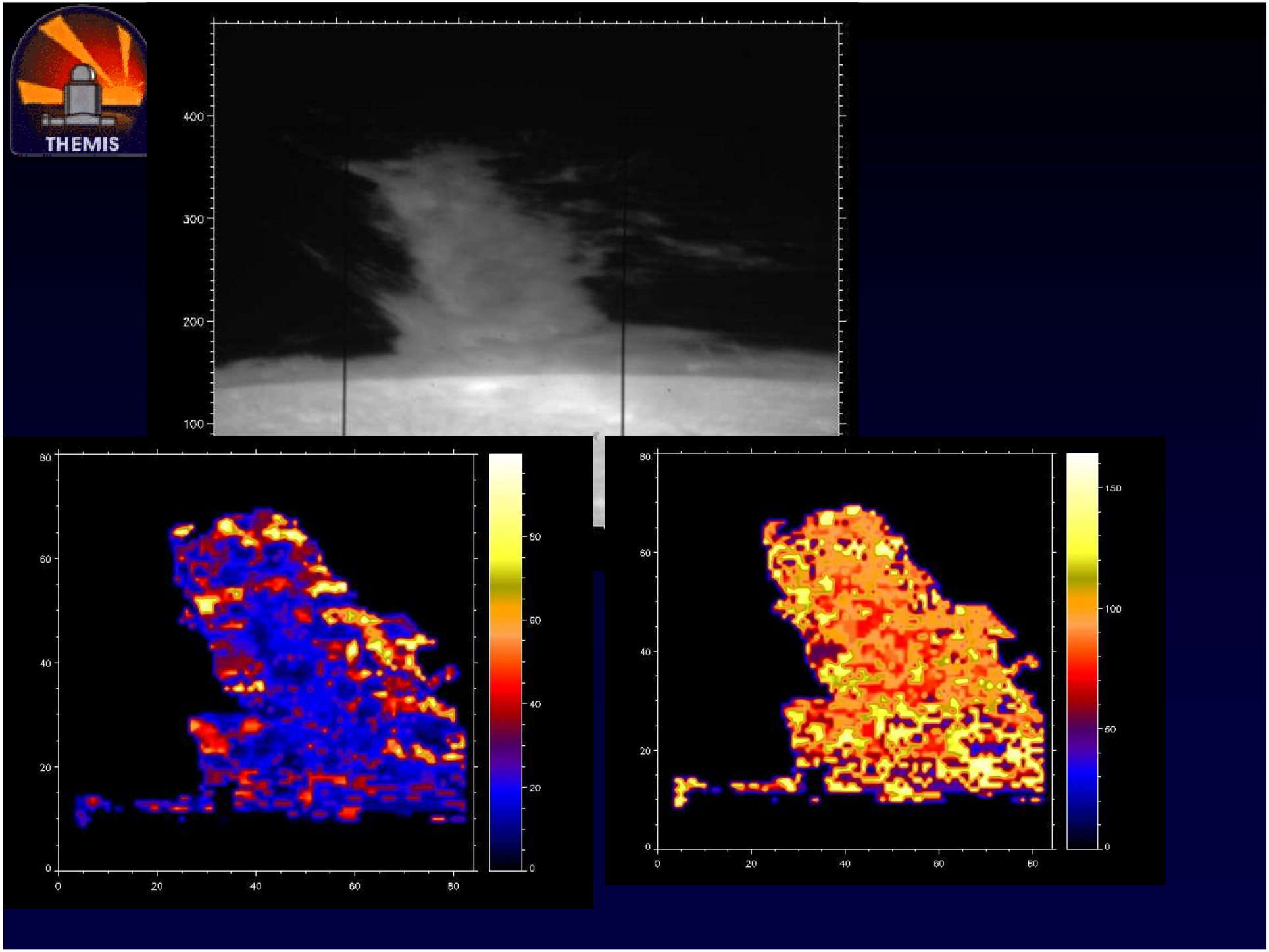
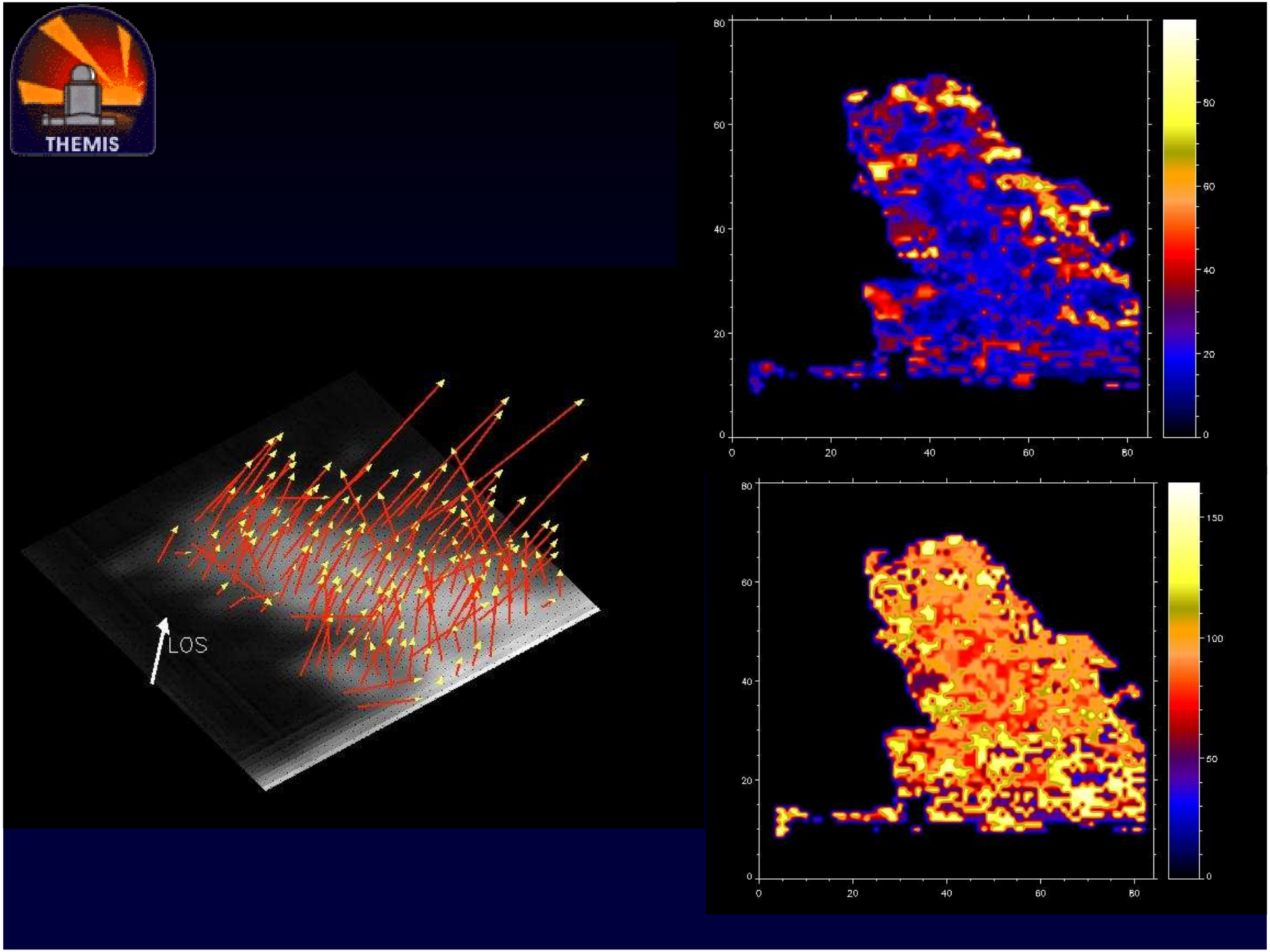
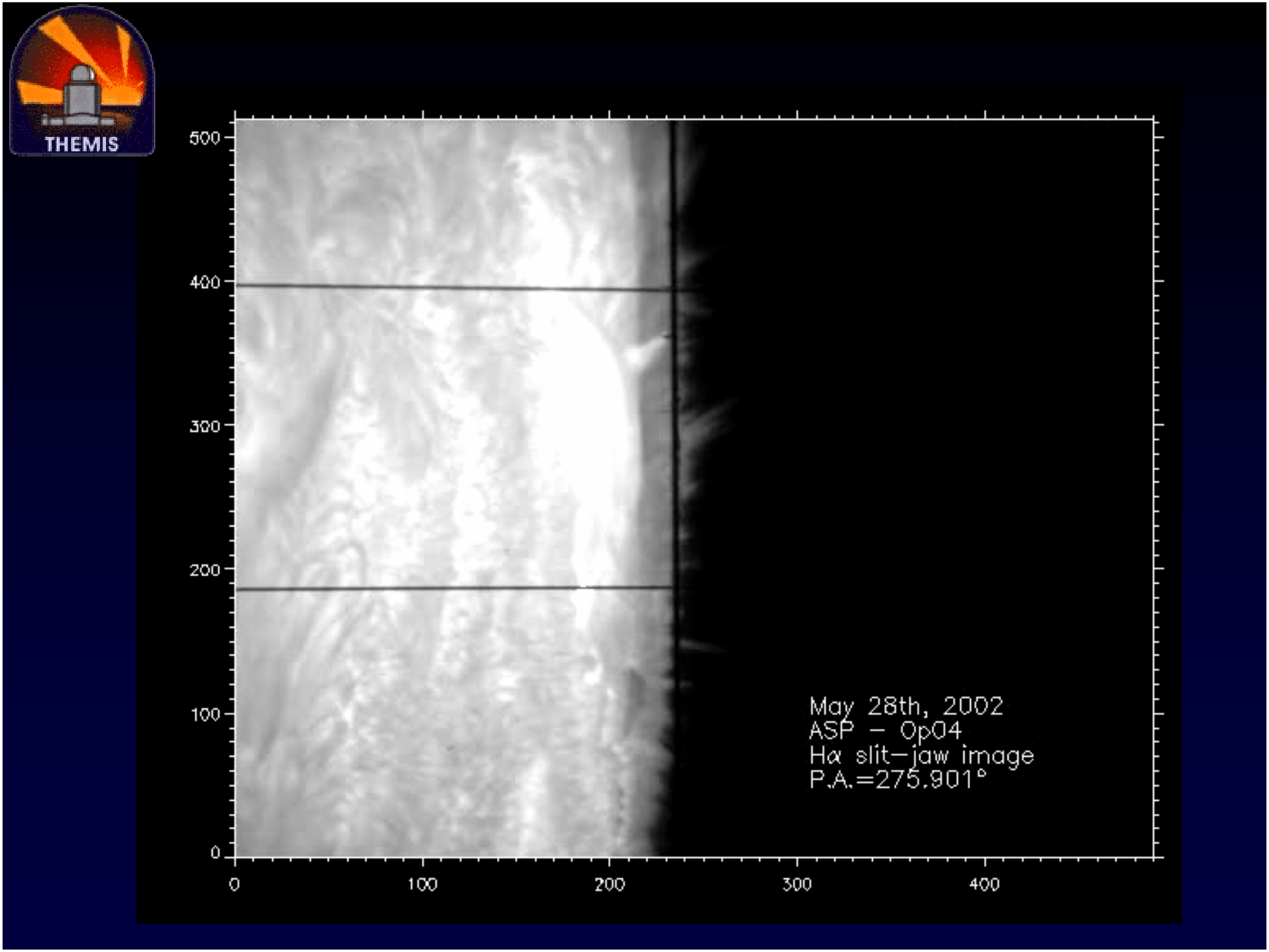
Magnetic fields in spicules

