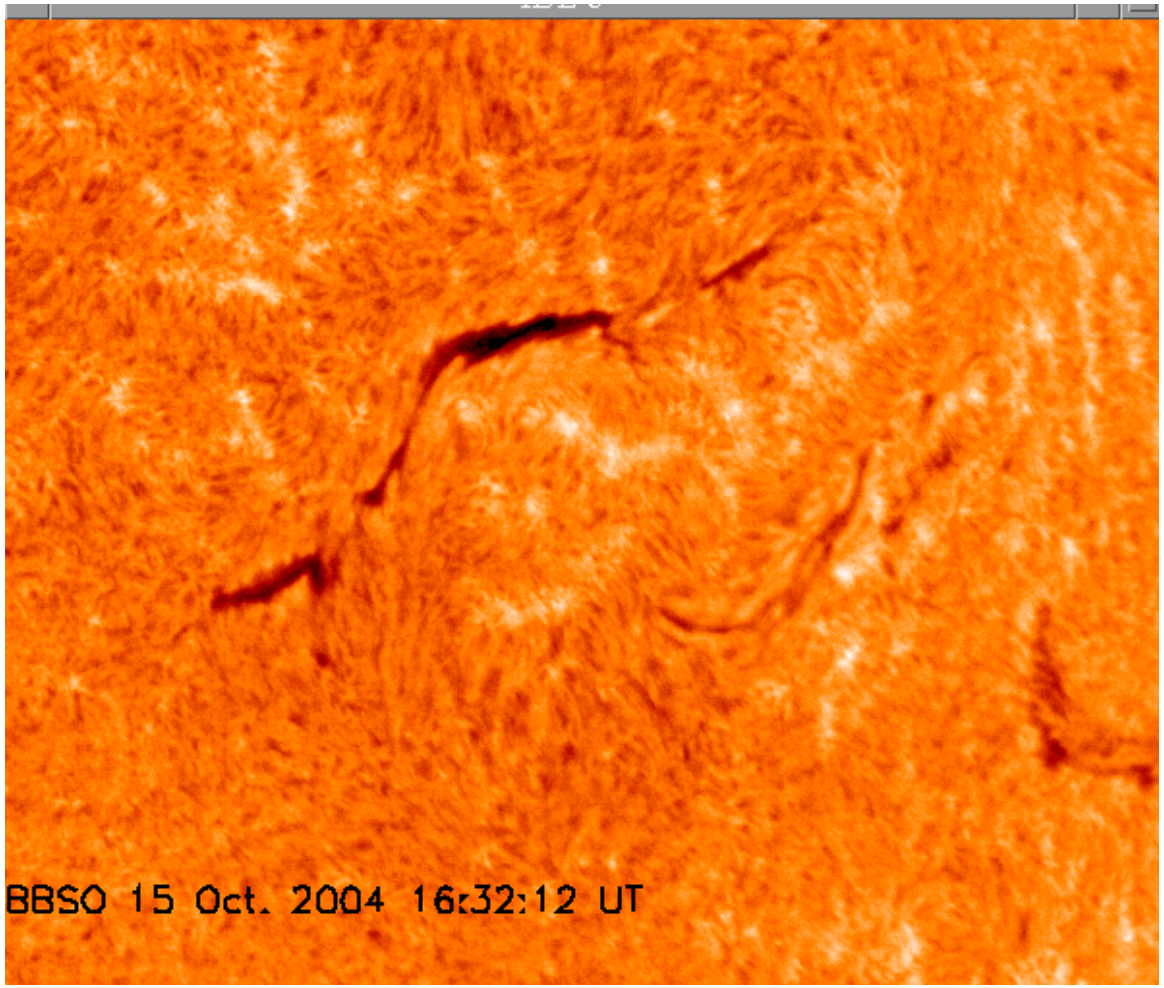
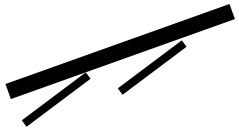
Importance of weak magnetic field polarities in filament channels

JOP 178 Filament
October 15-17 2004



B.Schmieder

Avec la participation de
P.Mein, A. Lopez, T.Roudier,
A.Sainz, V.Bommier, G.Aulanier
F.Auchere et l'équipe
de THEMIS et du DOT



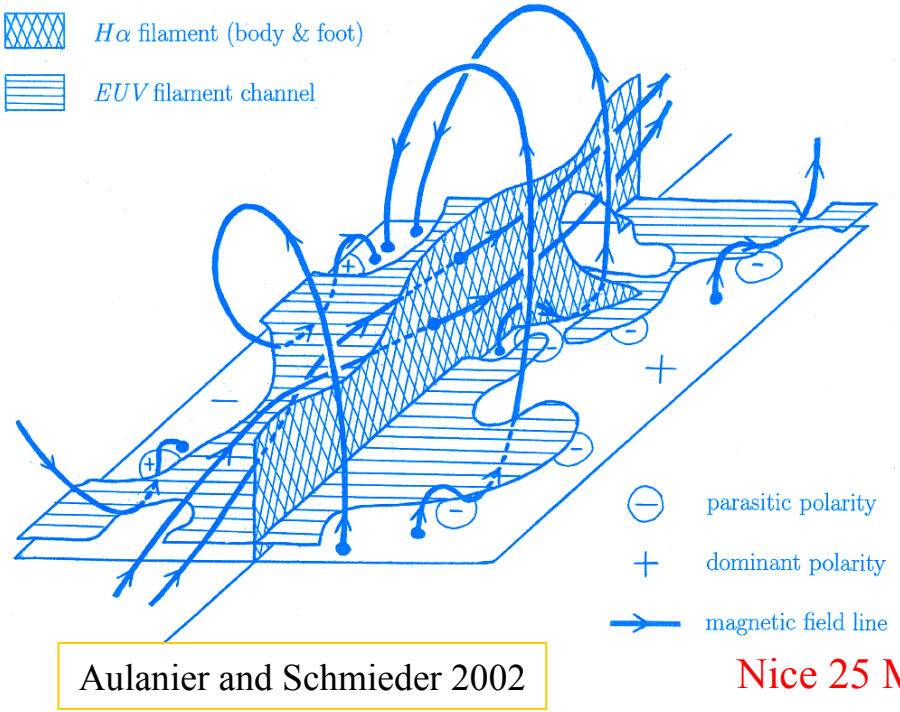
sinistral

Nice 25 Mai 2005

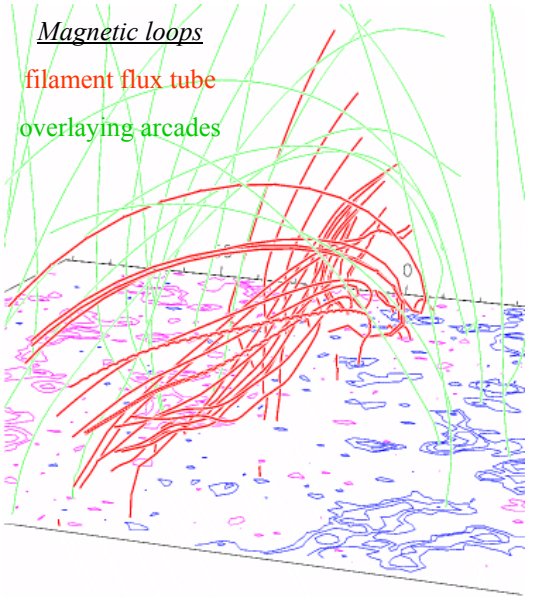
Model 1: Magnetic topology of filament channels

Filament body :
magnetic dips in weakly twisted (0.6 turns) and discontinuous flux tube

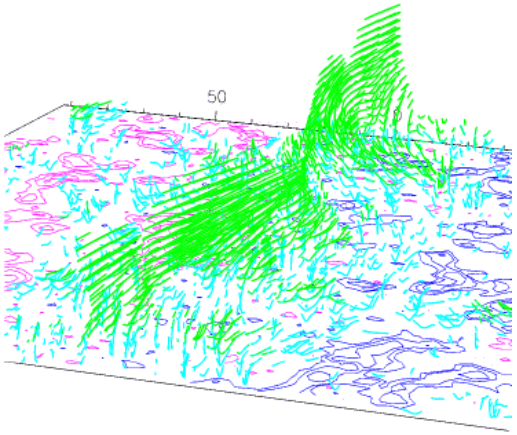
Hα & EUV extensions :
low-lying dips due to parasitic polarities located near the footpoints of some long overlaying sheared loops



Aulanier and Schmieder 2002



Magnetic dips
z > 4 Mm
z < 4 Mm



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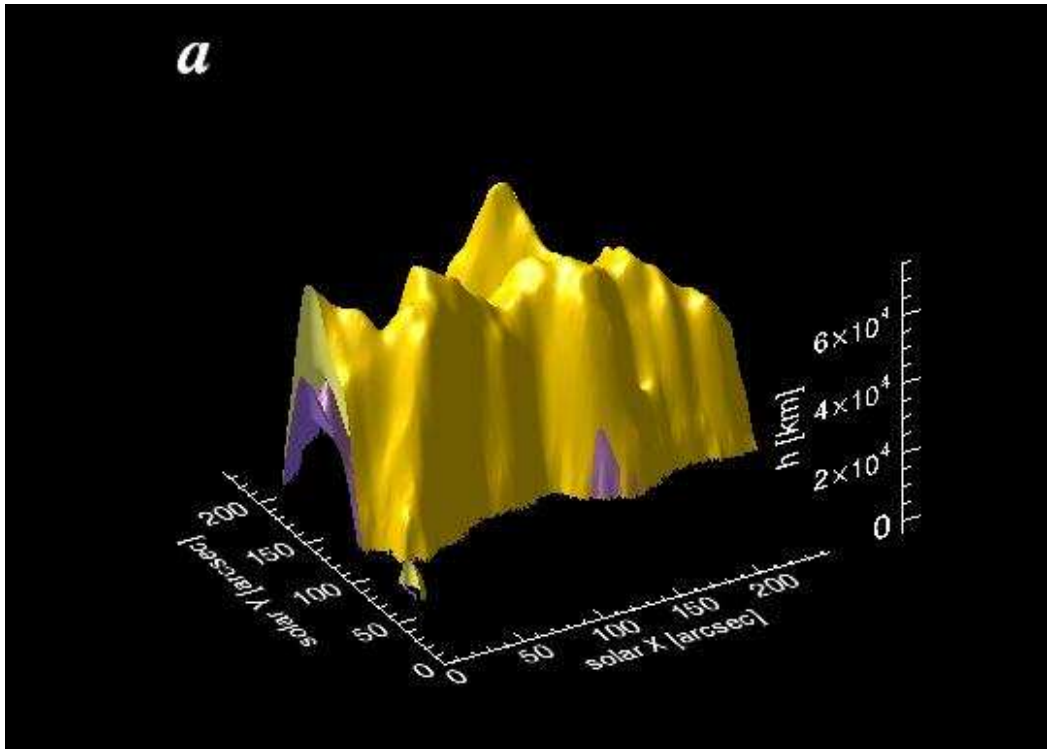
Model 2: Spectroscopic model



3D EUV filament

Filament is visible in EUV line because of the absorption of the line by the hydrogen continuum at the same wavelength

⟶ needs to be at a high enough altitude.

With a spectroscopic model (Heinzel et al 2003, Schwartz et al. 2004)

To resolve this problem of EUV channel

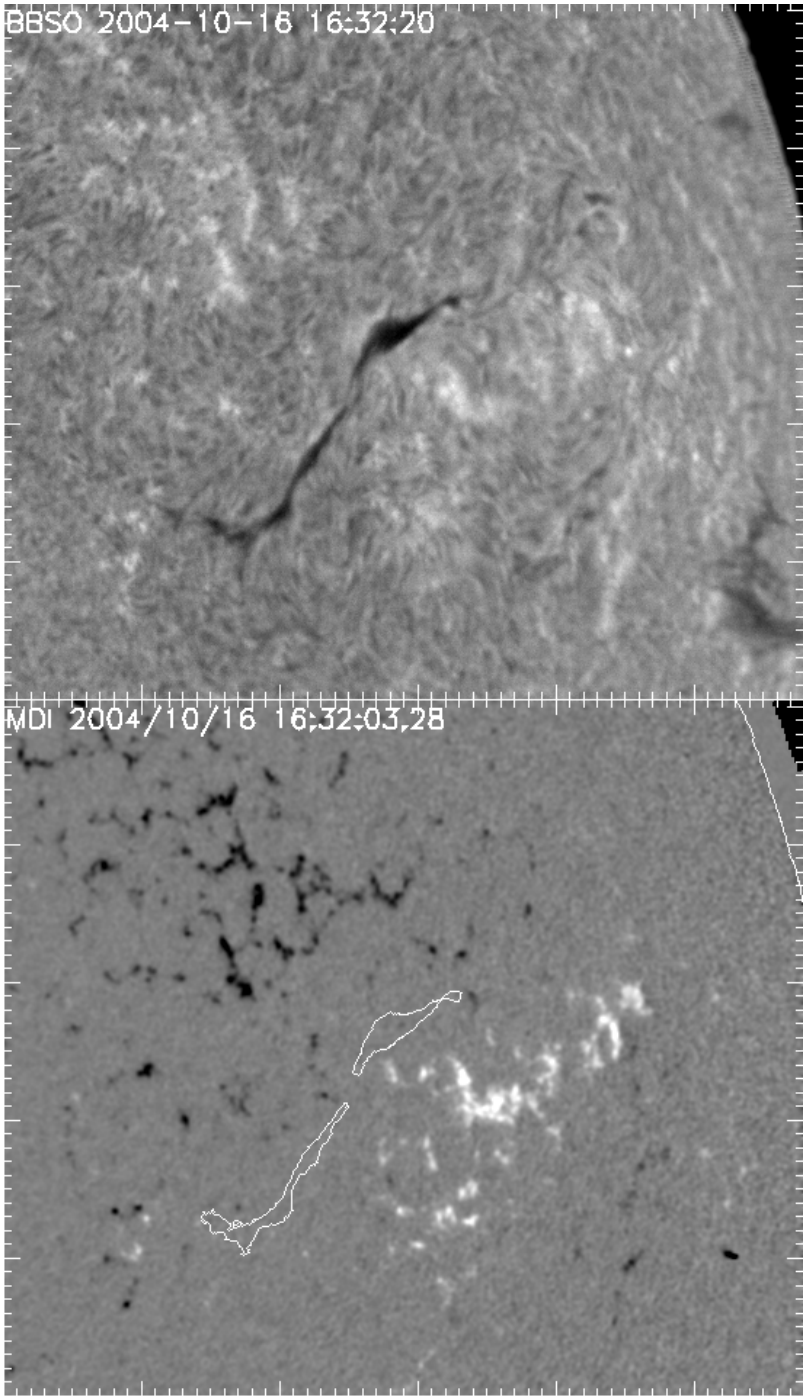
Campaign of multi wavelength observations:
THEMIS, MTR and MSDP
SOHO : CDS lines at 10^4 to 10^6 K
TRACE: 171 A (10^6 K)
EIT 304 (10^5 K)

