Syntheses of Concepts Involving Filaments

A few research directions for Solar Cycle 24

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Different Ways of Synthesizing

Diverse Observations of Same Subject

Active Region Filament ↔ Quiescent Filaments

Same Topic – Different Approaches

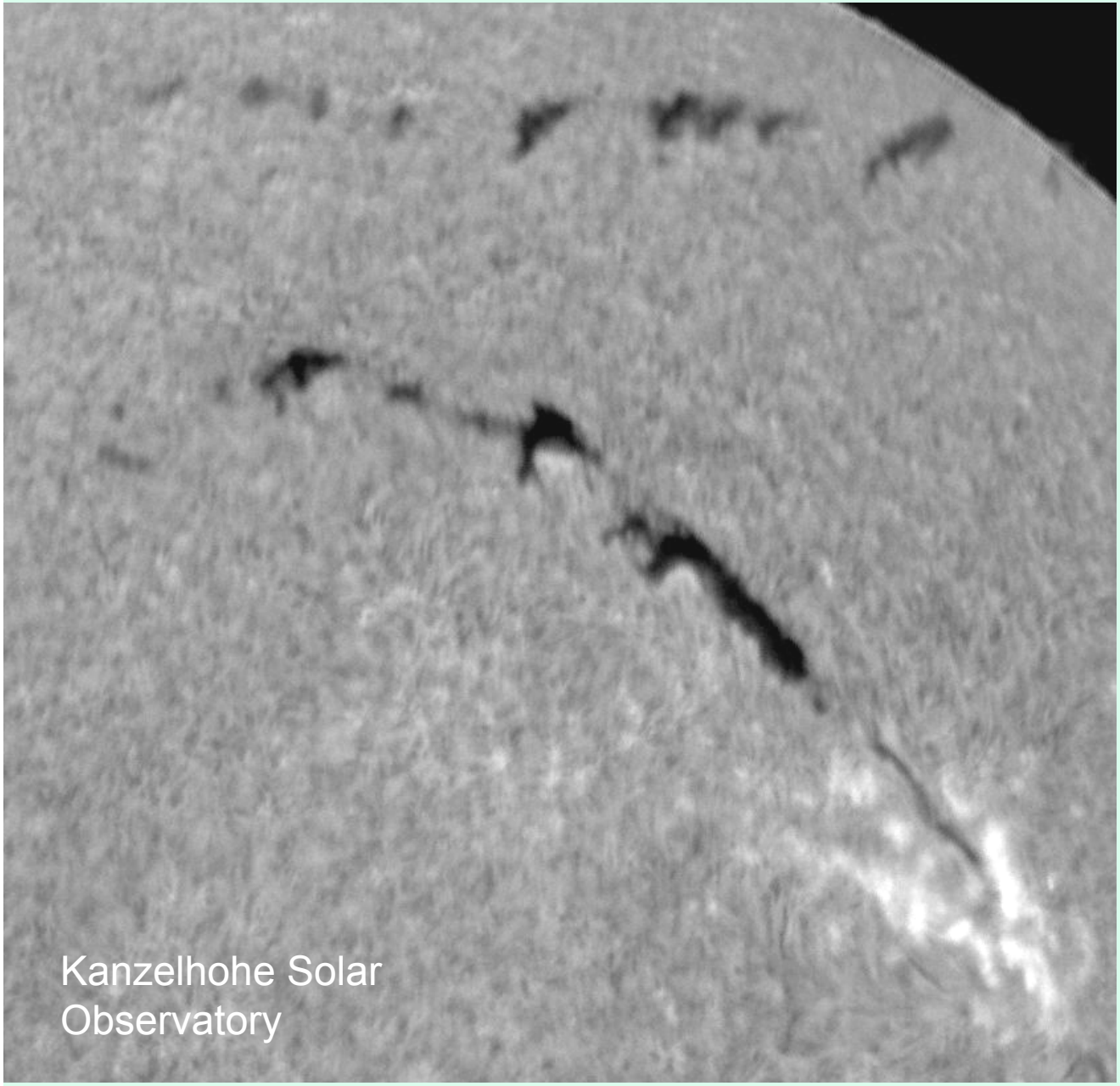
Filaments → Observations
Filaments → Modeling

