

HAZEL Inversion of the Filament Observed by the DST/FIRS on May 29/30, 2017

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HAZEL (HAnle and ZEeman Light)

is a computer program for the synthesis and inversion of Stokes profiles caused by the joint action of atomic level polarization and the Hanle and Zeeman effects.

(Asensio Ramos, A., Trujillo Bueno, J., & Landi Degl'Innocenti, E. ApJ, 2008, 683, 542)

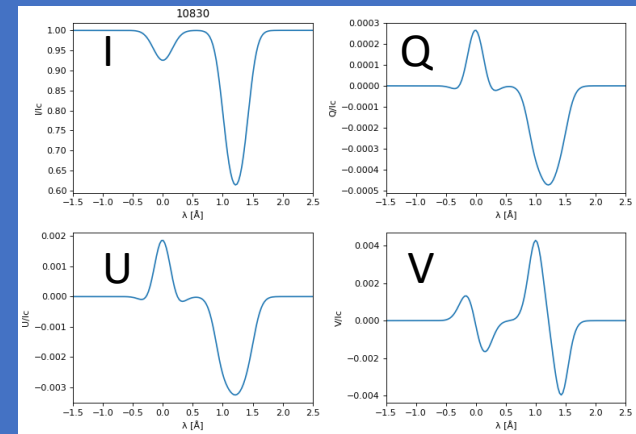
Model parameters:

Magnetic field
LOS velocity

...

HAZEL

Stokes profiles:



May 29 :

The filament is stable. The FIRS observation time is 14:41 until 15:21. Blue contour shows the FIRS observed filament.

May 30:

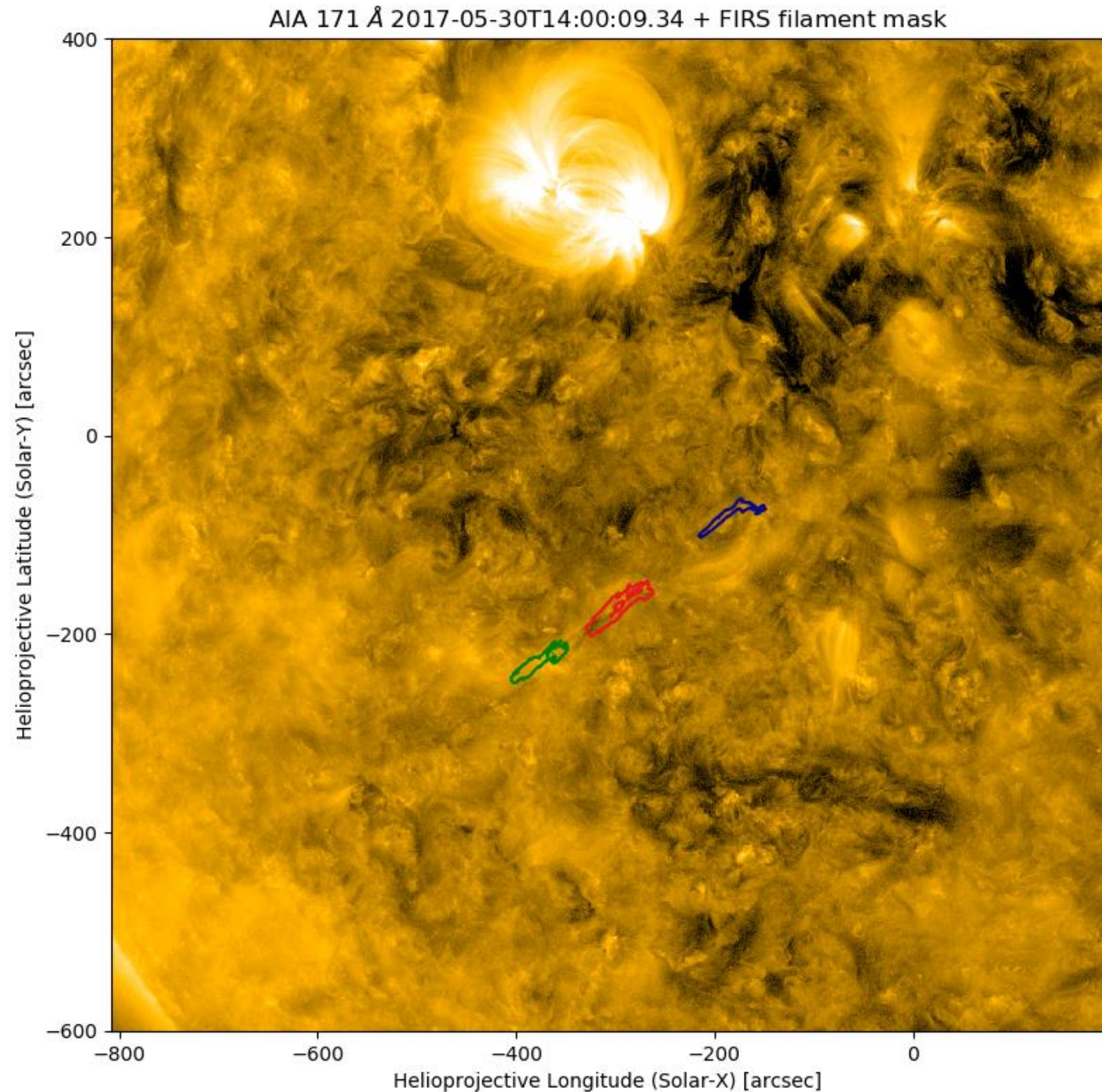
The filament starts rising at \sim 08:00.

The 1st FIRS observation today is 13:47 until 14:20, while the filament is rising. (Red contour)

Filament width is larger than it on May 29.

