On the need of high-res/small-FOV vs. large-FOV magnetograms

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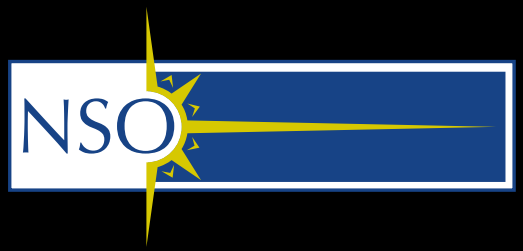
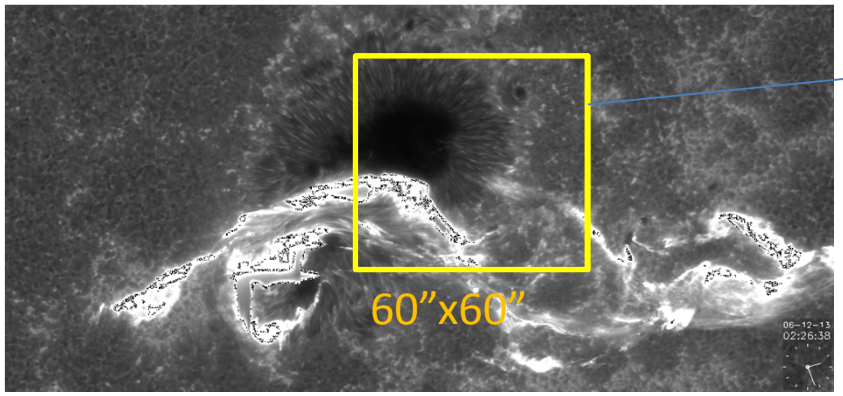


Outline

1. Is there an easy answer?
2. Orphan penumbrae: emerging flux ropes
3. Orphan penumbrae: regular penumbrae
4. Solving the paradigm: synoptic observations
5. Conclusions: the tough part

1.- Is there an easy answer?



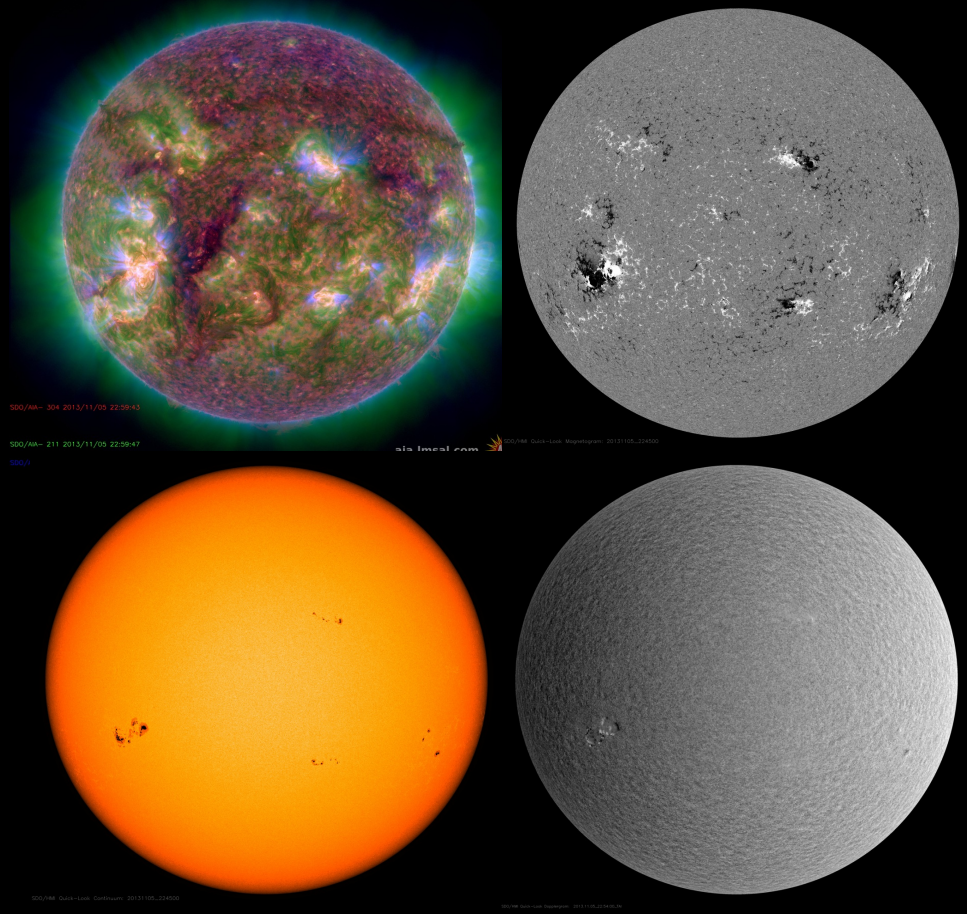
Do you want a continuous observation for days with this FOV?

- The answer to this question depends on what are we trying to investigate.
- Fundamental physical processes: flux cancellation, formation of kG structures, wave triggering…
- Global evolution of magnetic fields: AR evolution, large-scale connectivity, polar field reversal…

Yes: We need both high spatial resolution and large FOV

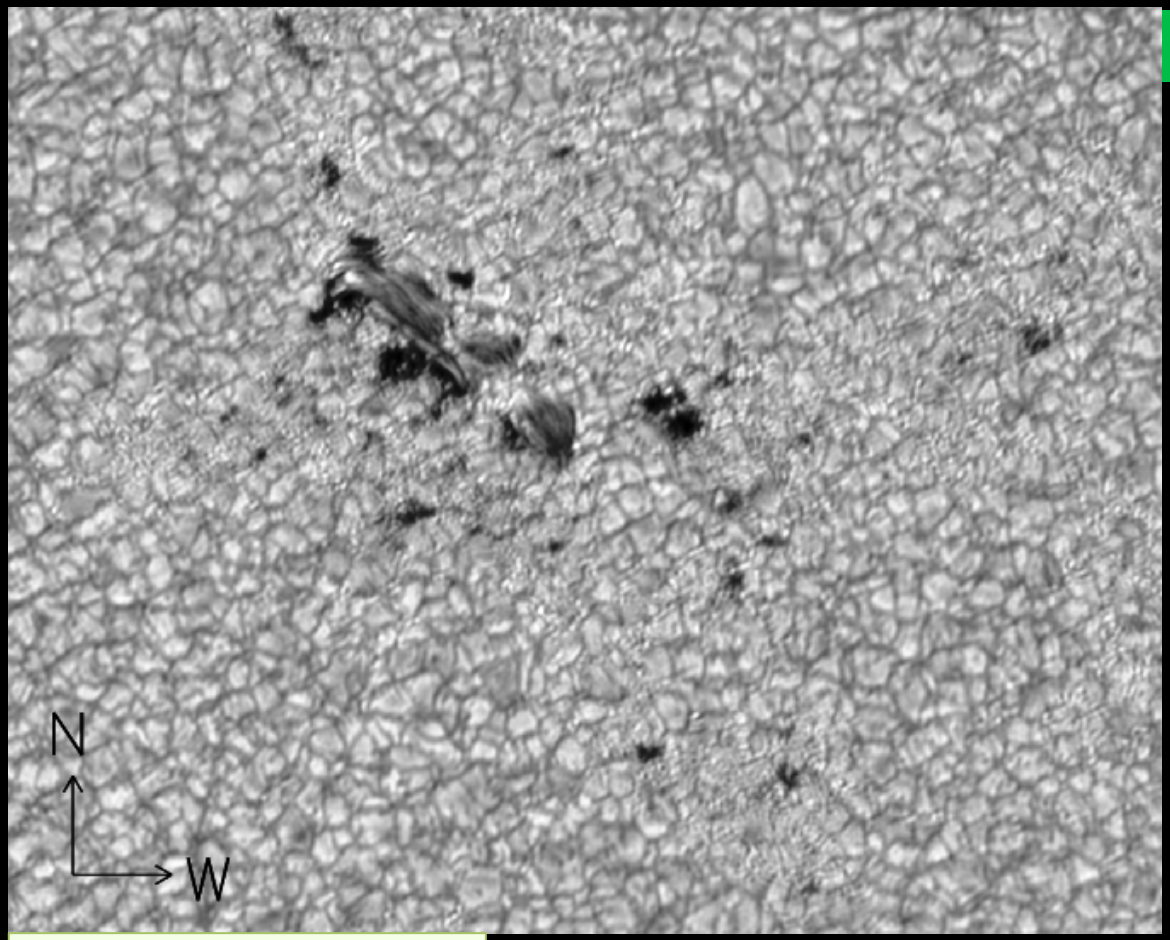
1.- Is there an easy answer?

- Isn't SDO providing some of that? <u>All the Sun, all the time</u>



I did my PhD "begging" for 1 arcsec resolution…

2.- Orphan penumbrae: emerging flux ropes

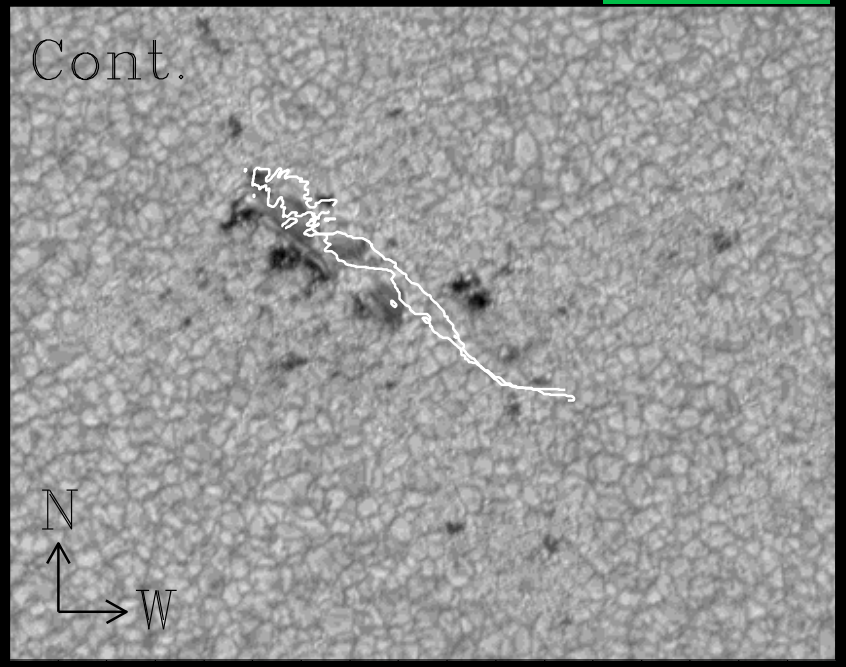


DOT

Kuckein et al., 11

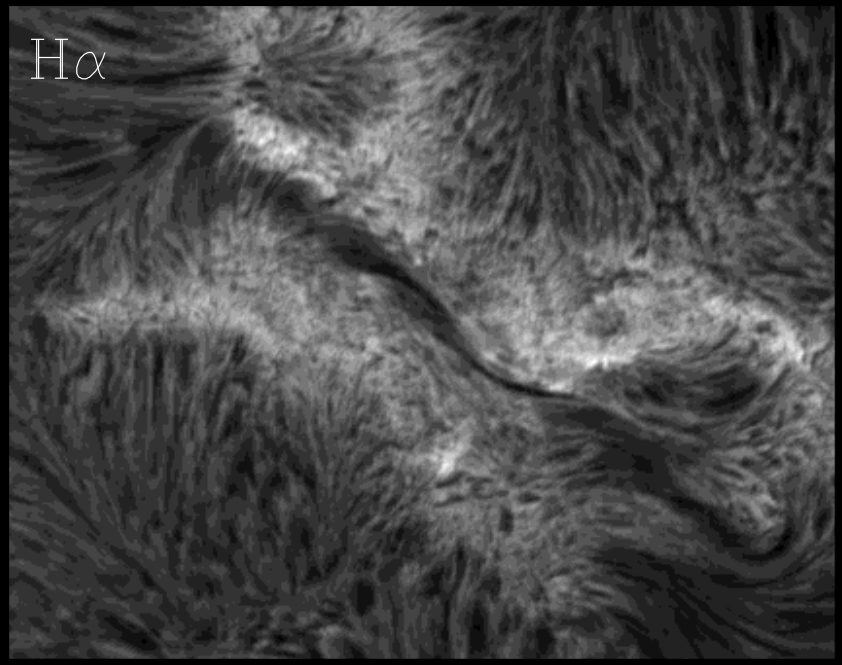
2.- Orphan penumbrae: emerging flux ropes

