

# Summary of Comments on chor\_pss\_rev.dvi

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Page: 1

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:40:38 PM

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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:40:41 PM

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mission

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Sequence number: 3  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:42:11 PM

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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:42:15 PM

 T

derived

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Sequence number: 5  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:42:30 PM

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chorus

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Sequence number: 6  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:42:45 PM

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Sequence number: 7  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:42:48 PM

 T

on

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## Page: 2

---

Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:43:06 PM



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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:43:08 PM



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Sequence number: 3  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:43:22 PM



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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:43:25 PM



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Sequence number: 5  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:44:27 PM



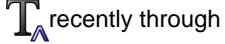
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Sequence number: 6  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:43:50 PM



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Sequence number: 7  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:44:10 PM



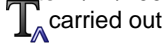
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Sequence number: 8  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:45:12 PM



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Sequence number: 9  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:45:17 PM



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Sequence number: 10  
Author: Jolene

Comments from page 2 continued on next page

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Subject: Cross-Out  
Date: 2/22/2004 5:45:37 PM

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Sequence number: 11  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:45:39 PM

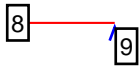
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Sequence number: 12  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:45:51 PM

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## Page: 3

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:46:21 PM

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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:46:24 PM

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Sequence number: 3  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:46:42 PM

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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:46:46 PM

~~T~~<sub>A</sub> Finally,

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Sequence number: 5  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:47:02 PM

~~T~~<sub>A</sub> plasma wave

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Sequence number: 6  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:47:13 PM

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Sequence number: 7  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:47:13 PM

~~T~~<sub>A</sub><sup>a</sup>

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Sequence number: 8  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:49:35 PM

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Sequence number: 9  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:49:38 PM

~~T~~<sub>A</sub> derived

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Sequence number: 10  
Author: Jolene

Comments from page 3 continued on next page

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11

Subject: Cross-Out  
Date: 2/22/2004 5:48:54 PM



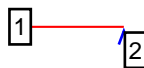
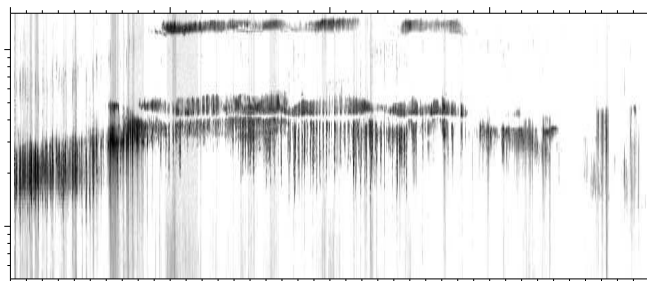
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Sequence number: 11  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:48:39 PM



spectral matrices

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# Page: 4

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:49:55 PM



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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:50:02 PM



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Sequence number: 3  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:50:11 PM



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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:50:13 PM