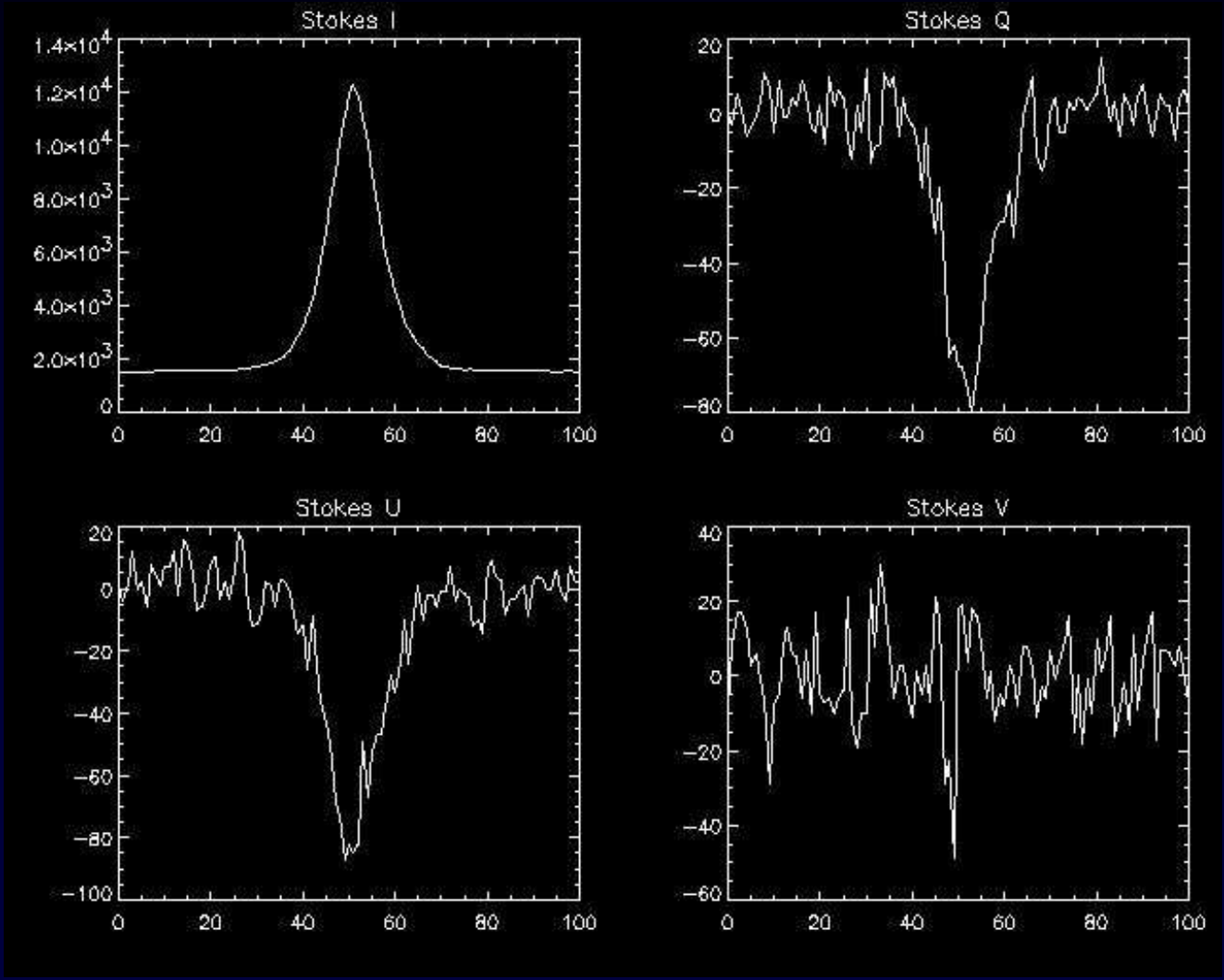
Arturo López Ariste
Roberto Casini (HAO)