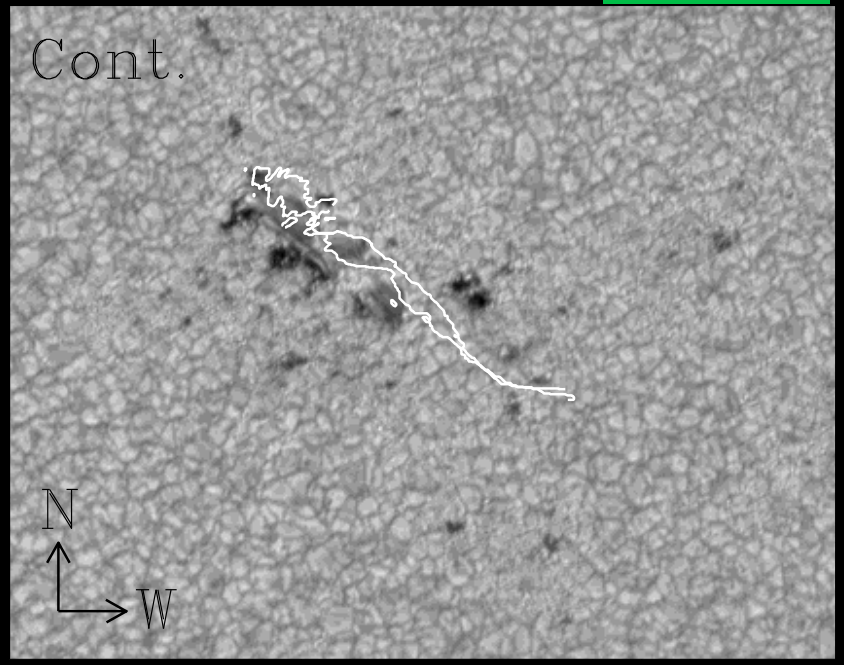
DOT



2.- Orphan penumbrae: emerging flux ropes

DOT

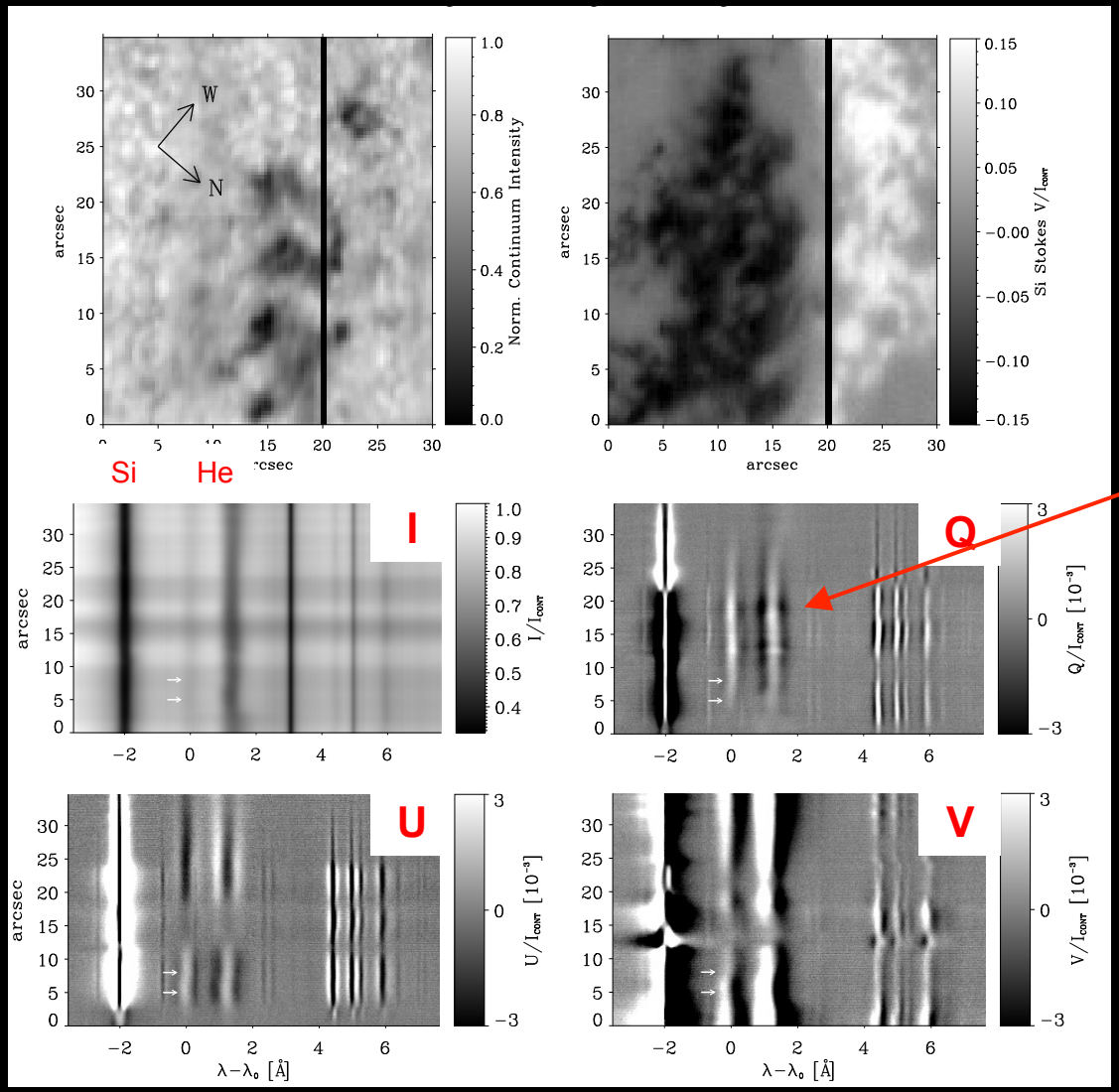




This orphan penumbral regions is the photospheric counterpart of the AR filament !

2.- Orphan penumbrae: emerging flux ropes

The 10830Å spectral window



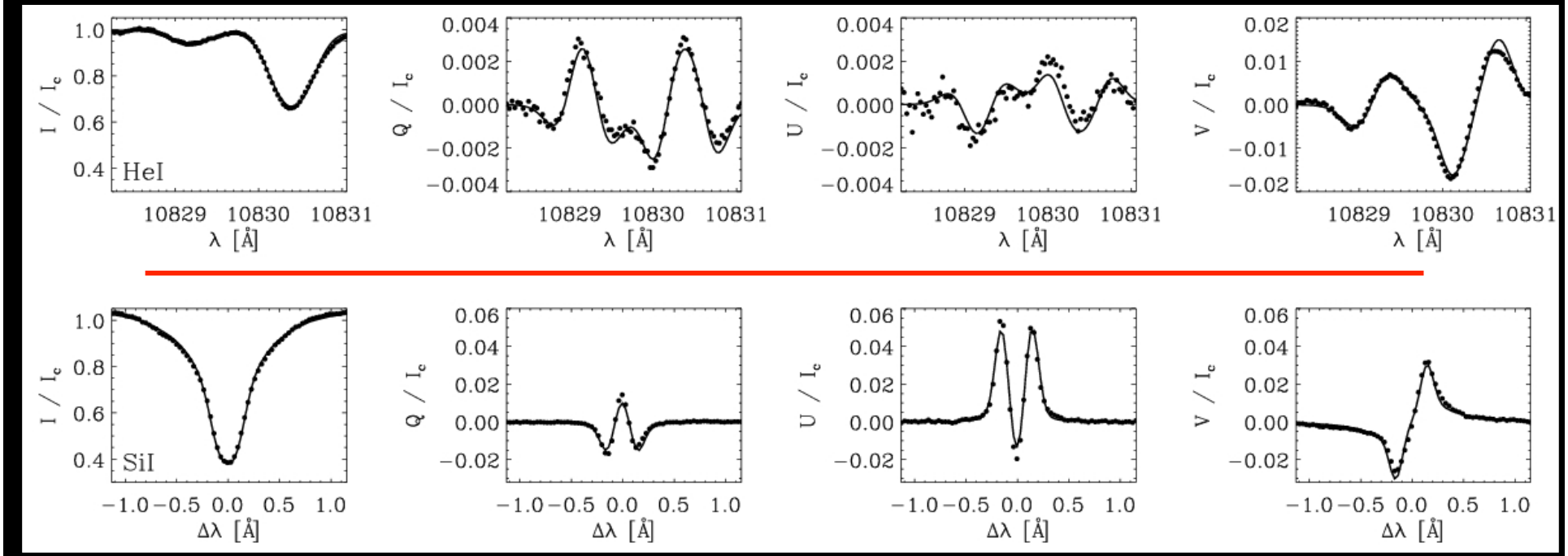
VTT/TIP

Zeeman-like shapes

Kuckein et al, 09

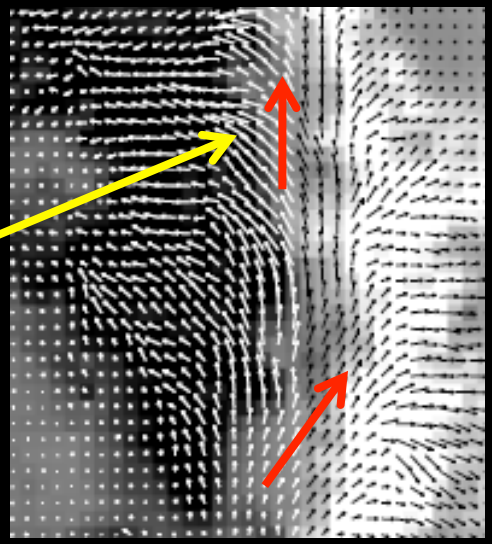
2.- Orphan penumbrae: emerging flux ropes

