Motivation

1) Earlier work on single satellites shown that phase space density can be tracked from one spacecraft to another and provide clues as to the average electric field value in the intermediate regions. [Whipple et al., 1998, 1999].

Particularly with the advent of Cluster this work has increased importance.

2) In the inner magnetosphere such work is even more promising, because B-fields are strong and E-fields are smaller (and more difficult to measure).

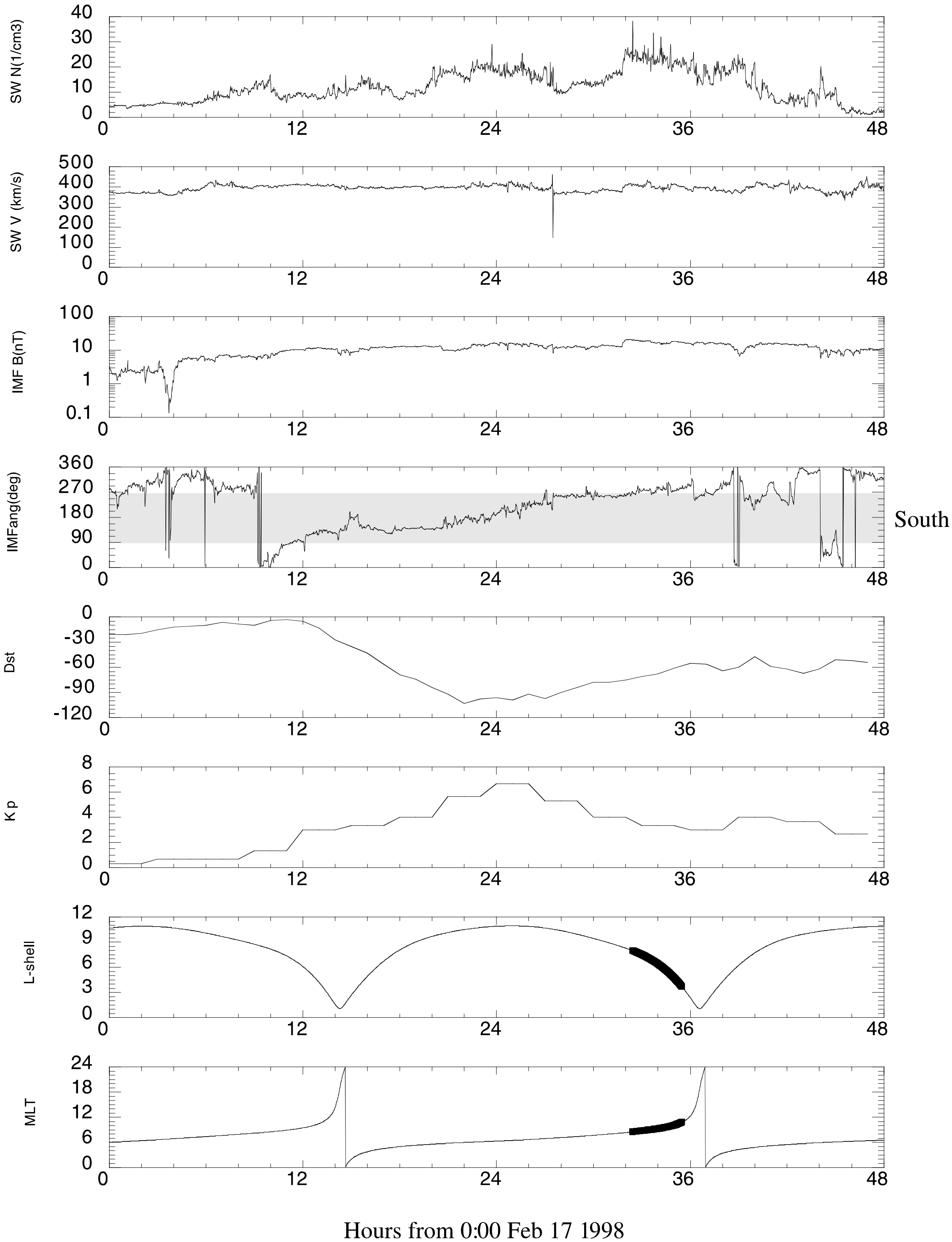
3) Programmatic considerations are well: Constellation ORION and LWS program.

