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CLUSTER OBSERVATIONS OF A FLUX TRANSFER EVENT (FTE)

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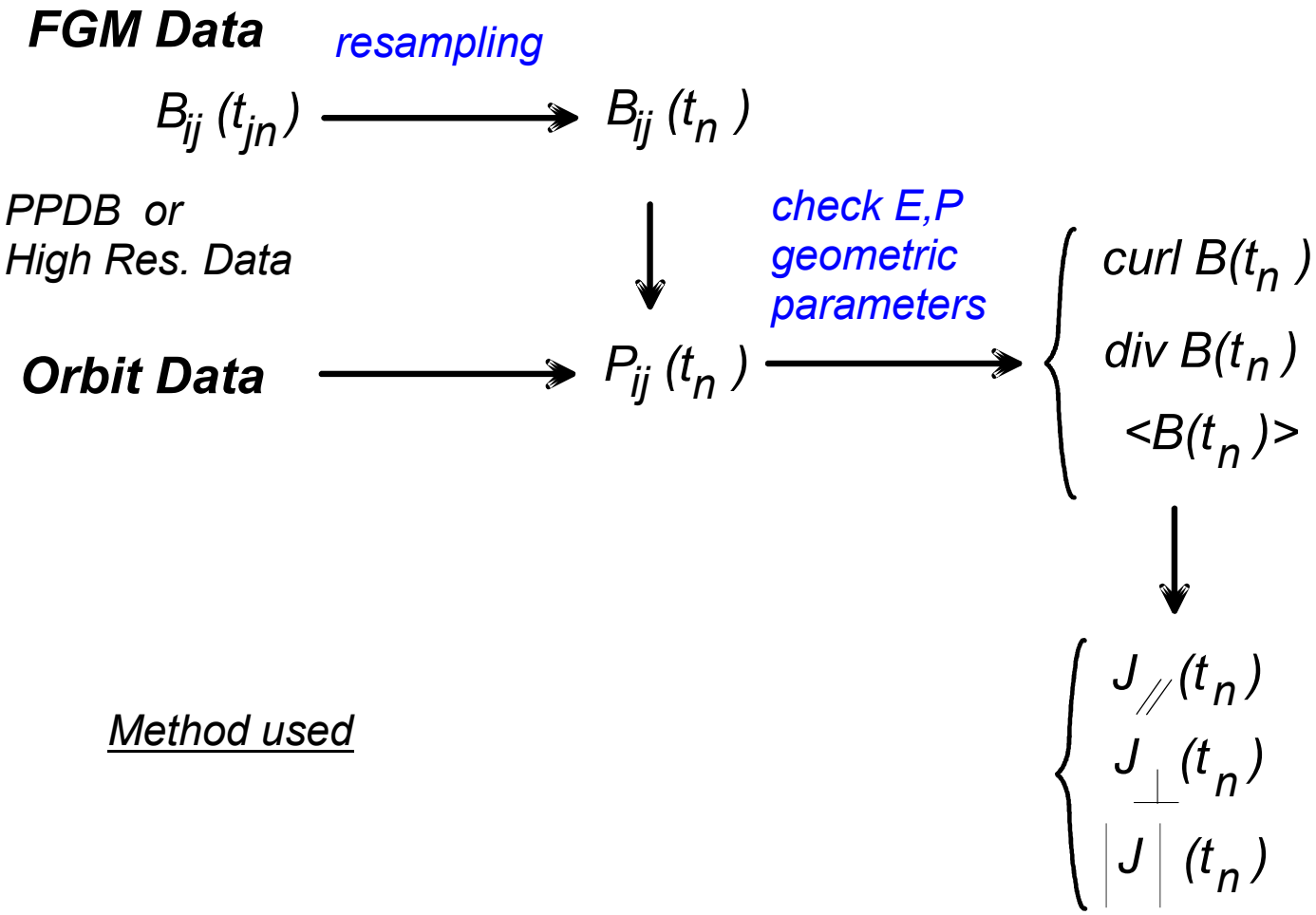
On Jan. 26th, 2001, around 11:31 UT, Cluster crossed one isolated FTE.

Data from several instruments on Cluster (PEACE, CIS, EFW, FGM, WHISPER and STAFF) are used to investigate the structure and the dynamics of this FTE.