ME inversion code *MELANIE*



IAC's full (LTE) radiative transfer inversion code *SIR*

2.- Orphan penumbrae: emerging flux ropes

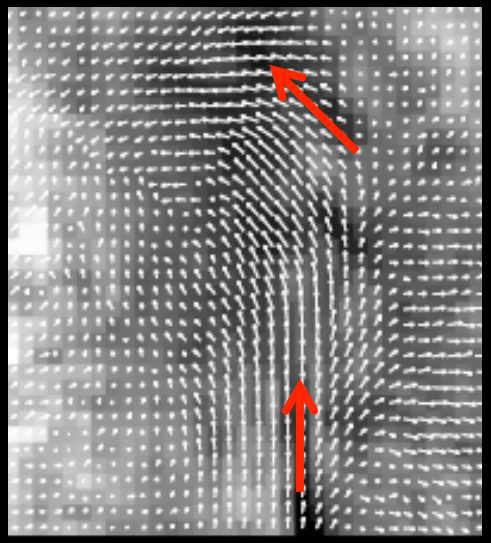


Shear

Si

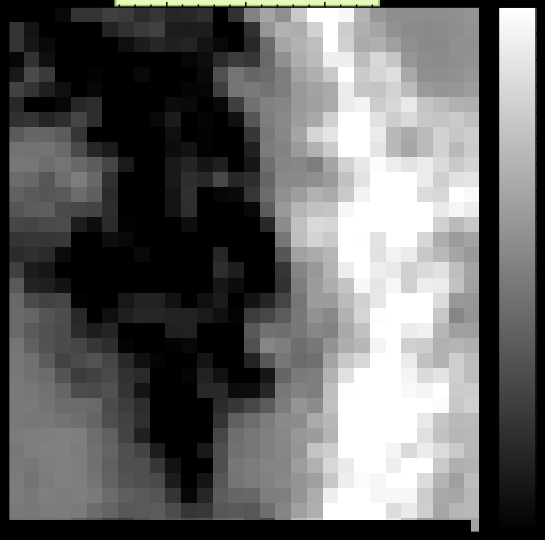
$B_\perp$ ~1100 G

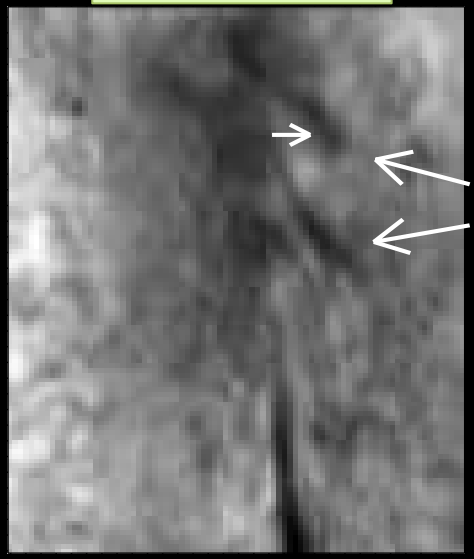
Photosphere



He

Chromosphere



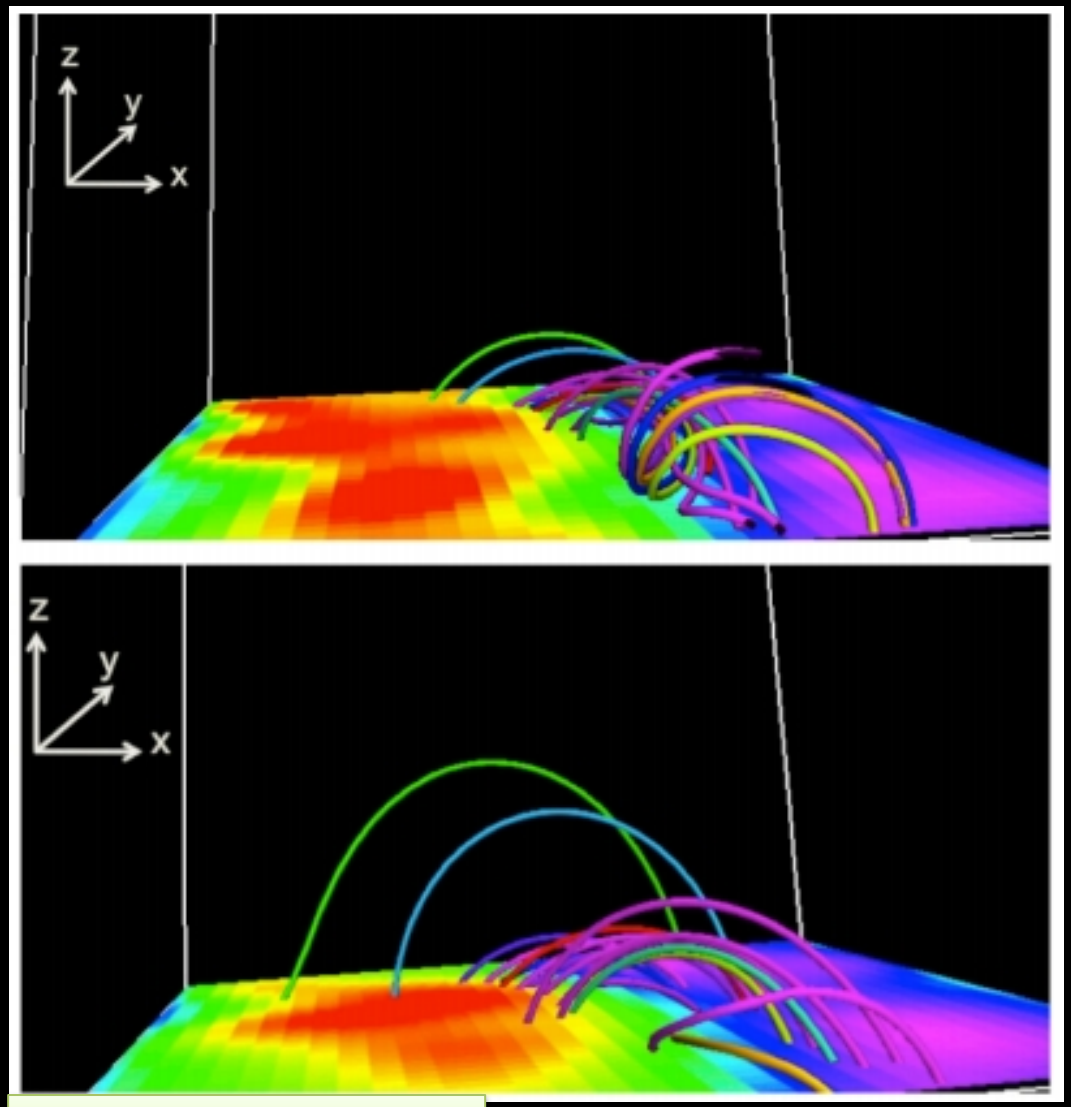


$B_\perp$ ~ 600 G

Poster: Sawada et al.

S2-P-19

2.- Orphan penumbrae: emerging flux ropes



Yelles Chaouche et al. 2012

NLFF Extrapolations from the photosphere

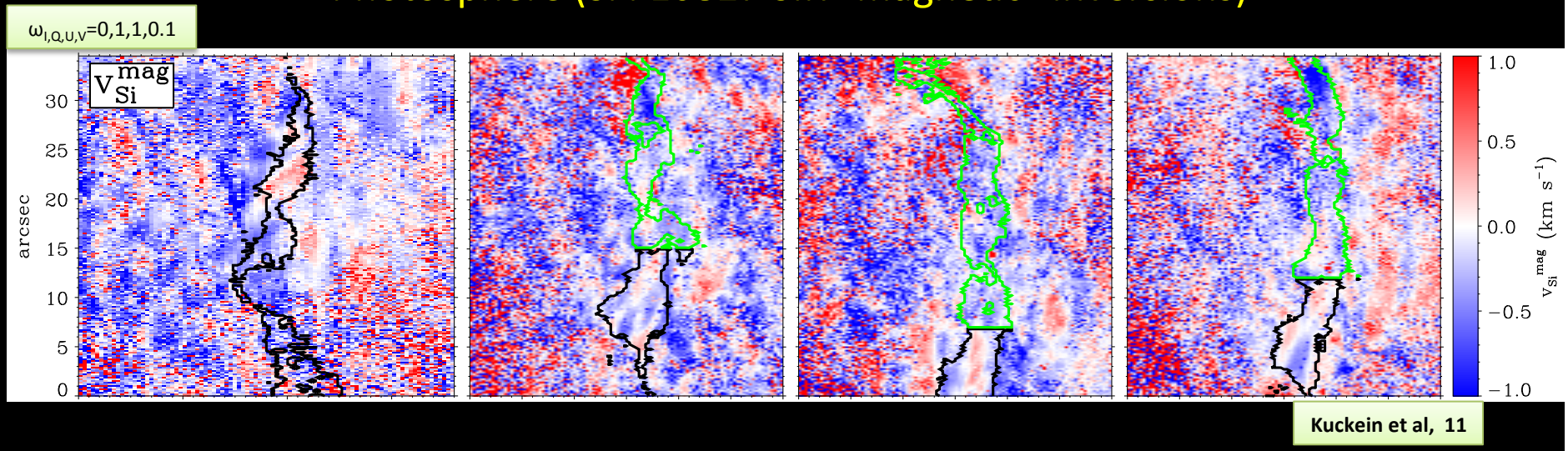
(find the axis of the rope)

NLFF Extrapolations from the chromosphere

(find the top of the rope)

2.- Orphan penumbrae: emerging flux ropes

Photosphere (Si I 10827 SIR "magnetic" inversions)



