FASR and The Quiet Sun

Hallucinations of an Enthusiastic Outsider

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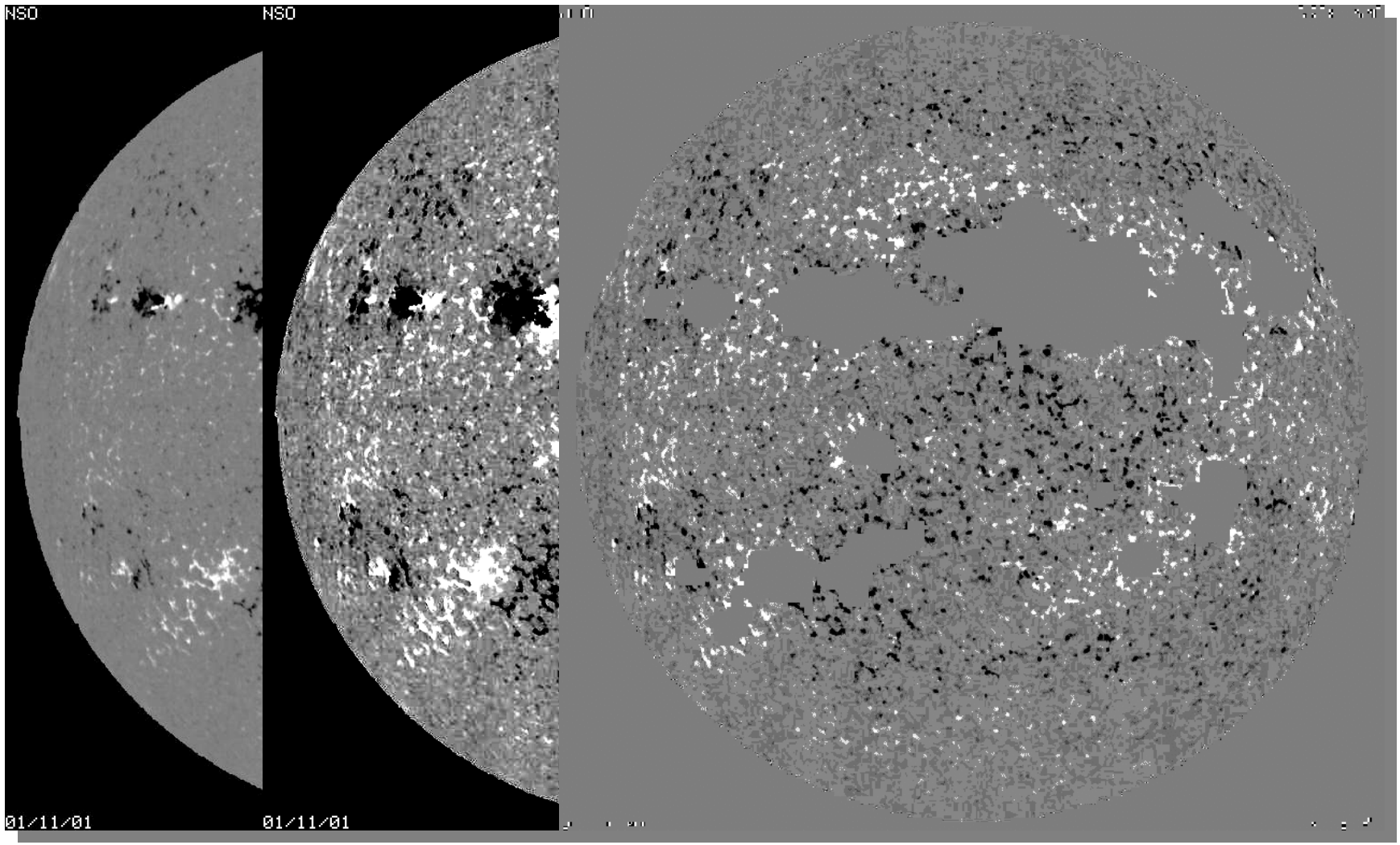
The End

The ‘Quiet Sun’ does not exist!

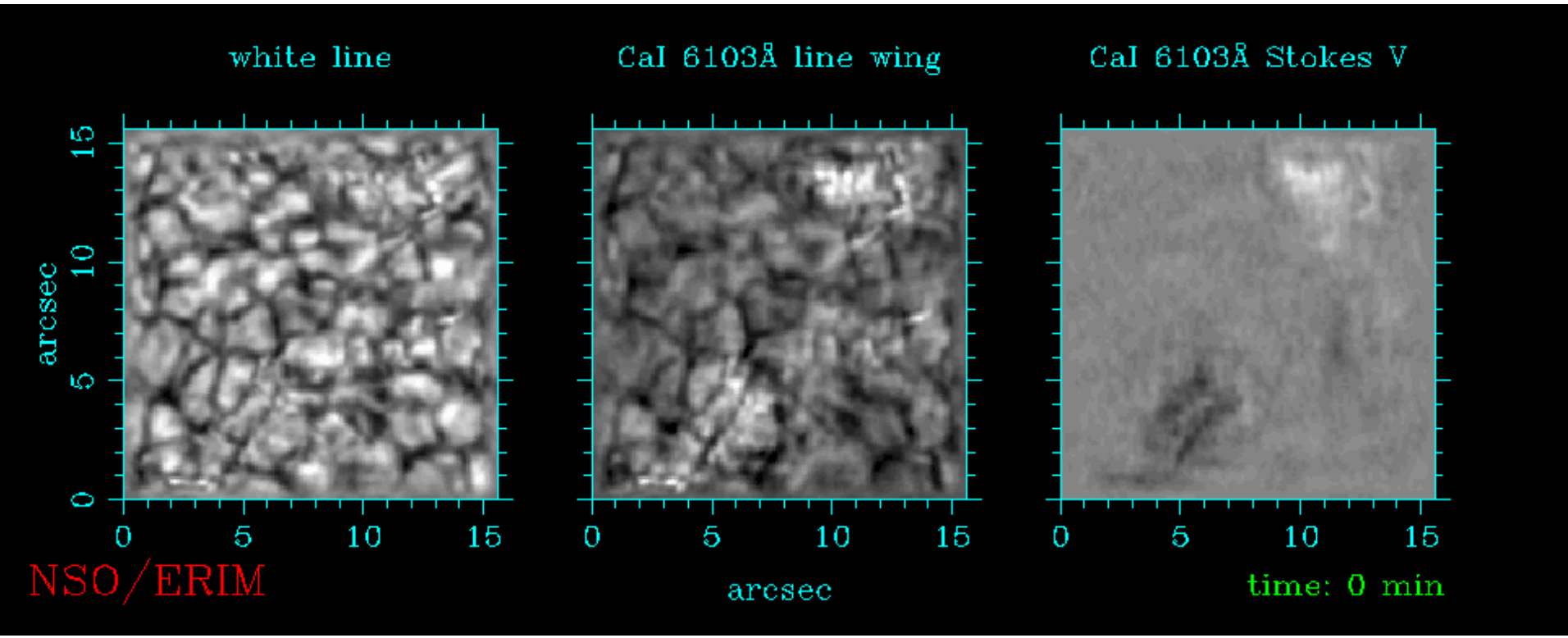
Where is The Quiet Sun?