Long term objective: To obtain E-field distribution as a function of location using PSD and its mapping from one spacecraft to another. Determine number of spacecraft that are necessary given an accuracy level and a spatial resolution for Efield.

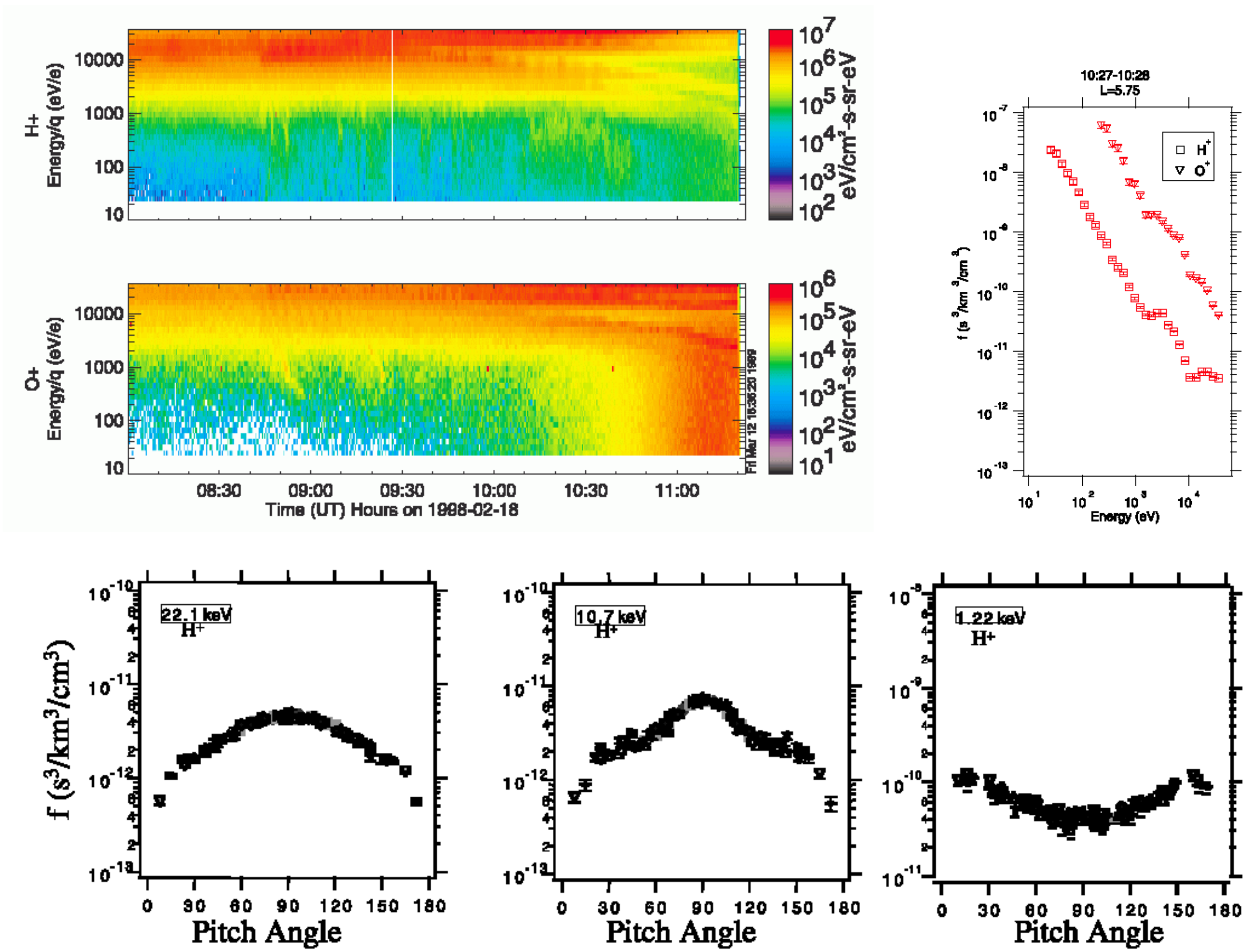
Short term objective: To explain particle signatures on multiple spacecraft with SAME model fields.Such signatures may be: Nose dispersions (Ejiri et al., 1980; Kistler et al., 1989);
Wedge dispersions (Yamauchi et al., 1996; Ebihara et al., 2000), the more classical bouncing ion clusters (Quinn and McIlwain, 1979), VDIS (Bosqued et al., 1993), or more recently observed TDIS (Sauvaud et al., 1999).