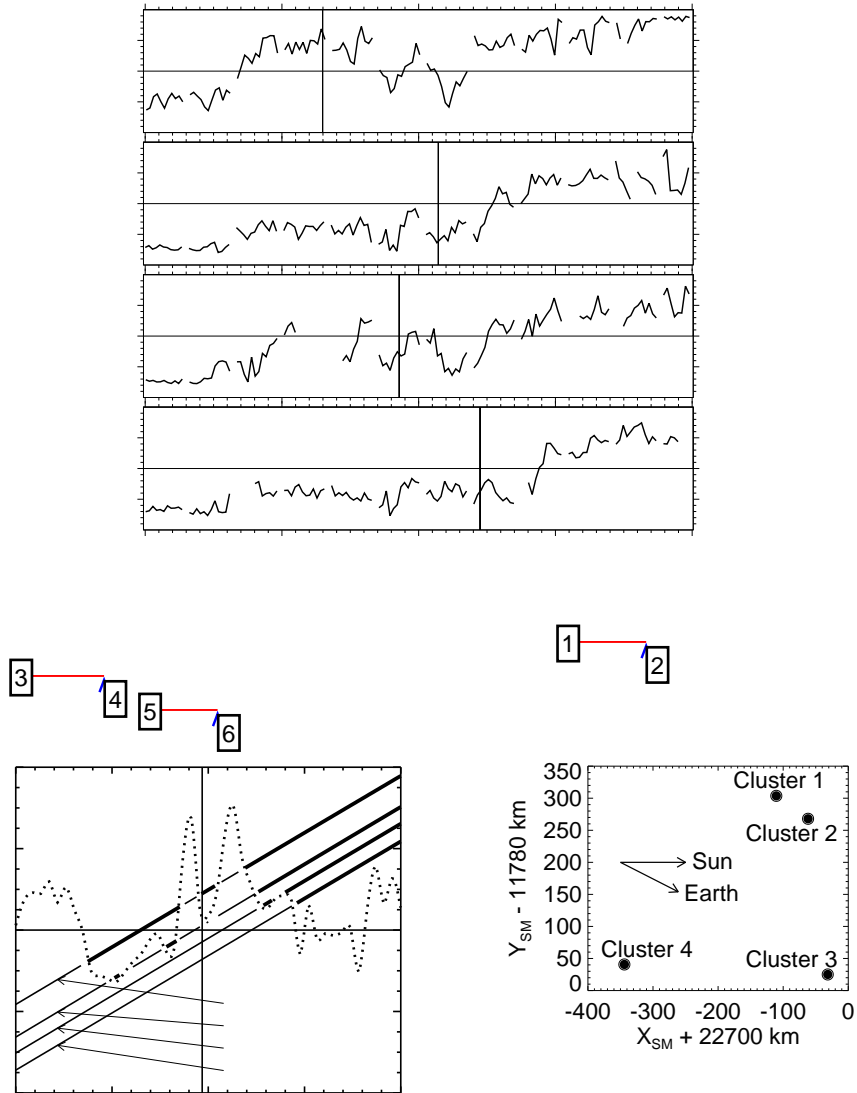


Fig. 3. (a) [7] oblique lines represent changes of the sign of  $S_{||} / \sigma S_{||}$  along the orbit of the four Cluster [8] spacecraft [9] plotted in the  $Z_{SM}$  coordinate as a function of time; the dotted line is the estimated central position [10] the chorus source region (see text). The horizontal solid line is the magnetic equator, the vertical solid line shows the moment when the center of mass of the four spacecraft crosses the equator. (b) Positions of the spacecraft in the equatorial plane. Arrows show the earthward and the sunward directions.

(dotted line in Fig. 3a) can be drawn, separating the positive and negative values of  $S_{||} / \sigma S_{||}$  and hence indicating the central position of the chorus source region.

To estimate this central position at a given time we have used an approximative method based on linear interpolation or extrapolation of the obtained  $S_{||} / \sigma S_{||}$  values. The procedure is as follows:

## Page: 5

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:50:41 PM



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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:50:45 PM



The vertical

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Sequence number: 3  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:51:36 PM



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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:51:38 PM



time

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Sequence number: 5  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:51:02 PM



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Sequence number: 6  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:51:08 PM



A dipole

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Sequence number: 7  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:51:48 PM



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Sequence number: 8  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:51:52 PM



The four

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Sequence number: 9  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:53:42 PM



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Sequence number: 10  
Author: Jolene

