MGS OBSERVATIONS OF THE SOLAR WIND INTERACTION WITH MARS

Daniel Winterhalter(1), Christian Mazelle (2) , Didier Vignes(2), David Mitchell(3), Dana Crider(4), Mario Acuna(4), and Jack Connerney(4)

(1)Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109;

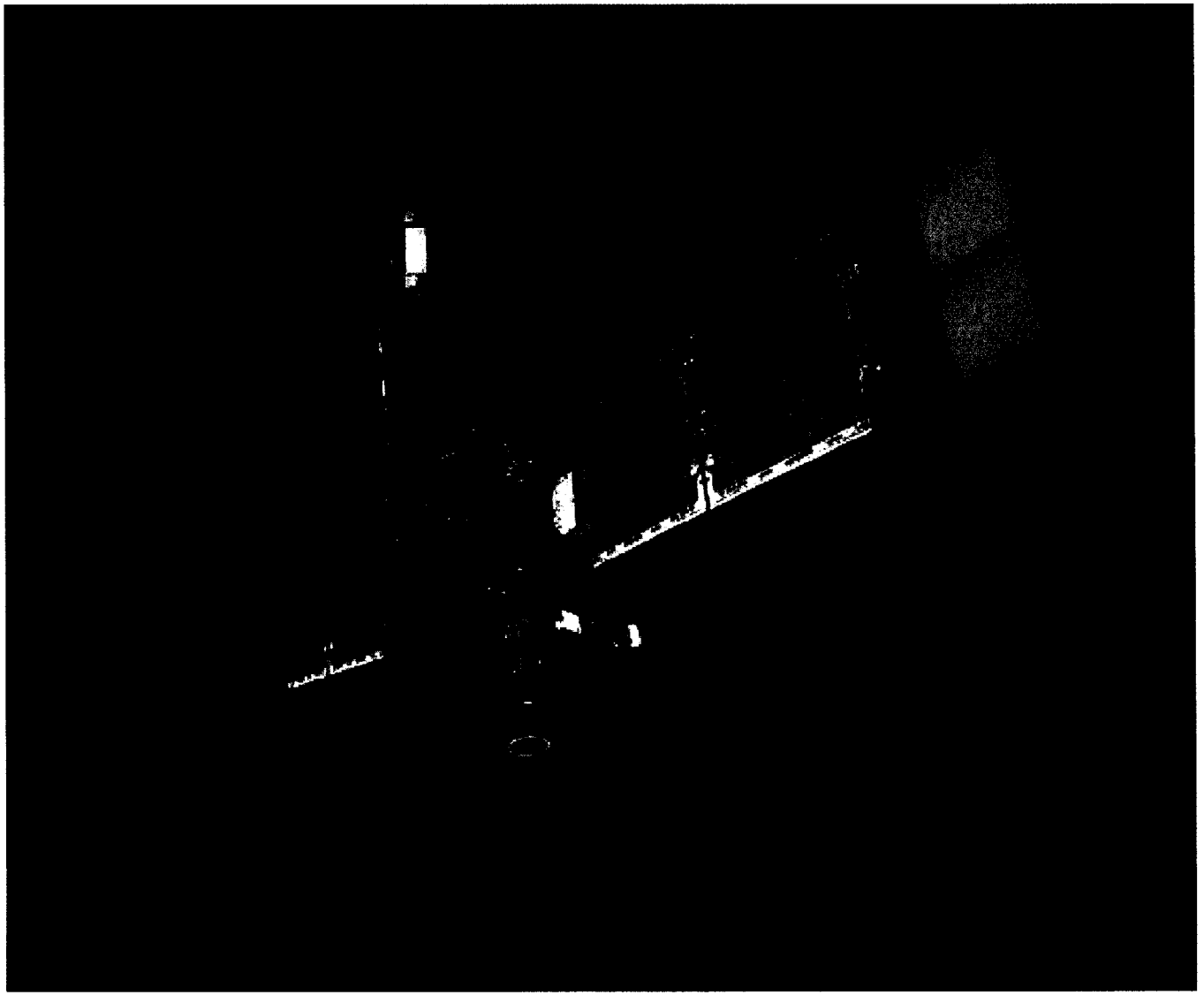
(2)Centre d'Etude Spatiale des Rayonnements, Toulouse, France;

(3)Space Science Laboratory, University of California, Berkeley, CA 94720;

(4)NASA Goddard Space Flight Center, Greenbelt, MD 20771;

NASA

Mars Global Surveyor



ABSTRACT

From March 1998 to September 1998 the Mars Global Observer spacecraft orbited Mars in the elliptical "Science Phasing Orbits" (SPO), collecting definitive measurements of the planet's interaction with the solar wind. The spacecraft traversed Mars' bow shock and the pile-up boundary locations twice each orbit, for 292 orbits, at slowly changing local times as the orbit plane evolved from near the dawn-dusk meridian past the noon-midnight meridian.

A preliminary analysis of the MGS data shows that, as seen in previous studies, the positions of the boundaries (normalized with solar wind pressure) is highly variable, and that the average shock surface deviates from the average shape determined from previous Mars data. It is probable that the positions and shapes of the boundaries are modified by (some of) the highly localized magnetic anomalies discovered by MGS. The variability from orbit to orbit of the positions and shapes might be the consequence of the anomalies, fixed on the rotating planet, appearing and disappearing as viewed from the solar wind direction. We will report on our investigation of the solar wind/Mars boundaries and on their dependence on the near surface magnetic anomalies.

Magnetometer and Electron Reflectometer (MAG/ER) Instrumentation

Two Triaxial Fluxgate Magnetometers and an Electron Reflectometer are used. Two to sixteen vector samples per second of the in-situ magnetic field are acquired, and measurements of electron flux as a function of pitch angle resolve local surface fields.

