Cluster observations of high-beta plasma blobs in the magnetosheath

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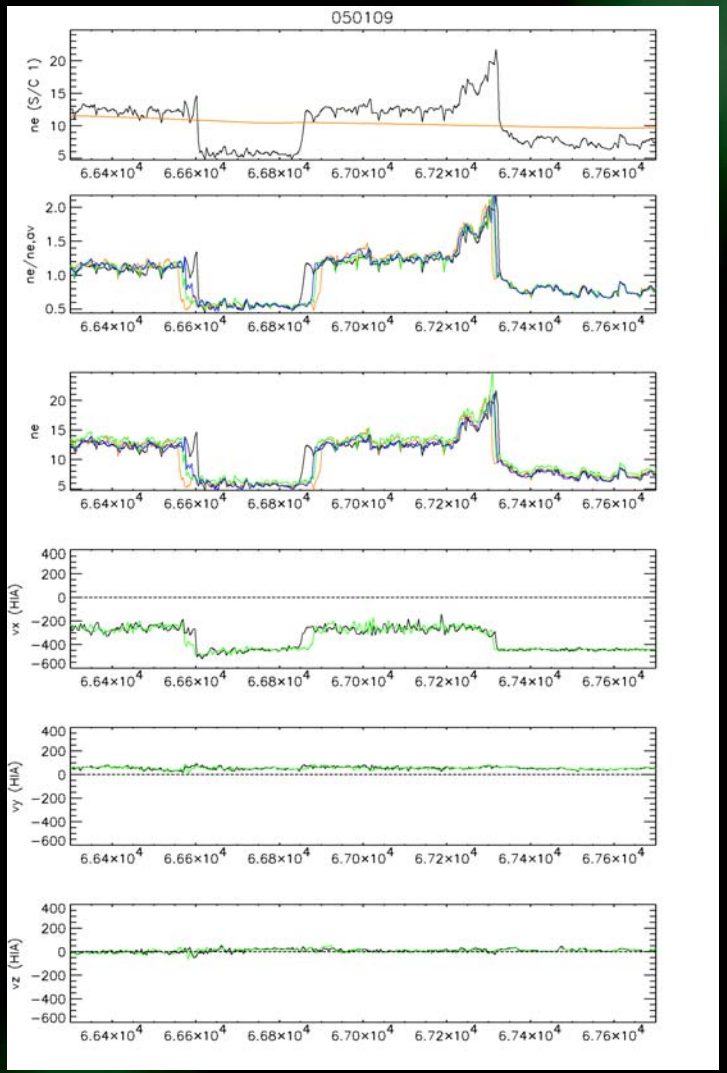
Methodology

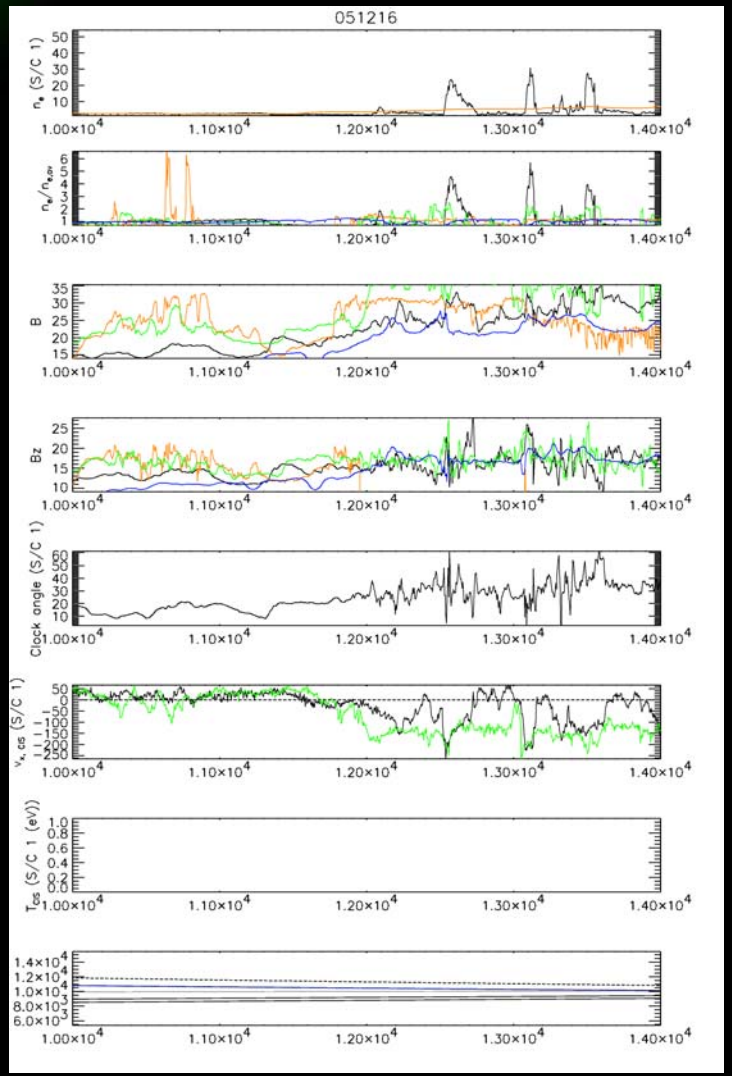
I. Event selection

- Two main tracks
  - Clearly isolated events with $n_e/n_{BG} \sim 2$
  - All events over a smaller threshold $n_e/n_{BG} > 1.5$
- Take care to exclude crossings of MP and BS
  - No appreciable change in drift velocity, in paticular no sign changes
  - No ”nested structures”
  - No appreciable changes in temperature

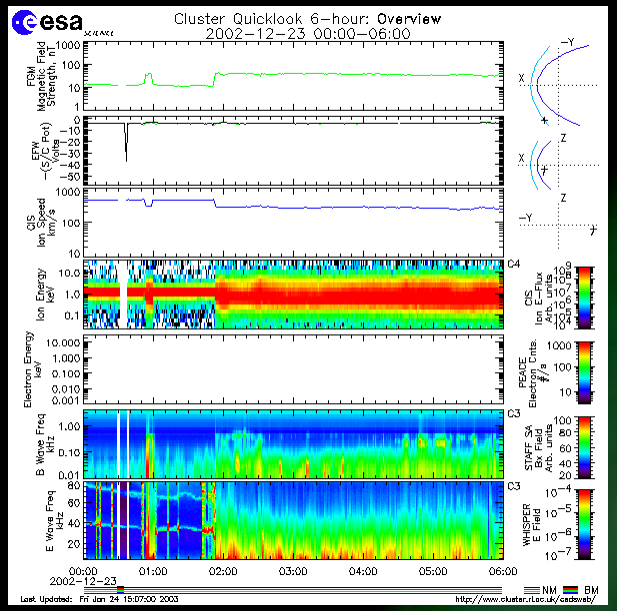
Methodology

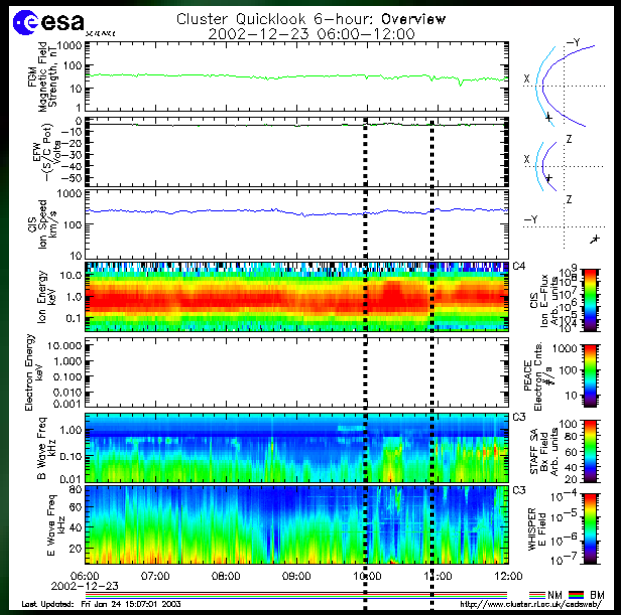
I. Event selection

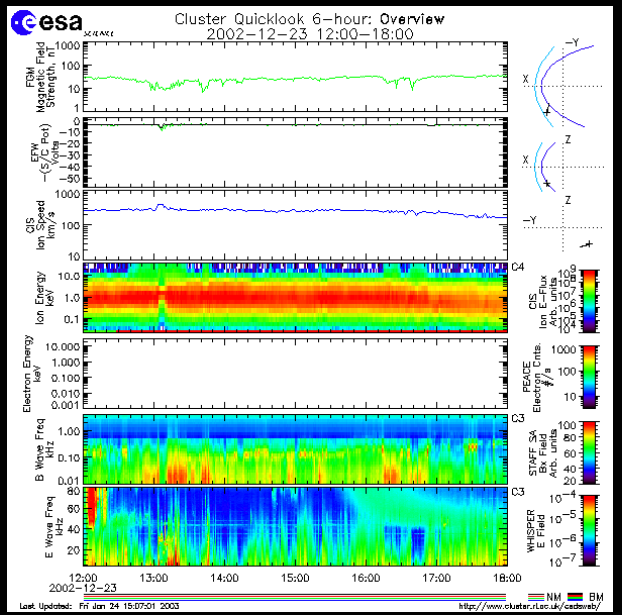




2002-12-23/24


esa
Cluster Quicklook 6-hour: Overview
2002-12-23 00:00-06:00
FGM Magnetic Field Strength, nT
EFW -(S/C Pot) Volts
CIS Ion Speed km/s
Ion Energy keV
Electron Energy keV
B Wave Freq kHz
E Wave Freq kHz
CIS Ion E-Flux Arb. units
PEACE Electron Cnts #/s
STAFF SA Bx Field Arb. units
WHISPER E Field
00:00 01:00 02:00 03:00 04:00 05:00 06:00
2002-12-23
NM BM
Last Updated: Fri Jan 24 15:07:00 2003
http://www.cluster.rl.ac.uk/cedsweb/


esa
Cluster Quicklook 6-hour: Overview
2002-12-23 06:00-12:00
FGM Magnetic Field Strength, nT
EFW -(S/C Pot) Volts
CIS Ion Speed km/s
Ion Energy keV
Electron Energy keV
B Wave Freq kHz
E Wave Freq kHz
CIS Ion E-Flux Arb. units
PEACE Electron Cnts #/s
STAFF SA Bx Field Arb. units
WHISPER E Field
06:00 07:00 08:00 09:00 10:00 11:00 12:00
2002-12-23
NM BM
Last Updated: Fri Jan 24 15:07:01 2003
http://www.cluster.rl.ac.uk/cedsweb/


esa
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2002-12-23 12:00-18:00
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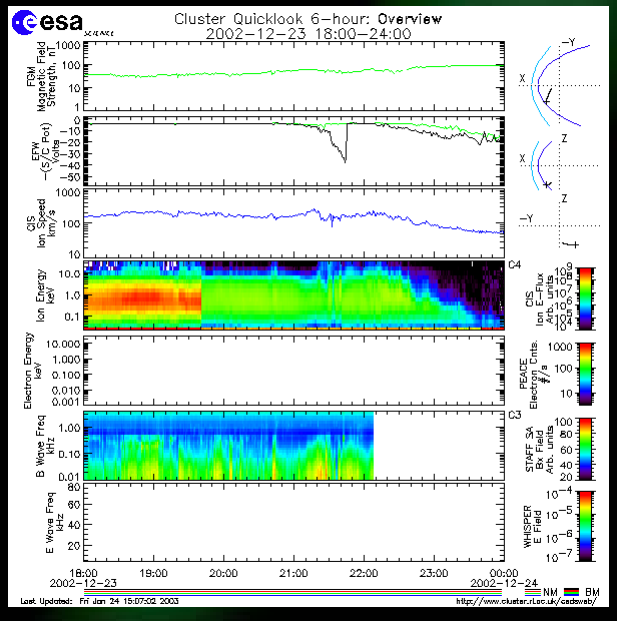
EFW -(S/C Pot) Volts
CIS Ion Speed km/s
Ion Energy keV
Electron Energy keV
B Wave Freq kHz
E Wave Freq kHz
CIS Ion E-Flux Arb. units
PEACE Electron Cnts #/s
STAFF SA Bx Field Arb. units
WHISPER E Field
12:00 13:00 14:00 15:00 16:00 17:00 18:00
2002-12-23
NM BM
Last Updated: Fri Jan 24 15:07:01 2003
http://www.cluster.rl.ac.uk/cedsweb/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Cluster Quicklook 6-hour: Overview
2002-12-23 18:00-24:00
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EFW -(S/C Pot) Volts
CIS Ion Speed km/s
Ion Energy keV
Electron Energy keV
B Wave Freq kHz
E Wave Freq kHz
CIS Ion E-Flux Arb. units
PEACE Electron Cnts #/s
STAFF SA Bx Field Arb. units
WHISPER E Field
18:00 19:00 20:00 21:00 22:00 23:00 00:00
2002-12-23
2002-12-24
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Last Updated: Fri Jan 24 15:07:02 2003
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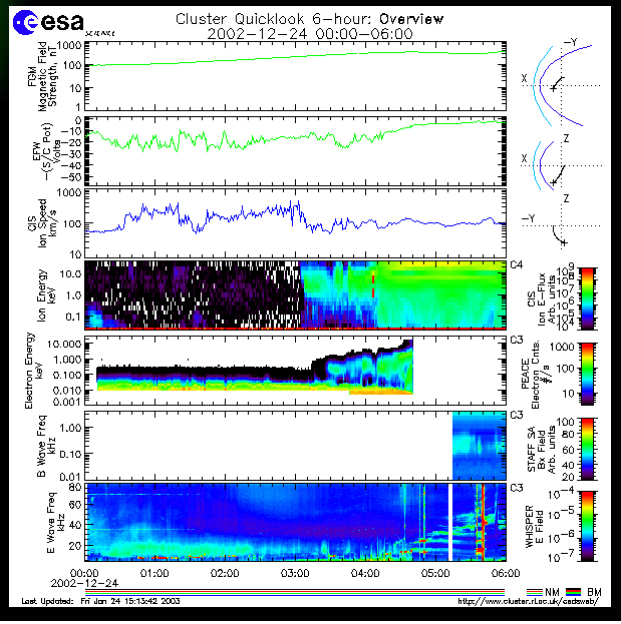
esa
Cluster Quicklook 6-hour: Overview
2002-12-24 00:00-06:00
FGM Magnetic Field Strength, nT
EFW -(S/C Pot) Volts
CIS Ion Speed km/s
Ion Energy keV
Electron Energy keV
B Wave Freq kHz
E Wave Freq kHz
CIS Ion E-Flux Arb. units
PEACE Electron Cnts #/s
STAFF SA Bx Field Arb. units
WHISPER E Field
00:00 01:00 02:00 03:00 04:00 05:00 06:00
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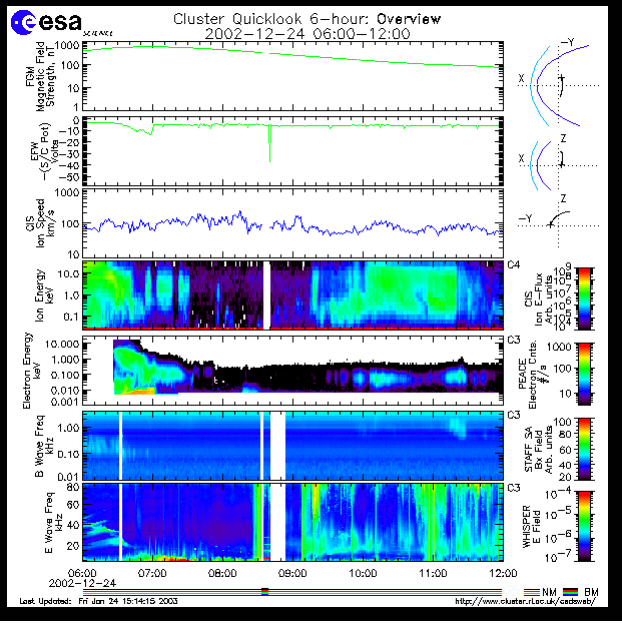

esa
Cluster Quicklook 6-hour: Overview
2002-12-24 06:00-12:00
FGM Magnetic Field Strength, nT
EFW -(S/C Pot) Volts
CIS Ion Speed km/s
Ion Energy keV
Electron Energy keV
B Wave Freq kHz
E Wave Freq kHz
CIS Ion E-Flux Arb. units
PEACE Electron Cnts #/s
STAFF SA Bx Field Arb. units
WHISPER E Field
06:00 07:00 08:00 09:00 10:00 11:00 12:00
2002-12-24
NM BM
Last Updated: Fri Jan 24 15:14:15 2003
http://www.cluster.rl.ac.uk/cedsweb/

Methodology

II. Analysis

- Two main tracks
  - Order according to minimum variance analysis (MVA)
  - Order according to drift velocity (DV)
- Check cross-correlation as a function of distance across principal directions to approximate scale sizes.