THEMIS
400
300
200
100
80
60
40
20
0
0
20
40
60
80
80
60
40
20
0
150
100
50
0

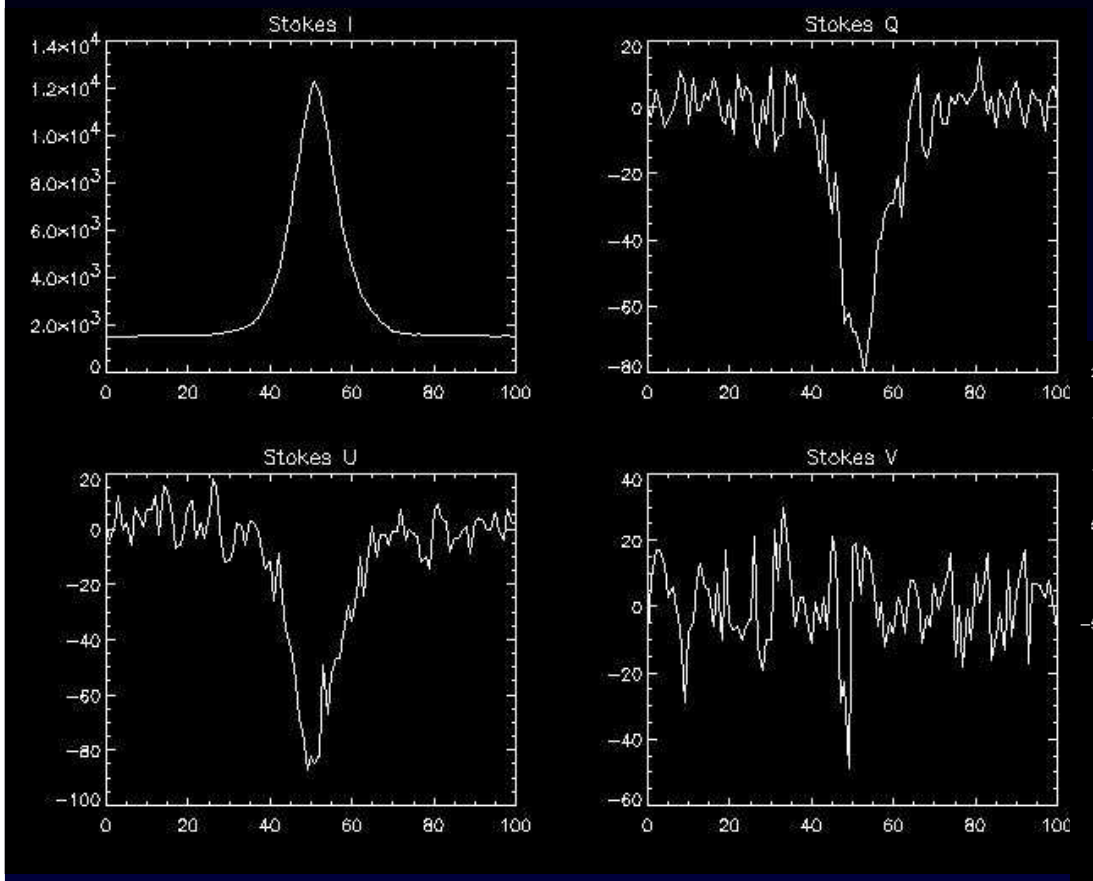

THEMIS
LOS
0
20
40
60
80
100
150

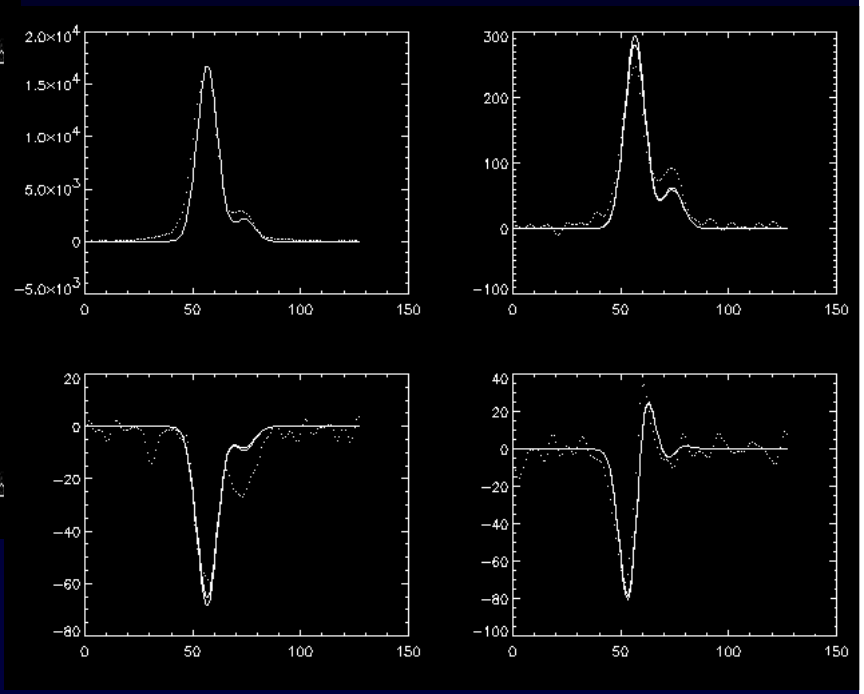

THEMIS
500
400
300
200
100
0
0
100
200
300
400
May 28th, 2002
ASP – Op04
Hα slit–jaw image
P.A.=275.901°

