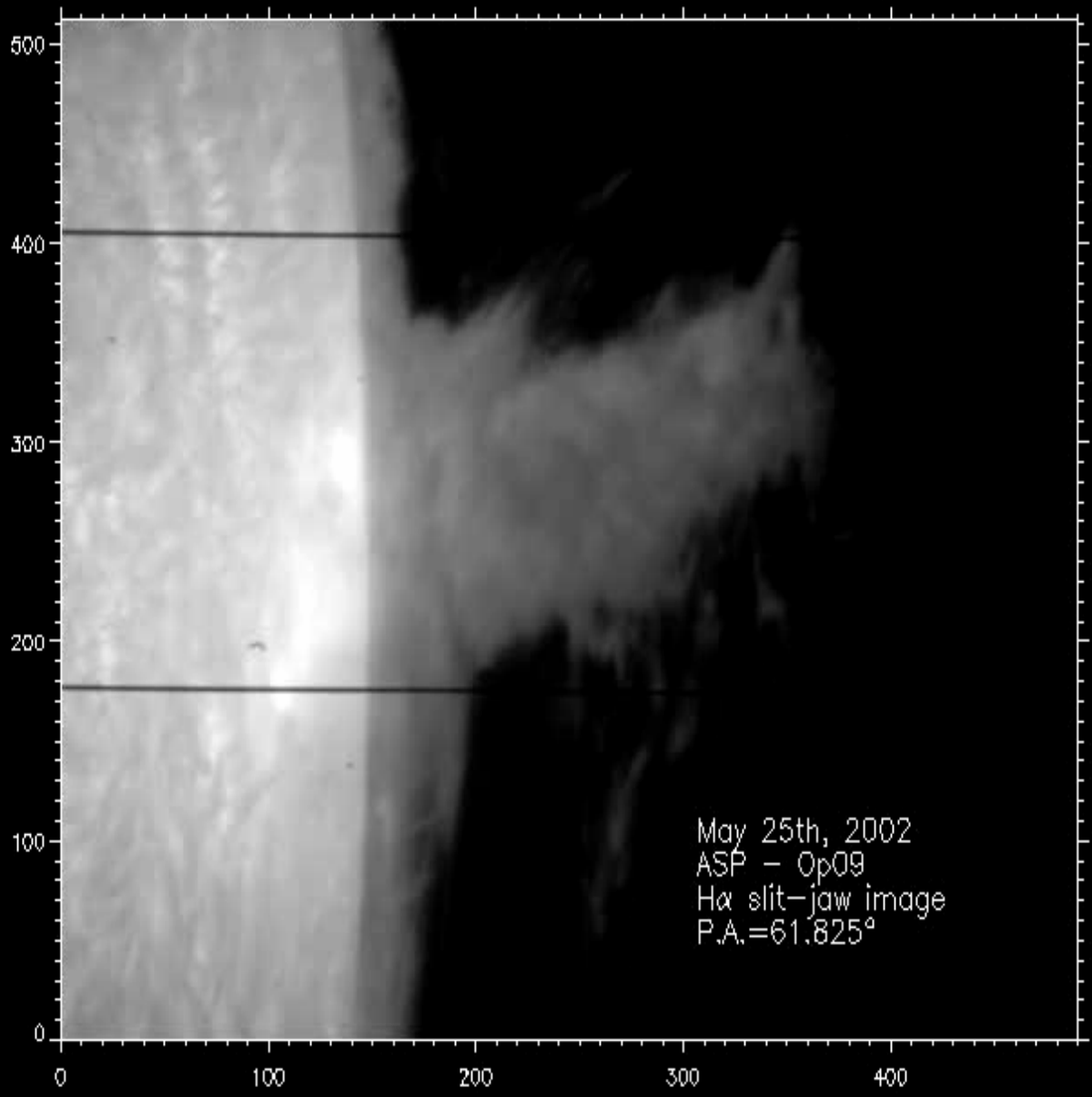
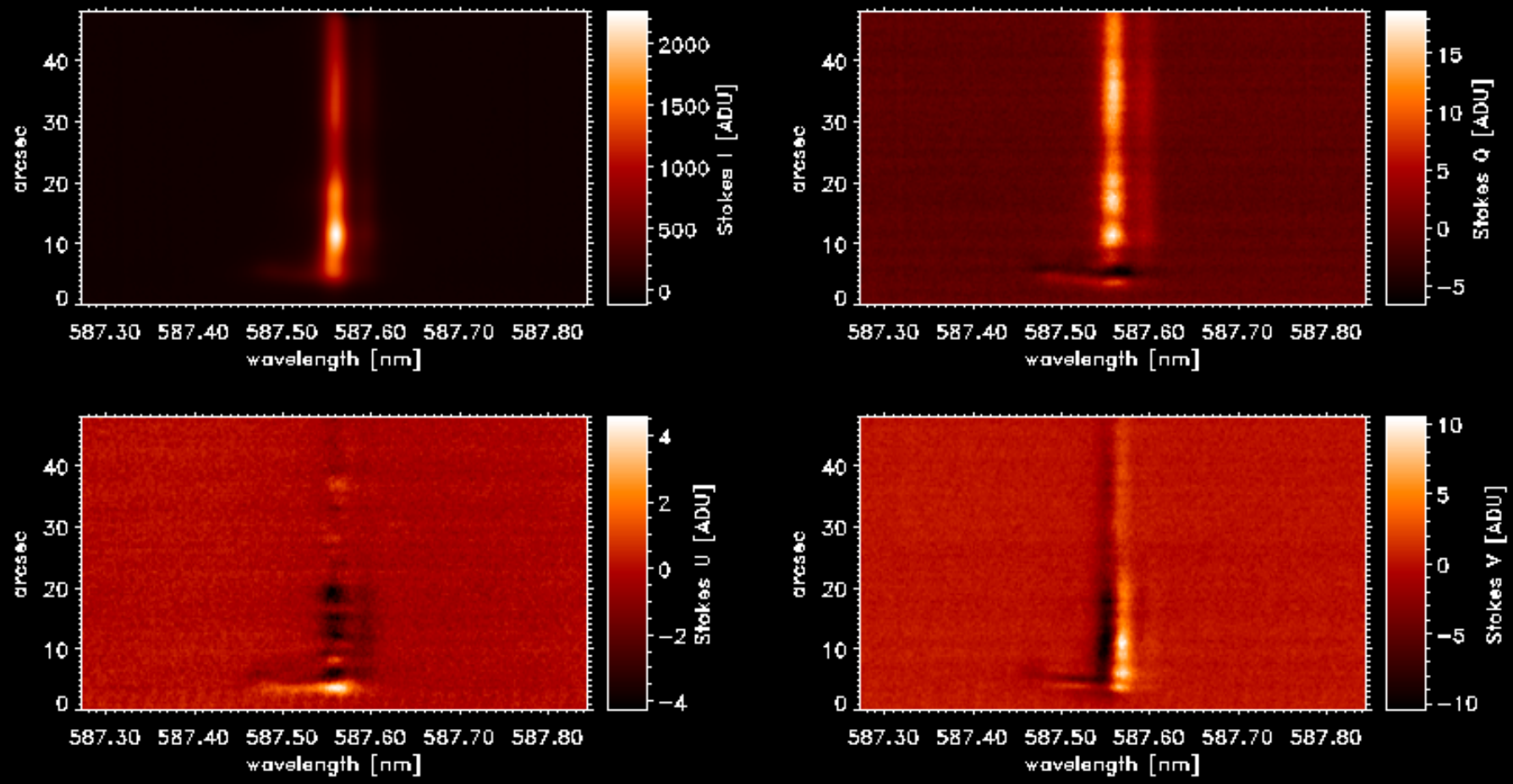
From polarimetry to magnetic fields in prominences

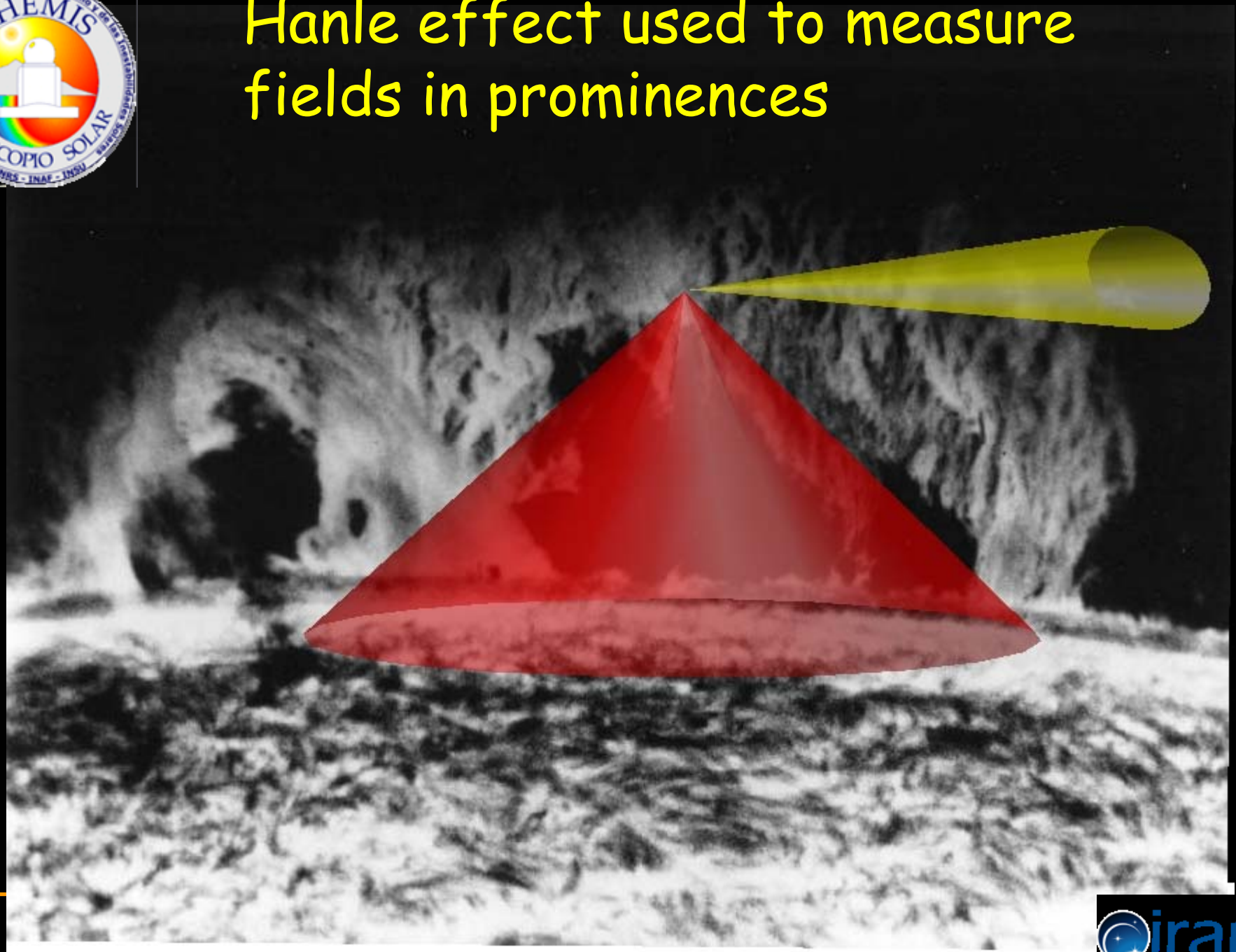
A. López Ariste

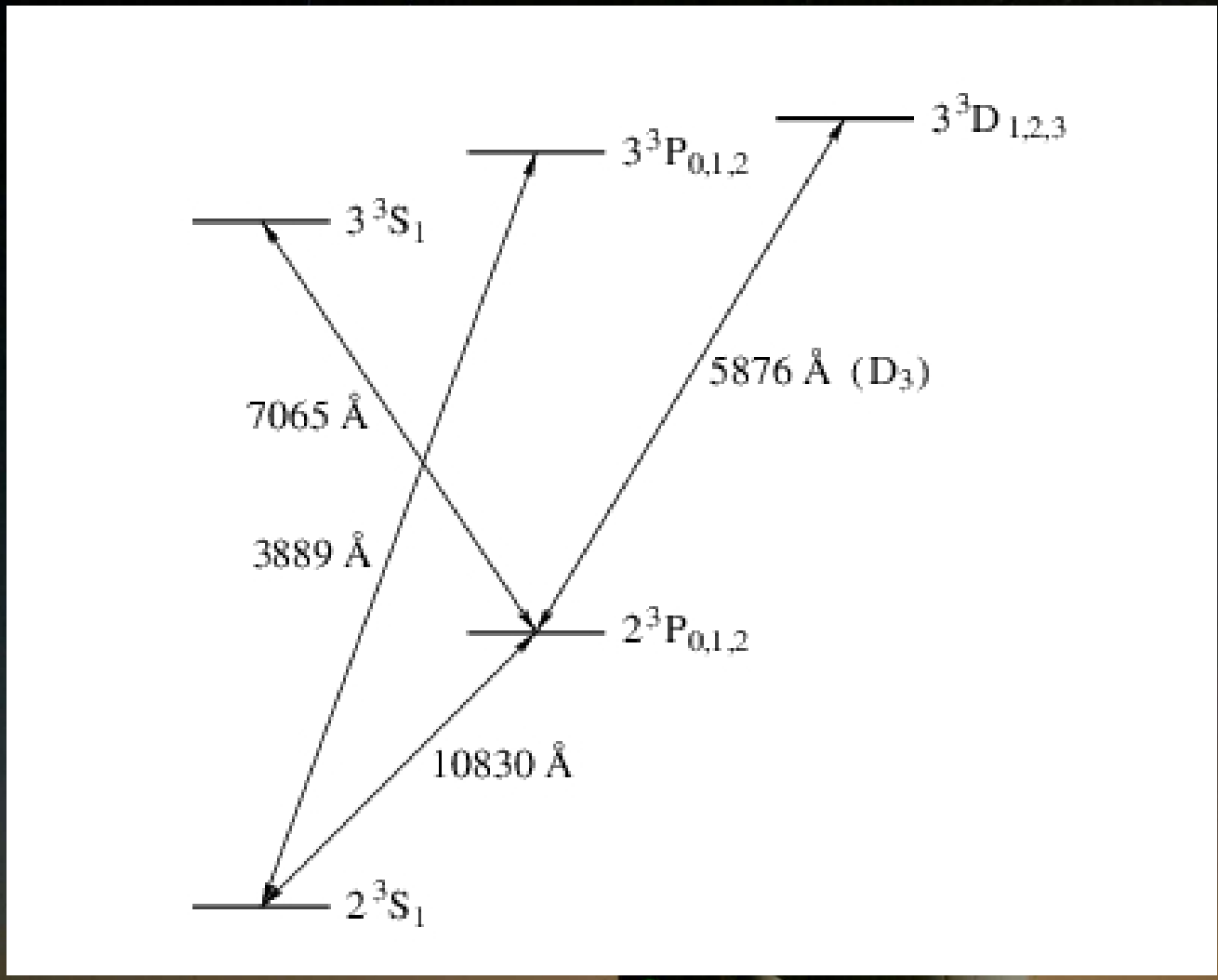

500
400
300
200
100
0
0
100
200
300
400
May 25th, 2002
ASP – Op09
Hα slit-jaw image
P.A.=61.825°

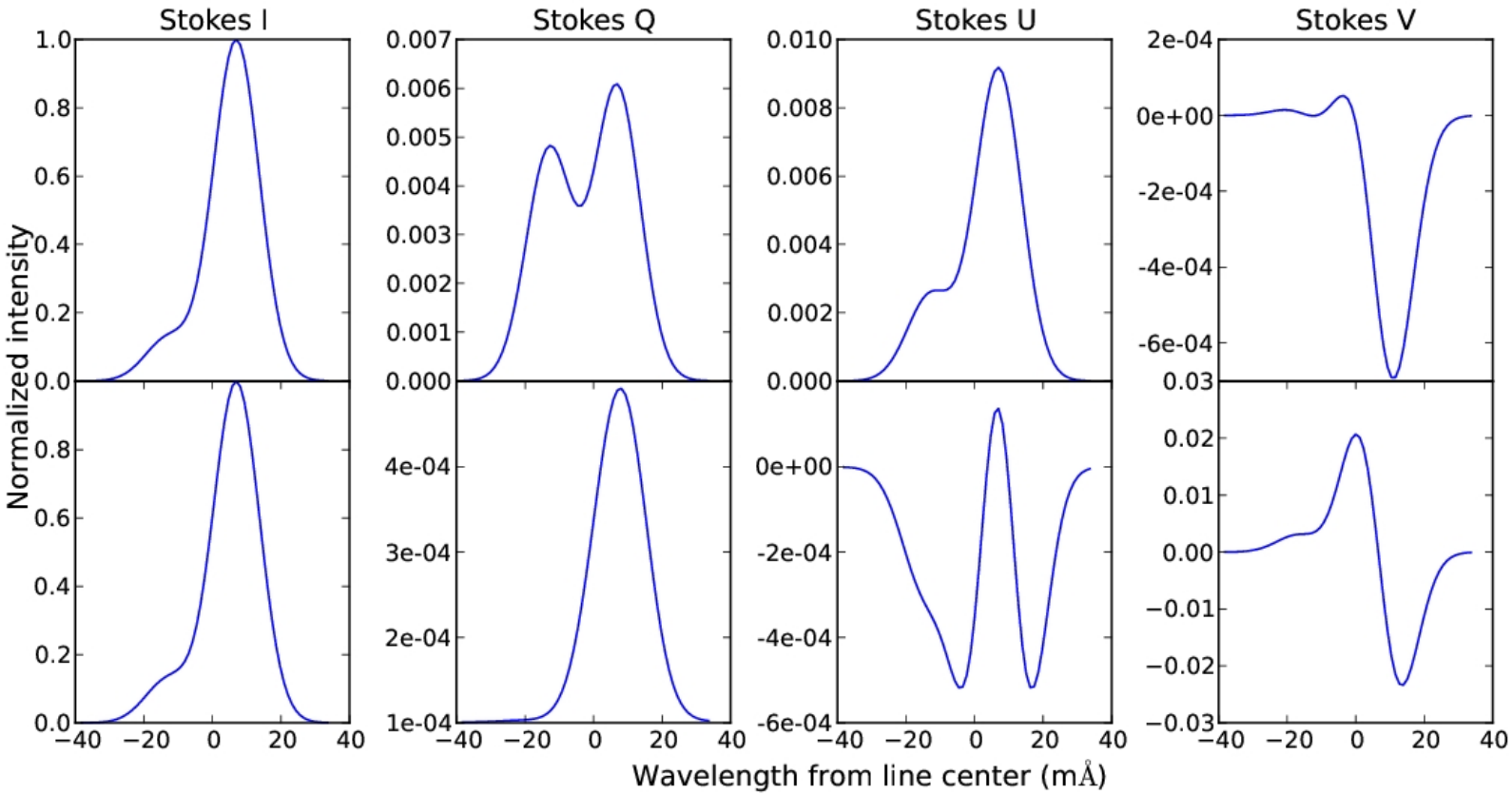


Paletou et al. 2001

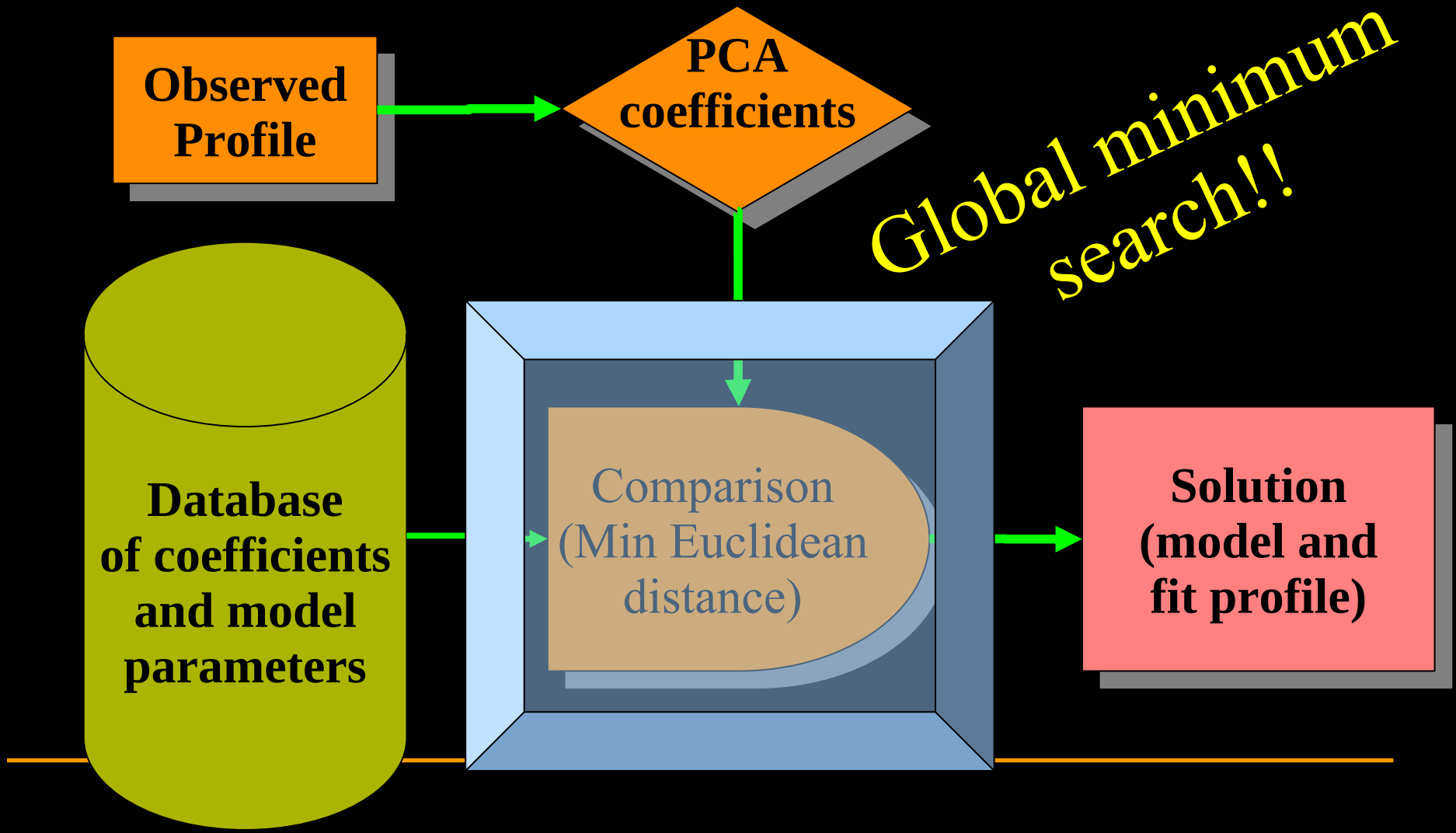
Hanle effect used to measure fields in prominences