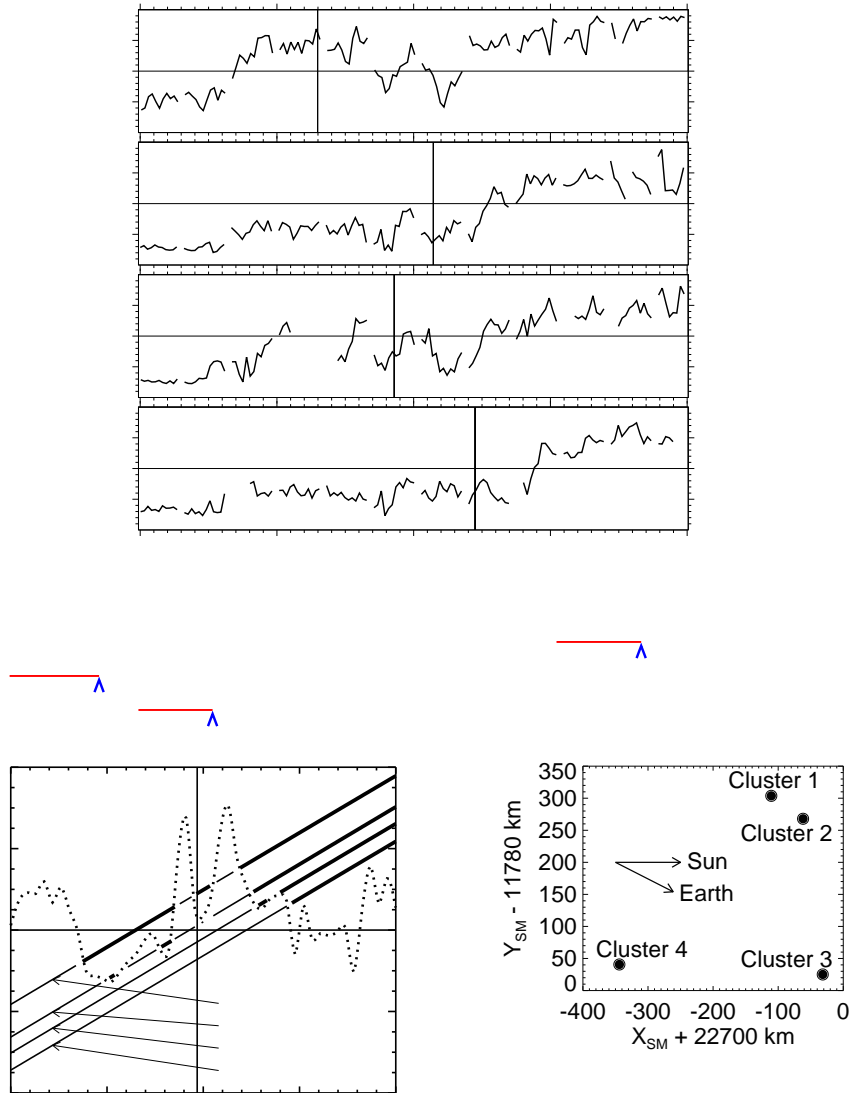


Fig. 3. (a) Four oblique lines represent changes of the sign of  $S_{\parallel} / \sigma S_{\parallel}$  along the orbit of the four Cluster spacecraft plotted in the  $Z_{SM}$  coordinate as a function of time; the dotted line is the estimated central position of the chorus source (11) (see text). The horizontal solid line is the magnetic equator, the vertical solid line shows the (12) moment when the center of mass of the four spacecraft crosses the equator. (b) Positions of the spacecraft in the equatorial plane. Arrows show the earthward and the sunward directions.

(dotted line in Fig. 3a) can be drawn, separating the positive and negative values of  $S_{\parallel} / \sigma S_{\parallel}$  and hence indicating the central position of the chorus source region.


To estimate this central position at a given time we have used an (15) approximate method based on linear interpolation or extrapolation of the obtained  $S_{\parallel} / \sigma S_{\parallel}$  values. The procedure is as follows: (16)

Subject: Inserted Text  
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 with

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Sequence number: 11  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:53:55 PM

 plotted


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Sequence number: 12  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:54:06 PM



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Sequence number: 13  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:54:49 PM

 obtained from a model

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Sequence number: 14  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:54:24 PM

 time


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Sequence number: 15  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:55:00 PM



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Sequence number: 16  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:55:04 PM