Kuckein et al, 11

Spine: $\langle v_{mag} \rangle = -0.142$ km/s

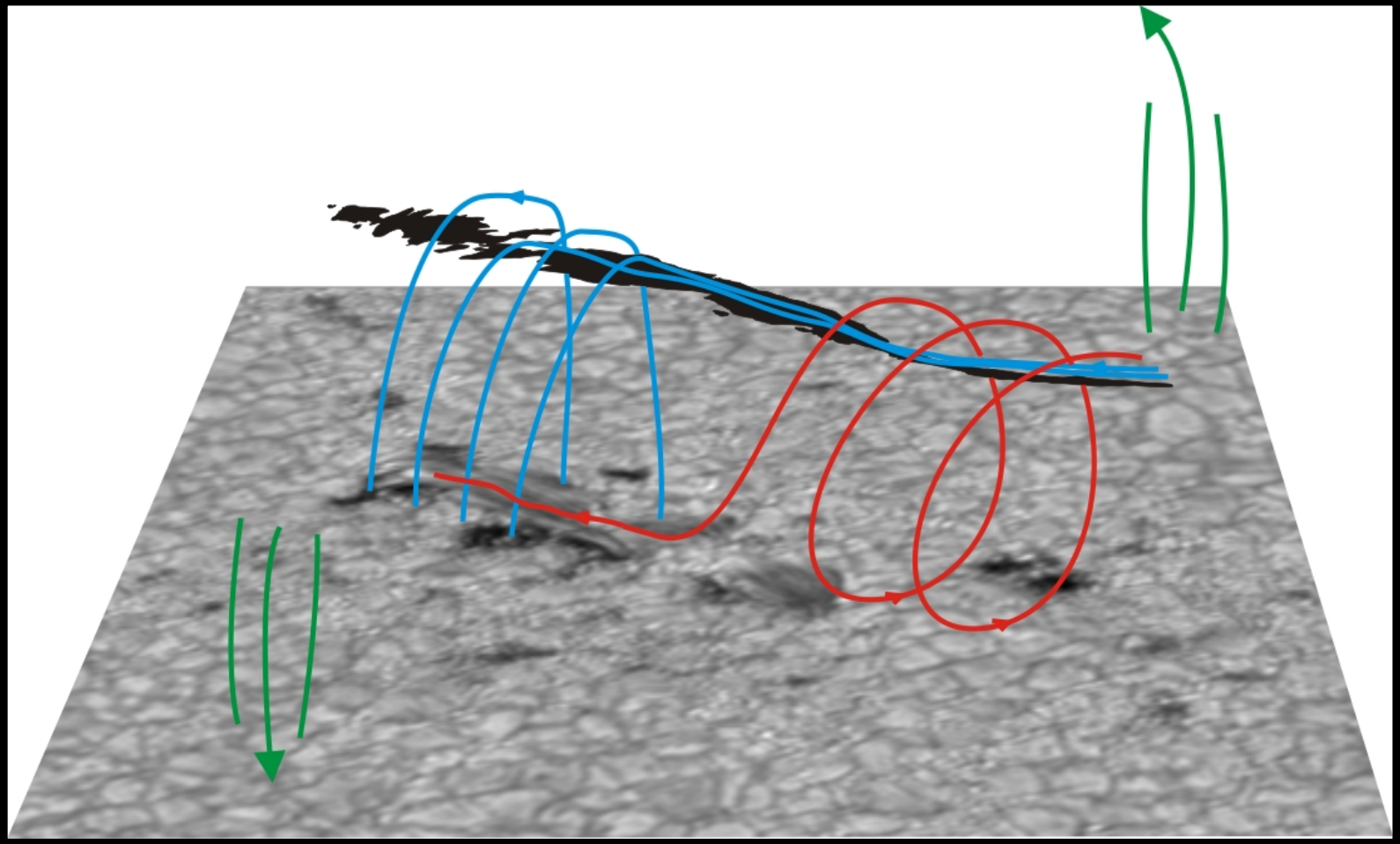
Orphan P: $\langle v_{mag} \rangle = -0.222$ km/s

The Si I "magnetic" inversions indicate upflowing transverse fields in the photosphere

Emerging flux rope

2.- Orphan penumbrae: emerging flux ropes

Inferred configuration: Flux Rope Emergence “a-la” Okamoto et al.

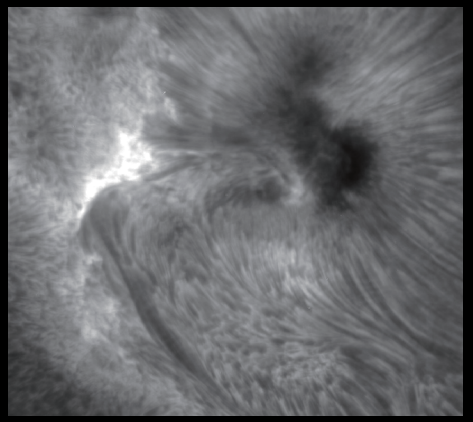


2.- Orphan penumbrae: emerging flux ropes

Okamoto et al. (2008,2009) found:

- "Sliding door" effect
- Normal to inverse transition
- Highly sheared transverse fields

<u>Evidence for an emerging flux rope</u>



Okamoto et al., 08, 09

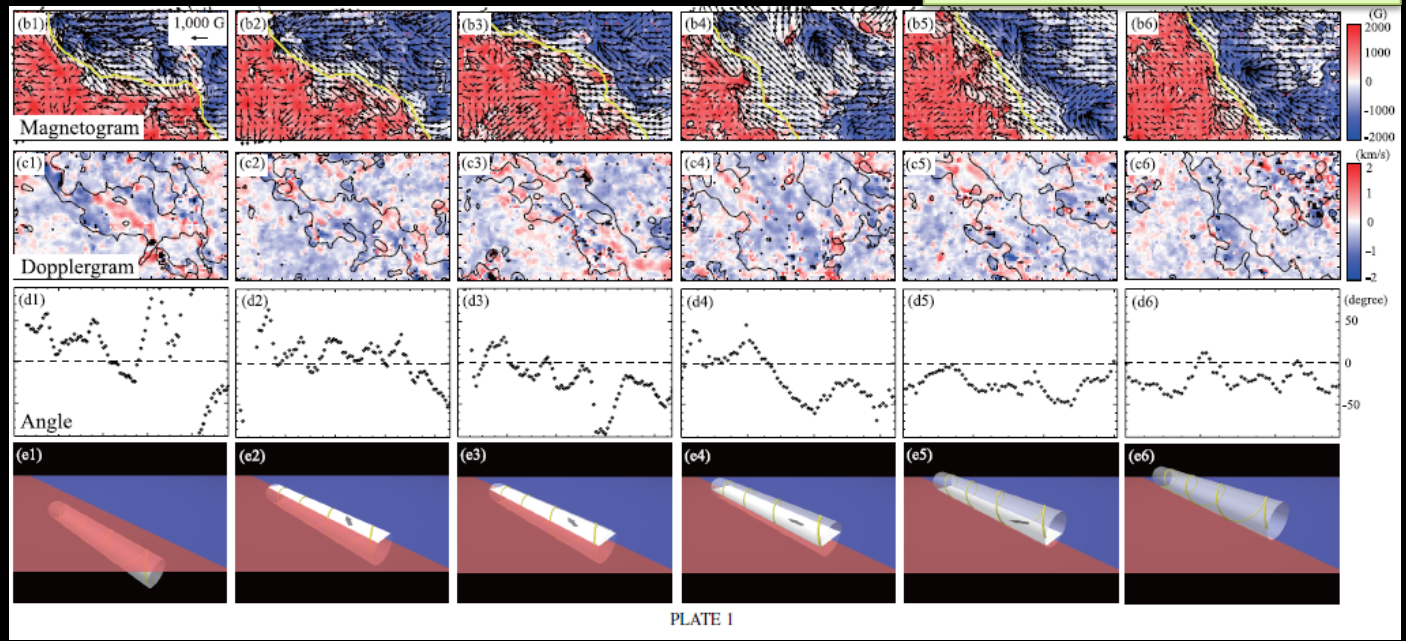
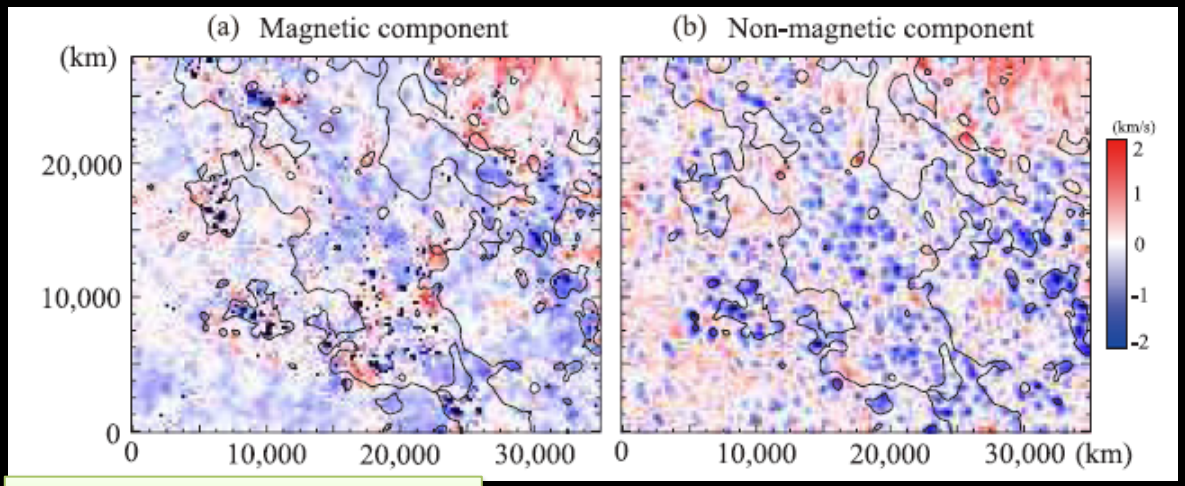


PLATE 1

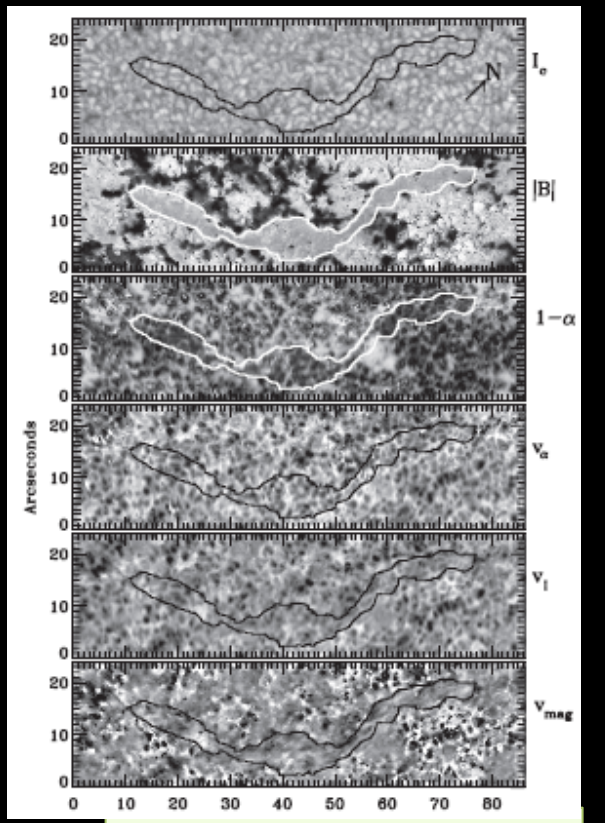
2.- Orphan penumbrae: emerging flux ropes

Observed flows

- LCT dominated by moat flows, mesogranulation
- LCT Absence of shear flows
- Magnetic components shows upflows
- No normal oriented fields with downflows