Methodology

II. Analysis

- ”Flow chart”

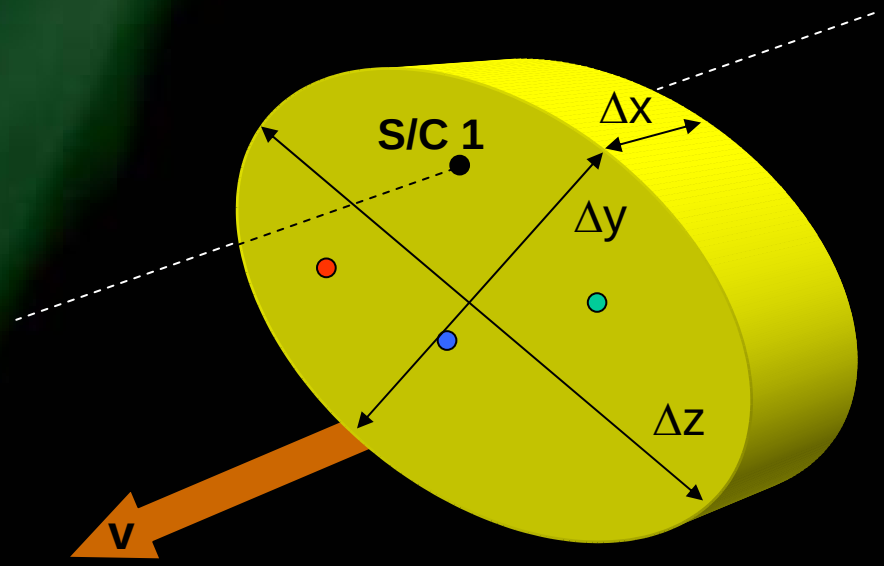
$$\delta n_\alpha = \left| \mathbf{n}_\alpha - \langle \mathbf{n} \rangle \right|$$

$$\delta n = Max\left(\delta n_\alpha \right) < 10\%$$

Determination of scale sizes

1. Along x-direction: width of half maximum of Δn_e

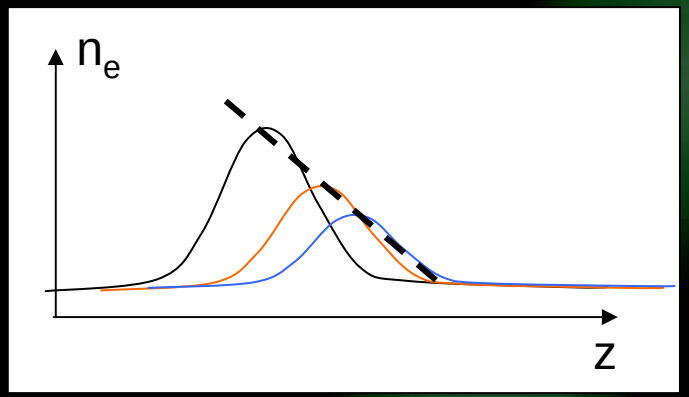
2. y and z: in effect only four measurement points



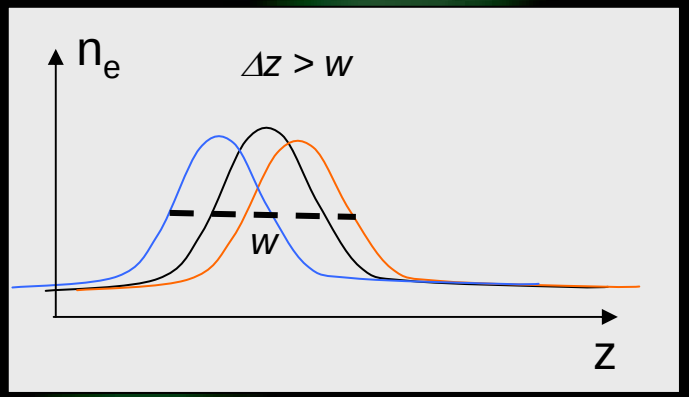
Determination of scale sizes

Use several different methods:

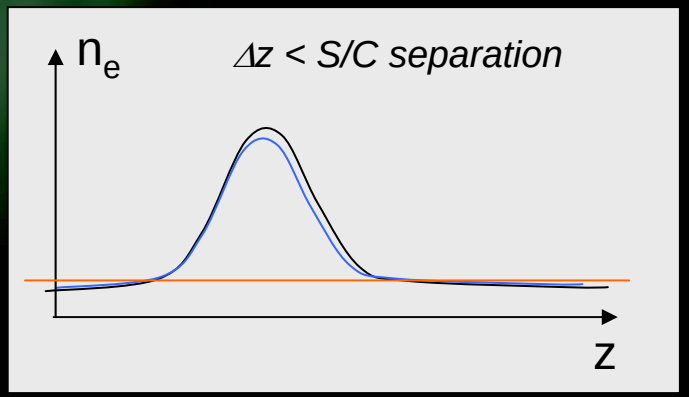
1. Extrapolate ● ○



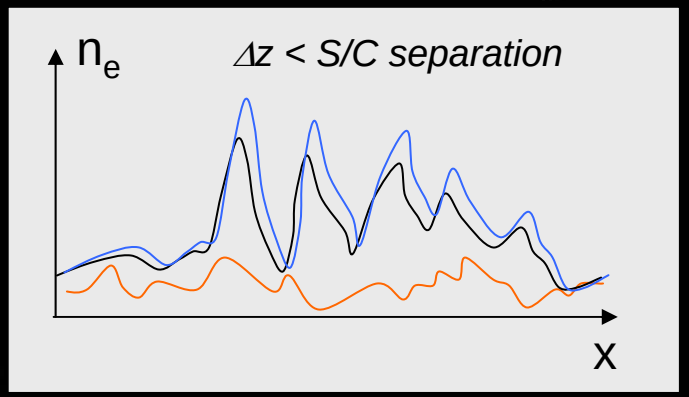
2. Half width of single event △



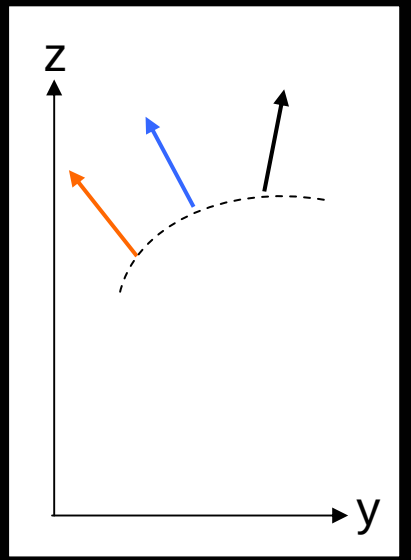
3. No signal on 1-3 S/C ▲ △



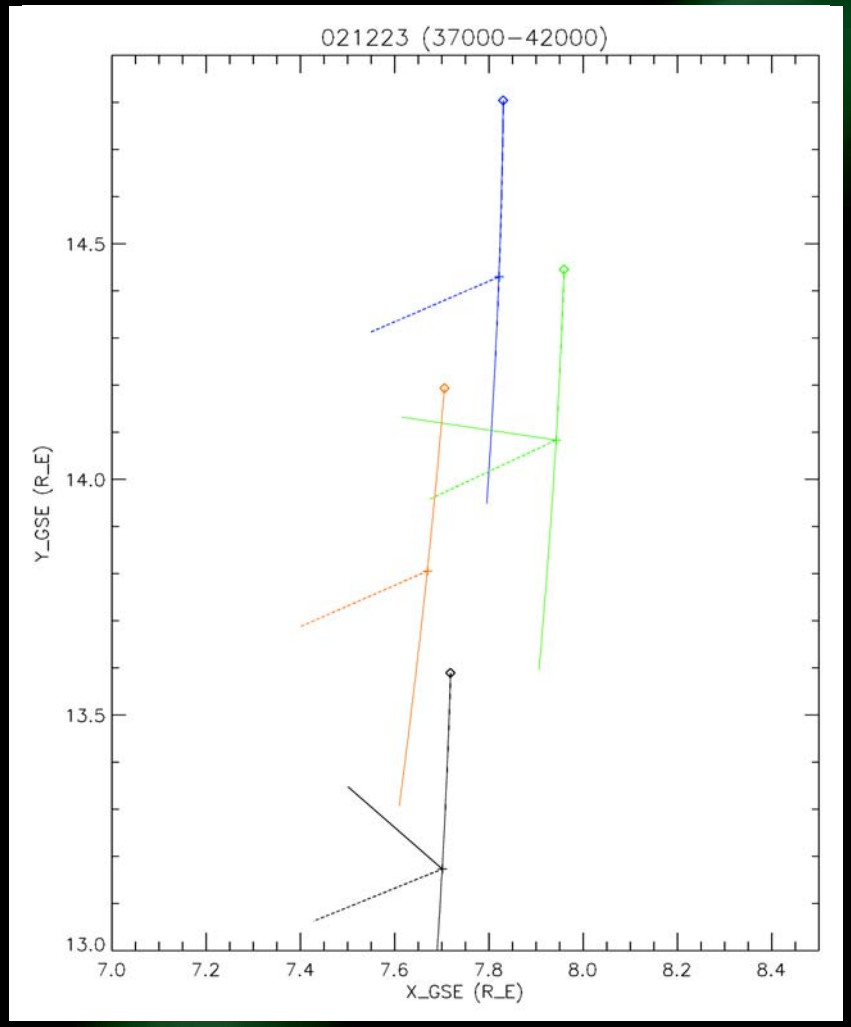
4. Cross correlation < thres. ■ □

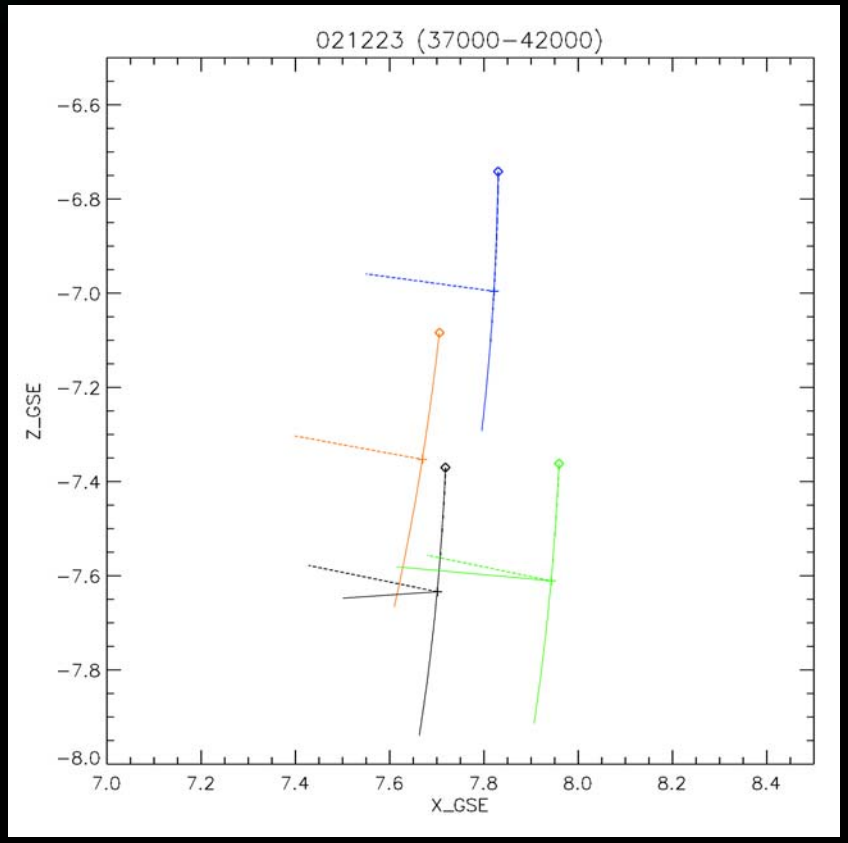


5. Fit surface to curvature +



2002-12-23 (39 315 s)





Asdf söldk fälskdf säldk äs

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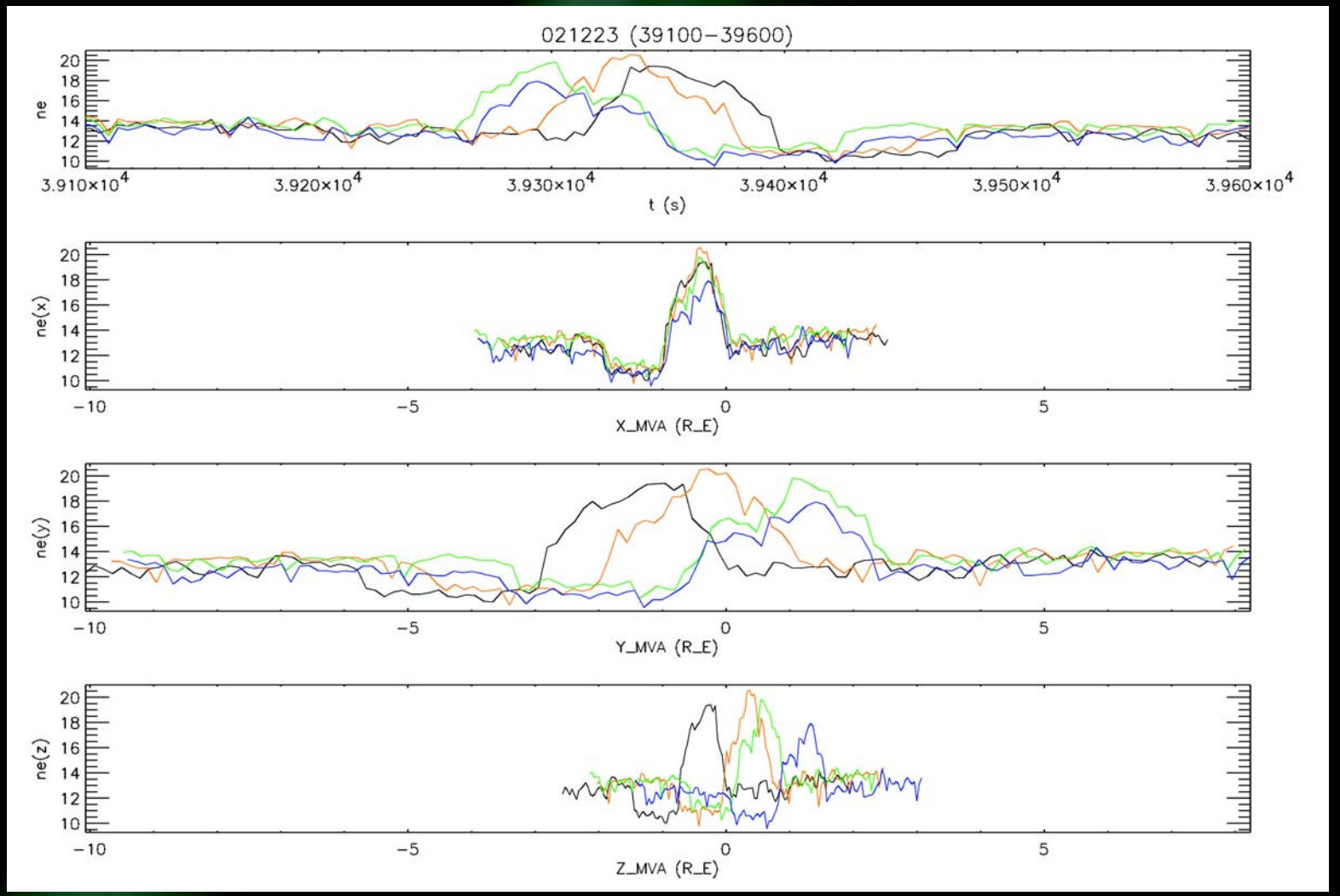

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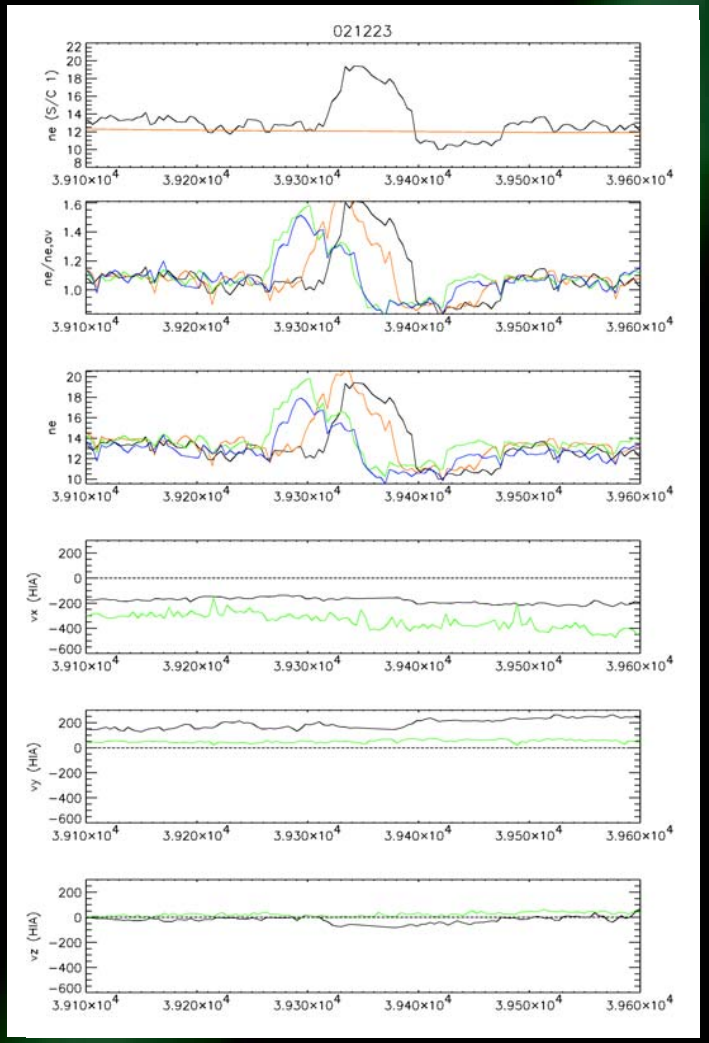

