIPJ2000)

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## 9 The observed magnetic field signature and the interpretation

The following plot shows the complete measurement during the HONDA encounter event. Figure 41 displays the magnetic field data in ECLIPJ2000 coordinates. A broad structure over about 48 hours on July 4/5 can be identified. In Figure 42 the same data, rotated to the minimum variance system can, are presented. An attempt to interpret the observed structure as the consequence of a line current revealed a current of about 90 MA, leading to the blue structure added to the plot.

Figure 43 shows the minimum distance between ROSETTA and the fitted line current.

In the next step the data were rotated to the Honda centered solar orbital (HS0, CSO) coordinate system. Refer to Figure 44 for the result. It shows up that the observed magnetic field structure has just transversal components but no contribution in a component parallel to the COMET-SUN direction. This means also that the calculated current just streams in COMET-SUN direction. For a comet tail this seem to be an impossible direction!

Nevertheless a little bit more analysis has been done. In Figure 45 the observed structure is plotted versus the relative trajectory length. It can be seen that the width of the structure is about 4 million kilometers broad.

Figure 46 gives an impression about the orientation and the rotation of the magnetic field signature.

In Figure 47 the angle between the magnetic field and the sun direction has been plotted. Due to the slightly undetermined offset this angle has to be interpreted with care. Nevertheless a slow rotation can be seen for the time interval of the investigated structure. Afterwards the field is oscillating in a more turbulent way.

The last Figure 48 shows the projected angles between the magnetic field and the ECLIPJ2000 coordinate axes. Also this plot has to be read with care due to the offset uncertainty.