MAG:

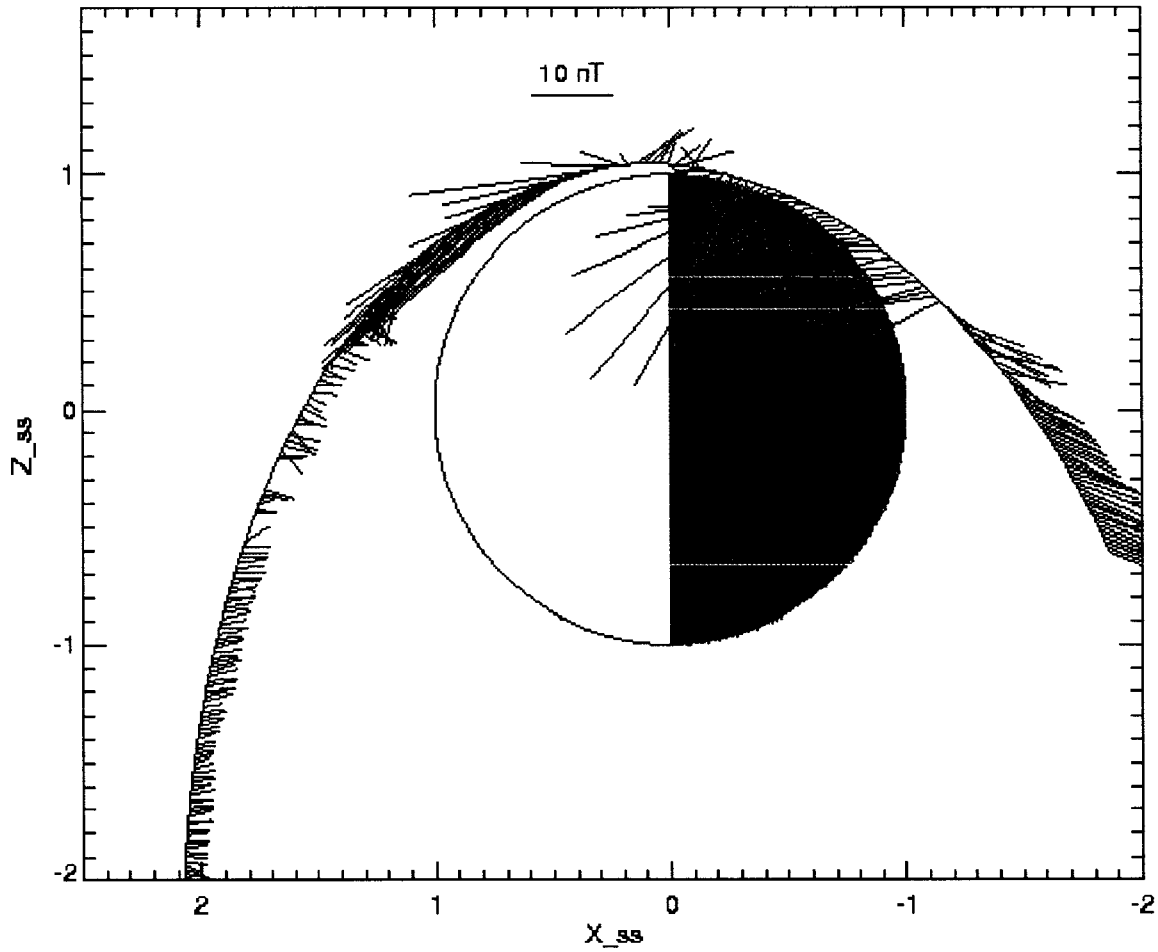
- Dual Triaxial Fluxgate Magnetometers;
- Resolution: 7 Ranges by Factor of 4 from + 16 nT to+65,526 nT (12bits/ sample);