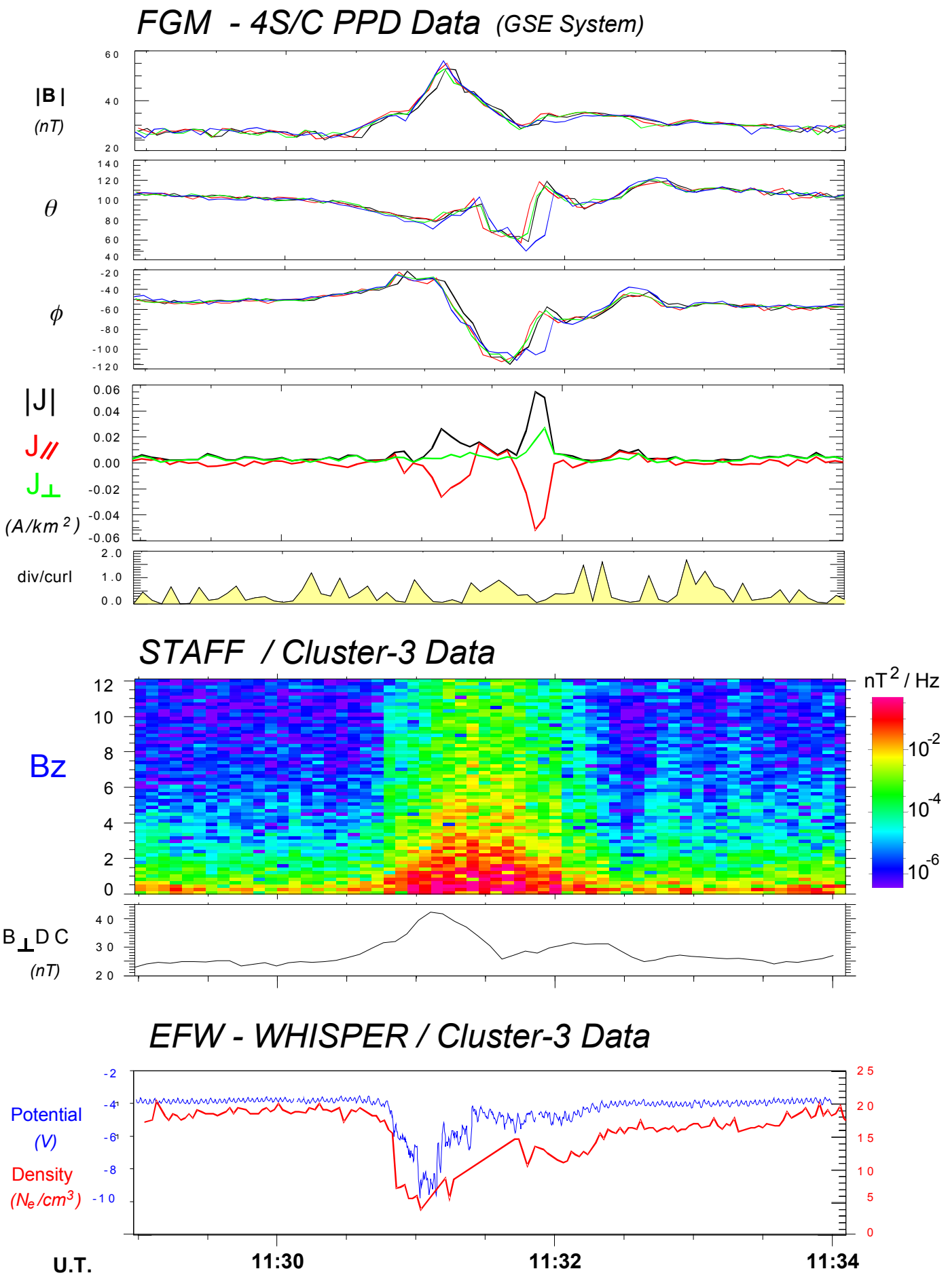
Data from FGM are used to determine the current density, via the curlometer method. Thus the profile of the current density inside the FTE, is obtained from the 4-vector magnetic fields measurements.

The FTE is shown to be a force-free "tubular" structure; the current is anti-parallel to B, and it is maximum near the boundary of the FTE (hence the tubular structure).


FGM Data
resampling
$B_{ij}(t_{jn})$
$B_{ij}(t_n)$
PPDB or
High Res. Data
check E,P
geometric
parameters
curl $B(t_n)$
div $B(t_n)$
$<B(t_n)>$
Orbit Data
$P_{ij}(t_n)$
$J_{//}(t_n)$
$J_{\perp}(t_n)$
$|J|(t_n)$

Method used

CLUSTER 26 / January / 2001



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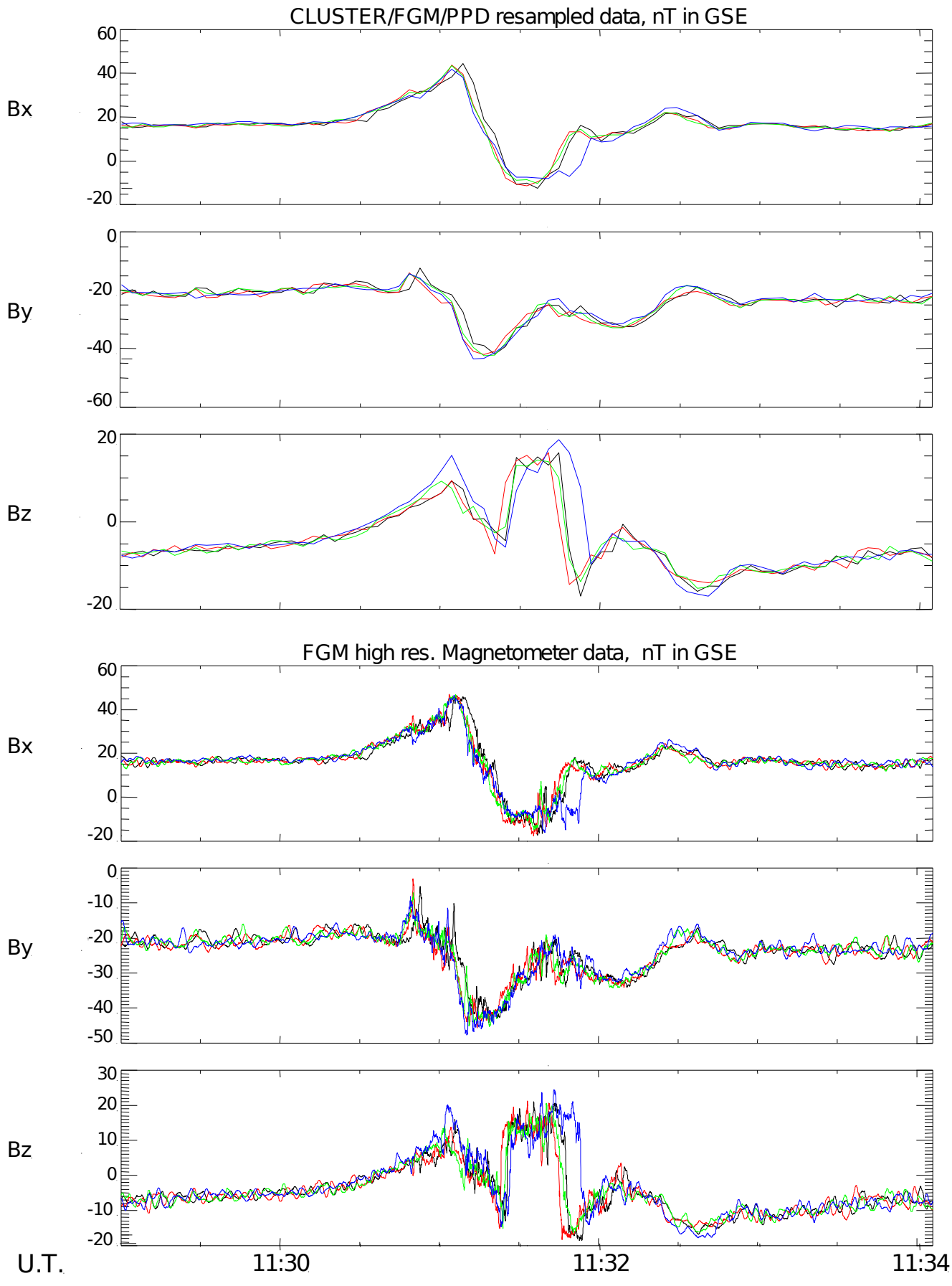
CLUSTER / FGM