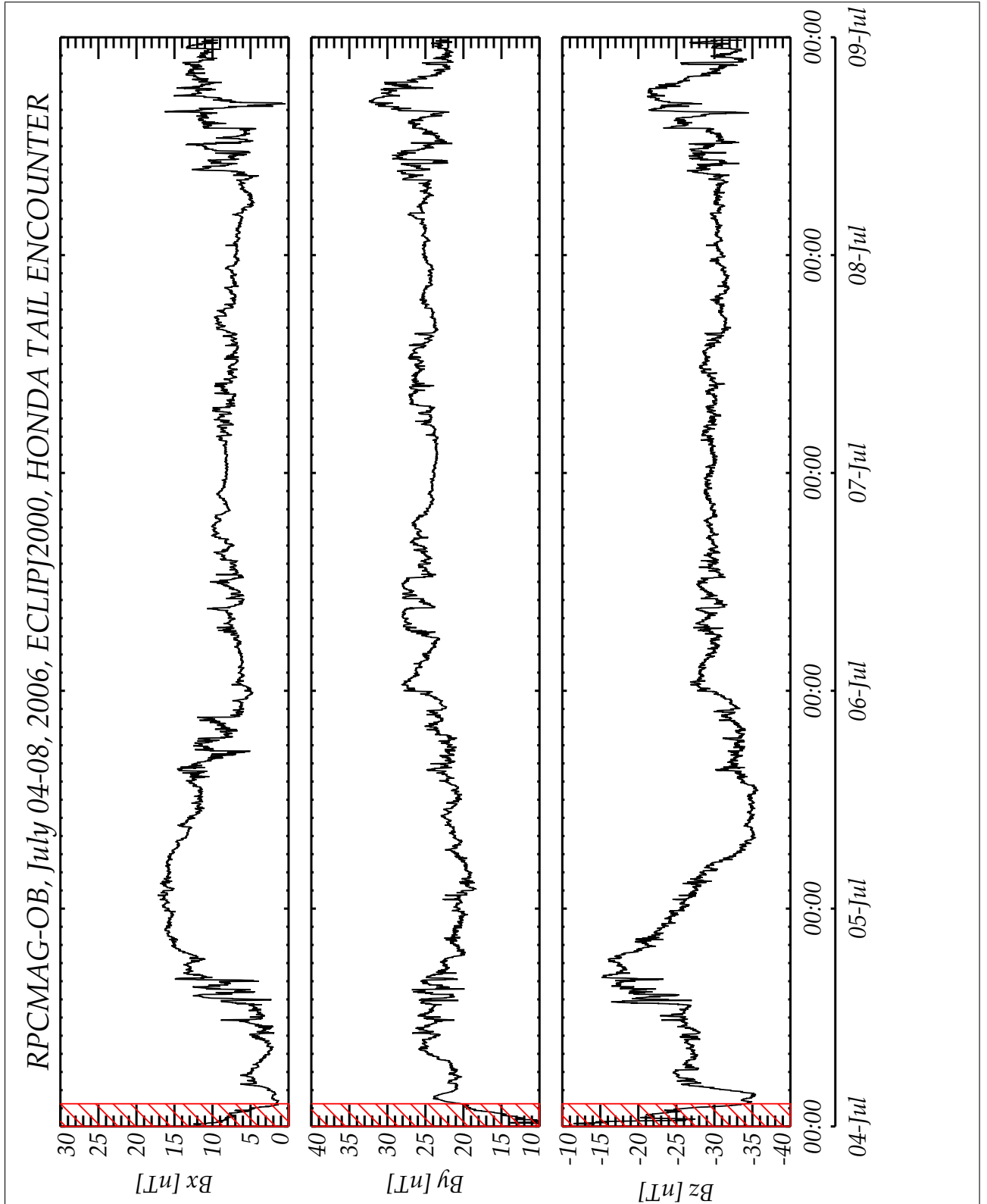


Figure 41: The observed magnetic field structure. ECLIPJ2000 Coordinates

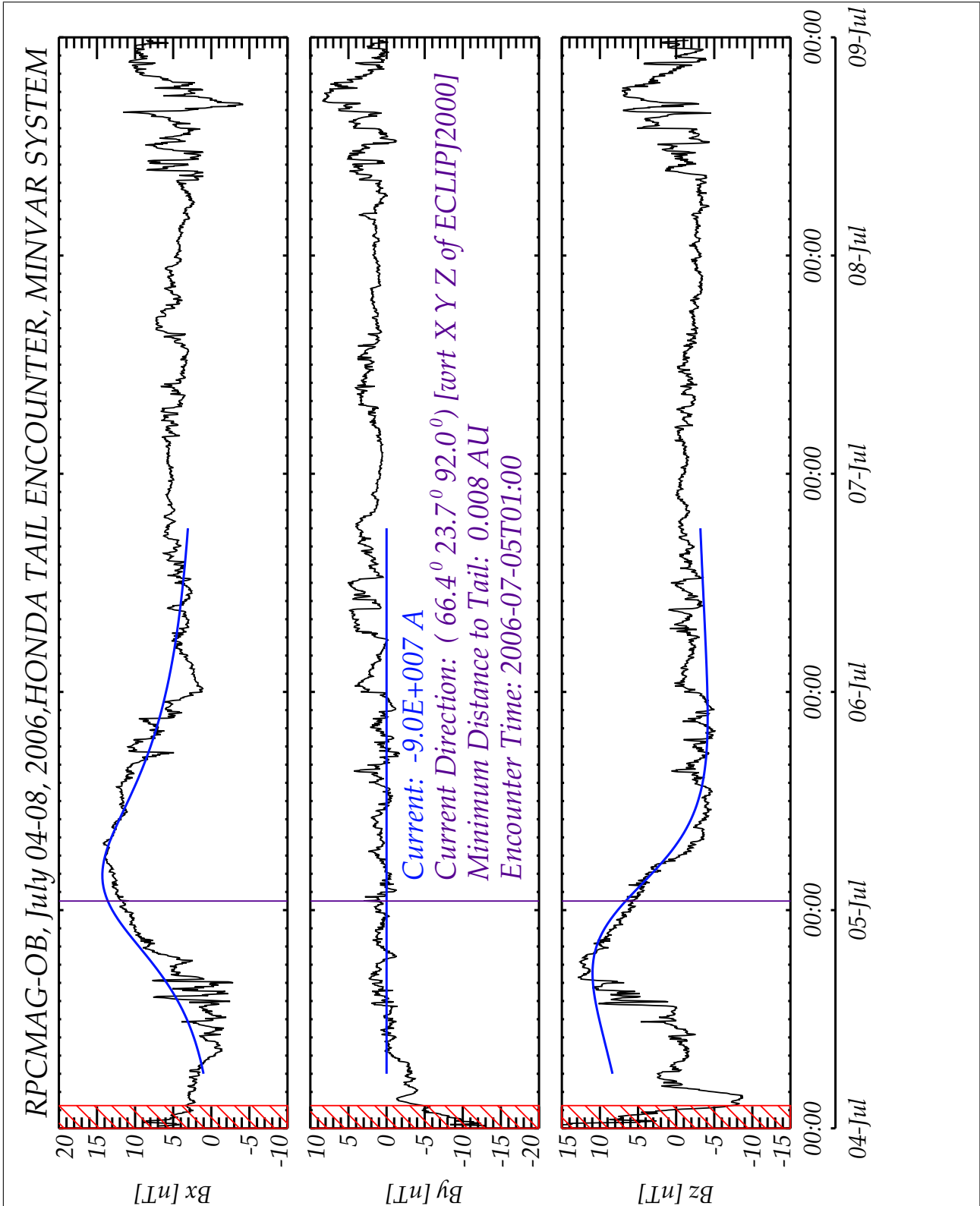


Figure 42: The observed magnetic field structure rotated to the Minimum Variance System