 approximation

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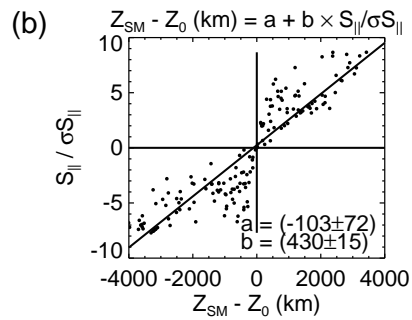
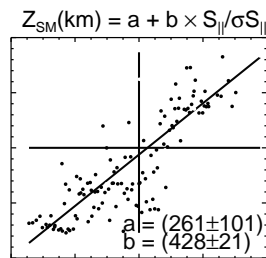
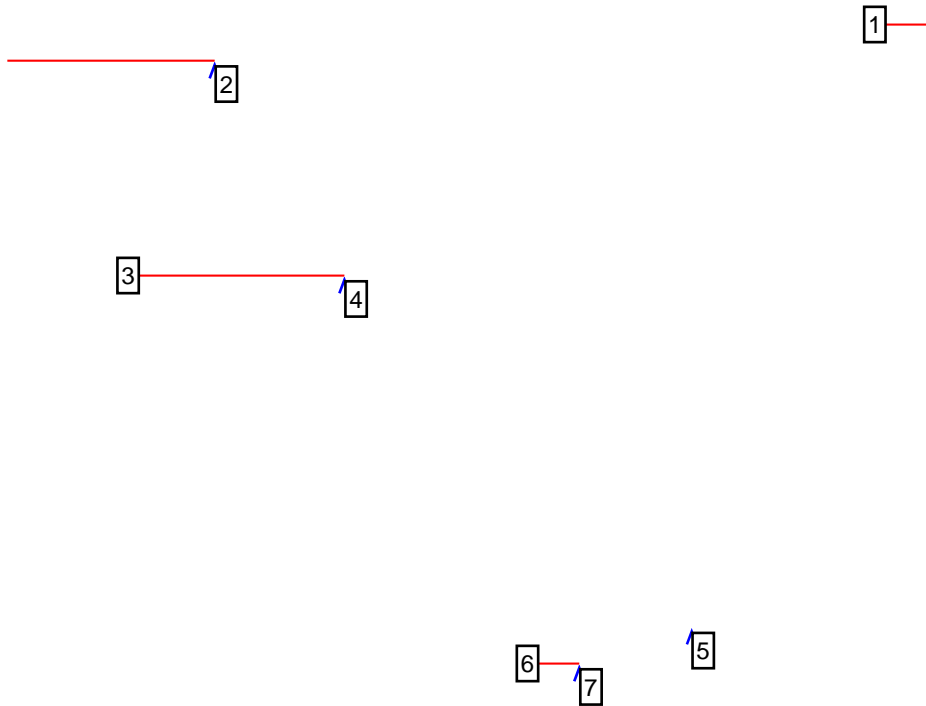


Fig. 4. (a) Linear fit to the obtained  $S_{||} / \sigma S_{||}$  values as a function of the  $Z_{SM}$  coordinate. (b) The same but using the difference of the  $Z_{SM}$  coordinate and the estimated central position of the source.

# Page: 6

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:55:38 PM



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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:55:47 PM



ranging from 1 through 3

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Sequence number: 3  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:56:09 PM



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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:56:23 PM



ranges from 1 through 4

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Sequence number: 5  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:56:32 PM



fit

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Sequence number: 6  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:56:45 PM



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Sequence number: 7  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:56:47 PM



performed

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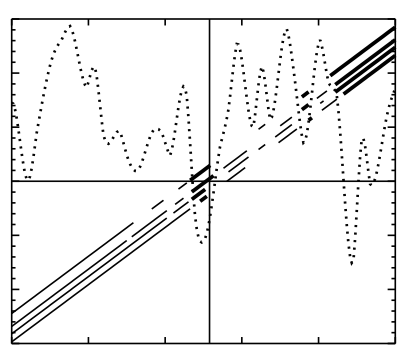
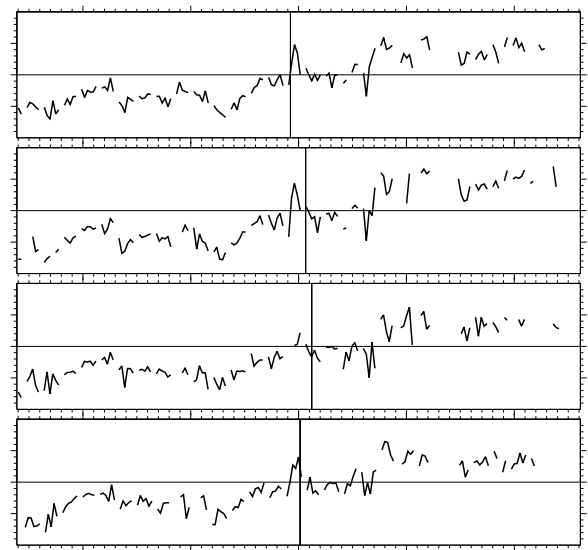
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## Page: 7