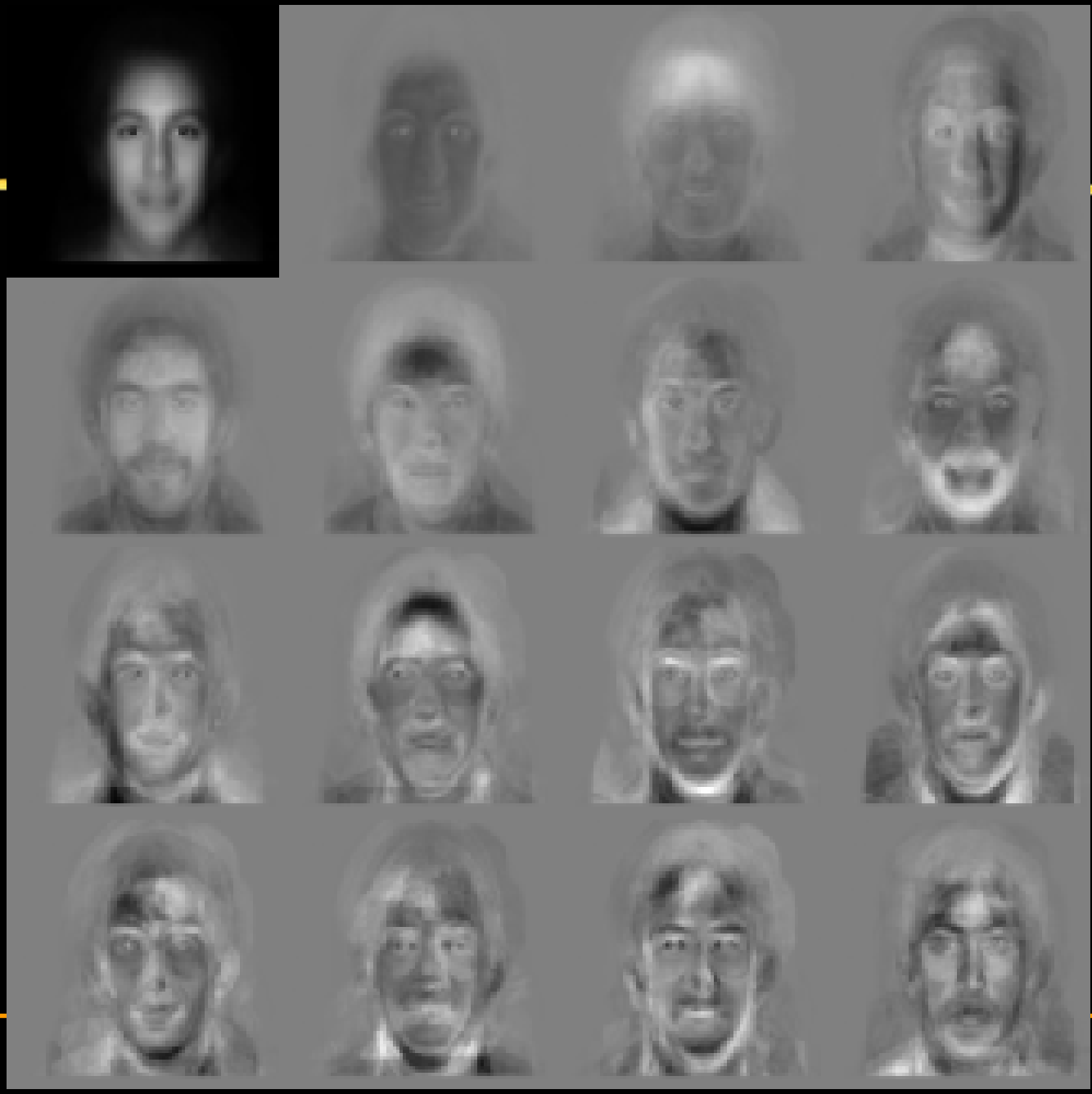


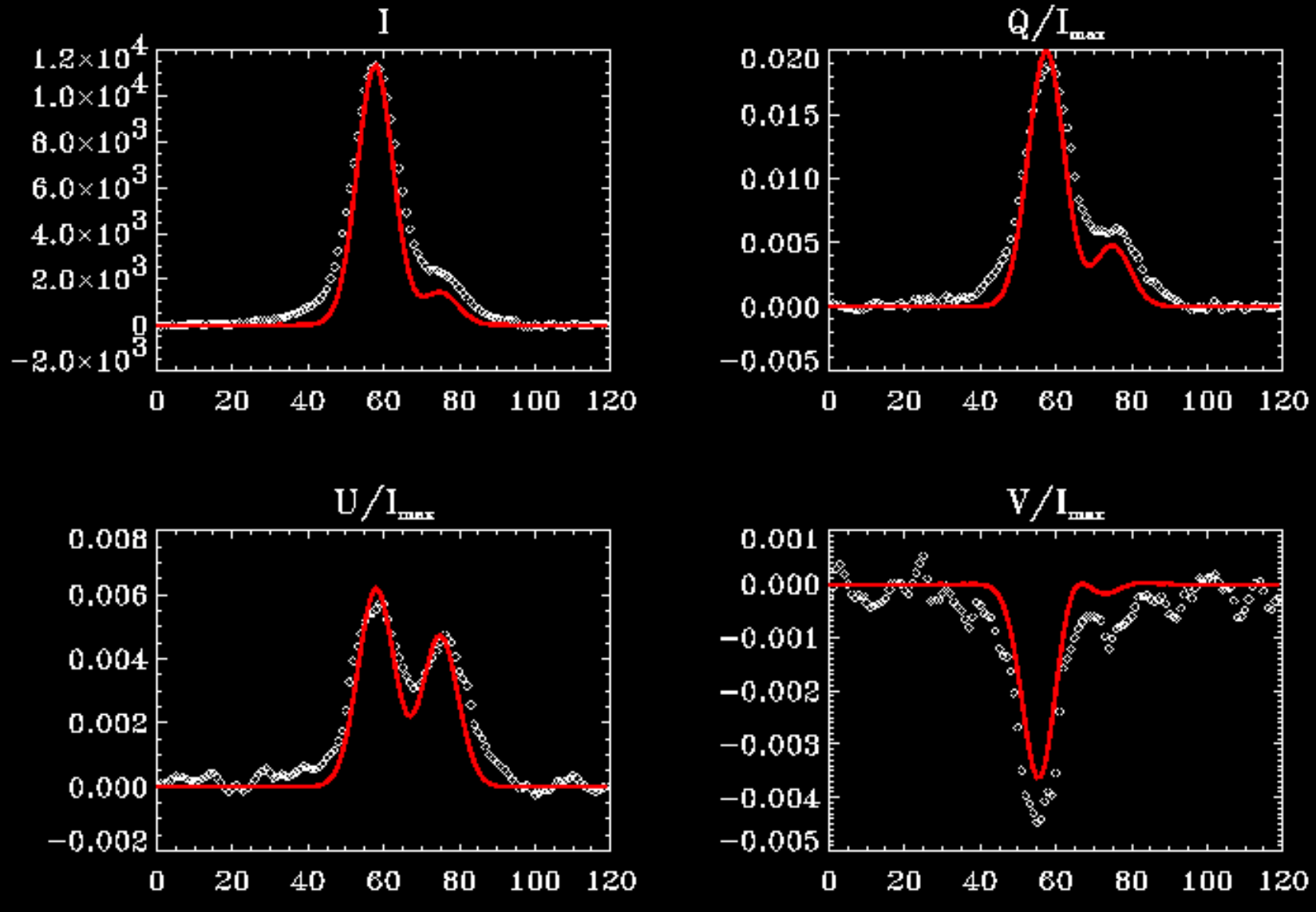

$3^3D_{1,2,3}$
$3^3P_{0,1,2}$
3^3S_1
5876 Å (D_3)
7065 Å
3889 Å
$2^3P_{0,1,2}$
10830 Å
2^3S_1


Stokes I
Stokes Q
Stokes U
Stokes V
Normalized intensity
Wavelength from line center (mÅ)

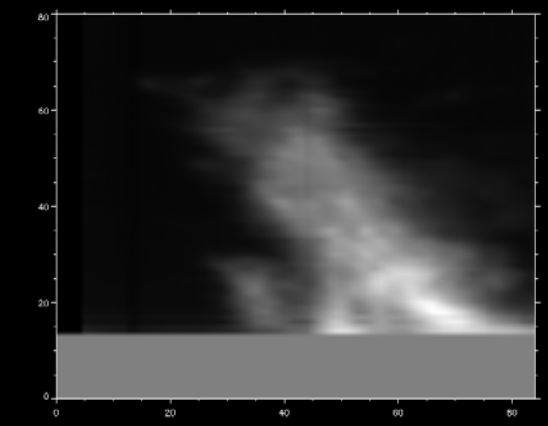
Inversion algorithm: PCA

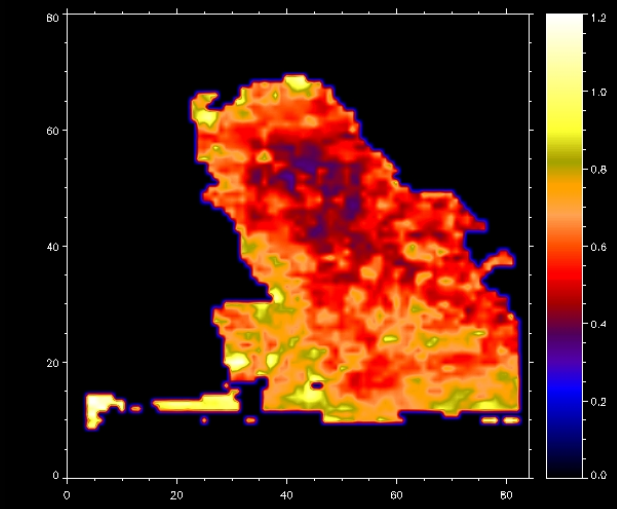


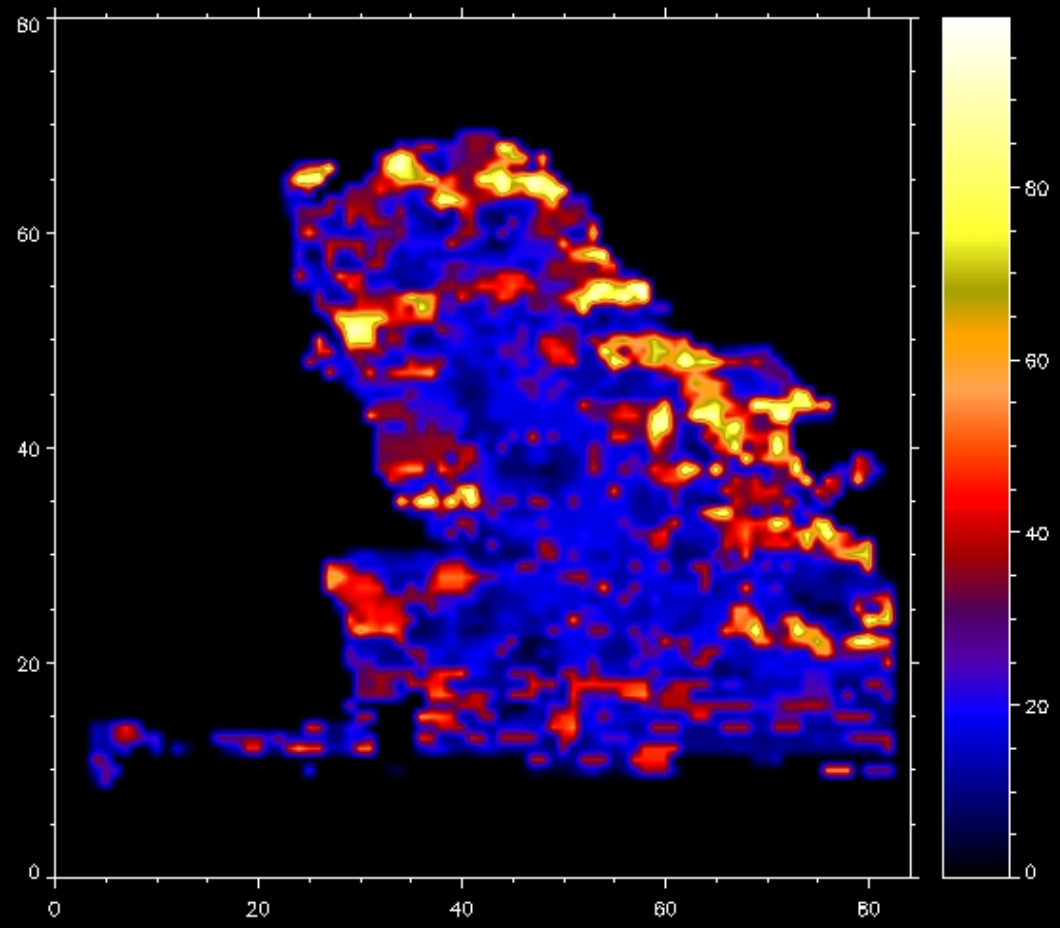



I
Q/I_max
U/I_max
V/I_max
1.2×10^4
1.0×10^4
8.0×10^3
6.0×10^3
4.0×10^3
2.0×10^3
0
−2.0×10^3
0.020
0.015
0.010
0.005
0.000
−0.005
0.008
0.006
0.004
0.002
0.000
−0.002
0.001
0.000
−0.001
−0.002
−0.003
−0.004
−0.005
0 20 40 60 80 100 120
Q/I_max
U/I_max
0.000
−4 −2 0 2
−1 0 1 2