Different but Related Subjects

- Filament Channels, Filaments, Filament Cavity, Overlying Coronal Loop System

- Erupting filaments, Erupting Filament Cavities, CMEs, Flares

Same subject – Diverse Cases



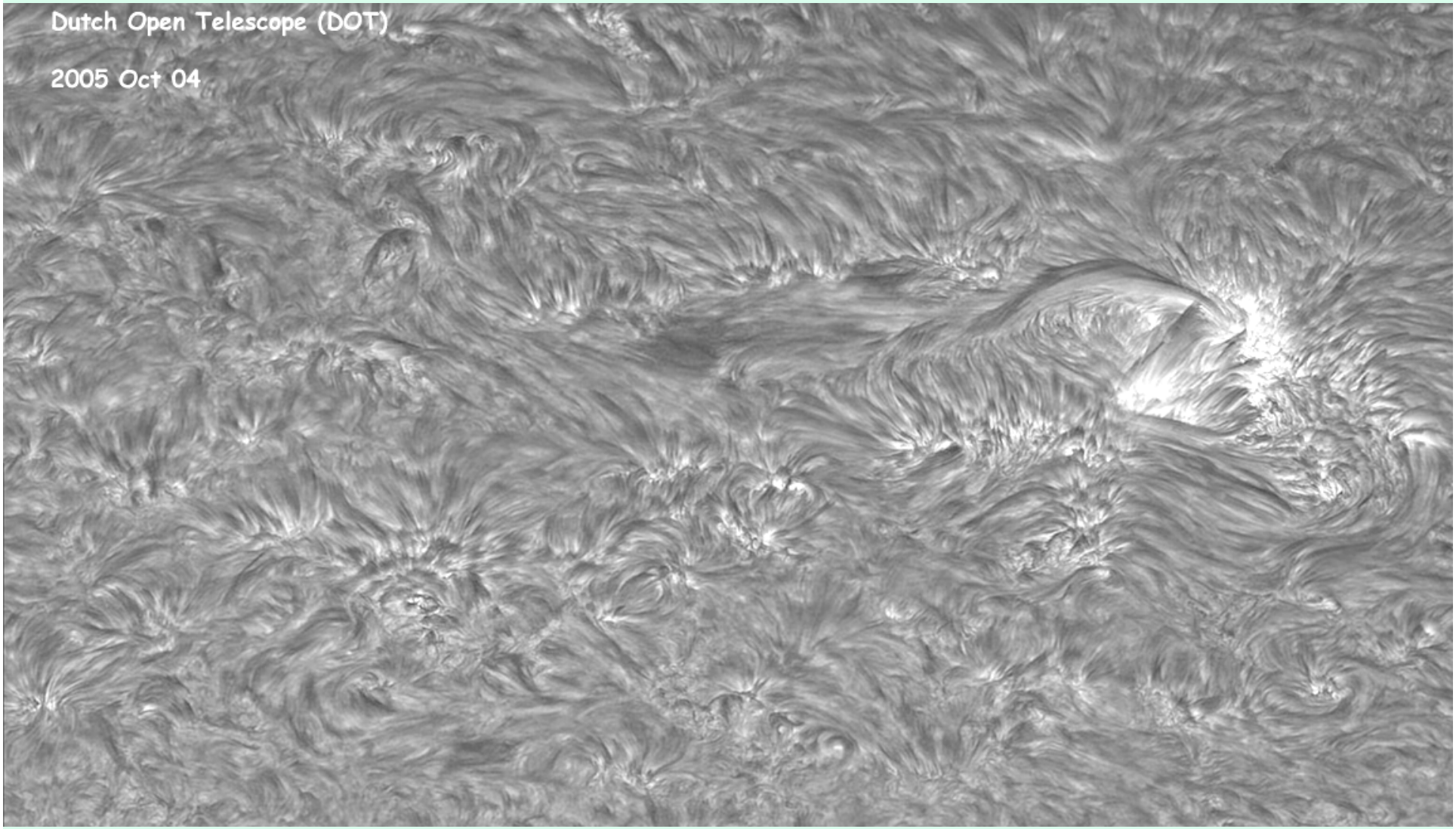
Quiescent polar crown filament

Quiescent filament

Intermediate filament

Active region filament

Active Region to Intermediate



The Continuous Spectrum of Filaments

From High Flux Density → Low Flux Density

From low vertical height ~10, 000 km →

up to height of ~ 90,000 km

Properties in Common among Filaments

1. Beneath a Coronal Loop System

2. Above a Polarity Reversal Boundary (Polarity Inversion Line) characterized by:

   - With cancelling magnetic fields at the photosphere
   - A filament channel in the chromosphere