Broadened profiles



Broadened profiles



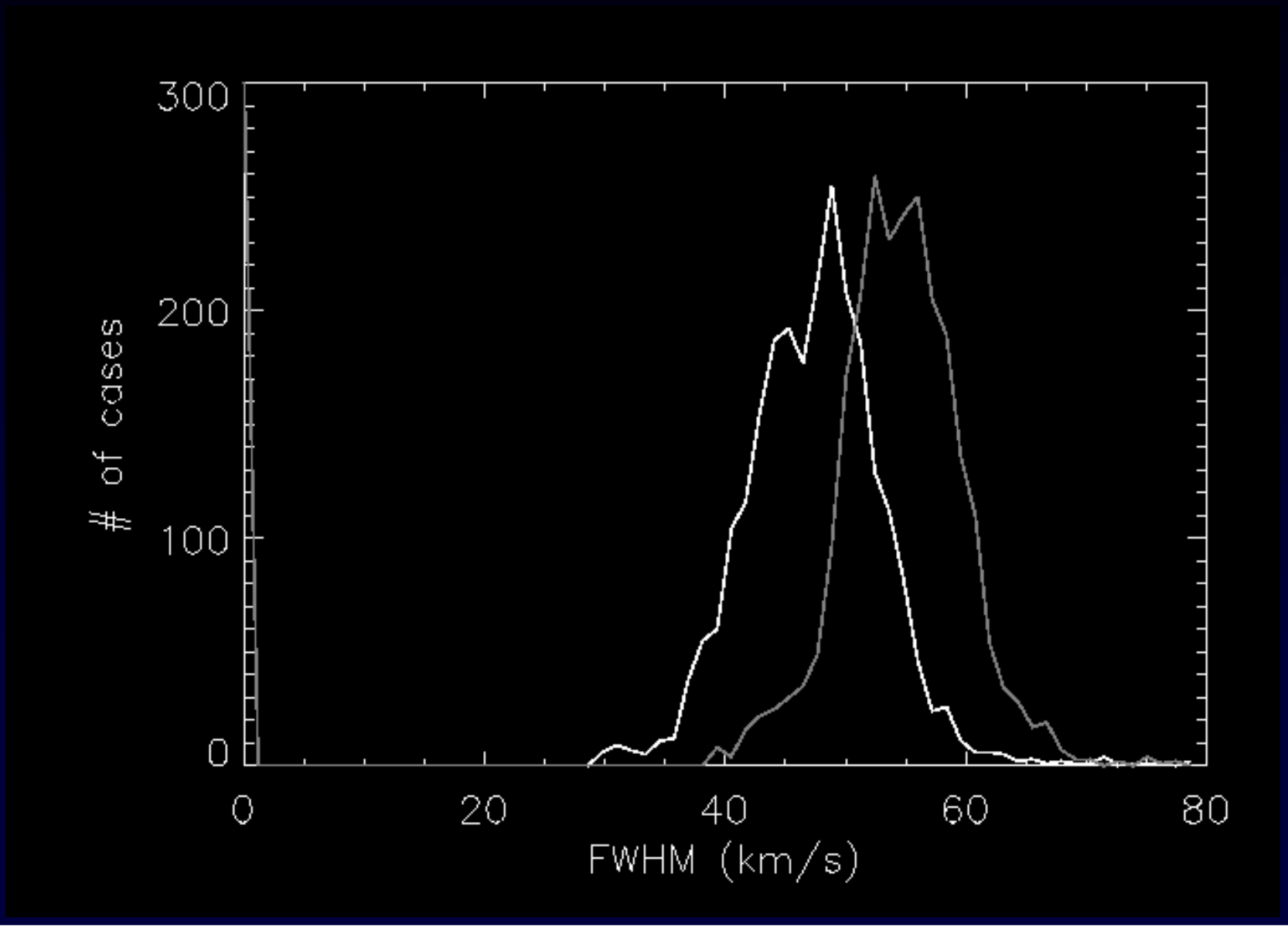


Aproach to inversion

1. Get an (empirical) description of the anomalous broadening:

   A convolution of Doppler-shifted profiles each one given a weight by a gaussian distribution

Subpixel velocity distributions



Aproach to inversion

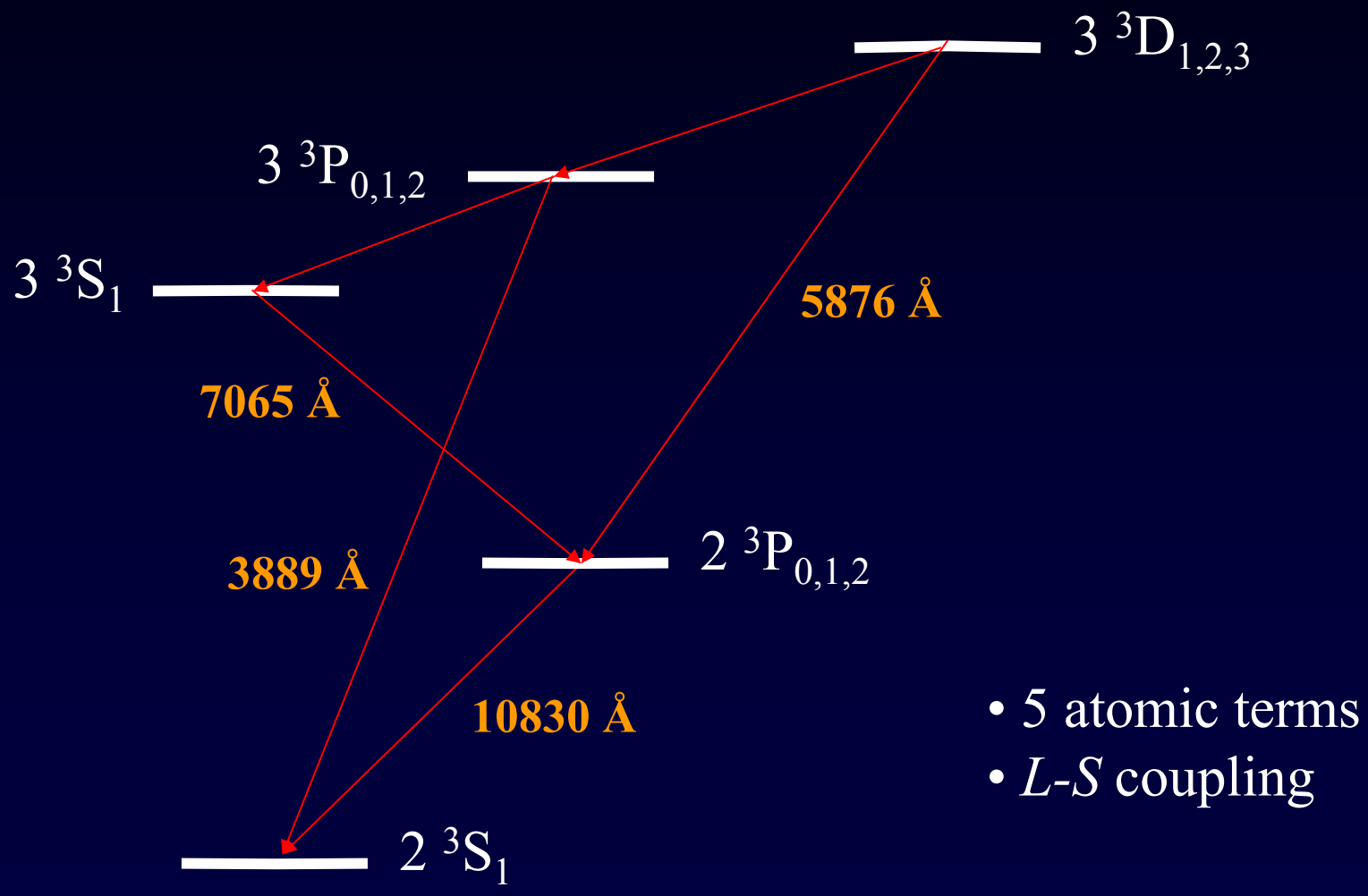
1. Get an (empirical) description of the anomalous broadening:

   A convolution of Doppler-shifted profiles each one given a weight by a gaussian distribution

2. Investigate how much magnetic information is still available in the so-broadened profiles:

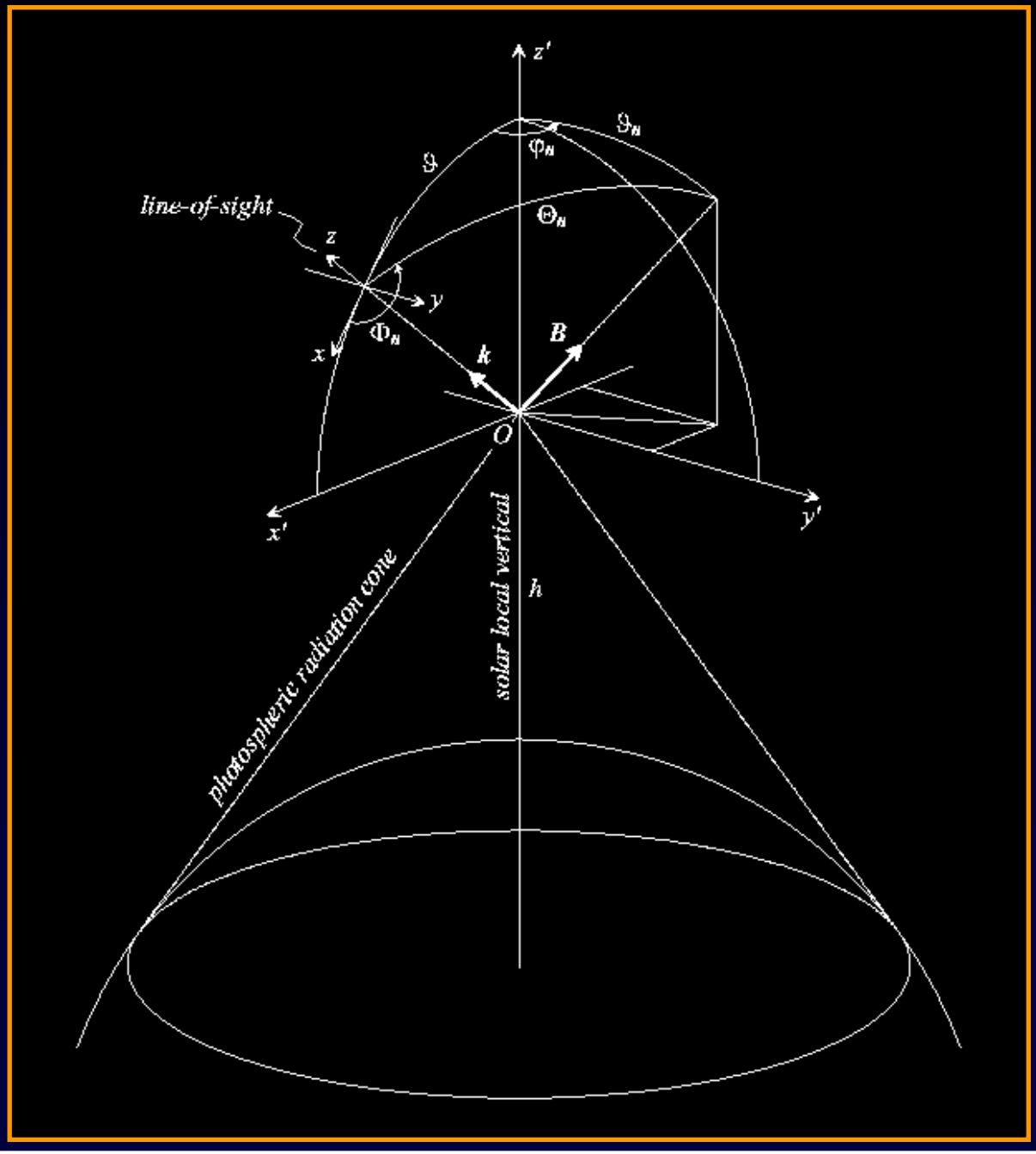
   Create synthetic profiles, broaden them and try to invert