Various Aspects of the Quiet Sun

- Magnetic fields:
  - Network fields: unipolar and mixed polarity, mostly strong (1-2kG) fields
  - Internetwork fields: mixed polarity, probably weak (0.01 to 0.5 kG) fields
  - Most flux emerges in quiet sun
  - CMEs launch from quiet sun too
  - Coronal holes occur in the quiet sun
  - (Erupting) filaments occur in the quiet sun (even close to the poles)
- Velocity fields:
  - Granulation and supergranulation
  - 3 to 5-min oscillations
  - Lots of ‘things’ in the chromosphere and corona
- Temperature structure:
  - The solar atmosphere is dynamic, in particular above the photosphere
  - Spatially and temporally highly intermittent very hot (EUV emission) and very cold (CO limb emission) gas

Photospheric Small-Scale Dynamics

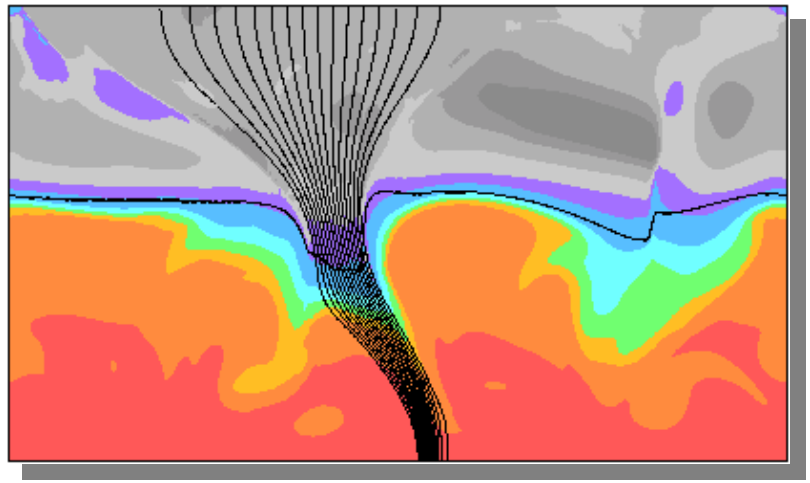


- Quiet network observed with Dunn Solar Telescope, Phase Diverse Speckle (PDS) and speckle deconvolution reconstructions (no adaptive optics)

With R. Paxman, D. Carrara, A. Basu, T. Rimmele

Network Magnetic Fields

- Importance of flux tubes:
  - building blocks of network and active regions
  - most likely channels for transporting energy to upper atmosphere
  - affect convection, irradiance, oscillations, solar cycle

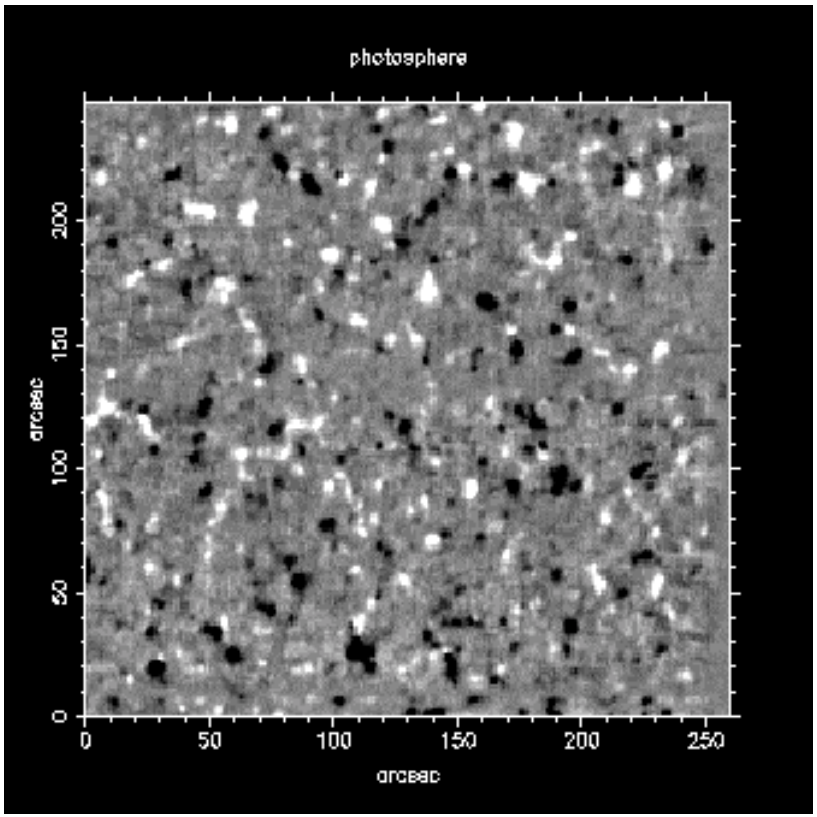


From O. Steiner

- Need to understand the role of flux tubes in heating the upper chromosphere and corona

- Therefore need to study flux tube structure, dynamics, connection to higher layers, brightness, energizing by convection, waves into upper atmosphere

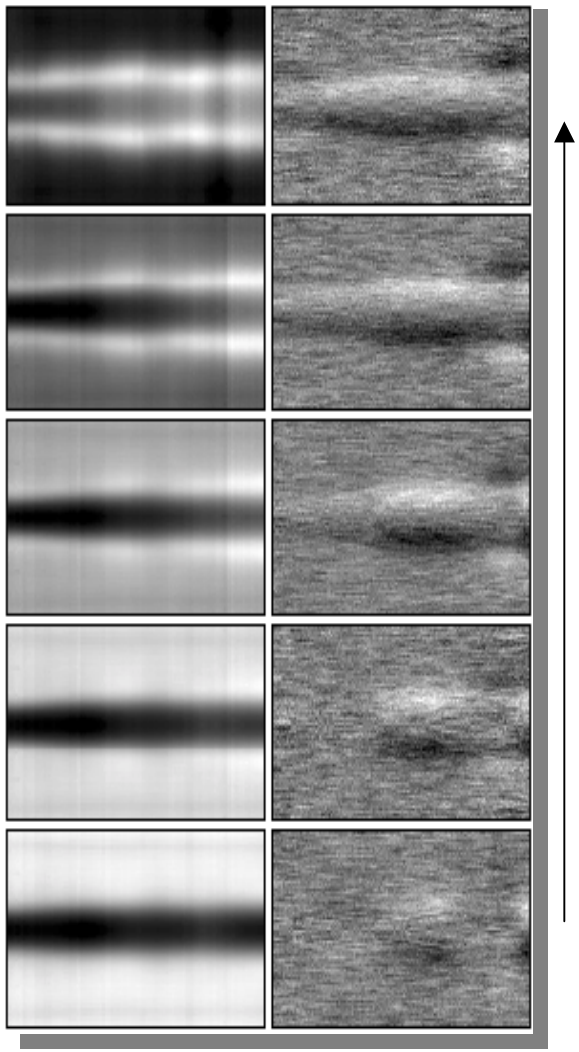
Photospheric and Chromospheric Magnetograms