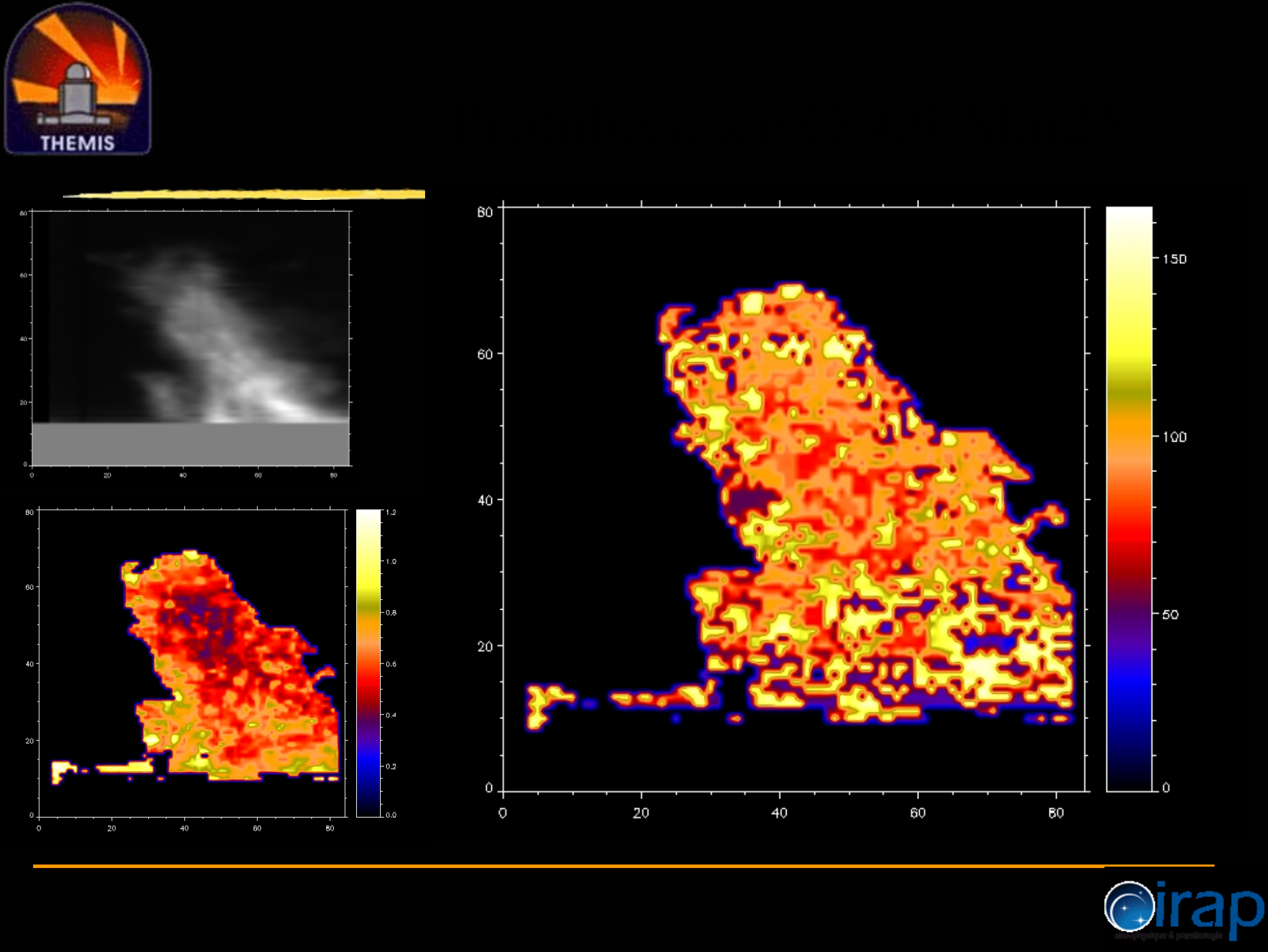
An example

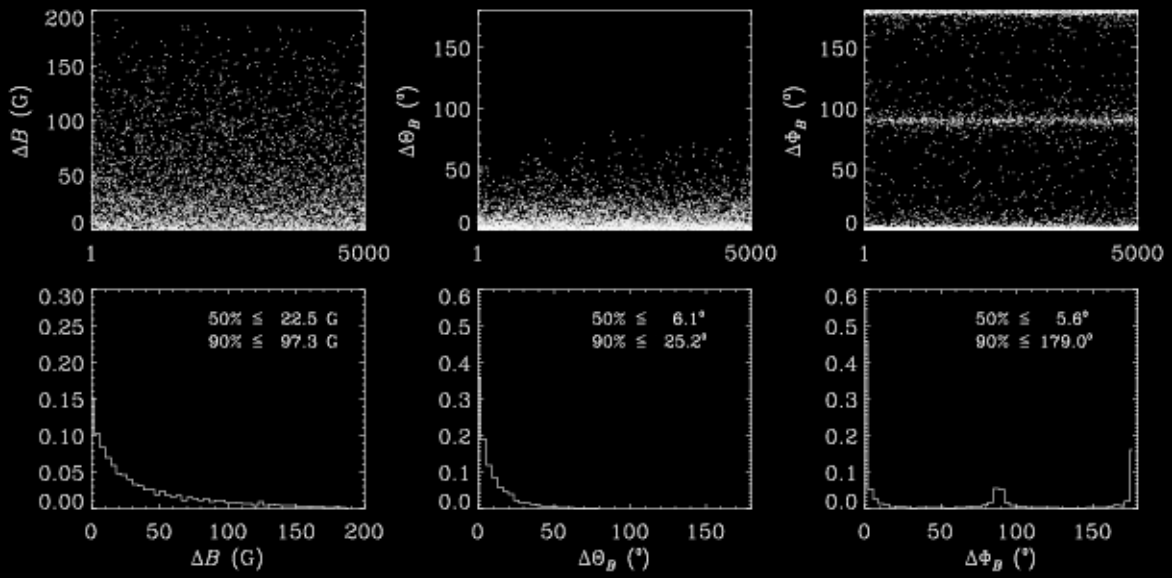




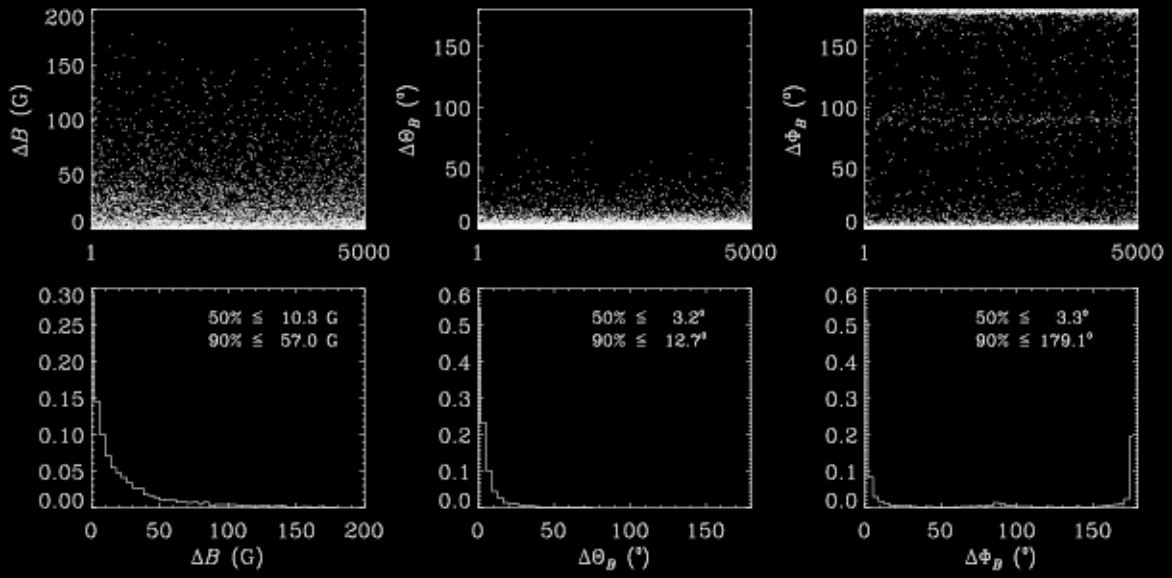


NSO/SPO DST with HAO/ASP, *by Casini, López Ariste, Tomczyk, & Lites 2002*

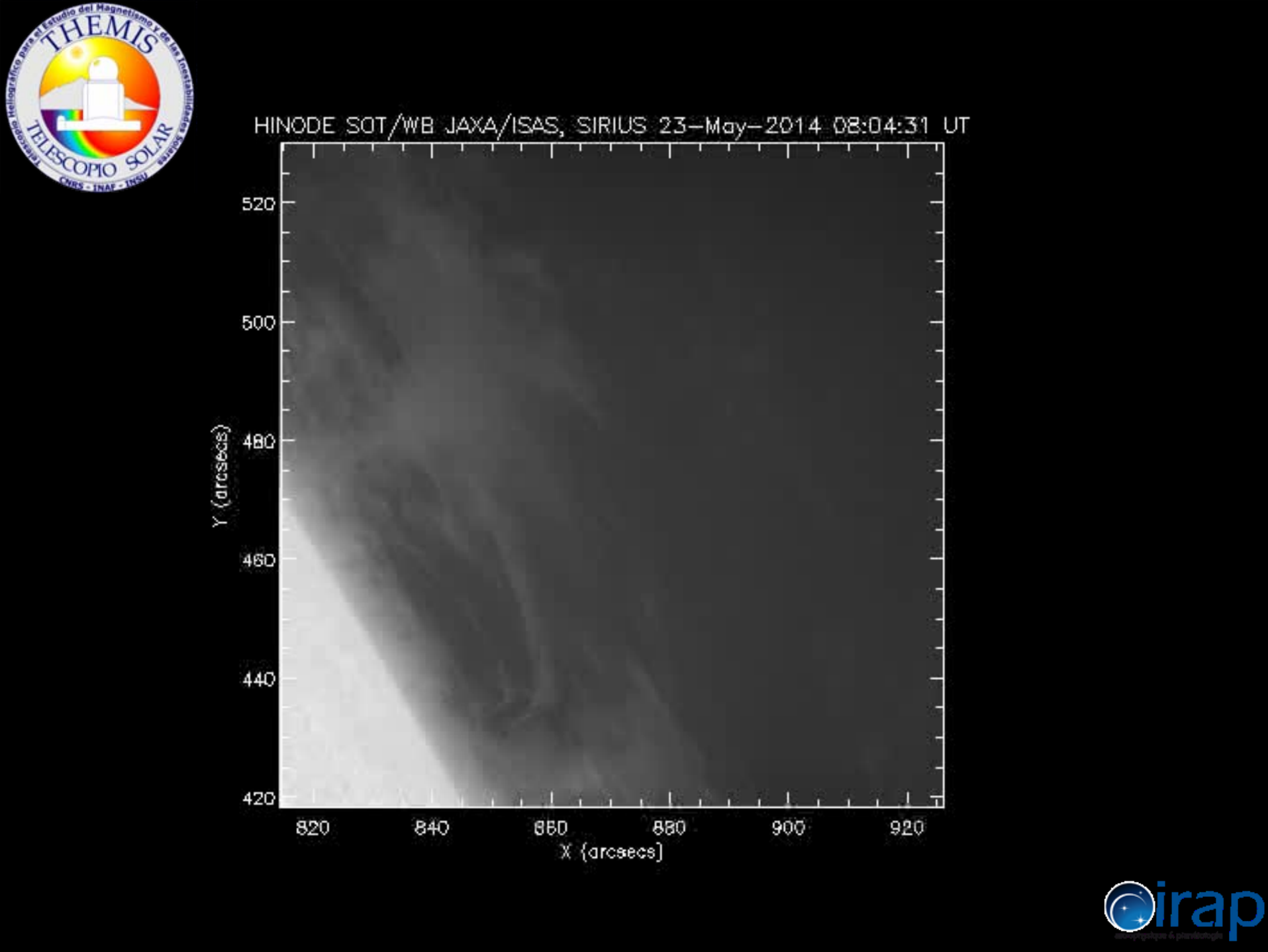

THEMIS
0
20
40
60
80
1.2
1.0
0.8
0.6
0.4
0.2
0.0
150
100
50

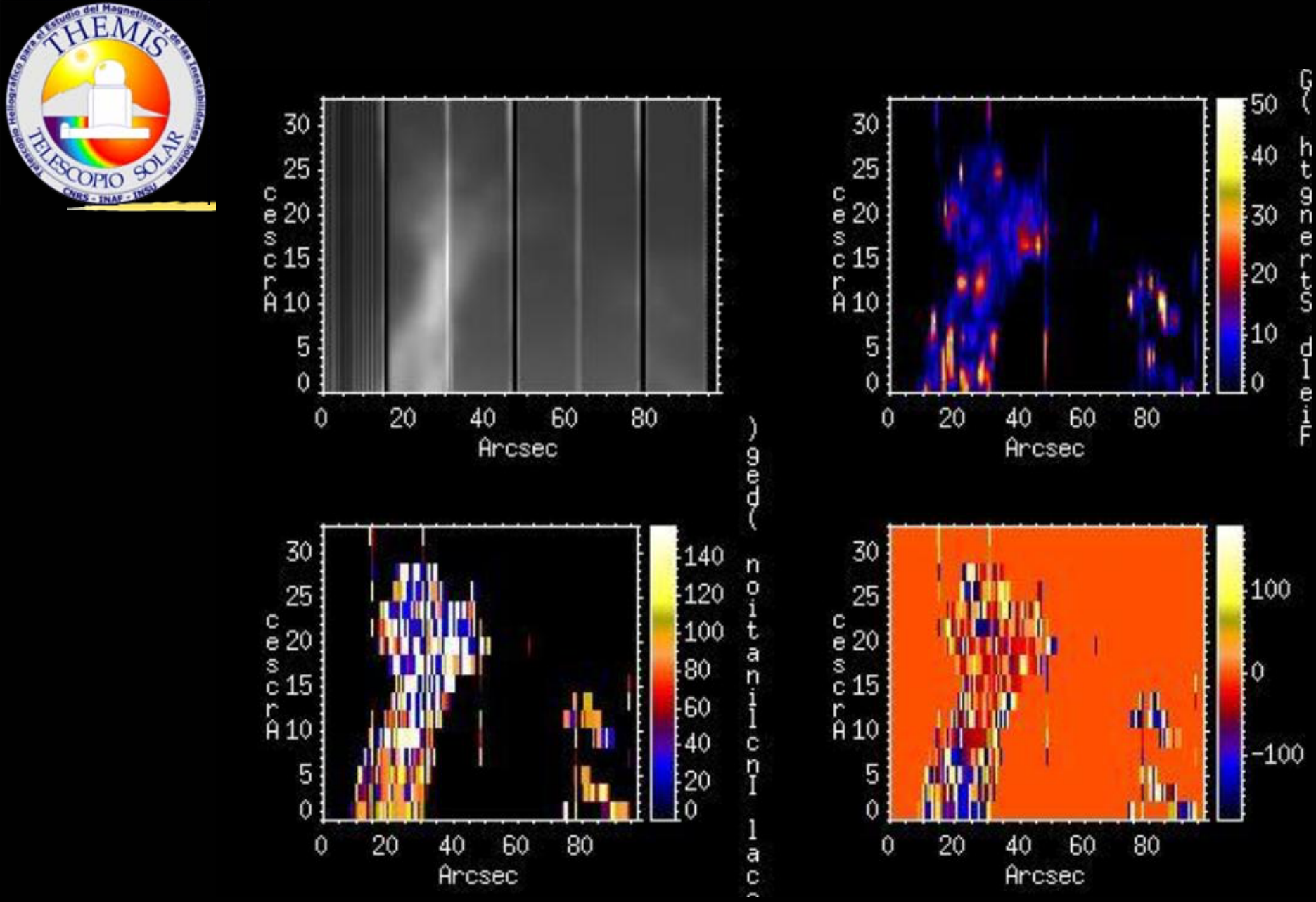


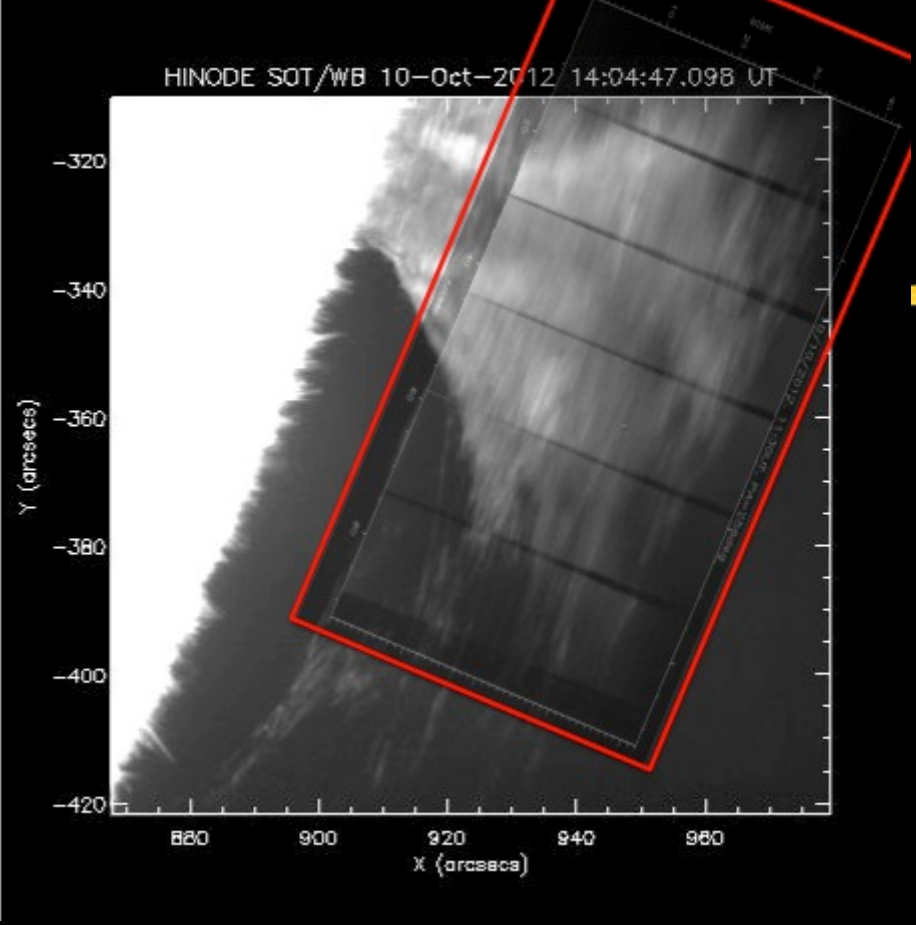
He 10830

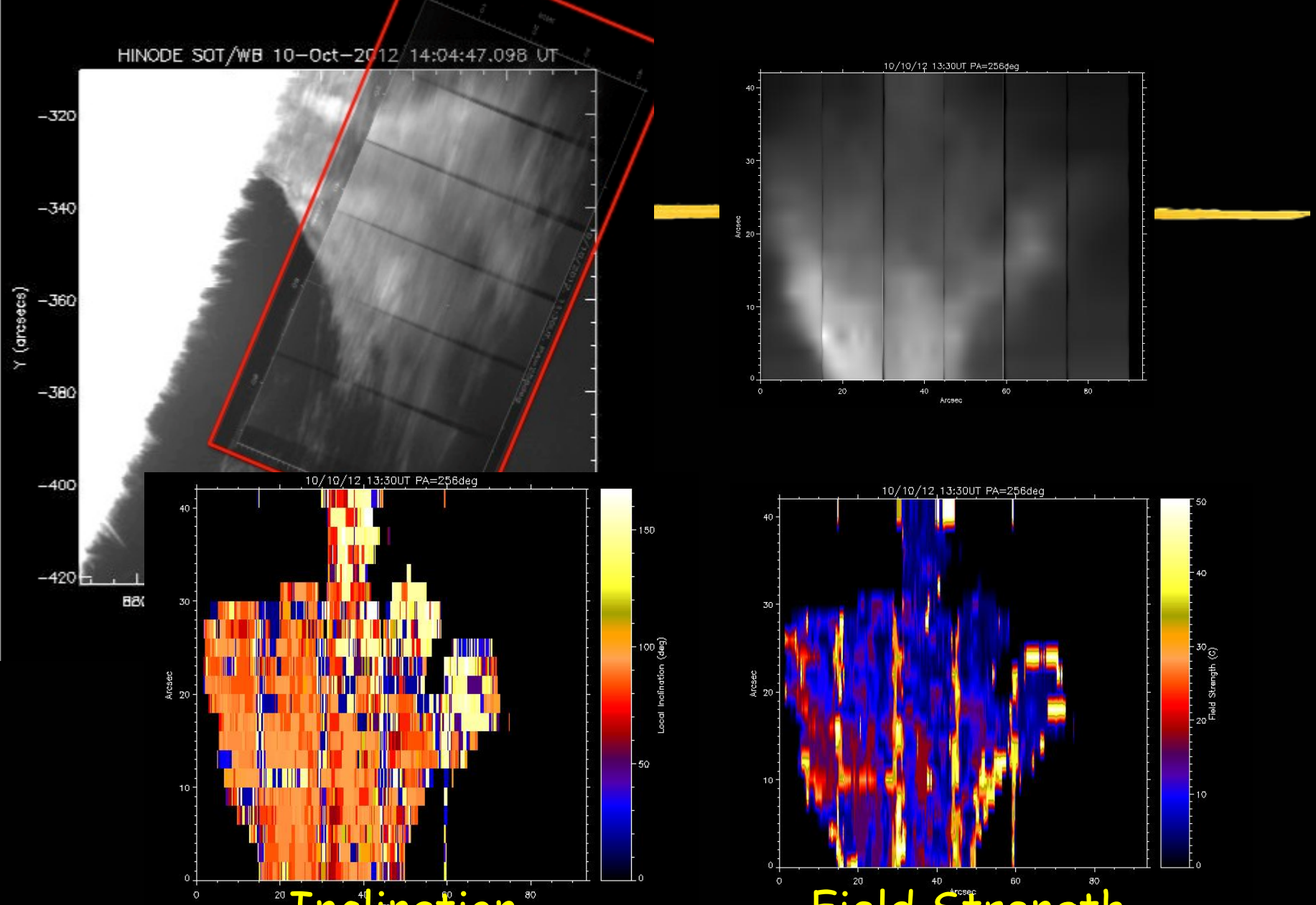


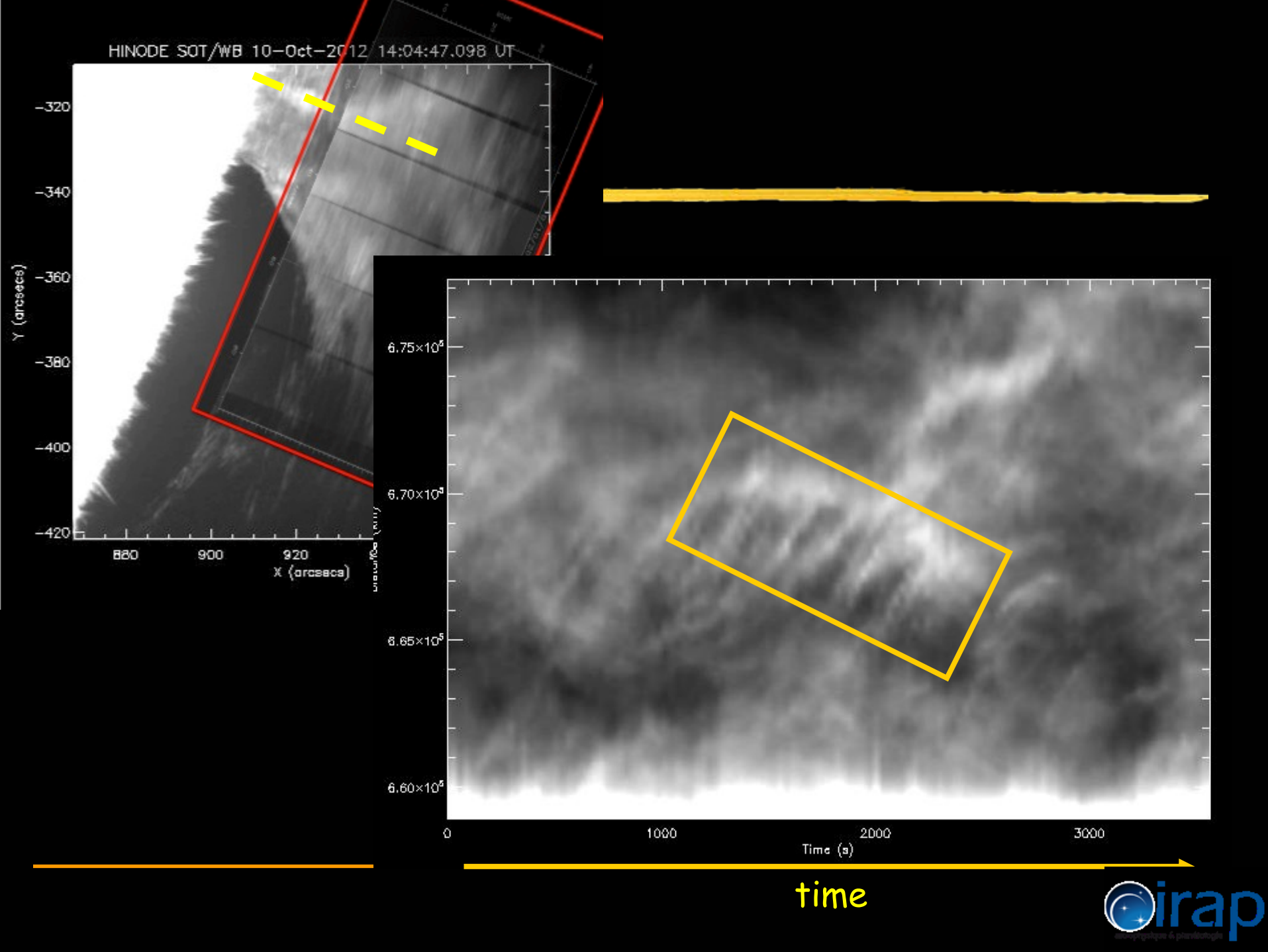
He D3

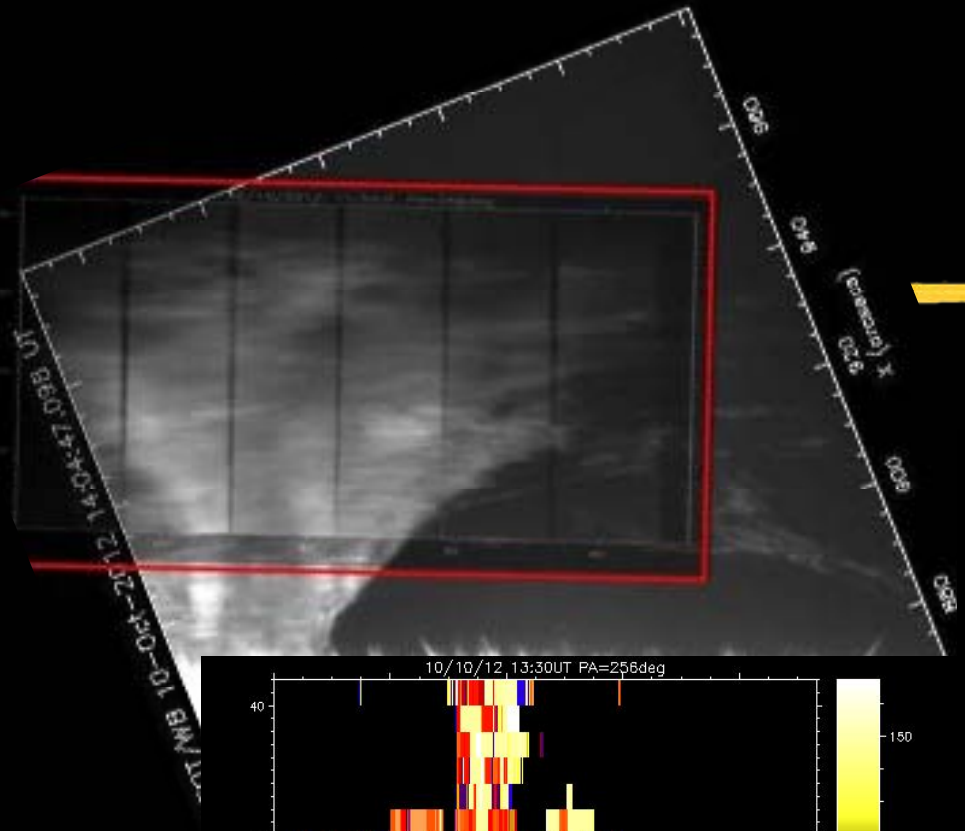

HINODE SOT/WB JAXA/ISAS, SIRIUS 23-May-2014 08:04:31 UT
520
500
480
460
440
420
Y (arcsecs)
820
840
860
880
900
920
X (arcsecs)

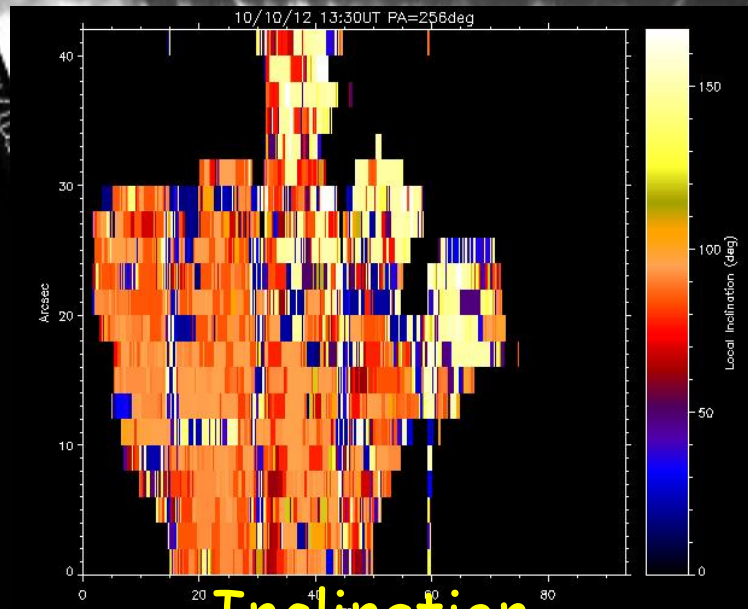

Arcsec
Arcsec
Arcsec
Arcsec


HINODE SOT/WB 10-Oct-2012 14:04:47.098 UT
-320
-340
-360