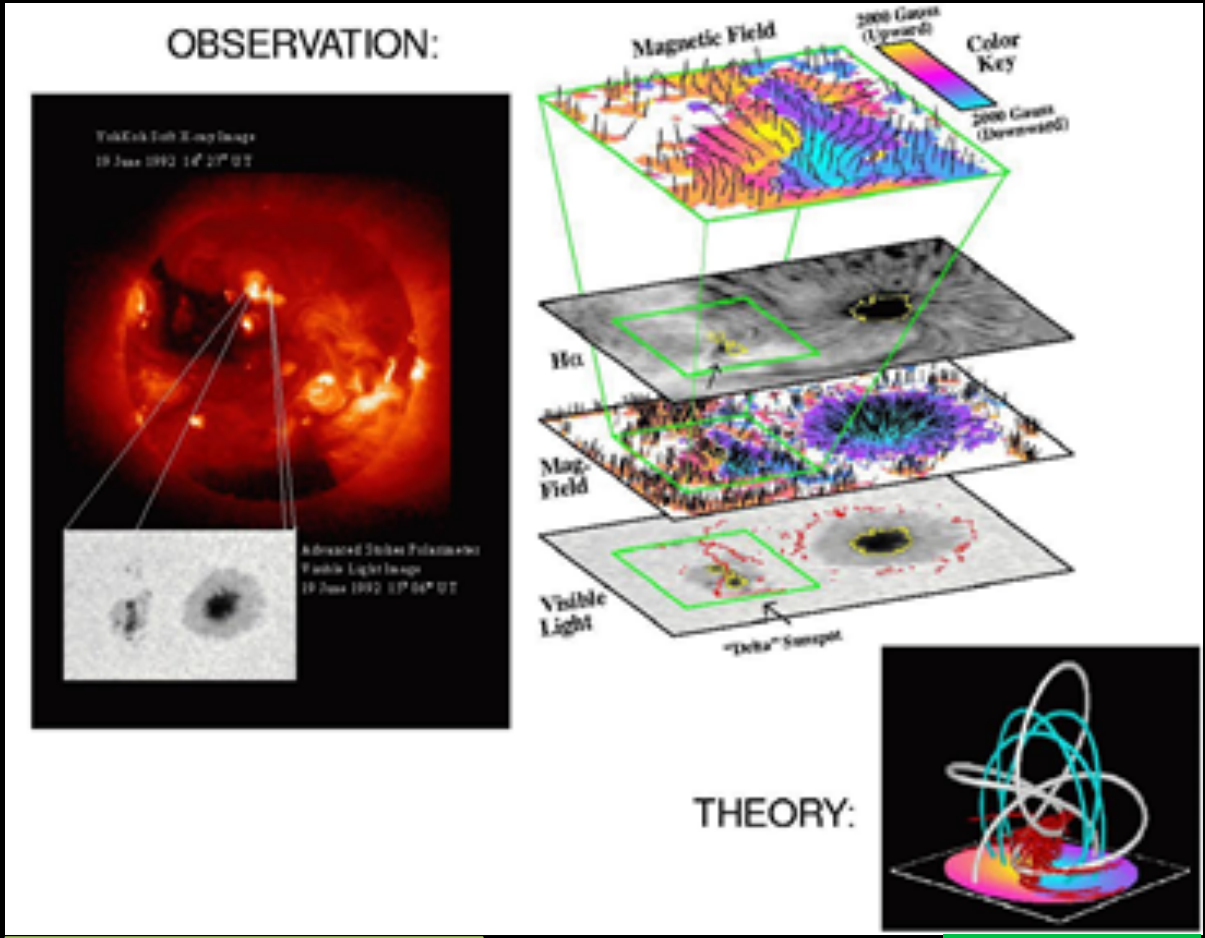


Okamoto et al, 09



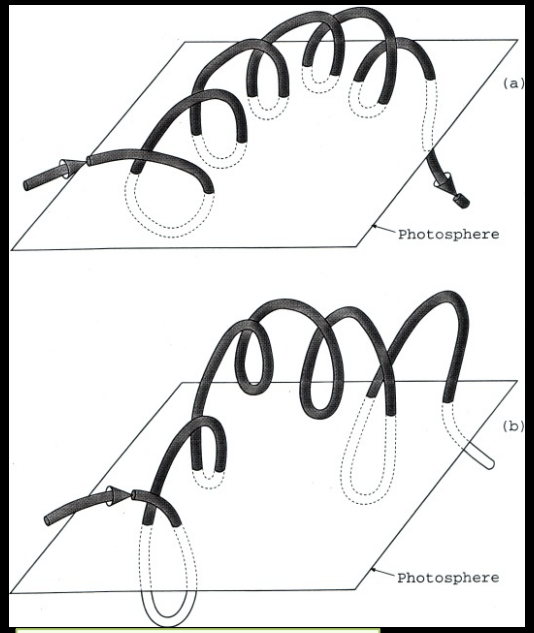
Lites et al, 10

2.- Orphan penumbrae: emerging flux ropes



Lites et al, 95

ASP



Low, 2001

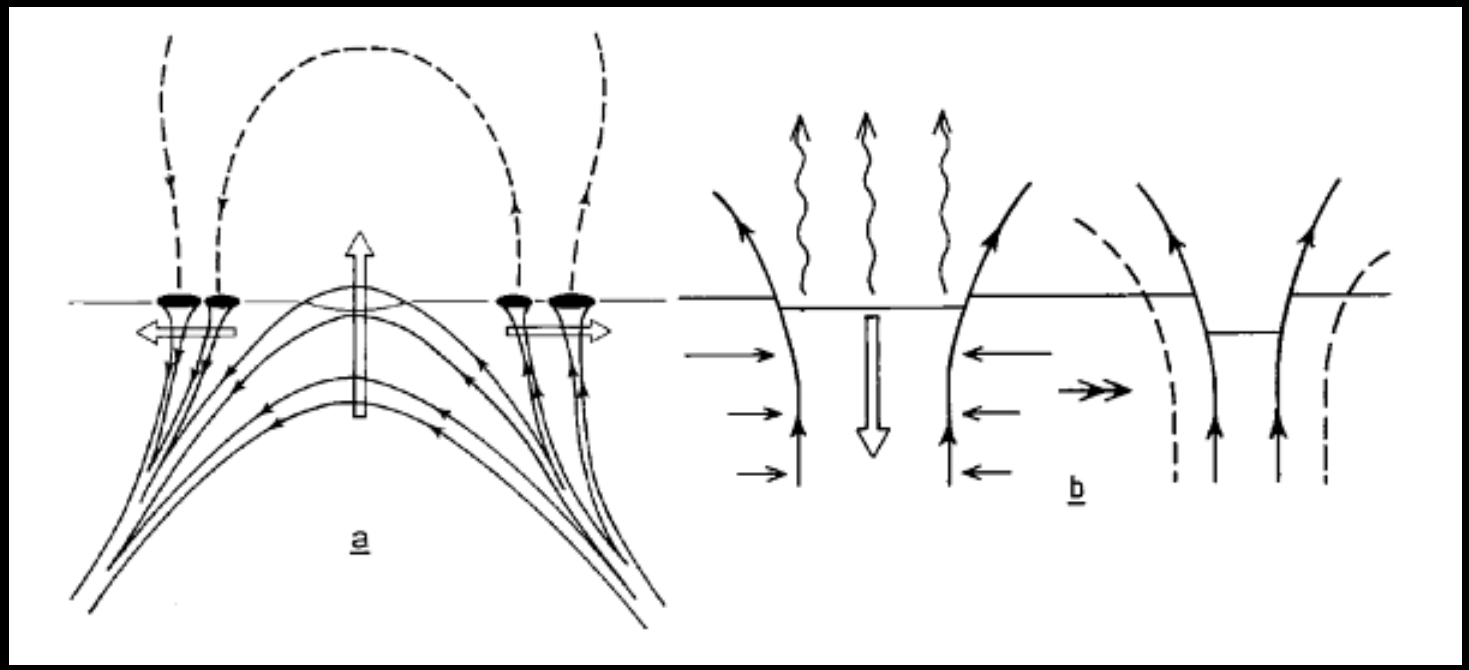
O-loop emergence

Based on a δ-spot

(orphan penumbrae)

3.- Orphan penumbrae: regular penumbrae

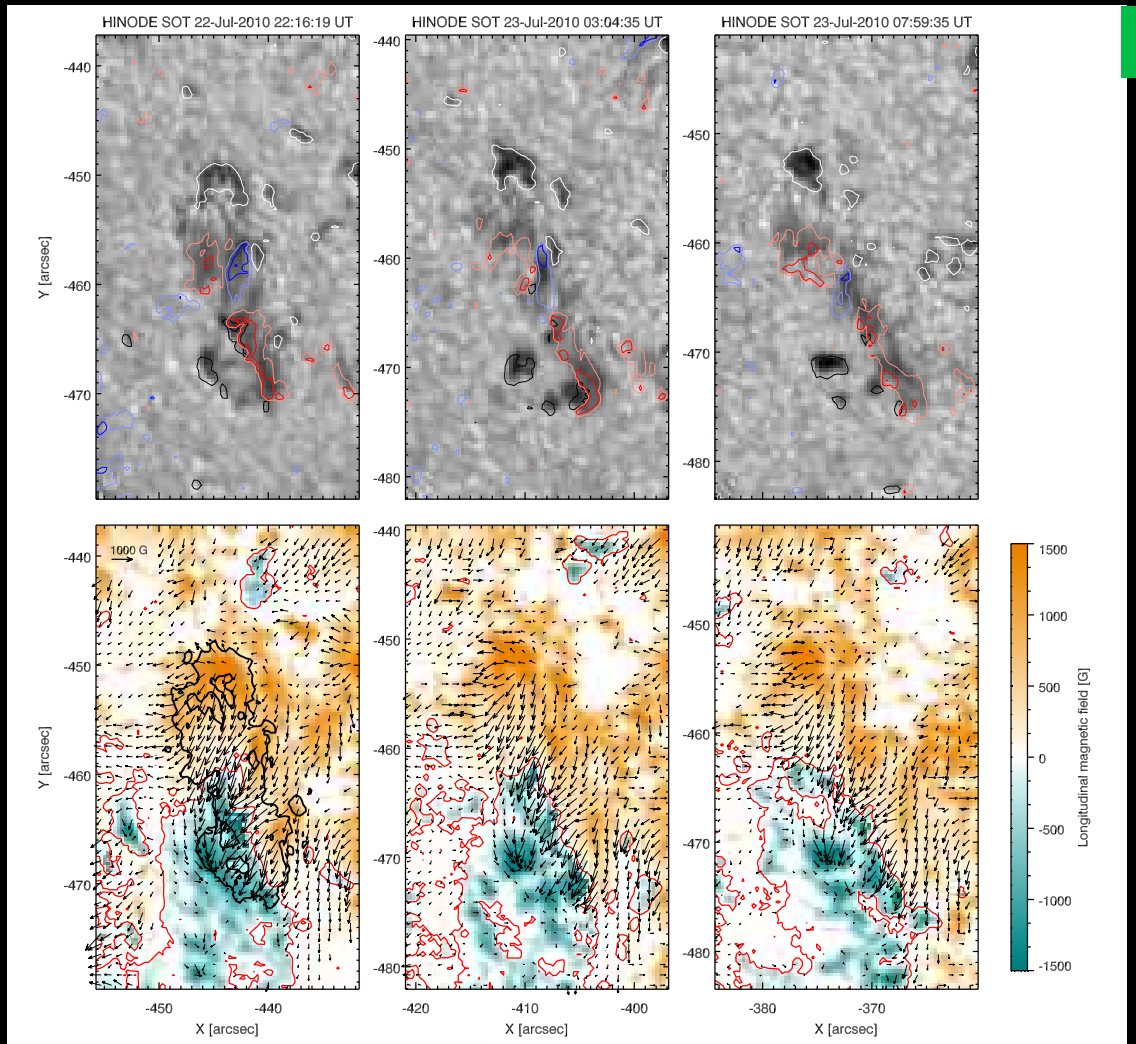
1. Are all orphan penumbrae emerging flux ropes?
2. Recent Hinode observations suggest other possibilities
3. Emerging omega-loops (submerging?)
4. Emerging fields at equipartition strengths