Study of the disparition brusque and formation

The EUV filament channel is not well visible in some part

The filament threads are observed at 10^5 K and 10^6 K

Weak polarities in the filament channel are responsible of the changes



16 October 2004

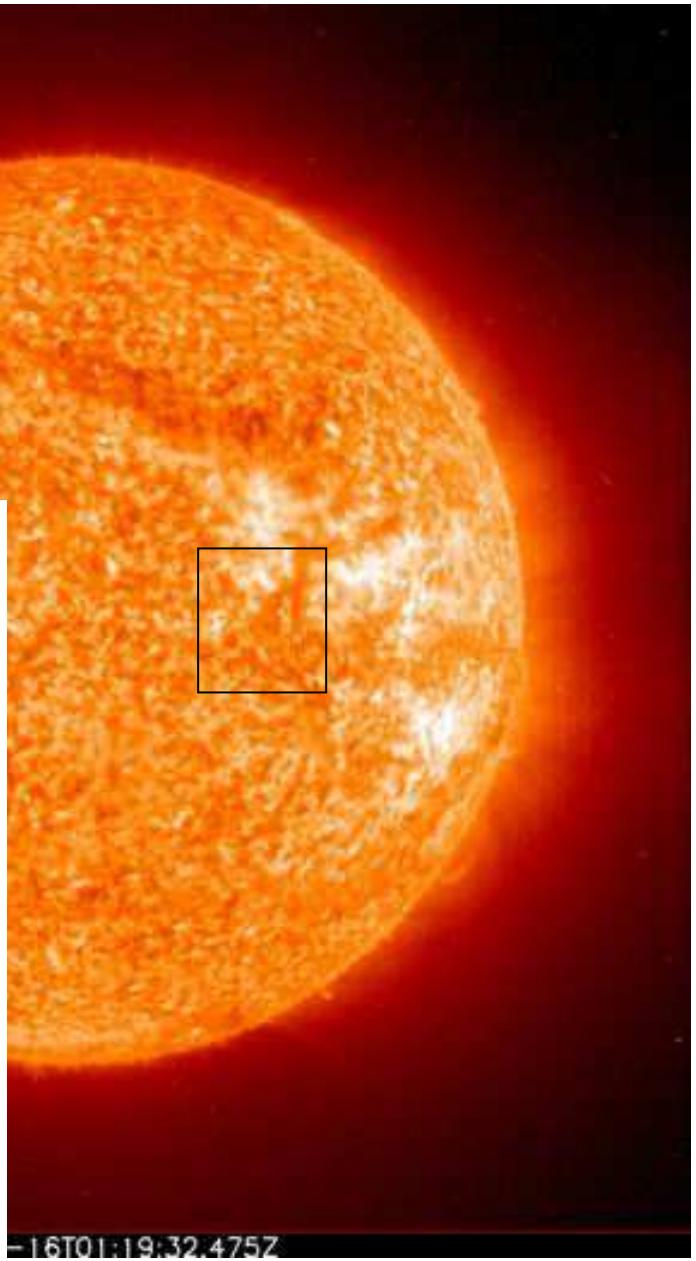
BBSO

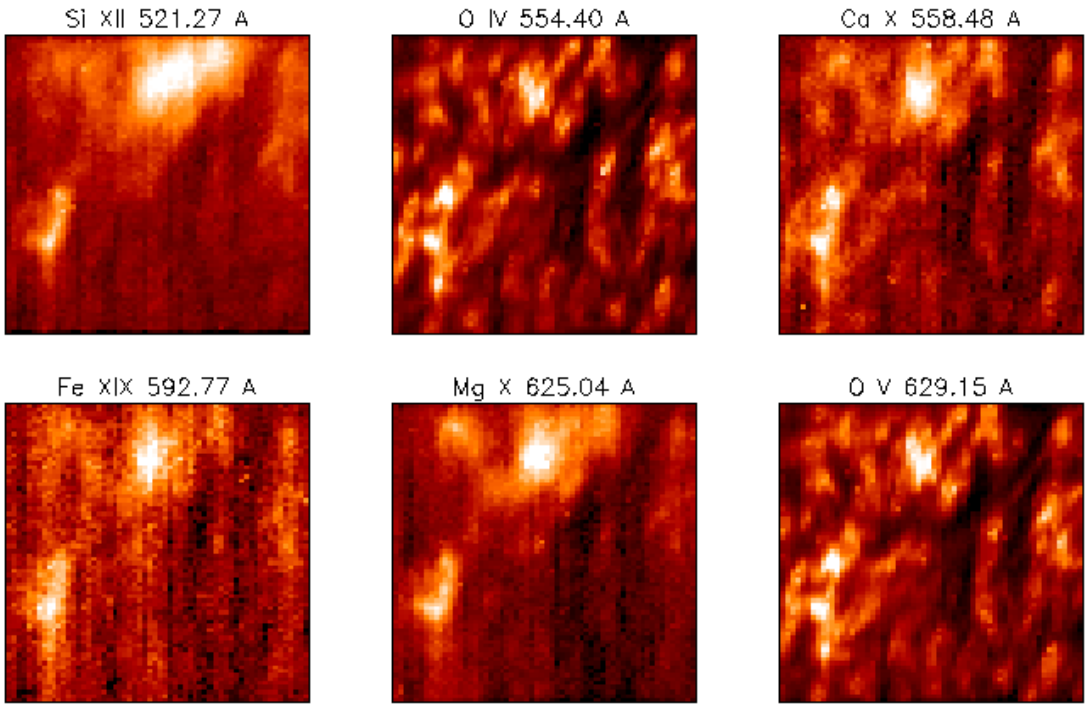
In the North hemisphere
Sinistral filament (does not follow the hemisphere rule)

MDI

EIT

CDS

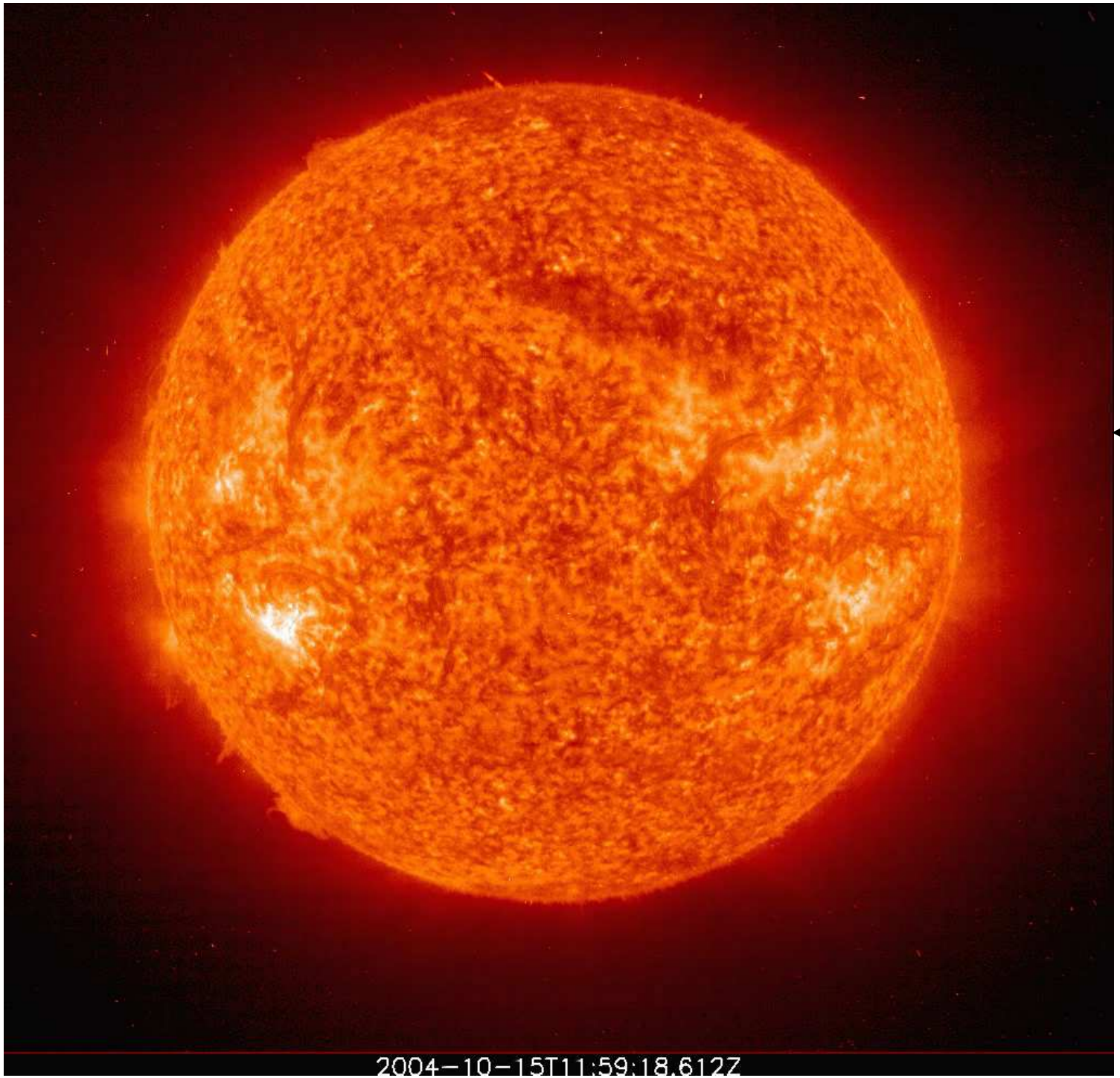




SOHO/CDS NIS Raster, 16-Oct-2004 14:24:59

ARCONT_1 -- JOP 178 - A Filament and its Environment -- s31276r10.fits

Center = (525",2"), Size = 244"x240"



EIT 304 A

15 Oct

16 Oct

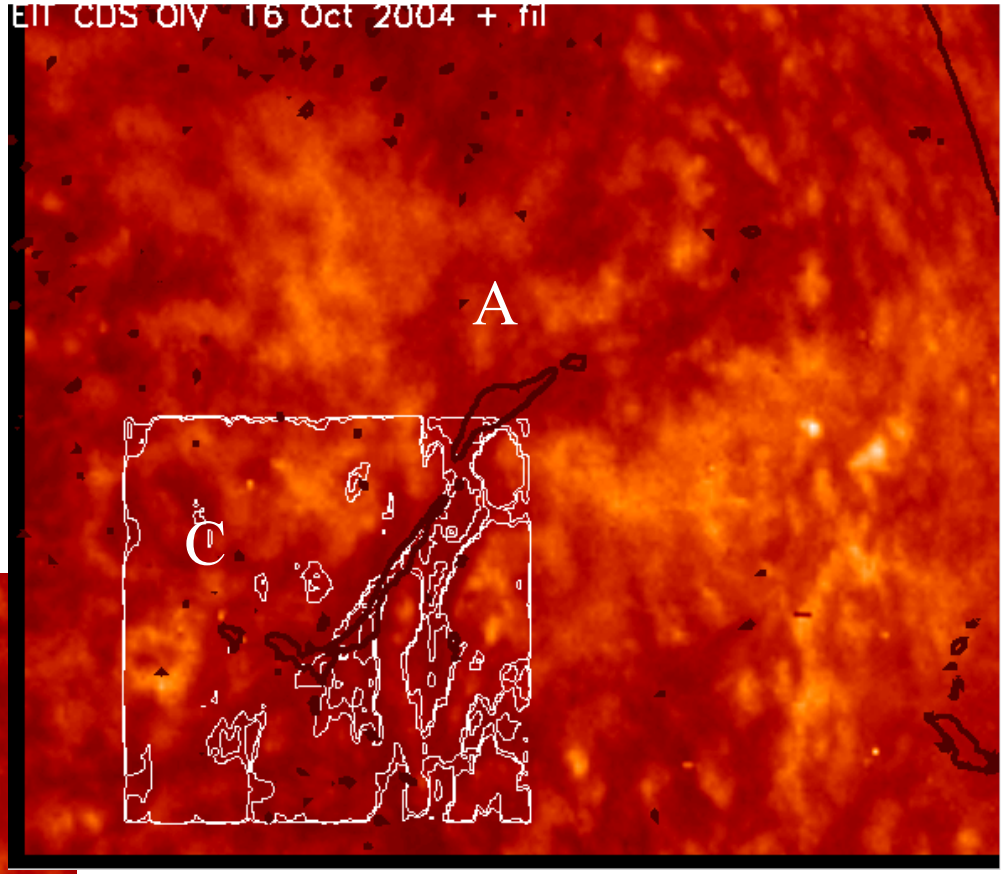
(gap)