He I atomic model



- 5 atomic terms
- *L-S* coupling

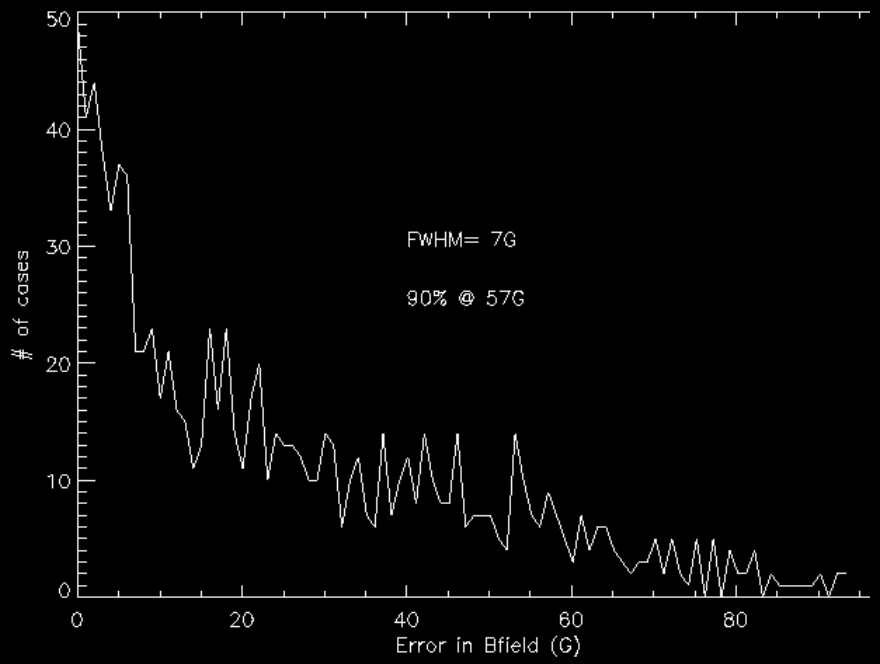
Scattering Geometry

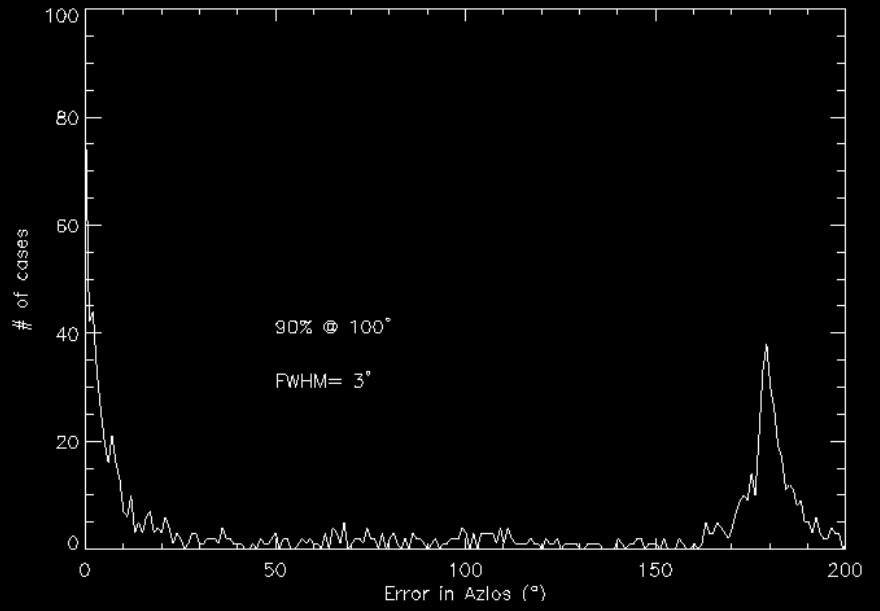


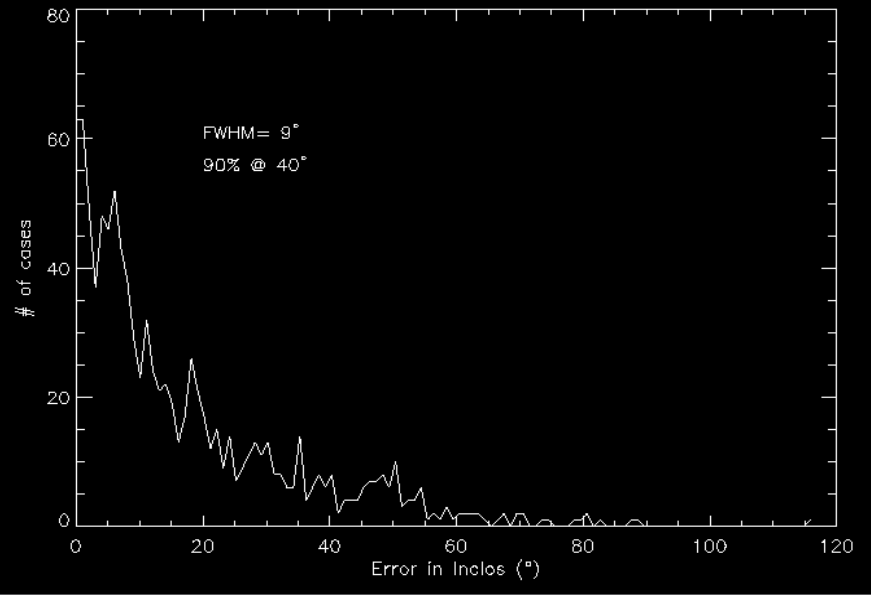
Model theory

- Quantum theory of polarized line formation (Landi Degl'Innocenti, 1983)
- Spectrally flat incident radiation (CRD)
- No collisions
- Includes level-crossing and coherence effects within each atomic term