In this work we present the multi-spacecraft case study of a storm (recovery) and first particle traces using a guiding center code. Contrary to previous work that utilized bounce-averaged equations, we preserve the bounce motion to enable us to compute effects from rapid Efield variations.

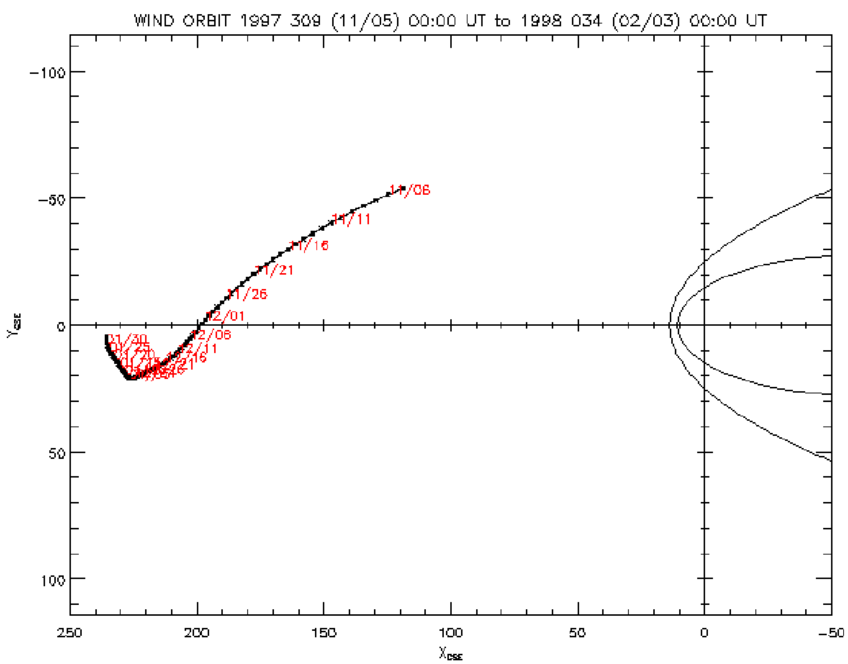
The code is compromise between generality of full particle tracing and speed of bounce averaged equations.