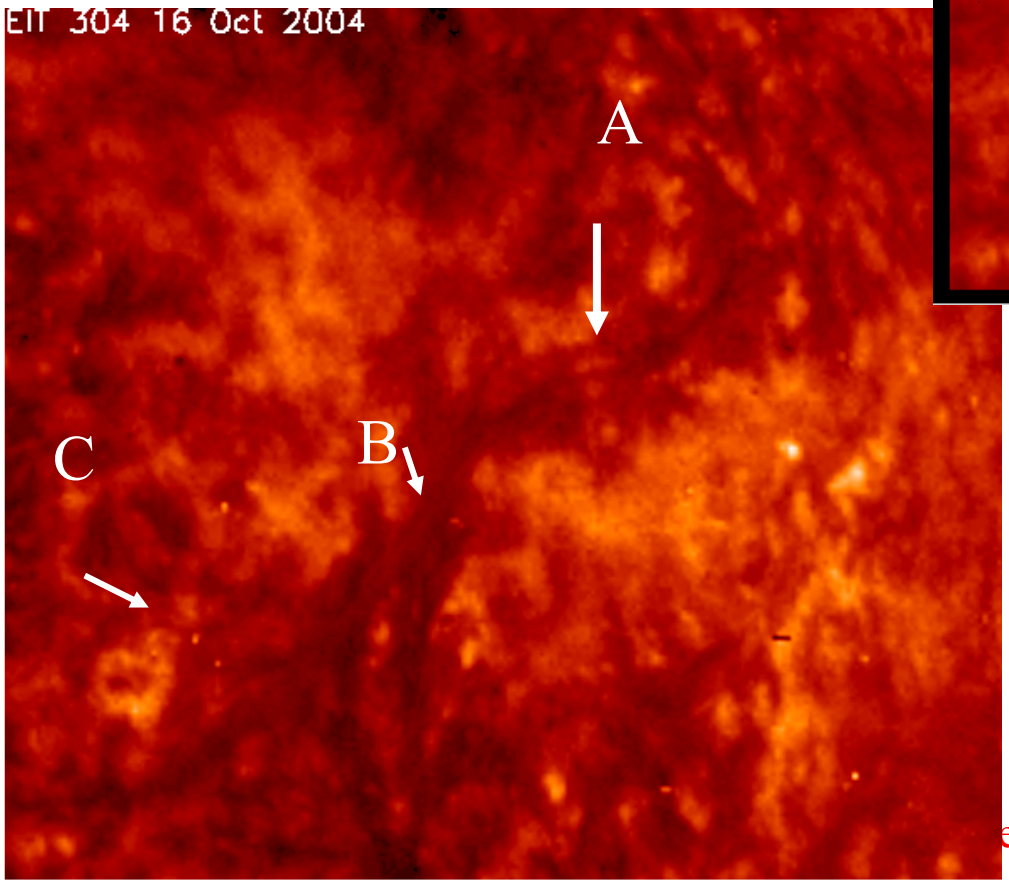
filament

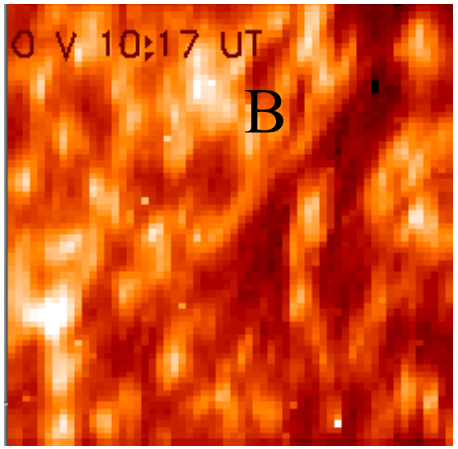
EUV filament

Dark, bright threads
or no existing

Emission in hot lines





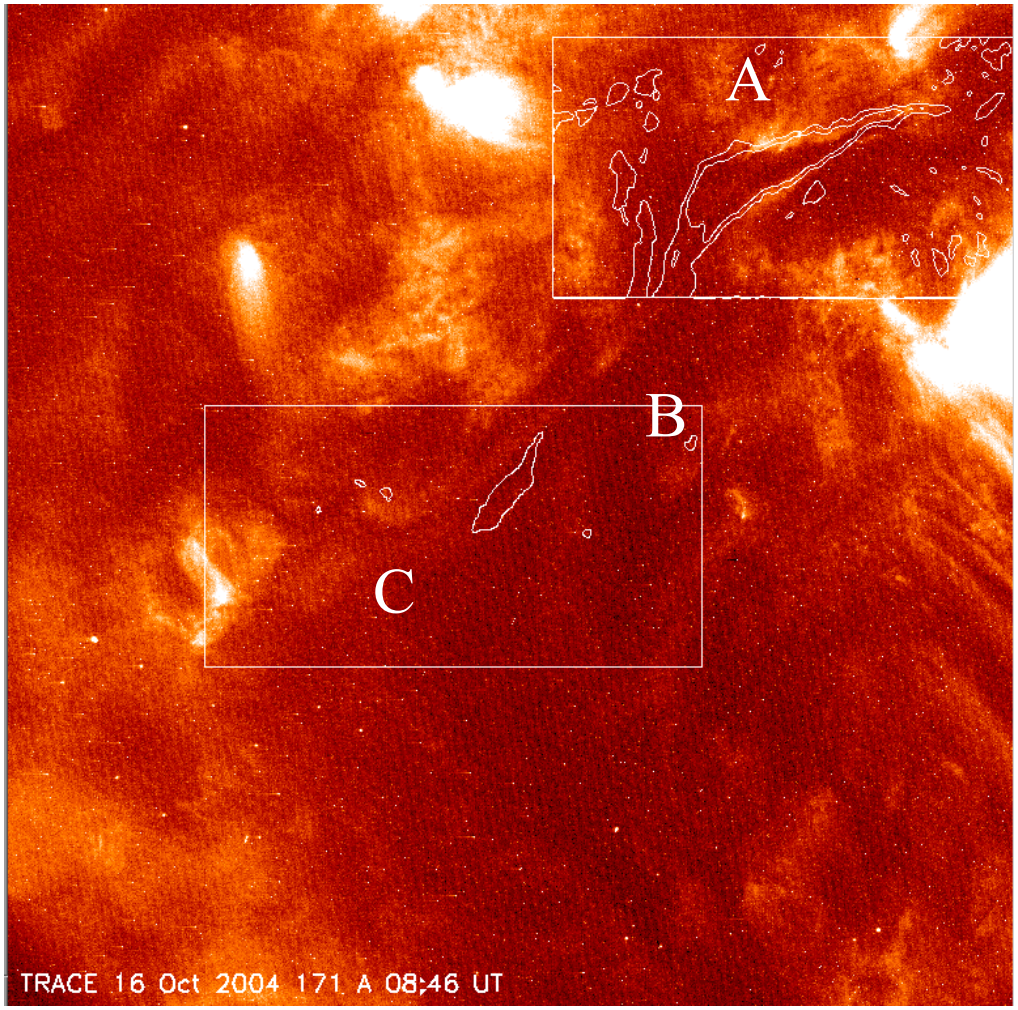


OV 10^5 K

Long
extensions

e 25 Mai 2005

TRACE 171 A – 10^6 degree



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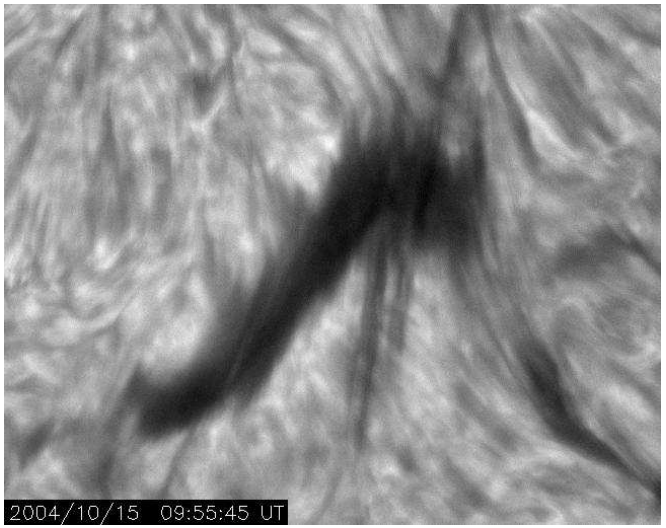
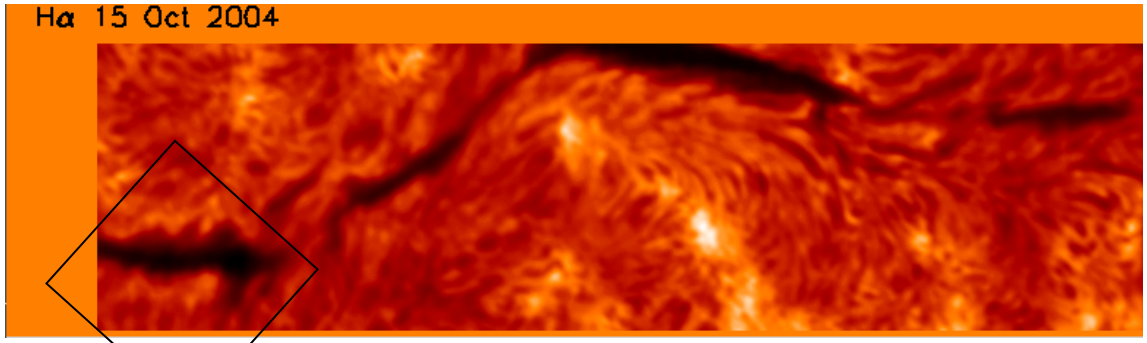
Evolution of the filament

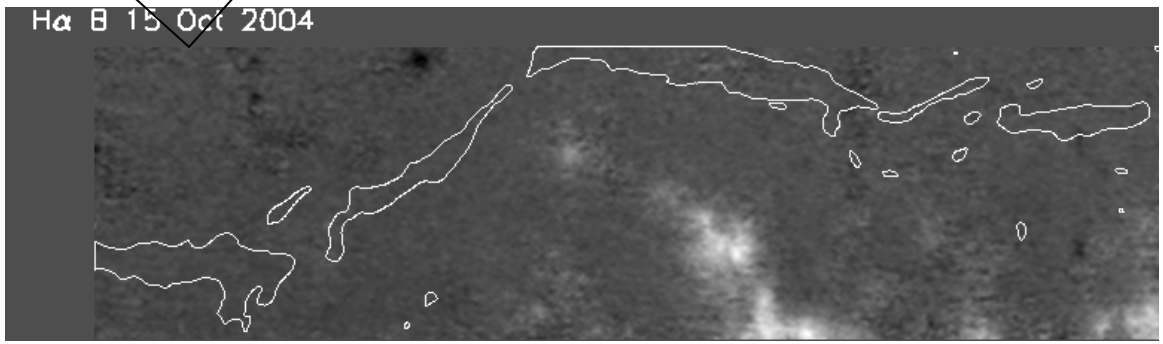
15 October 2004

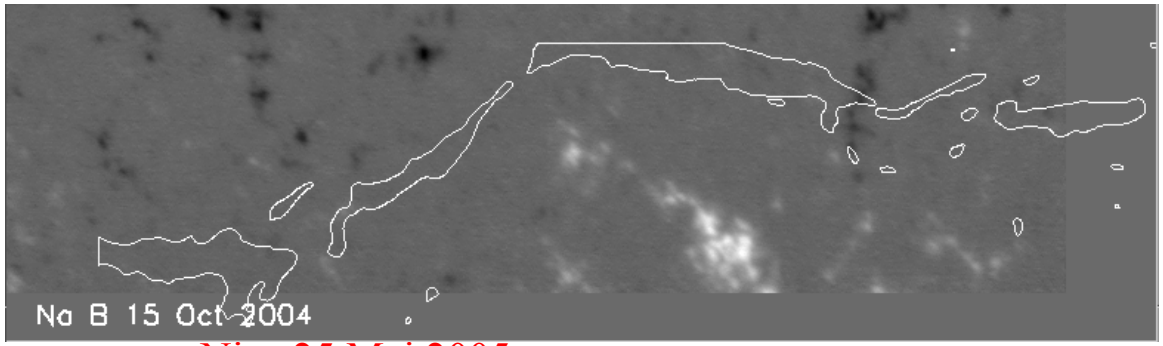
DOT

THEMIS/MSDP









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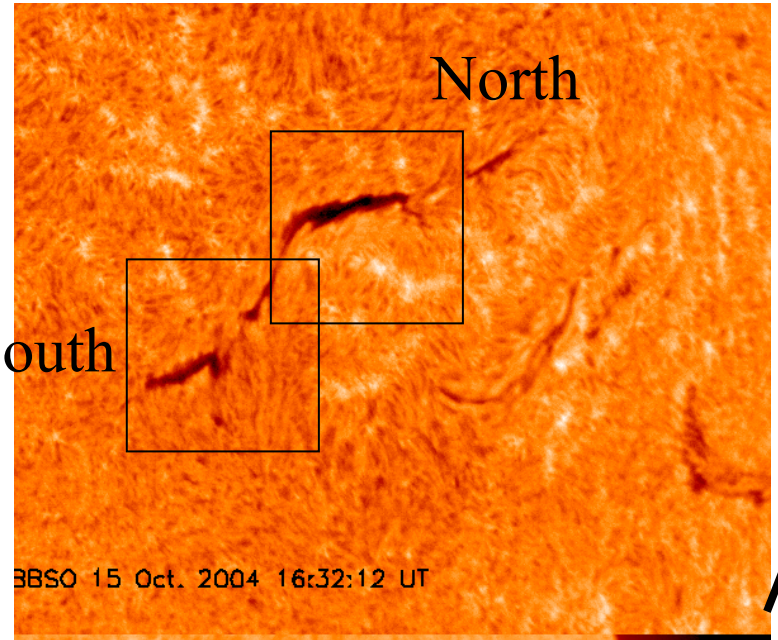
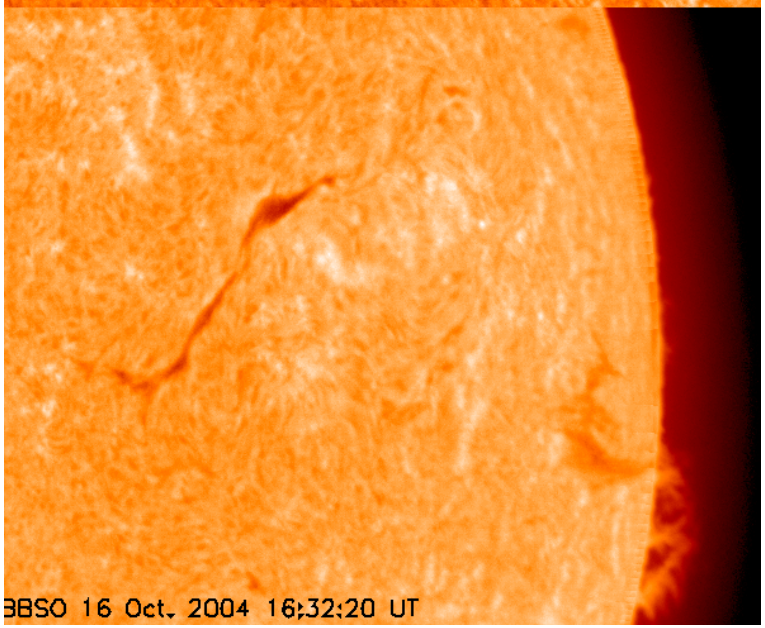
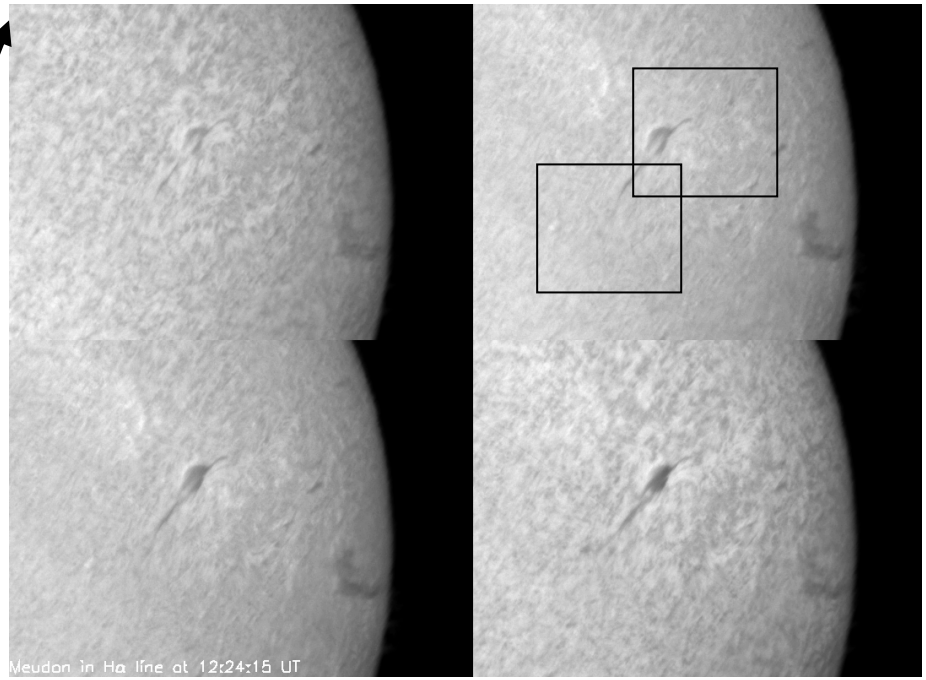