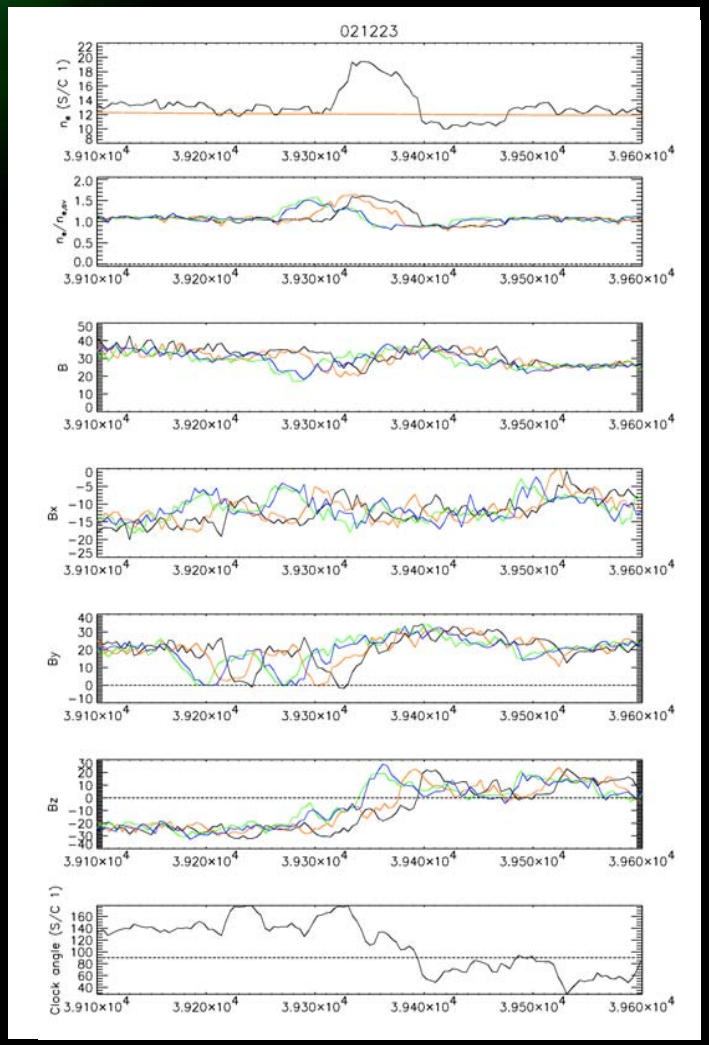

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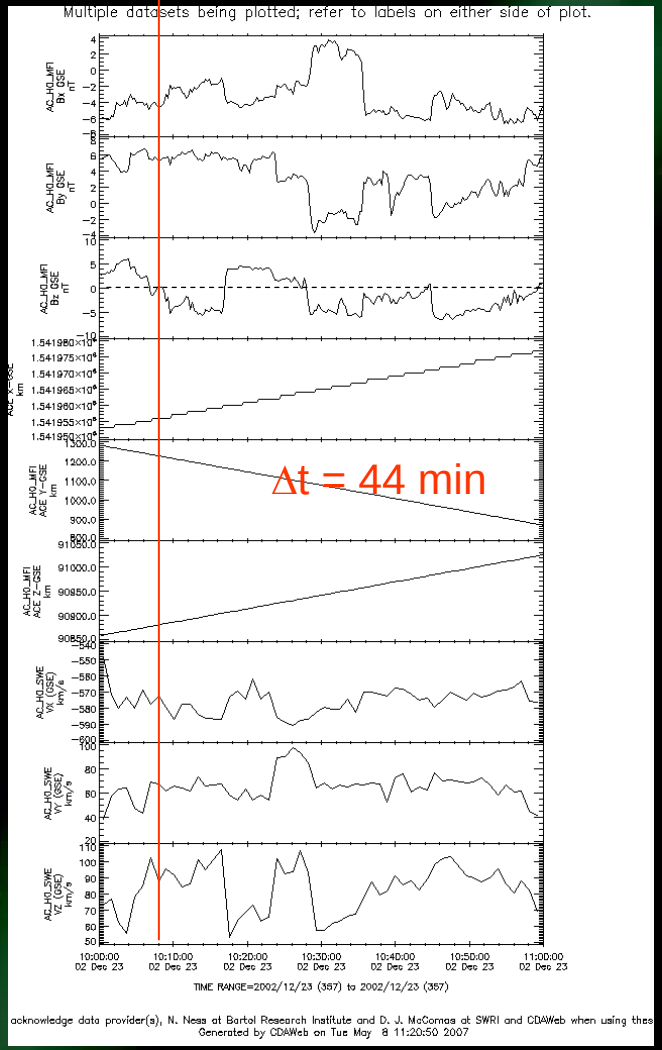
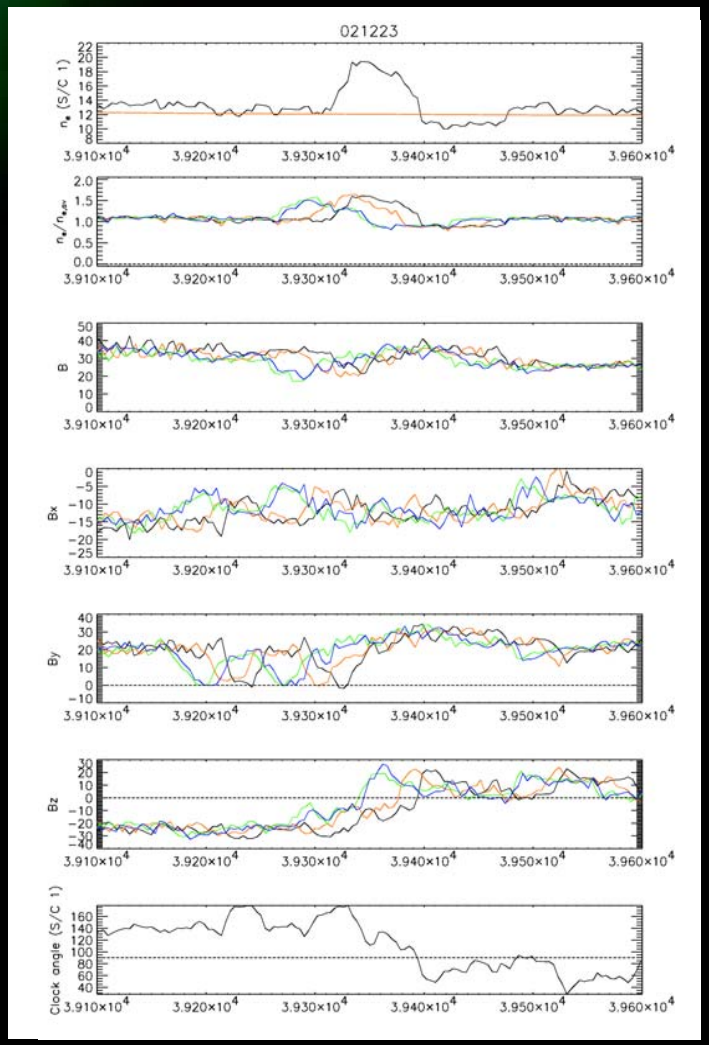
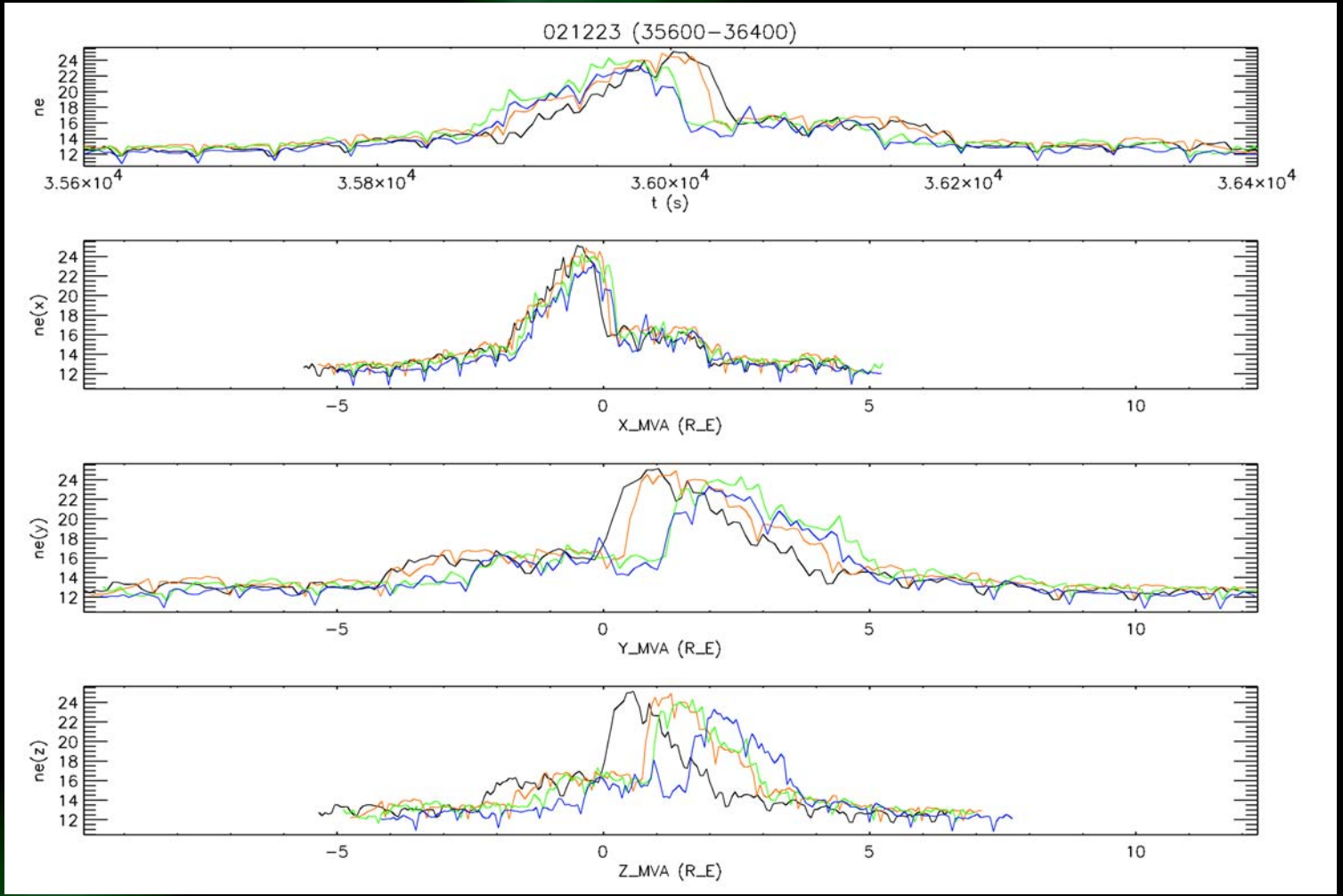




Solar wind???

2002-12-23 (36 040 s)



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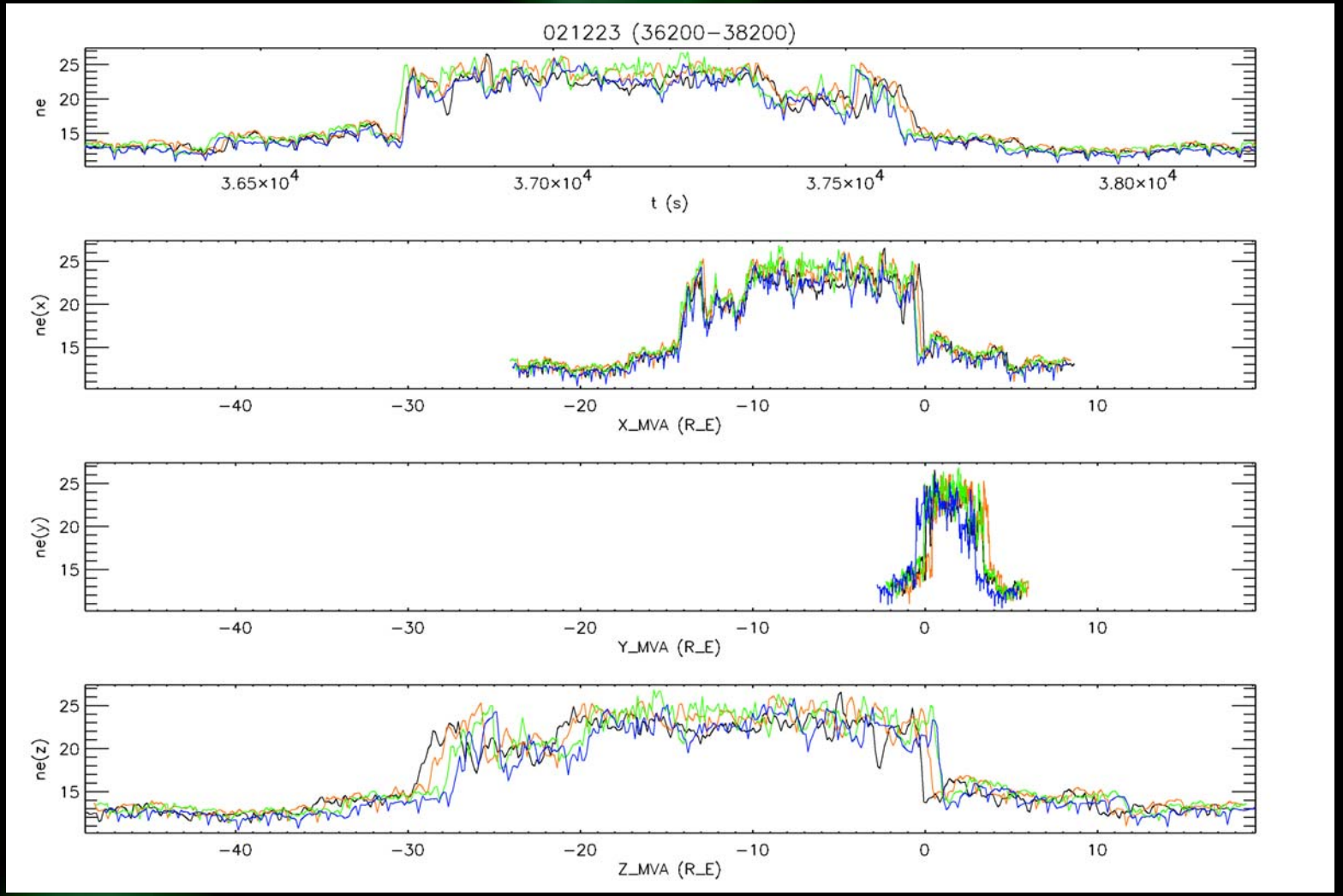
2002-12-23 (36 740 s)



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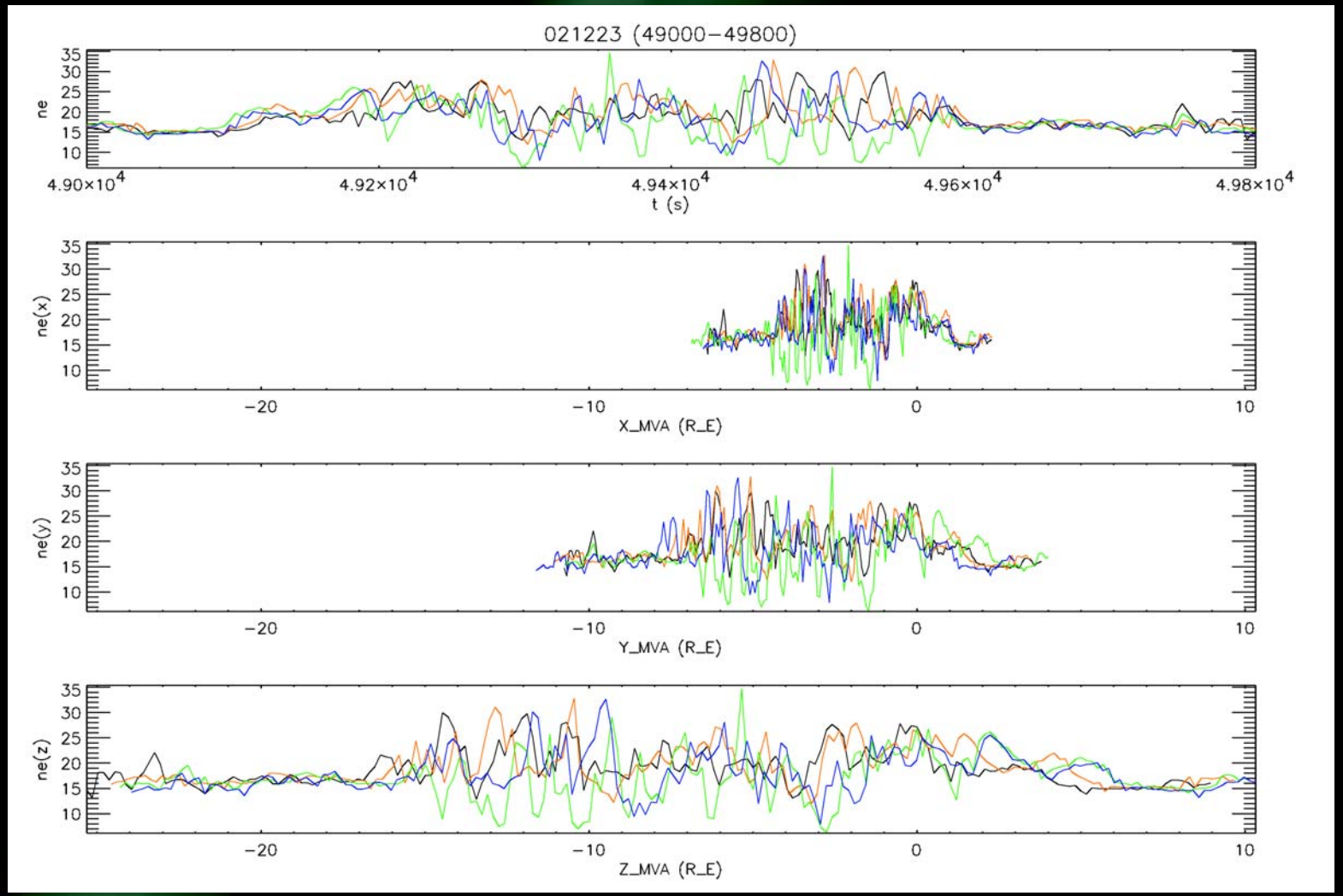
2002-12-23 (49 315 s)