3. Continuous Spectrum of Similar Types of Both Small and lLrge-scale Structure

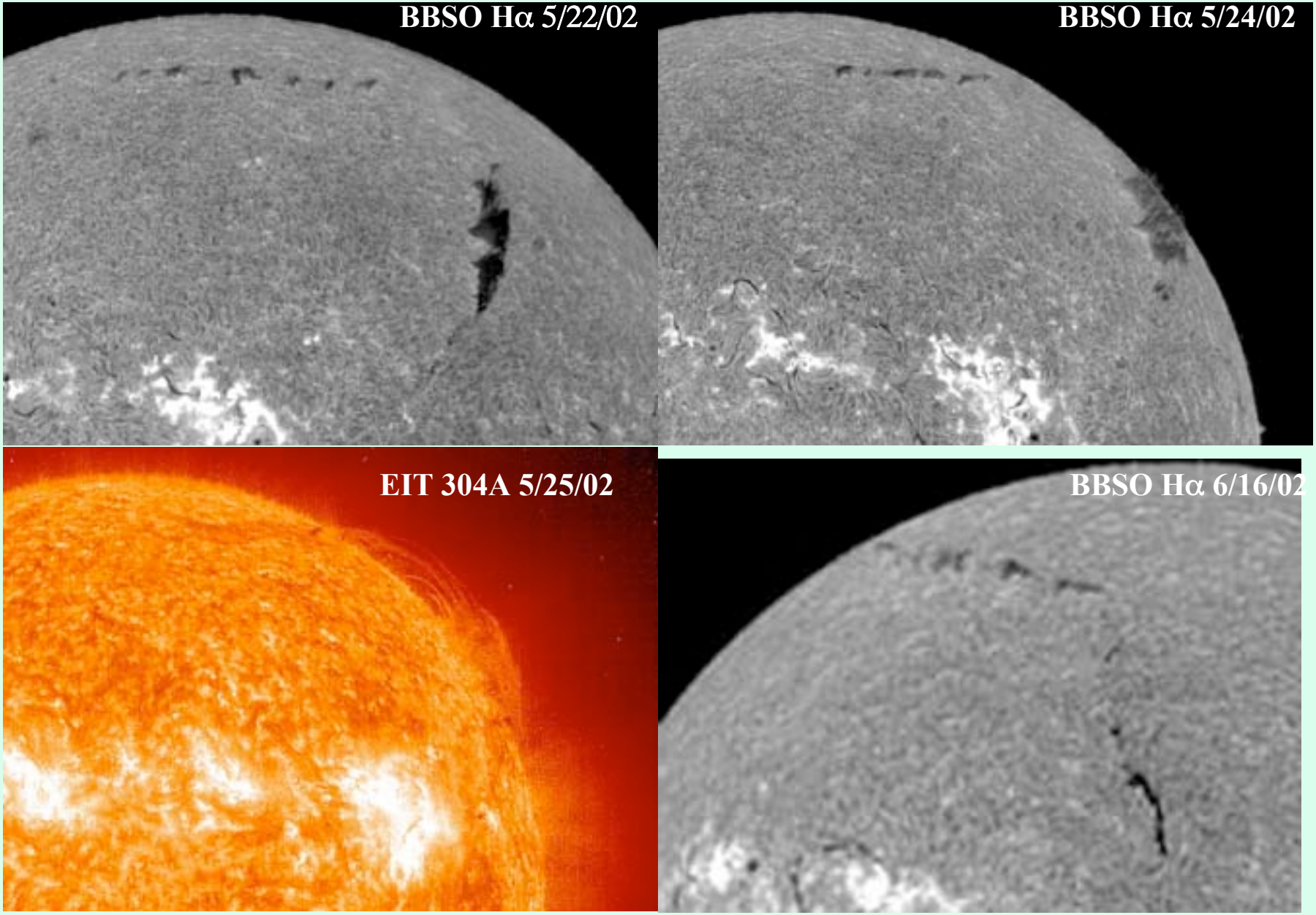
   Spines that is narrow, ribbon-like structure
   Barbs
   Arcs or bubbles at base of barbs

   - All composed threads
     - with similar dynamics
     - with consistent chirality between the spines and barbs