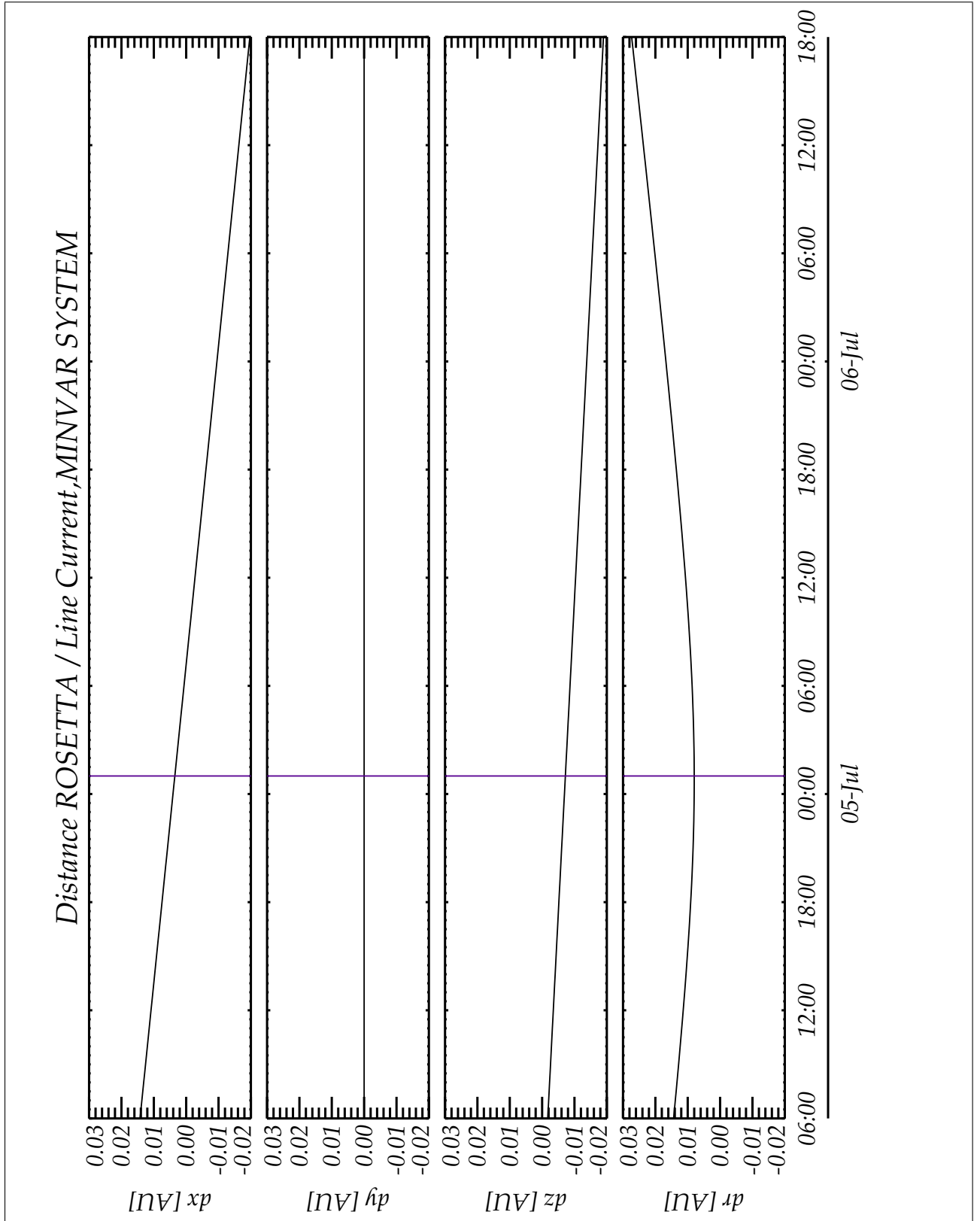


Figure 43: The minimum distance between ROSETTA and the anticipated current

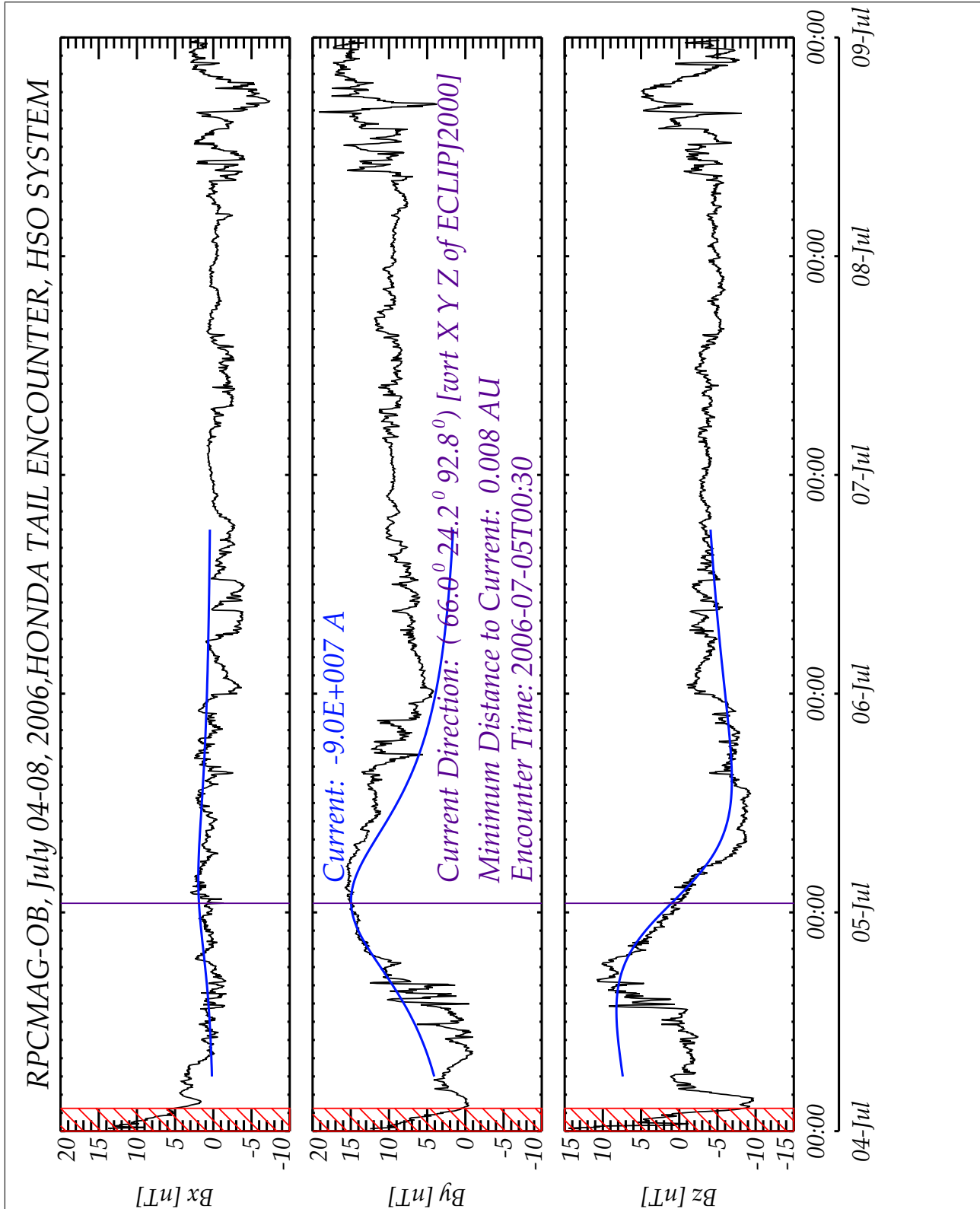


Figure 44: The observed magnetic field structure, rotated to the Honda centered Solar Orbital System. The fitted current generating the structure has been overlaid.