J ulian Day 391: 26/J anuary/2001



CLUSTER_ROPLOT/cocurldiv/visumag.ps P.Robert/V J un.2001 | Production date : 21/March/2002 18:02

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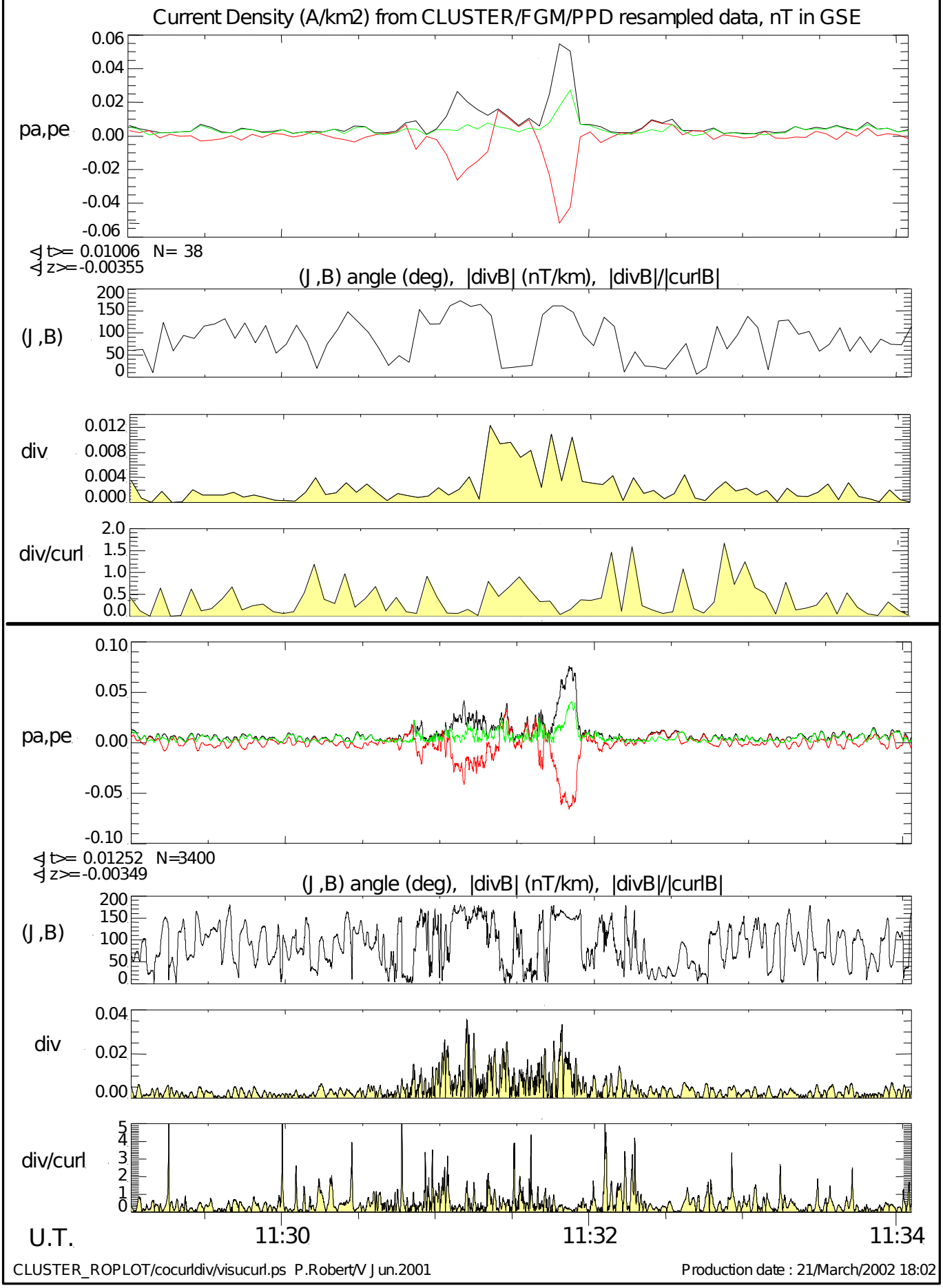
CLUSTER / FGM / Curl & Div