Spine & barbs

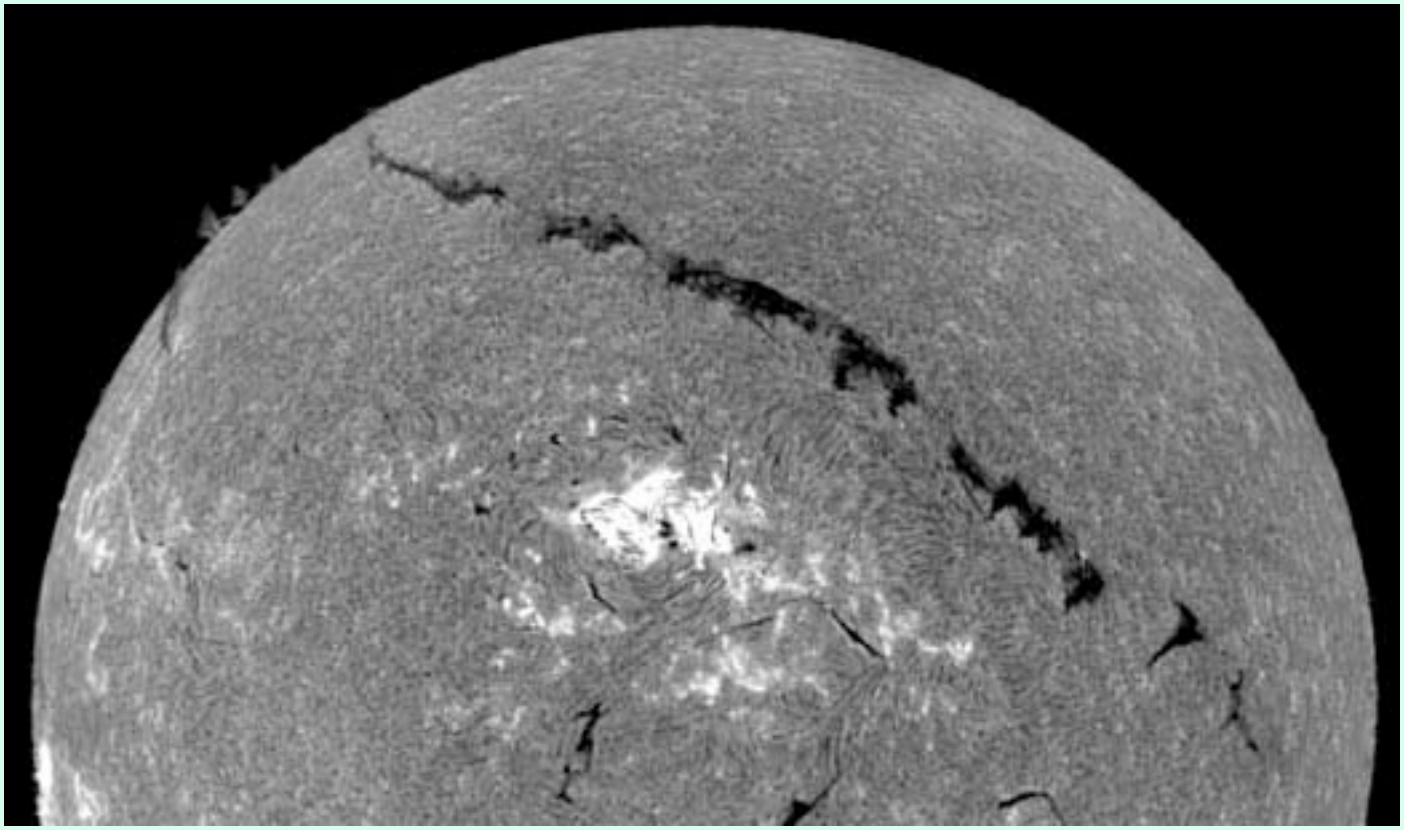
BBSO 2002

Same subject – Different Wavelengths

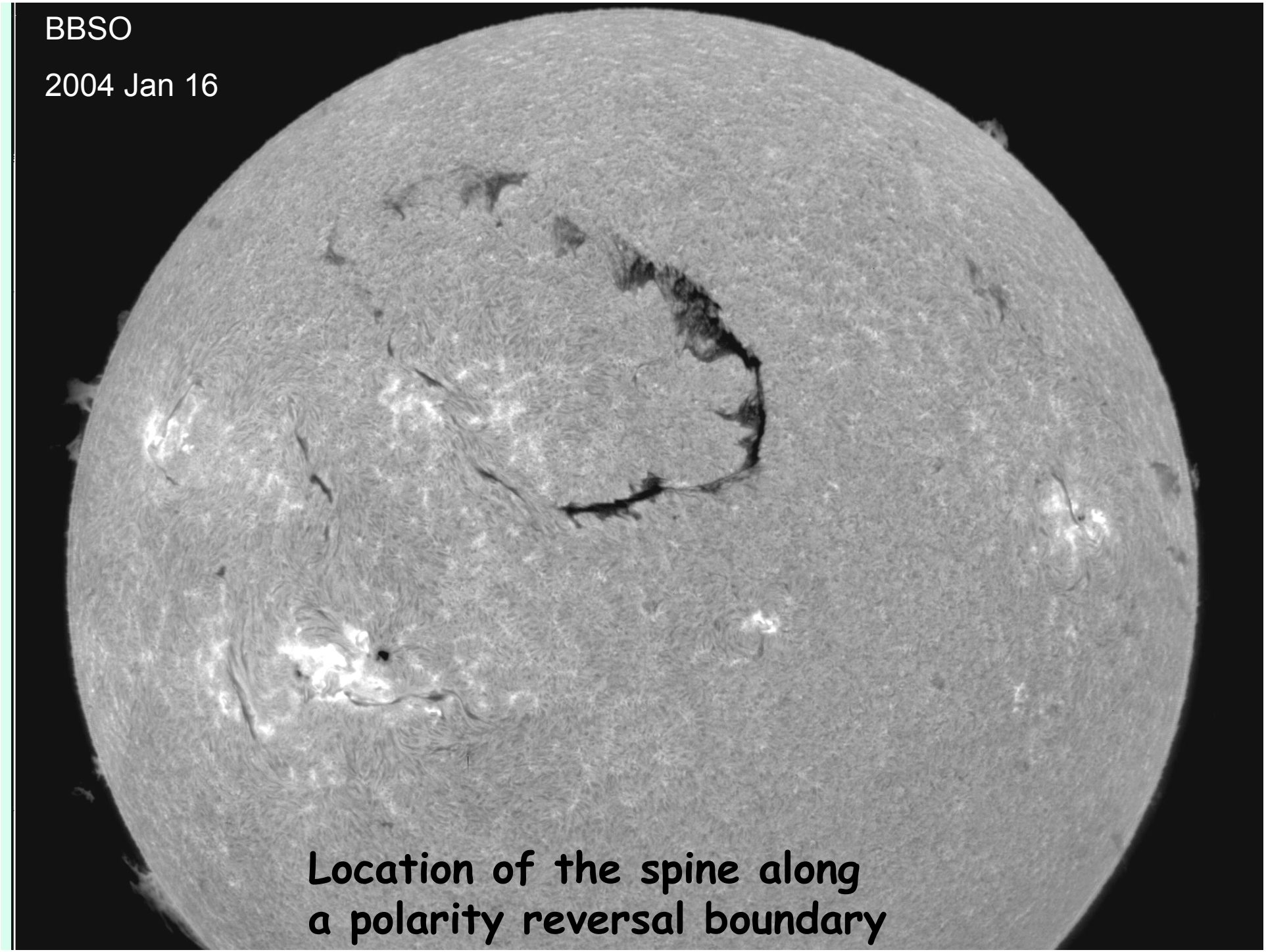