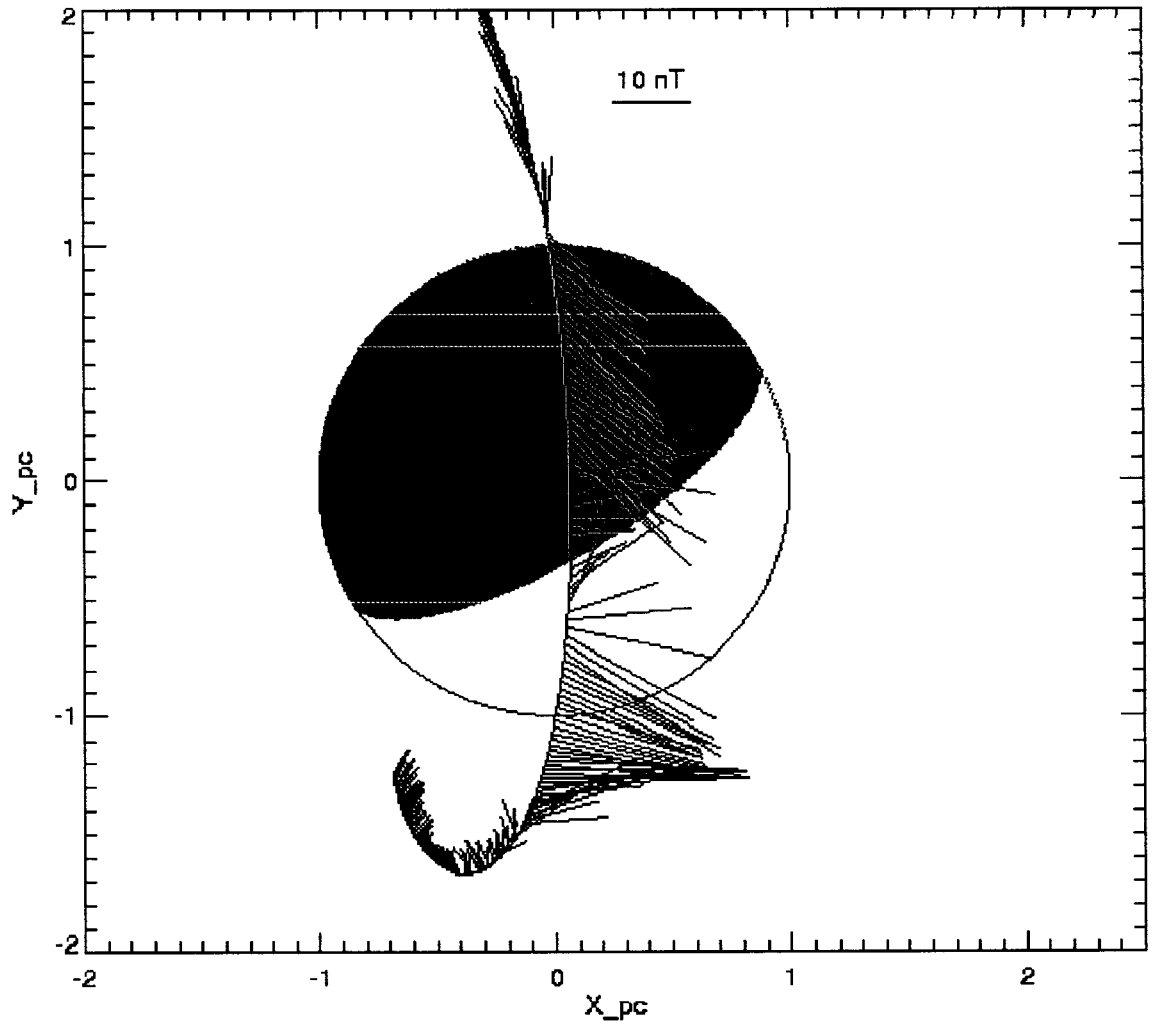
ER:

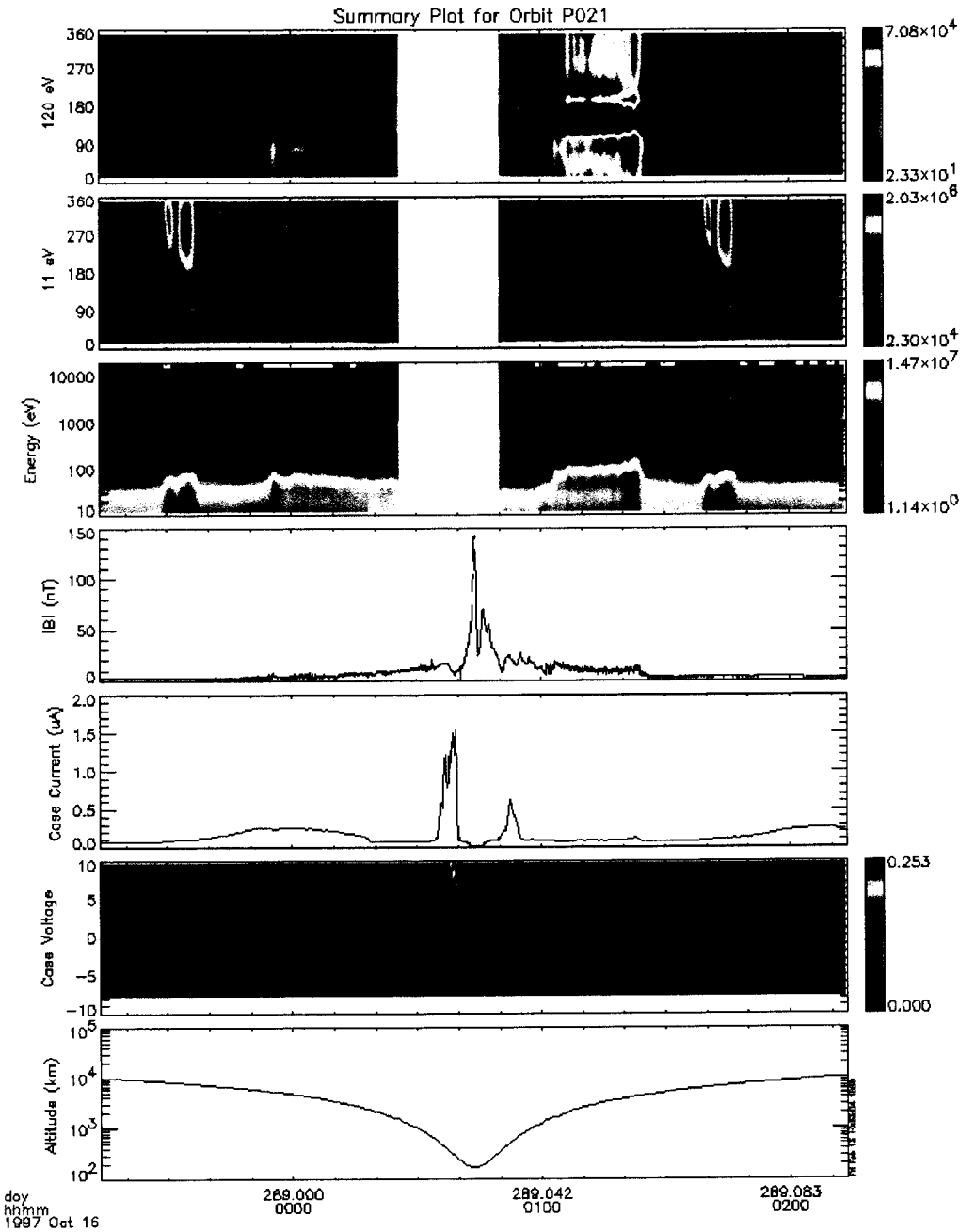
- Symmetrical Quadspherical Electrostatic Analyzer;
- FOV: 360° x 14°;
- 1 eV to 10 Kev with Energy Resolution $\Delta E/E$ of 0.25;