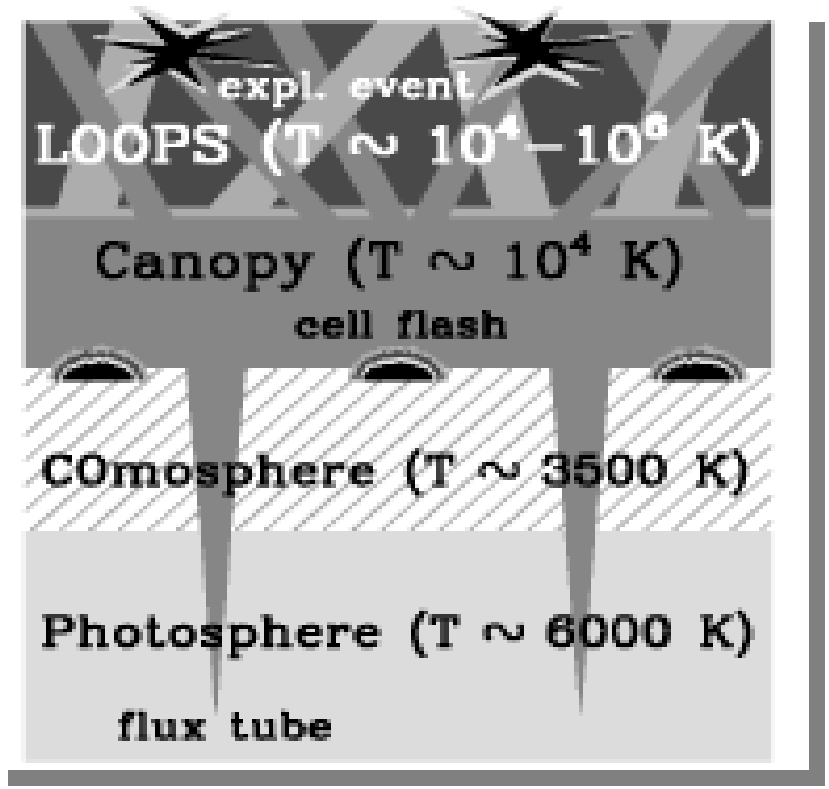
- Chromospheric features are more fuzzy despite simultaneous observations
- Magnetic fields expand with height
- However, in canceling magnetic fields, features are not larger!

Original data courtesy Karen Harvey

Where is the Quiet Network Canopy?

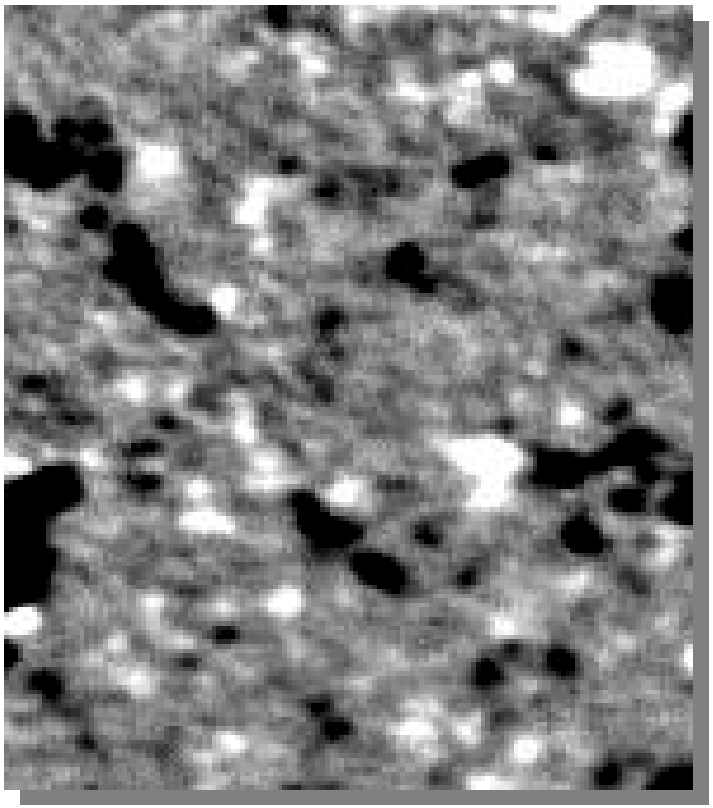


- FeII 492.4 nm over active region
- Similar effects seen in strong network
- Never observed in very quiet sun