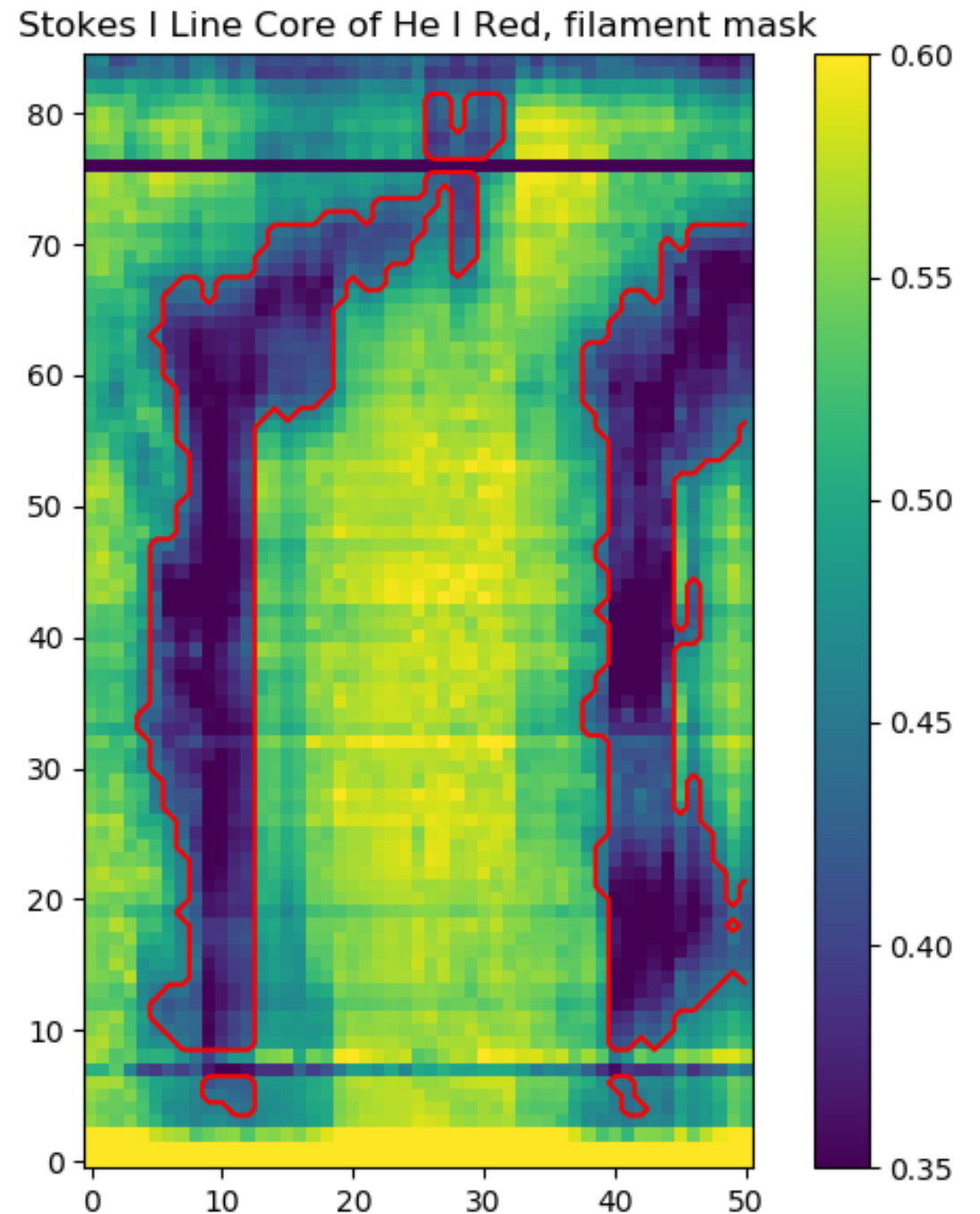
The 2nd FIRS observation today is 14:29 until 15:02, while the filament is rising. (Green contour)

The filament disappears in SDO/AIA 304 A image at \sim 18:00.



The observation on May 29

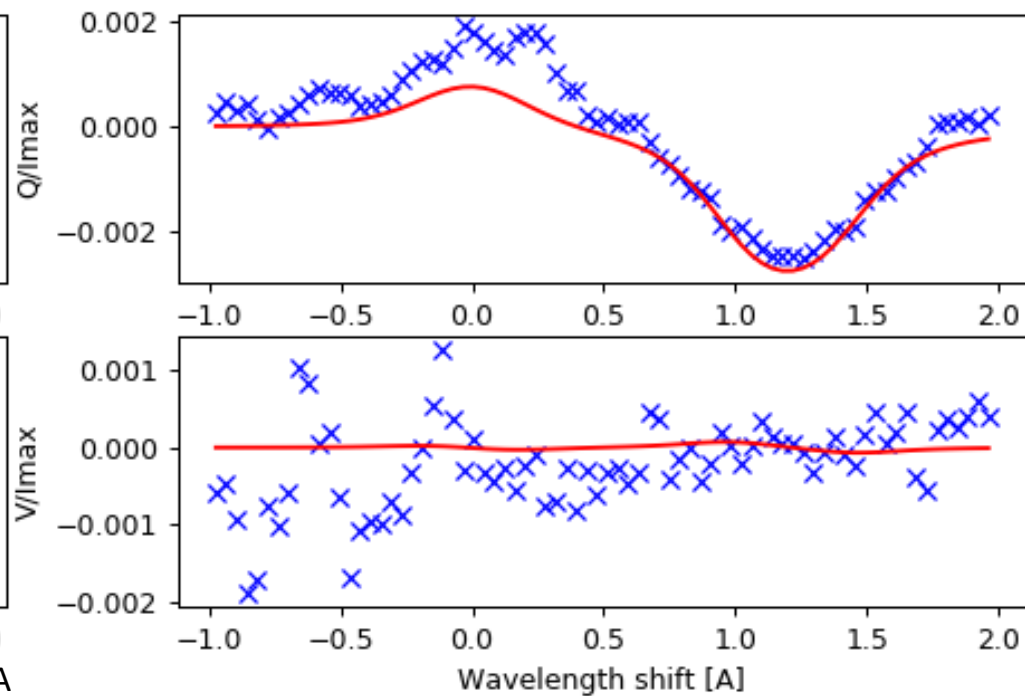
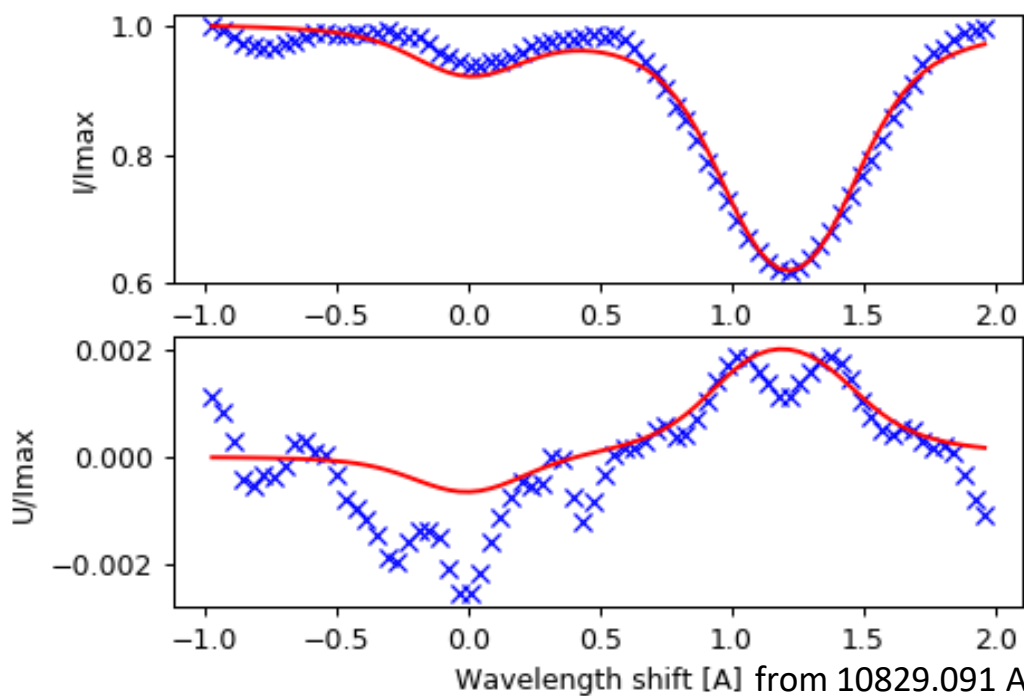
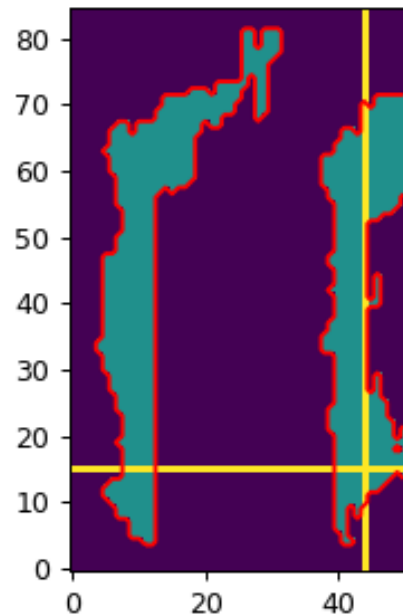
- The filament is scanned twice in 40 min.
- The **filament mask (red contour)** is obtained from the FIRS Stokes I Line Core image of He I Red.