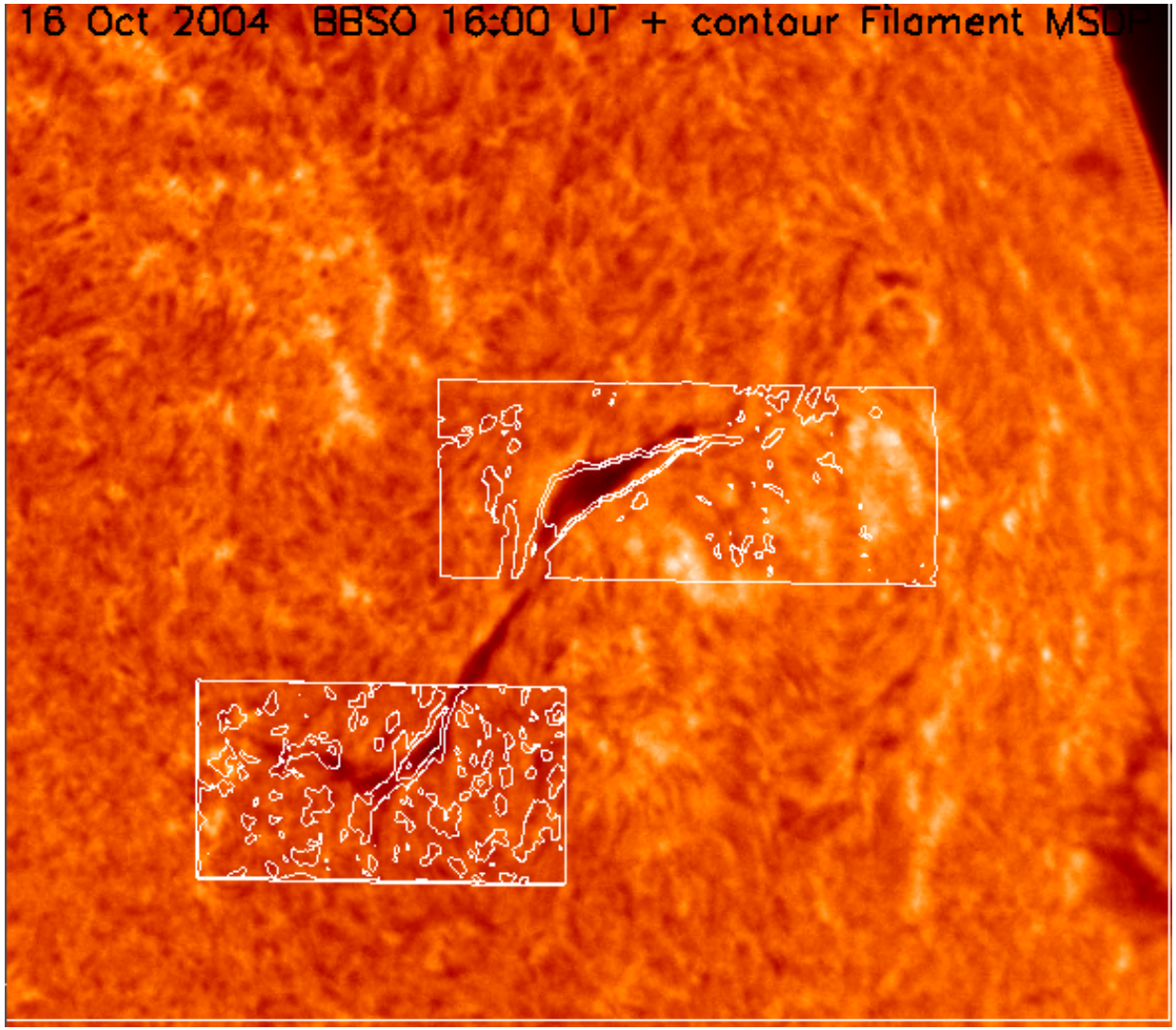


Eruption of the filament
16 October 2004



Meudon 16 Oct 12:24 UT

Observations of two sections by THEMIS



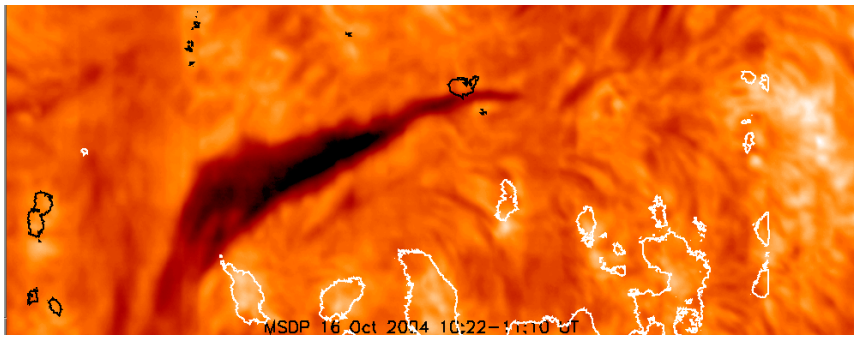
North

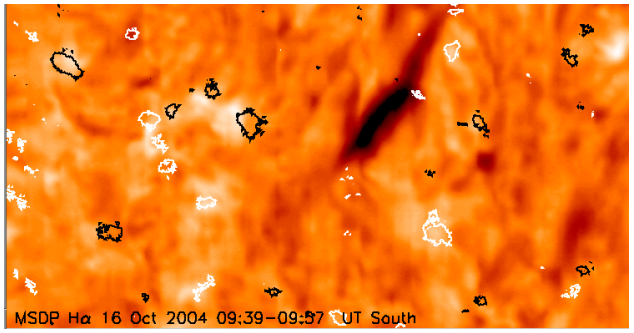
South

THEMIS MSDP 16 October 2004

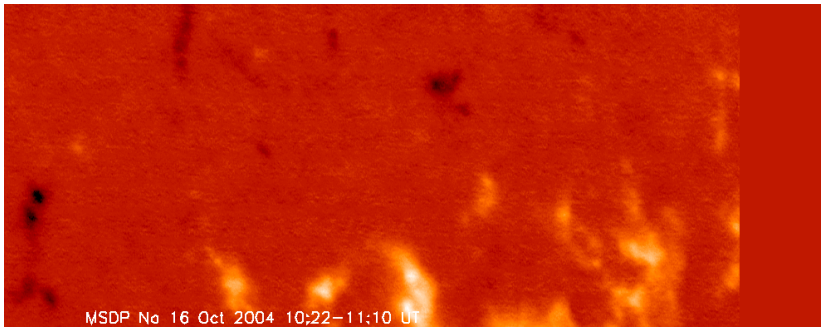
north

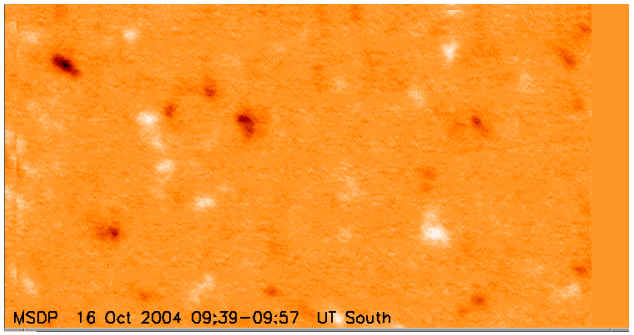
south



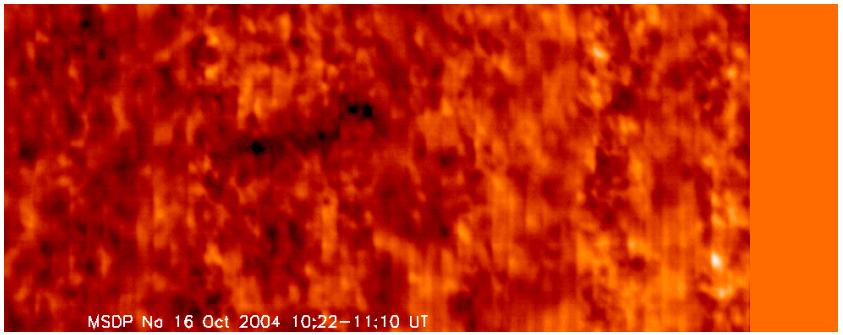


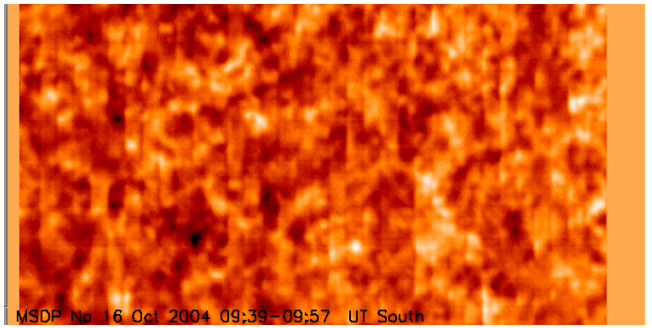
Hα





Na B





Na I

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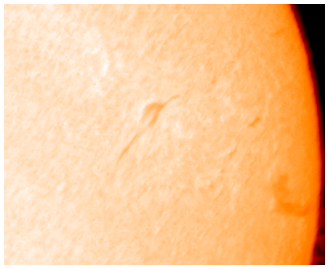
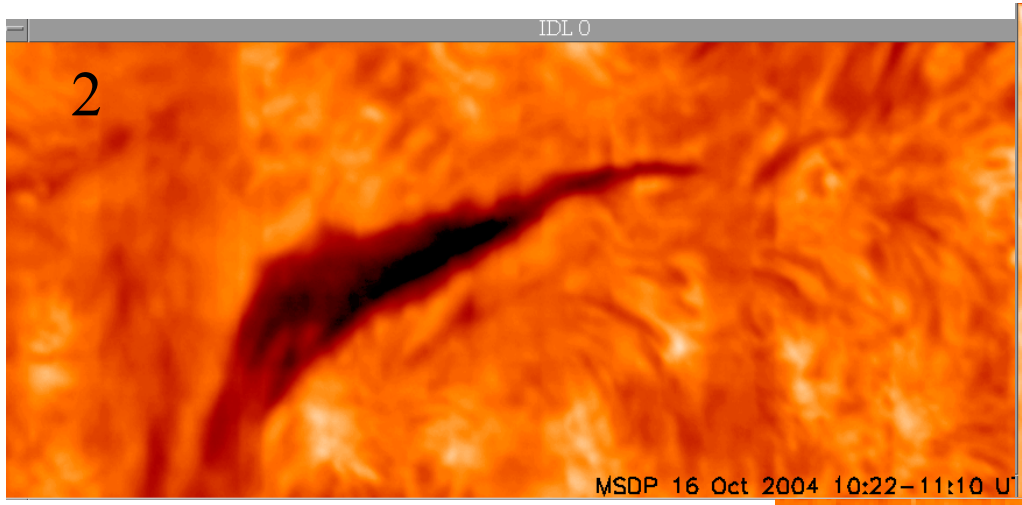
Filament changes during October 16 2004

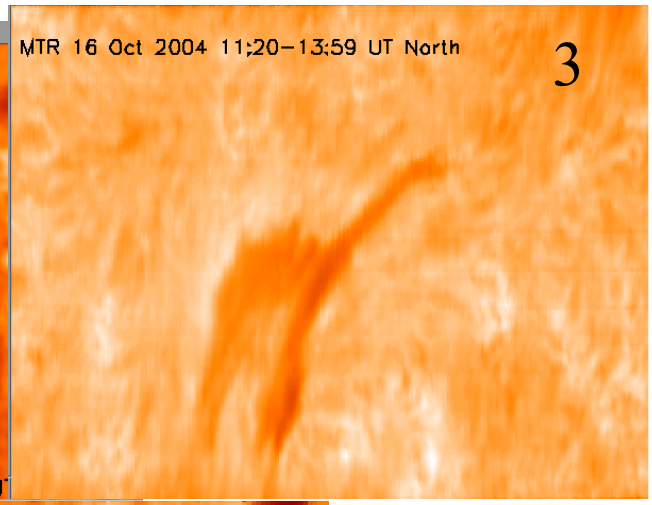
First the South (1): 09:30 and 12:20 UT

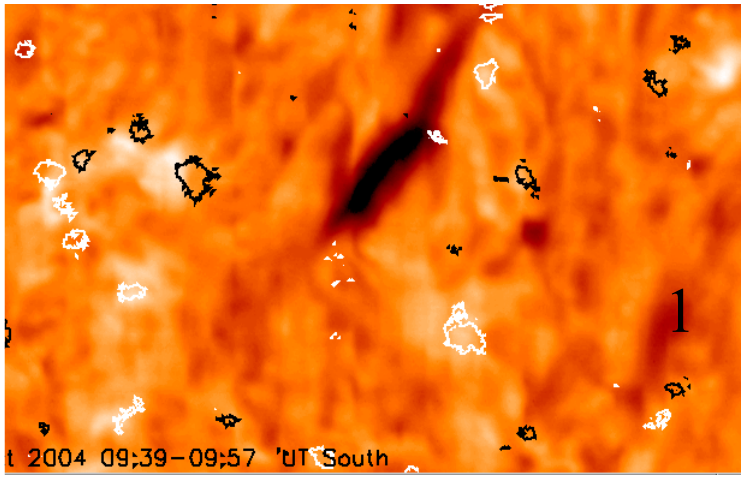
Second the North (3): 11:20 and 12:20 UT