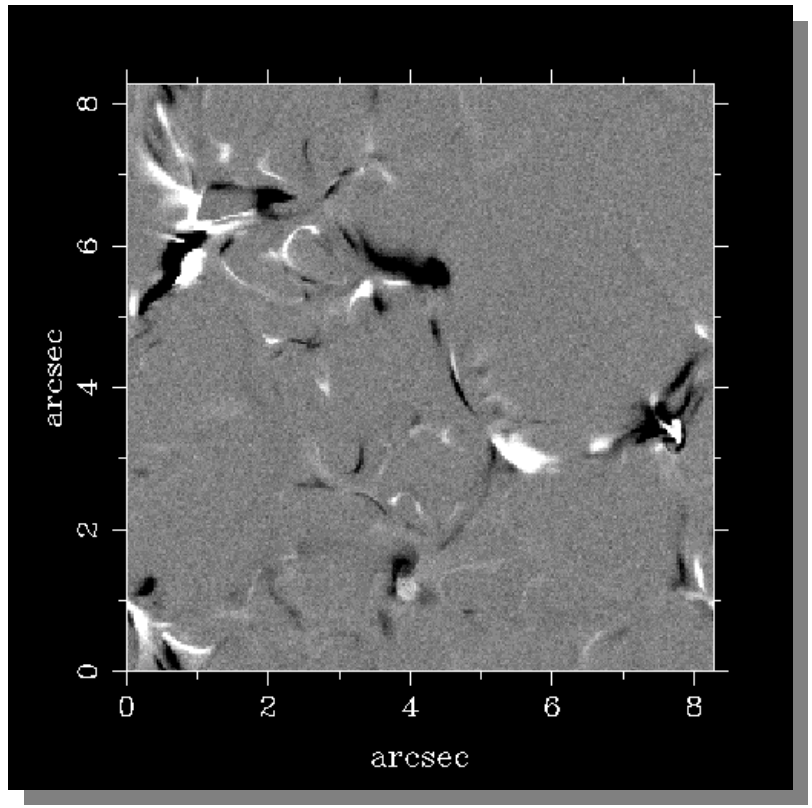


From T. Ayres

Ubiquitous Magnetic Fields



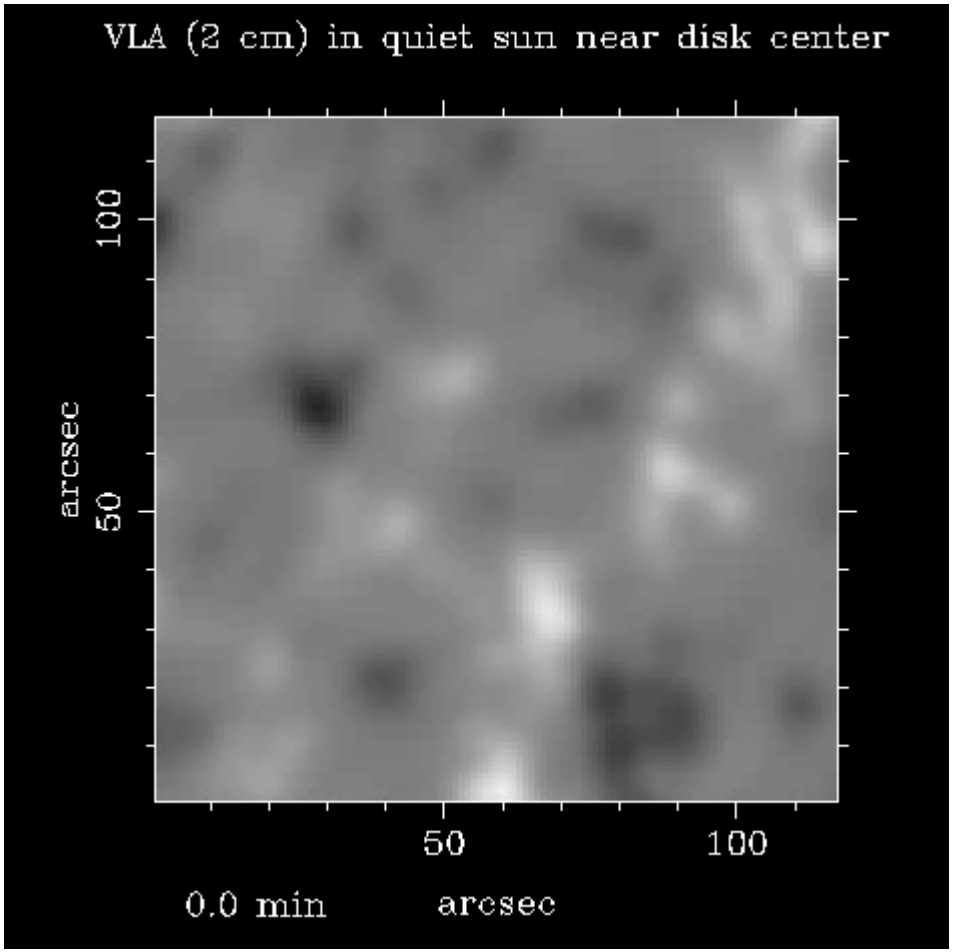
BBSO



With R. Stein and A. Nordlund

- = Intranetwork fields and ‘turbulent’ field observed with Hanle effect
- Probably due to small-scale dynamo

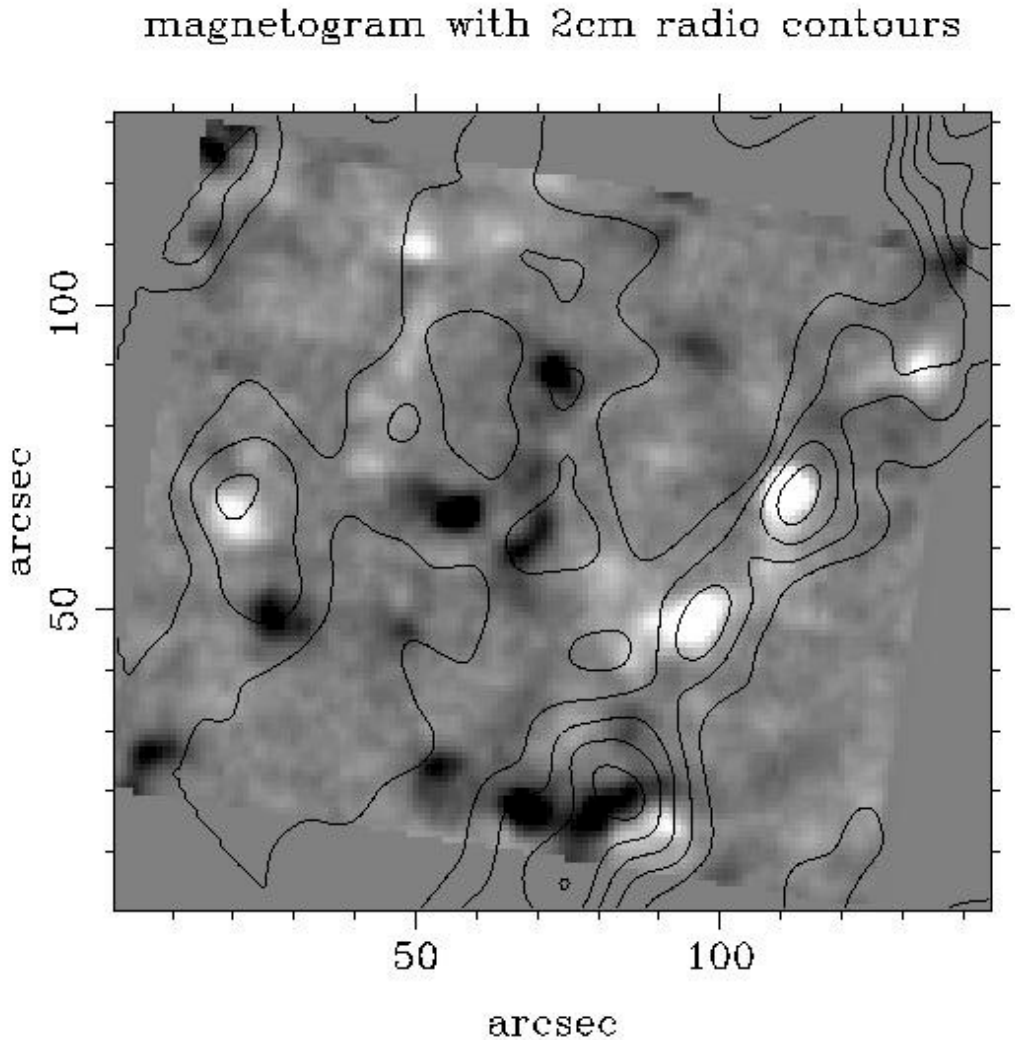
Temporal Variation of Network Radio Signal



- Your noise is my signal
- Lots of stuff is happening at small scales
- Some structures are consistent between snapshots spaced by 120 seconds