B11, Inc70.8 , azi-118.2, Height5, Tau0.9 , Vth5.6, Damping0.6 ,Vmac0.0 ,Beta1.0

May 29 Observation

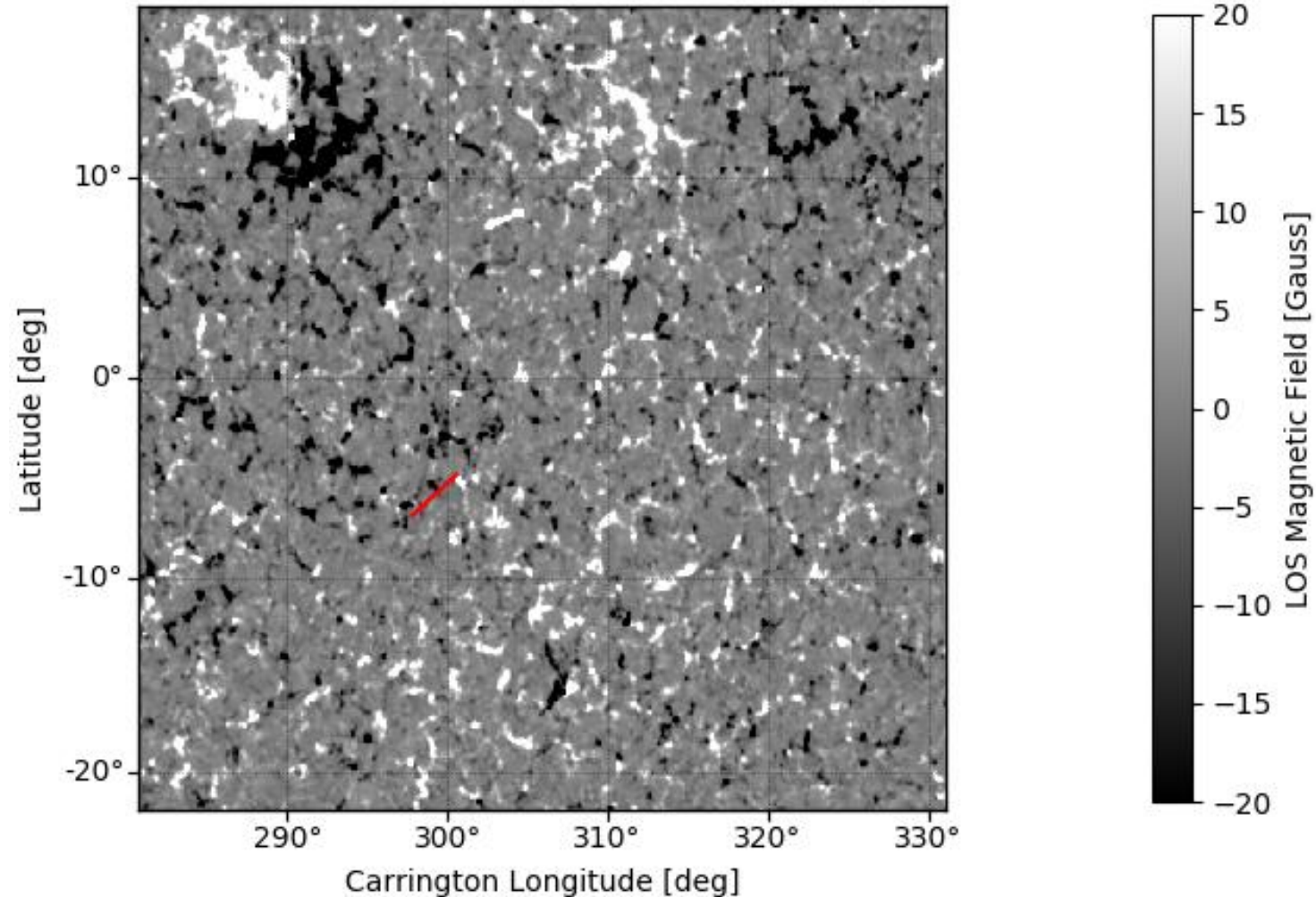
HAZEL inversion of one pixel (0.93" x 0.93")



Disambiguation of solutions

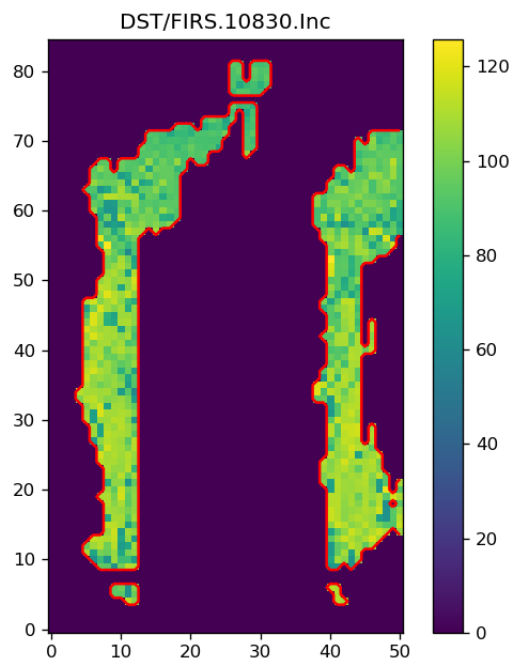
- There are four solutions.
- Two of them are with angle between field line and horizontal > 60 degree, and they are considered unreasonable.
- The leading polarity is positive. Thus, the magnetic field direction along the **filament spine** is from NW to SE (downward in FIRS CCD plane). And this is used to solve the 180-degree ambiguity.