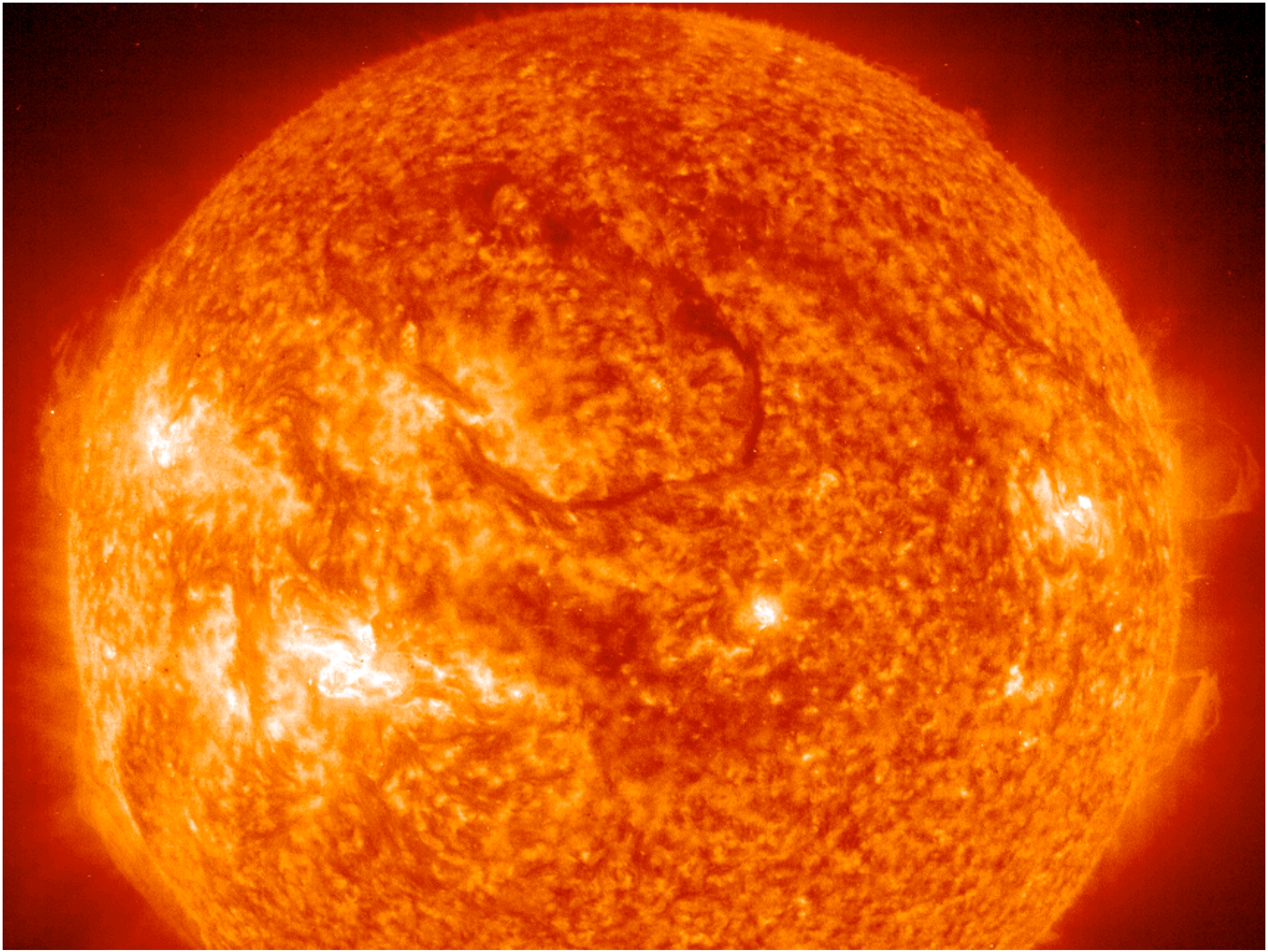
Enablement of Synthesis: multi-wavelength observations from space