Julian Day 391: 26/January/2001



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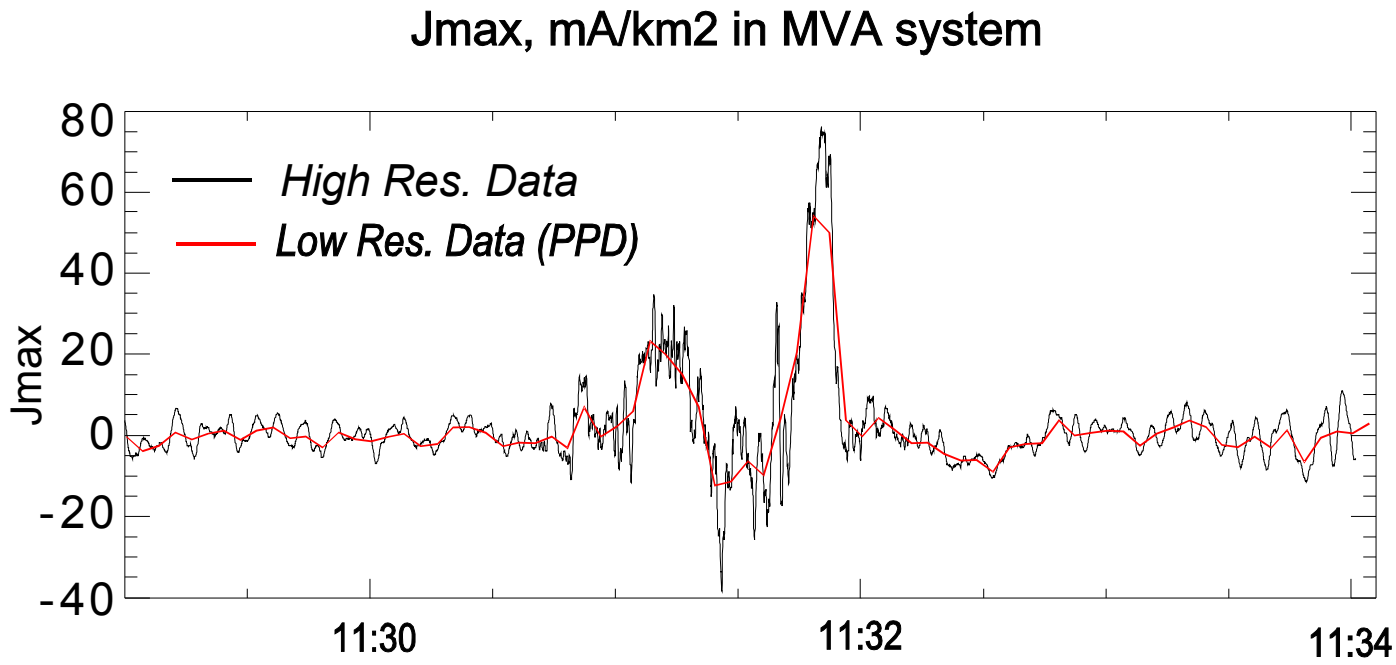
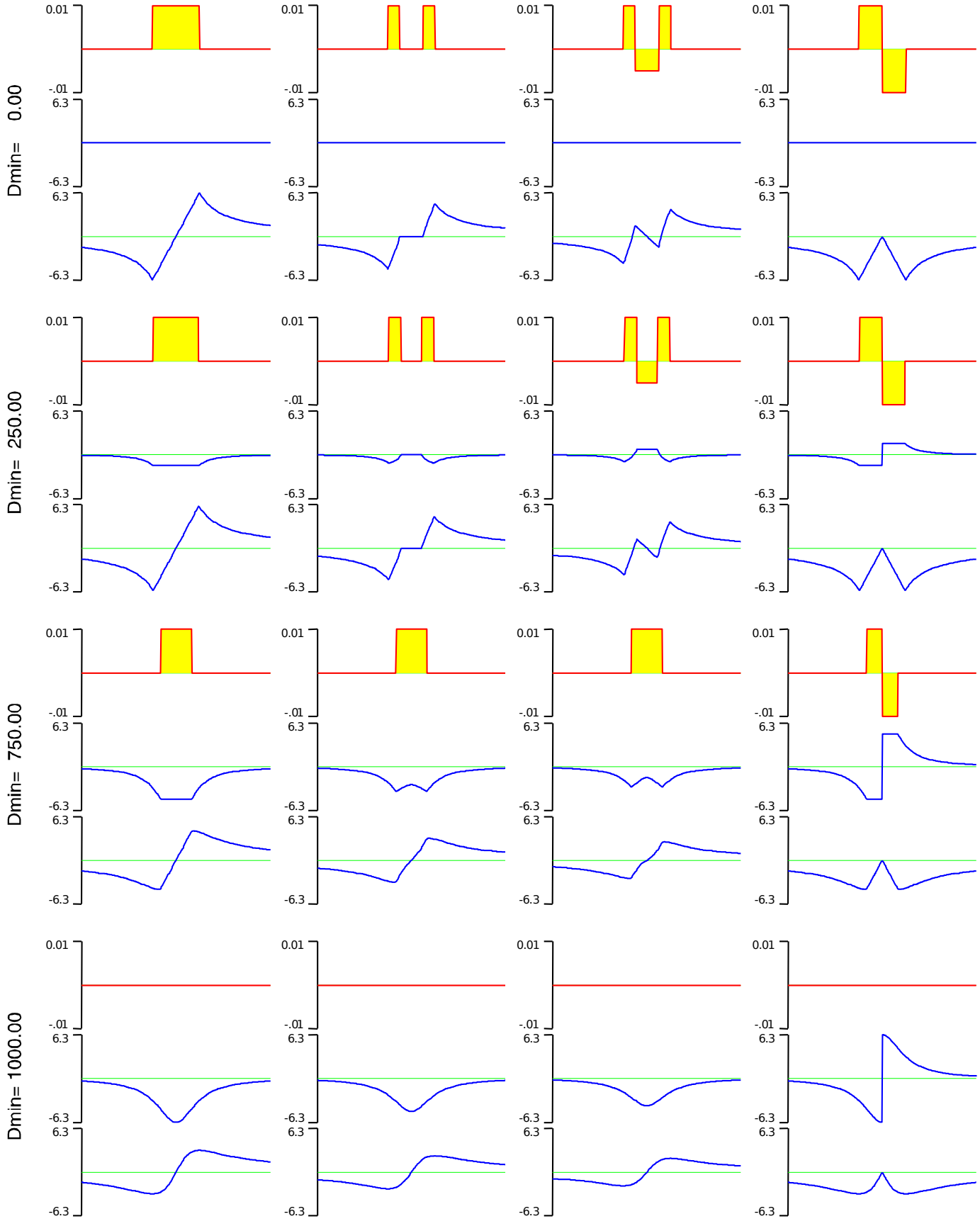
CLUSTER / FGM, January 26 2001