Schrijver & Zwaan, 2000

3.- Orphan penumbrae: regular penumbrae

Hinode/SP

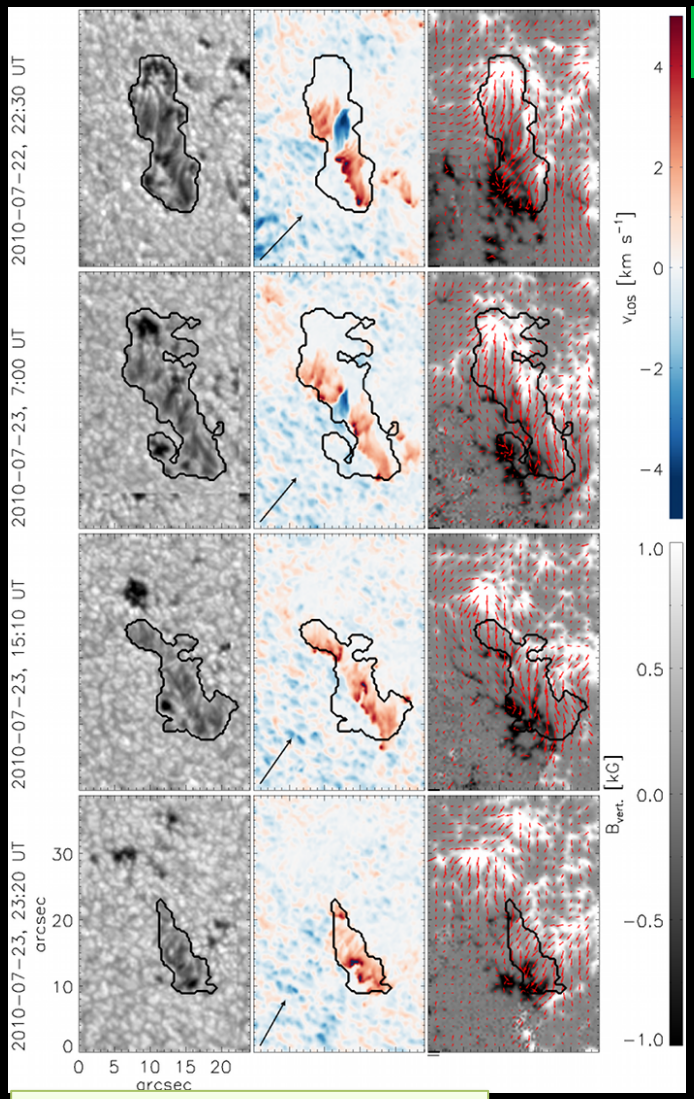


Zucarello et al., 2013

B ~1500 G

Hα shows no AR filament

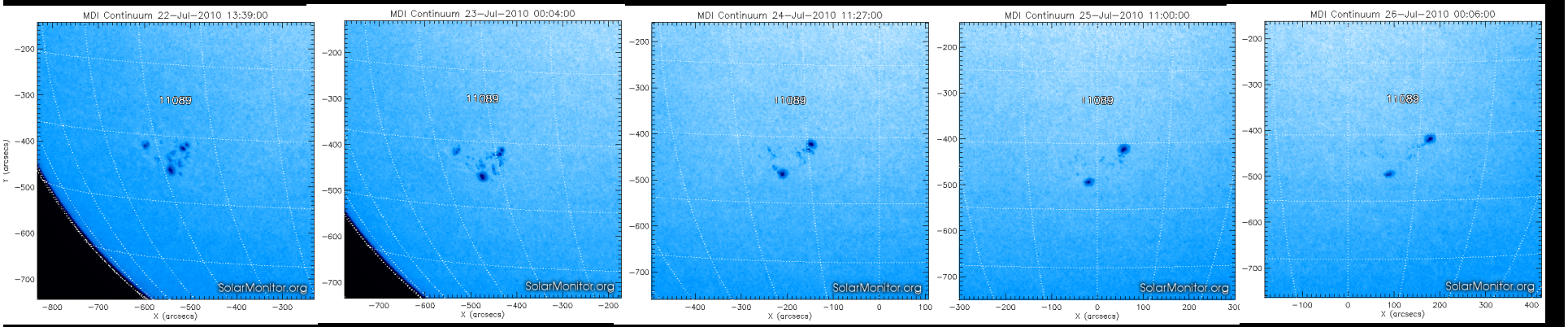
3.- Orphan penumbrae: regular penumbrae

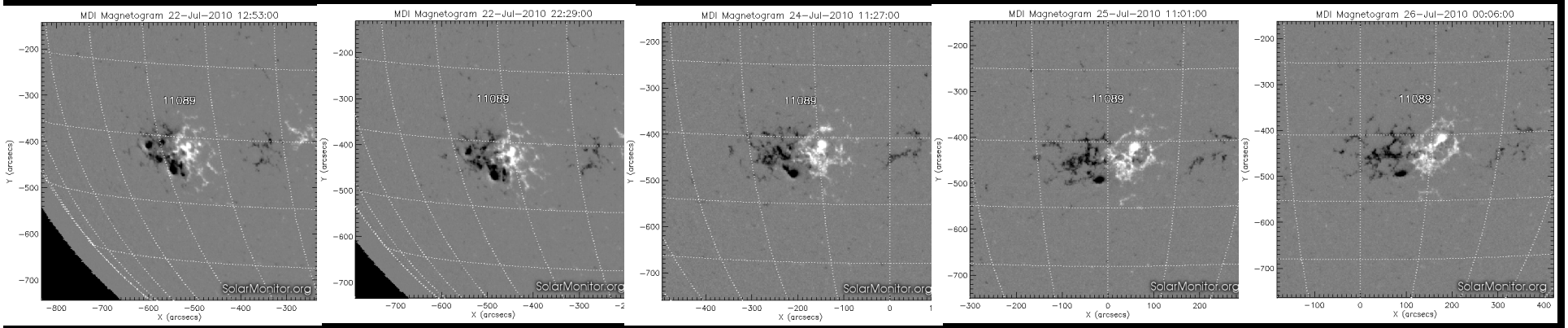


Hinode/SP

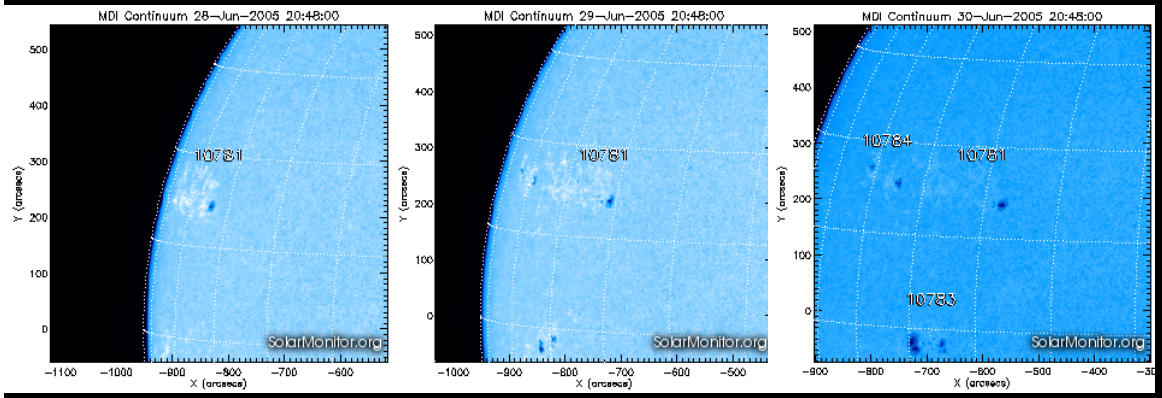
Jurcak et al., 2013

4.- Solving the paradigm: synoptic observations

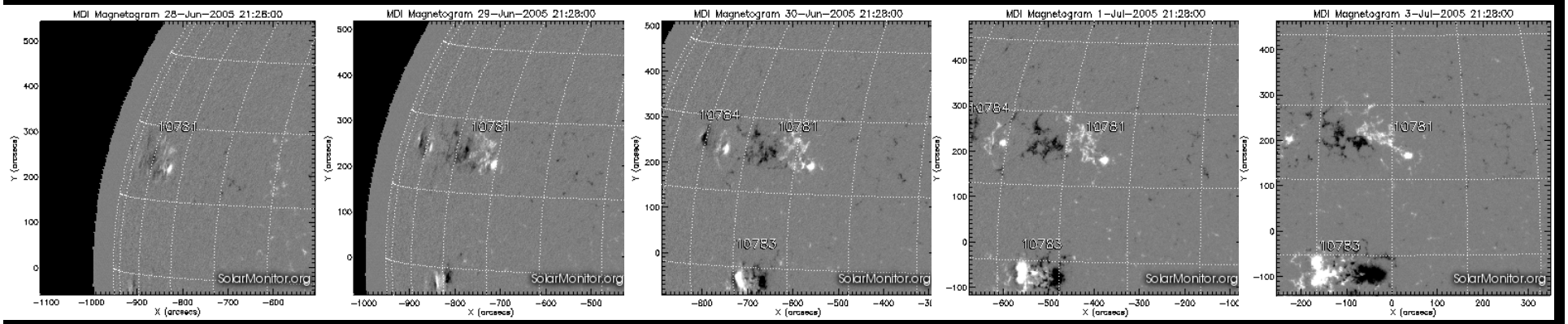




4.- Solving the paradigm: synoptic observations

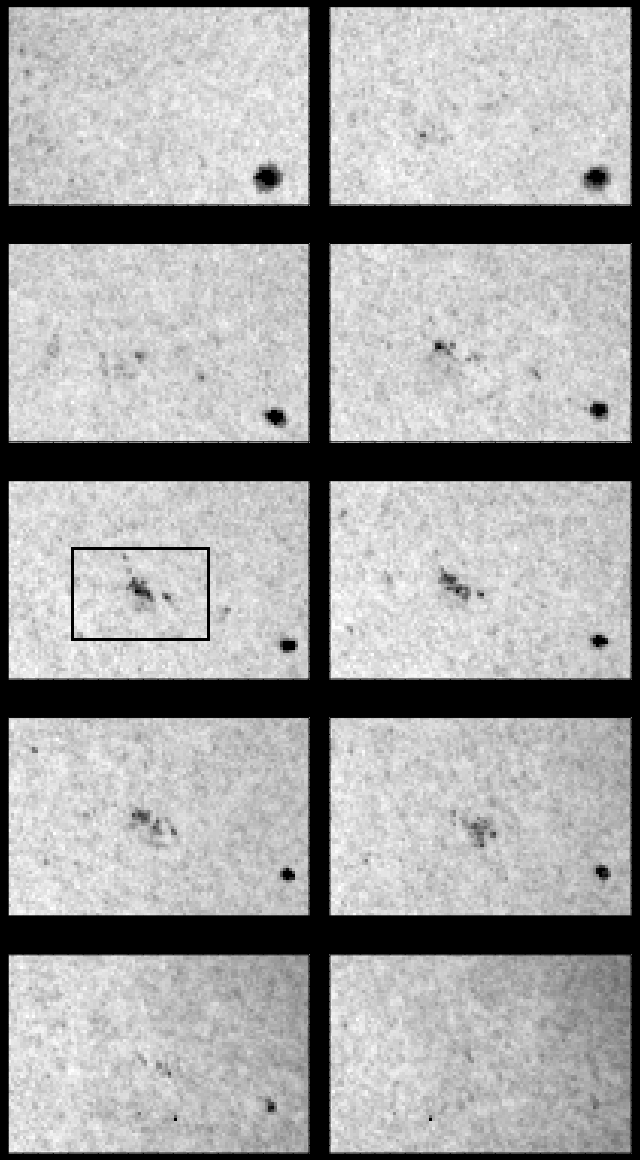


Only leader sunspot

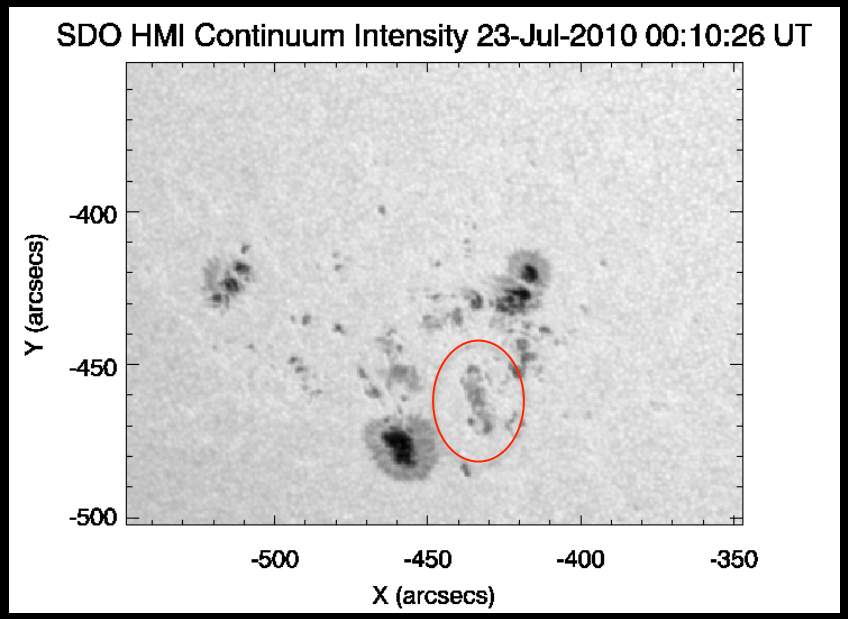


4.- Solving the paradigm: synoptic observations

Here by orphan we really meant orphan



SOHO/MDI



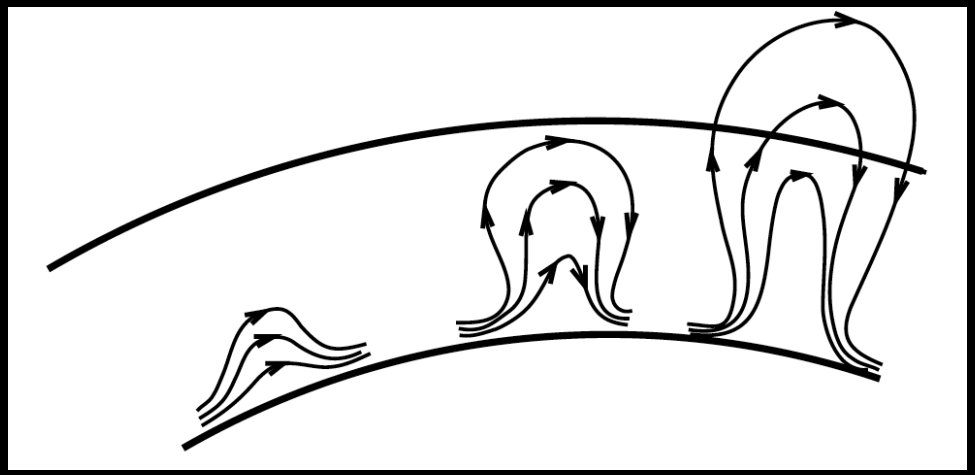
4.- Solving the paradigm: synoptic observations

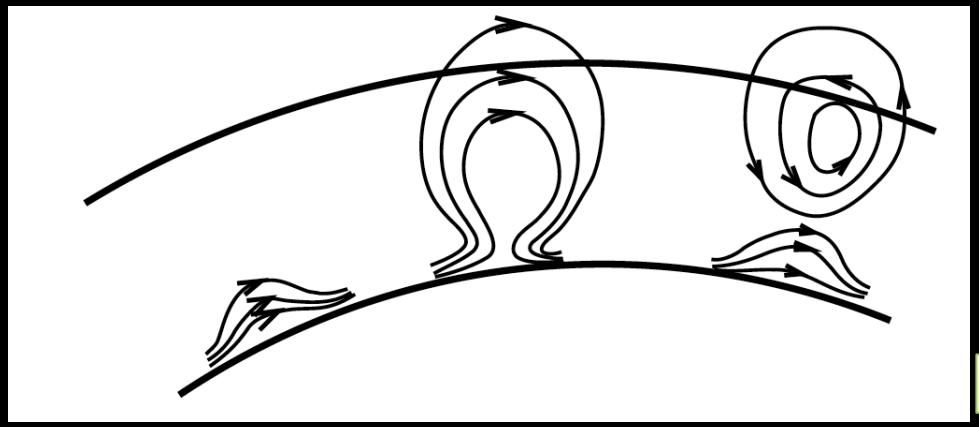
1. OP: They are located at AR neutral lines
2. OP: Strong (>1kG) horizontal fields: dark
3. OP new AR: they show Evershed-like & moat-like flows