Carrington Synoptic Chart Of Line-of-sight Field 2191-2192

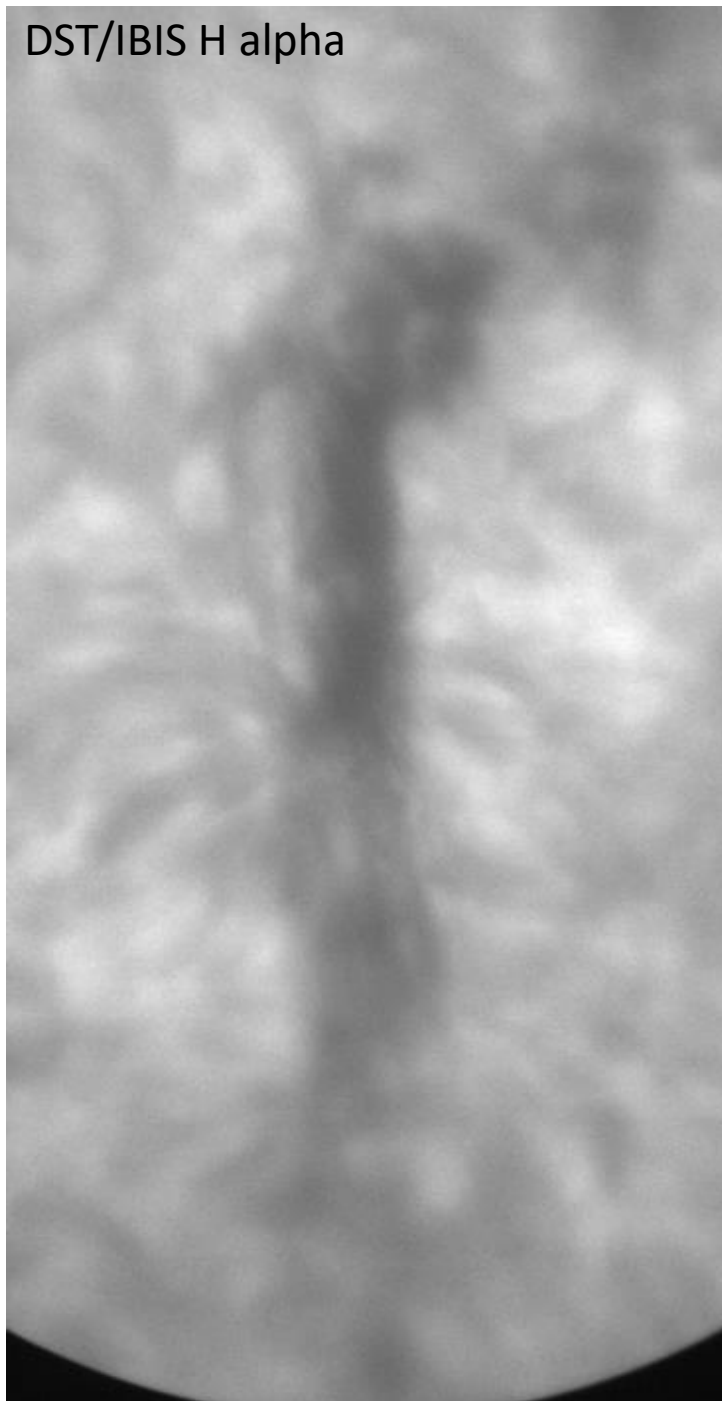


May 29 Observation

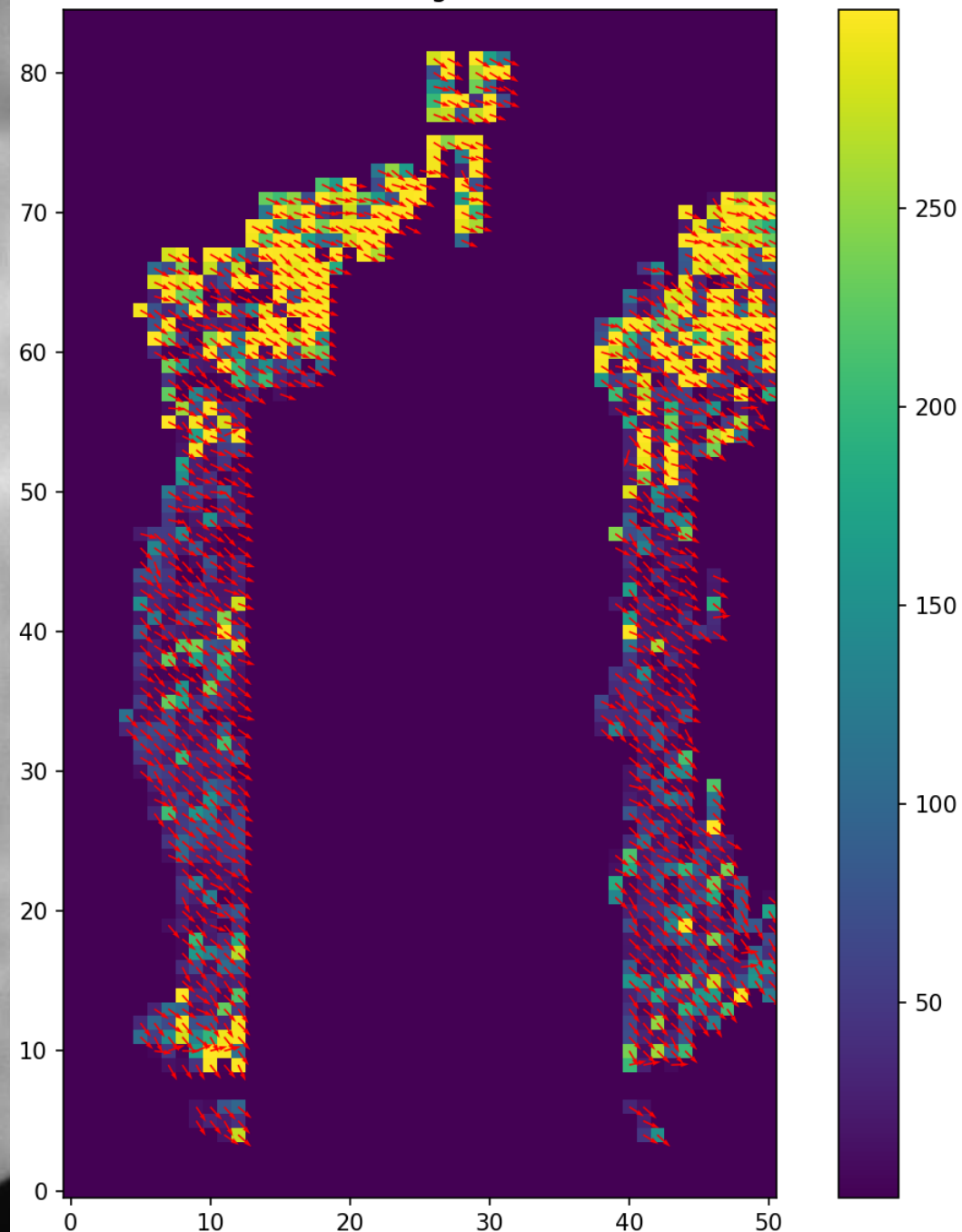
- Field strength is < 300 Gauss. Strong field at $y = 60 \sim 70$.
- Inclination is horizontal (~ 90 degree).
- H alpha threads are along magnetic field lines.