-380
-400
-420
Y (arcsecs)
880
900
920
940
960
X (arcsecs)

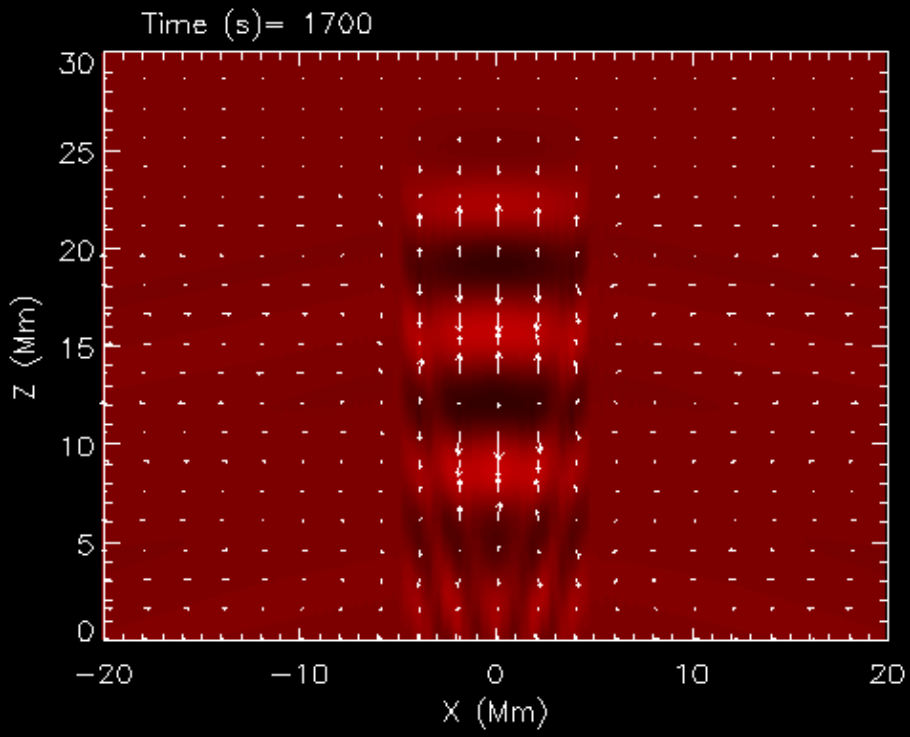

HINODE SOT/WB 10-Oct-2012 14:04:47.098 UT
Y (arcsecs)
-320
-340
-360
-380
-400
-420
10/10/12 13:30UT PA=256deg
Arcsec
Local Inclination (deg)
Field Strength (G)
Inclination
Field Strength


HINODE SOT/WB 10-Oct-2012 14:04:47.098 UT
-320
-340
-360
-380
-400
-420
Y (arcsecs)
880
900
920
X (arcsecs)
6.75×10⁵
6.70×10⁵
6.65×10⁵
6.60×10⁵
0
1000
2000
3000
Time (s)
time



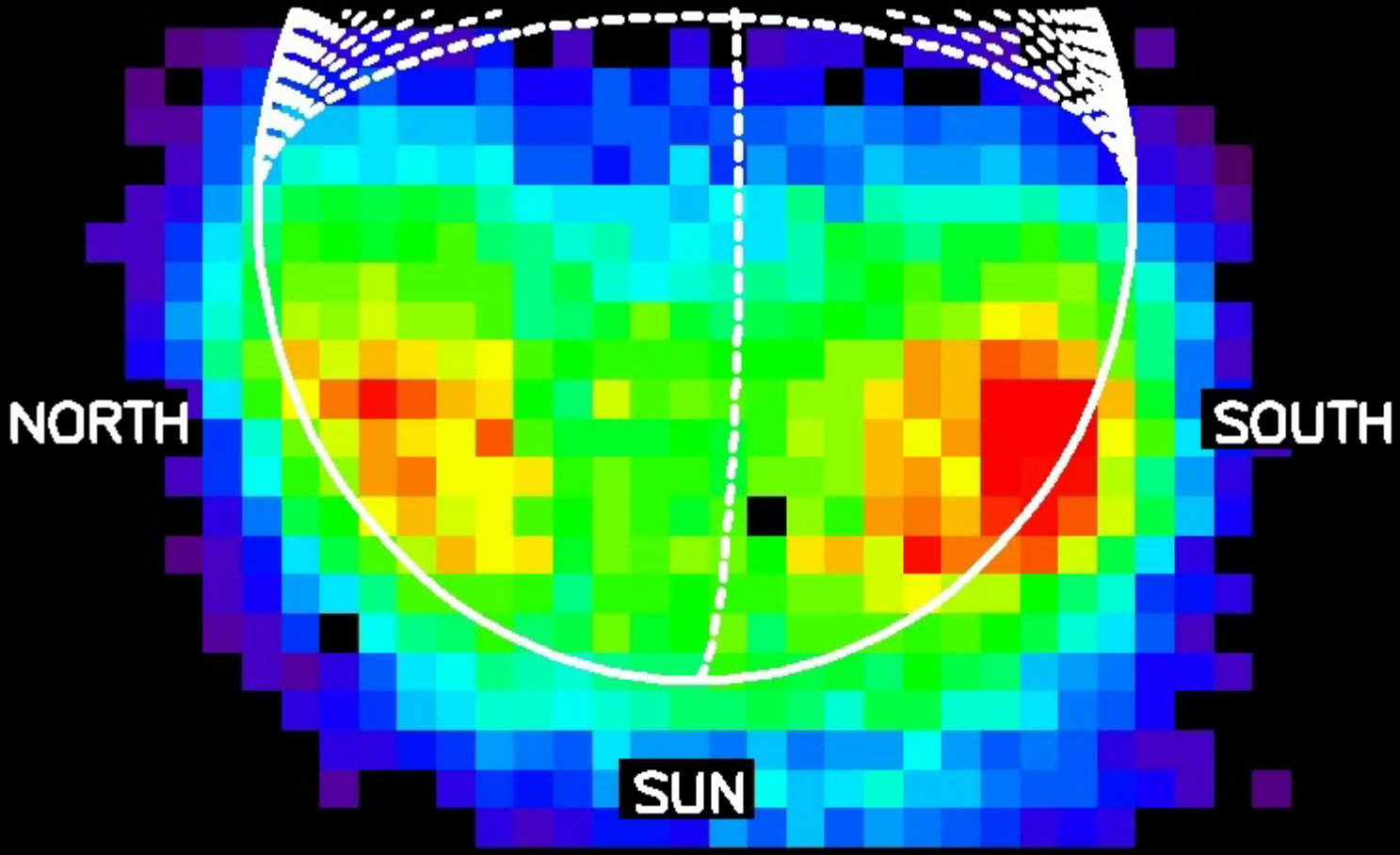


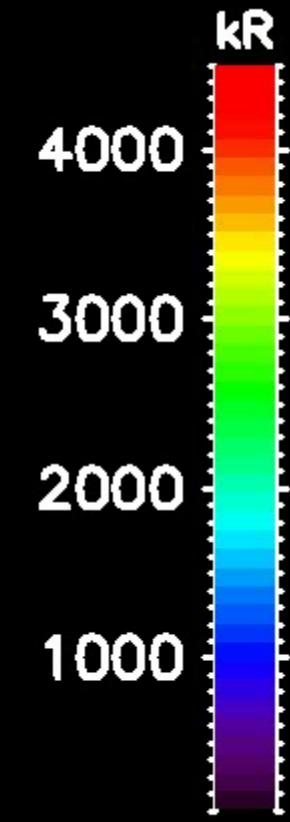
Inclination



Mercury's atmosphere:

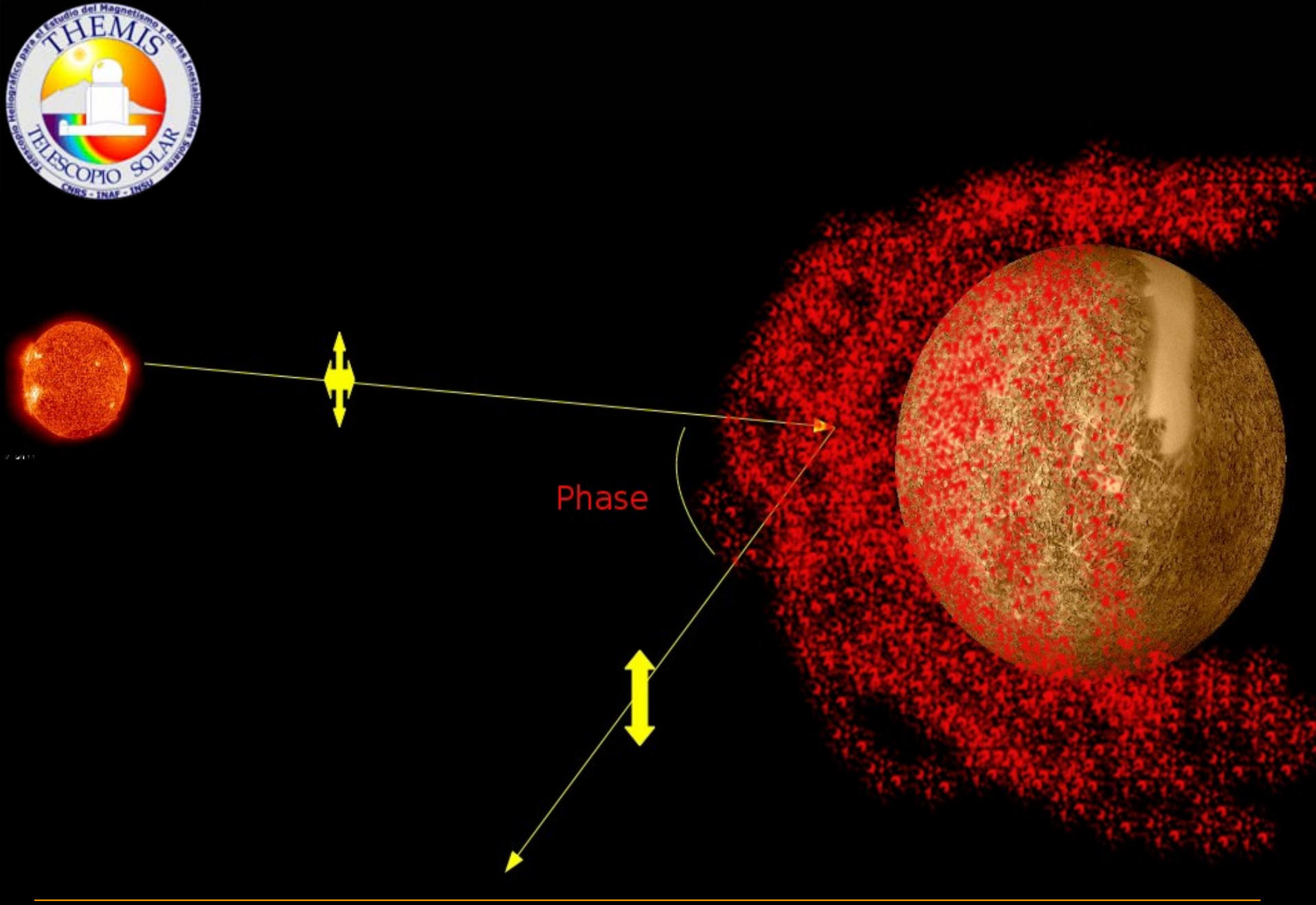
THEMIS
13 Juillet 2008



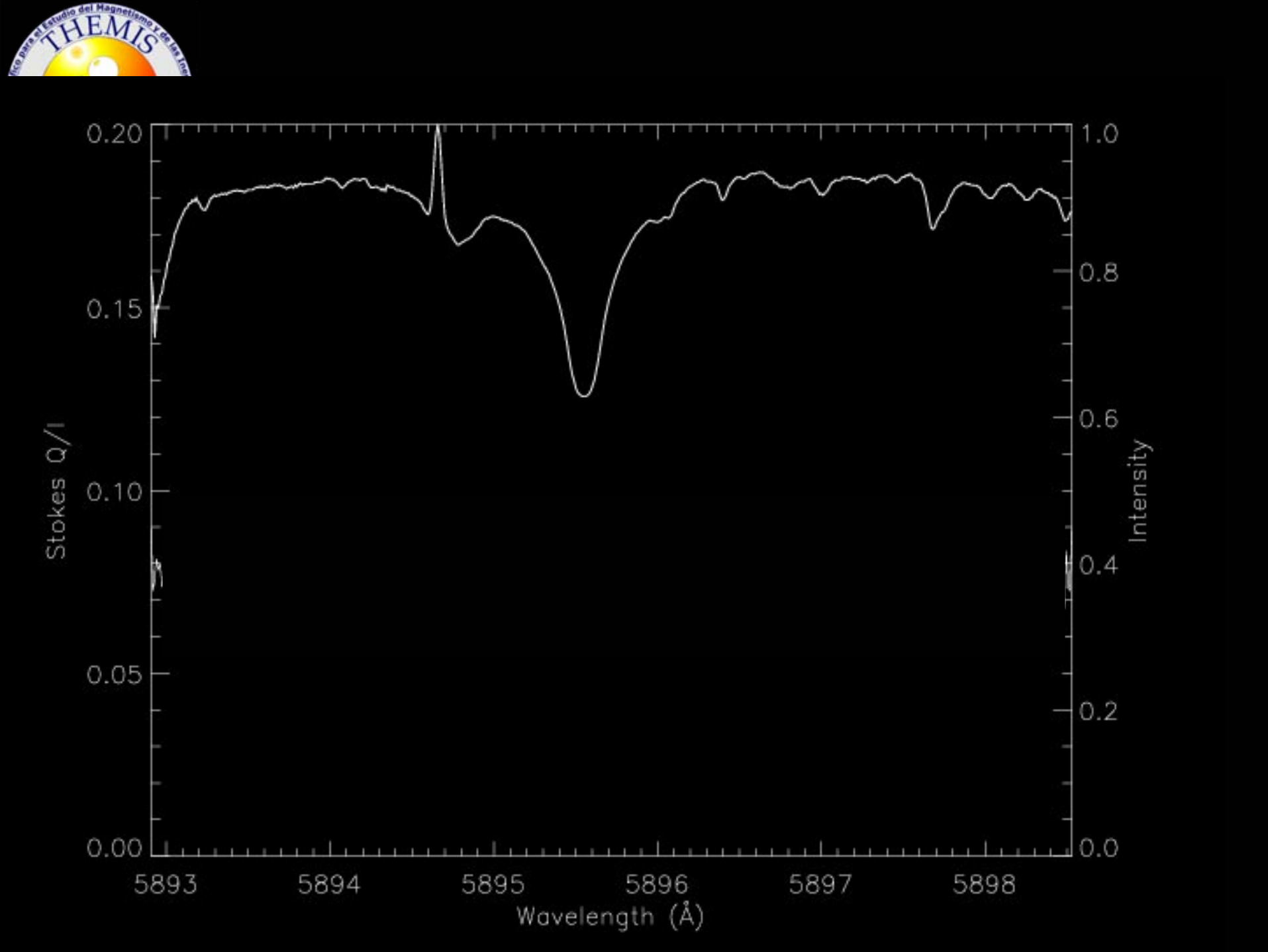


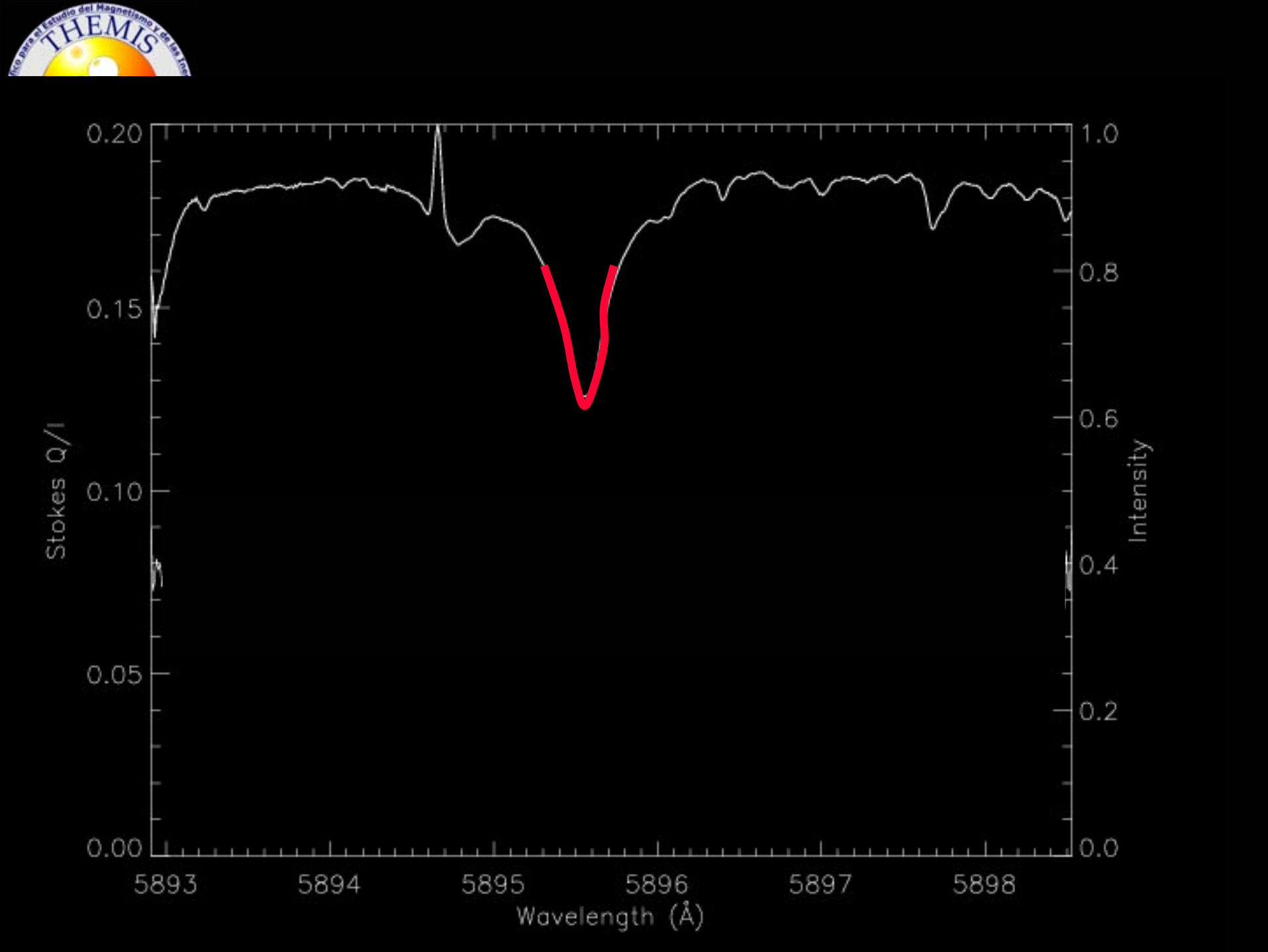
7 hours of continuous mapping.
Coronography at 83 $R_\odot$