4. OP new AR: Field orientation in normal configuration
5. OP new AR: No signature of Hα filament
6. OP new AR: They are really not that "orphan"
7. OP new AR: Emerging flat Ω-loops (able to halt convection)
8. OP old AR: Sheared fields (inverse orientation)
9. OP old AR: Hα filament
10. OP old AR: They are very isolated

We need better statistics

4.- Solving the paradigm: synoptic observations

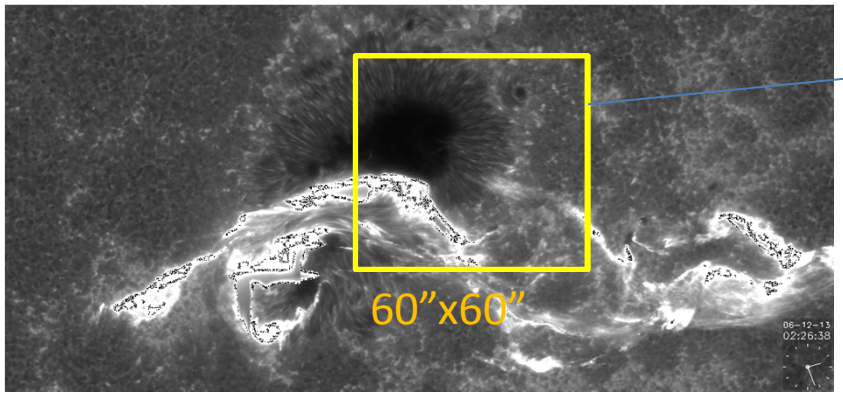
"Solar Magnetism: The State of Our Knowledge and Ignorance"





Parker, 09

5.- Conclusions: The tough answer



Do you want a continuous observation for days with this FOV?

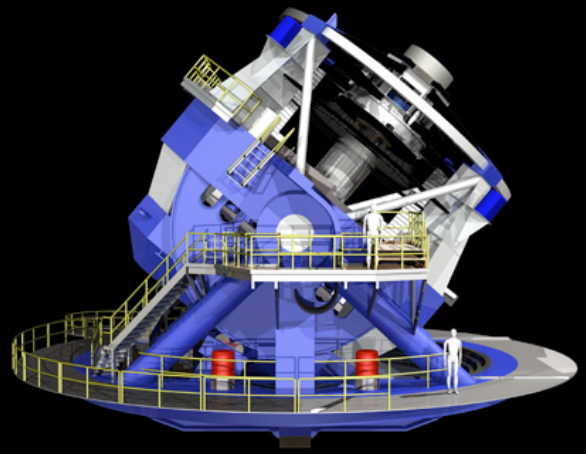
- Yes ! (100 km resolution, 10^{-4} pol. sensitivity, 1 second cadence)
- (As long as someone provides the context in time and in space)

None of these two programs should be taken for granted

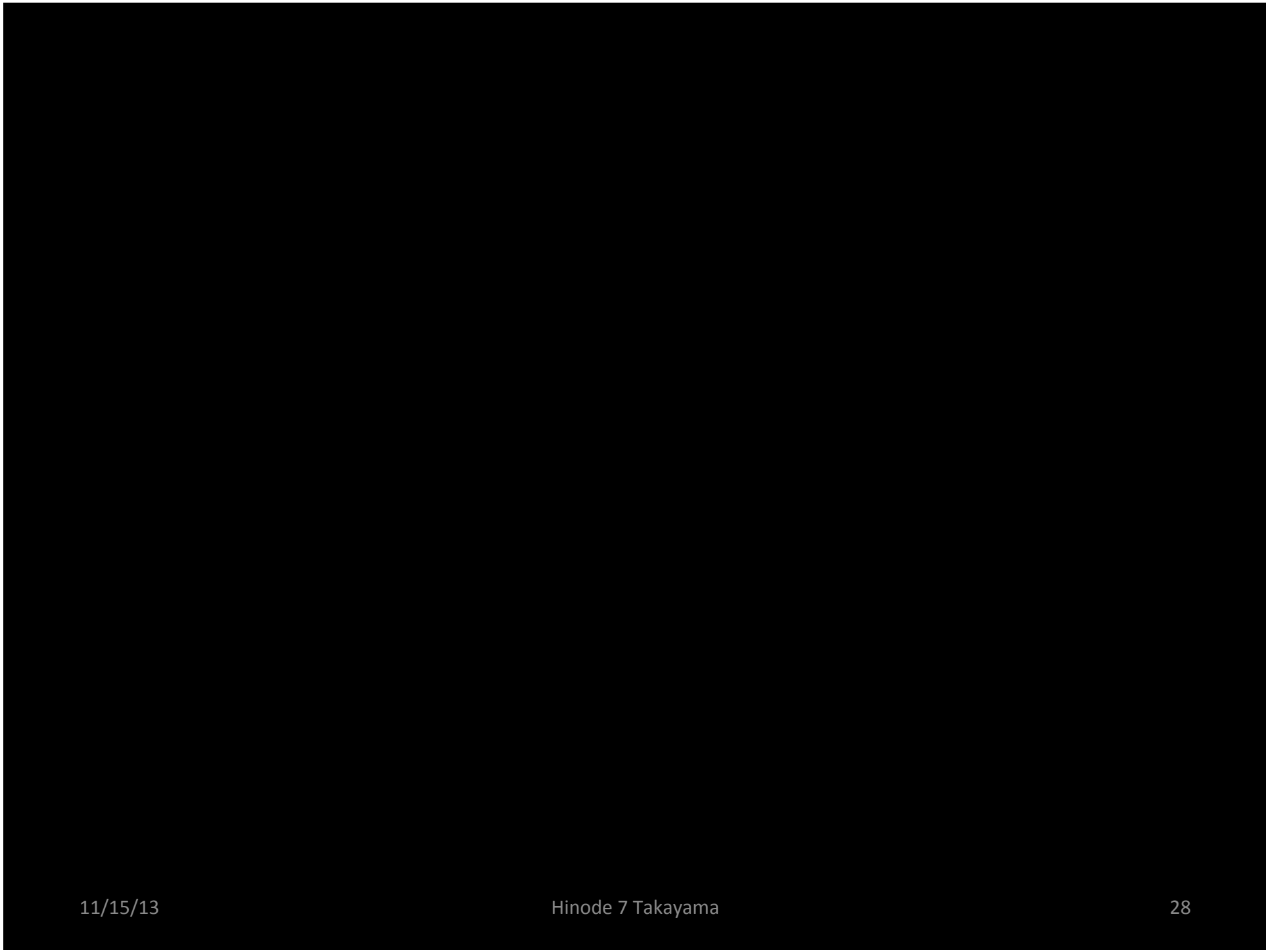
5.- Conclusions: The tough answer

Can we get 0.1 arcsec resolution and full disk imaging?