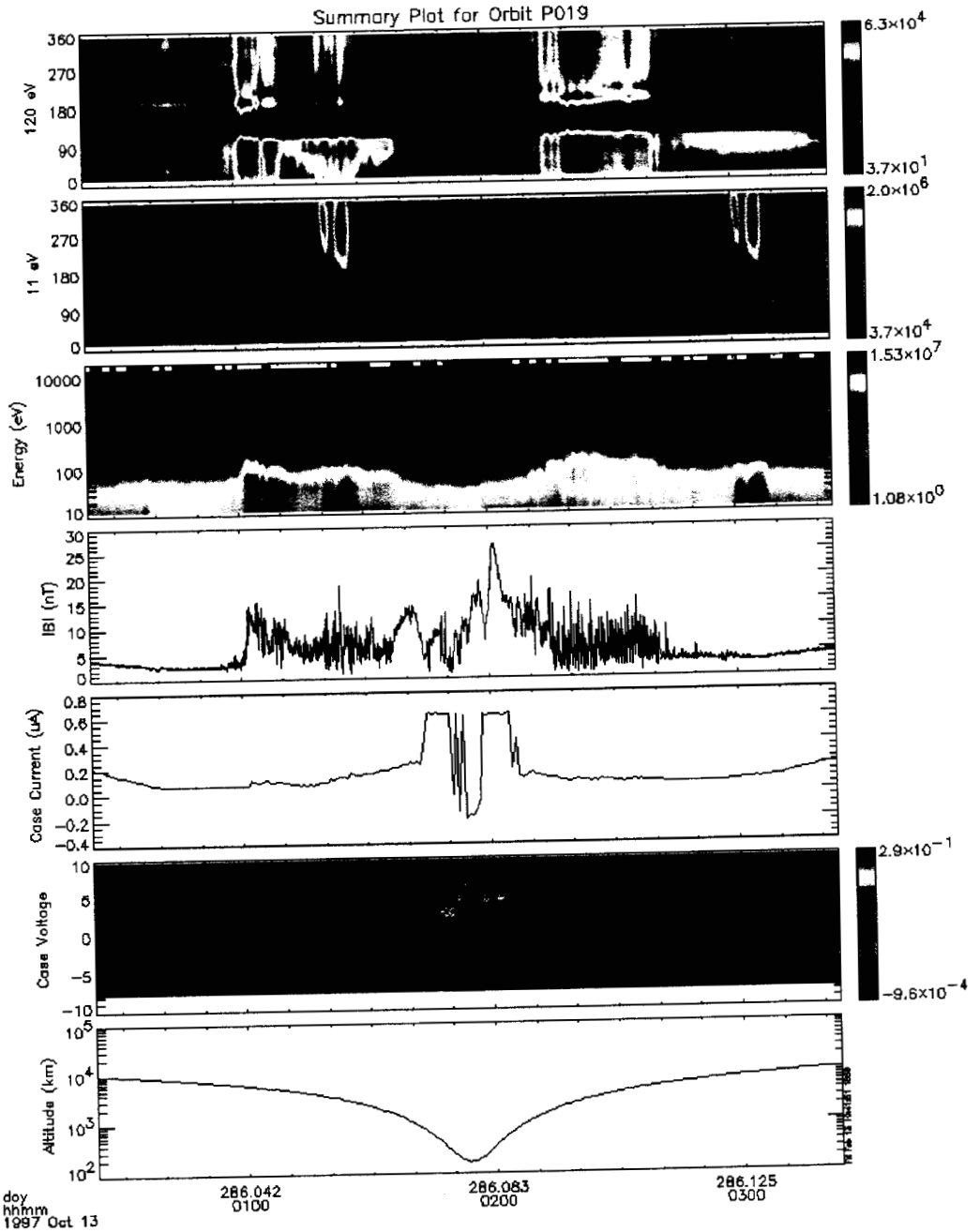
Electronics:

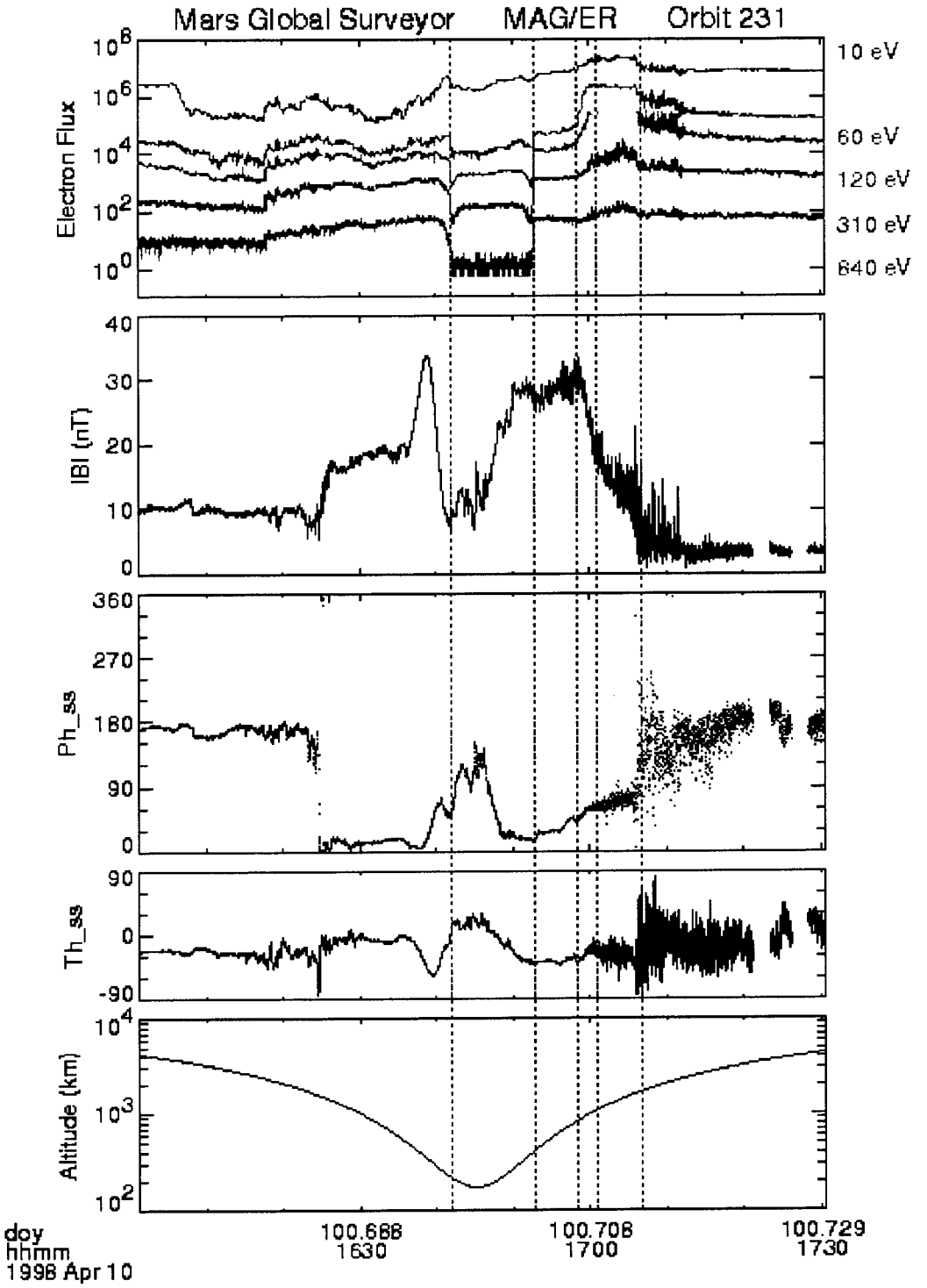
80C86 Microprocessor;
16 kilobyte Memory;
Measures from 2 to 16 Magnetic vectors/sec;
Data Rates: 324, 648, 1296 bits/sec;
Commands: Minimal, Serial Commands;