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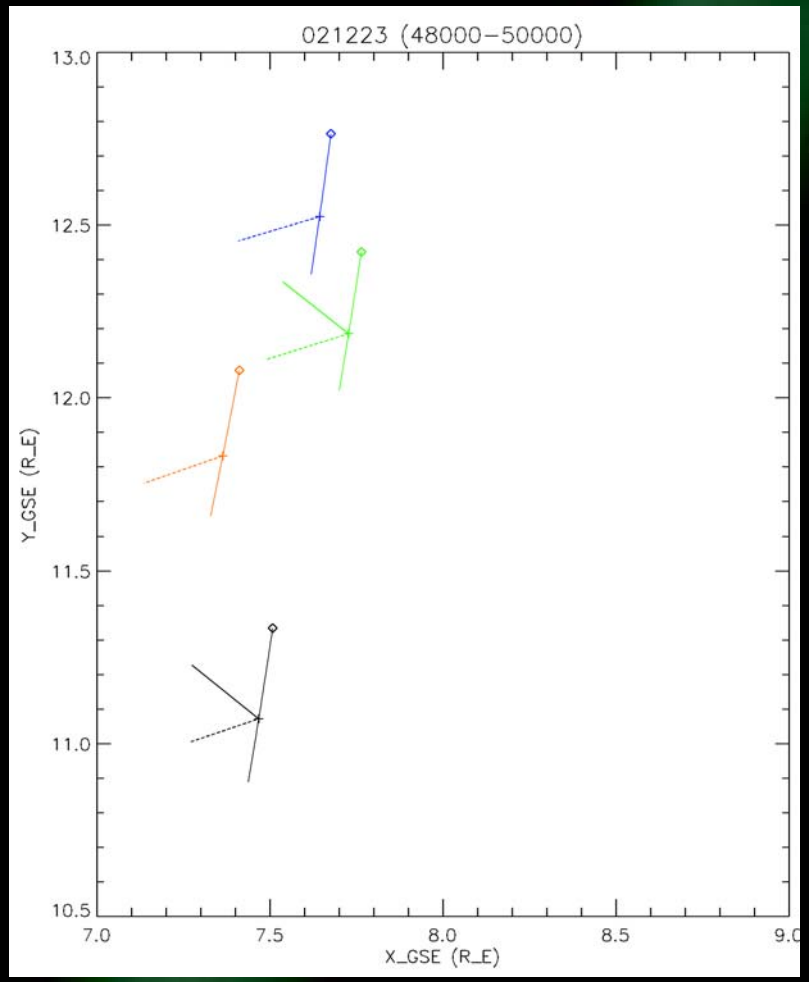
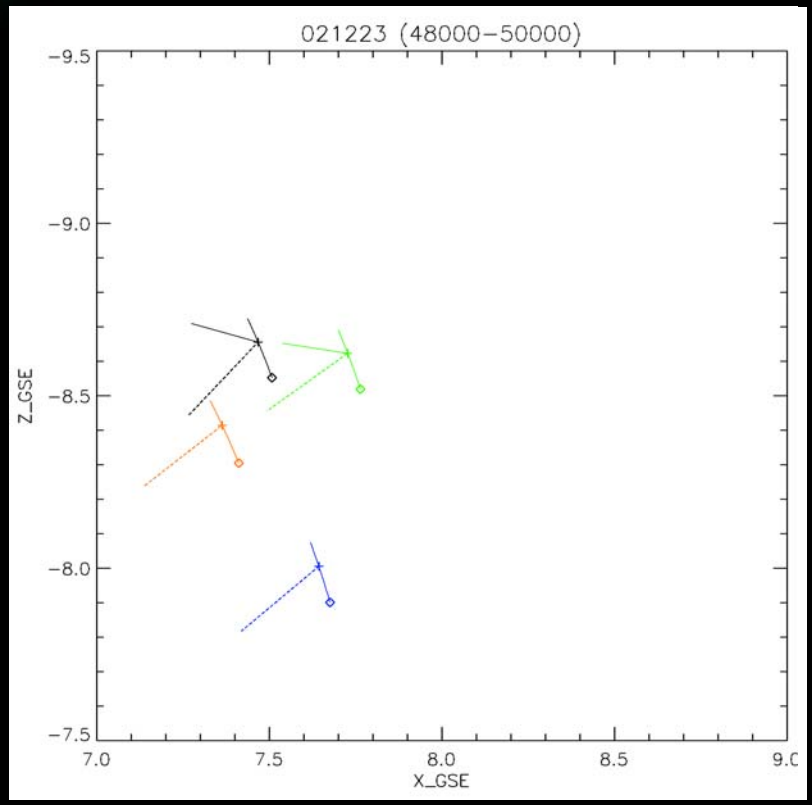
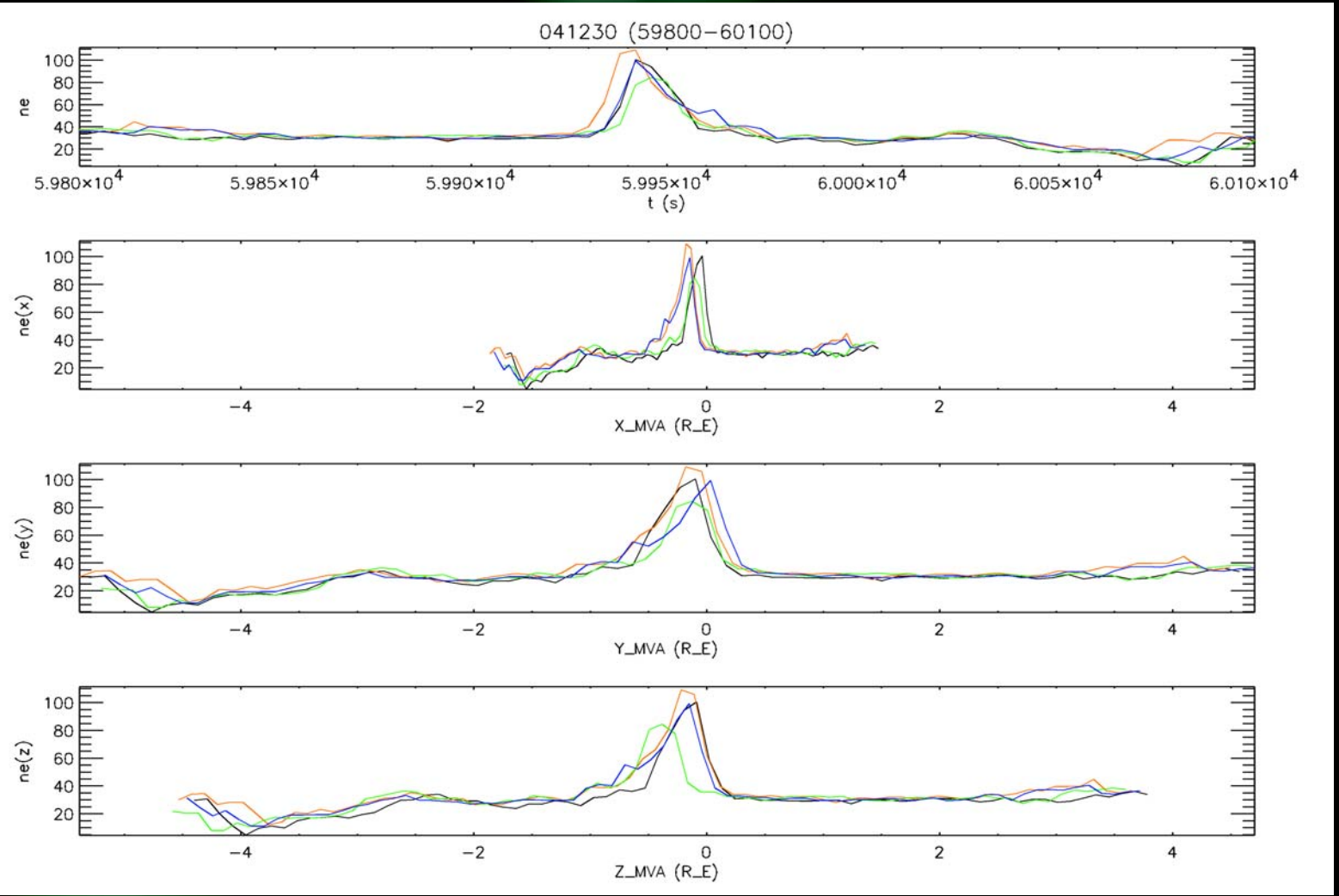
2002-12-23 (39 315 s)





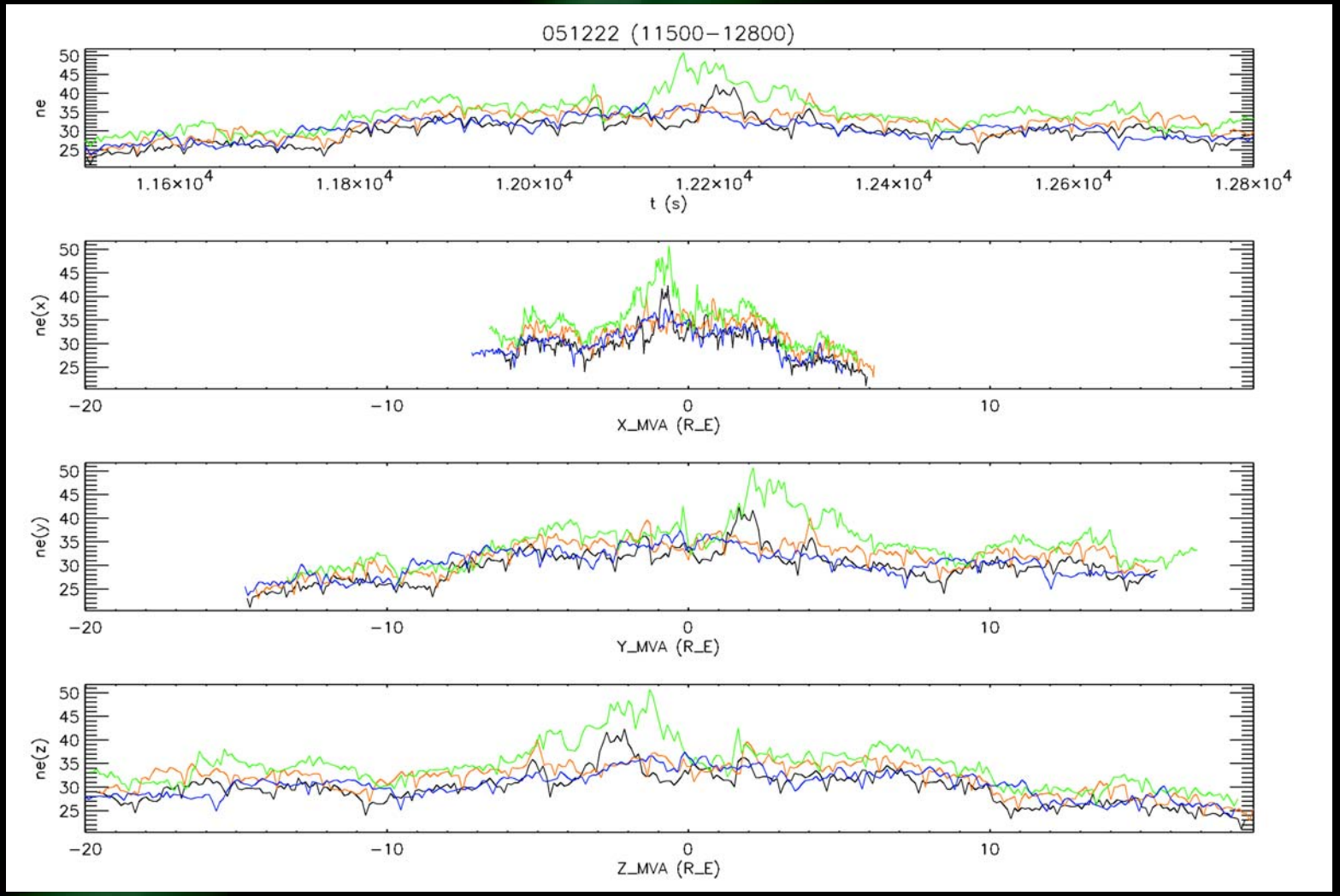
Asdf söldk fälskdf säldk äs

2004-12-30 (59 939 s)



Asdf söldk fälskdf säldk äs

2005-12-22 (12 130 s)



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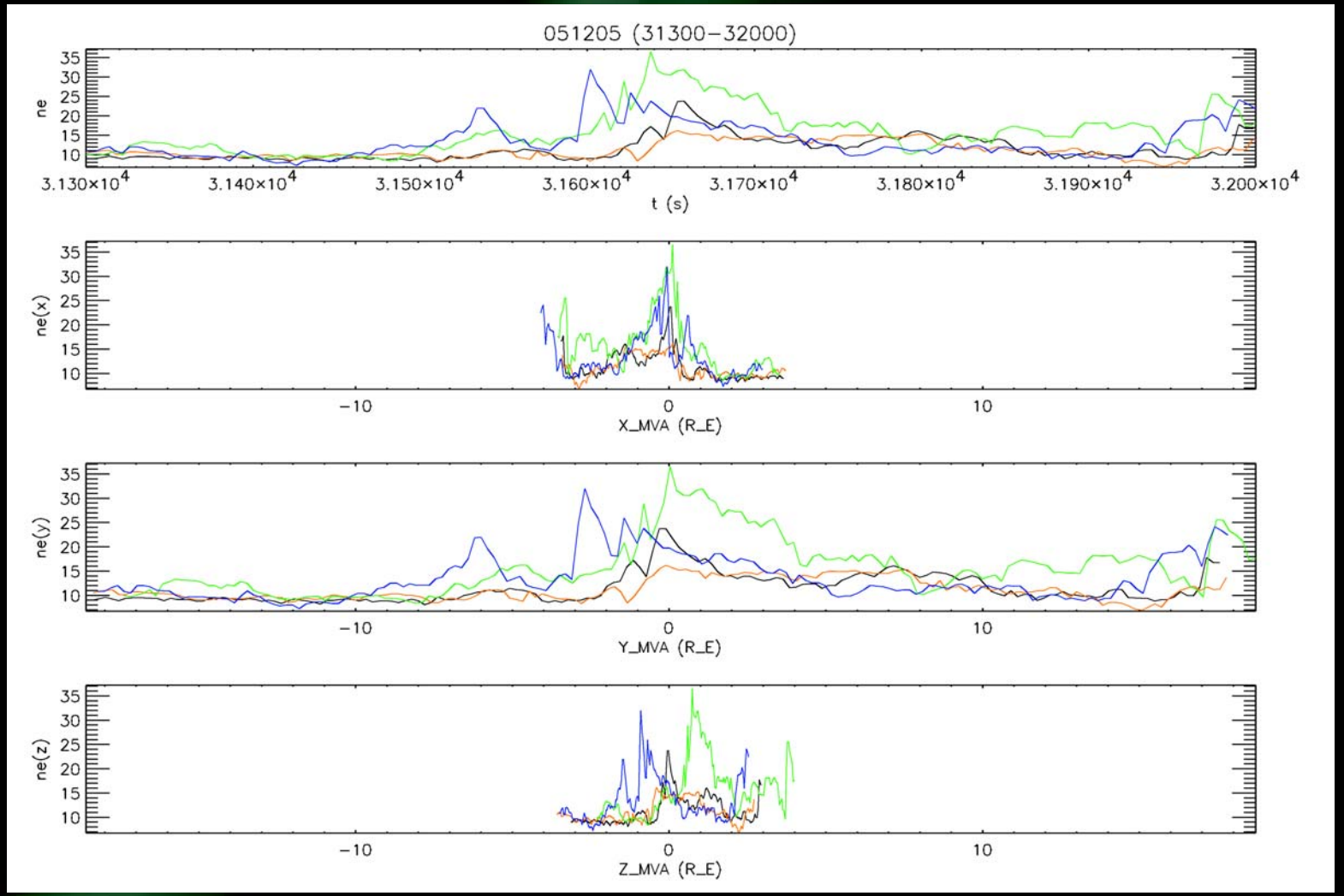
2005-12-05 (31 660 s)