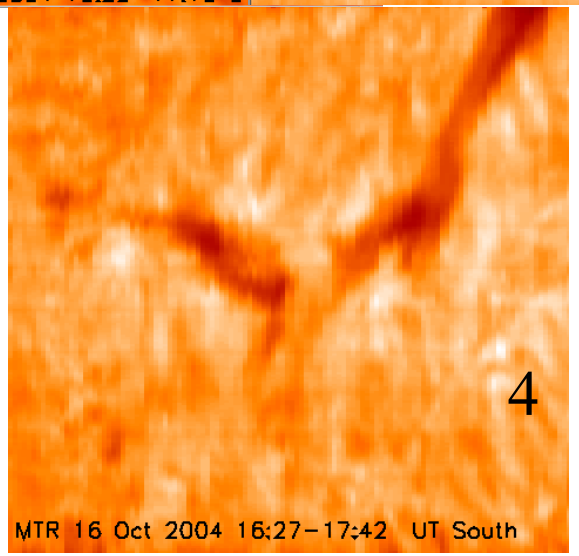
North







South

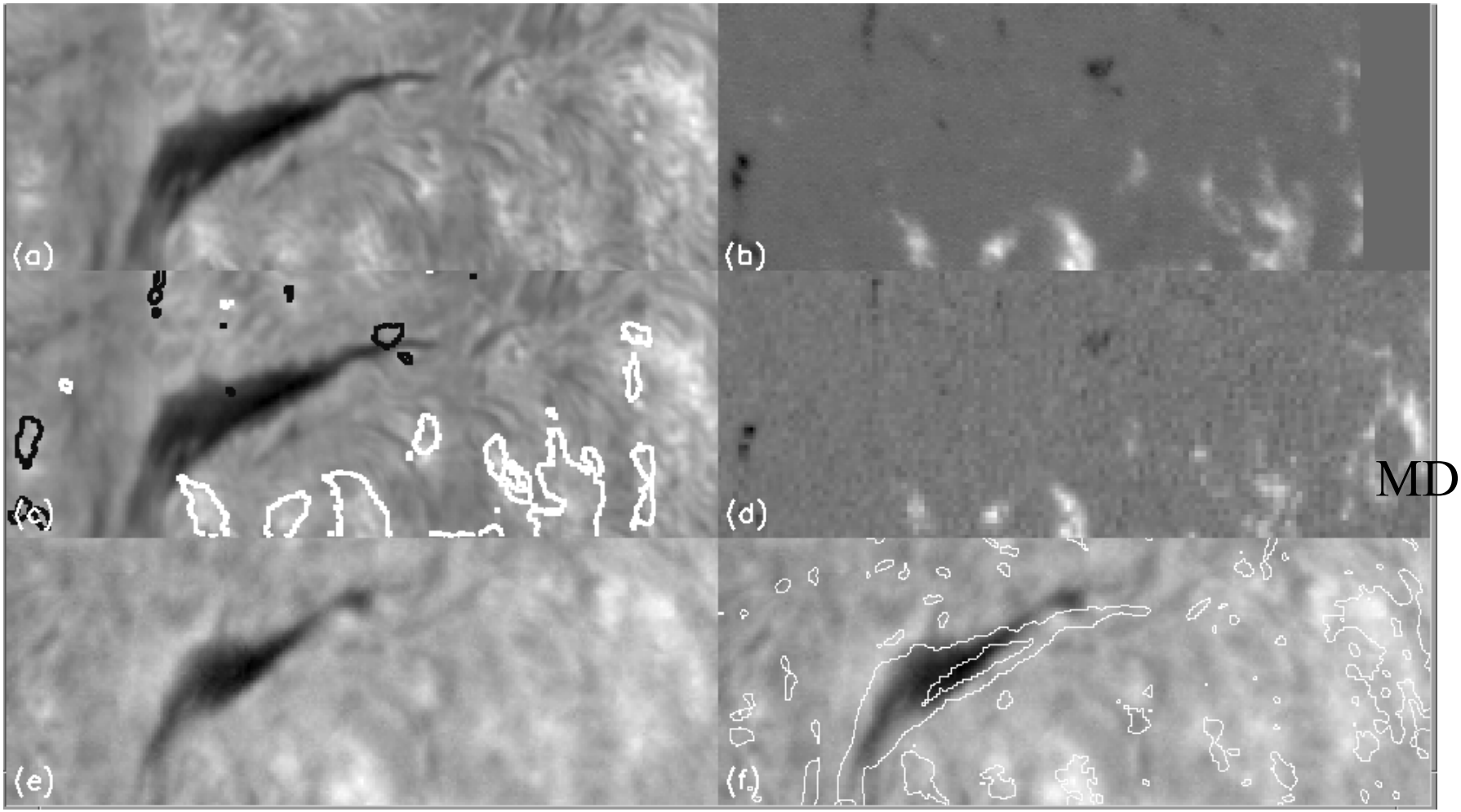


Nice 25 Mai 2005

North

MSDP 10:03-10:22 UT

Na 10:22-11:11 UT



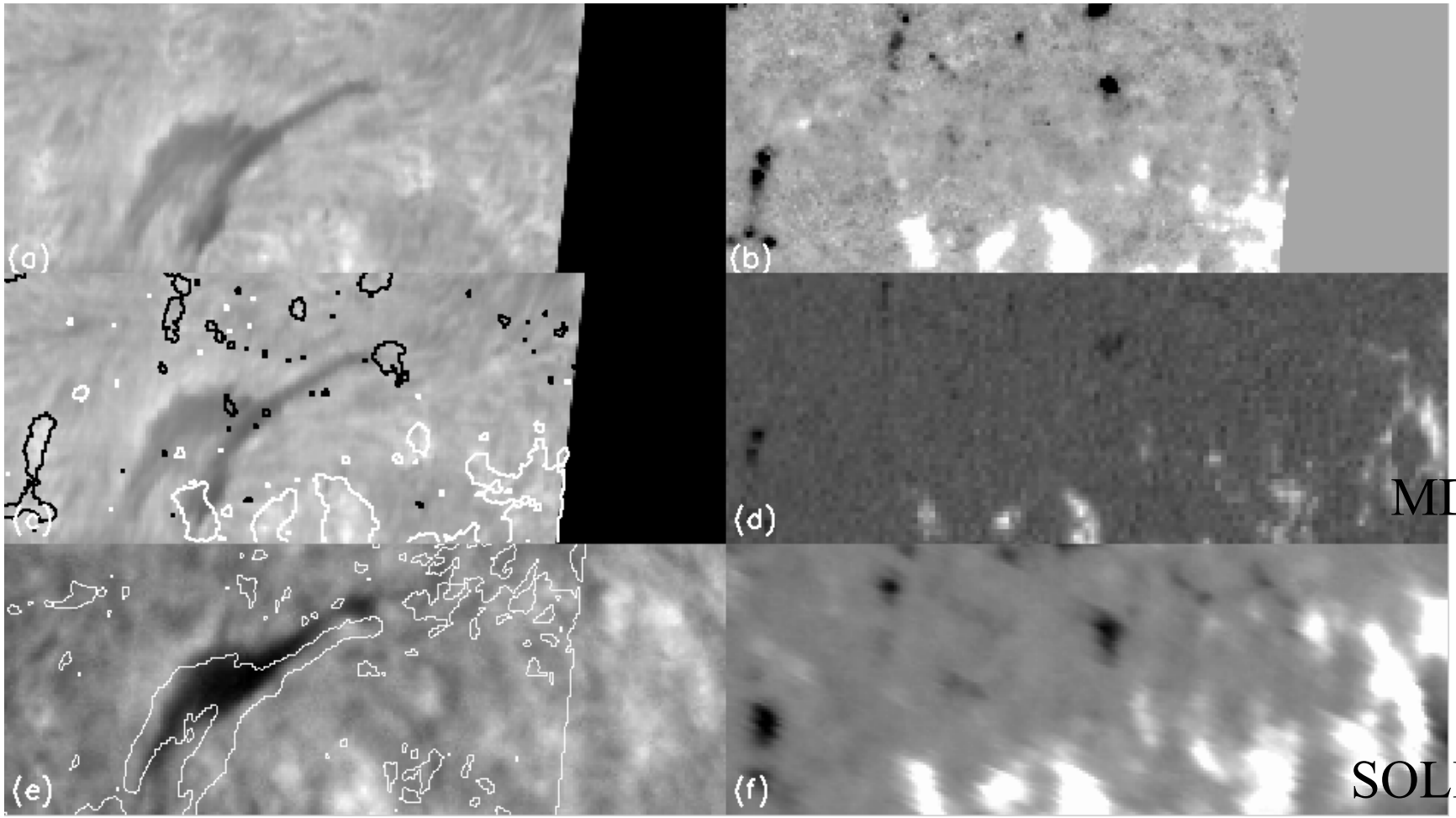
MDI

BBSO 16:00 UT

Nice 25 Mai 2005

North

MTR 14:38- 16:11 UT



MDI

SOLIS

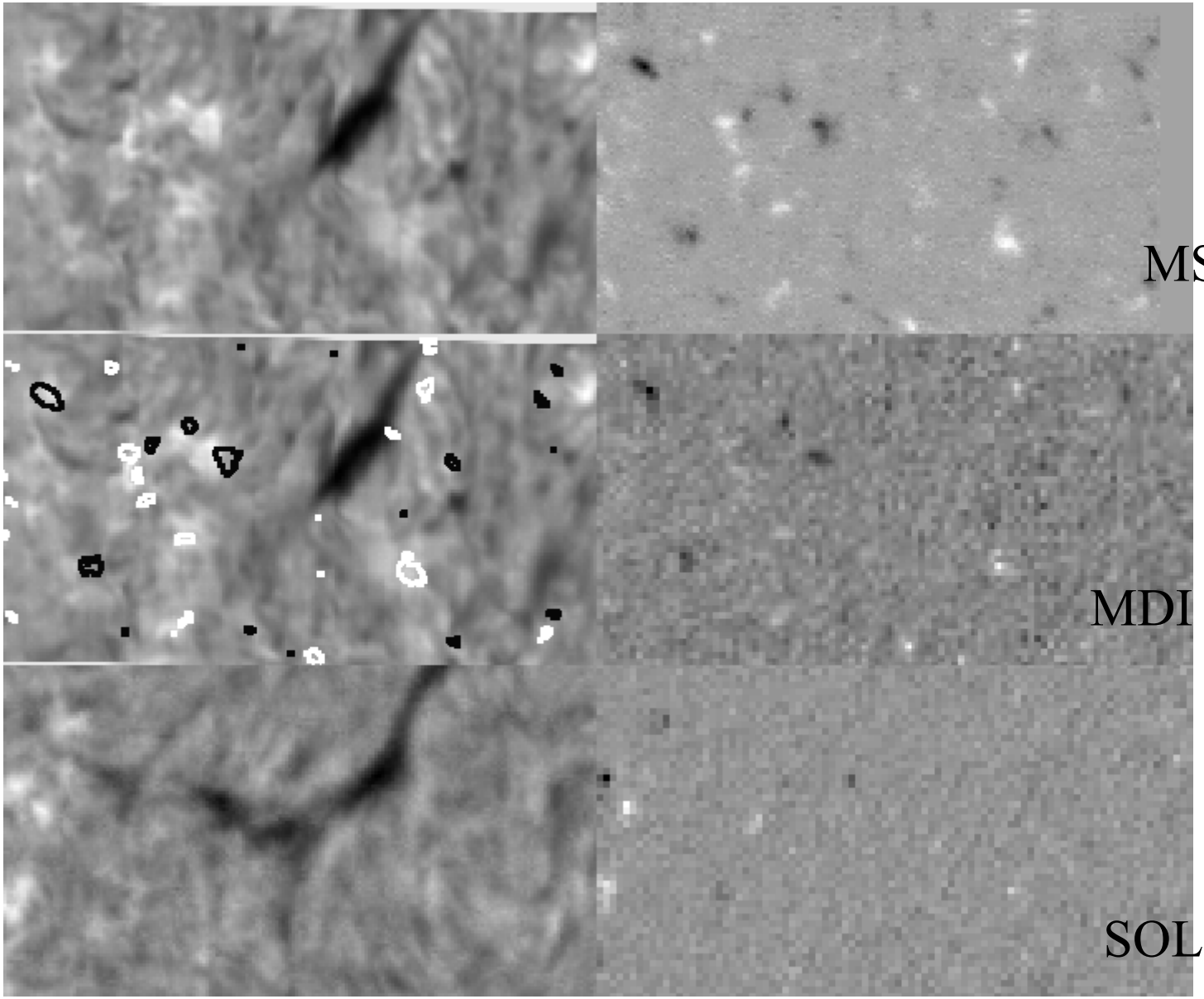
BBSO 16:00 UT

Nice 25 Mai 2005

South

MSDP 08:23-08:34 UT

Na 08:48-09:07 UT

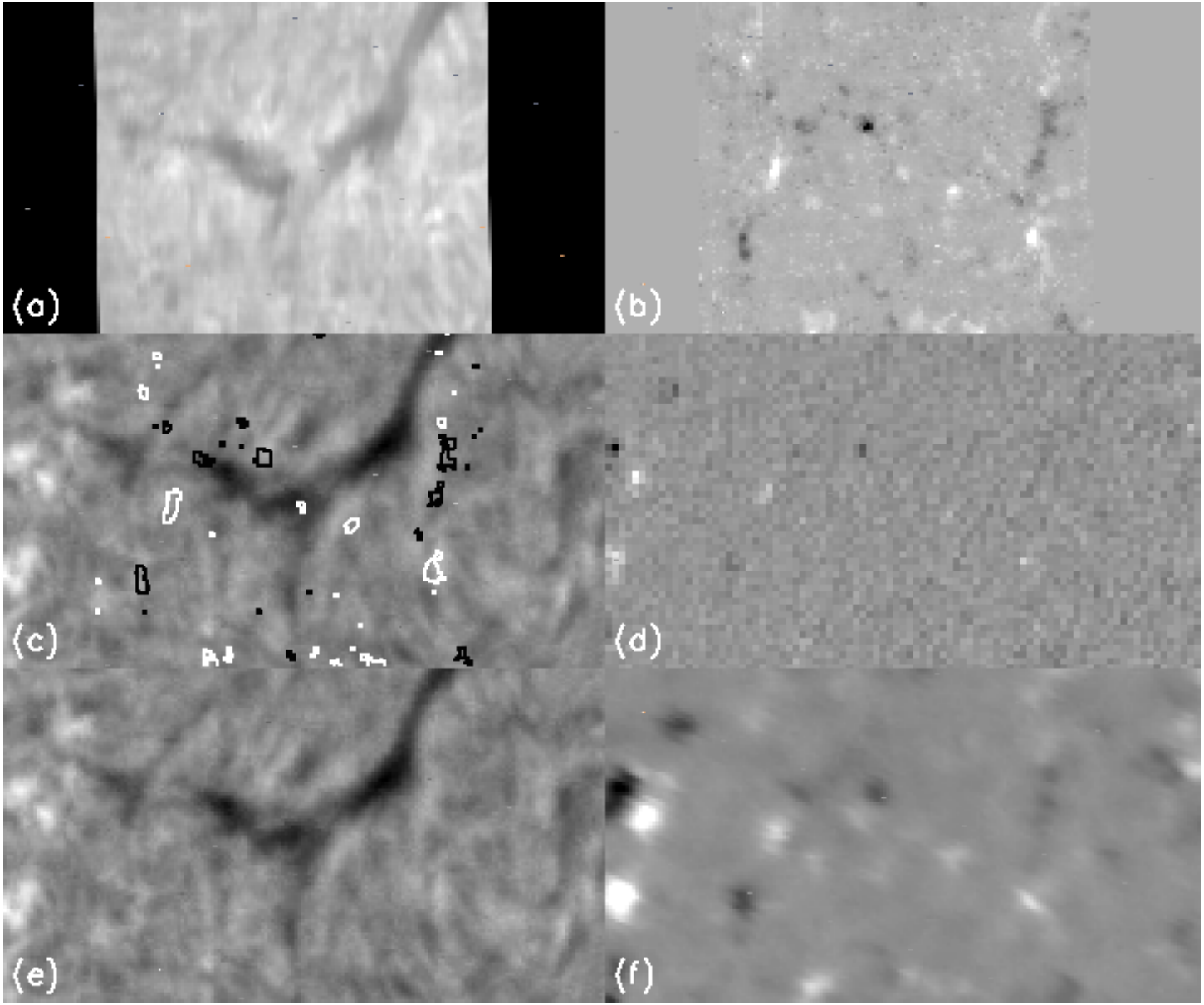


BBSO 16:00 UT

Nice 25 Mai 2005

South

MTR 16:27-17:42 UT



MTR Fe

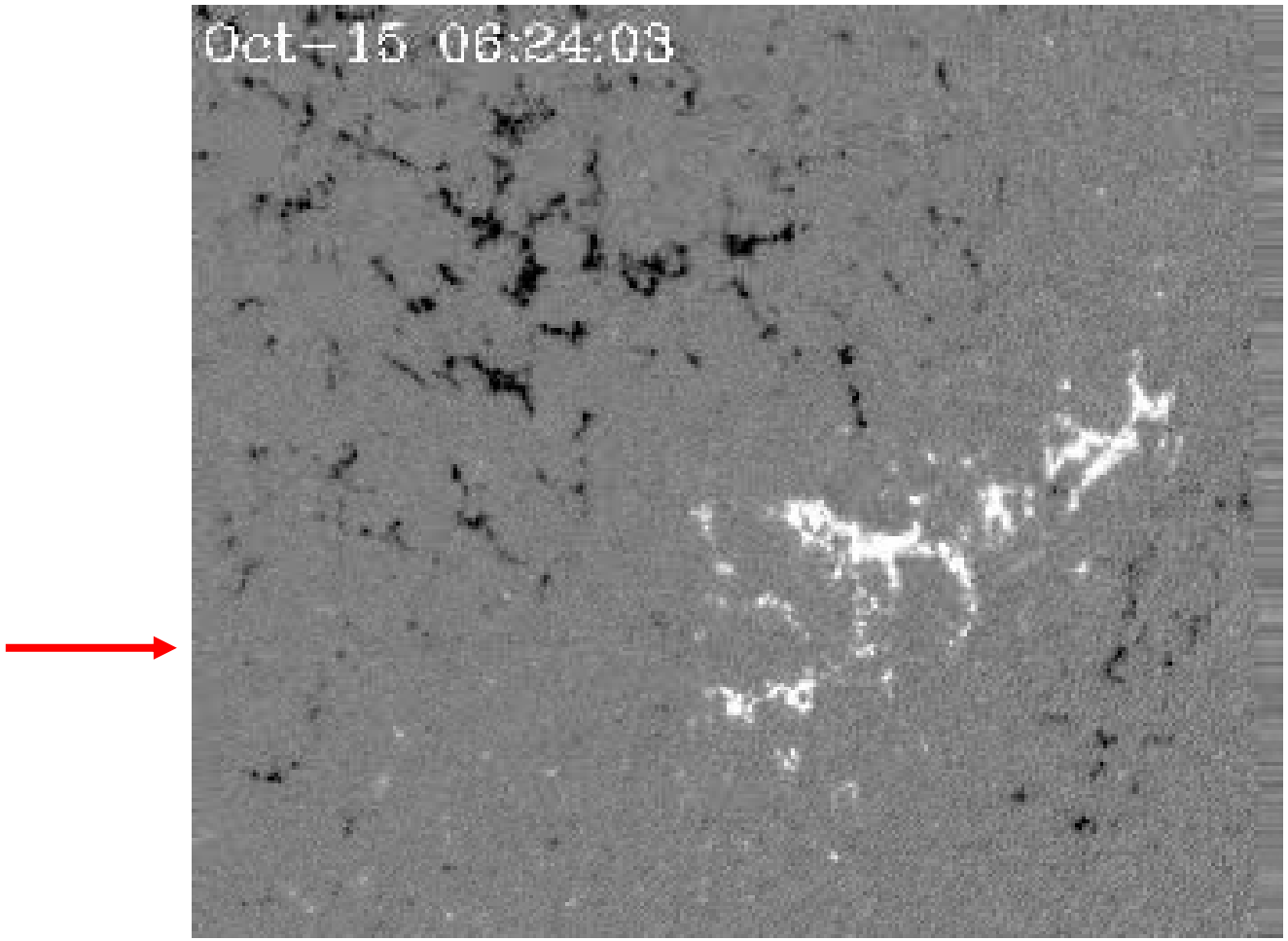
MDI Ni

SOLIS

BBSO 16:00 UT

Nice 25 Mai 2005

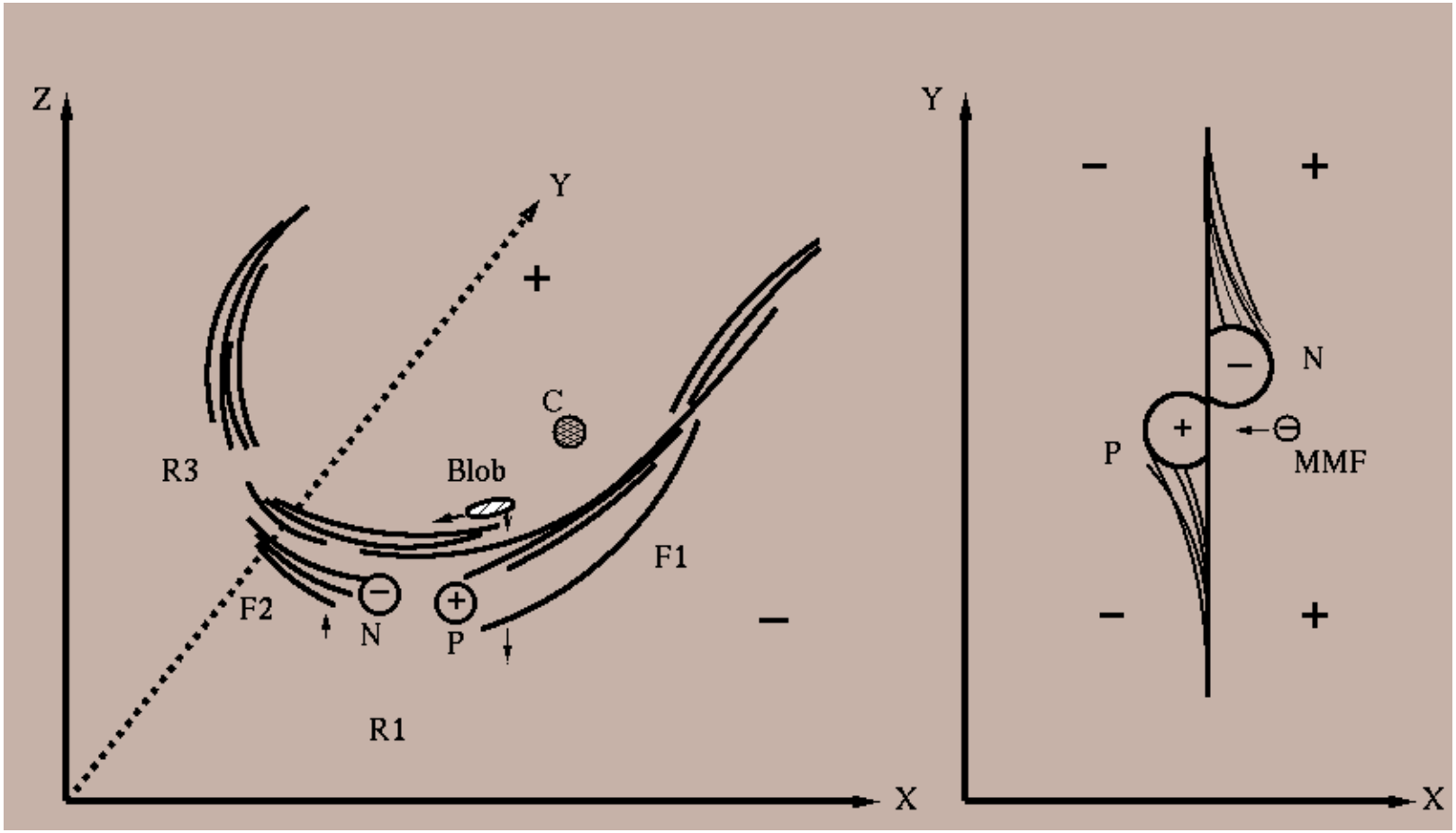
MDI movie



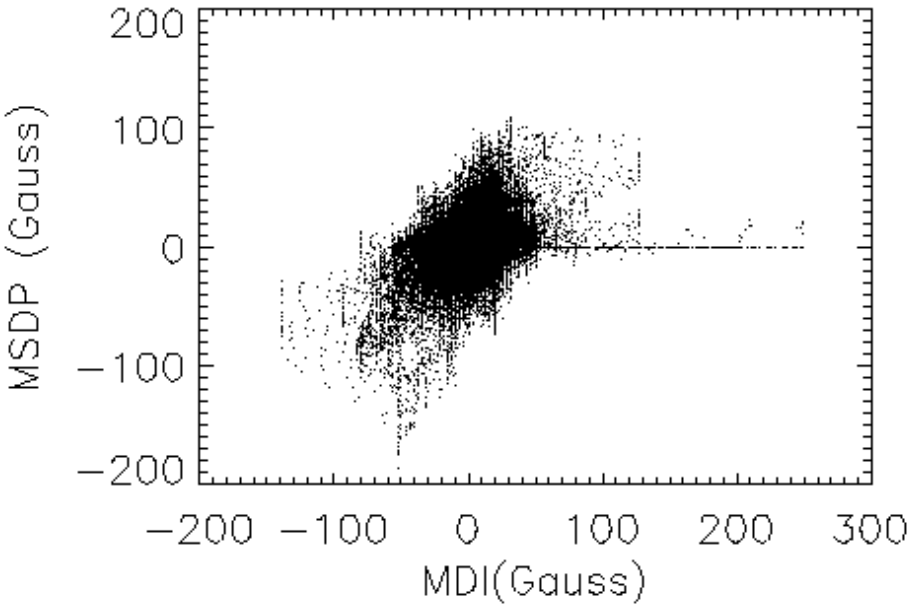
MDI 15 and 16 Oct : 1 min

Nice 25 Mai 2005

Sketch of the observations: footpoints



The filament as a vertical sheet with horizontal threads 2 faced on polarities

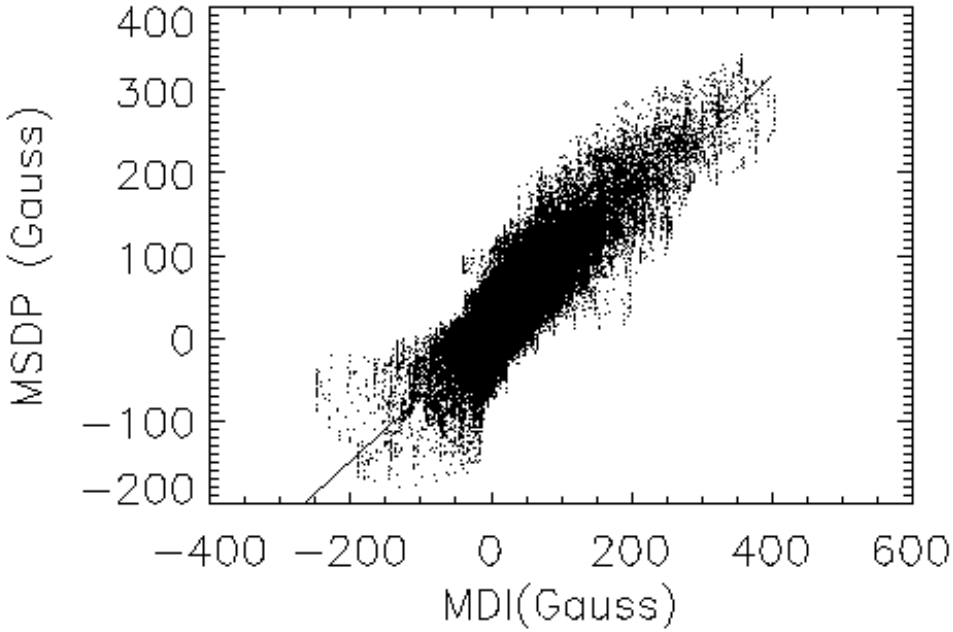


Calibration of THEMIS/MSDP

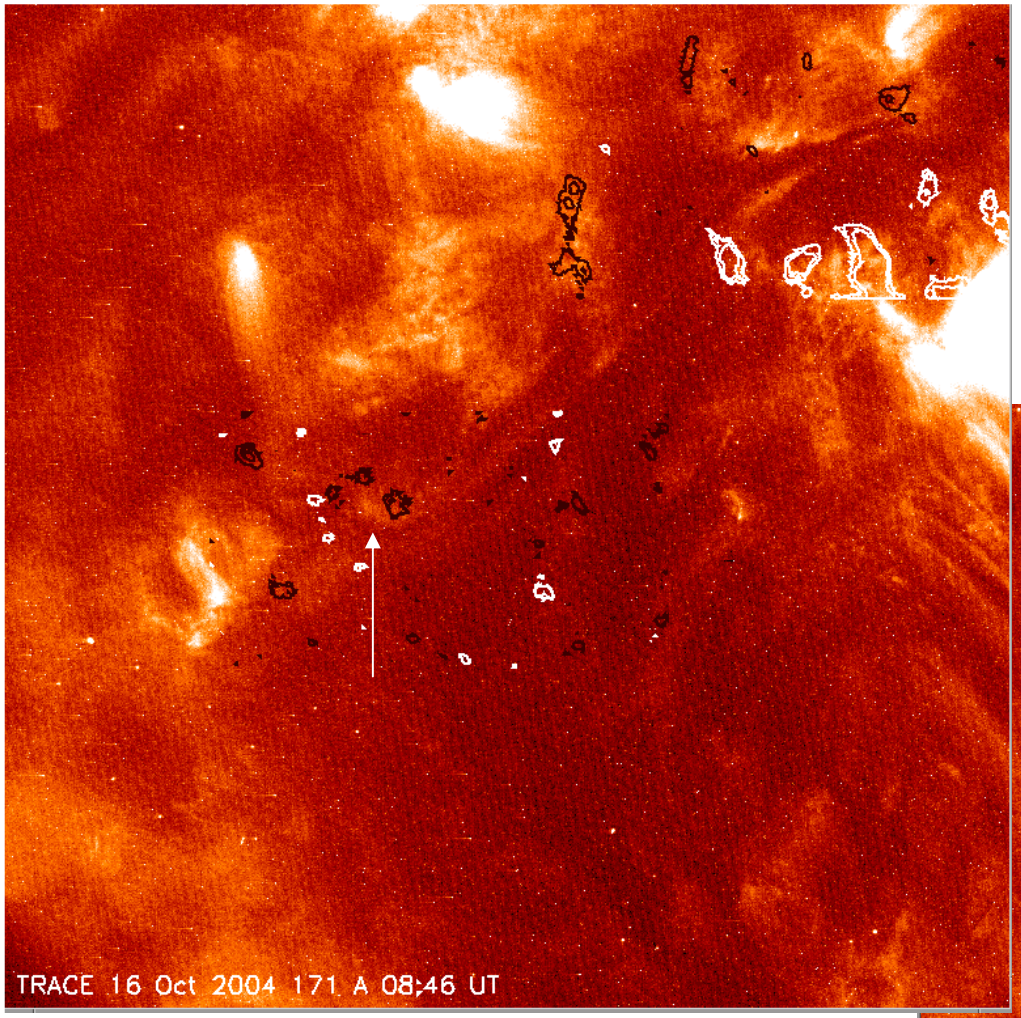
MSDP Na D1 0.24 A

MDI Ni I

Good Correlation for B> 100 G

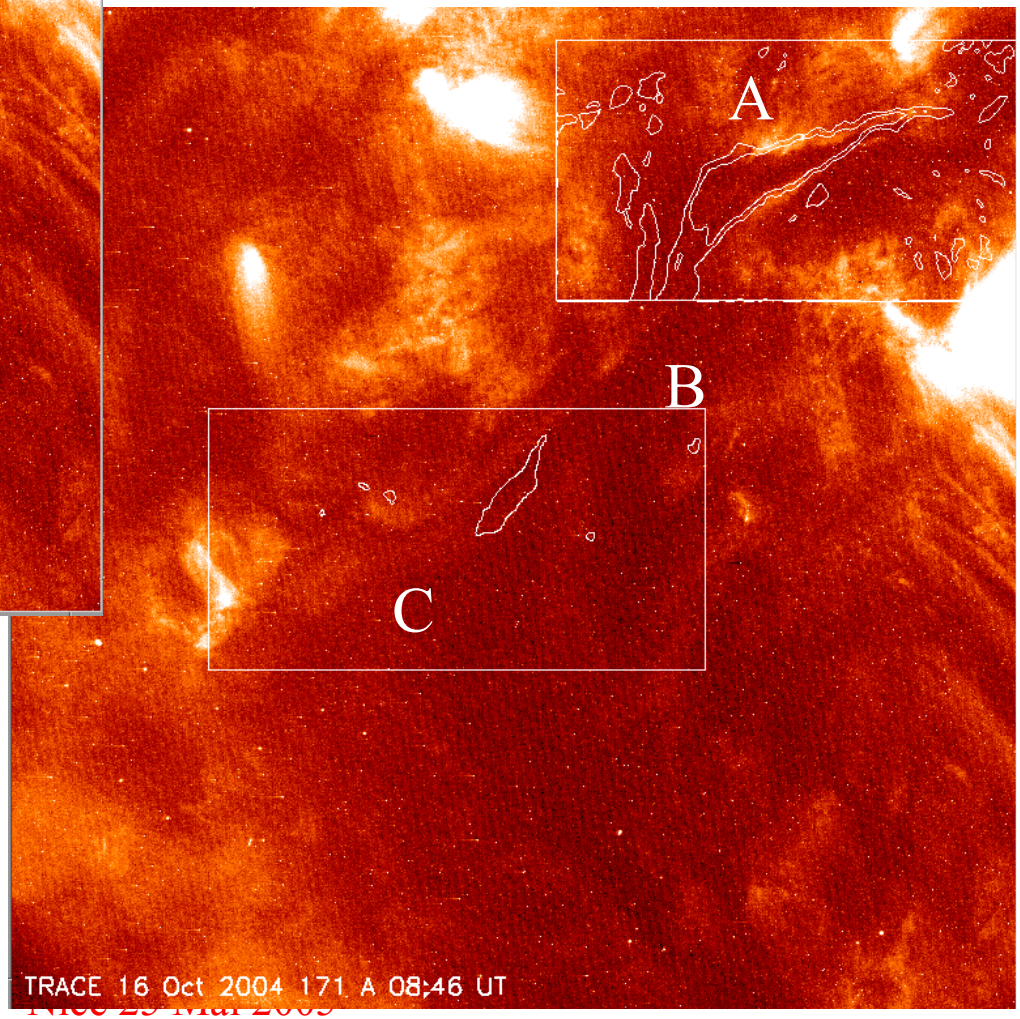


Observational summary



THEMIS weak polarities
B (30,100) magnetic contours

Filament threads at 10^6 K



Theoretical interpretation

Why does the South-East part of the Hα filament disappear ? How is it back later on ?