P.Robert / Cluster / mag_signat March 25, 18:24, 2002

B signatures provided by current structure models

R=1000.0 J=0.010 tet= 1.0 phi= 1.0 density=u



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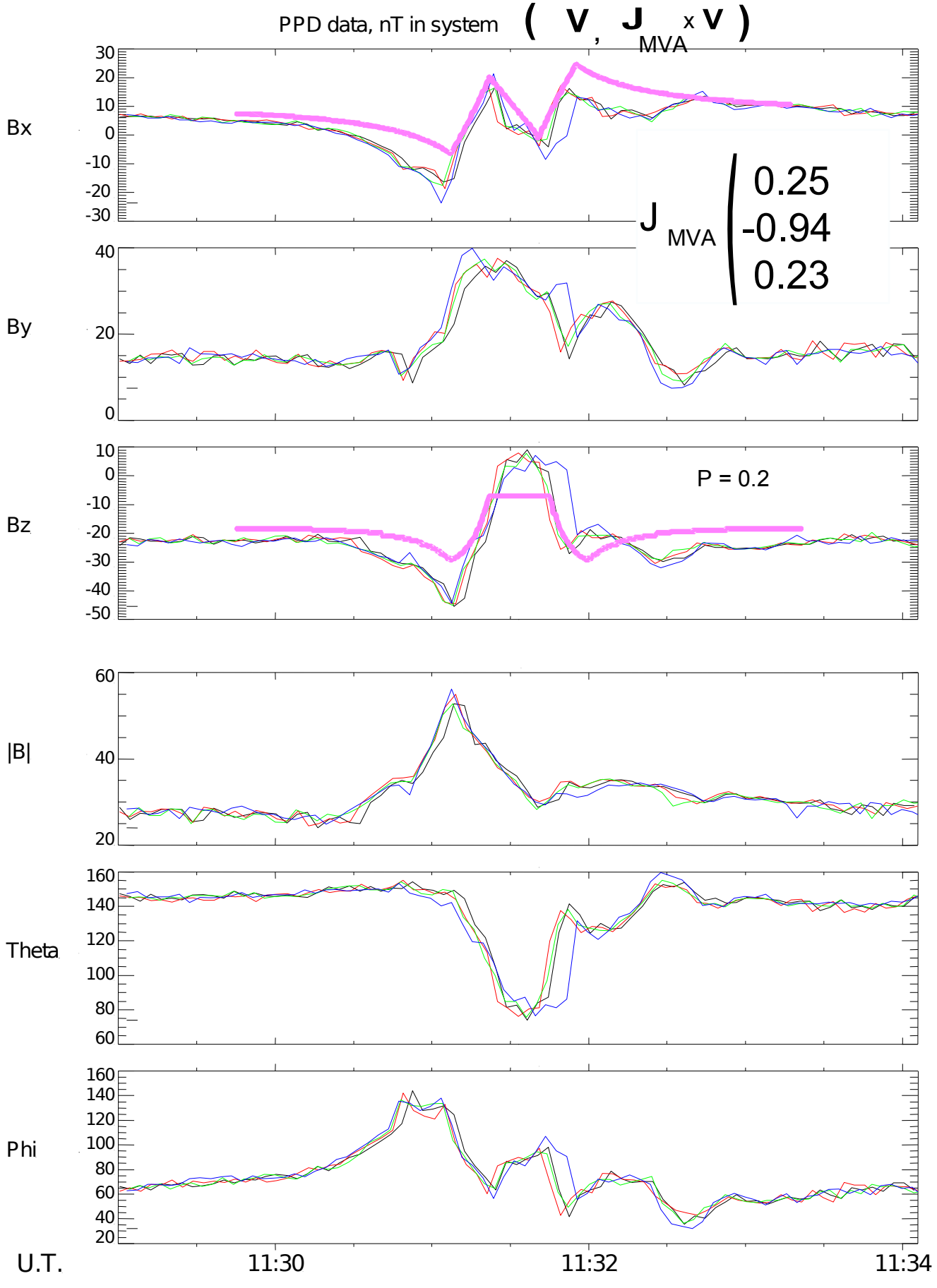
CLUSTER / FGM