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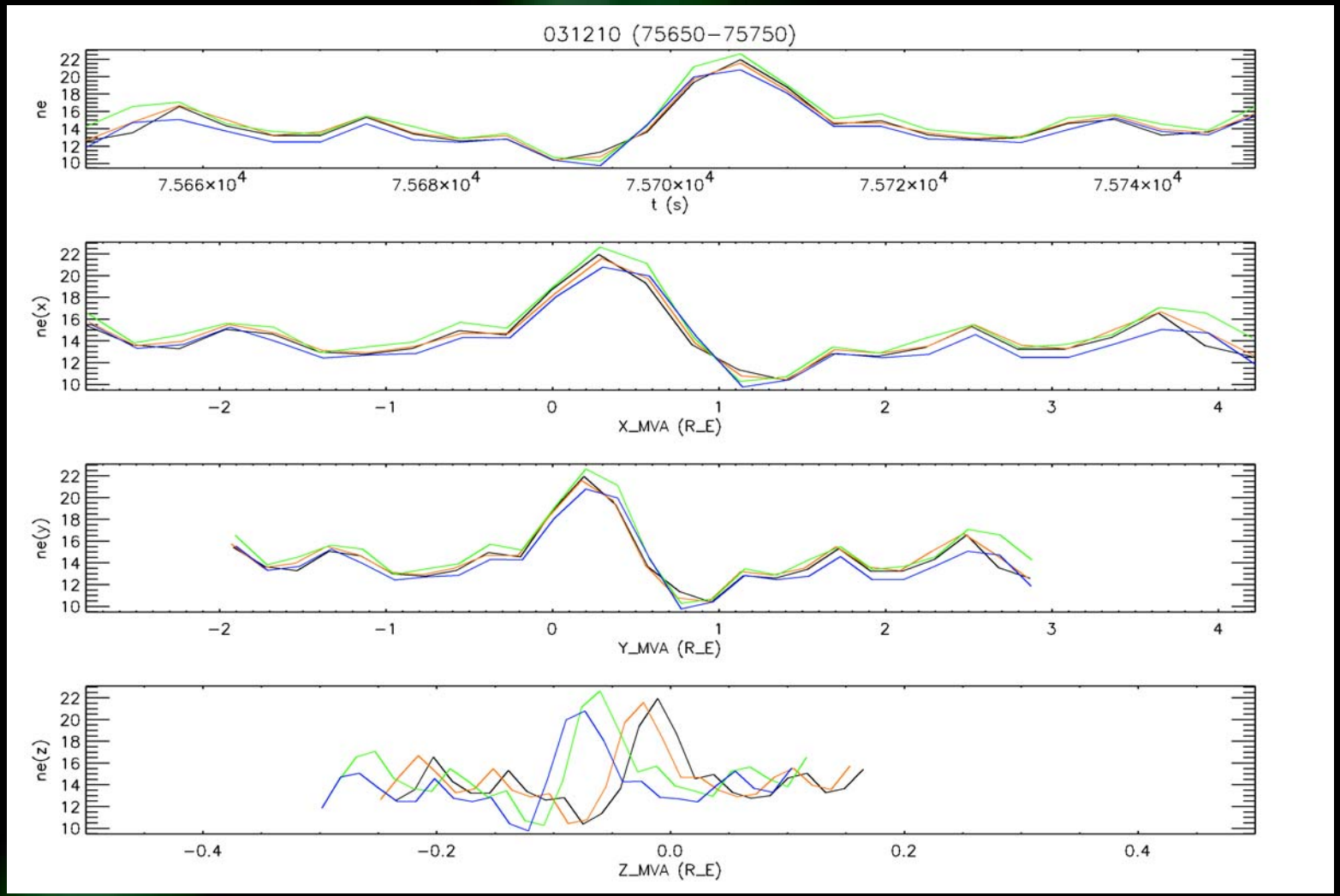
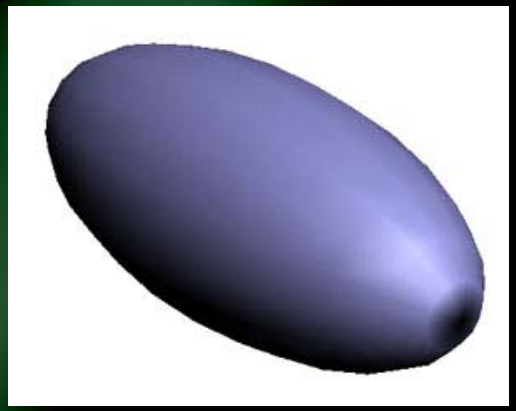
2003-12-10 (75 710 s)



Asdf söldk fälskdf säldk äs

Scale sizes

modelling



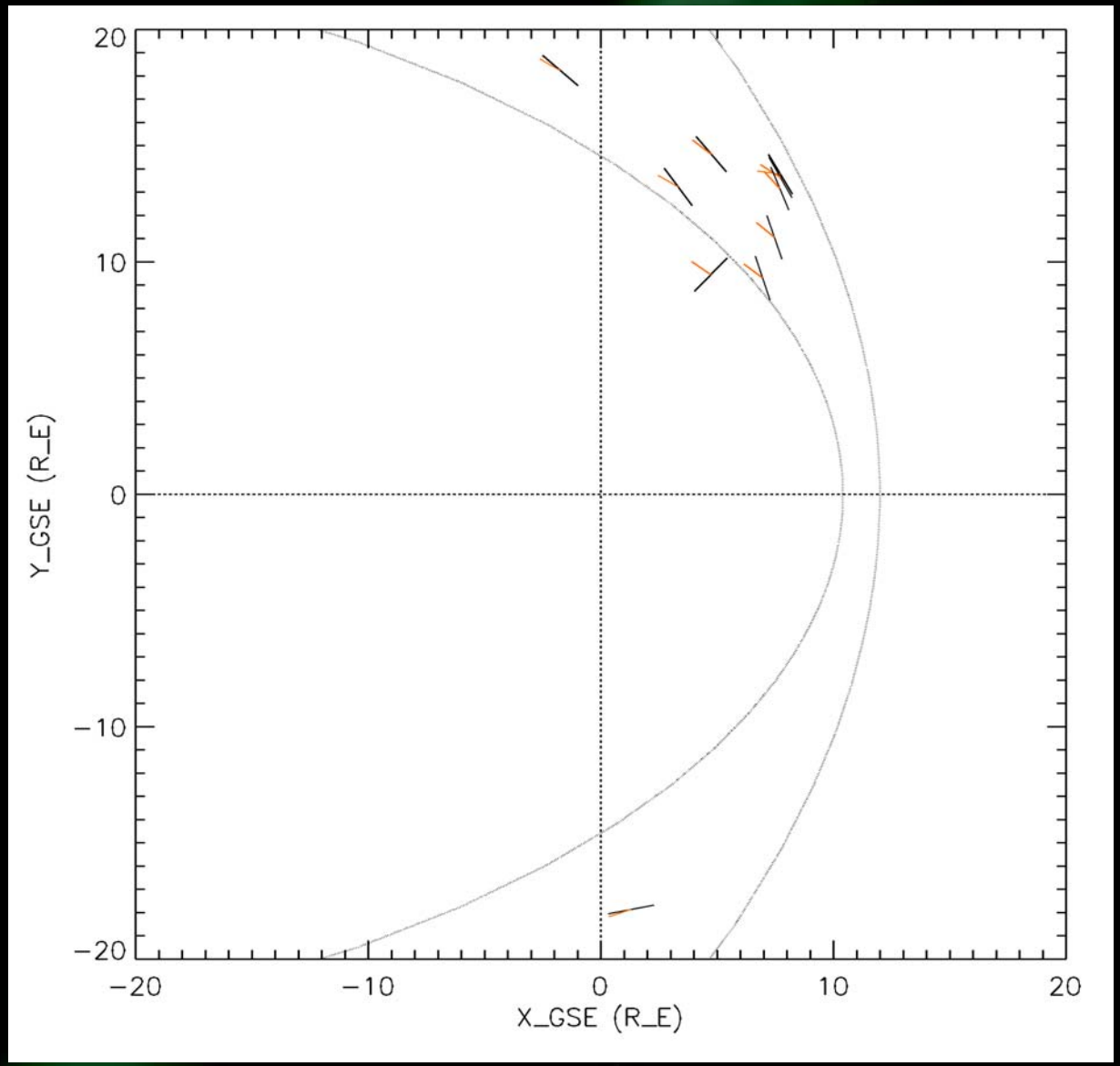
$$n(x,y,z) = n_0 \cdot e^{x^2/l_x^2} \cdot e^{y^2/l_y^2} \cdot e^{z^2/l_z^2} = n_0 \cdot e^{x^2/l_x^2} \cdot f(y,z)$$

$$\Rightarrow$$

$$f(y,z) = e^{y^2/l_y^2} \cdot e^{z^2/l_z^2} = n(x,y,z)/(n_0 \cdot e^{x^2/l_x^2})$$