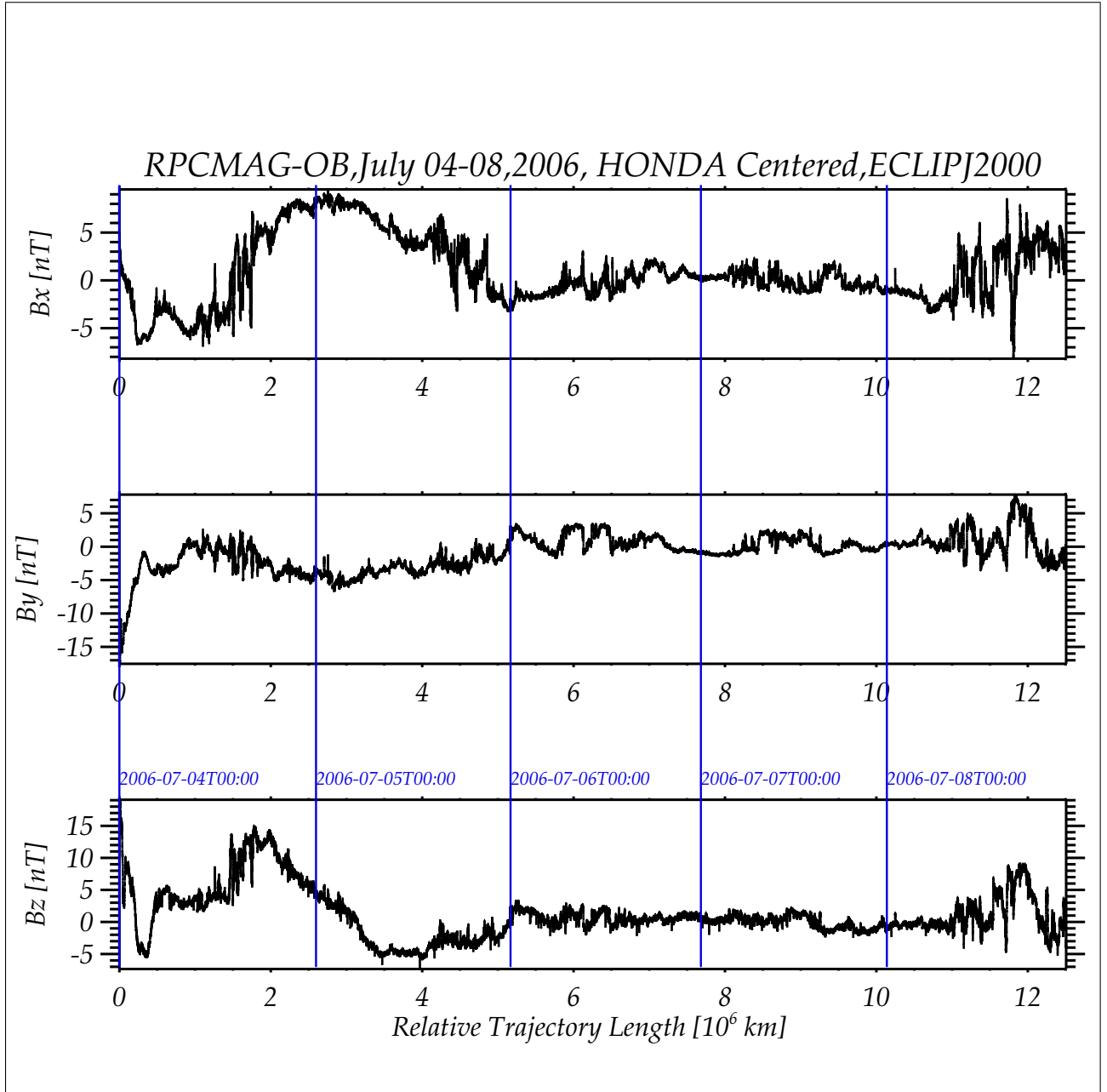


Figure 45: The observed magnetic field signature vs. the relative trajectory length