DST/IBIS H alpha

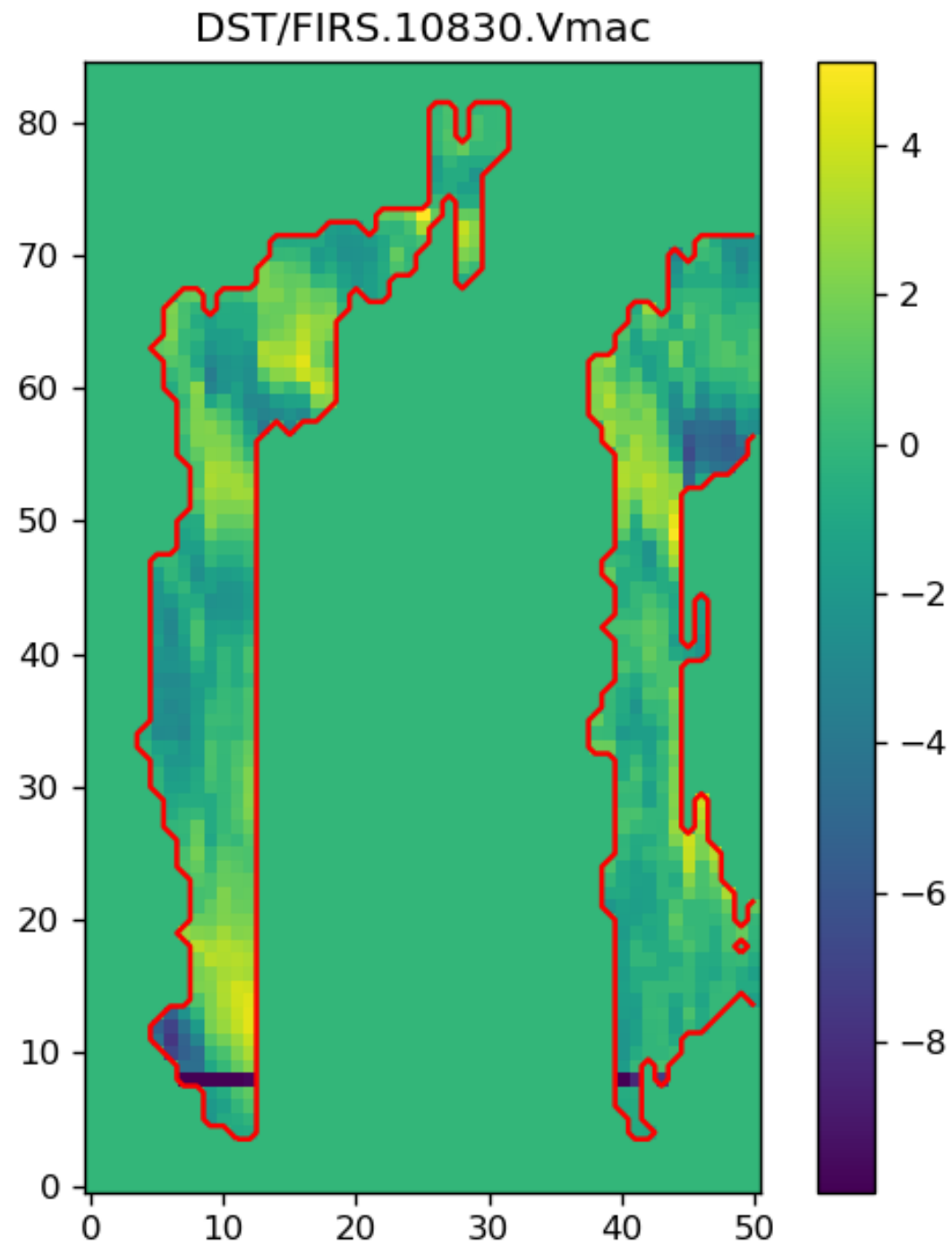


DST/FIRS.HAZEL Vector Mag. Azi. w.r.t. solar surface



May 29 Observation

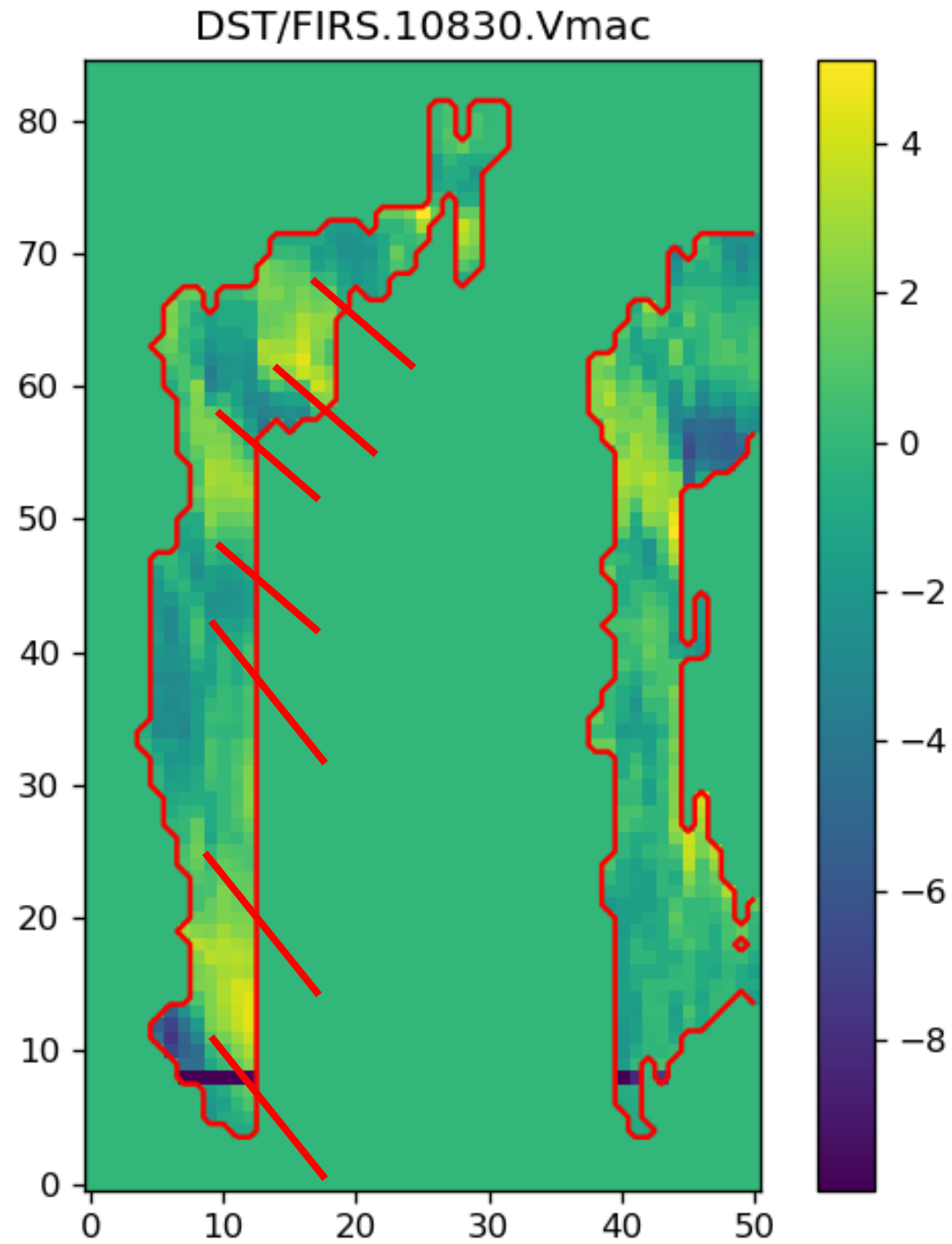
The LOS velocity is around 0 km/s



May 29 Observation

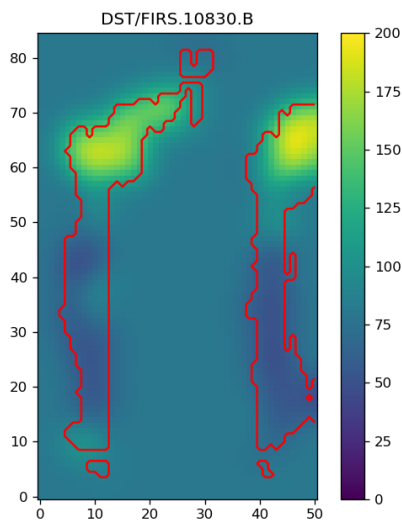
The LOS velocity is around 0 km/s

Velocity along thread changes gradually,
while velocity perpendicular to thread changes sharply.