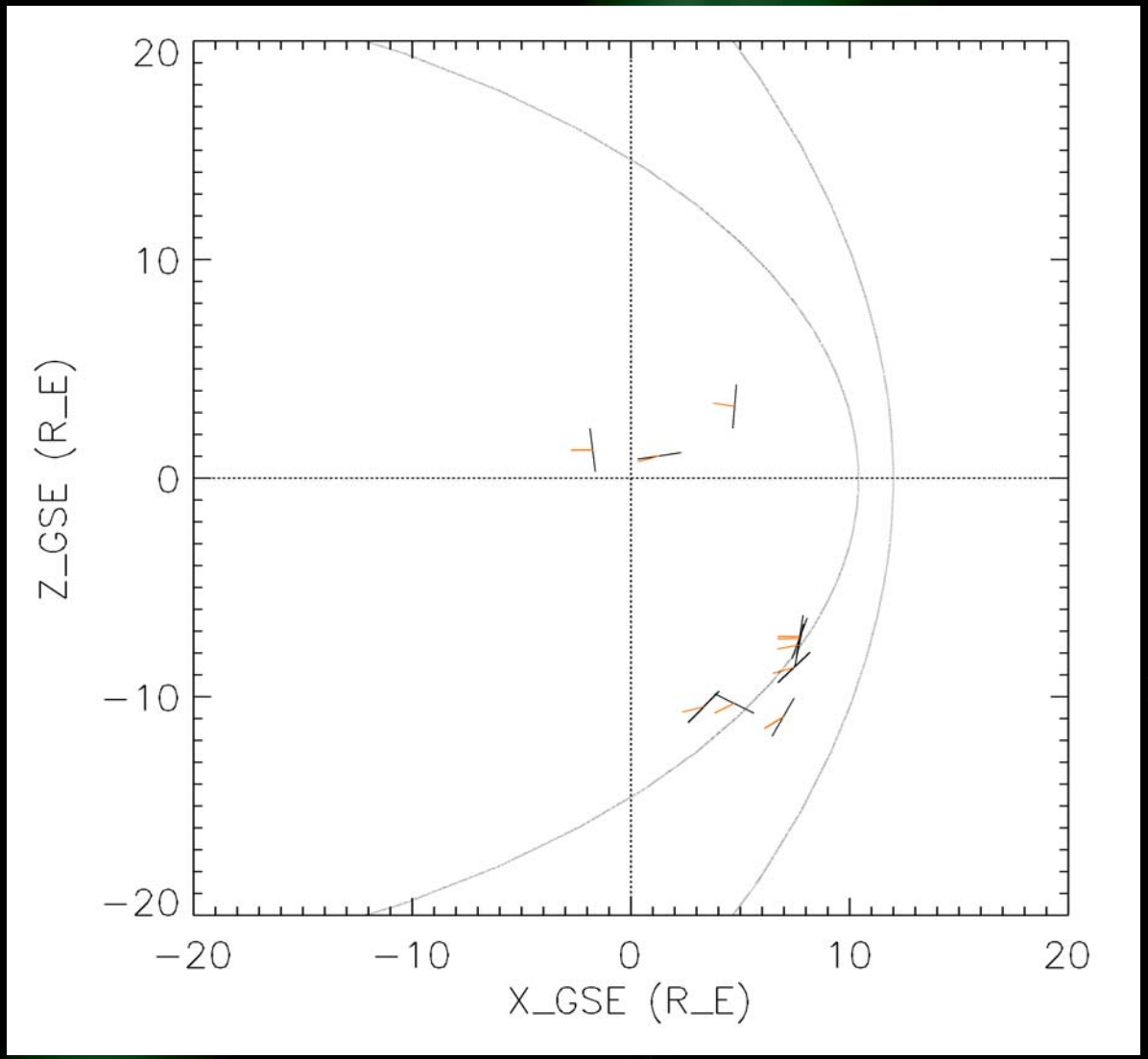
Asdf söldk fälskdf säldk äs

Orientation: x-y



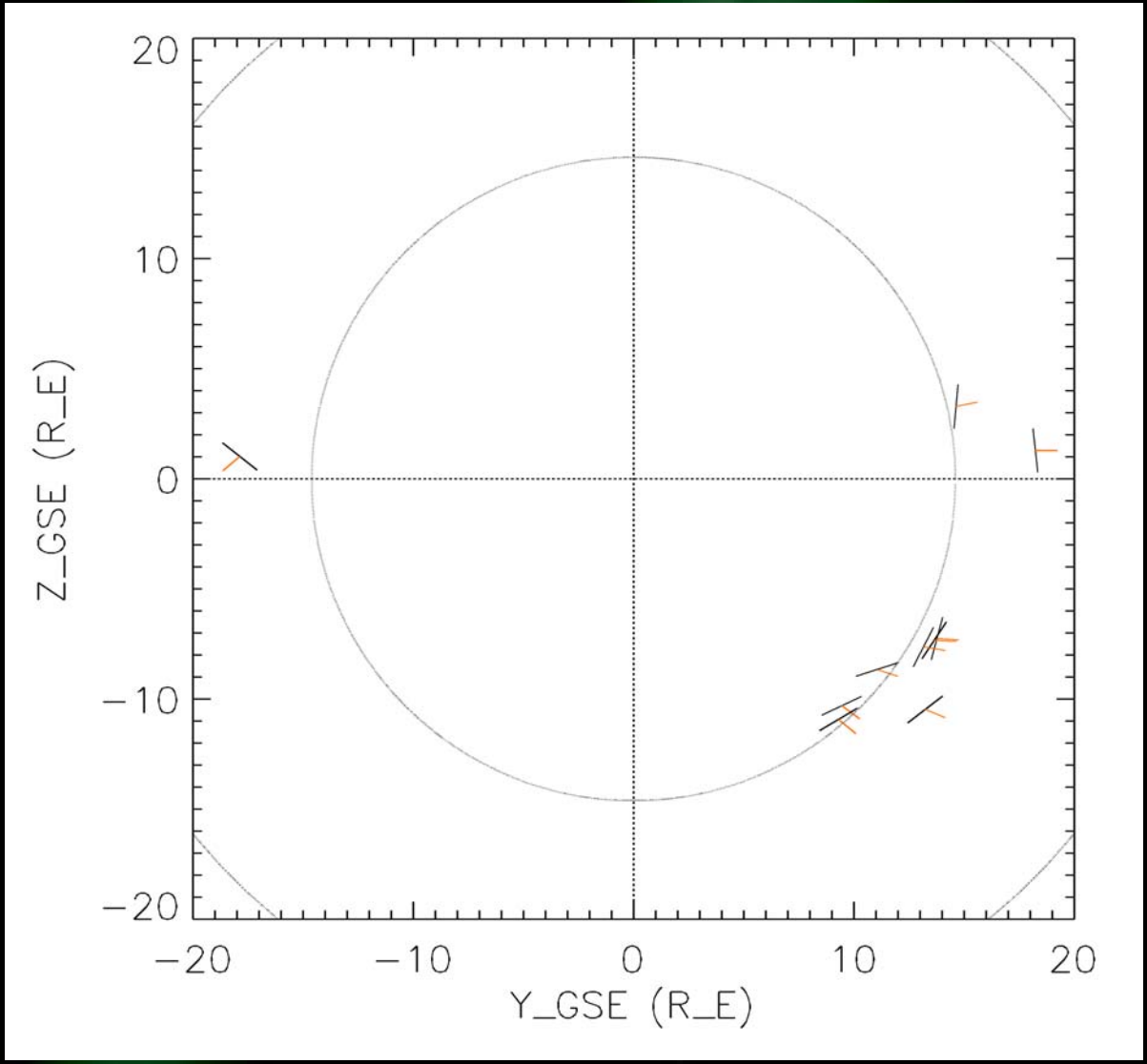
Asdf söldkfälskdf säldk äs

Orientation: x-z



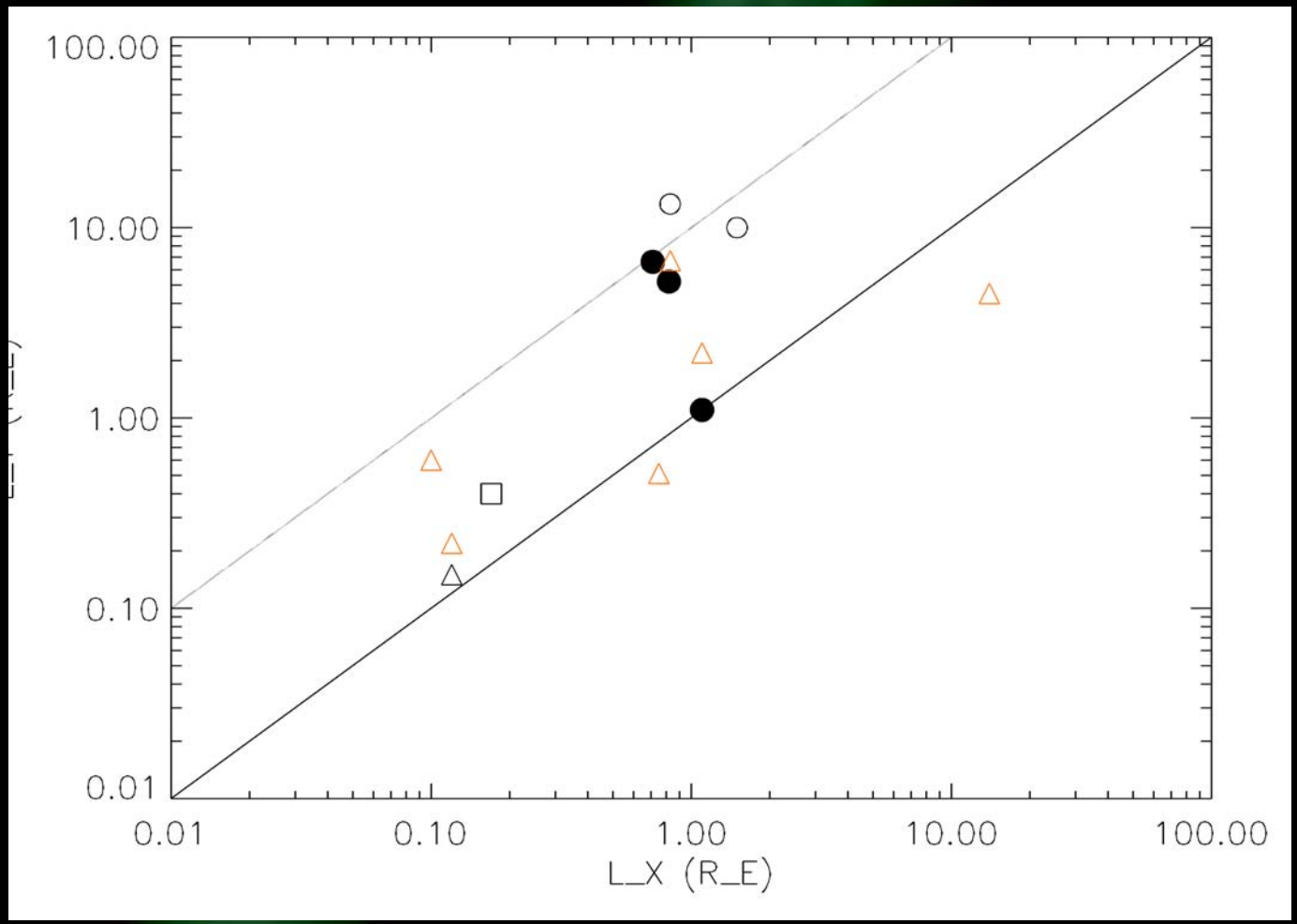
Asdf söldkfälskdf säldk äs

Orientation: y-z



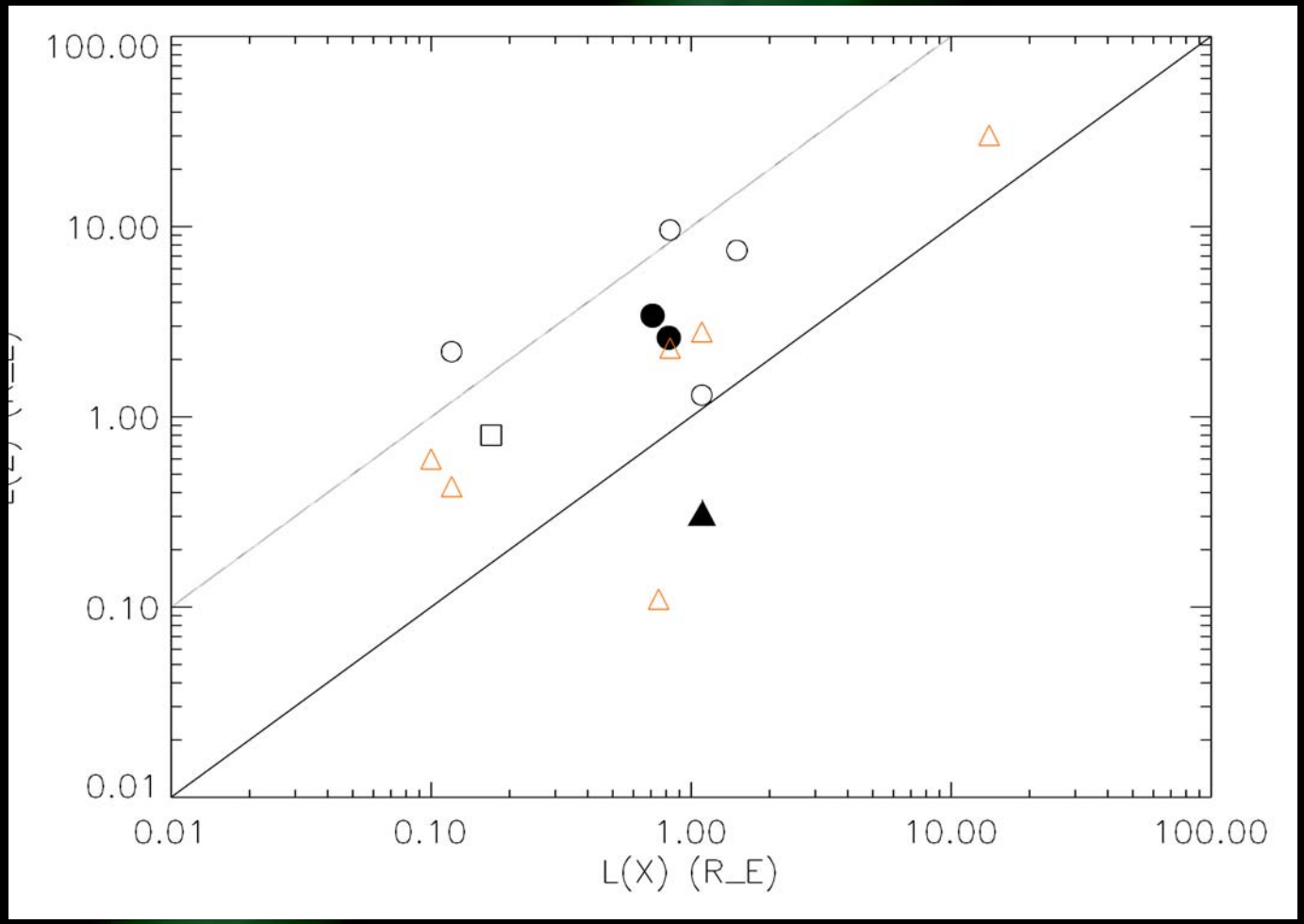
Asdf söldkfälskdf säldk äs

Scale sizes: x-y



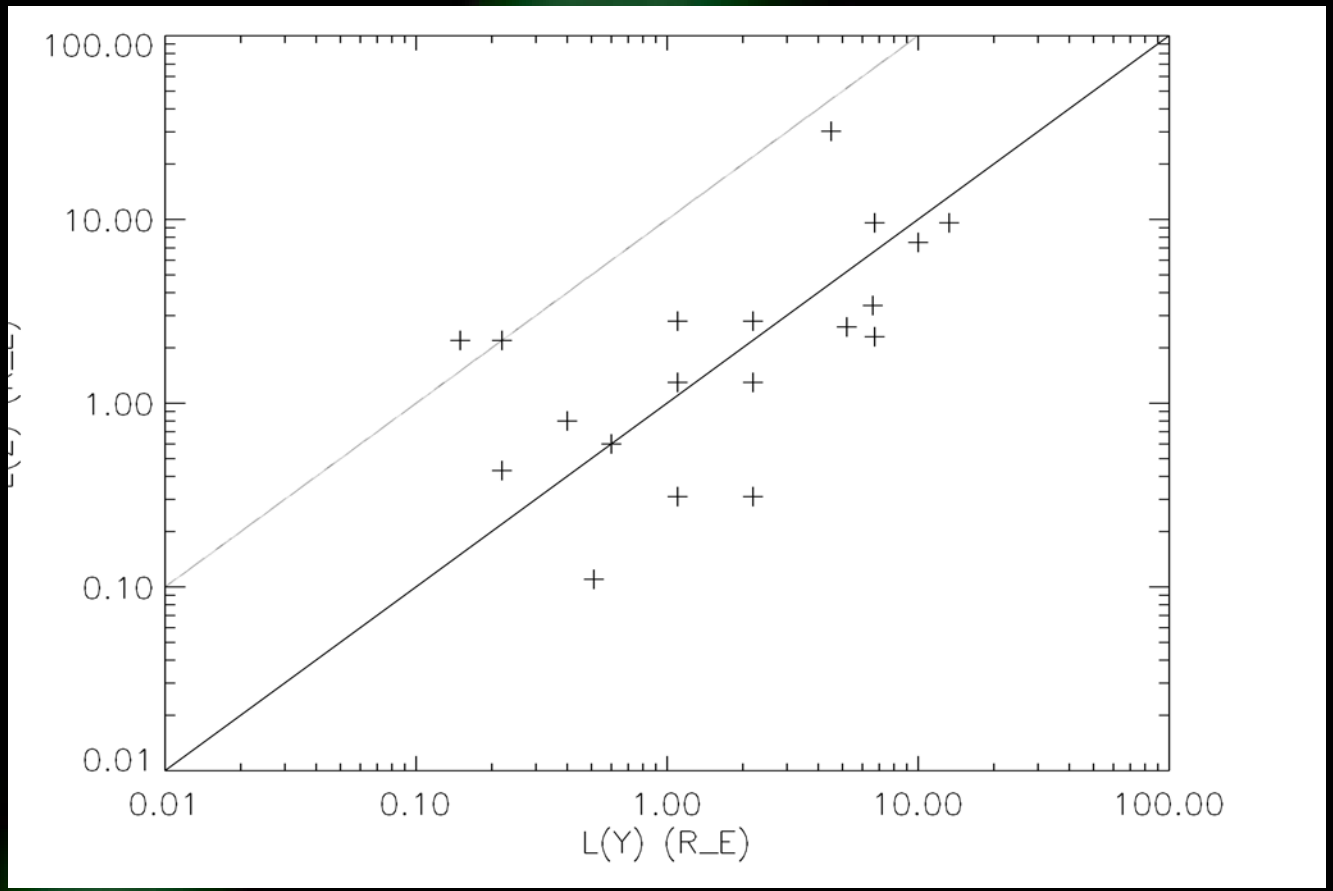
Asdf
söldkfälskdf
säldk äs

Scale sizes: x-z



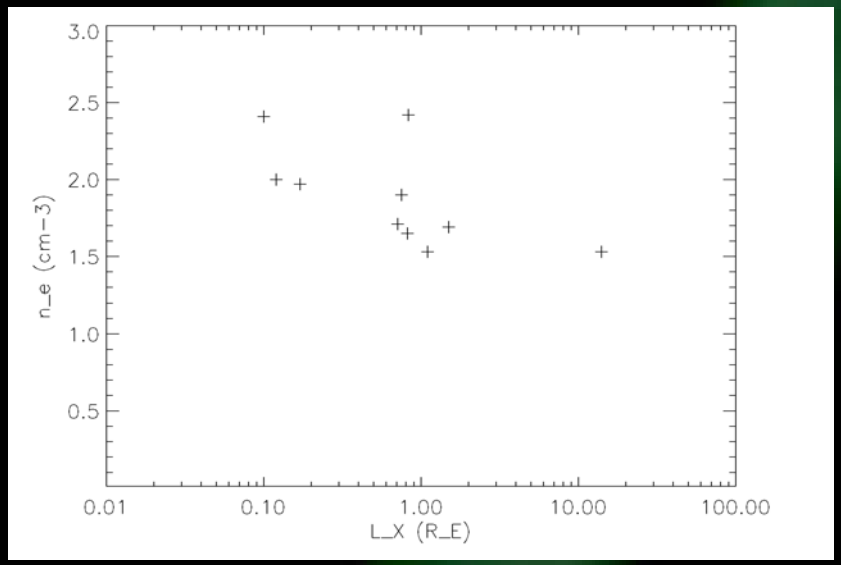
Asdf
söldkfälskdf
säldk äs

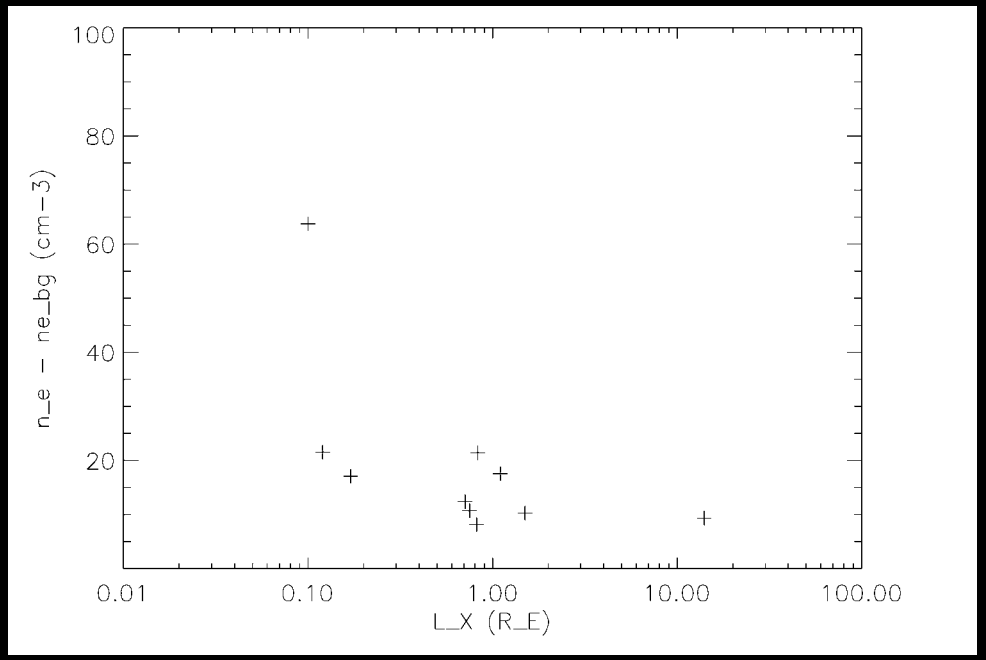
2002-12-23 (36 040 s)



Asdf söldk fälskdf säldk äs

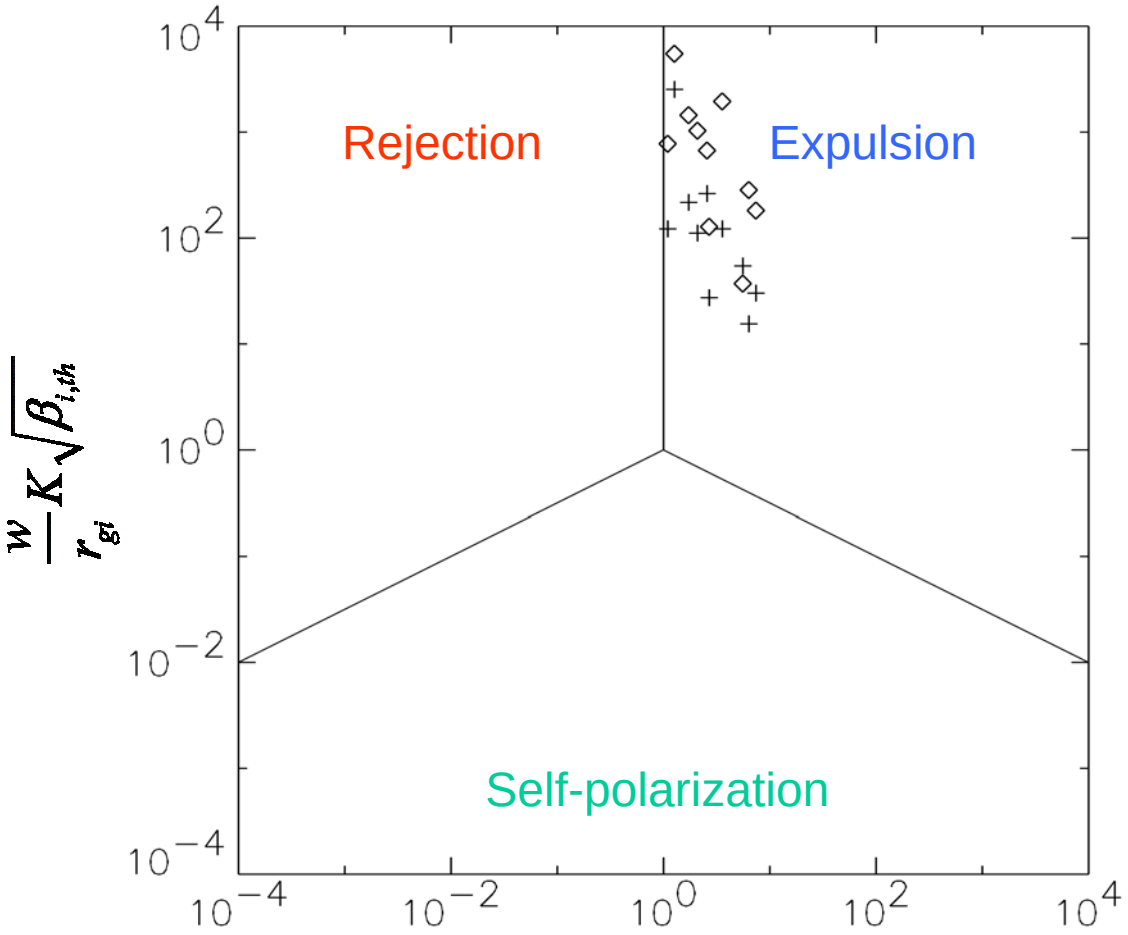
2002-12-23 (36 040 s)