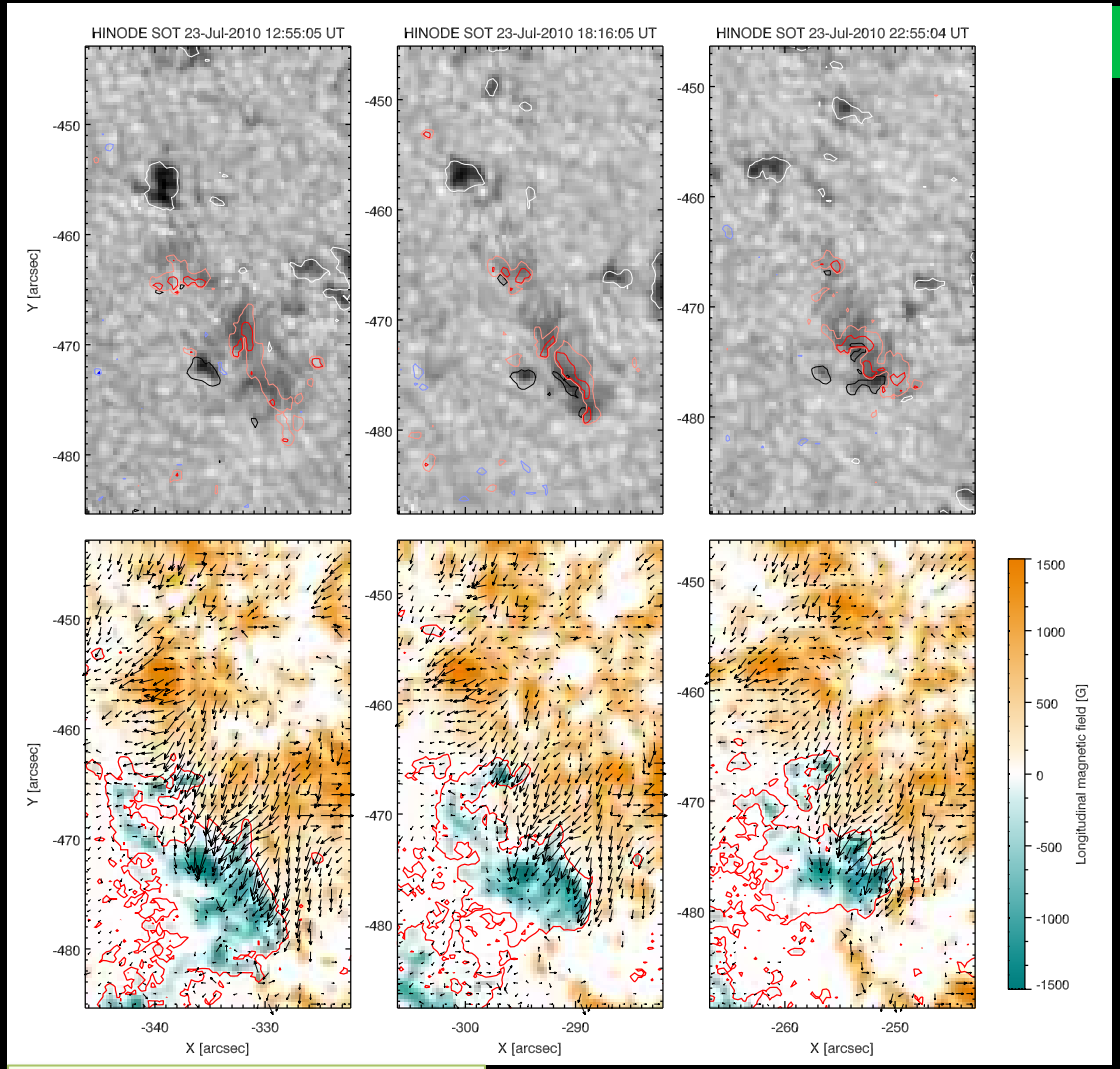
- LSST (Large Synoptic Survey Telescope)
- 8.4 meter, 3.5 degree FOV: high throughput astronomy
- 3200 Megapixels every 10 seconds: Big Data (30 TB a day)
- Processing: >100 PB with 100 Tflops computing power.
- Caveats: MCAO+spectroscopy+polarimetry
- Input for a high resolution WSA-Enlil model?



Thanks !



3.- Orphan penumbrae: regular penumbrae

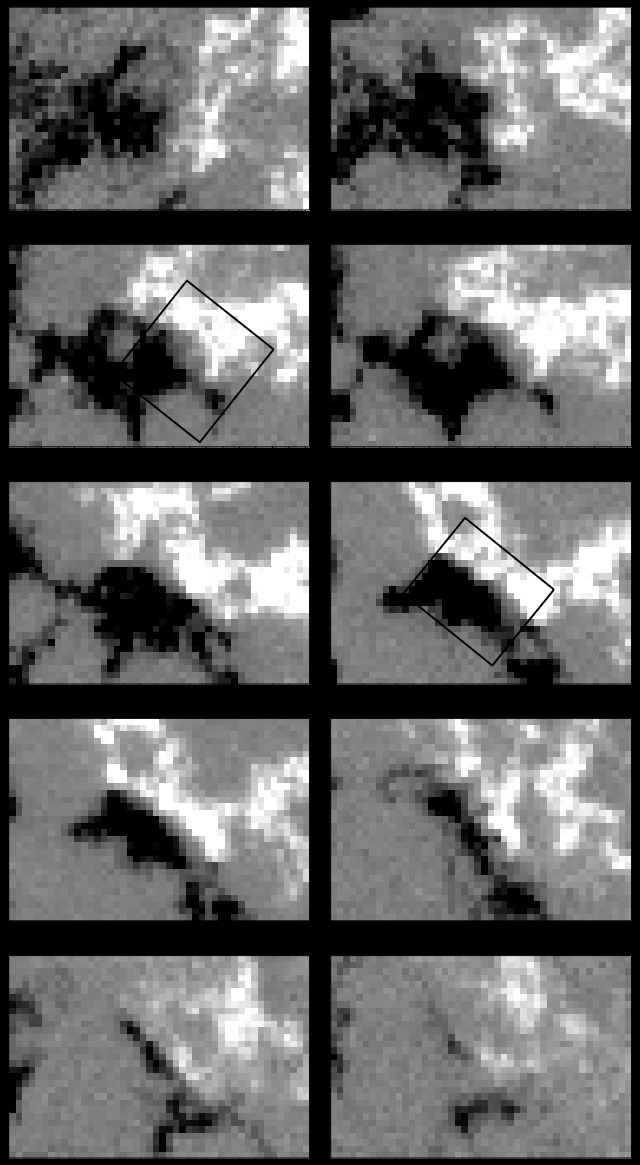


Hinode/SP

Zucarello et al., 2013

2.- Orphan penumbrae: emerging flux ropes

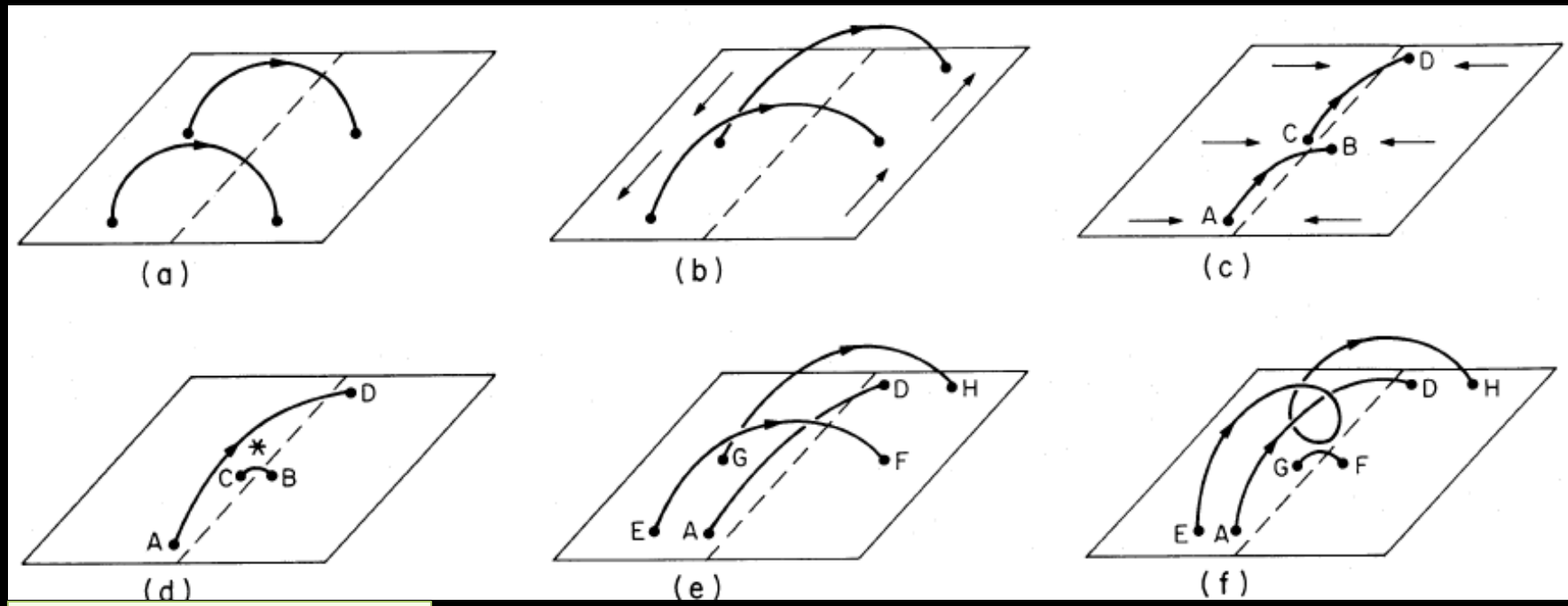
Sliding door?



SOHO/MDI

B_{TRA} observations of the Active Sun

Filament formation (Active and Quiescent)



Van Ballegooijen & Martens , 89

- CB (or GF) bipoles resulting from reconnection submerge
- Shear stays above the photosphere