Julian Day 391: 26/January/2001



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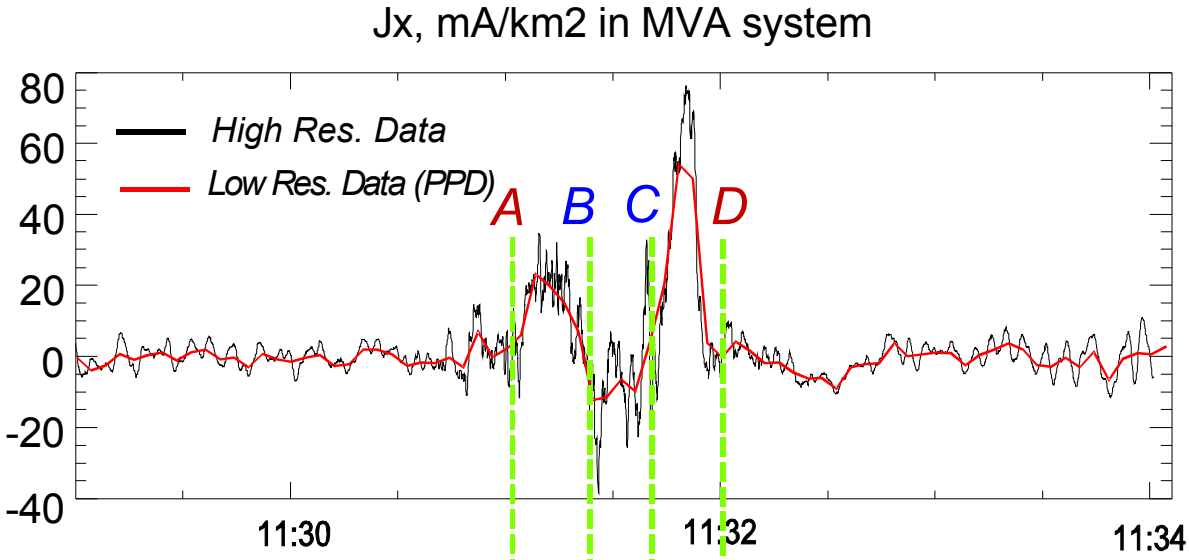
CLUSTER / FGM January 26, 2001



$\Delta t_2 \approx 60$ s

$\Delta t_1 \approx 16$ s

$J_2 \approx 30$ mA/km^2

$V \approx 170$ km/s (CIS)

$\Rightarrow \begin{cases} \Delta l_2 \approx 5100 \text{ km} \\ \Delta l_1 \approx 1360 \text{ km} \end{cases}$

$J_1 \approx -10$ mA/km^2

Assuming impact parameter ≈0.2

$\Rightarrow \begin{cases} R_2 \approx 5205 \text{ km} \\ R_1 \approx 1390 \text{ km} \end{cases}$

$\Rightarrow \begin{cases} I_2 \approx 2300 \text{ kA} \\ I_1 \approx 190 \text{ kA} \end{cases}$

For B, C positions:

$Bx = -\frac{1}{2}\mu_o(J_1 + J_2)y$

$By = \frac{1}{2}\mu_o(J_1 + J_2)x$

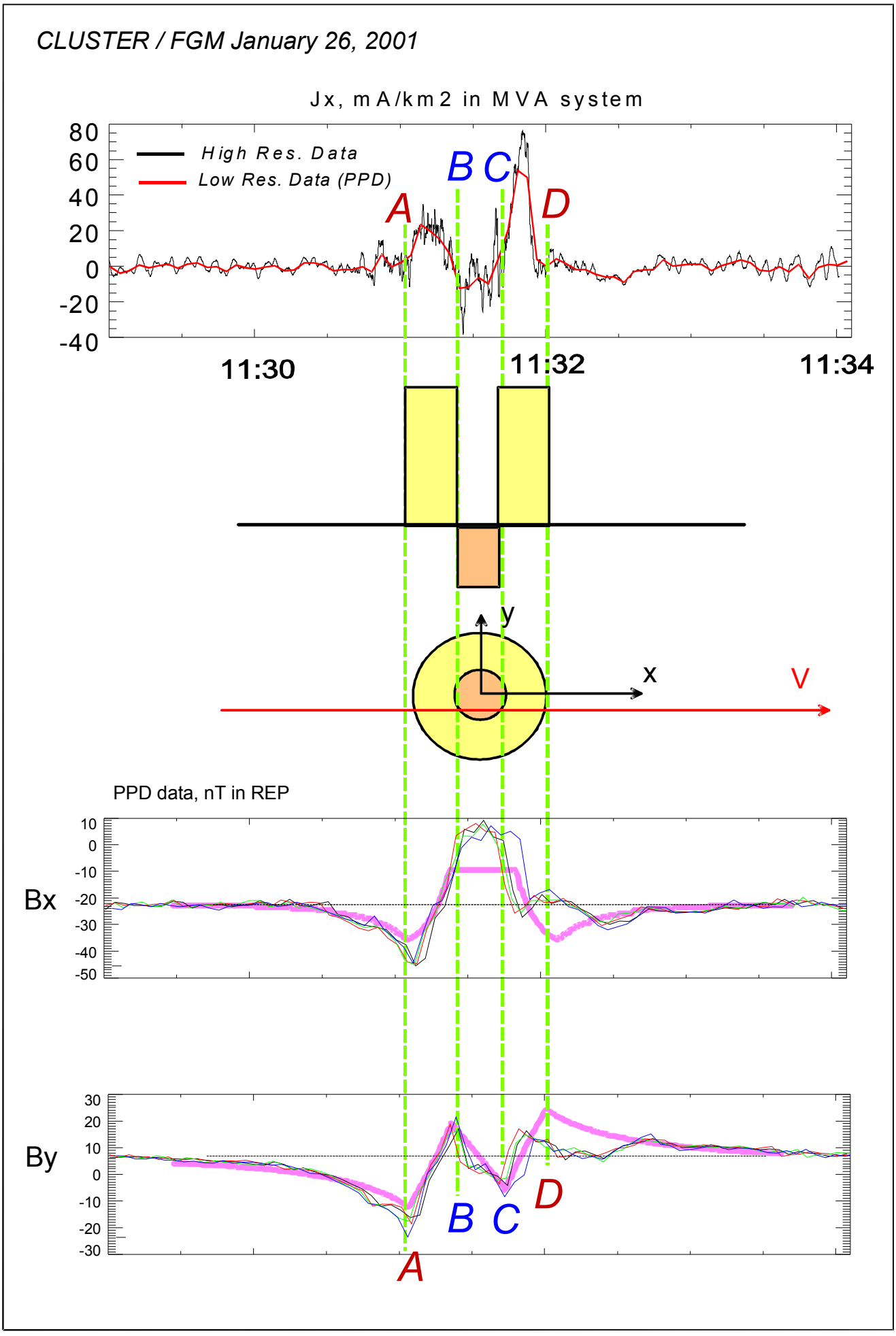
For A, D positions:

$Bx = -\frac{1}{2}\mu_o(J_1 R_1^2/(x^2 + y^2) + J_2)y$

$By = \frac{1}{2}\mu_o(J_1 R_1^2/(x^2 + y^2) + J_2)x$

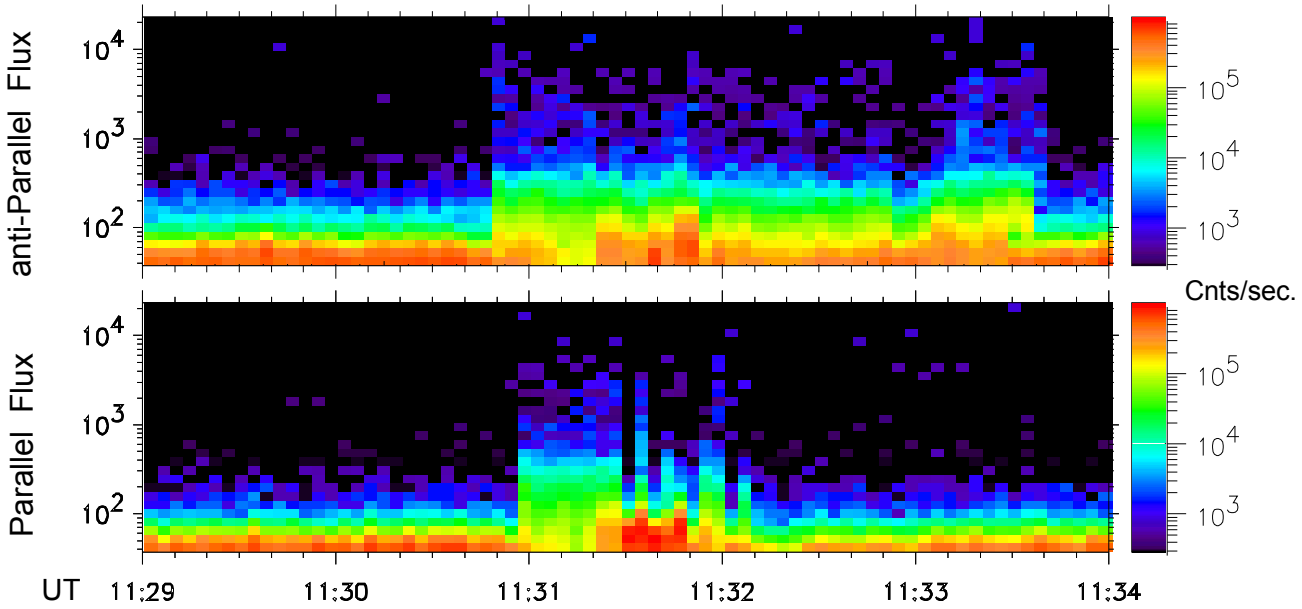
$\Rightarrow$

$Bx \approx 13$ nT	$Bx \approx 12$ nT
$By \approx 17$ nT	$By \approx 15$ nT

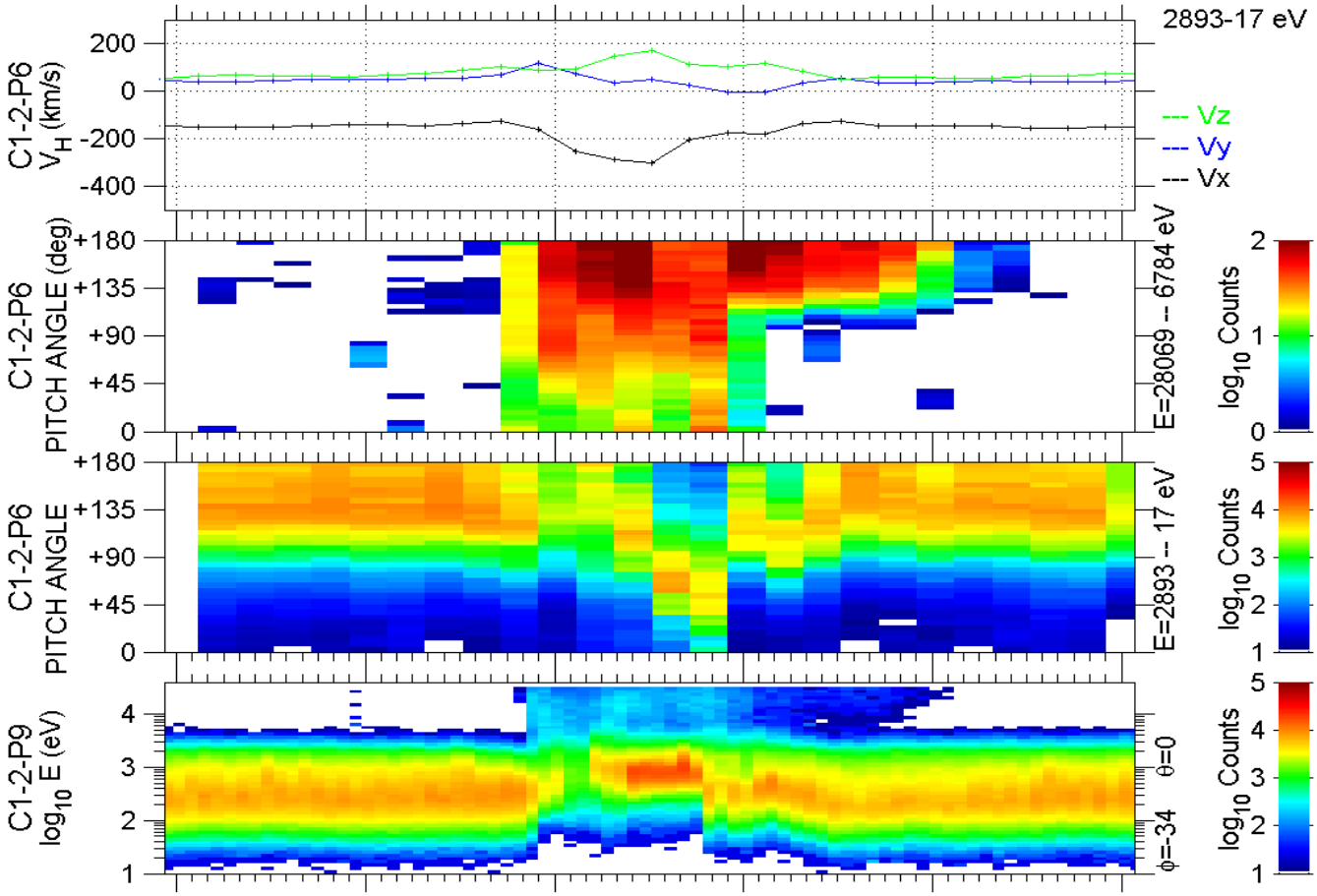

CLUSTER / FGM January 26, 2001
Jx, mA/km2 in MVA system
High Res. Data
Low Res. Data (PPD)
A
B C
D
80
60
40
20
0
-20
-40
11:30
11:32
11:34
y
x
V
PPD data, nT in REP
Bx
10
0
-10
-20
-30
-40
-50
By
30
20
10
0
-10
-20
-30
A
B C
D

CLUSTER 26 / January / 2001

PEACE / Cluster-1 Data



CIS / Cluster-1 Data



UT	11.29	11.30	11.31	11.32	11.33	11.34
Xgse	5.68	5.70	5.72	5.73	5.75	5.76
Ygse	8.22	8.23	8.24	8.25	8.26	8.27
Zgse	9.26	9.26	9.25	9.25	9.25	9.25
R C1	13.62	13.64	13.65	13.66	13.67	13.68

CONCLUSION

1) Curlometer method has been applied to FGM data. The method works both on the 4s time resolution of the PPDB, as on the High resolution data at 23 Hz, and give similar results.

2) A FTE has been shown to be a force-free « tubular » structure, with a current anti-parallel to B, and maximum near the boundary (hence the tubular structure).

3) The validity of the estimate of the current density via the curlometer method has been checked, by using the measured current density to build a double current tube model, and to determine its parameters (size, intensity, direction, position by respect to the 4 SC).

4) Then the corresponding magnetic signatures have been compared to the measured signatures, computed in the (**V,VxB**) system, showing a rather good agreement, taking into account the simplicity of the model.

5) As the FTE is crossed the modulus of the ion flow is found to increase velocity (from CIS). Data from PEACE and CIS give evidence for enhanced fluxe of energetic electrons and ions, in particular in the directions parallel and anti-parallel to B.

6) Against expectation, this enhancement in the flux of energetic particles, antiparallel to B, lasts much longer than that of electrons and ions parallel to B. Fluctuations observed from STAFF and EFW are shown to be driven unstable by the field aligned currents. We investigate the possible relation between these waves and the leakage of energetic particles, described above.

Full interpretation of the event, in relation with the particles data, is underway.