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:57:16 PM



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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:57:52 PM



also

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Sequence number: 3  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:58:09 PM



the

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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:58:22 PM



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Sequence number: 5  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:59:09 PM



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Sequence number: 6  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 5:59:31 PM



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Sequence number: 7  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 5:59:38 PM



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Sequence number: 8  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:01:15 PM



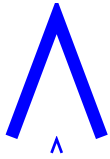
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Sequence number: 9  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:00:28 PM



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Sequence number: 10  
Author: Jolene



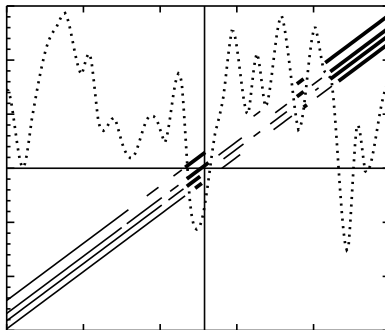
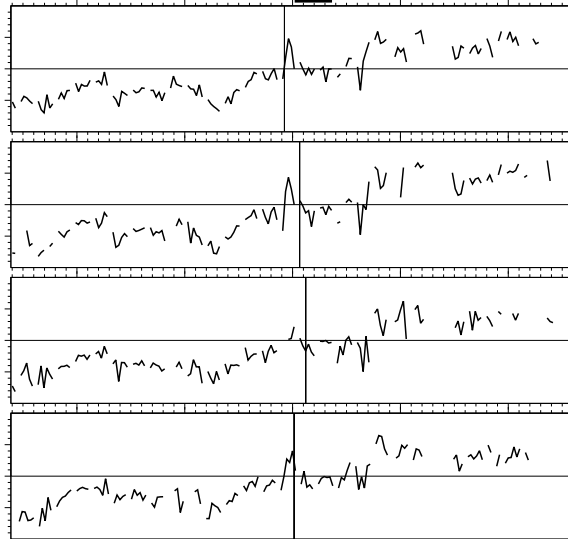
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12

11



Subject: Inserted Text  
Date: 2/22/2004 6:01:17 PM  
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Sequence number: 11  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:00:34 PM  
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Sequence number: 12  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:00:13 PM  
T a time interval two times shorter

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1  
2

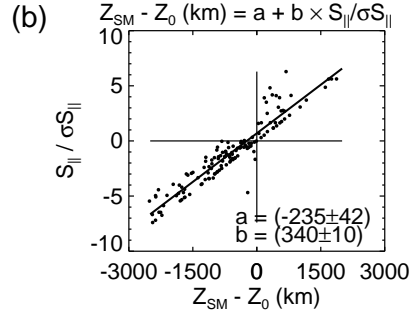
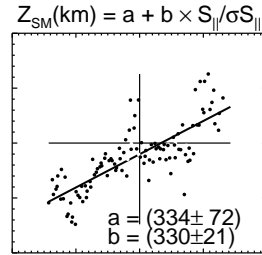


Fig. 7. The same as in Fig. 4 but for the data recorded on 18 April 2002.

#### 4 Discussion

The analysis presented above ~~3~~ led us to the estimation of the central position of the source region of whistler-mode chorus. It has to be ~~4~~ noted that this position is not necessarily the geometric center of the source region. ~~5~~ “centrality” is meant as the point where the parallel component of the total Poynting flux changes its ~~6~~ sign. We suppose that the source region has a finite dimension of a few thousands of km along the field line (*Santolik et al.*, 2003b). Inside this source region both directions of the Poynting flux are present simultaneously but on its southern end, the waves propagating to the South prevail, and similarly on its northern ~~7~~ end we mainly observe the waves propagating to the North. The central position of ~~8~~ this source region is then the point inside the source region where the parallel Poynting flux of waves propagating into the northern hemisphere equals the parallel flux of the waves propagating to the southern hemisphere.