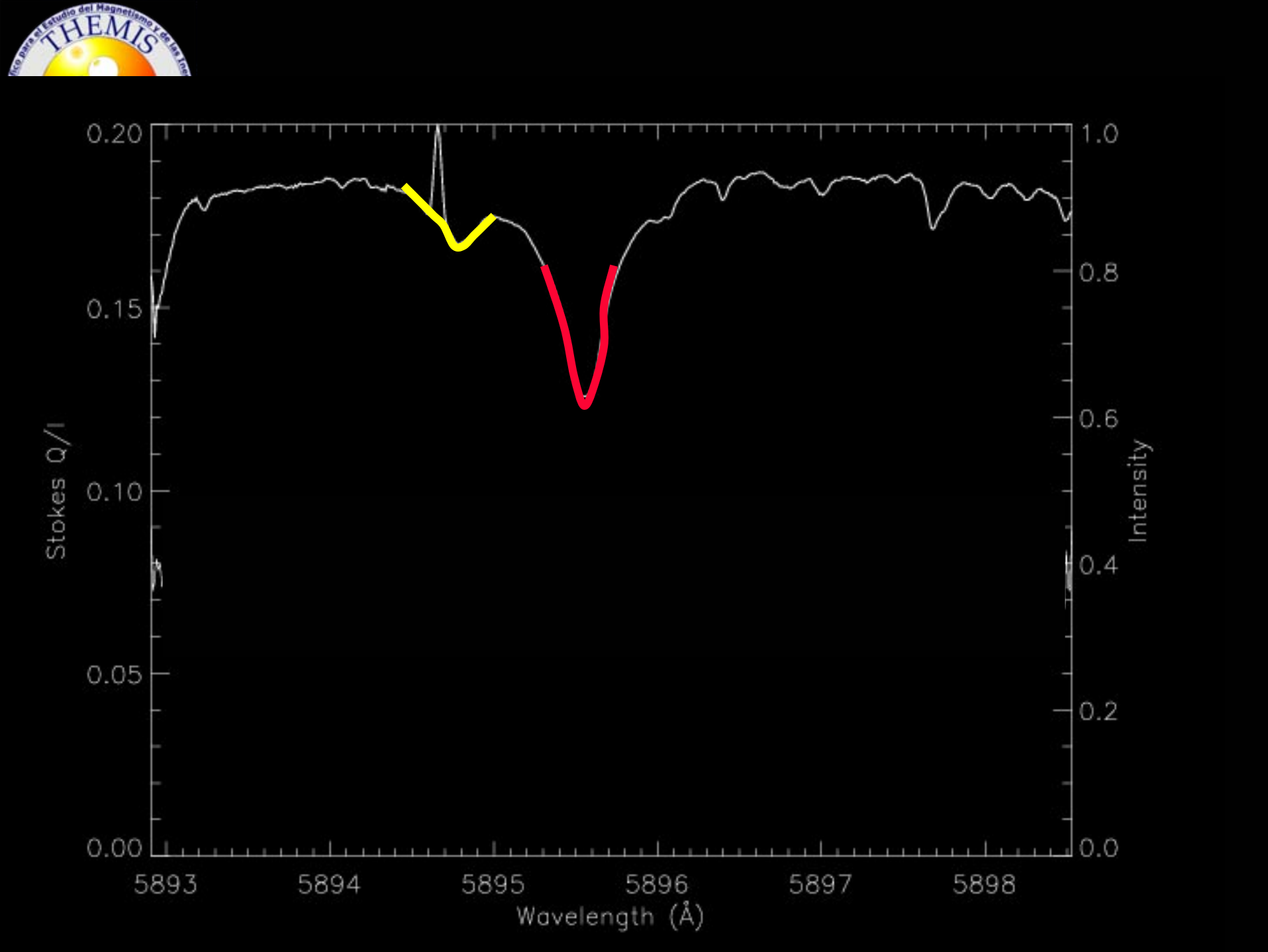
Intensity of the Na $D_{2\,I}$ line

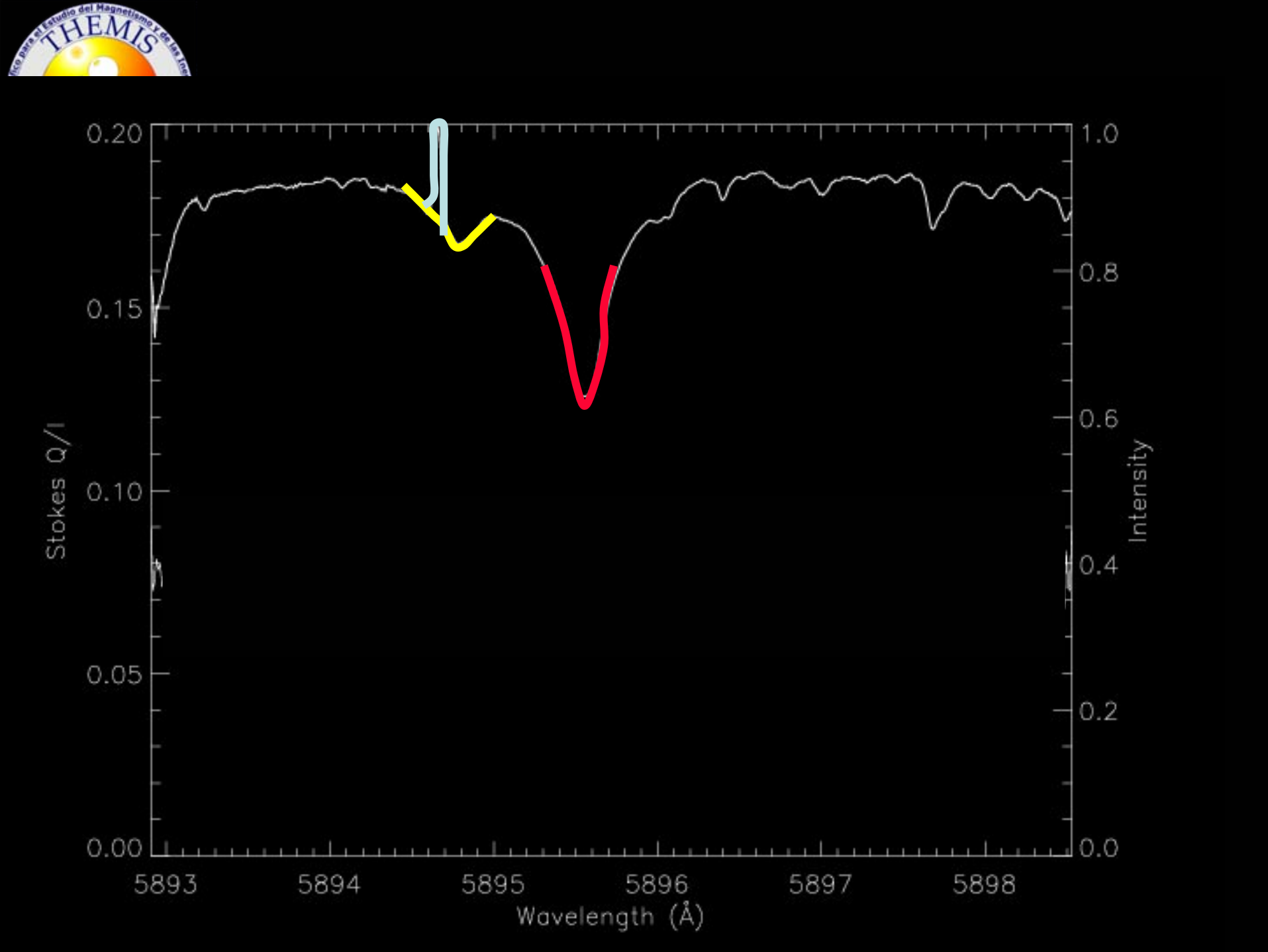

Phase

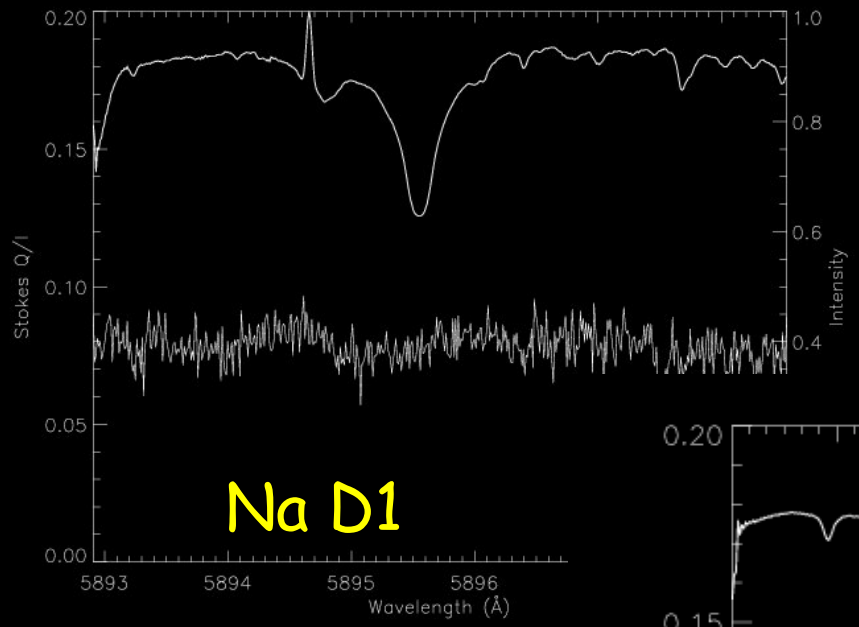
2013-09-23 16:57:41


0.20
0.15
0.10
0.05
0.00
Stokes Q/I
1.0
0.8
0.6
0.4
0.2
0.0
Intensity
5893
5894
5895
5896
5897
5898
Wavelength (Å)


0.20
0.15
0.10
0.05
0.00
Stokes Q/I
1.0
0.8
0.6
0.4
0.2
0.0
Intensity
5893
5894
5895
5896
5897
5898
Wavelength (Å)

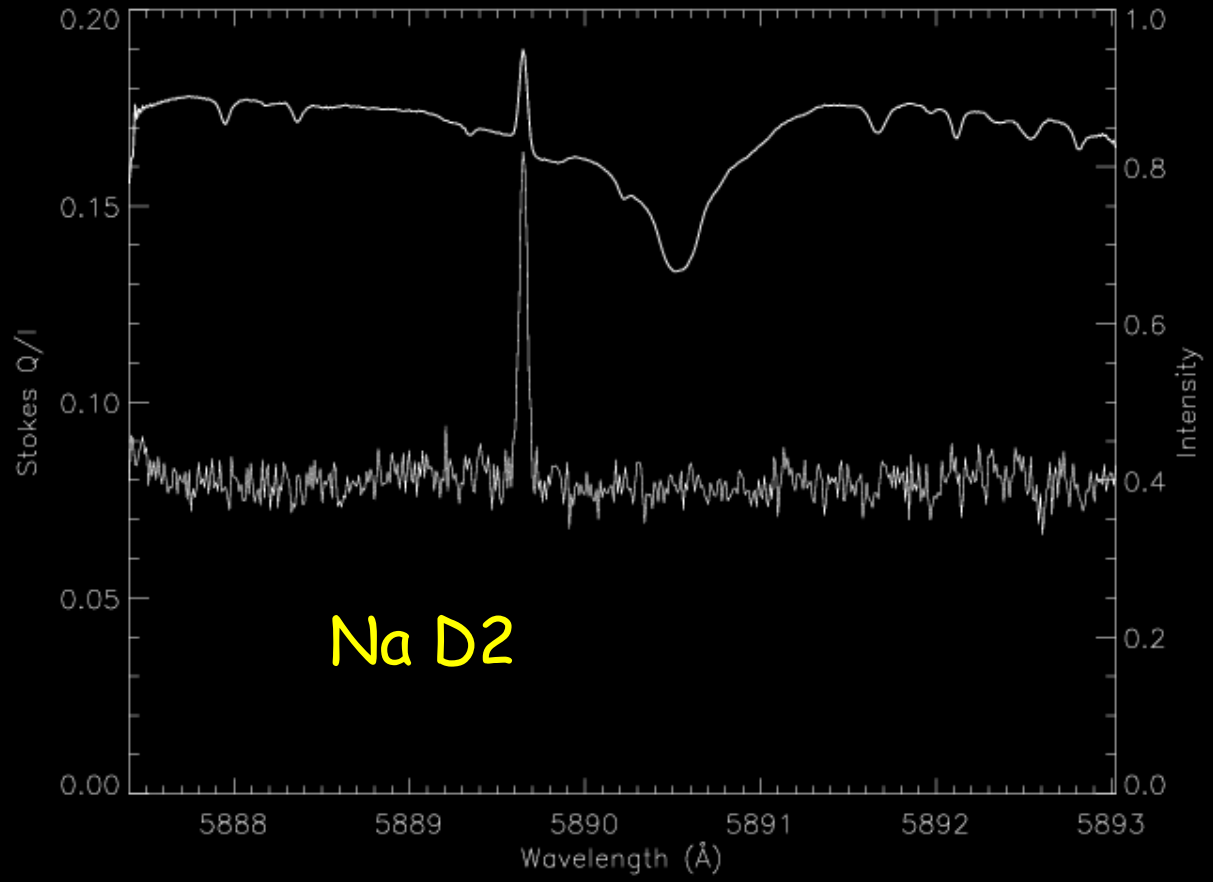

0.20
0.15
0.10
0.05
0.00
Stokes Q/I
1.0
0.8
0.6
0.4
0.2
0.0
Intensity
5893
5894
5895
5896
5897
5898
Wavelength (Å)

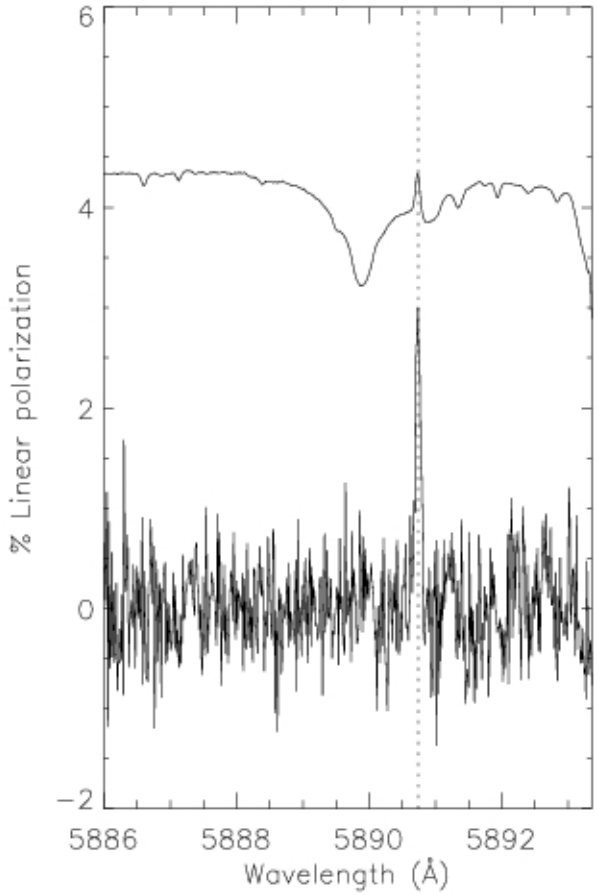

0.20
0.15
0.10
0.05
0.00
Stokes Q/I
1.0
0.8
0.6
0.4
0.2
0.0
Intensity
5893
5894
5895
5896
5897
5898
Wavelength (Å)

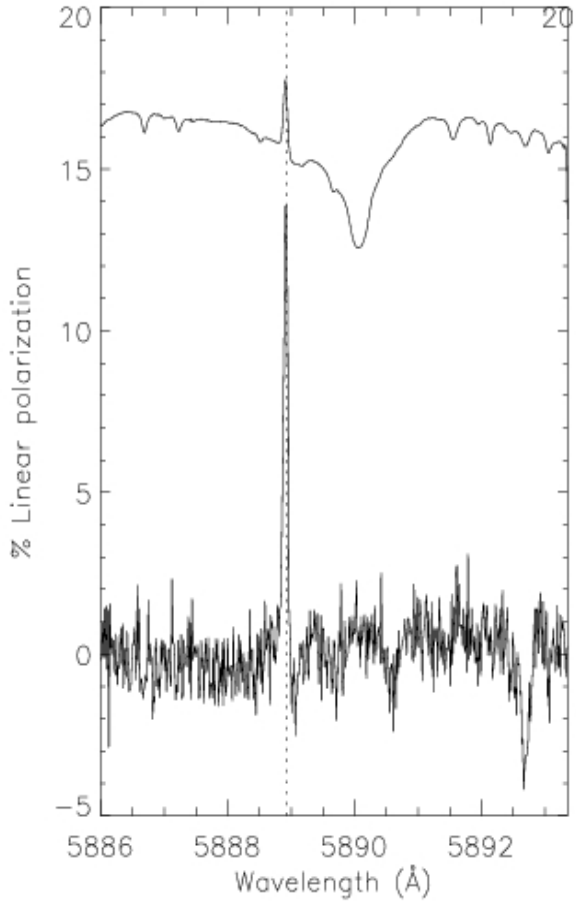


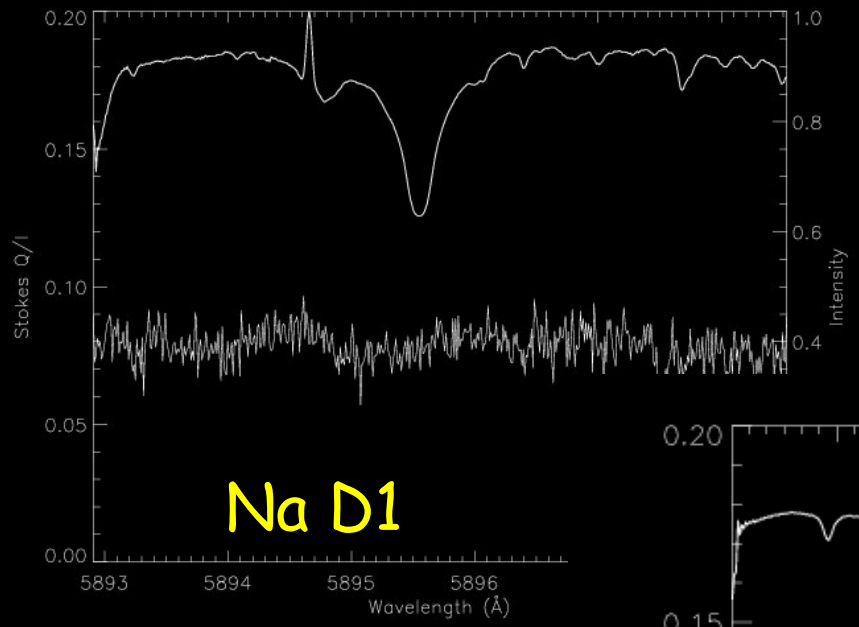
THEMIS POL^3 instrument
October 2010 & April 2011