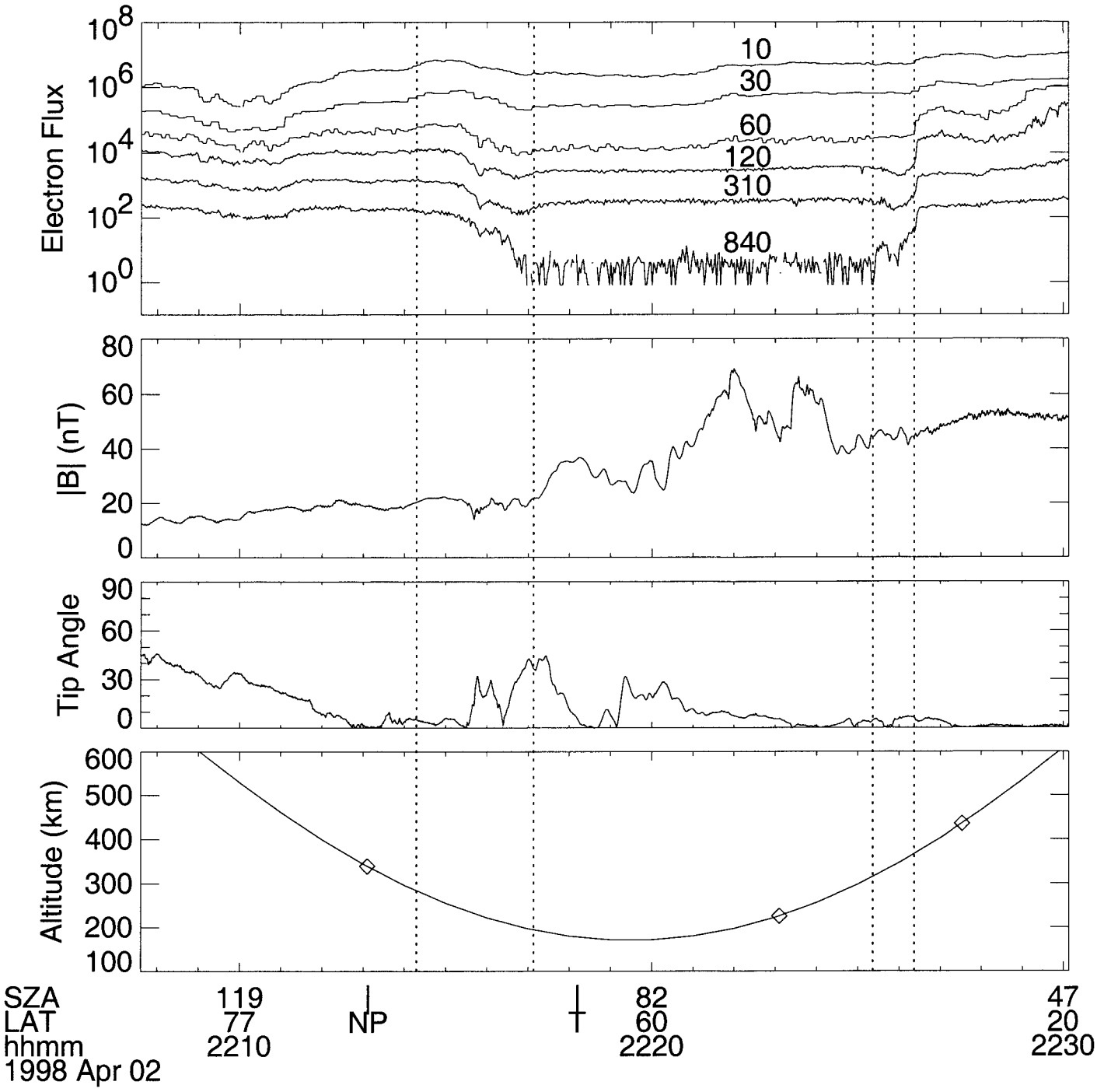

10 nT
1
0
-1
-2
Z_ss
2
1
0
-1
-2
X_ss

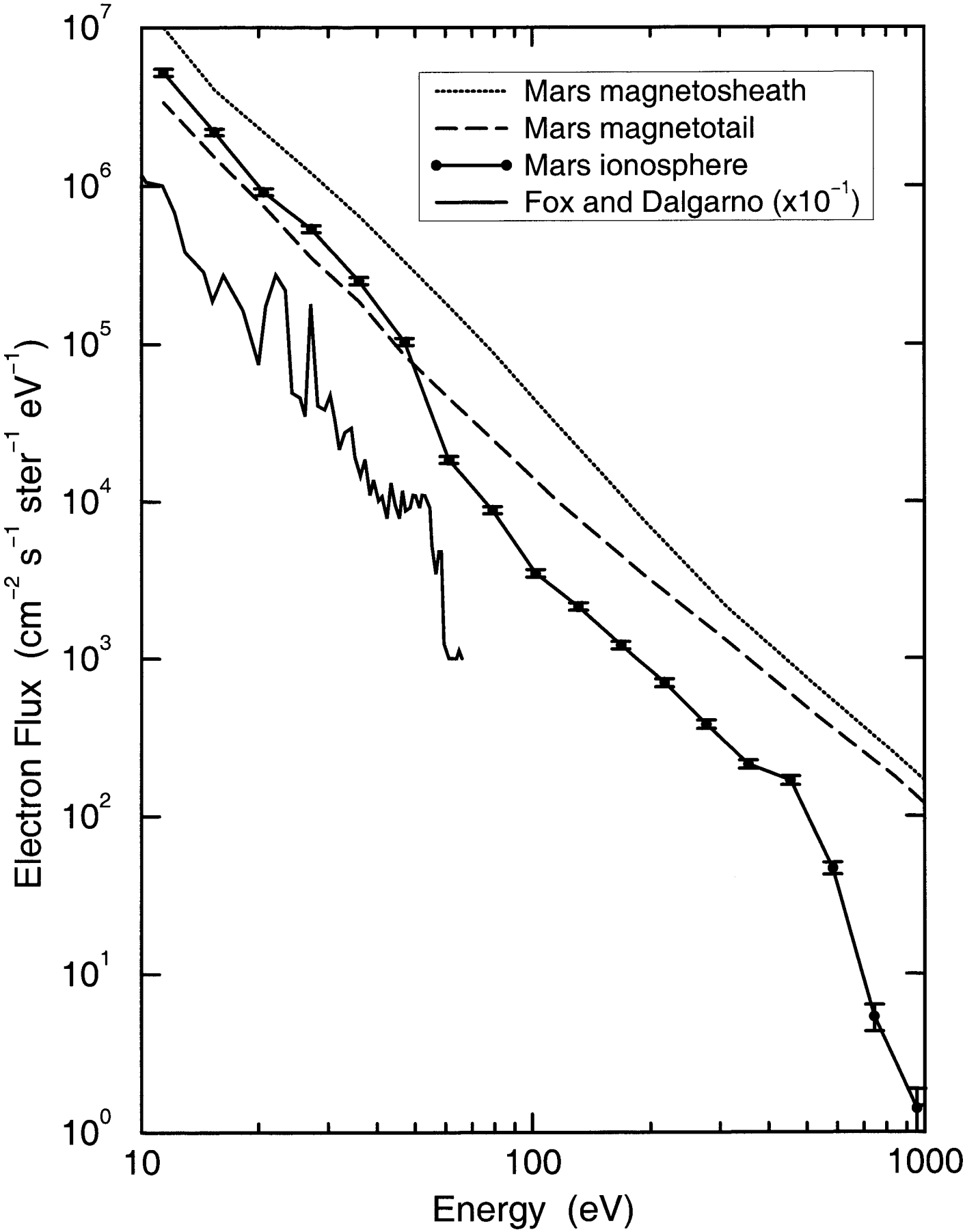

10 nT
Y_pc
X_pc
2
1
0
-1
-2
-2
-1
0
1
2

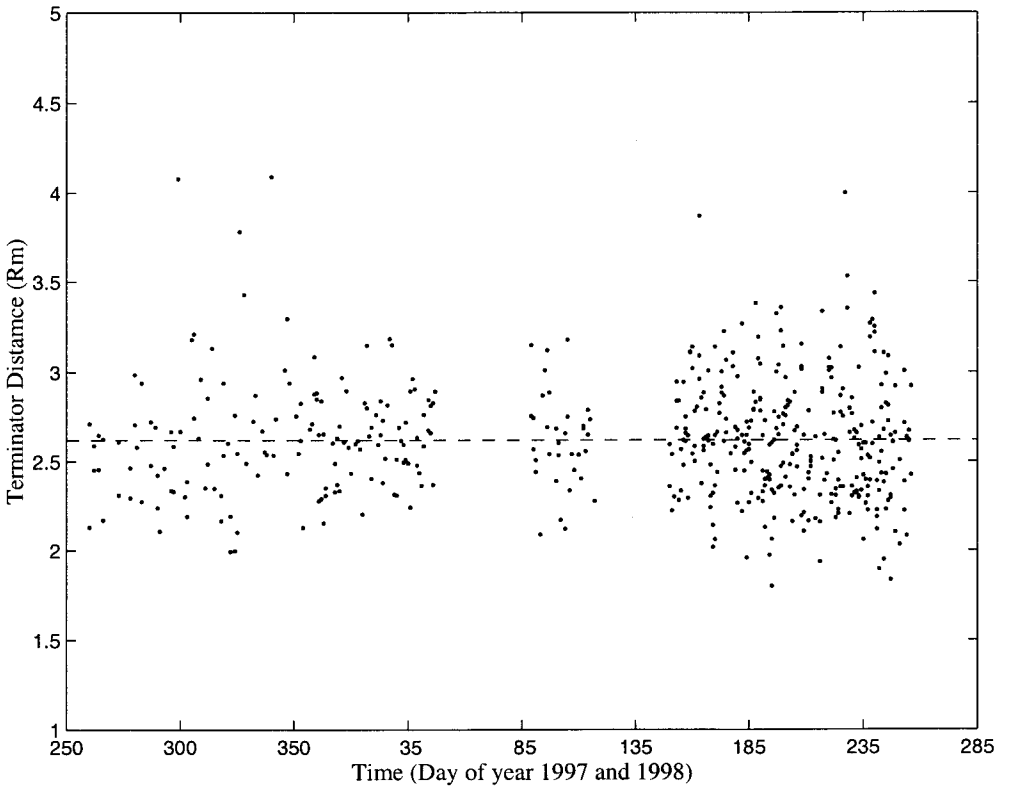

Summary Plot for Orbit P021
120 eV
360
270
180
90
0
7.08×10^4
2.33×10^1
11 eV
360
270
180
90
0
2.03×10^6
2.30×10^4
Energy (eV)
10000
1000
100
10
1.47×10^7
1.14×10^0
|B| (nT)
150
100
50
0
Case Current (μA)
2.0
1.5
1.0
0.5
0.0
Case Voltage
10
5
0
−5
−10
0.253
0.000
Altitude (km)
10^5
10^4
10^3
10^2