Asdf söldk fälskdf säldk äs

Penetration parameters



$$W_k = \frac{m_i n_e v_d^2}{2}$$

$$W_{i,th} = \frac{m_i n_e v_{i,th}^2}{2}, \quad T = 200\ \text{eV}$$

$$W_B = \frac{B_0^{\ 2}}{2\mu_0}, \quad B_0 = 50\ \text{nT}$$

$$\beta_k = \frac{W_k}{W_B}$$

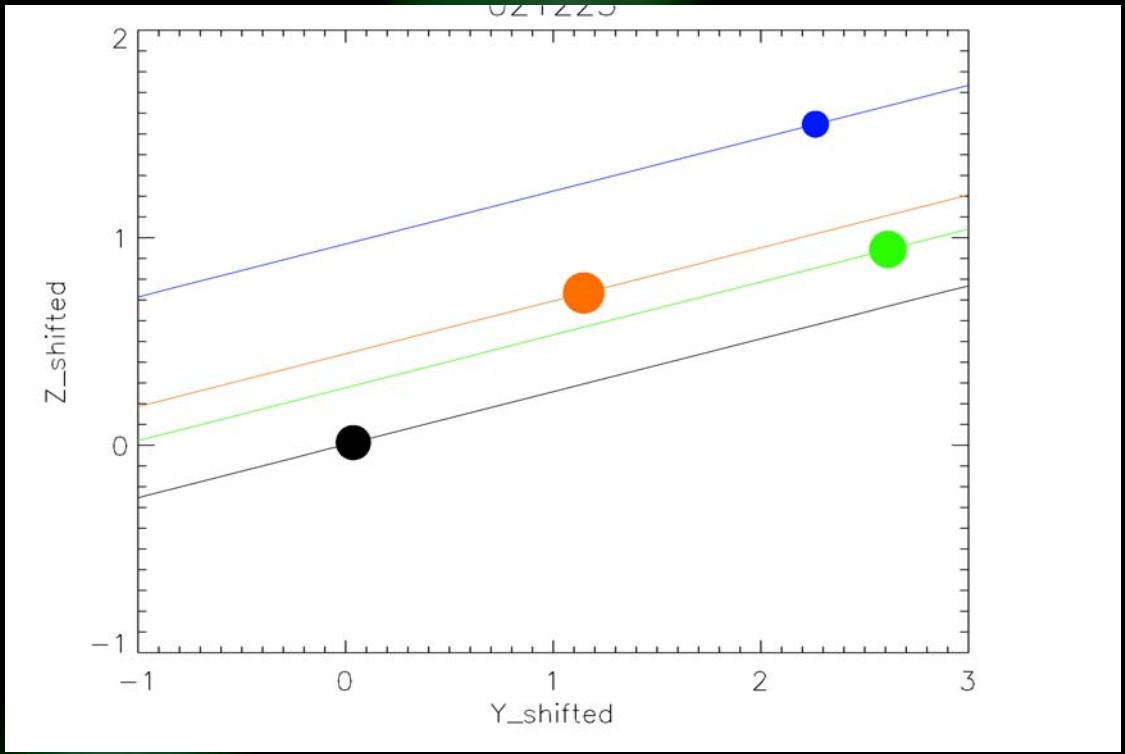
$$\beta_{i,th} = \frac{W_{i,th}}{W_B}$$

$$w = l_x$$

$$r_{gi} = \frac{m_i v_d}{eB_0}$$

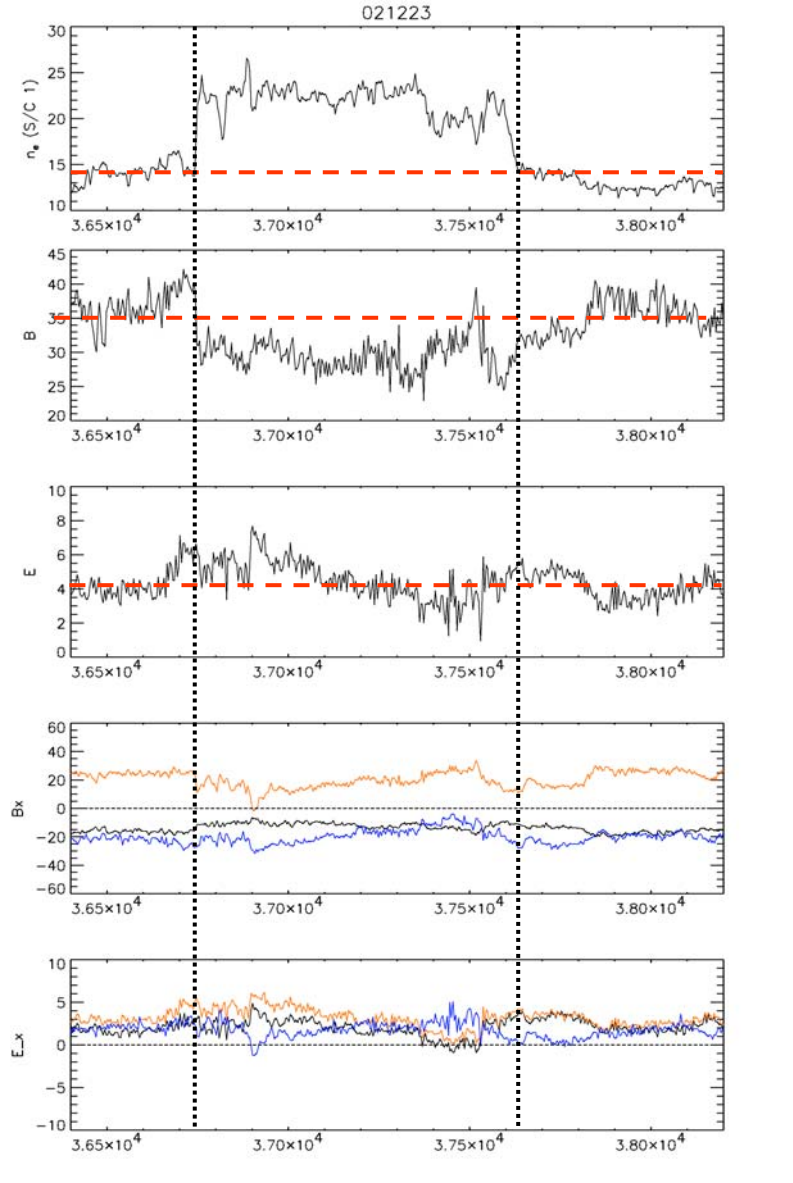
$$K = 2.3$$

2002-12-23 (36 040 s)



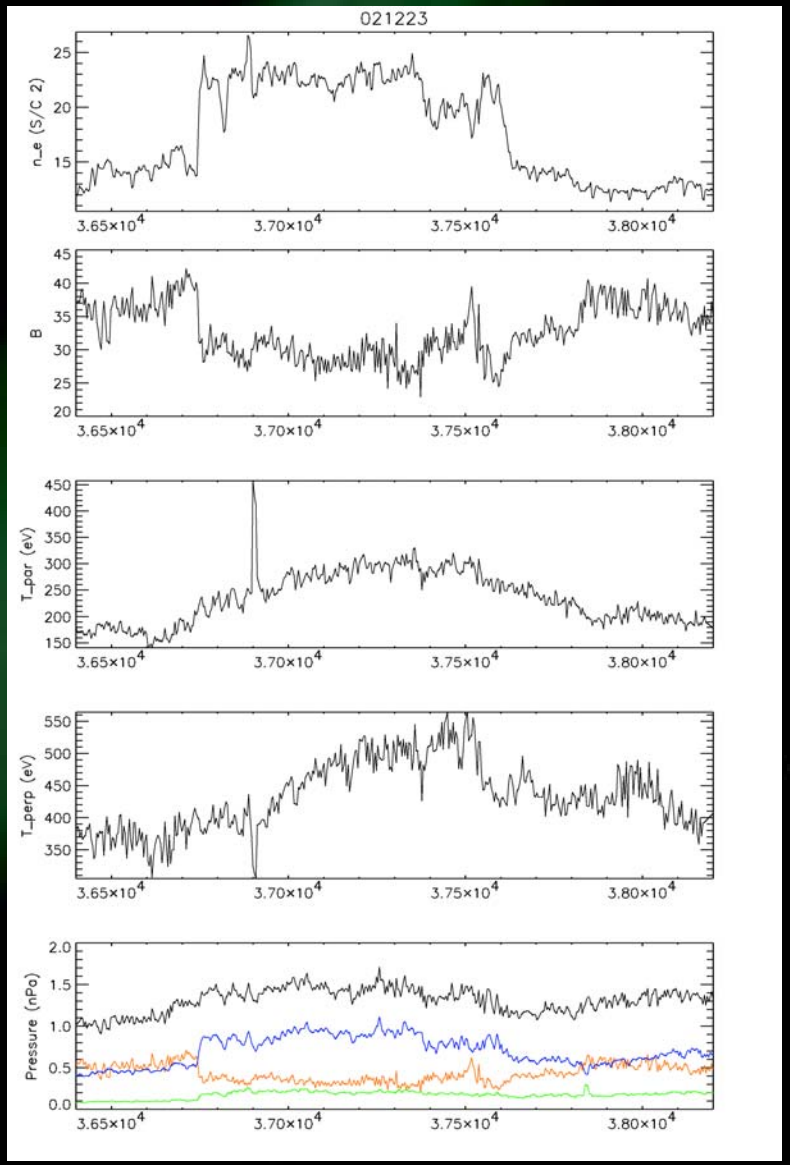
Asdf söldk fälskdf säldk äs

2002-12-23 (36 740 s)



Signature of diamagnetic behaviour and self-polarization.

2002-12-23 (36 740 s)



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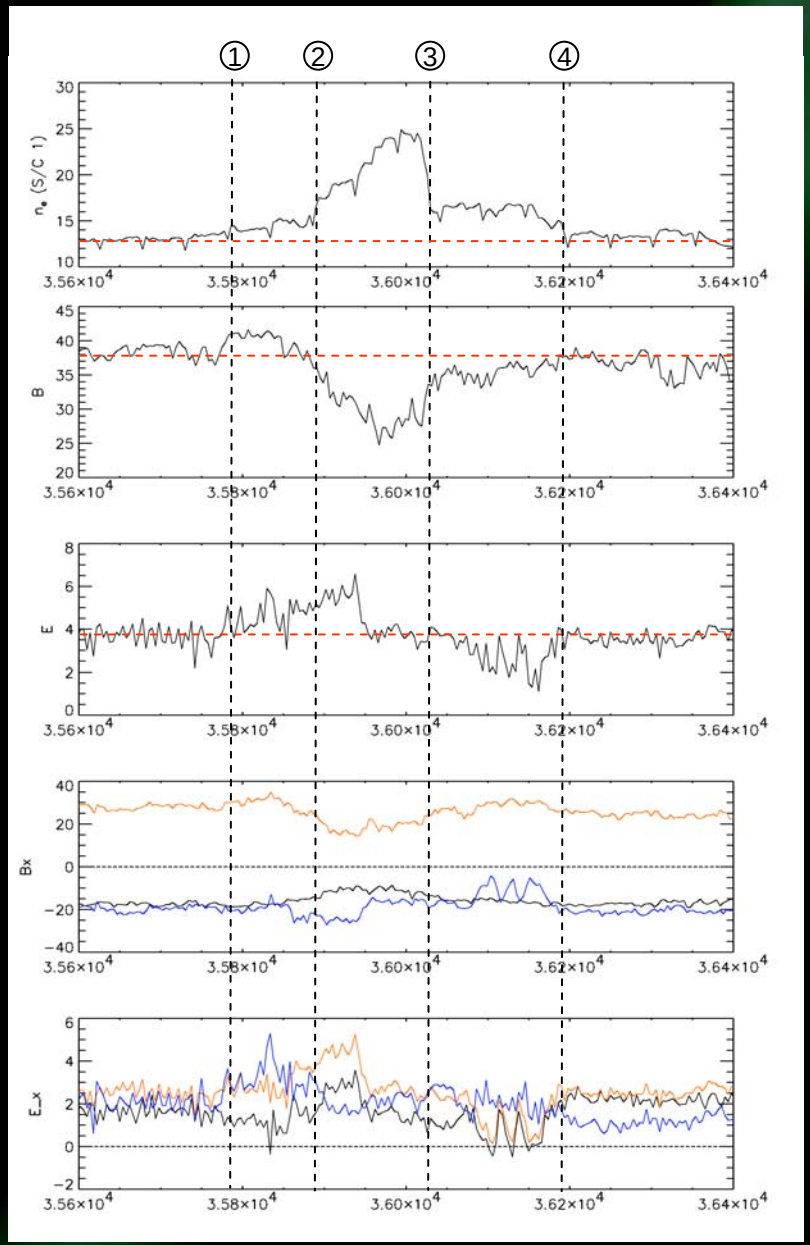
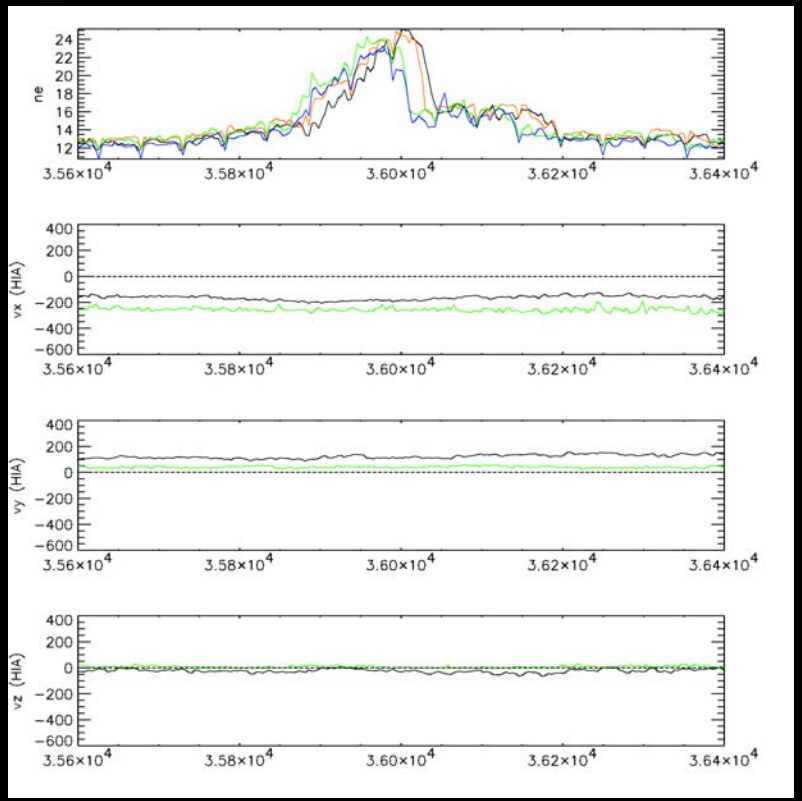
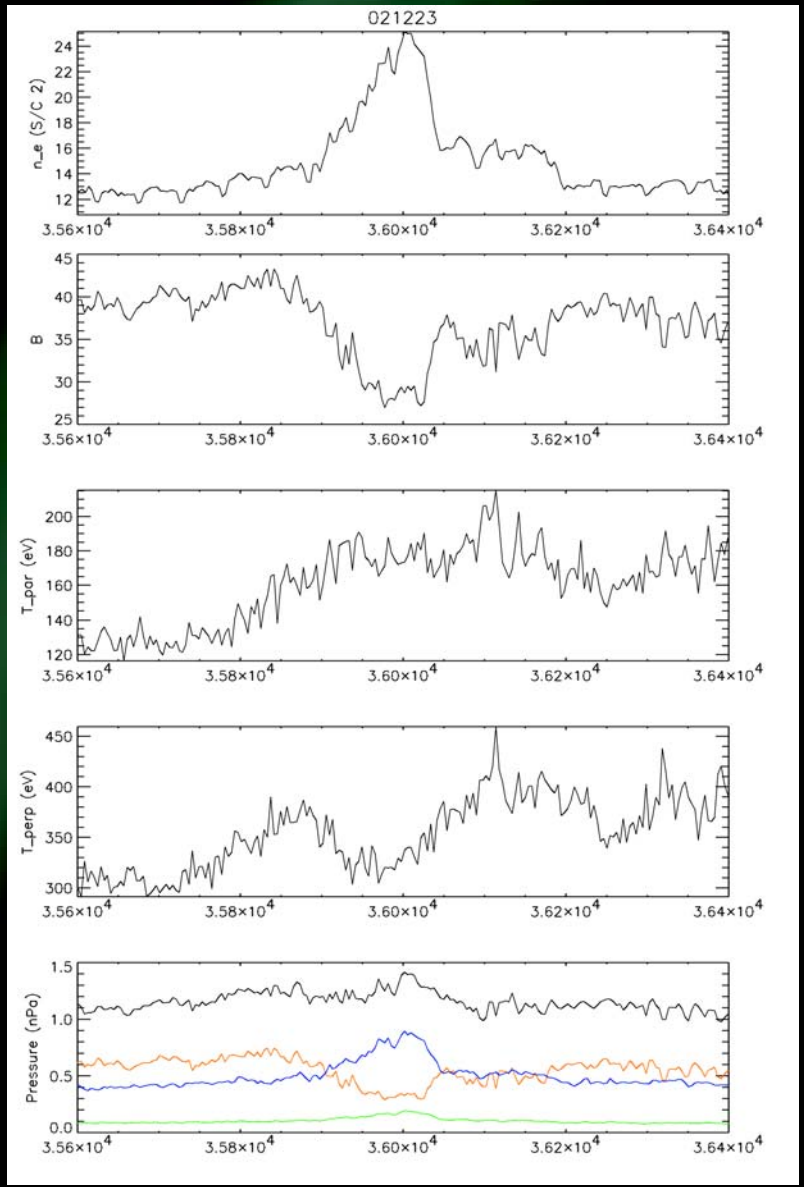


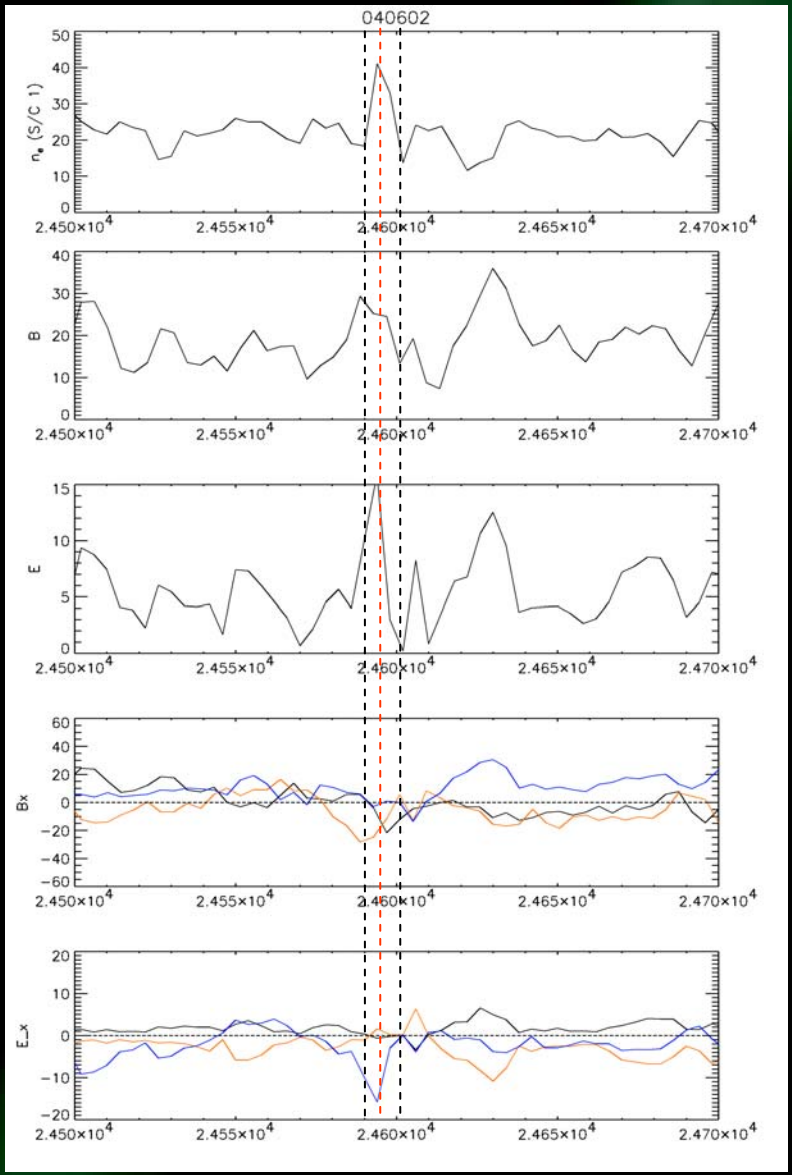
Signature of diamagnetic behaviour and self-polarization.