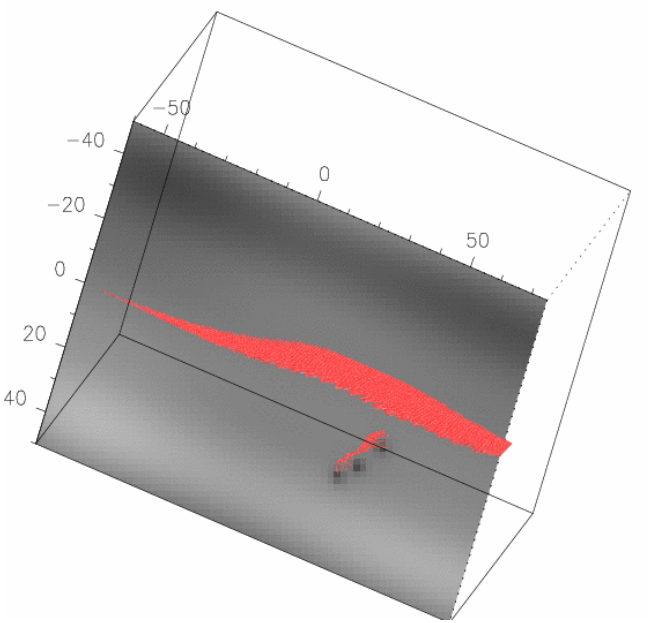
1. Simple heating due the reconnection (cancelling flux)

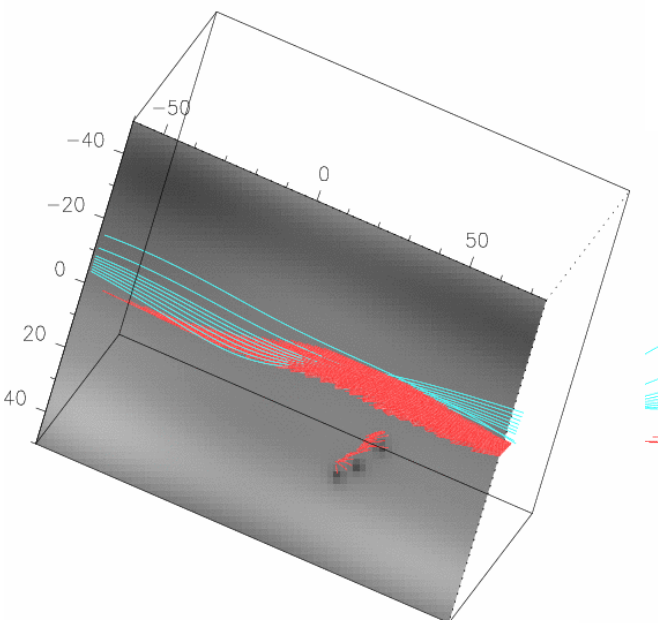
or

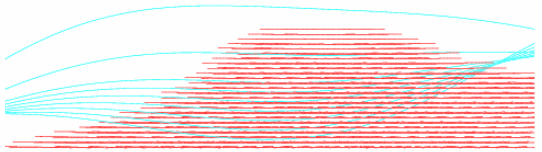
2. Change of the magnetic topology
   ➔ lfff model

Model for topology changing from – dips – to – arcade – to – dips

initial configuration







Side (limb) view

magnetic dips = Hα filament

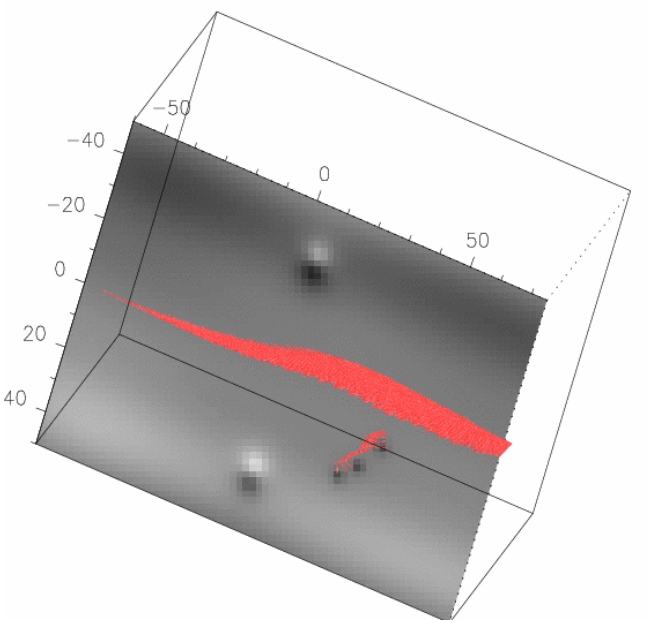
field lines above inversion line

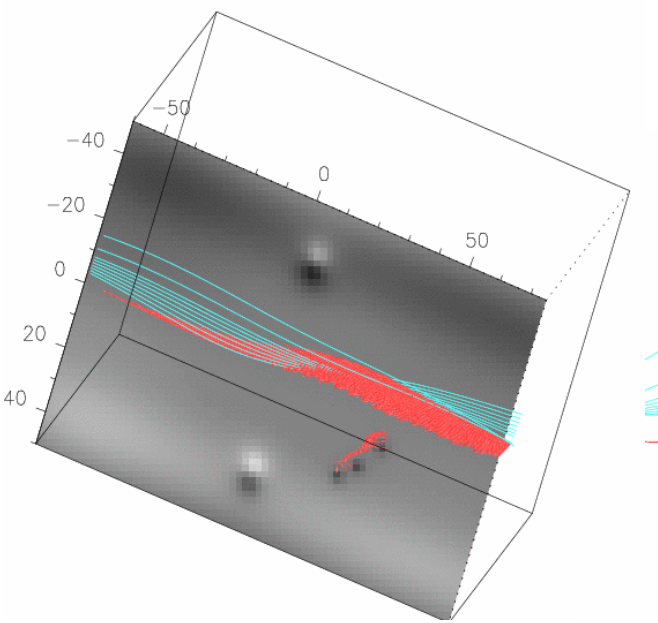
Nice 25 Mai 2005

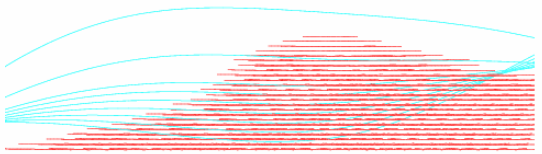
Model for topology changing from – dips – to – arcade – to – dips

emergence of 2 bipoles

Evolution = sequence of linear force-free field models only varying the positions of 2 converging polarities







Side (limb) view

magnetic dips = Hα filament

field lines above inversion line

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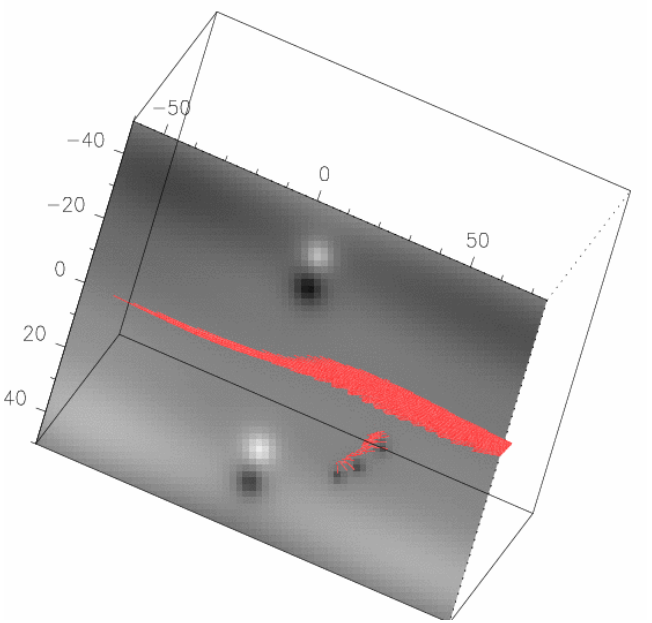
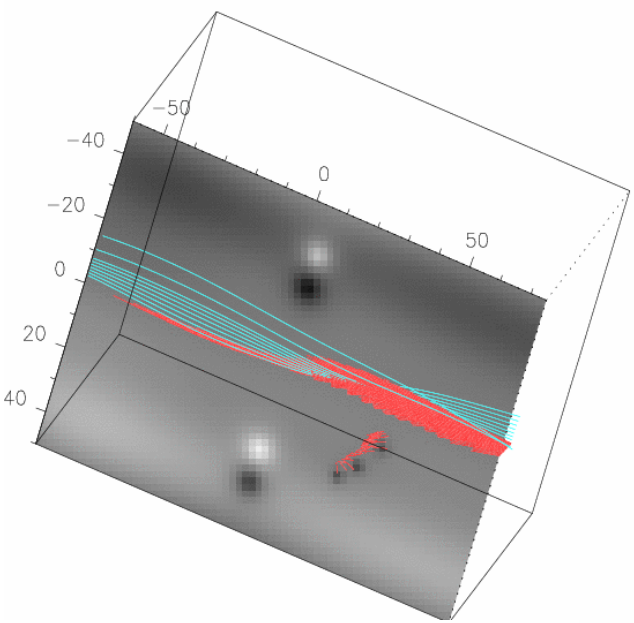
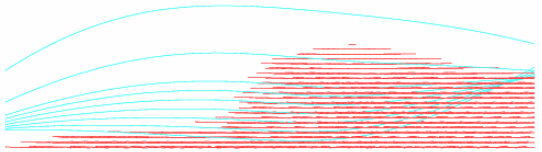
Model for topology changing from – dips – to – arcade – to – dips

merging towards inversion line 1/5

Evolution = sequence of linear force-free field models only varying the positions of 2 converging polarities