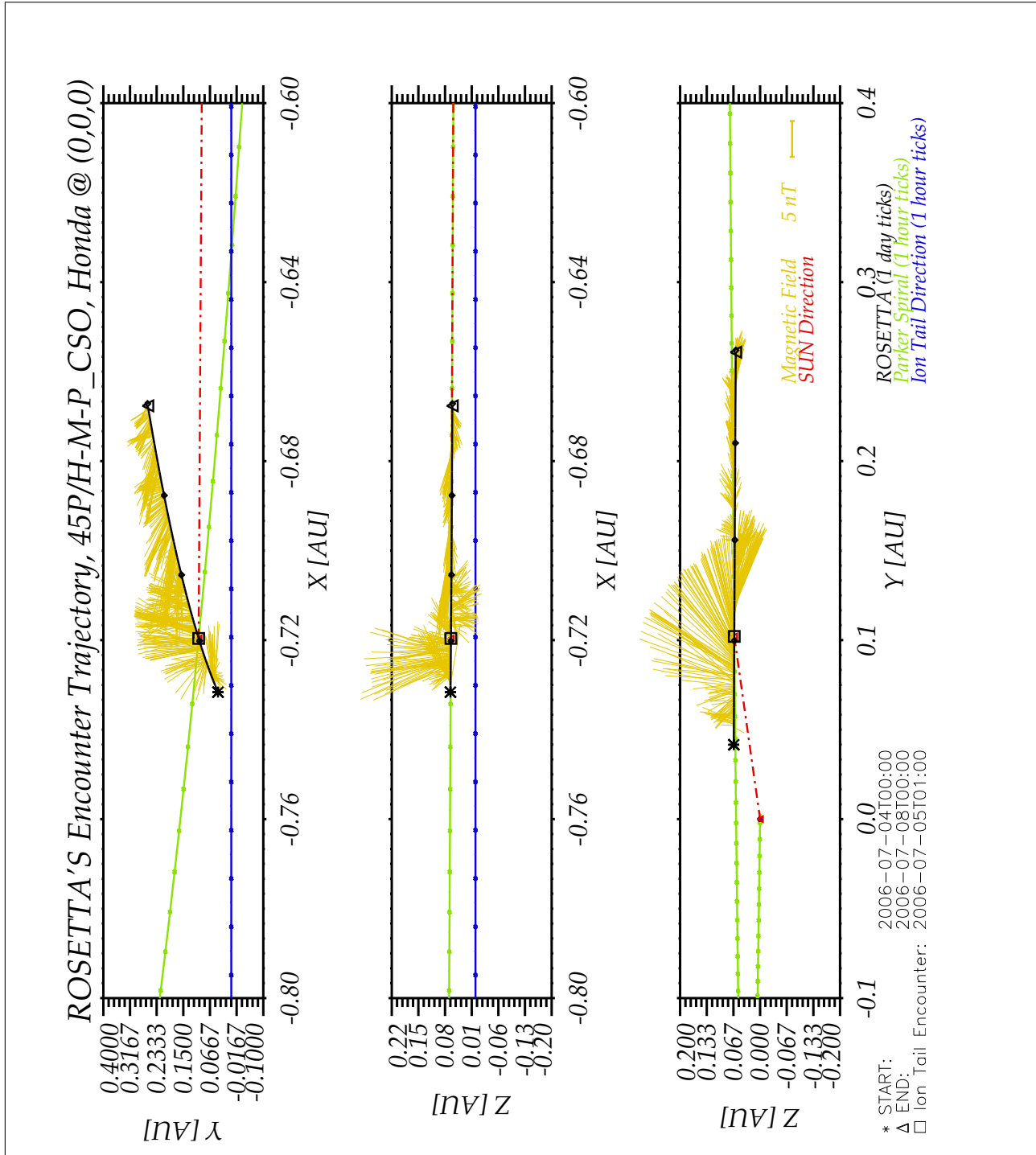


Figure 46: The observed magnetic field structure. Field direction in CSO (HSO) coordinates during the encounter time