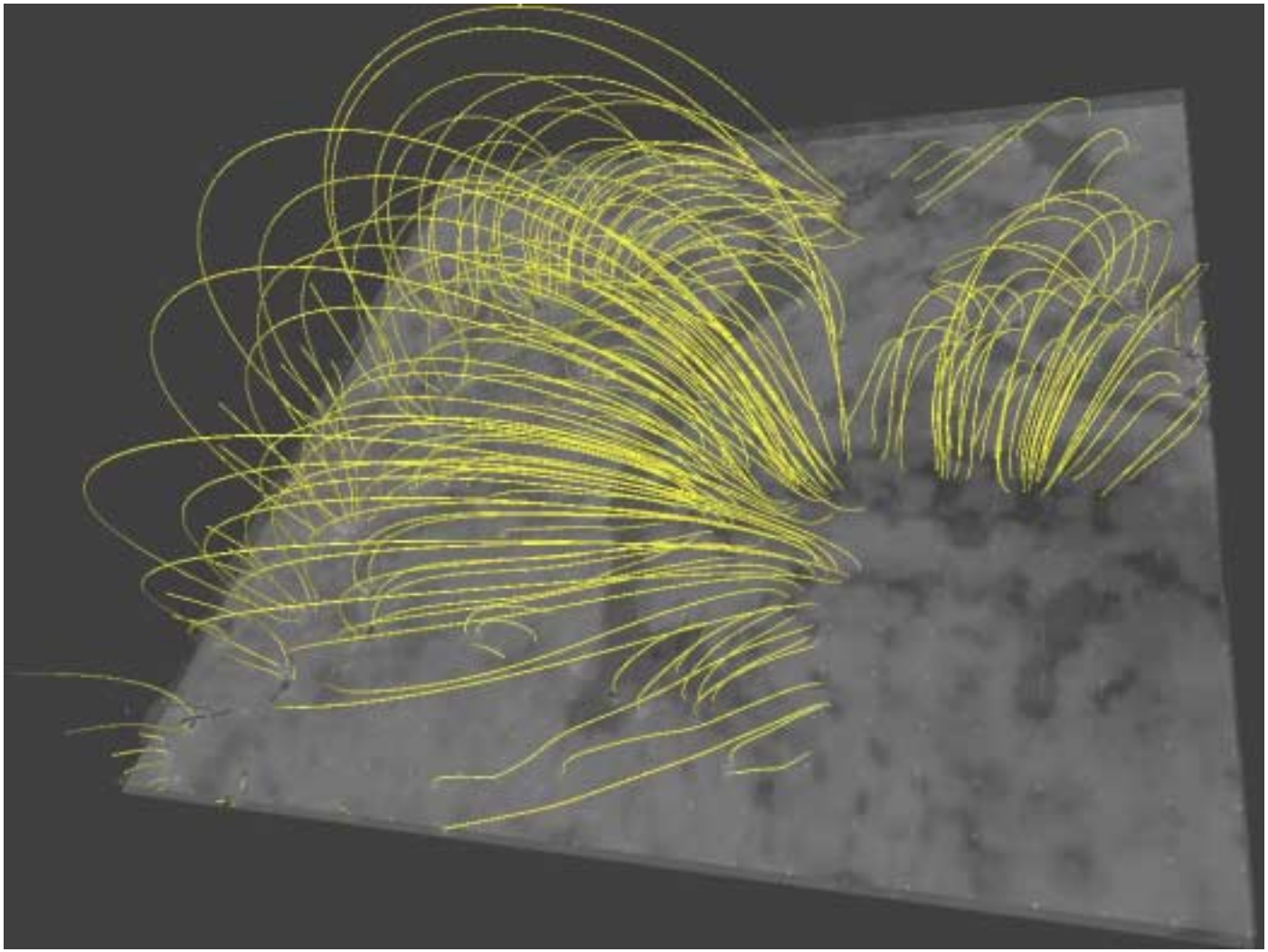
With S.Krucker, A.Benz, T.Bastian

Network Radio Signal

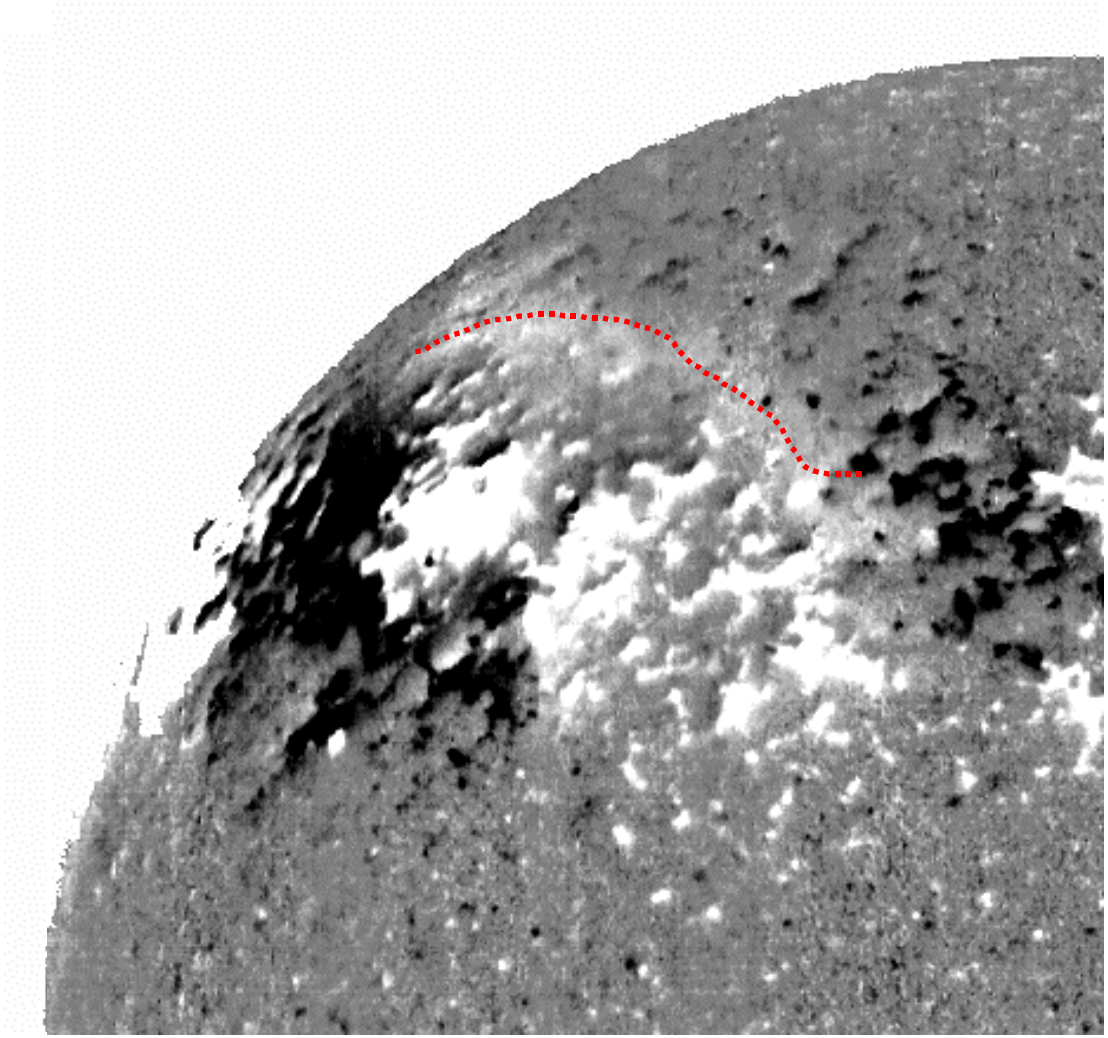


- **Average radio signal correlates well with (McMath-Pierce) magnetogram**
- **Relation of radio snapshots and photospheric magnetograms is not clear (yet)**