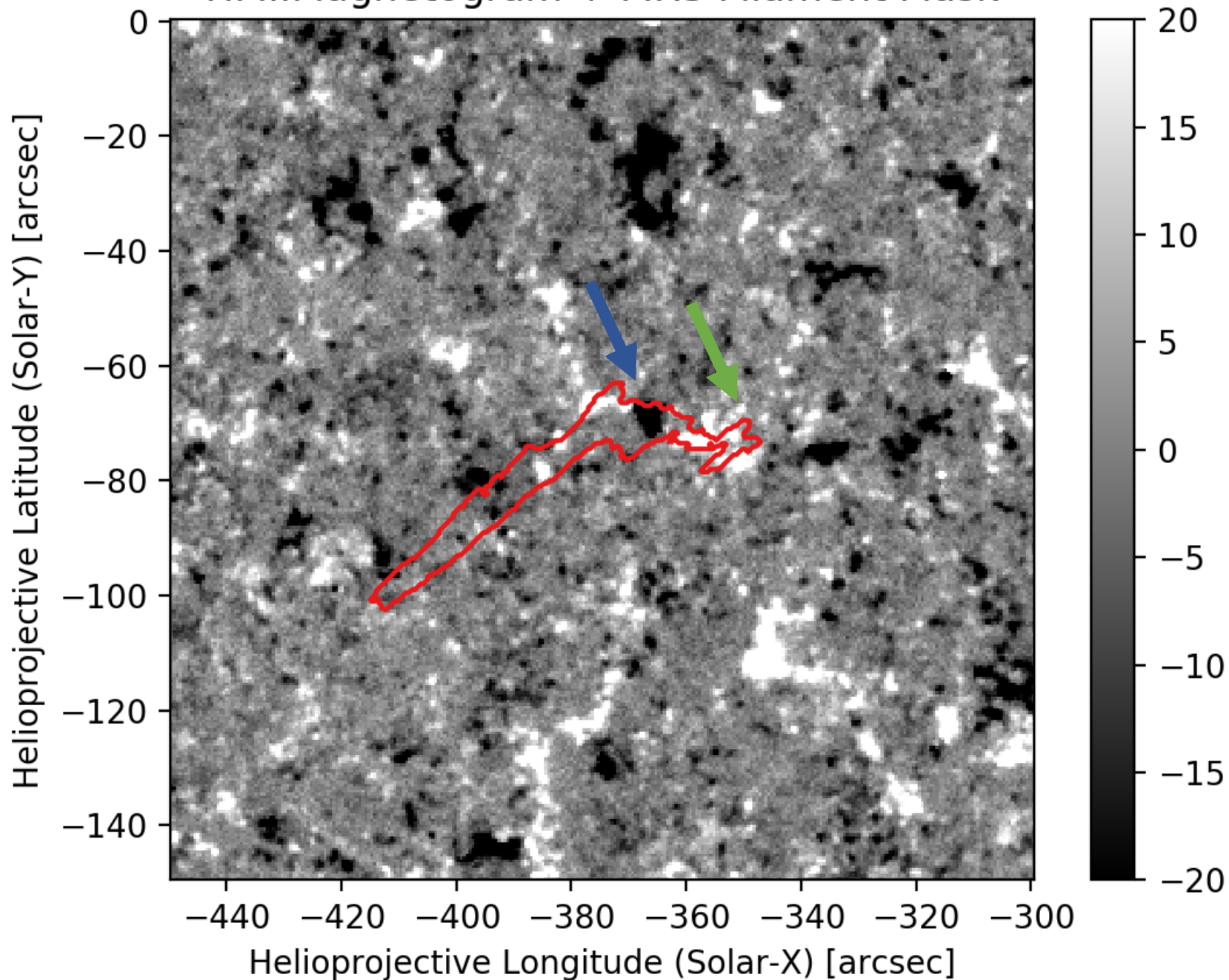
May 29 Observation

Arrows show strong photospheric field at the right end of observed filament.



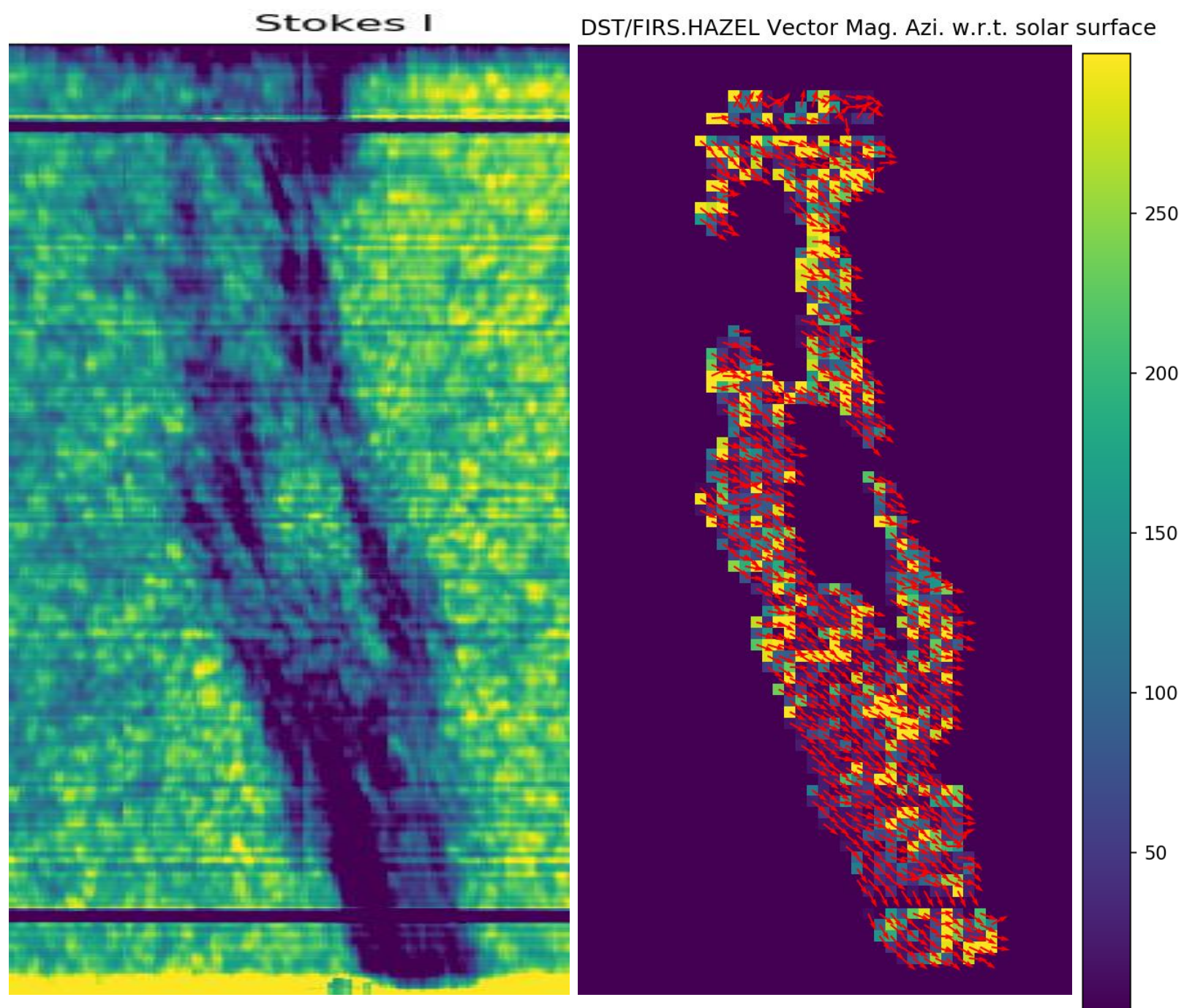
Positions of strong field of filament match positions of strong photospheric LOS field.