2002-12-23 (36 040 s)

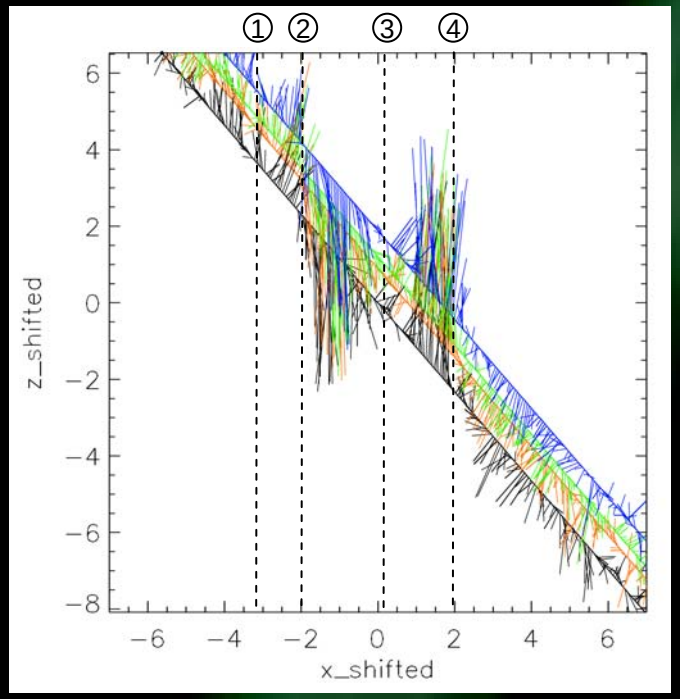


2004-06-02 (24 592 s)

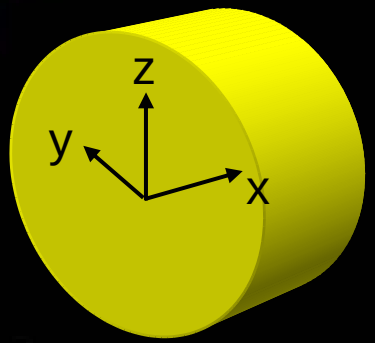


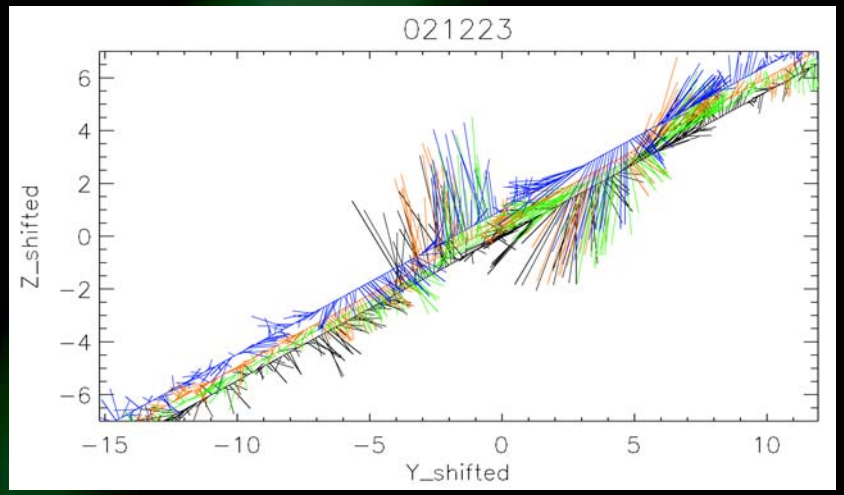
Signature of *para*magnetic behaviour (?) and self-polarization.

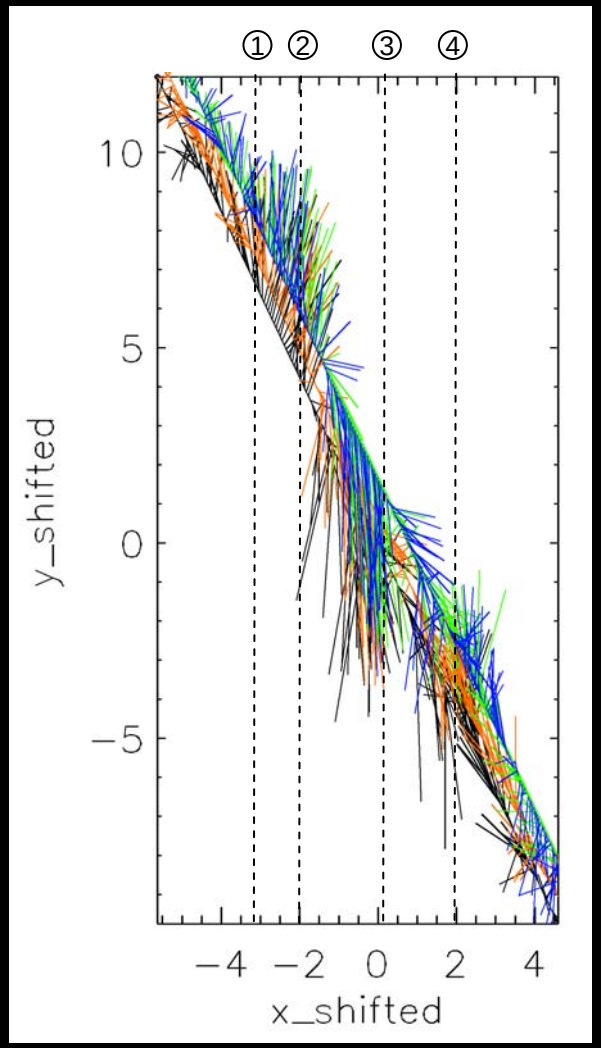
2002-12-23 (36 040 s)



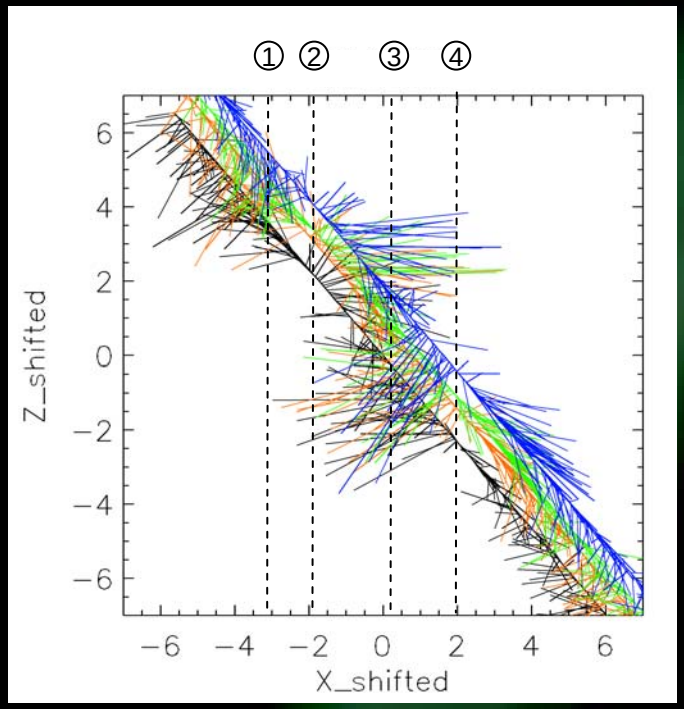
B



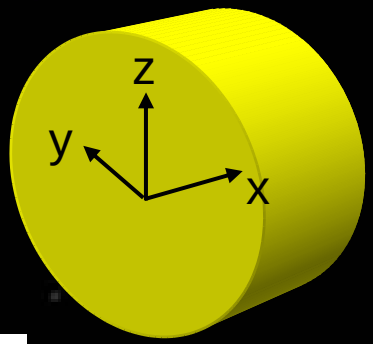


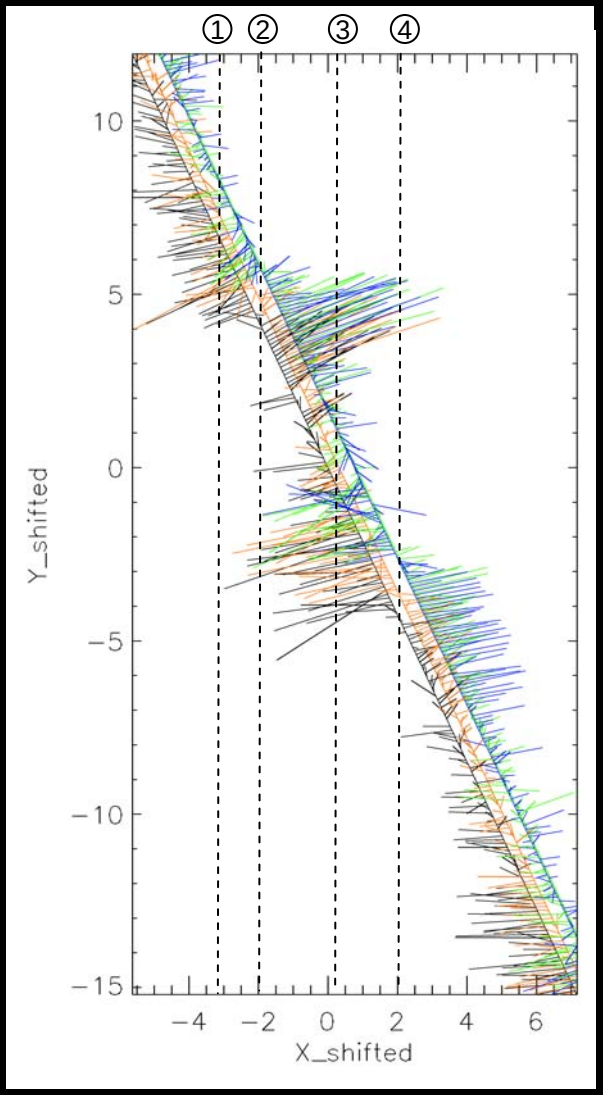


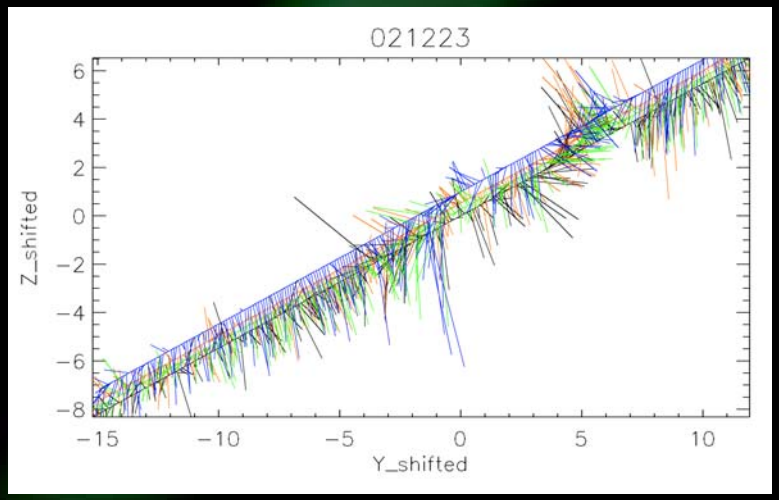
2002-12-23 (36 040 s)



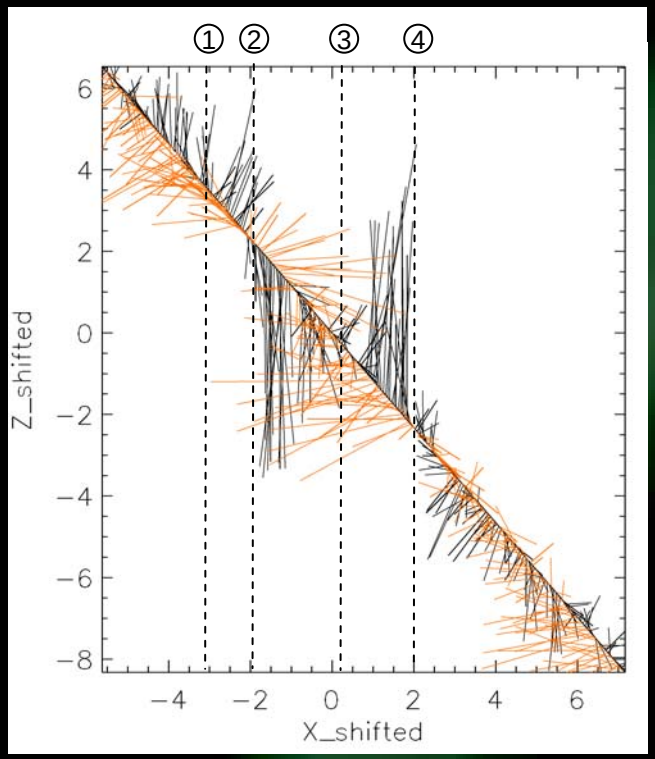
E



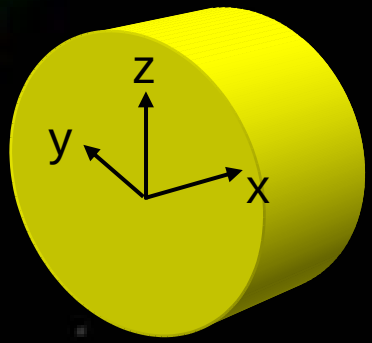


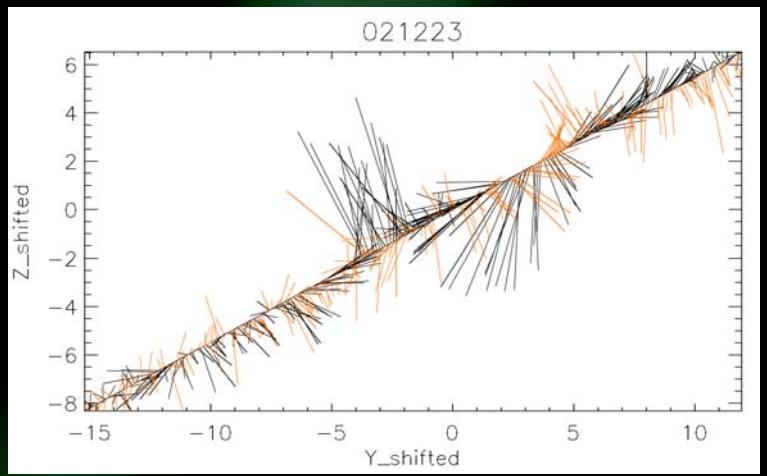


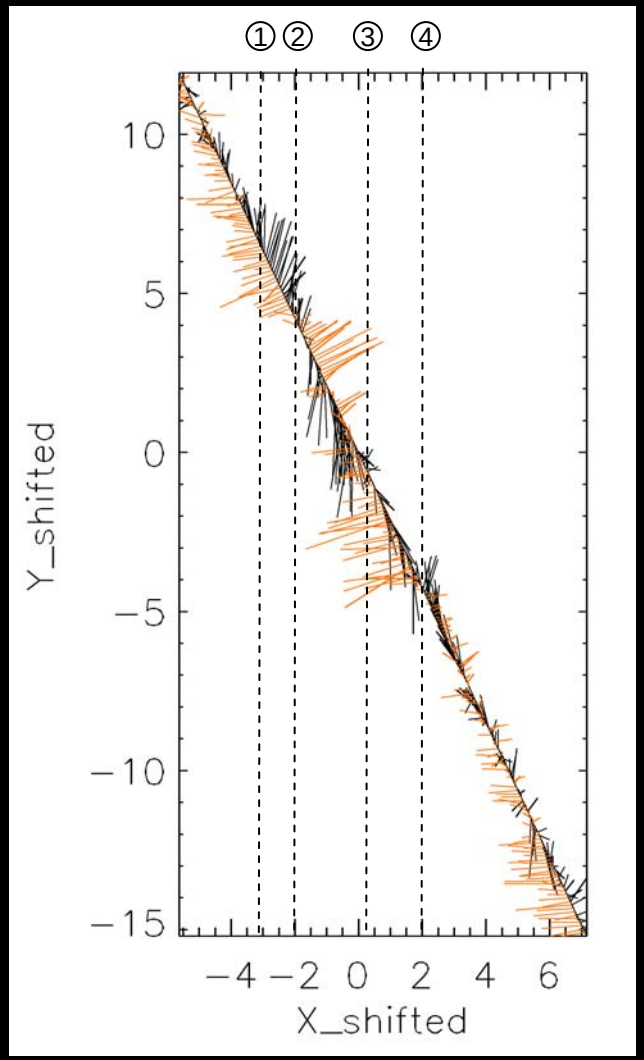
2002-12-23 (36 040 s)



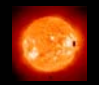
E and B







2002-12-23 (39315 s)

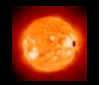


Asdf söldk fälskdf säldk äs

2004-12-30 (59 939 s)

Asdf söldk fälskdf säldk äs

2002-12-23 (39315 s)



Asdf söldk fälskdf säldk äs

XKXLXKJ

Asdf söldk fälskdf säldk äs

XKXLXKJ

Asdf söldk fälskdf säldk äs

Conclusions

- Fghfgh
- Fghfgh
- hfgh

Thank you for your attention!