Synthetic broad profiles inverted

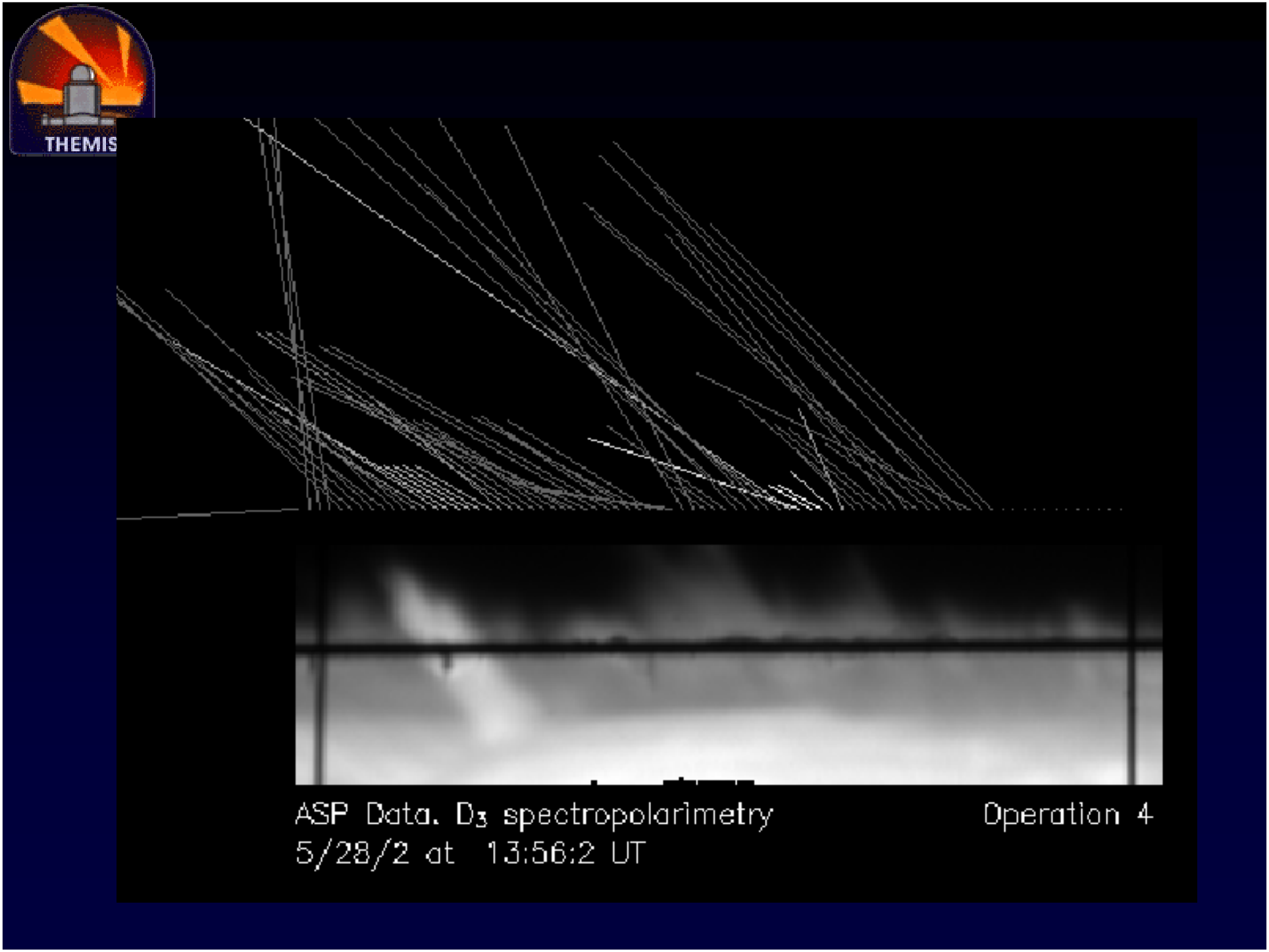


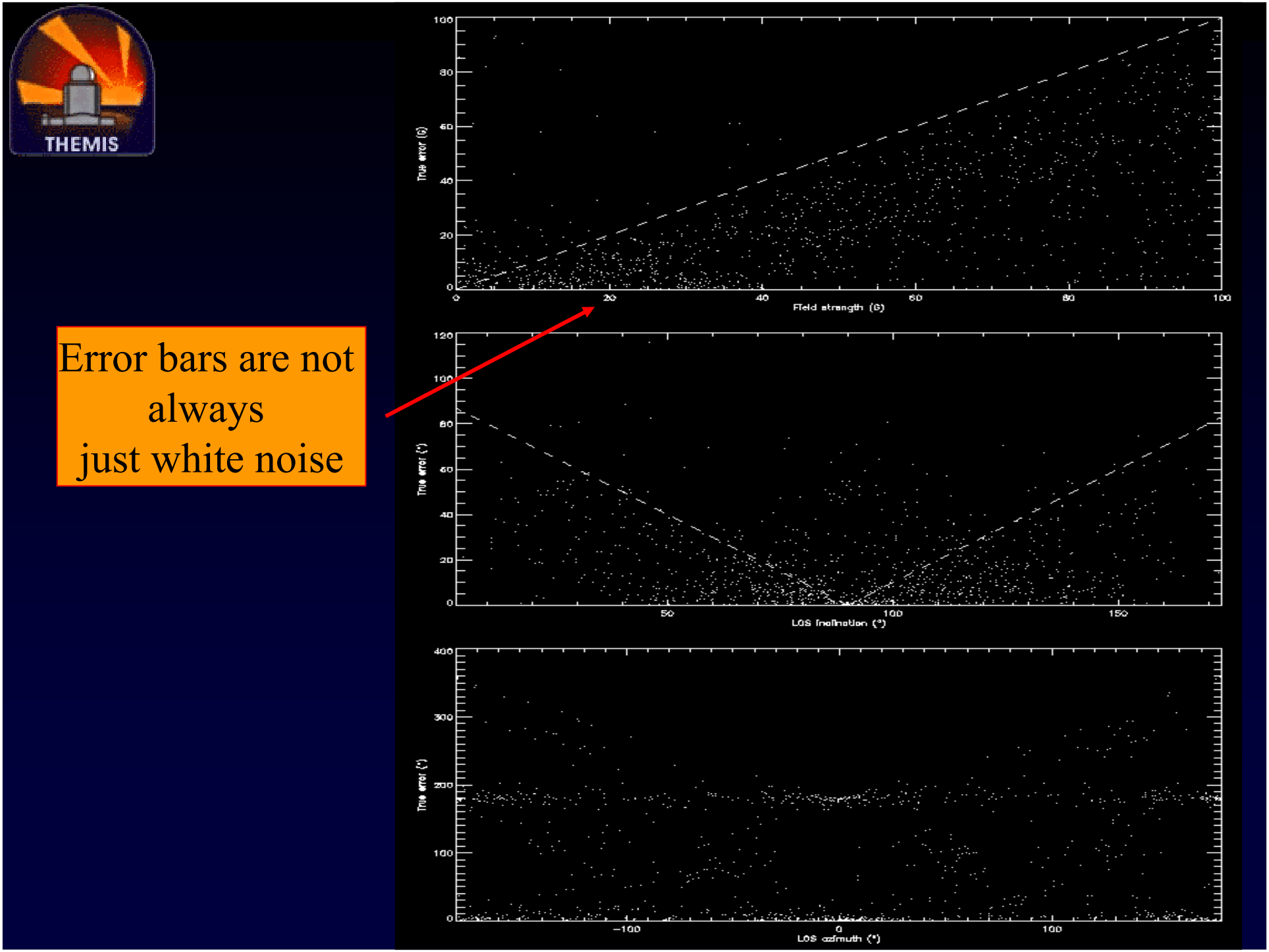




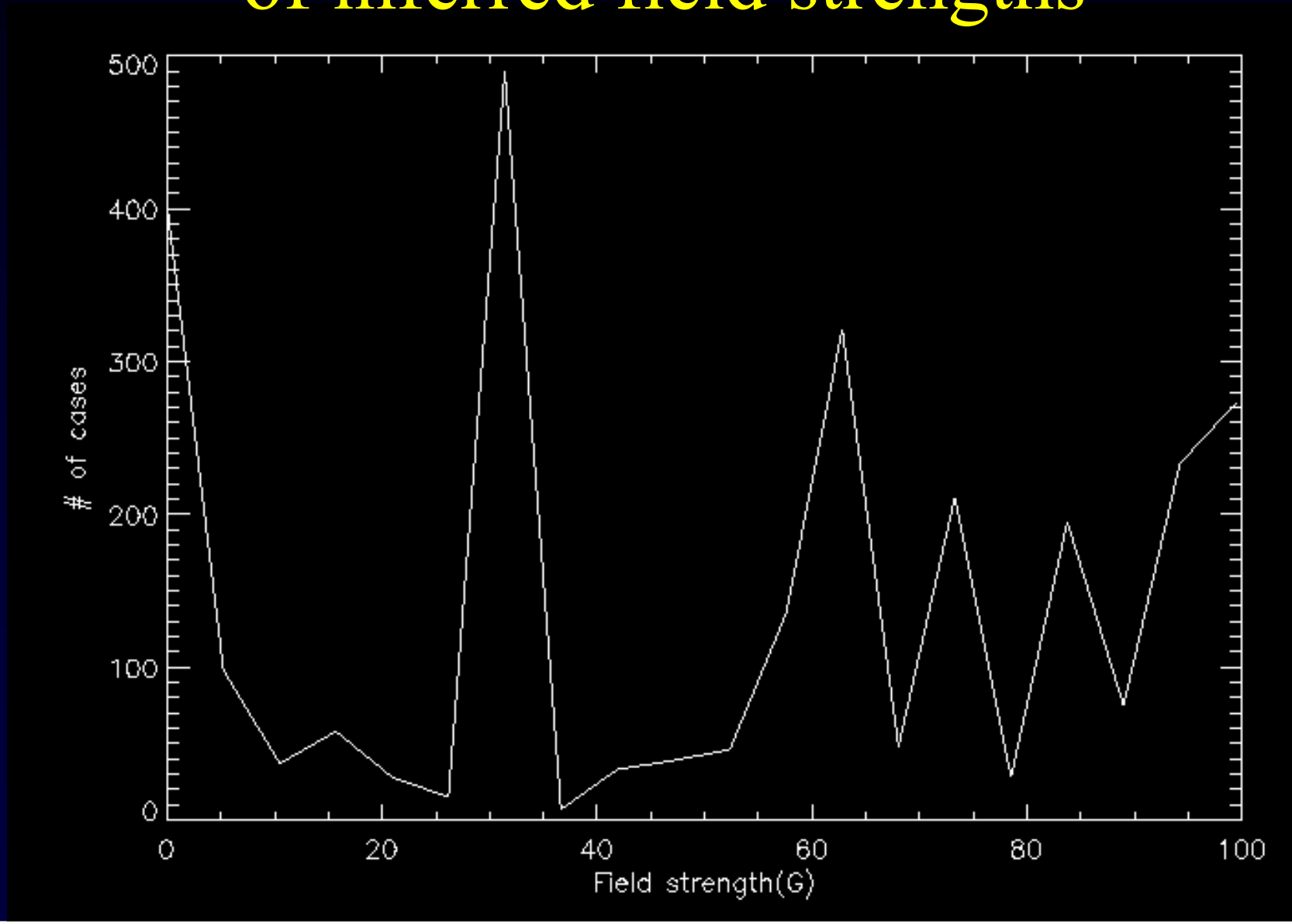
Aproach to inversion

1. Get an (empirical) description of the anomalous broadening:
   A convolution of Doppler-shifted profiles each one given a weight by a gaussian distribution
2. Investigate how much magnetic information is still available in the so-broadened profiles:
   Create synthetic profiles, broaden them and try to invert
3. Try with the real data and see what happens!


THEMIS
ASP Data. D3 spectropolarimetry
Operation 4
5/28/2 at 13:56:2 UT


THEMIS
Error bars are not always just white noise
True error (G)
Field strength (G)
True error (°)