We have observed random fluctuations of the estimated central position of the source region. There are two possible explanations. Either this is a property of the source mechanism itself, or the entire magnetic configuration is tail-like and flaps over the spacecraft, carrying the chorus source region with it. Under quiet conditions this latter possibility is not very likely to happen at the radial distance of our observations ( $\sim 4 R_E$ ). However, during storm conditions it is not unrealistic to have strong magnetic distortions at this radial distance. We have thus examined this possibility for the case of 31 March 2001. Figure 8 shows  $S_{||}/\sigma S_{||}$  measured onboard Cluster 1, together with the direction of the ambient magnetic field  $B_0$  measured on the same spacecraft, and with the simulated results obtained from the dipole model calculated along the spacecraft orbit. We can see that the deviation  $\theta_{BM}$  of the  $B_0$  direction from the  $Z_{SM}$  axis is larger than the dipole model pre-

## Page: 8

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:01:27 PM



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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:01:30 PM



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Sequence number: 3  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:02:07 PM



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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:02:15 PM



allows us to estimate the location

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Sequence number: 5  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:03:01 PM



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Sequence number: 6  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:03:22 PM



Our definition of the "central position" is defined

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Sequence number: 7  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:03:35 PM



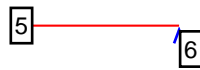
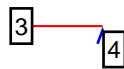
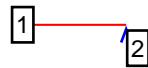
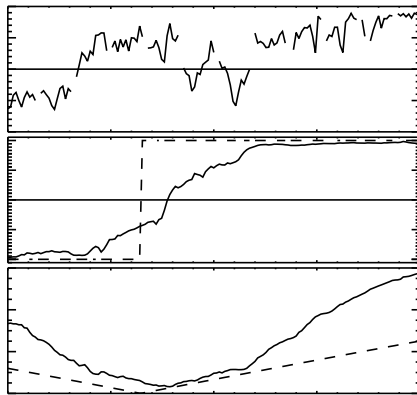
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Sequence number: 8  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:03:36 PM



side

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7



# Page: 9

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:04:55 PM



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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:04:58 PM



associated with

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Sequence number: 3  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:05:06 PM



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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:05:09 PM



does not

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Sequence number: 5  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:05:32 PM



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Sequence number: 6  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:05:35 PM



over almost

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Sequence number: 7  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:05:59 PM



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Sequence number: 8  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:06:12 PM



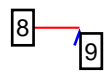
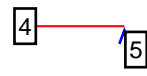
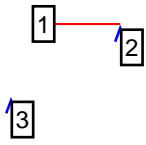
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Sequence number: 9  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:06:15 PM



on

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## Page: 10

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:06:38 PM



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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:06:40 PM



mission

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Sequence number: 3  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:06:57 PM



significantly

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Sequence number: 4  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:07:26 PM



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Sequence number: 5  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:07:29 PM



associated with

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Sequence number: 6  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:07:38 PM



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Sequence number: 7  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:07:39 PM



of

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Sequence number: 8  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:07:53 PM



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Sequence number: 9  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:07:59 PM

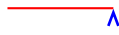
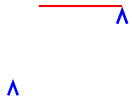


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Sequence number: 10  
Author: Jolene

Comments from page 10 continued on next page



Subject: Note

Date: 2/22/2004 6:09:40 PM



Add a comma after Wehrlin;

Put first initials of Chanteur and  
Perraut in front of their last names

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↑5

# Page: 11

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Sequence number: 1  
Author: Jolene  
Subject: Cross-Out  
Date: 2/22/2004 6:10:06 PM

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Sequence number: 2  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:10:09 PM

T<sub>A</sub> in press,

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Sequence number: 3  
Author: Jolene  
Subject: Note  
Date: 2/22/2004 6:10:53 PM

 Put first initials of 2nd through 4th authors in front of their last names.

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Sequence number: 4  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:11:13 PM

T<sub>A</sub>O.,

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Sequence number: 5  
Author: Jolene  
Subject: Inserted Text  
Date: 2/22/2004 6:11:33 PM

T<sub>A</sub>O.,

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