Filaments/Prominences



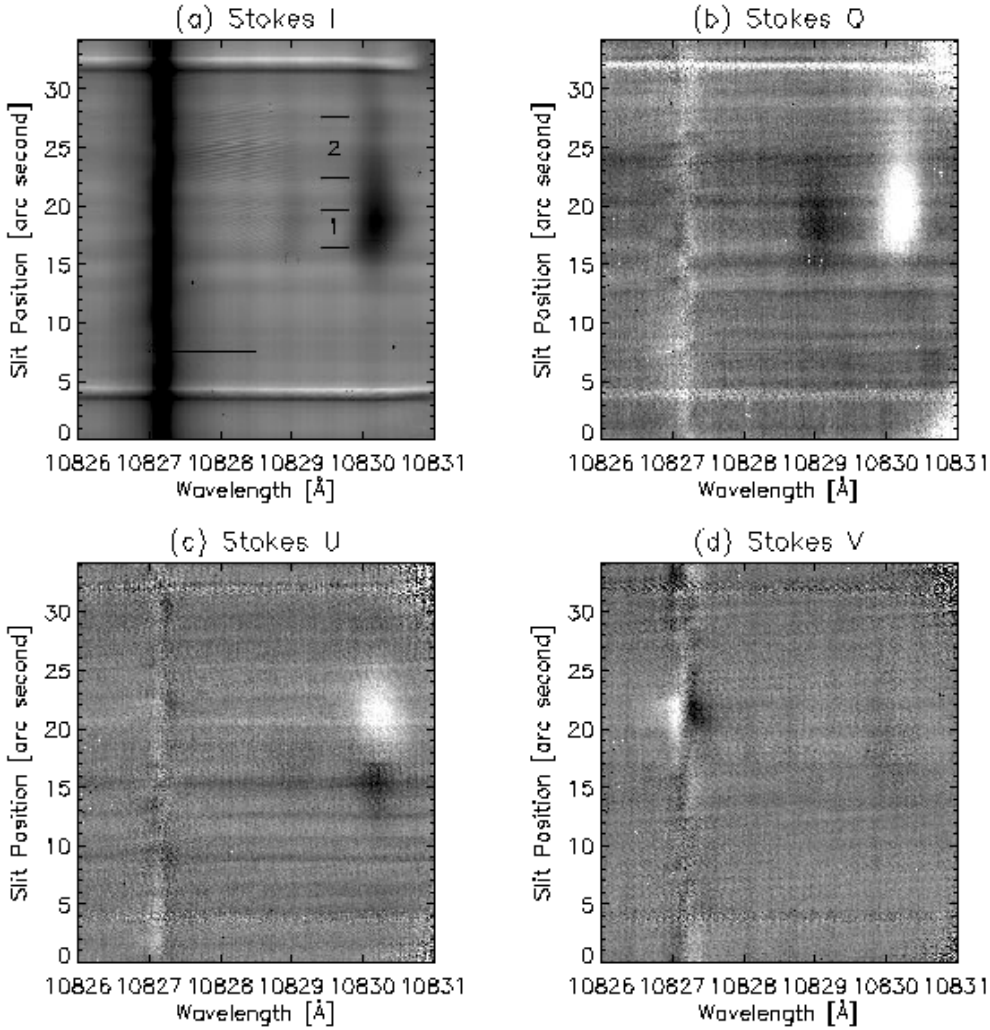
Filament Channel Field in Chromosphere



- Photospheric field shows polarity reversal
- Chromospheric field shows unipolar pattern
- Grey scale saturates at +/- 50 Mx/cm^2

From Harvey et al. 1999

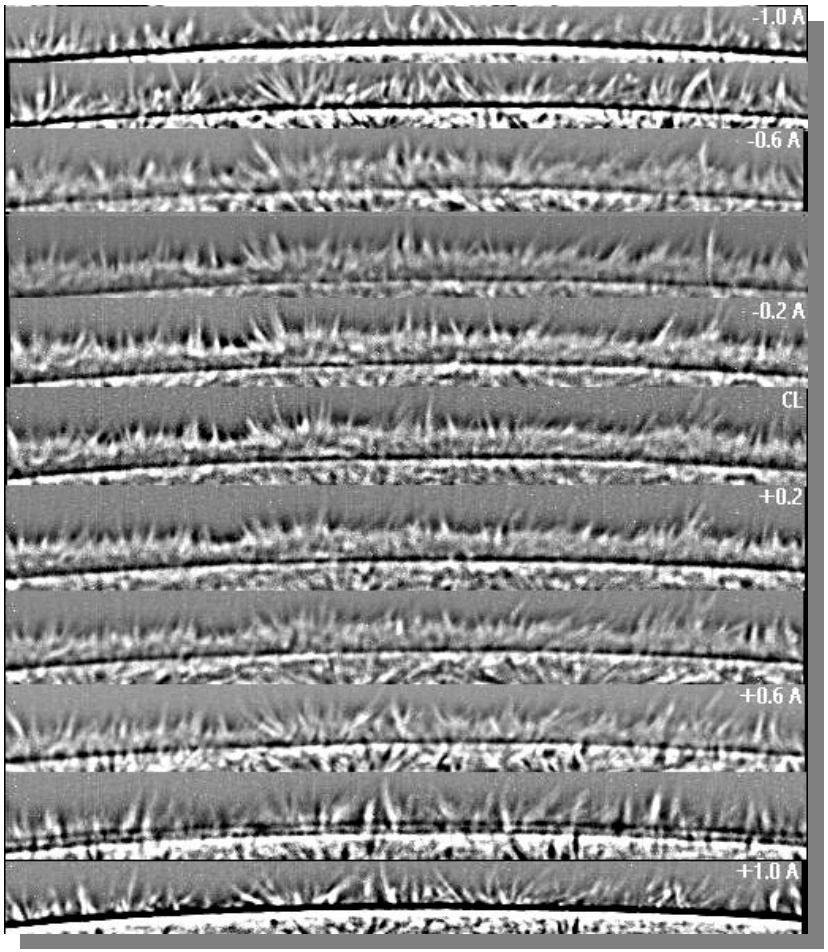
Filaments/Prominences



- Scattering polarization and Hanle effect in filaments and prominences
- On-disk magnetic field measurements are rare
- Measured polarization often not compatible with existing filament field models
- Need to understand magnetic field configuration in and around prominences
- Need to understand why (and when?) they erupt