Side (limb) view

magnetic dips = Hα filament

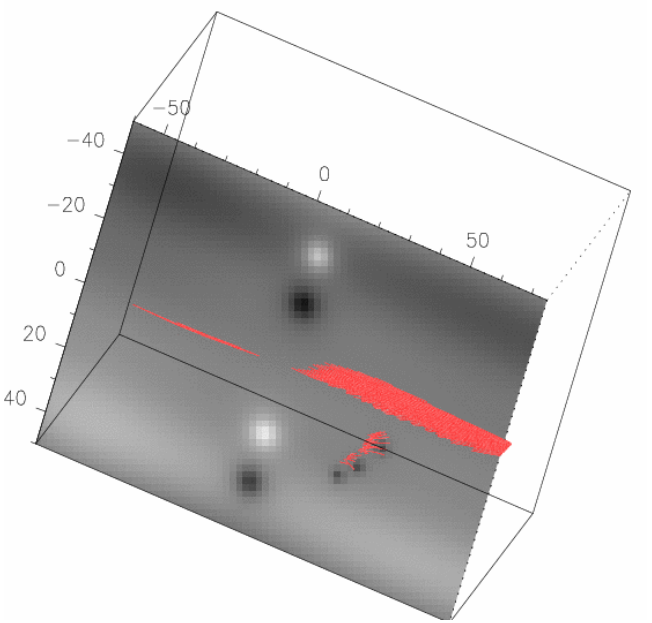
field lines above inversion line

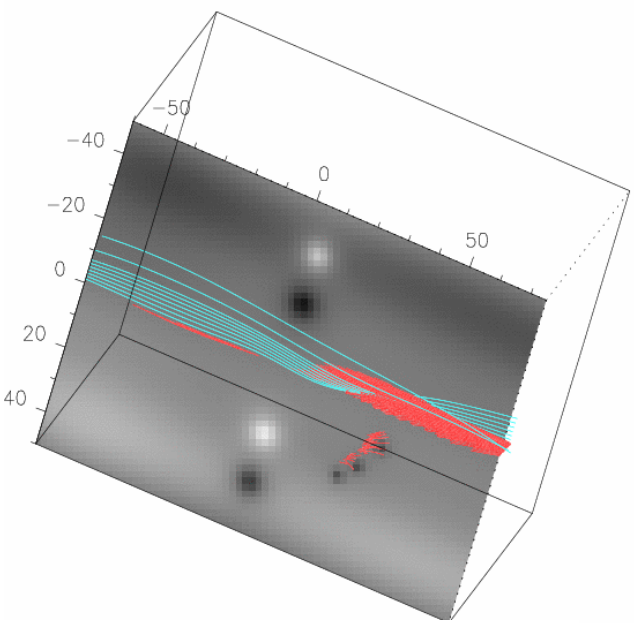
Nice 25 Mai 2005

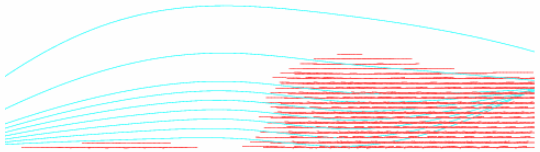
Model for topology changing from – dips – to – arcade – to – dips

merging towards inversion line 2/5

Evolution = sequence of linear force-free field models only varying the positions of 2 converging polarities







Side (limb) view

magnetic dips = Hα filament

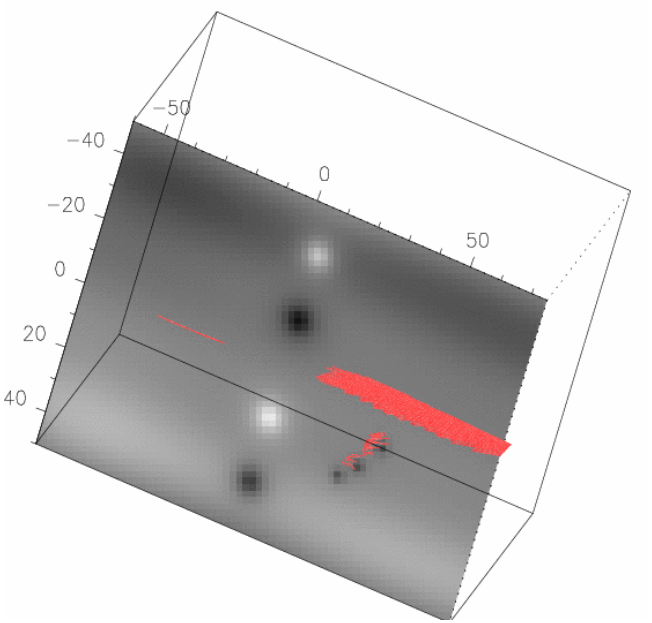
field lines above inversion line

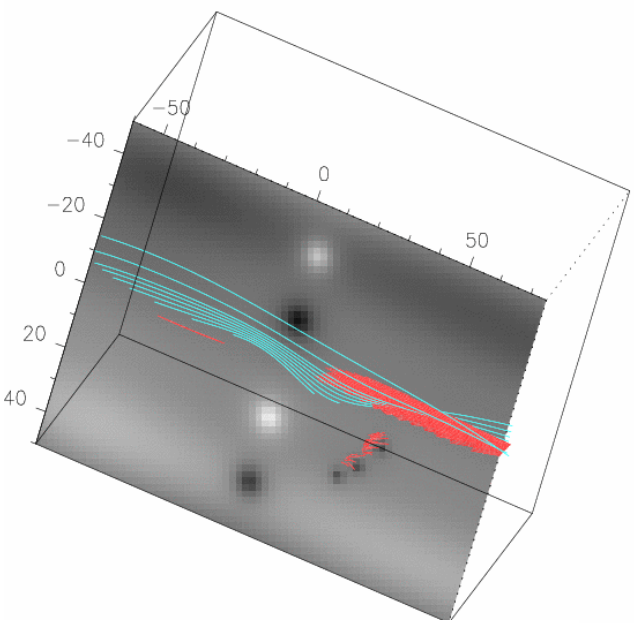
Nice 25 Mai 2005

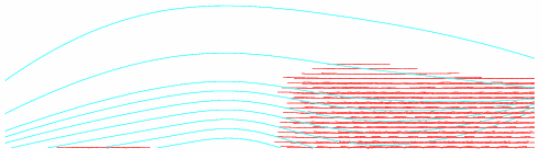
Model for topology changing from – dips – to – arcade – to – dips

merging towards inversion line 3/5

Evolution = sequence of linear force-free field models only varying the positions of 2 converging polarities







Side (limb) view

magnetic dips = Hα filament

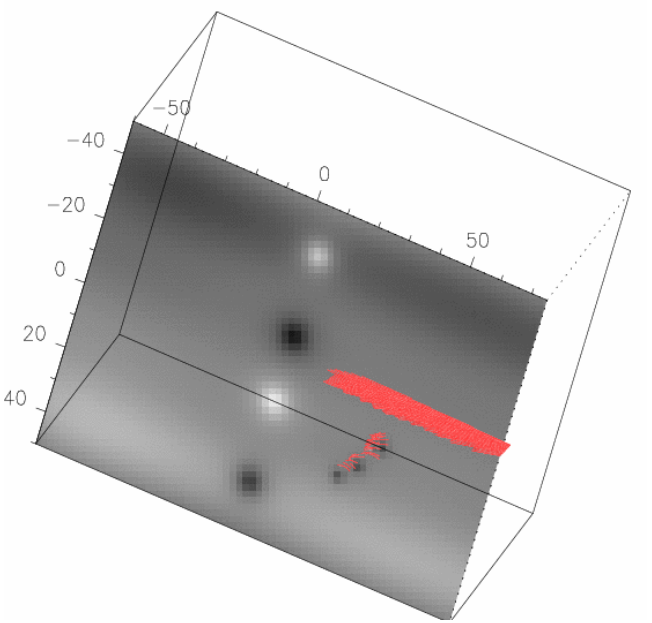
field lines above inversion line

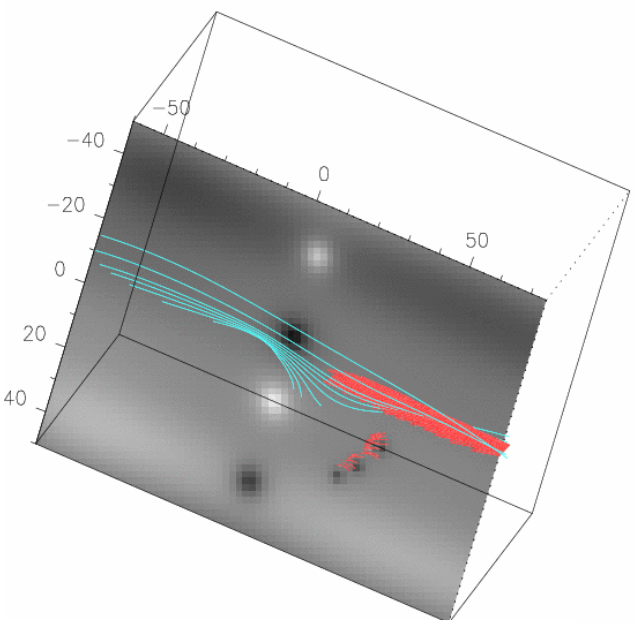
Nice 25 Mai 2005

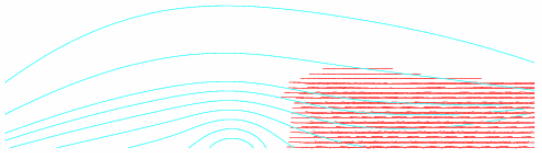
Model for topology changing from – dips – to – arcade – to – dips

merging towards inversion line 4/5

Evolution = sequence of linear force-free field models only varying the positions of 2 converging polarities







Side (limb) view

magnetic dips = Hα filament

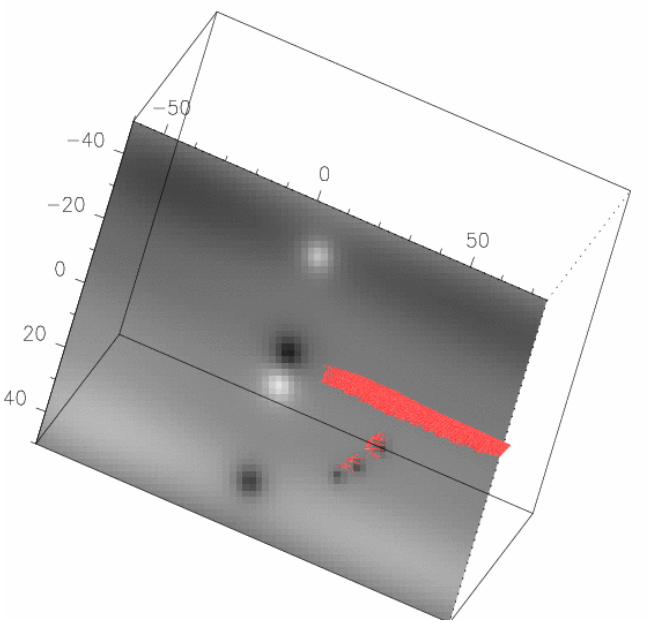
field lines above inversion line

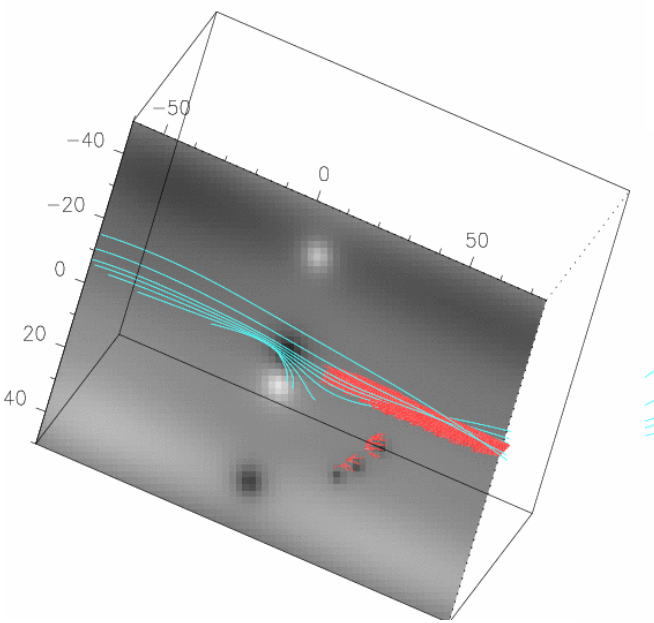
Nice 25 Mai 2005

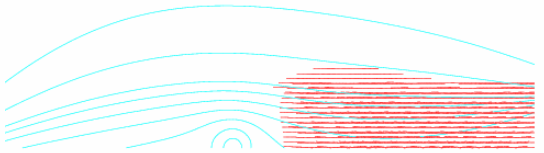
Model for topology changing from – dips – to – arcade – to – dips

merging towards inversion line 5/5

Evolution = sequence of linear force-free field models only varying the positions of 2 converging polarities







Side (limb) view

magnetic dips = Hα filament

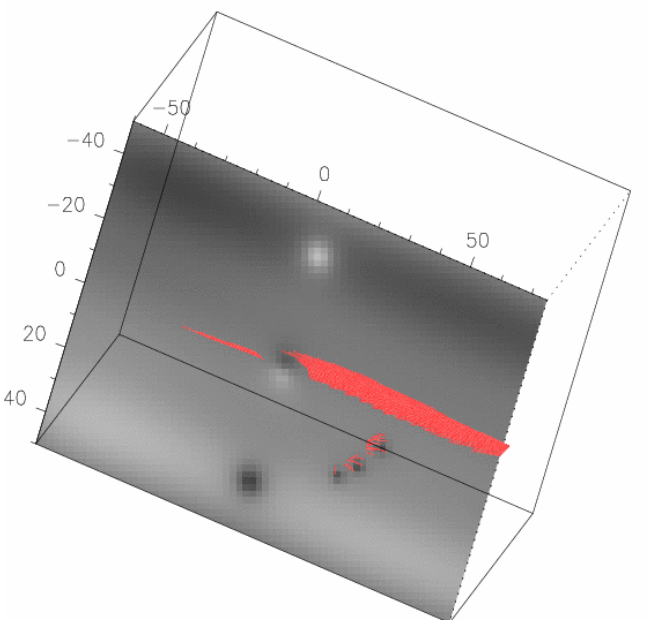
field lines above inversion line

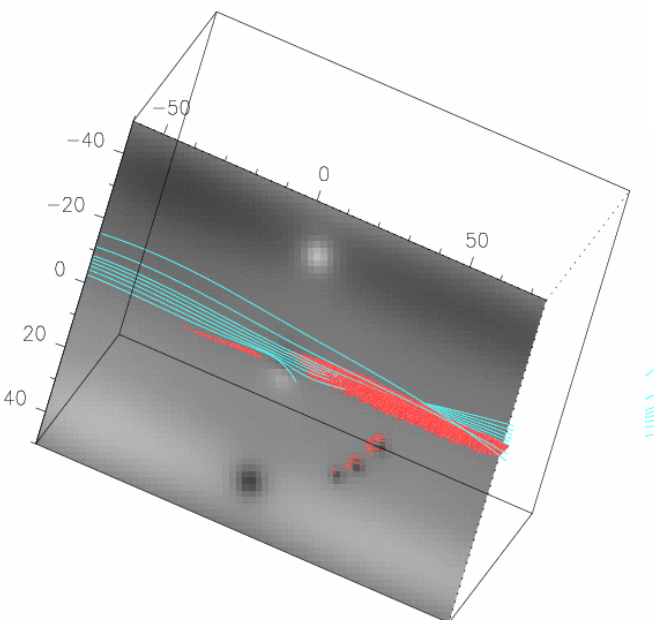
Nice 25 Mai 2005

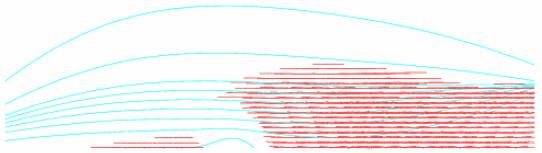
Model for topology changing from – dips – to – arcade – to – dips

flux cancelation 1/2

Evolution = sequence of linear force-free field models only varying the positions of 2 converging polarities