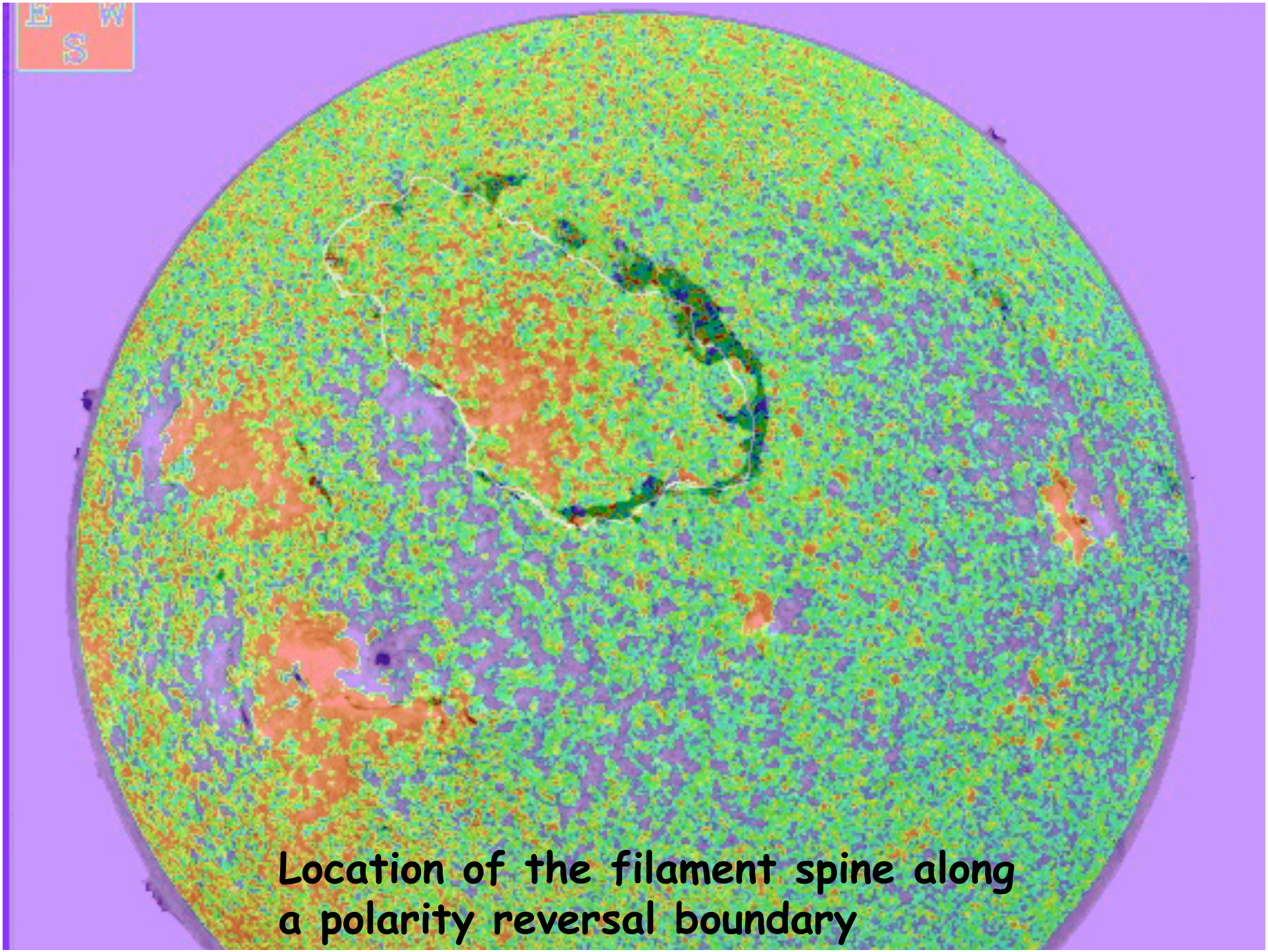
All filaments can merge if they have the same chirality