López Ariste et al. (2011)



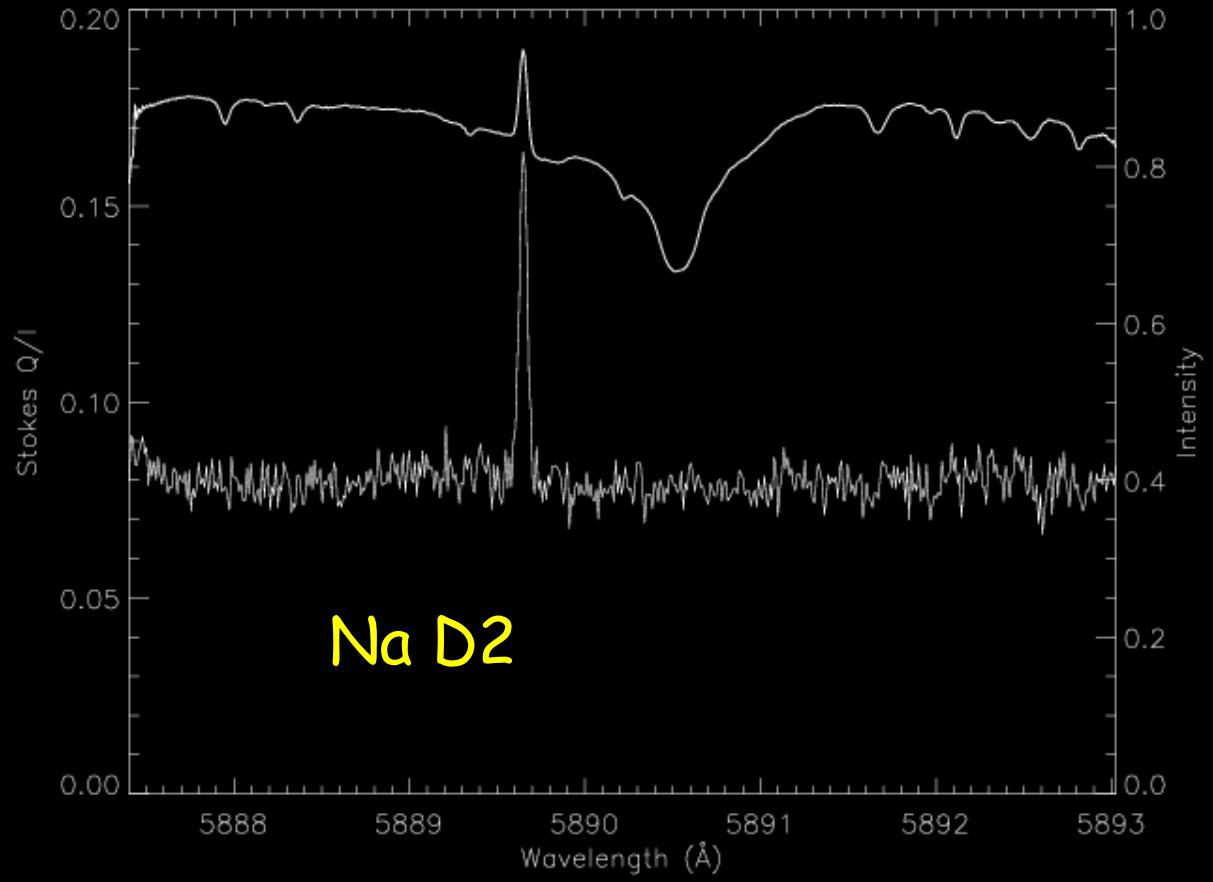

6
4
2
0
−2
% Linear polarization
5886
5888
5890
5892
Wavelength (Å)


20
15
10
5
0
−5
% Linear polarization
5886
5888
5890
5892
Wavelength (Å)

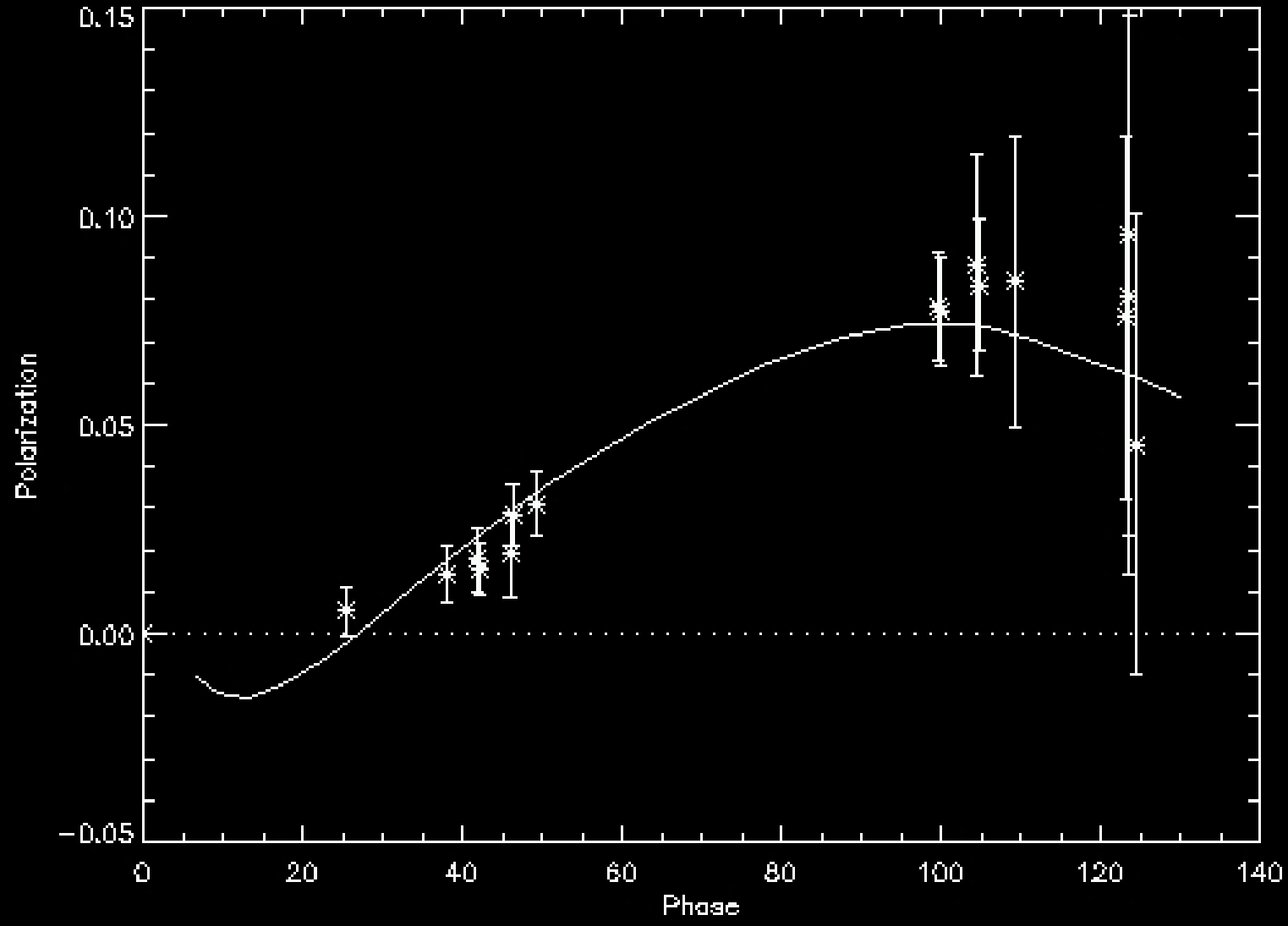


THEMIS POL^3 instrument
October 2010 & April 2011

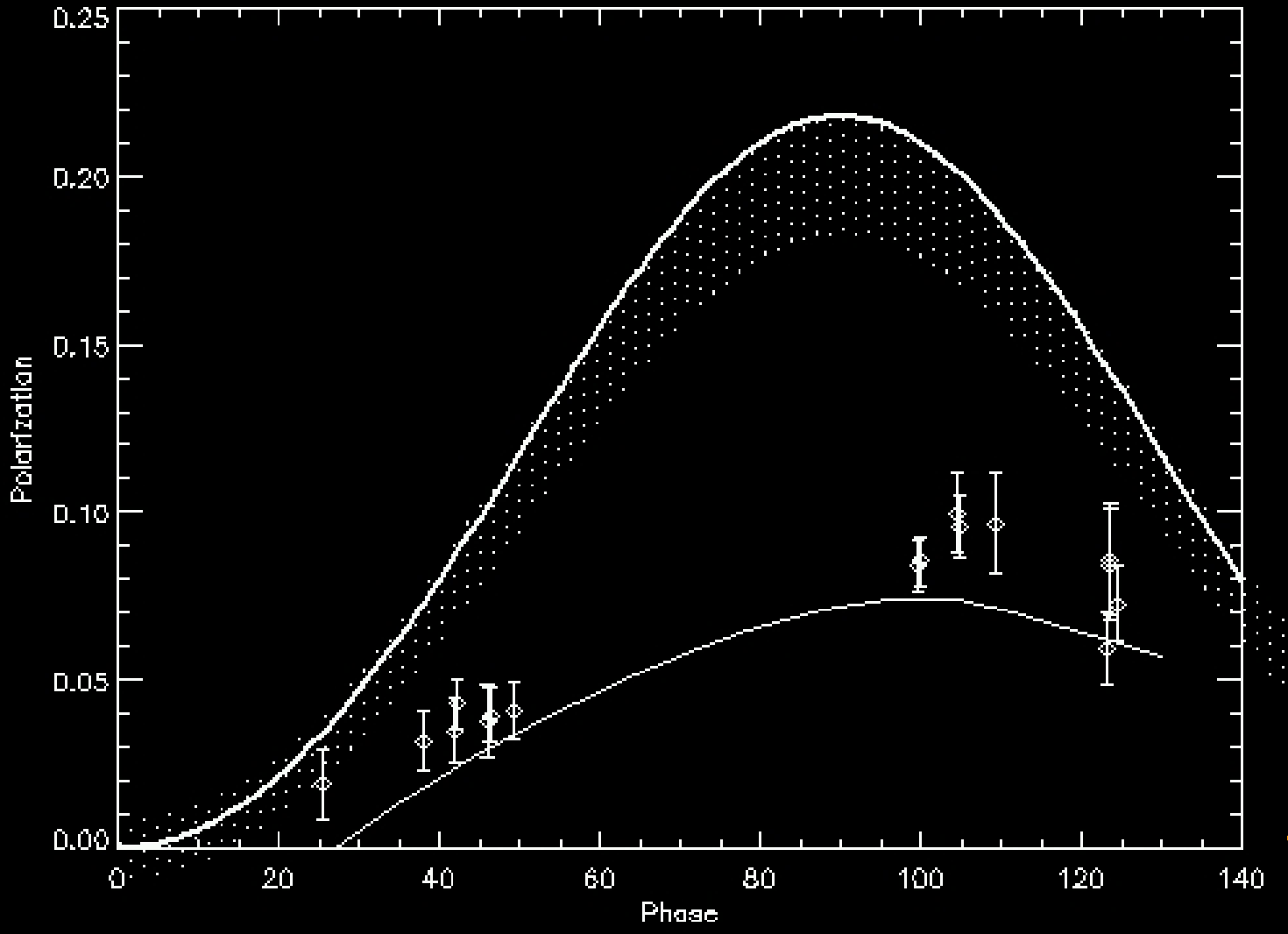
López Ariste et al. (2011)



Polarisation of the continuum

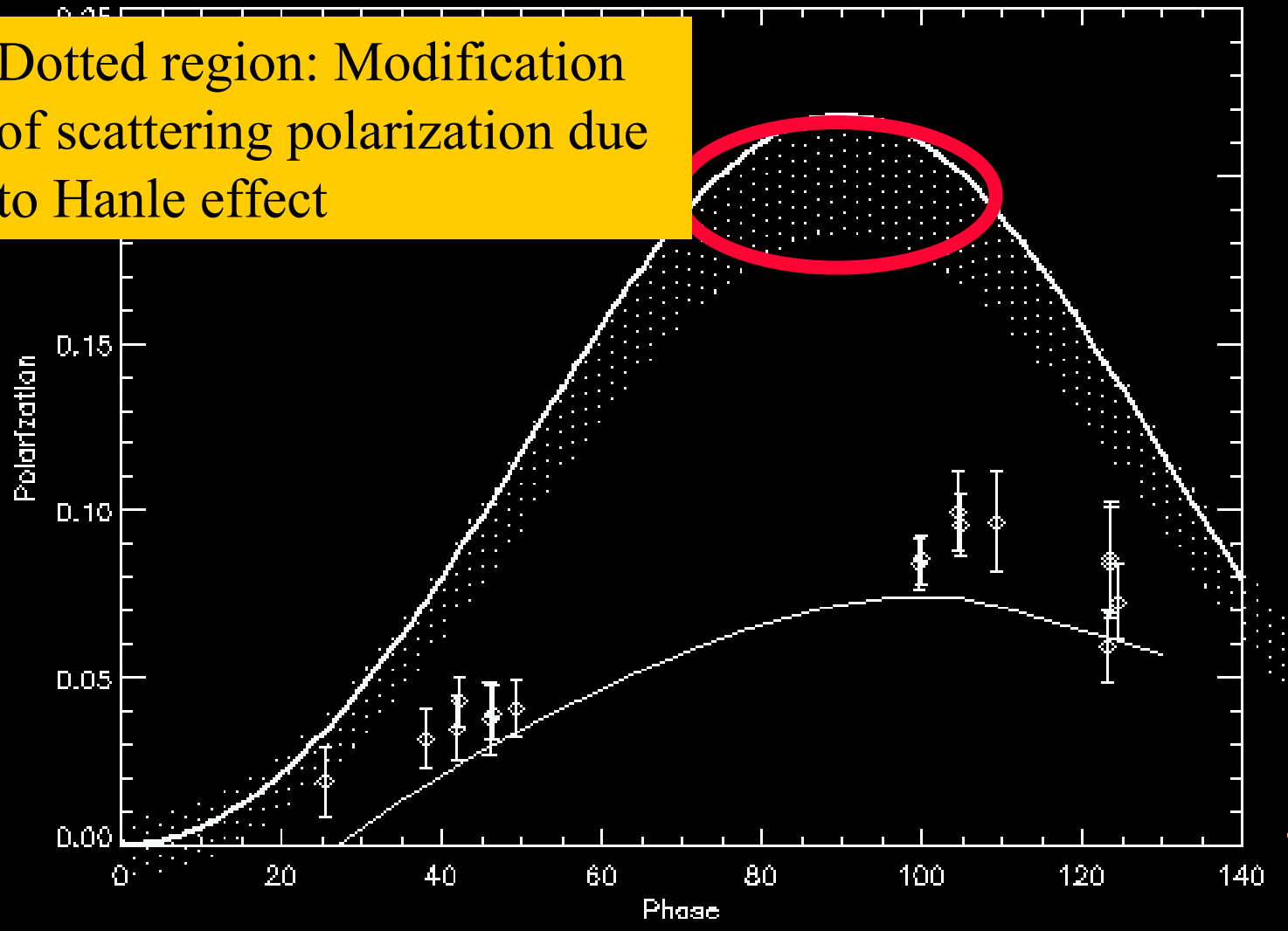


Polarisation of Na D_2



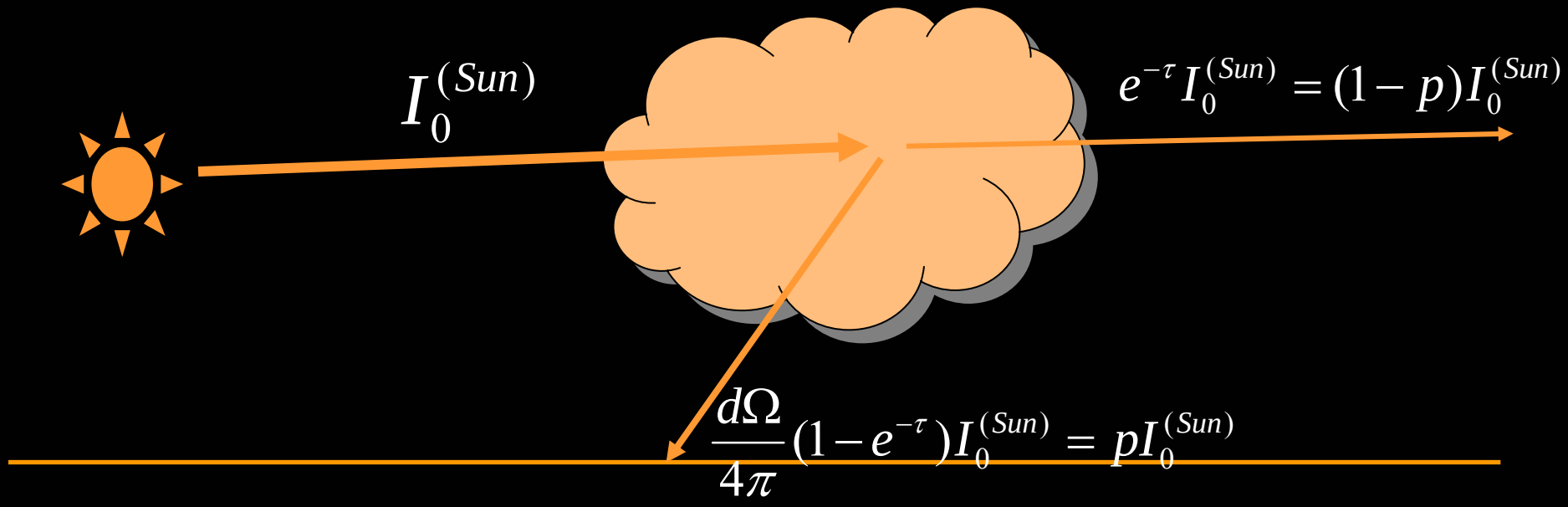
Polarisation of Na D_2

Dotted region: Modification of scattering polarization due to Hanle effect



Radiative transfer effects

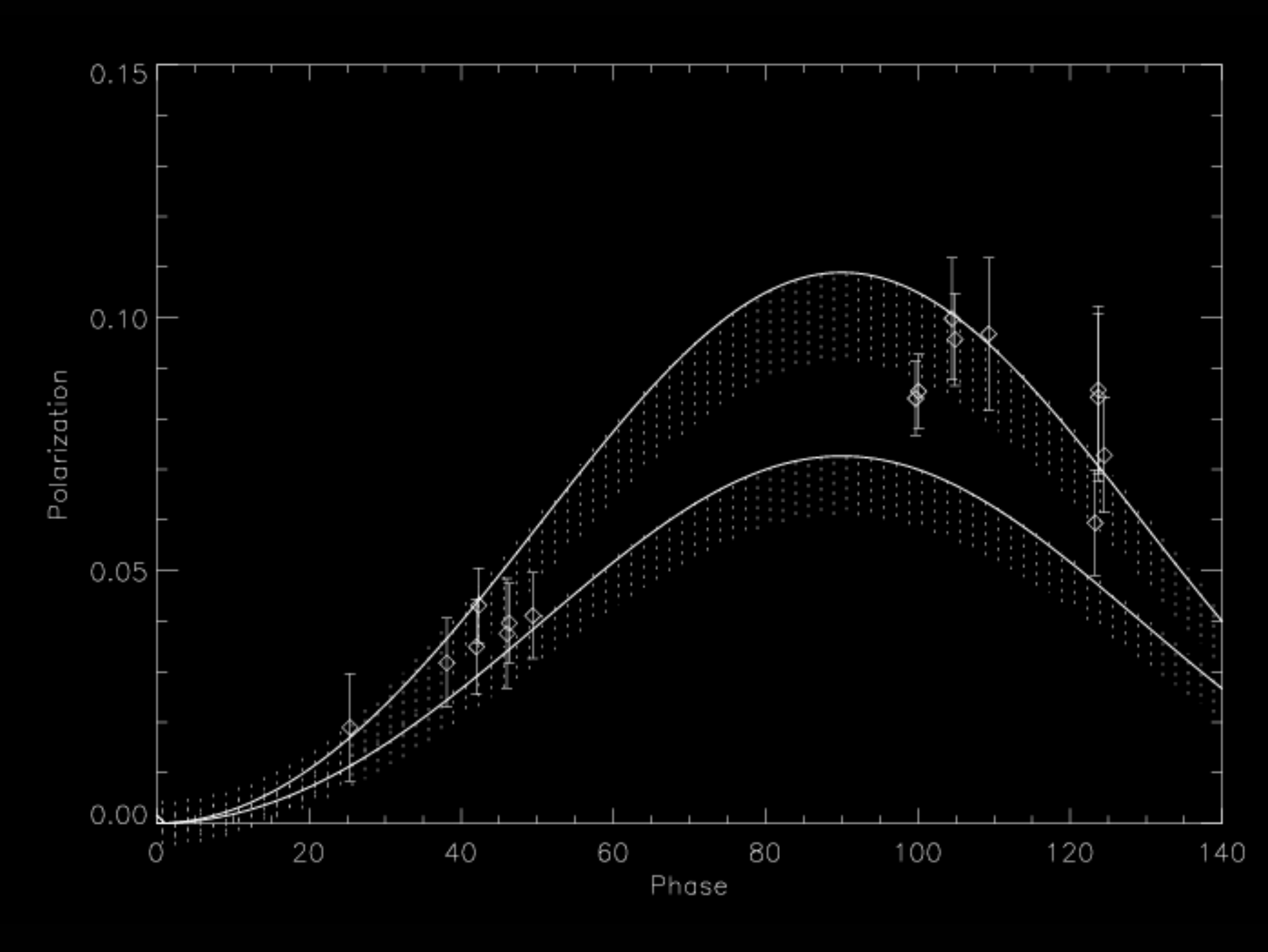
$$M\left(\frac{Q}{I}\right) = \frac{pQ}{pI + p^2 I + p^3 I + \cdots}$$