doy
hhmm
1997 Oct 16
289.000
0000
289.042
0100
289.083
0200

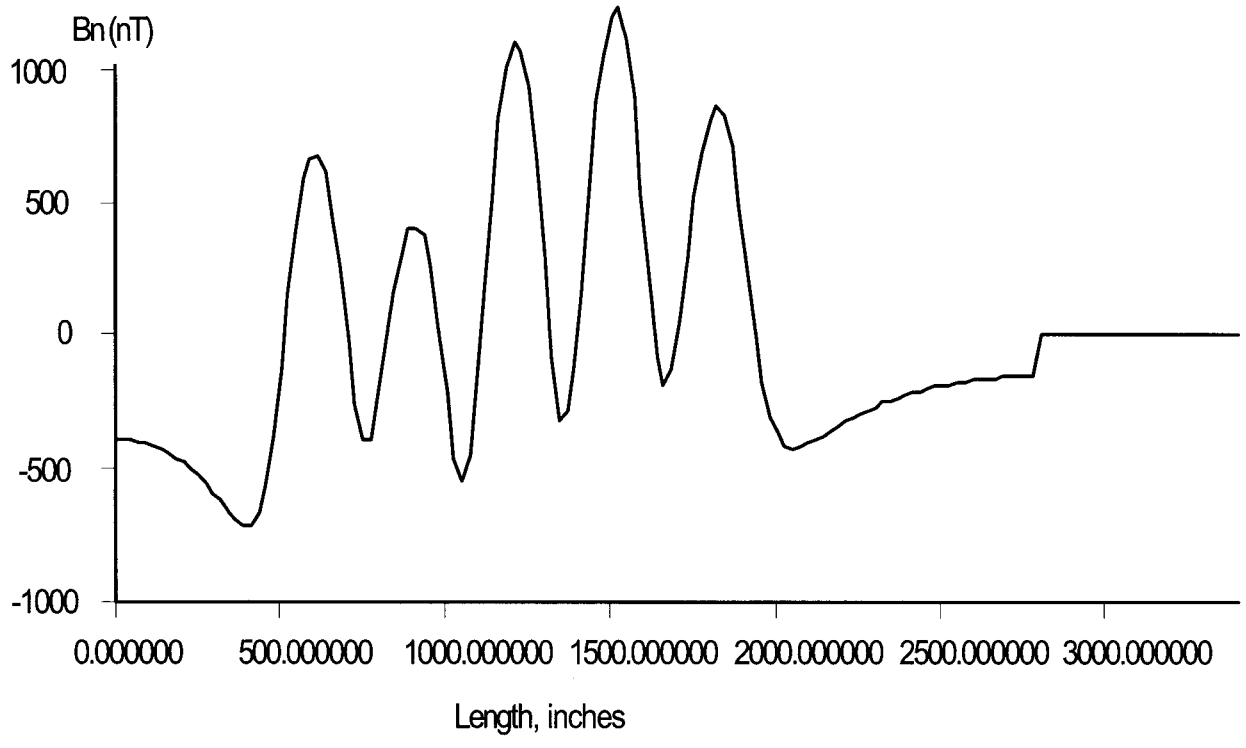

Summary Plot for Orbit P019
120 eV
360
270
180
90
0
6.3×10^4
3.7×10^1
11 eV
360
270
180
90
0
2.0×10^6
3.7×10^4
Energy (eV)
10000
1000
100
10
1.53×10^7
1.08×10^0
|B| (nT)
30
25
20
15
10
5
0
Case Current (μA)
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
Case Voltage
10
5
0
−5
−10
2.9×10^−1
−9.6×10^−4
Altitude (km)
10^5
10^4
10^3
10^2
doy
hhmm
1997 Oct 13
286.042
0100
286.083
0200
286.125
0300