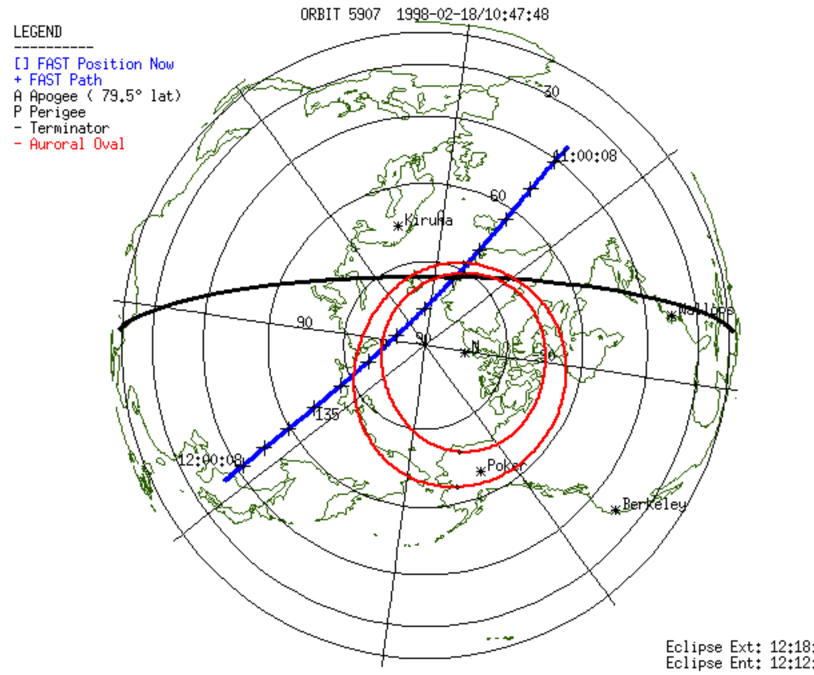


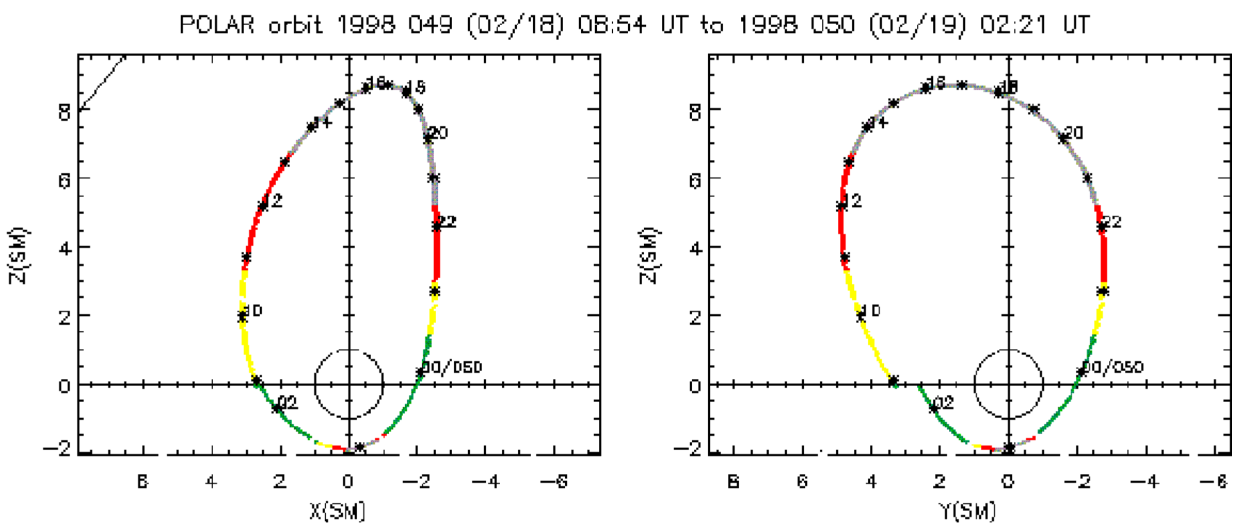
WIND and activity index (Dst, Kp) data for the 1998-Feb-17/18 storm. EQ-S position also shown at the bottom (from Kistler et al., 1999).