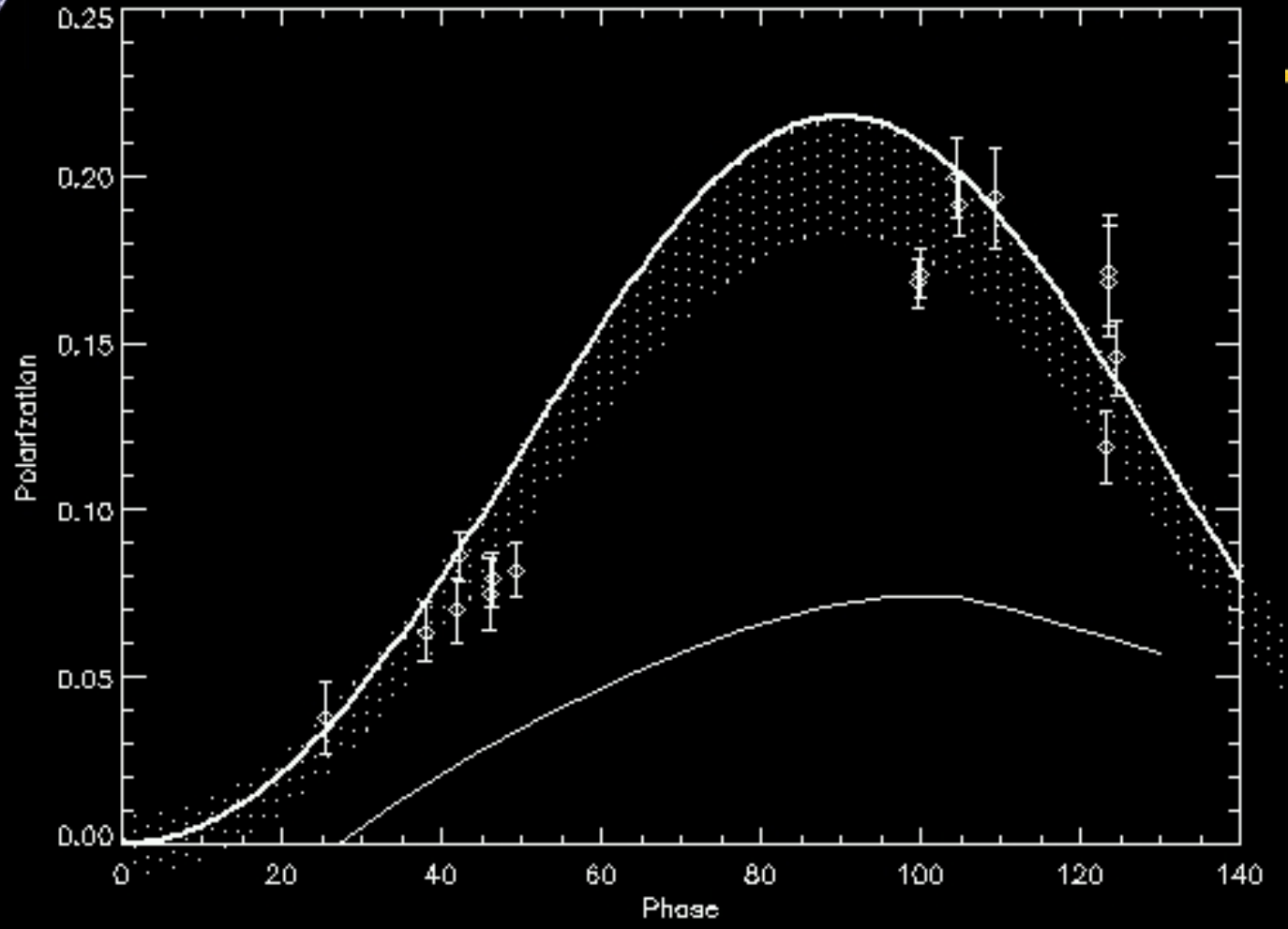
From D_2/D_1 intensity ratios and models of the exosphere of Mercury