LOS inclination (°)
True error (°)
LOS azimuth (°)

Inversion of real data: Distribution of inferred field strengths

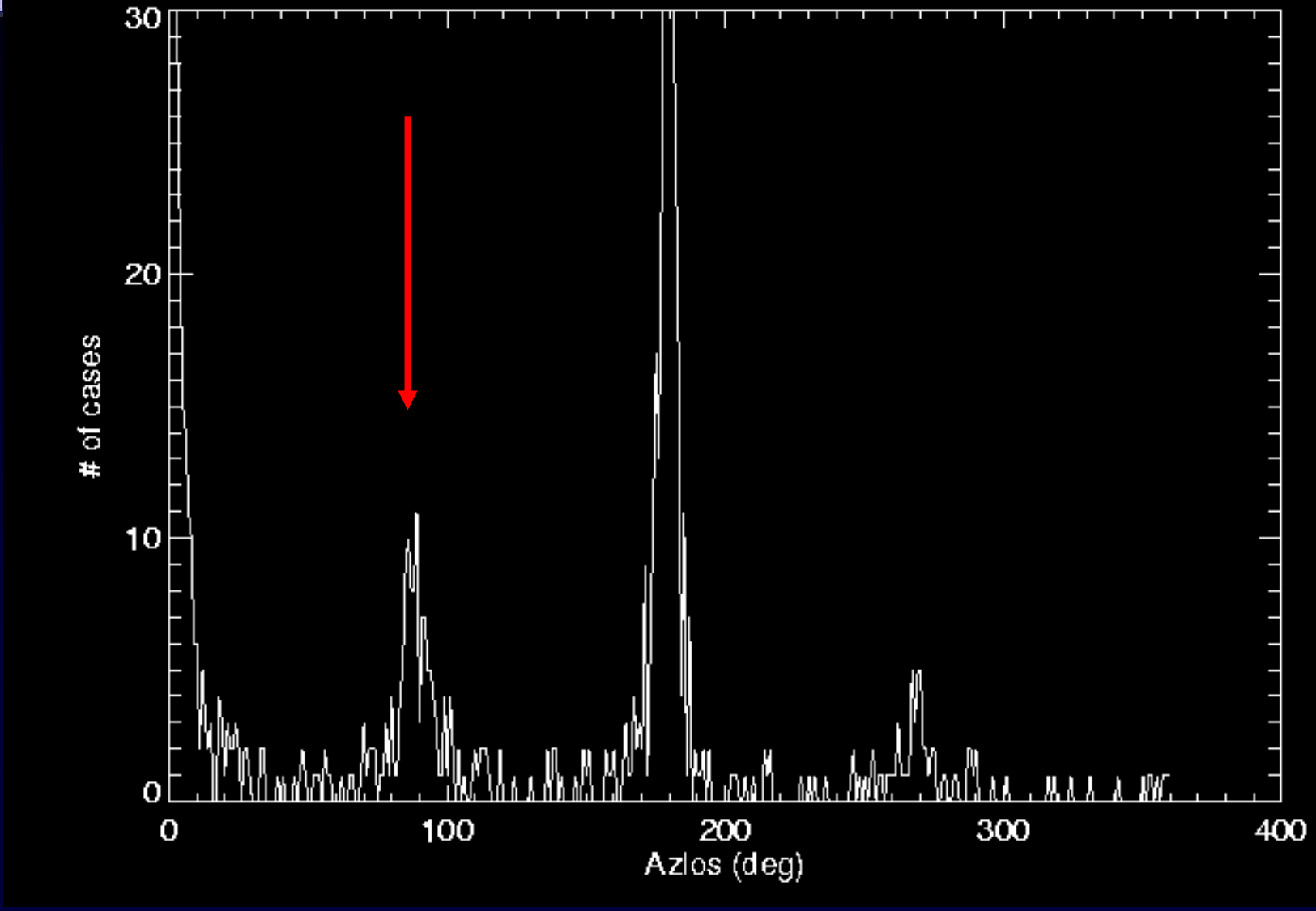


Not yet done!


ASP Data. D_3 spectropolarimetry
5/28/2 at 13:54:2 UT
Operation 4

The 90 degrees ambiguity

$$Q \approx \frac{3}{8}\omega(3\cos^2\vartheta_B - 1)\sin^2\Theta_B\cos 2\Phi_B$$


30
20
10
0
# of cases
0
100
200
300
400
Azlos (deg)

A few conclusions

•Broadened profiles are well reproduced by subpixel velocity distribution (either real or arisen from projection effects)

•Magnetic field in spicules appear to be either ALIGNED or TRANSVERSAL to the visible structure

•Field strengths of up to 40 G are present. No much higher than that though.