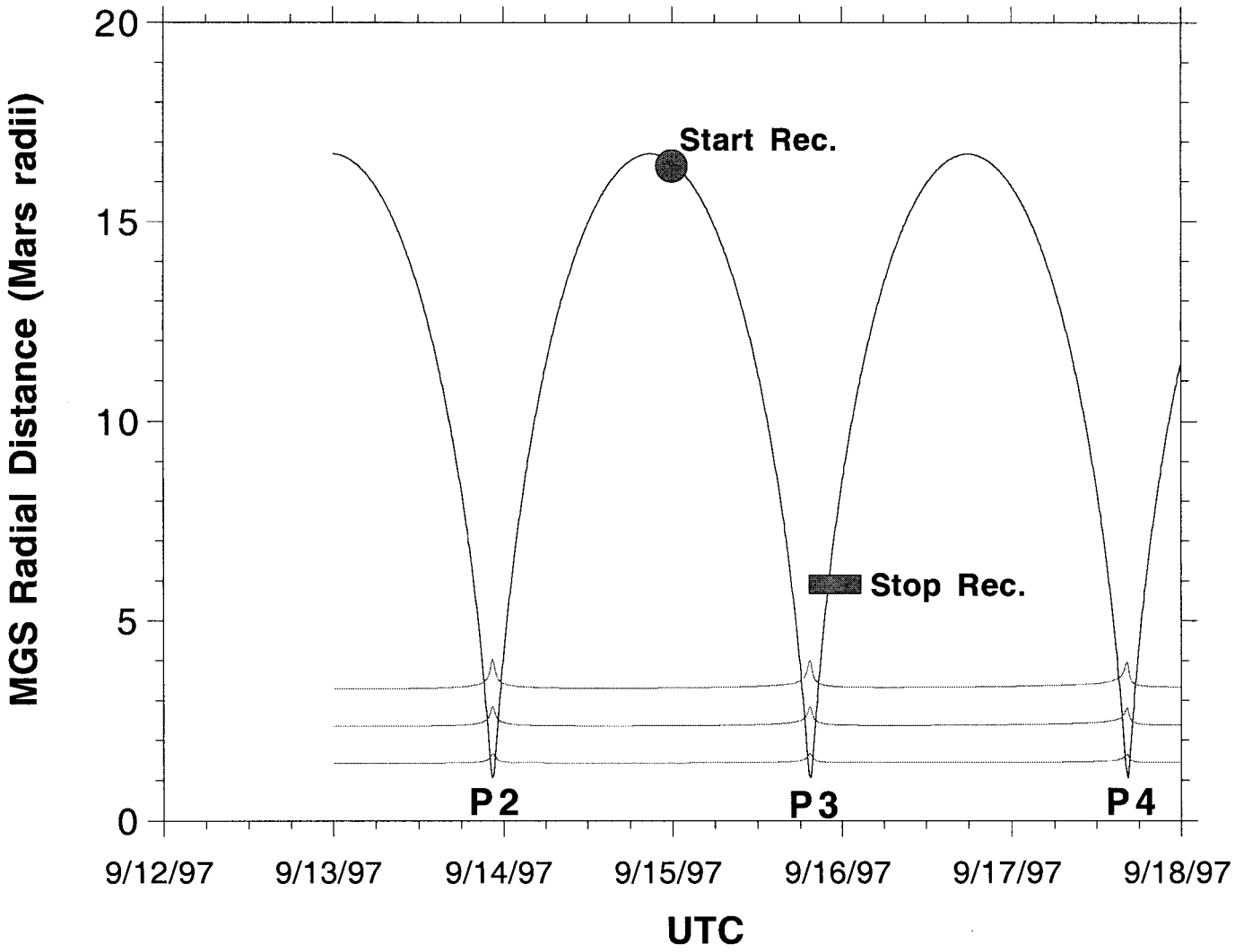

Mars Global Surveyor
MAG/ER
Orbit 231
Electron Flux
10 eV
60 eV
120 eV
310 eV
640 eV
|B| (nT)
Ph_ss
Th_ss
Altitude (km)
doy
hhmm
1998 Apr 10
100.688
1630
100.708
1700
100.729
1730


Electron Flux
10
30
60
120
310
840
|B| (nT)
Tip Angle
Altitude (km)
SZA 119 82 47
LAT 77 60 20
hhmm 2210 2220 2230
1998 Apr 02
NP


Mars magnetosheath
Mars magnetotail
Mars ionosphere
Fox and Dalgarno (x10^{-1})
Electron Flux (cm^{-2} s^{-1} ster^{-1} eV^{-1})
Energy (eV)
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10
100
1000


Terminator Distance (Rm)
5
4.5
4
3.5
3
2.5
2
1.5
1
250
300
350
35
85
135
185
235
285
Time (Day of year 1997 and 1998)


Bn (nT)
1000
500
0
-500
-1000
0.000000
500.000000
1000.000000
1500.000000
2000.000000
2500.000000
3000.000000
Length, inches


MGS Radial Distance (Mars radii)
20
15
10
5
0
Start Rec.
Stop Rec.
P2
P3
P4
9/12/97
9/13/97
9/14/97
9/15/97
9/16/97
9/17/97
9/18/97
UTC