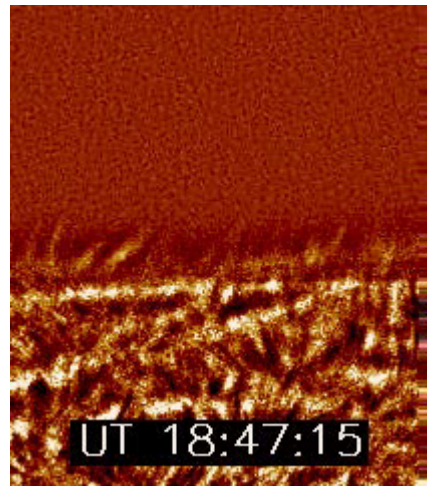
From Lin et al. 1998

Other Interesting Structures



BBSO

- Spicules
- Cold chromosphere
- Blinkers
- …



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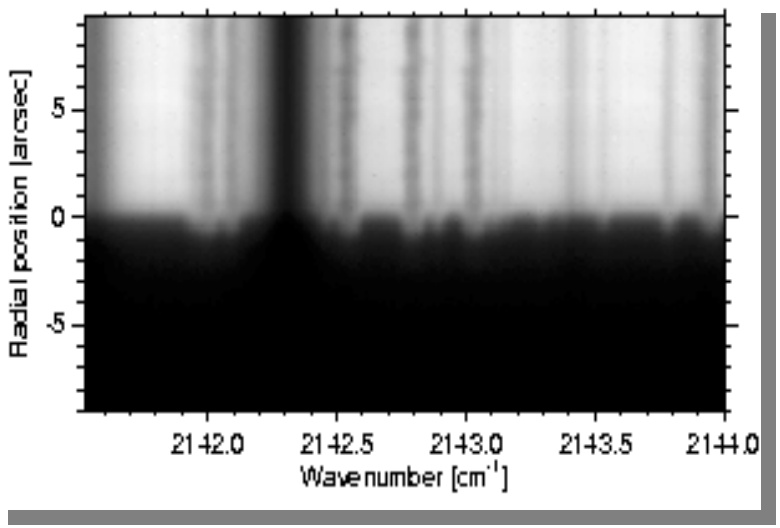
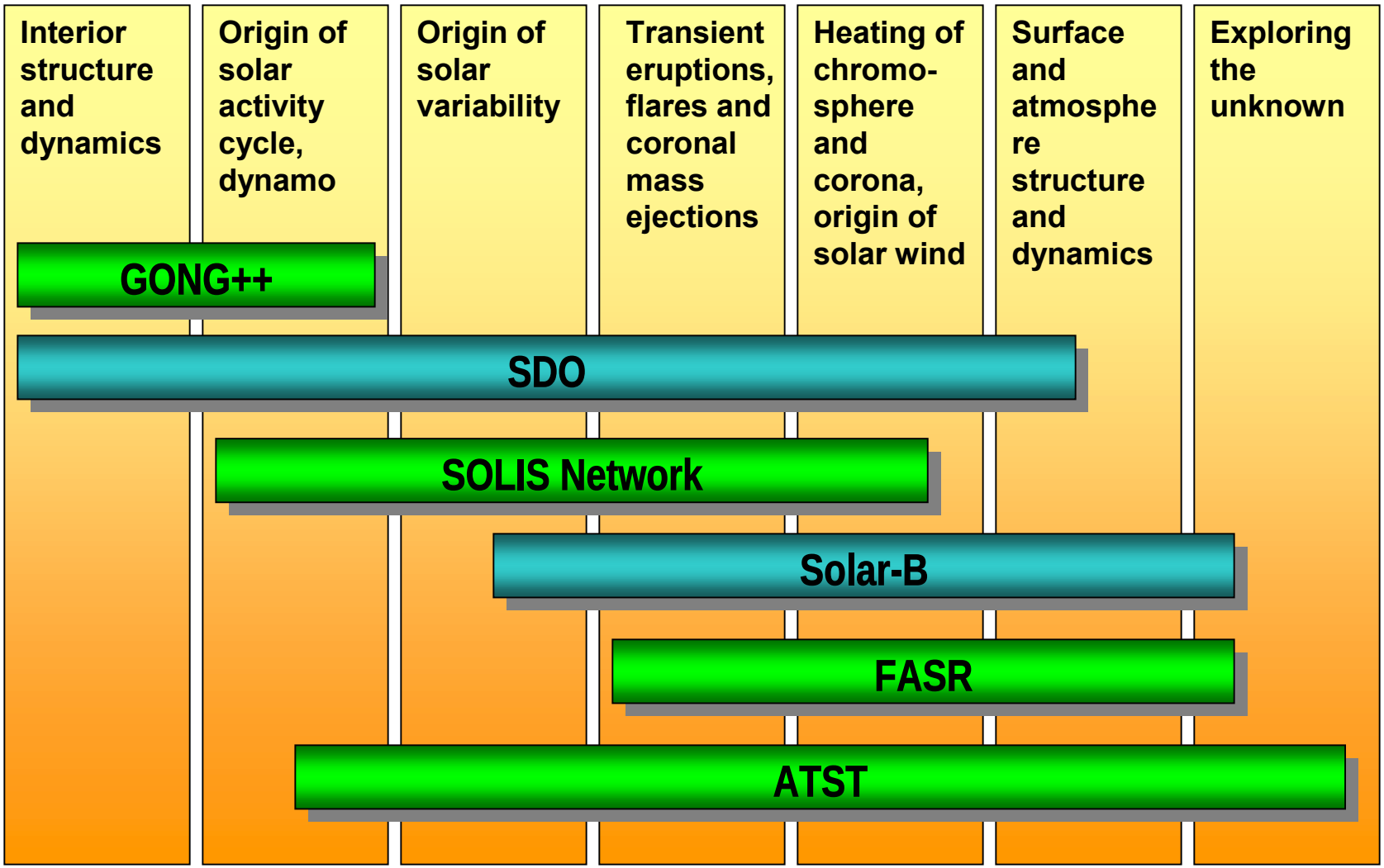


Some Interesting Questions for FASR

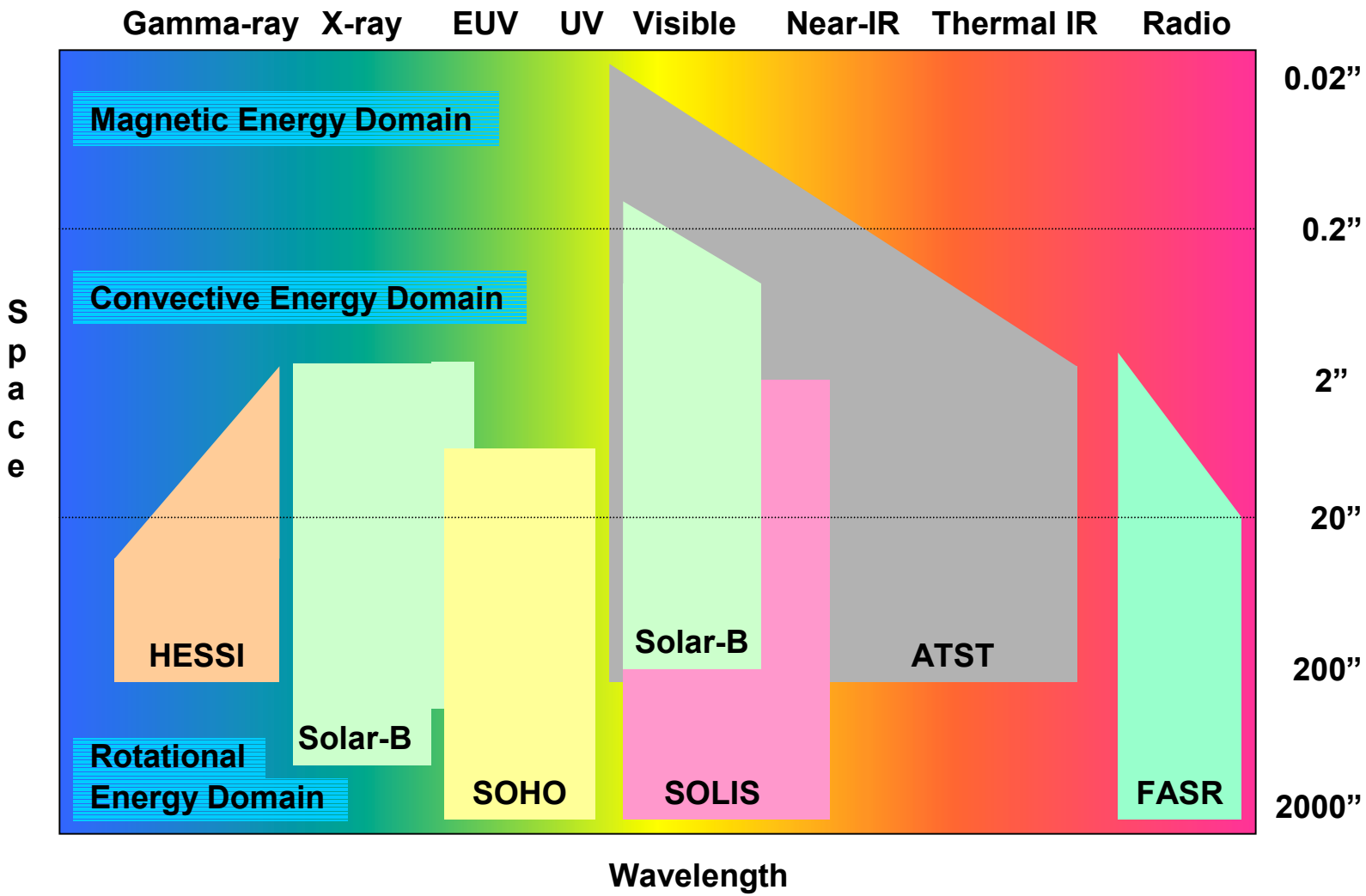
- What is the magnetic field topology above the photosphere?
- How is energy moved from the photosphere through the chromosphere and transition region into the corona?
- What determines the location of filaments and filaments channels, what is their structure, and what determines their stability?
- What are spicules?
- How is magnetic flux removed (for dynamo)?