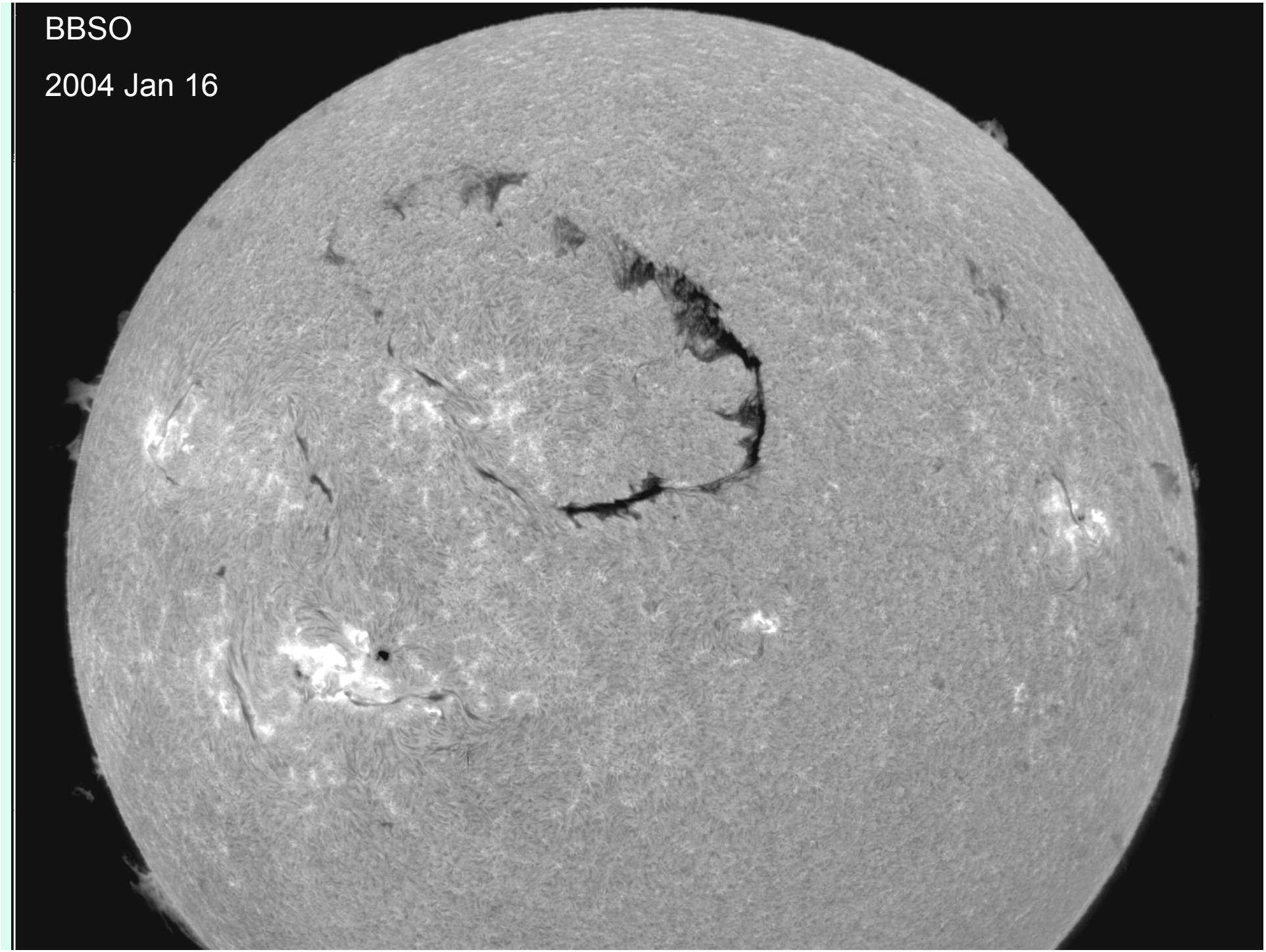
Anderson and Martin 2004, ASP Conf. Series ,