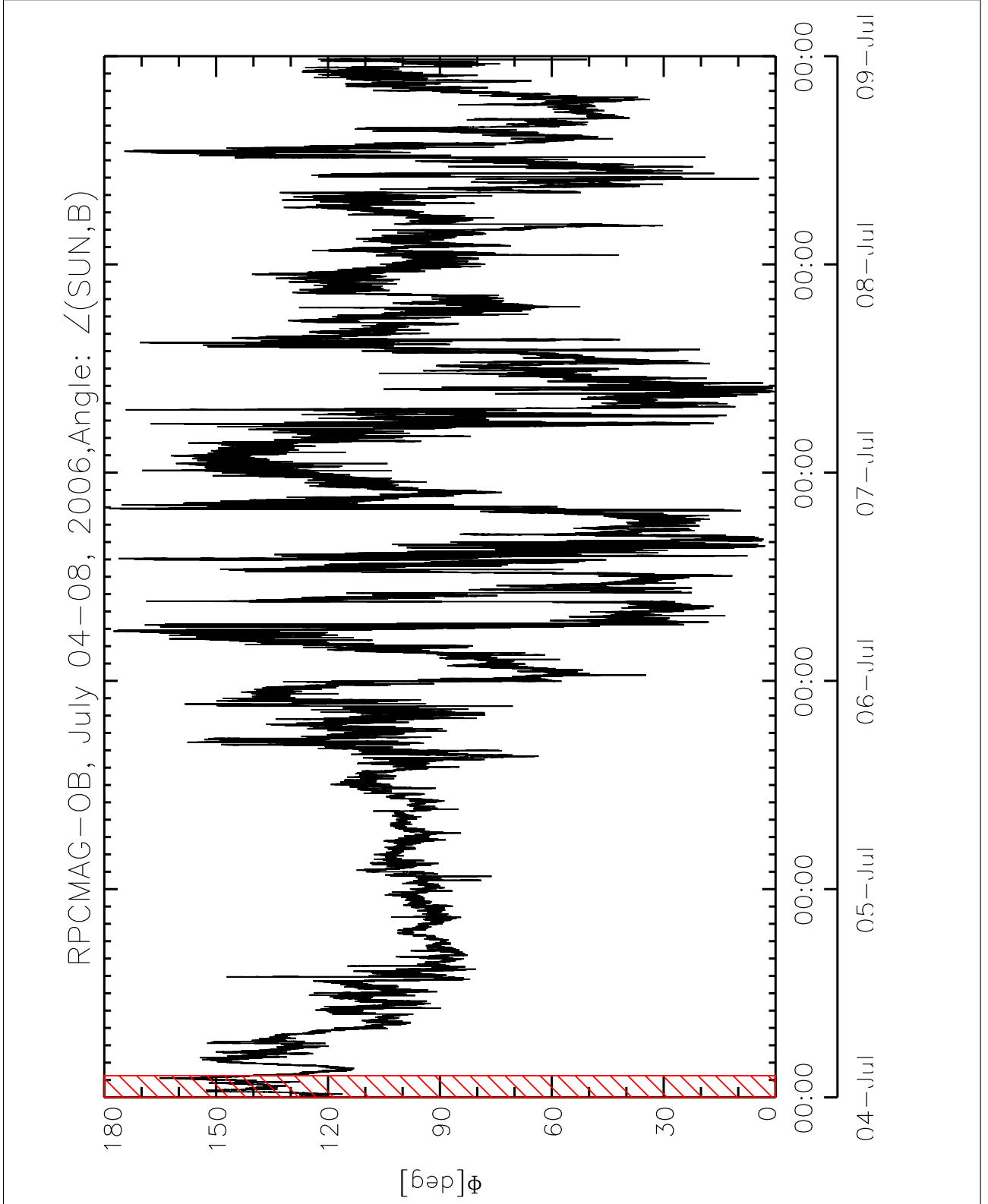


Figure 47: The calculated angle between the magnetic field and the sun direction

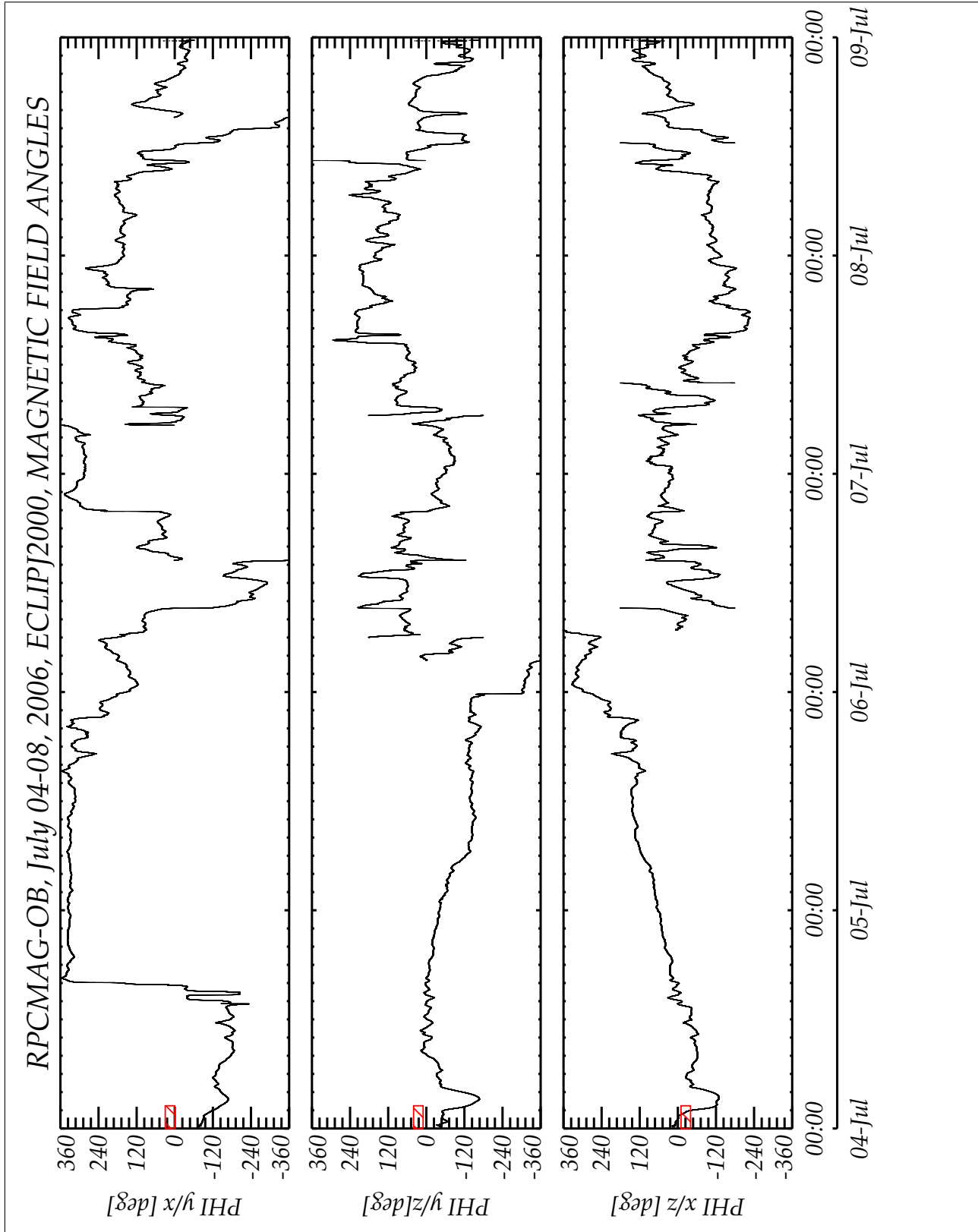


Figure 48: The projected angles between the magnetic field and the ECLIPJ2000 coordinate axes

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Comet:	<b>45P/HONDA-MRKOS-PAJDUSAKOVA</b>				
Time of predicted tail Encounter:	2006-07-06T19:30				
Mean Time of measured Event:	<b>2006-07-05T01:00</b>				
Structure Width:	$\approx 40$				h
Measured field:	15	7	20	15	nT <sub>pp</sub> , [Bx,By,Bz],B
Position of ROSETTA	0.47	1.18	0.03	1.27	AU, [x,y,z],r
Position of COMET:	0.16	0.52	-0.01	0.54	AU, [x,y,z],r
Distance Comet-ROSETTA:	0.31	0.66	0.042	0.73	AU, [x,y,z],r
Velocity of ROSETTA	-27.3	2.9	-0.1	27.5	km/s, [vx,vy,vz],v
Velocity of COMET:	-49.3	23.1	3.7	54.5	km/s, [vx,vy,vz],v
Relative Velocity COMET-ROSETTA:	-21.9	20.1	3.8	30.0	km/s, [vx,vy,vz],v
Tail Angles wrt ECLIPJ2000 :	47.8	42.4	92.8		deg, [X,Y,Z]
Tail propagating Time:	2.79				days
Velocity of ROSETTA normal to Tail:	22.2				km/s
Current Direction from MINVAR:	66.4	23.7	92.1		deg
Current Strength:	$9 \times 10^7$				A
PARKER Angle wrt ECLIPJ2000:	19.7	70.3	89.1		deg
PARKER / Current Direction Angle:	46.7				deg

Table 1: Calculated parameters. Positions and velocities given in ECLIPJ2000 Frame

## 10 Conclusion

Although a clear magnetic field structure over about 48 h or 4 million kilometers has been seen at the time of a possible encounter between ROSETTA and the ion tail of comet HONDA-MRKOS-PAJDUSAKOWA, the origin of the signal can most likely not be found in the comet's ion tail. The direction of the current which could generate such a structure does not fit to the common model of cometary tails. Unfortunately there are no different magnetometers available in the vicinity of the ROSETTA at the time of the event which could give a hint of the source. But anyway we have the strong guess that the observed structure is just a broad disturbance in the solar wind maybe caused by a solar flare event or something similar but not by the comet itself.