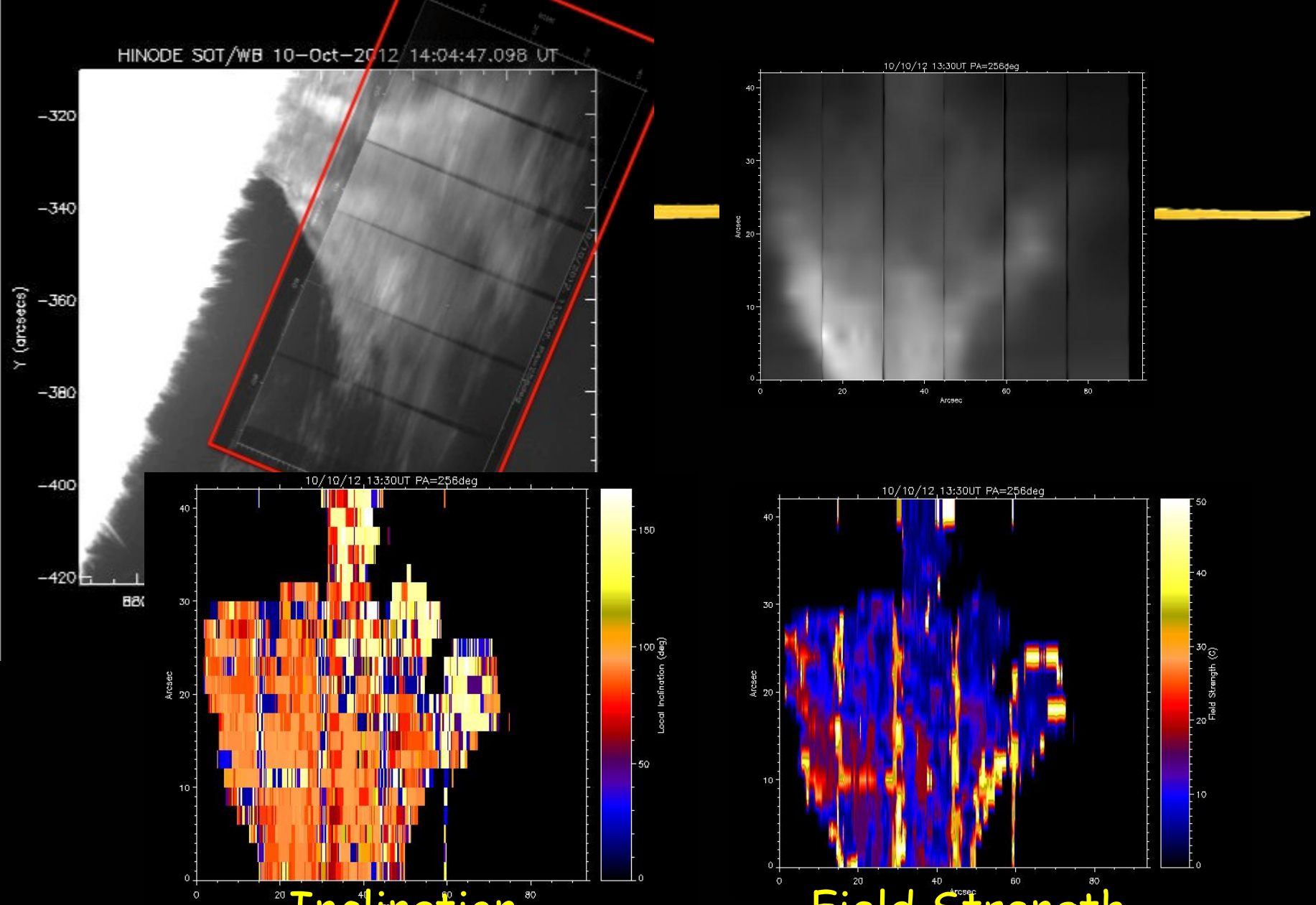
$$\tau = 1 \rightarrow 1.5$$

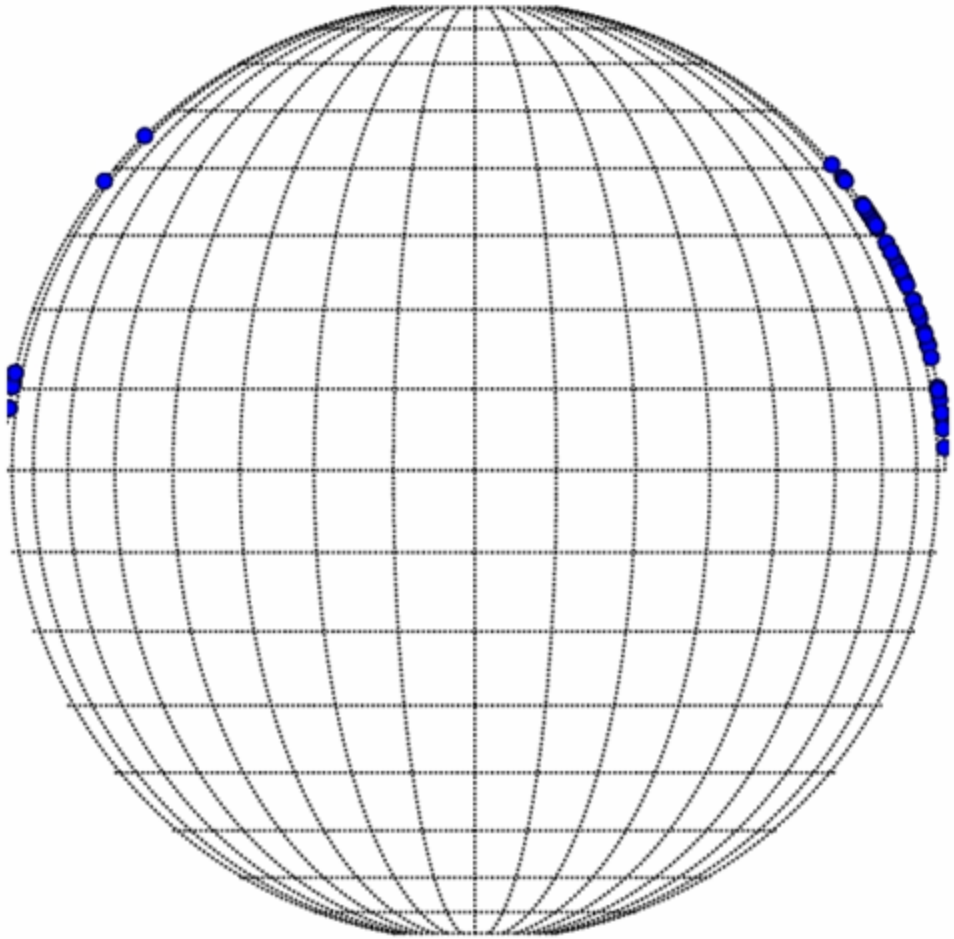
$$p = 0.6 \rightarrow 0.8$$

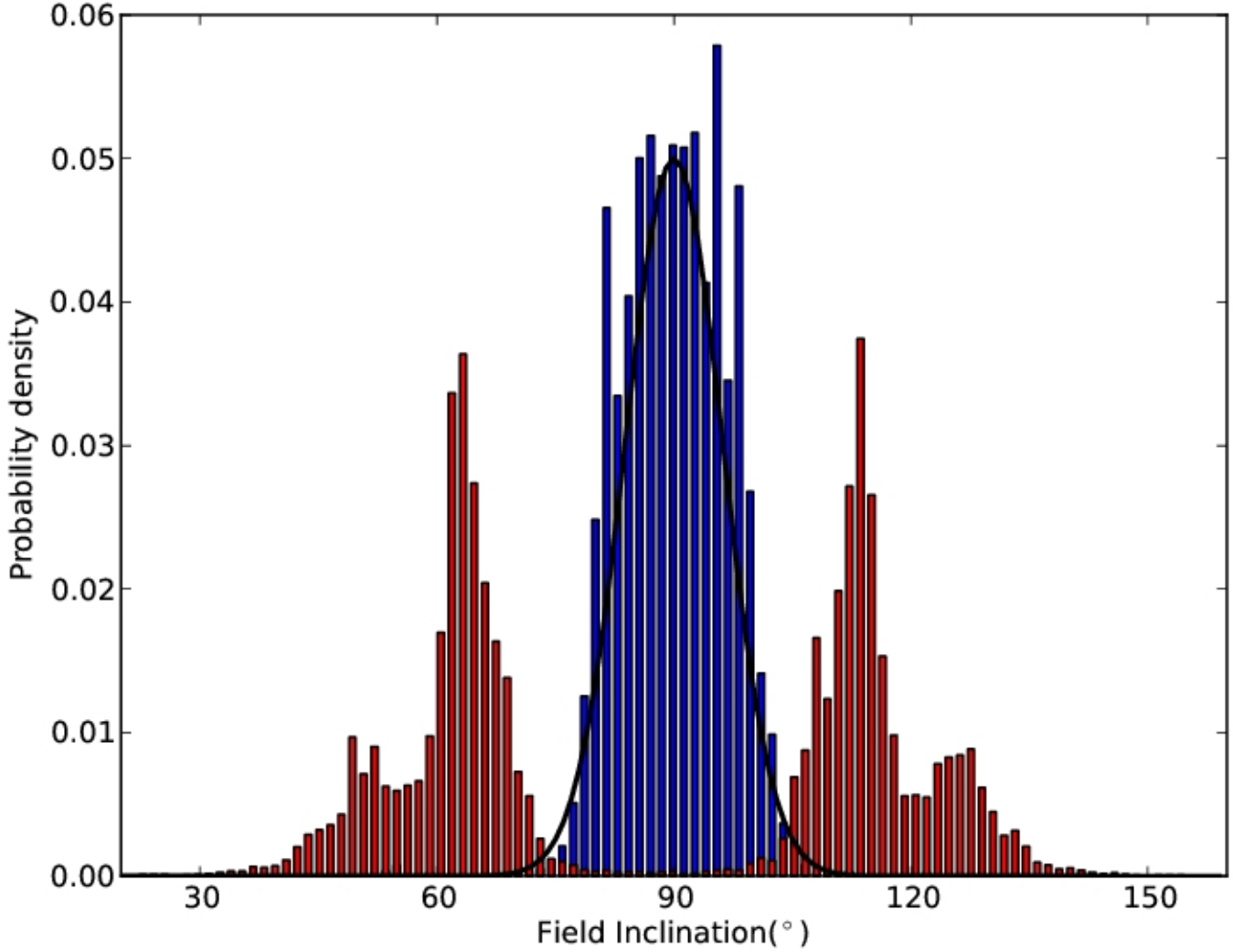

0.15
0.10
0.05
0.00
Polarization
0
20
40
60
80
100
120
140
Phase

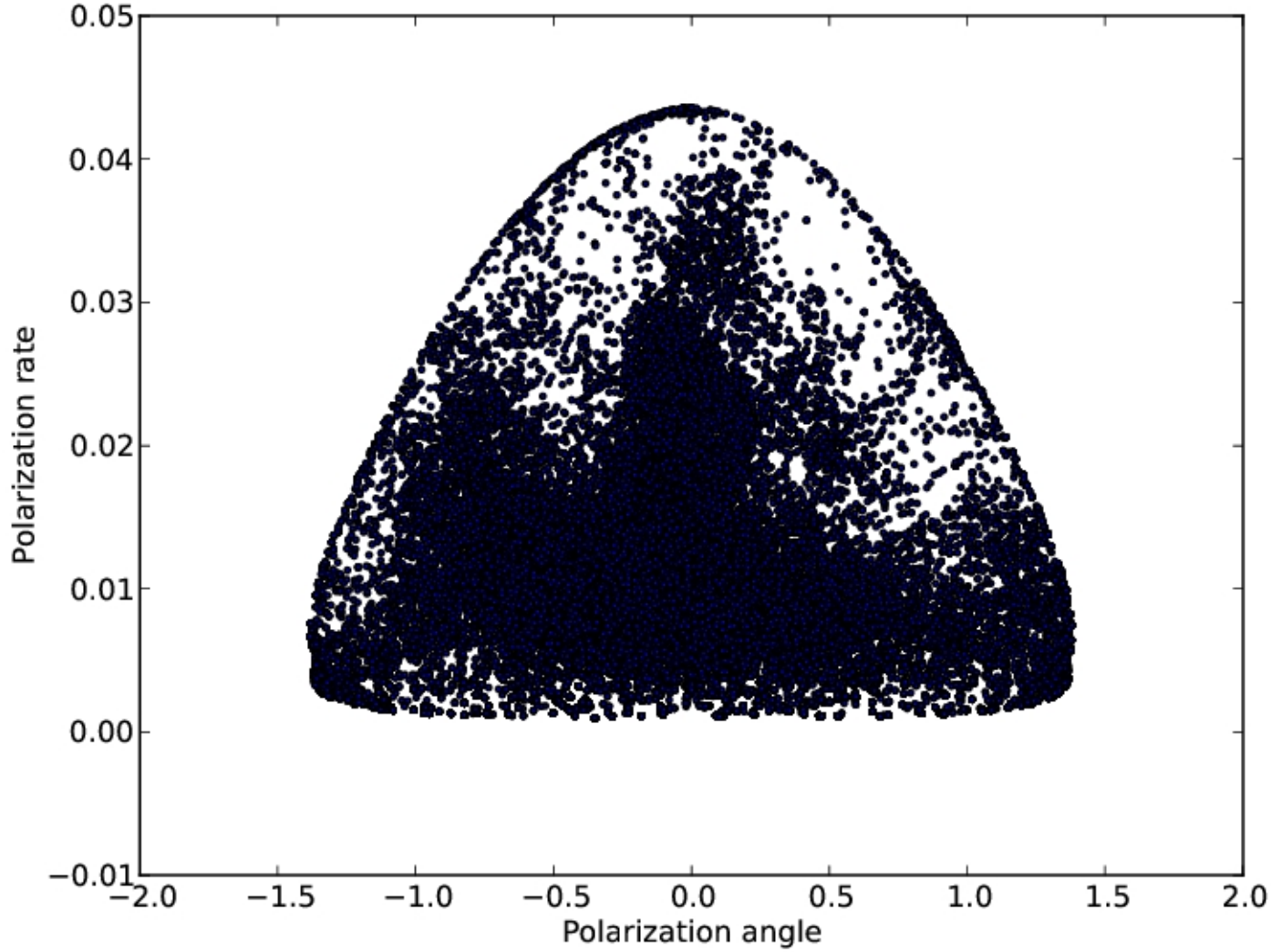
If $\tau = 1.3$

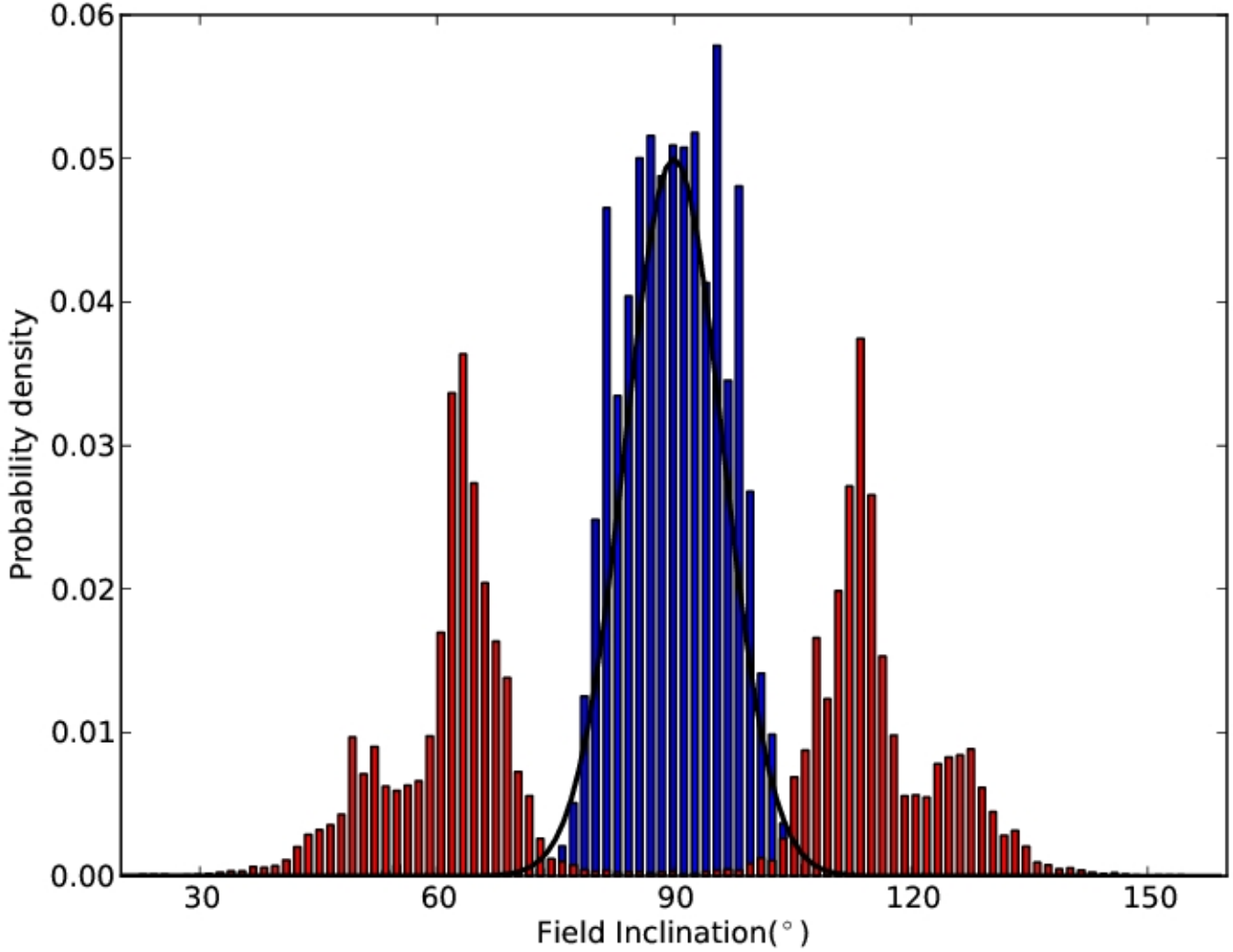

0.25
0.20
0.15
0.10
0.05
0.00
Polarization
0
20
40
60
80
100
120
140
Phase

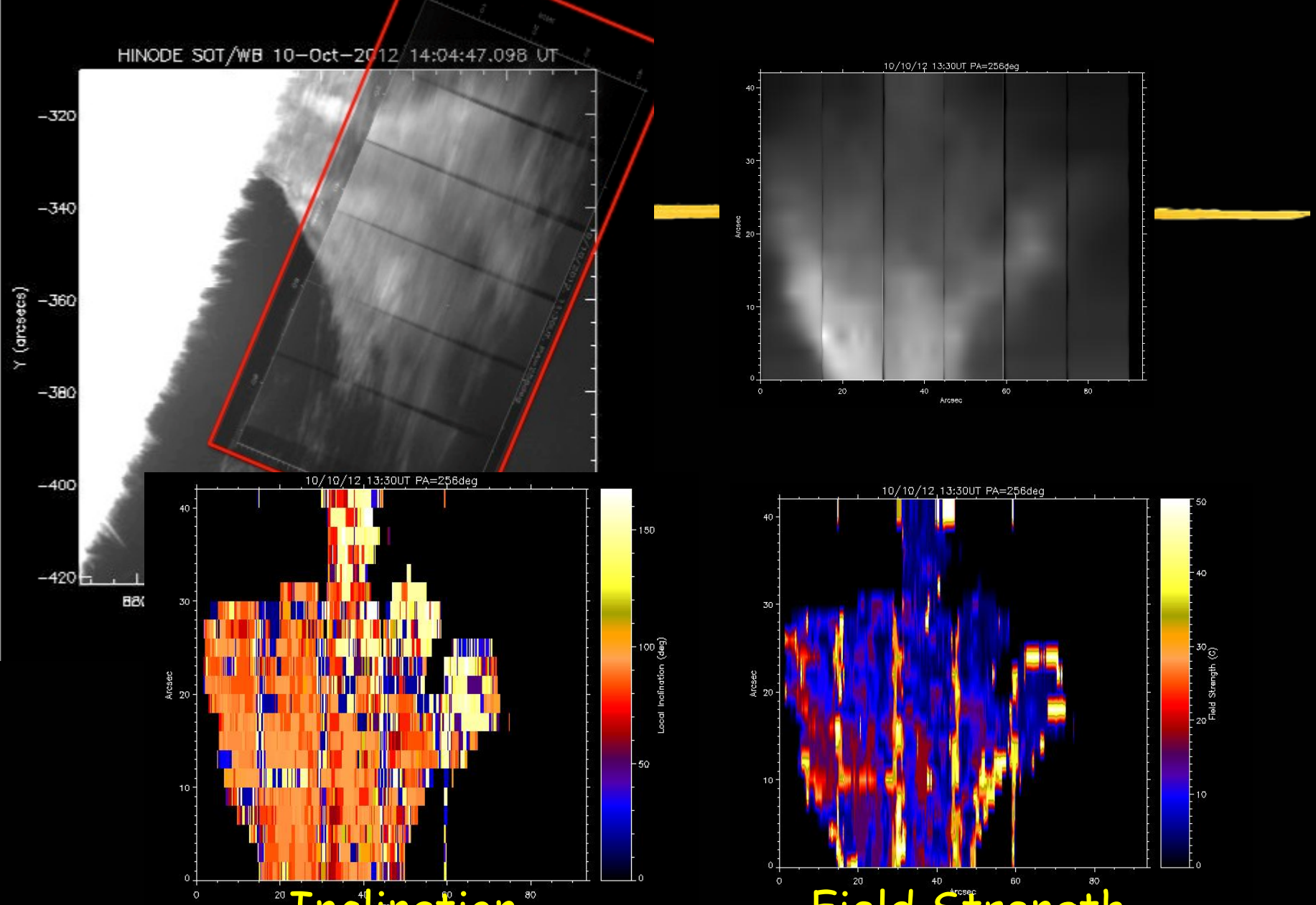

HINODE SOT/WB 10-Oct-2012 14:04:47.098 UT
Y (arcsecs)
-320
-340
-360
-380
-400
-420
10/10/12 13:30UT PA=256deg
Arcsec
Local Inclination (deg)
Field Strength (G)
Inclination
Field Strength



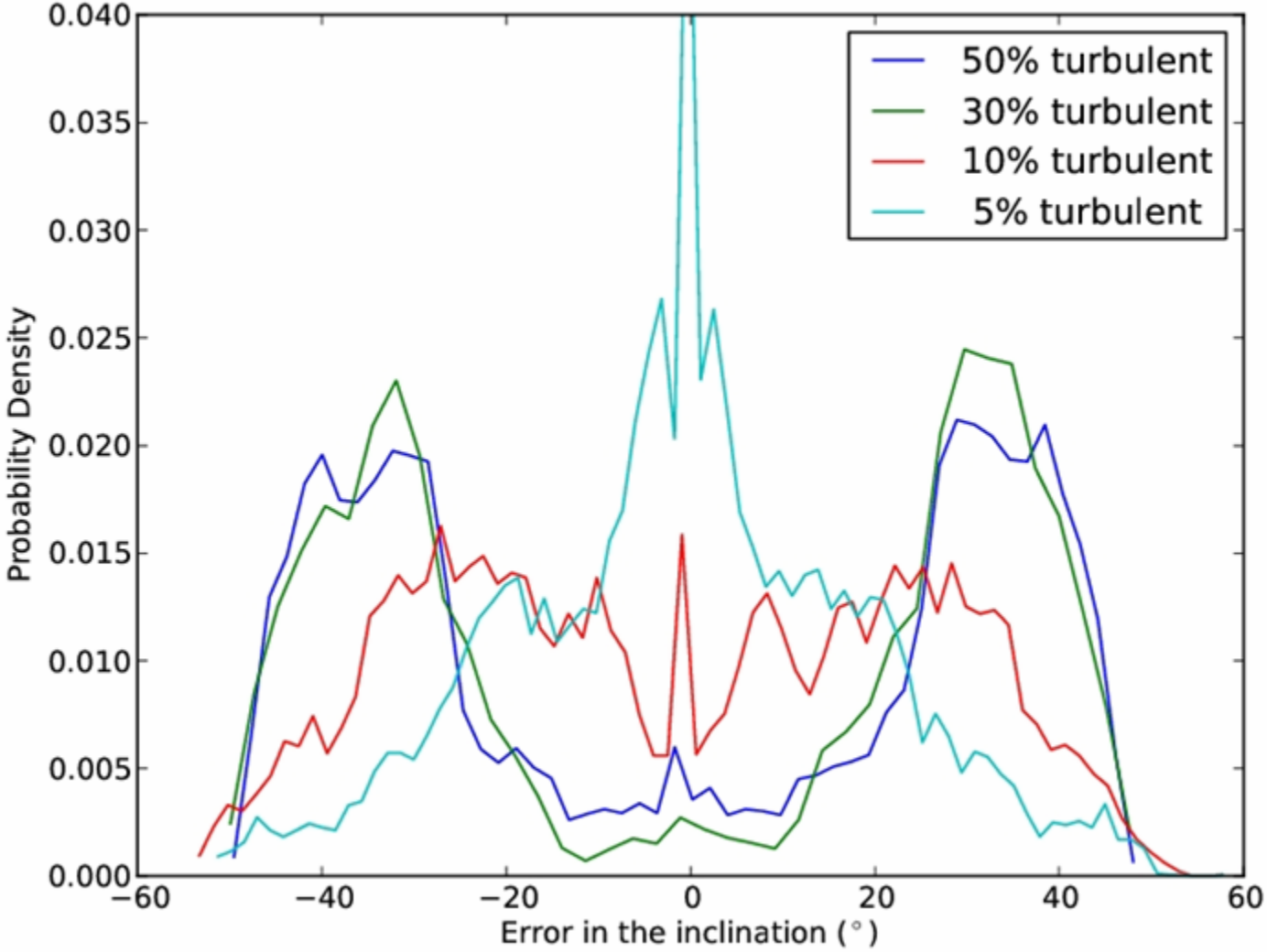

0.06
0.05
0.04
0.03
0.02
0.01
0.00
Probability density
30
60
90
120
150
Field Inclination(°)

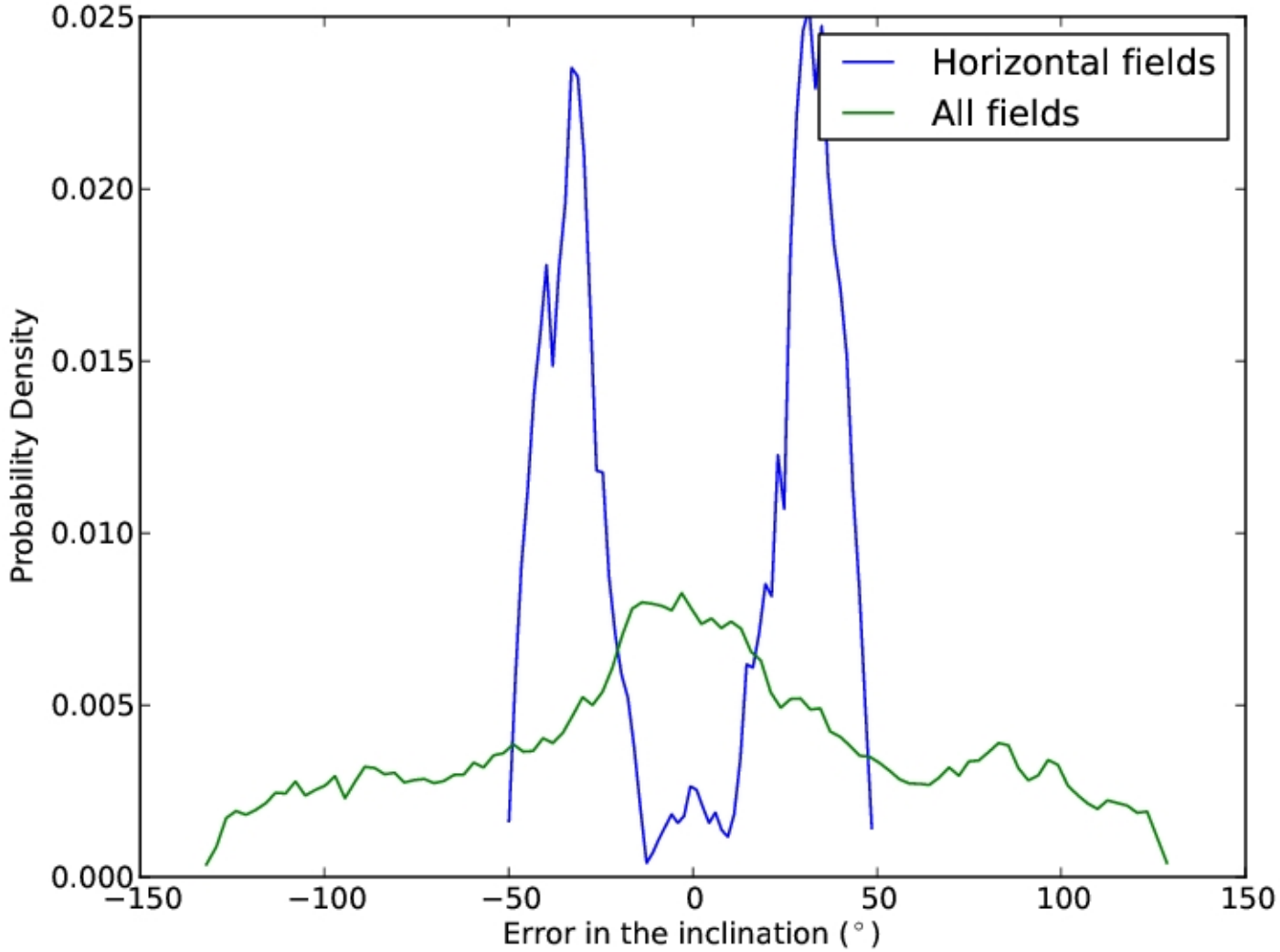

0.05
0.04
0.03
0.02
0.01
0.00
−0.01
Polarization rate
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
Polarization angle

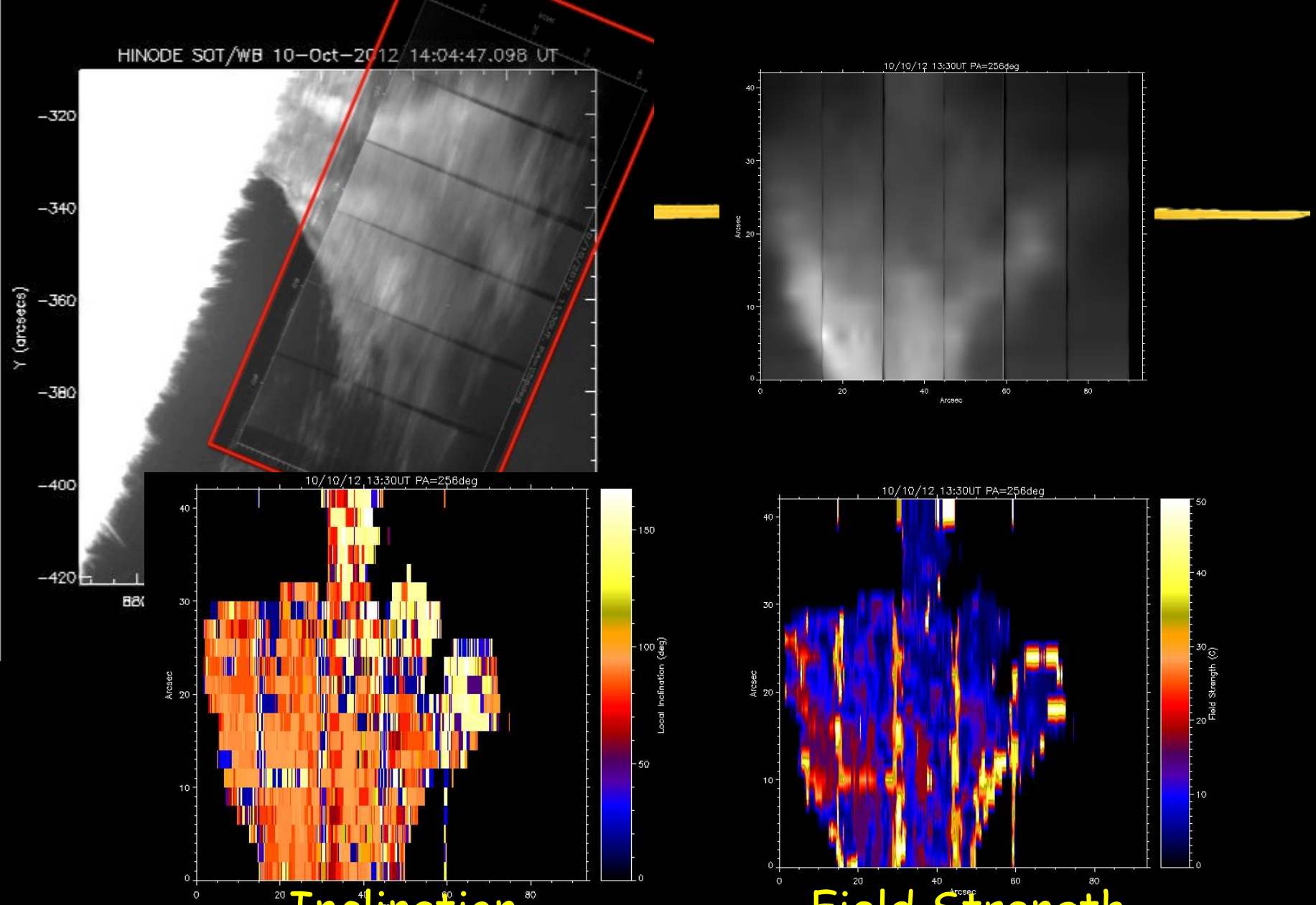

0.06
0.05
0.04
0.03
0.02
0.01
0.00
Probability density
30
60
90
120
150
Field Inclination(°)


HINODE SOT/WB 10-Oct-2012 14:04:47.098 UT
Y (arcsecs)
-320
-340
-360
-380
-400
-420
10/10/12 13:30UT PA=256deg
Arcsec
Local Inclination (deg)
Field Strength (G)
Inclination
Field Strength

INVERSION RELIES ON MODELS




Horizontal fields
All fields
Probability Density
0.025
0.020
0.015
0.010
0.005
0.000
−150
−100
−50
0
50
100
150
Error in the inclination (°)


HINODE SOT/WB 10-Oct-2012 14:04:47.098 UT
Y (arcsecs)
-320
-340
-360
-380
-400
-420
10/10/12 13:30UT PA=256deg
Arcsec
Local Inclination (deg)
Field Strength (G)
Inclination
Field Strength

PCA Inversion Code
NOAA 0651
LOS
iXon1 /V
Xenics
iXon2 /V
Ixon2
iXon3 /V
Ixon3
He 10830 Å
He D3
5786 Å
Hα
BLACK BOX
StrSwitch EC Series
iXon5 /V
Ixon5
iXon6 /V
Ixon6

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