HMI.Magnetogram + FIRS Filament Mask



The 1st observation on May 30

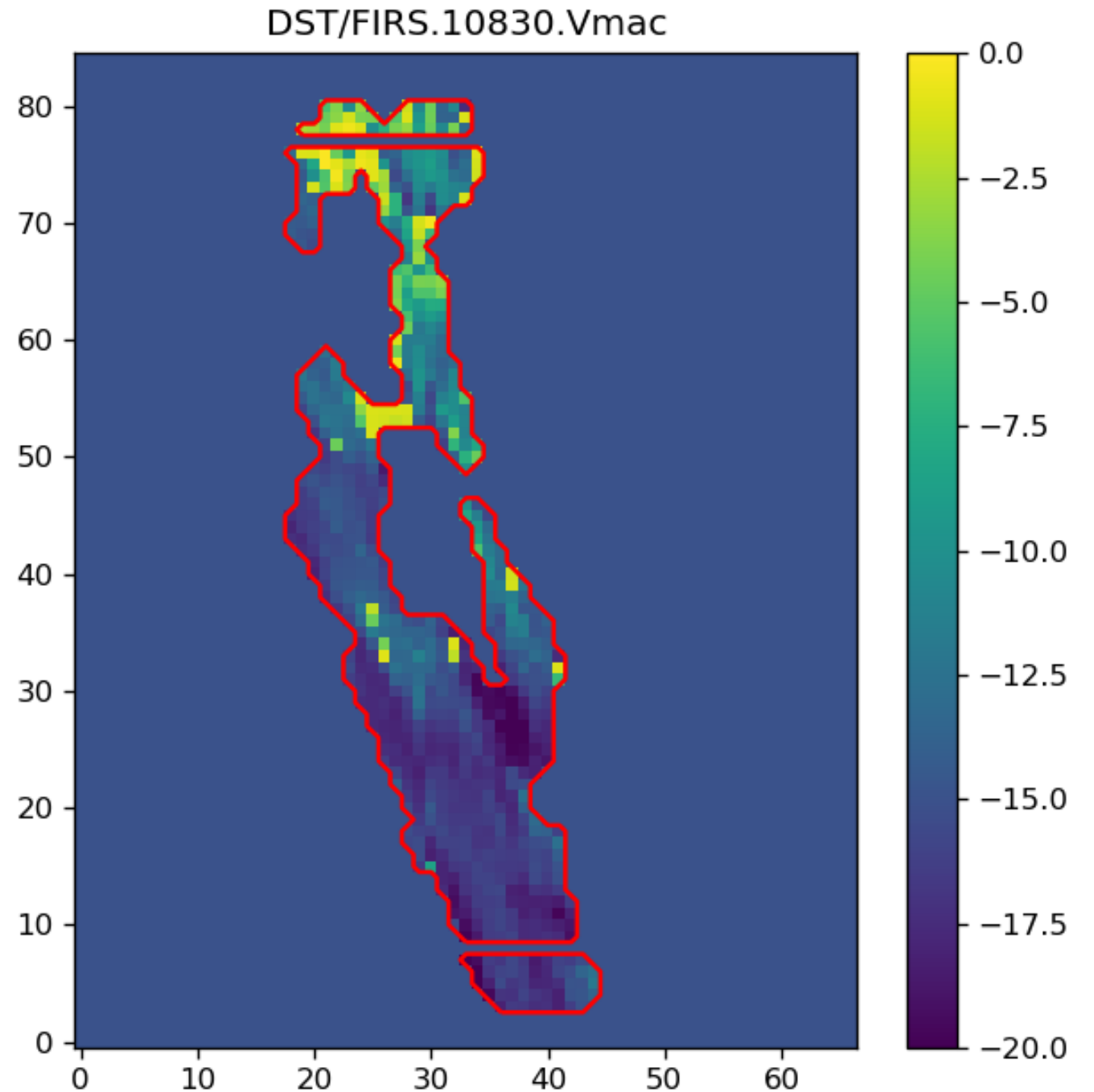
- He I threads are along magnetic field line.