- No single facility can answer these questions, data from many facilities need to be combined
- Need to take a Systems Approach to modeling

Solar Science and Missions Overview

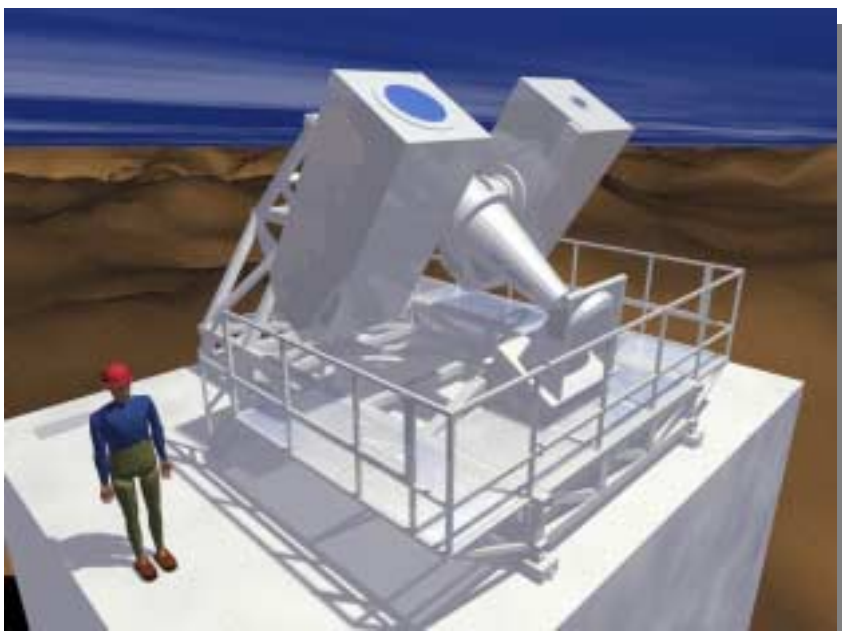


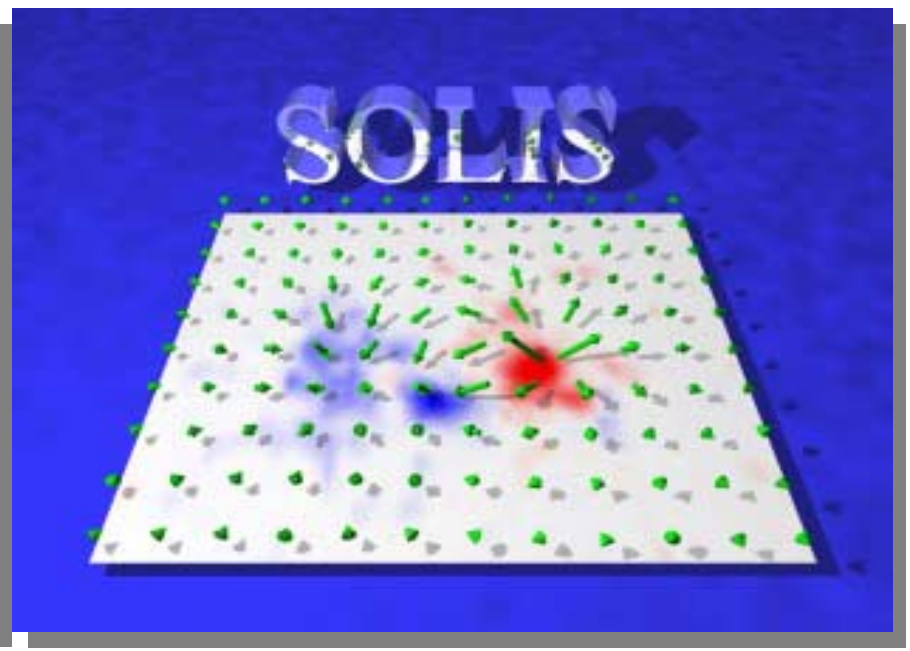
Spatial vs Wavelength Coverage



SOLIS Vector-Spectromagnetograph (solis.nso.edu)

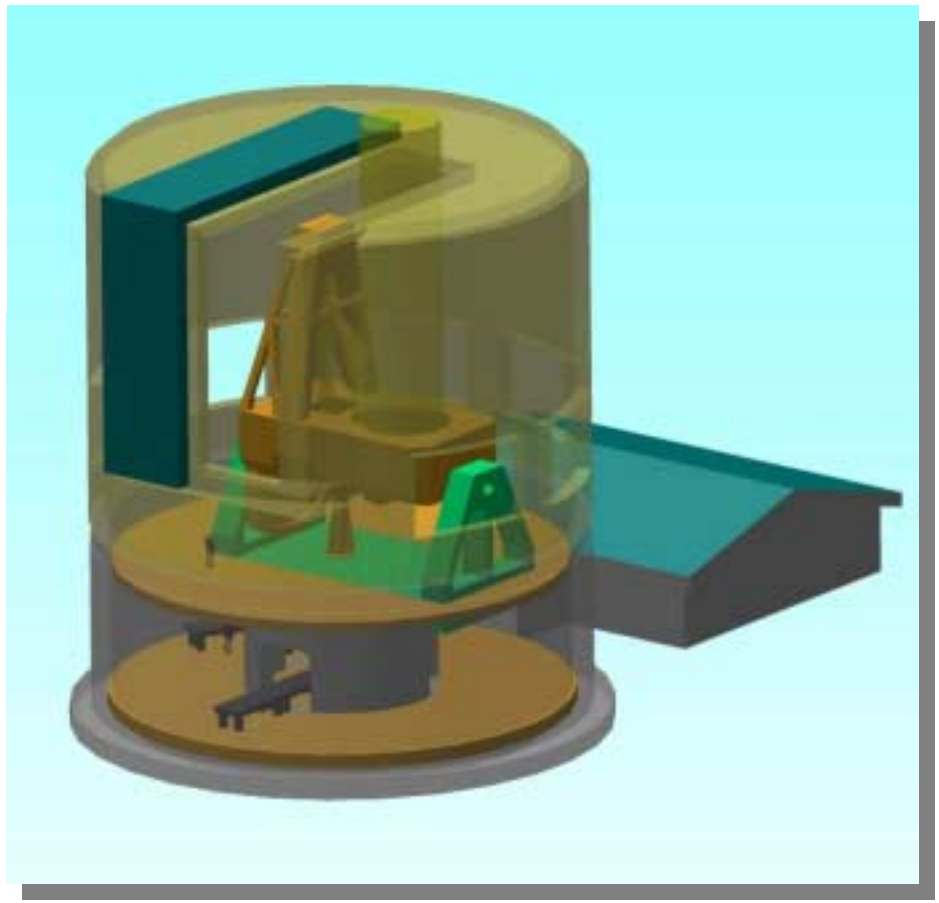
Data Product	Frequency
Full-disk vector magnoetgram in FeI 630.15, 630.25 nm	**3 per day**
Full-disk line-of-sight magnetogram in CaII 854.2 nm	**3 per day**
Full-disk intensity in HeI 1083.0 nm (polarimetry upgrade possible)	**3 per day**
Full-disk images in CaIIK, Hα, etc.	**1 per minute**





Advanced Technology Solar Telescope (atst.nso.edu)

- 4-m optical telescope
- 0.3 to 28 μm
- Diffraction limited spatial resolution (0.03 arcsec)
- Field of View 3-5 arcmin



Model and image courtesy Mark Warner

The End (Really!)