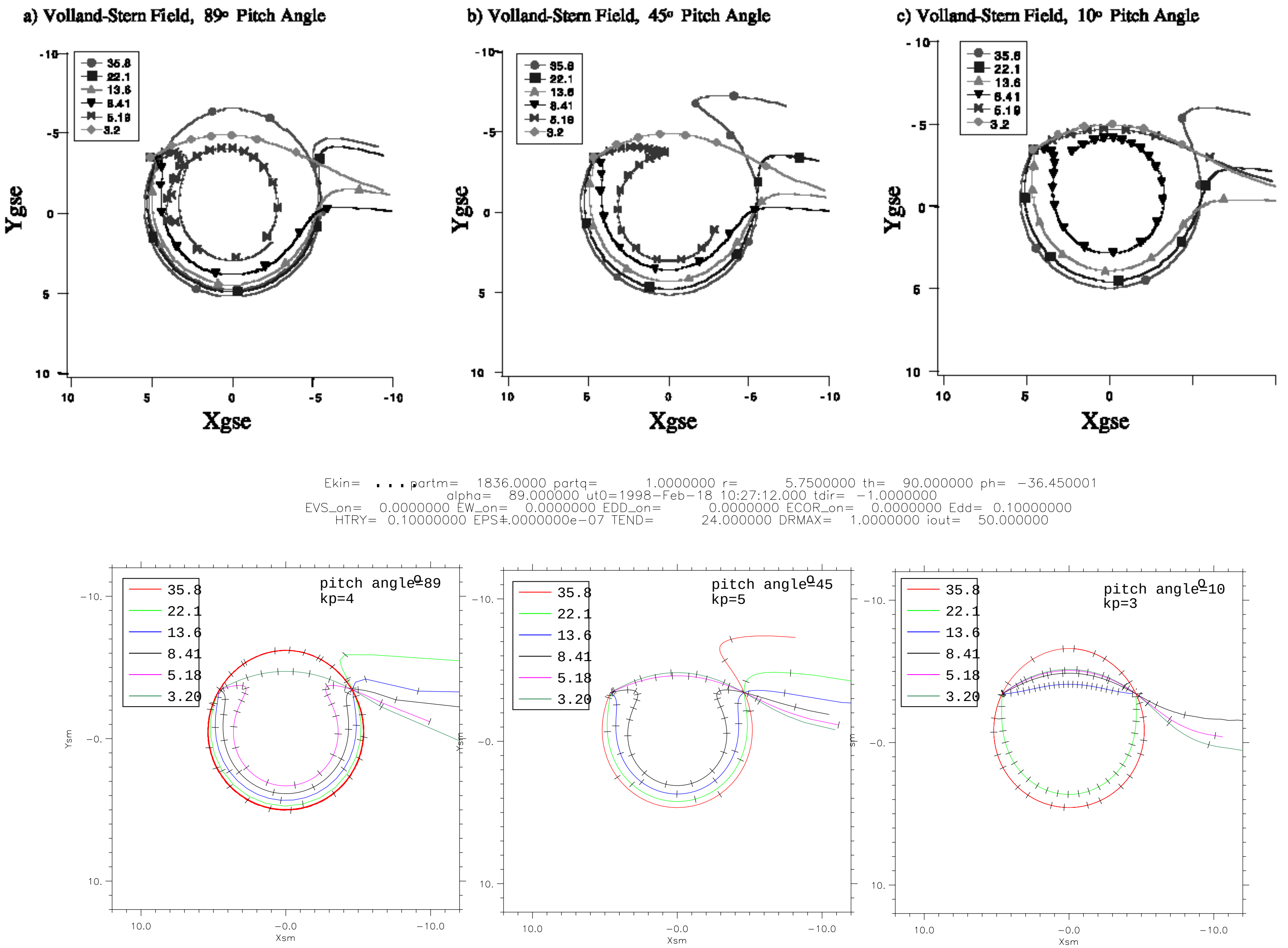


EQ-S spectrograms (top left) of H+ and O+ showning gaps (depletions) in flux from 09:30 UT onwards. A distribution function shown at top right at 10:27 UT as function of energy and at bottom as function of pitch angle characterizes the gaps.
From Kistler et al., Ann. Geophys. 1999 (v.12, p. 1611).