The 1st observation on May 30

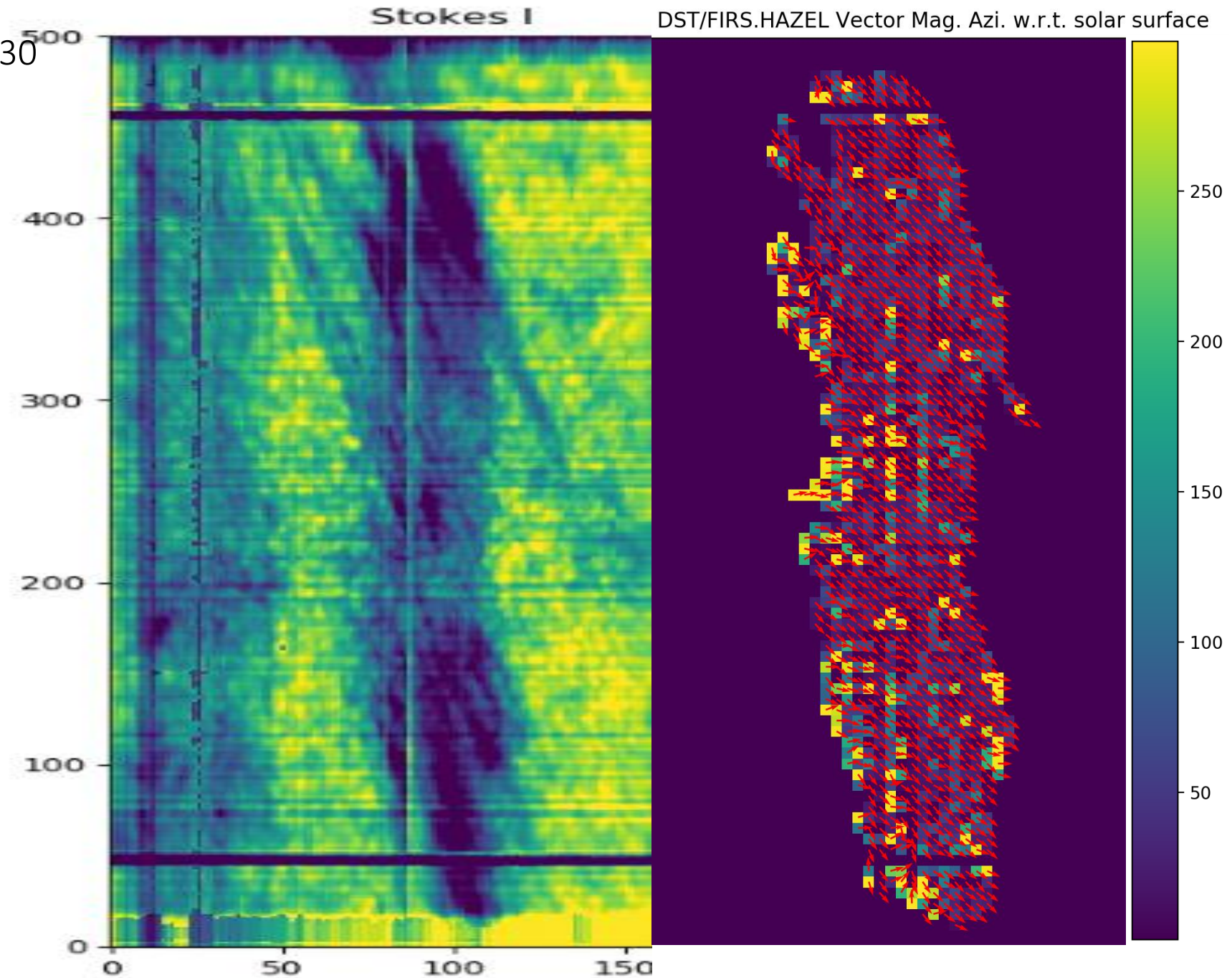
The maximum LOS velocity is ~20 km/s.

Velocity along thread changes gradually, while velocity perpendicular to thread changes sharply.



The 2nd observation on May 30

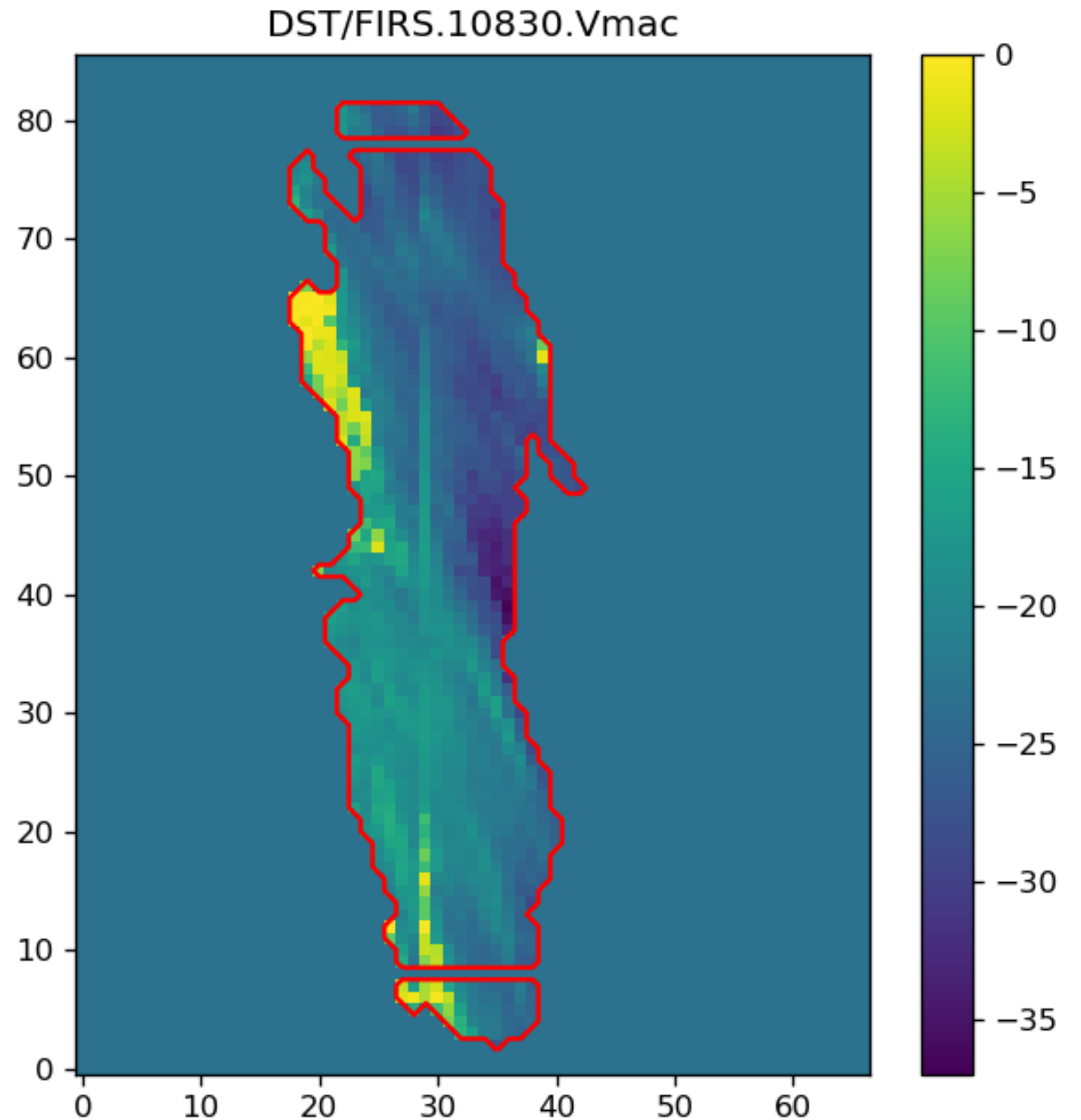
- He I threads are along magnetic field line.



The 2nd observation on May 30

The maximum LOS velocity is ~ 35 km/s.

Velocity along thread changes gradually, while velocity perpendicular to thread changes sharply. Adjacent threads are with different LOS velocity.



Conclusions

- Magnetic field strength is < 300 G. Positions of strong field of filament match positions of strong photospheric LOS field.
- Inclination angle is horizontal.
- H alpha threads and He I threads are magnetic field aligned.
- The LOS velocity of the three observations are 0, 20, and 35 km/s.
- Some He I threads are clearly separated in the FIRS observations on May 30. Velocity along thread changes gradually, while velocity perpendicular to thread changes sharply. Adjacent threads are with different LOS velocity.
- The inversion results support the flux-rope model.