Side (limb) view

magnetic dips = Hα filament

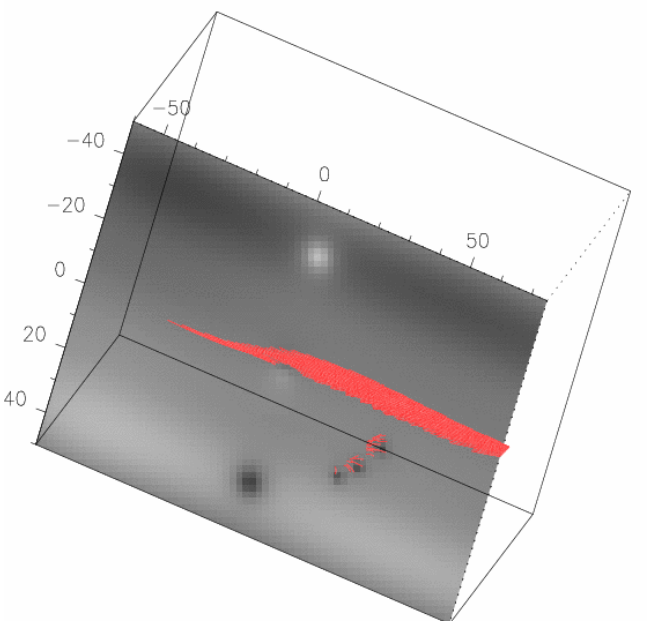
field lines above inversion line

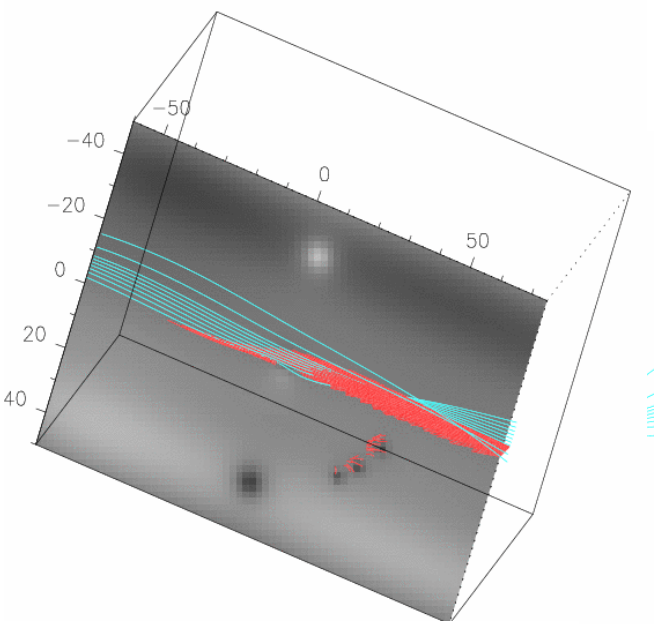
Nice 25 Mai 2005

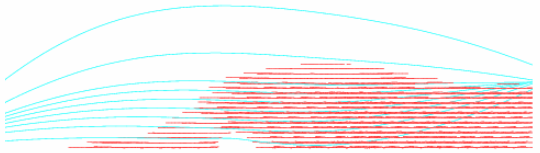
Model for topology changing from – dips – to – arcade – to – dips

flux cancelation 2/2

Evolution = sequence of linear force-free field models only varying the positions of 2 converging polarities







Side (limb) view

magnetic dips = Hα filament

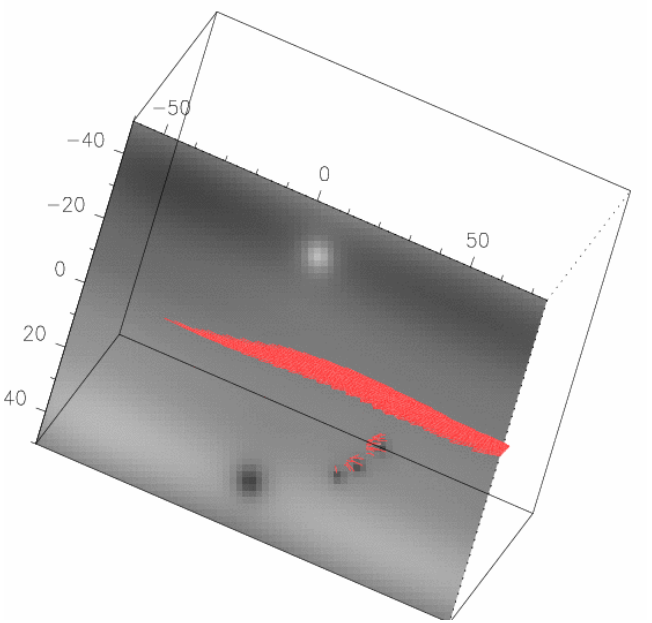
field lines above inversion line

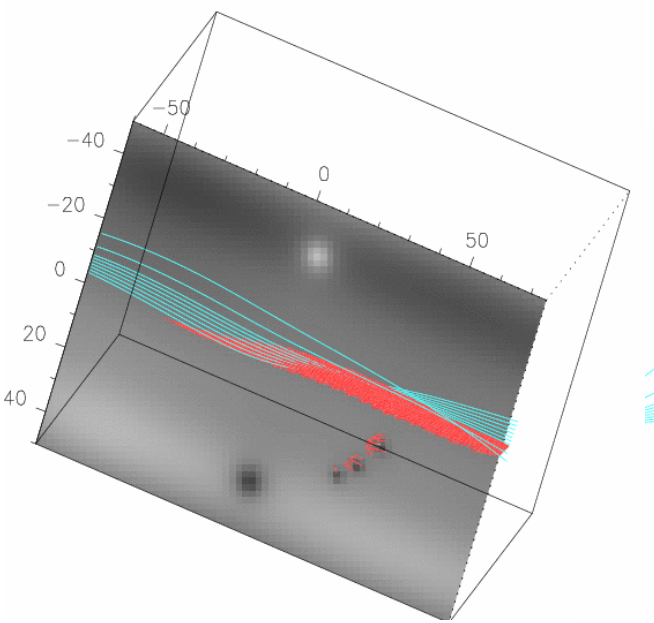
Nice 25 Mai 2005

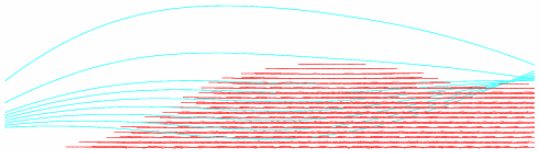
Model for topology changing from – dips – to – arcade – to – dips

final configuration

Evolution = sequence of linear force-free field models only varying the positions of 2 converging polarities







Side (limb) view

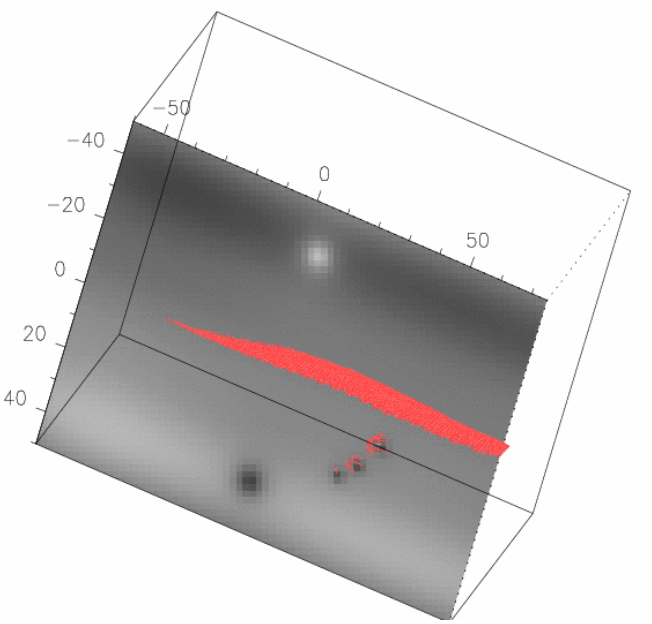
magnetic dips = Hα filament

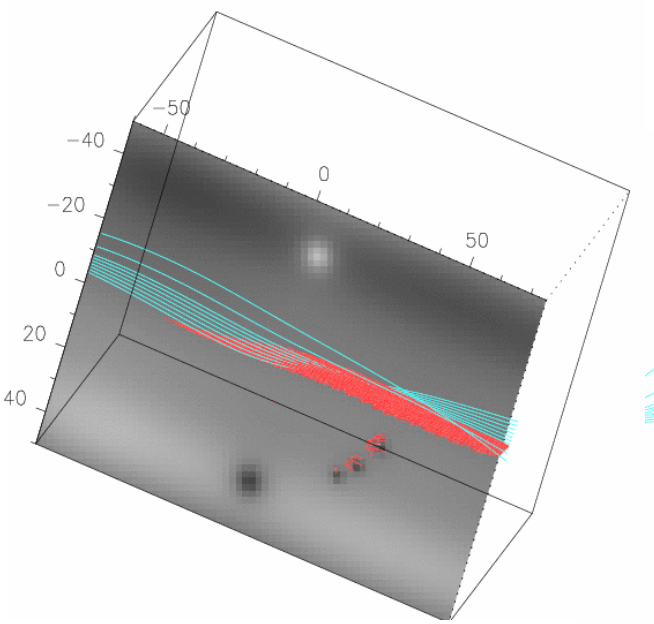
field lines above inversion line

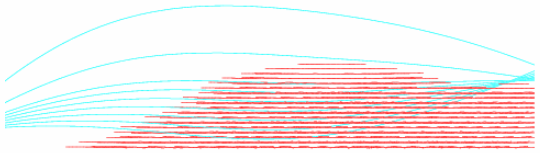
Nice 25 Mai 2005

Model for topology changing from – dips – to – arcade – to – dips

final configuration
nearly back to…







Side (limb) view

magnetic dips = Hα filament

field lines above inversion line

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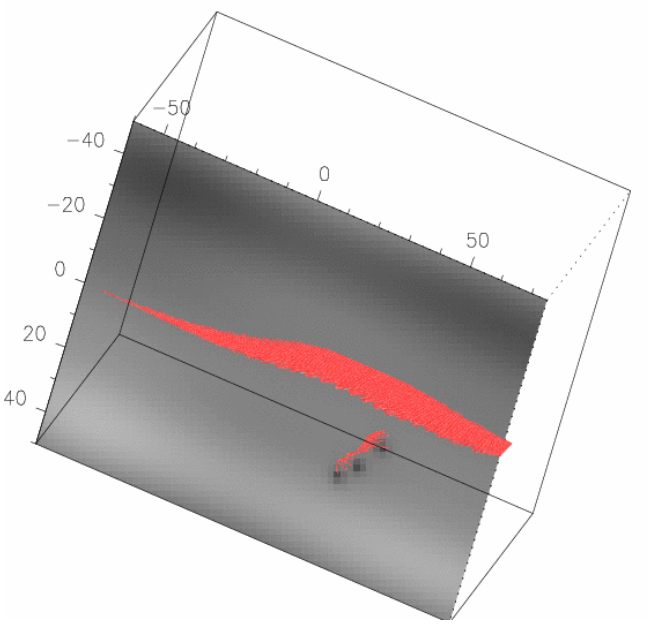
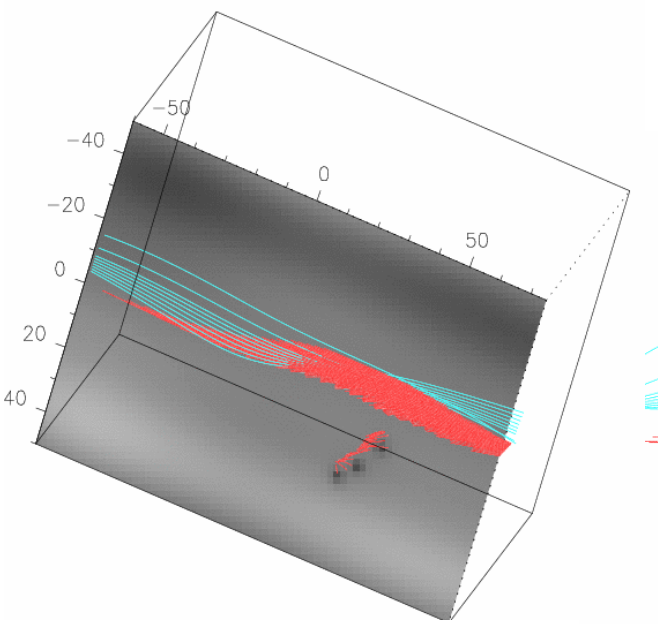
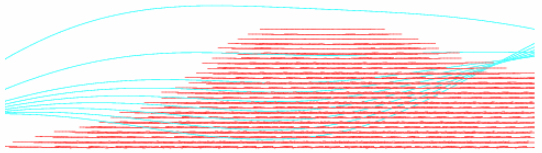
Model for topology changing from – dips – to – arcade – to – dips

...the
initial configuration







Side (limb) view

magnetic dips = Hα filament

field lines above inversion line

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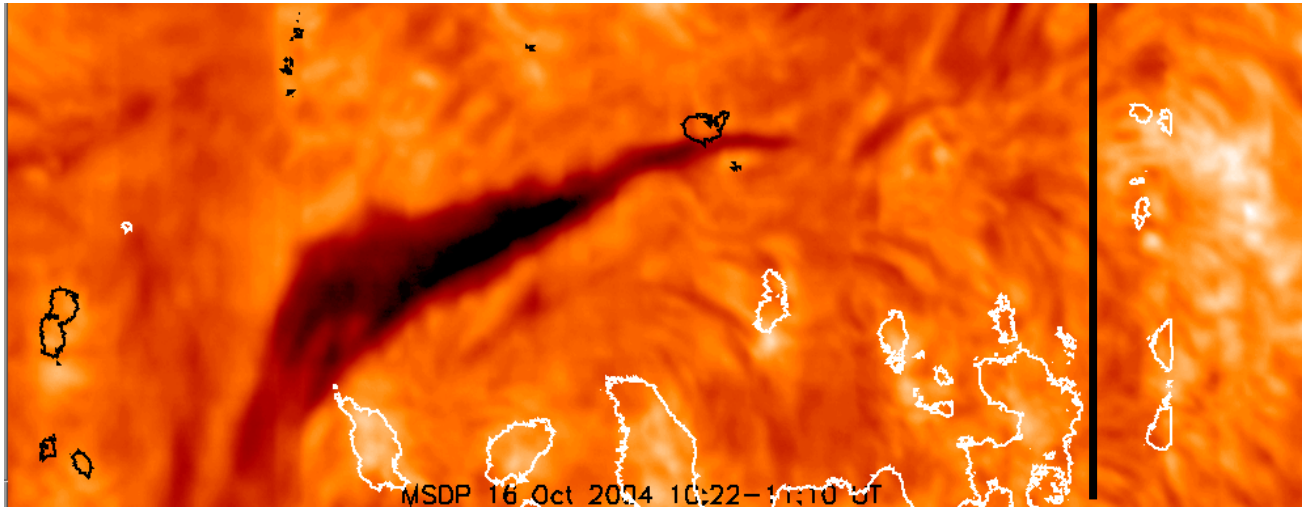
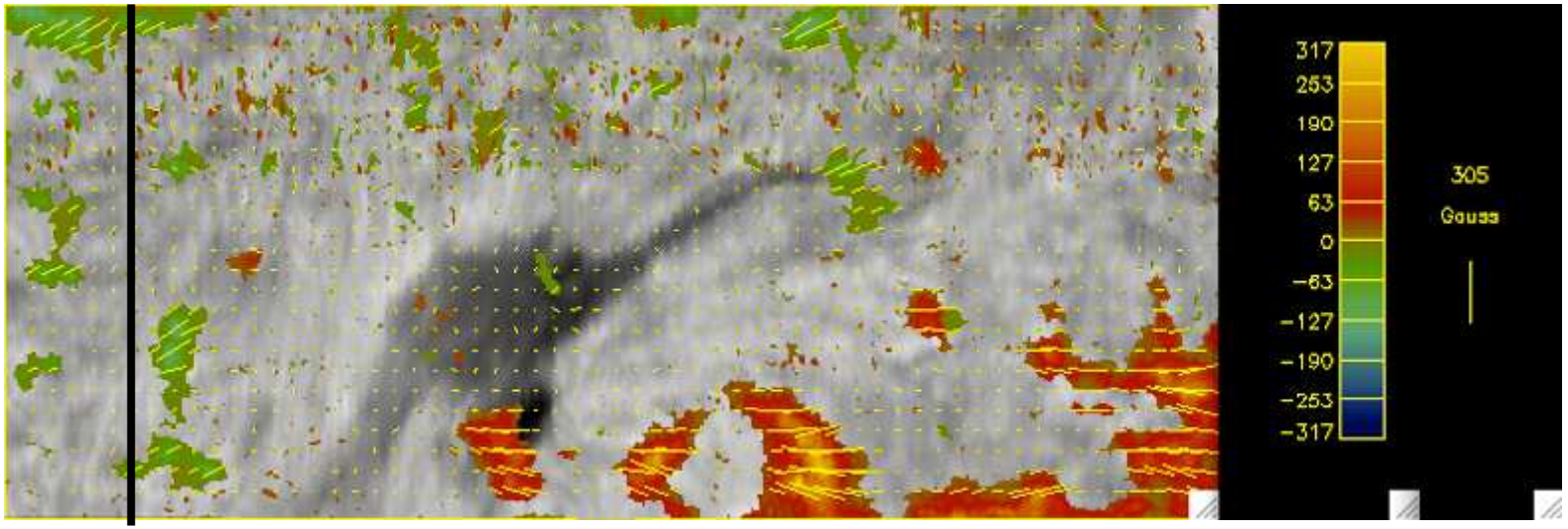
The end

Nice 25 Mai 2005

THEMIS



MSDP
100’’x250’’



MTR

End

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