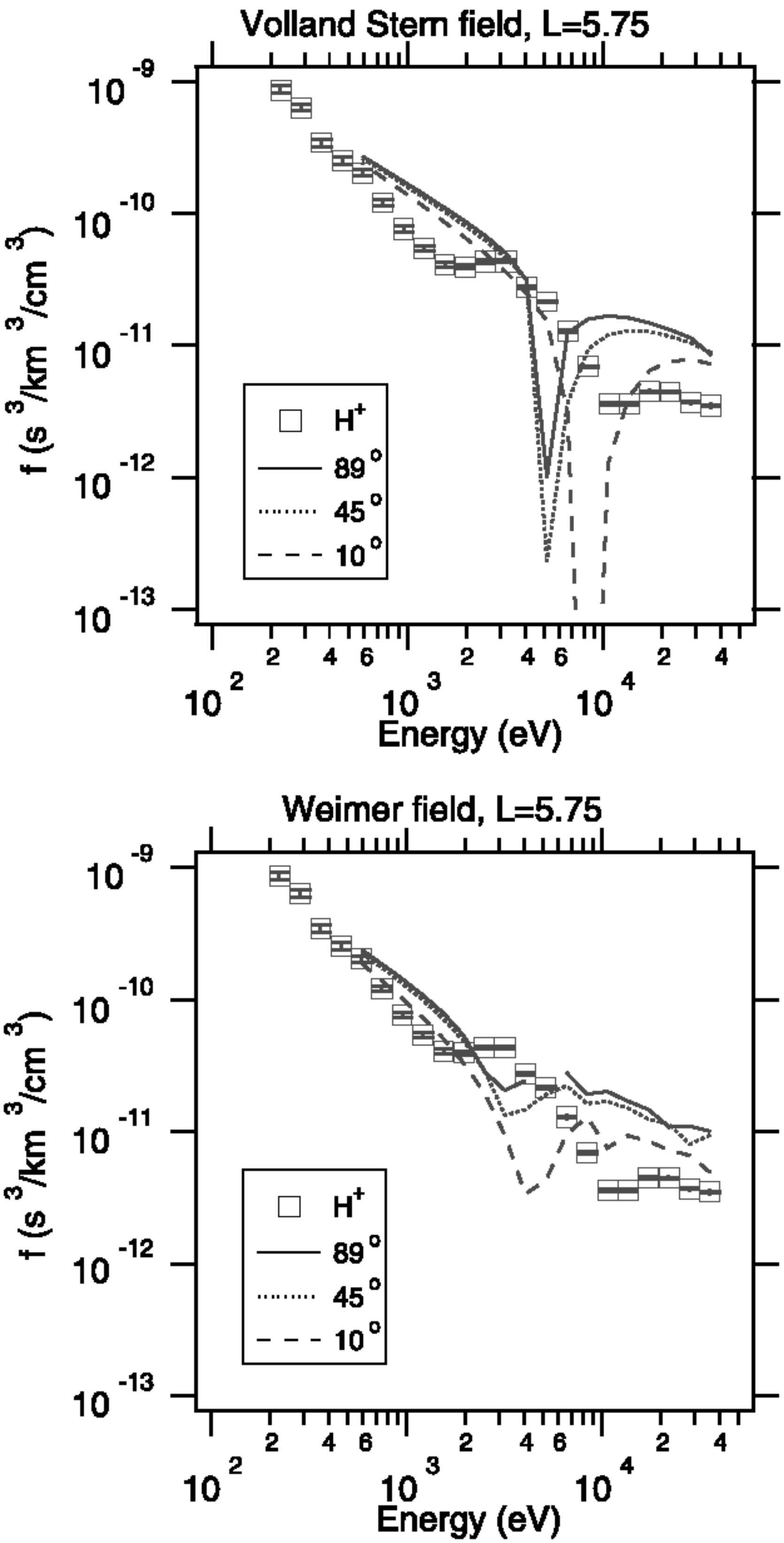

WIND ORBIT 1997 309 (11/05) 00:00 UT to 1998 034 (02/03) 00:00 UT
11/06
11/11
11/16
11/21
11/26
12/01
12/06
12/11
12/16
01/30
X_GSE
Y_GSE


ORBIT 5907 1998-02-18/10:47:48
LEGEND
[] FAST Position Now
+ FAST Path
A Apogee (79.5° lat)
P Perigee
- Terminator
- Auroral Oval
Kiruna
Poker
Berkeley
12:00:08
Eclipse Ext: 12:18:
Eclipse Ent: 12:12:

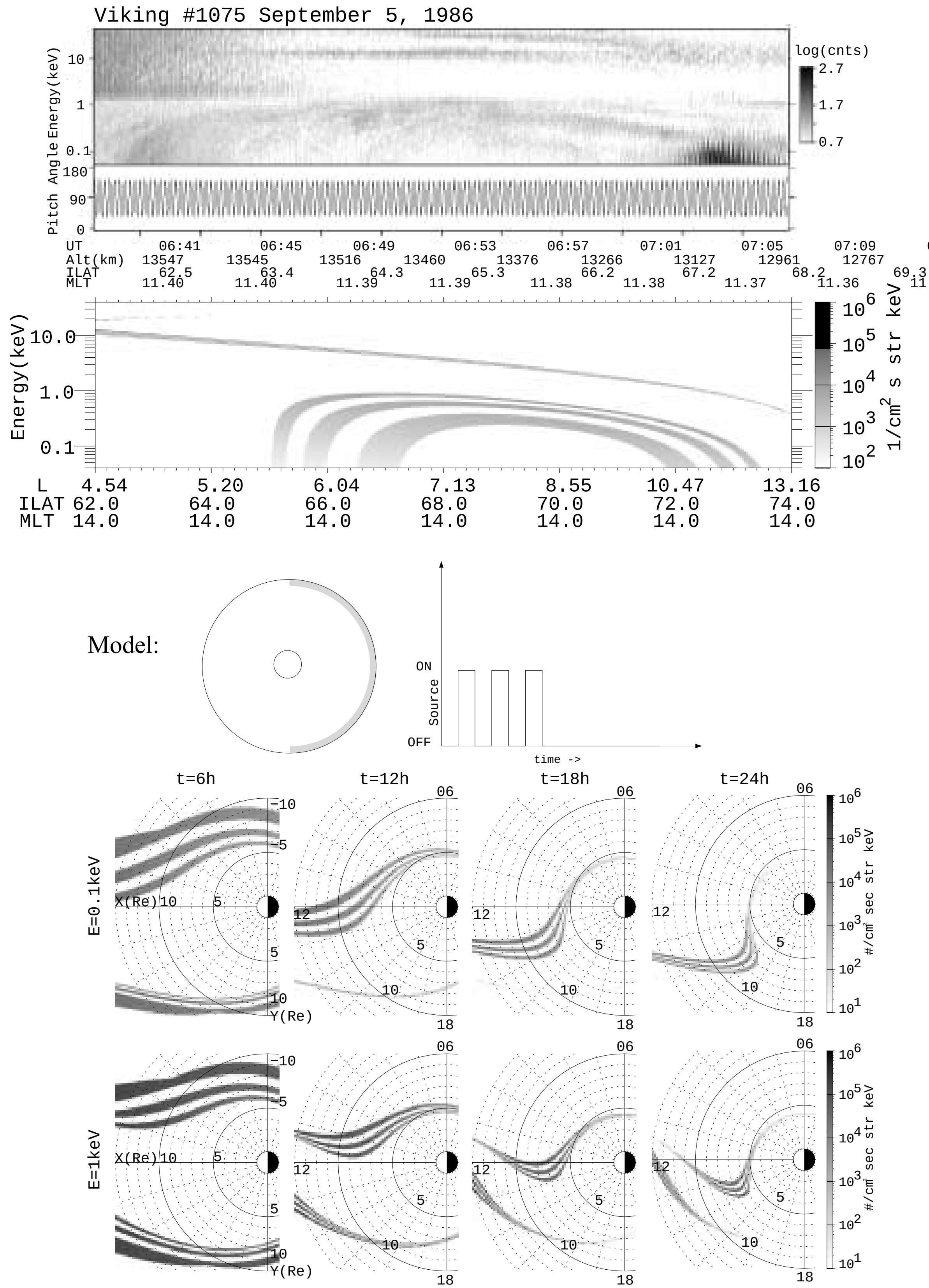

POLAR orbit 1998 049 (02/18) 08:54 UT to 1998 050 (02/19) 02:21 UT
Z(SM)
X(SM)
Y(SM)
00/050
02
10
12
14
16
18
20
22



a) Volland-Stern Field, 89° Pitch Angle
b) Volland-Stern Field, 45° Pitch Angle
c) Volland-Stern Field, 10° Pitch Angle
35.8
22.1
13.6
8.41
5.18
3.2
Ygse
Xgse
Ekin= partm= 1836.0000 partq= 1.0000000 r= 5.7500000 th= 90.000000 ph= −36.450001
alpha= 89.000000 ut0=1998−Feb−18 10:27:12.000 tdir= −1.0000000
EVS_on= 0.0000000 EW_on= 0.0000000 EDD_on= 0.0000000 ECOR_on= 0.0000000 Edd= 0.10000000
HTRY= 0.10000000 EPS=1.0000000e−07 TEND= 24.000000 DRMAX= 1.0000000 iout= 50.000000
pitch angle=89°
kp=4
pitch angle=45°
kp=5
pitch angle=10°
kp=3
35.8
22.1
13.6
8.41
5.18
3.20
Ysm
Xsm



From Kistler et al., 1999



From: Ebihara et al., 2000.