BBSO
2004 Jan 16
Location of the spine along
a polarity reversal boundary

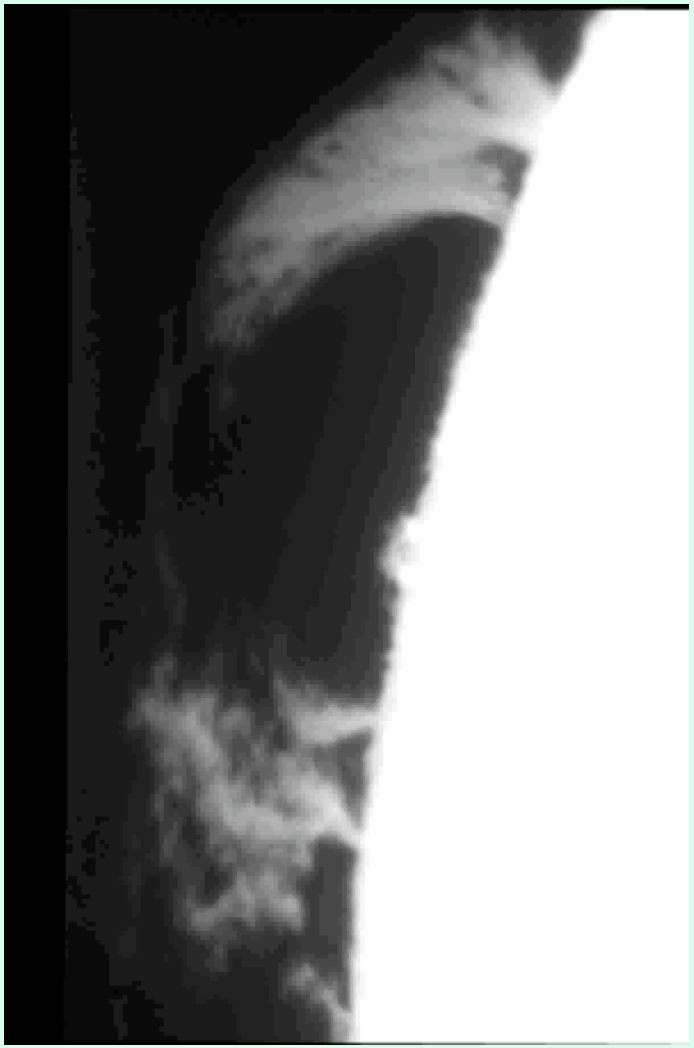




Location of the filament spine along a polarity reversal boundary

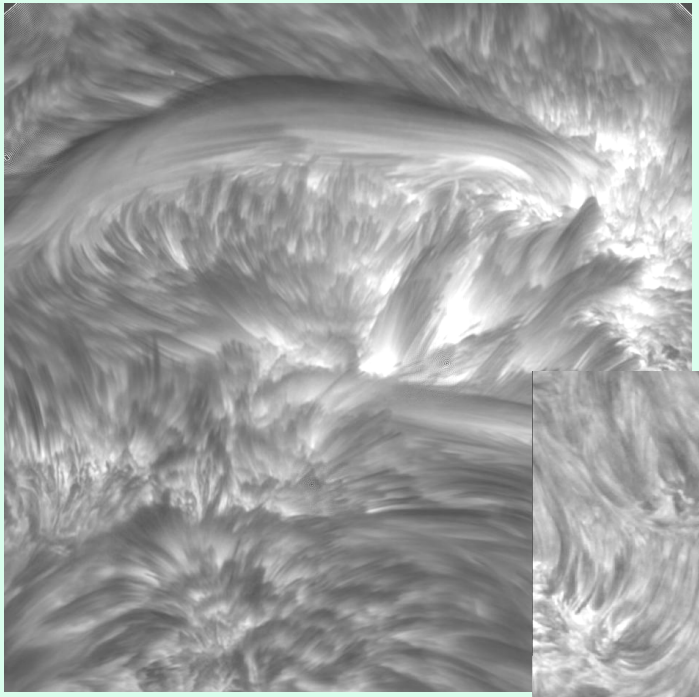

BBSO
2004 Jan 16

Counterstreaming along spine

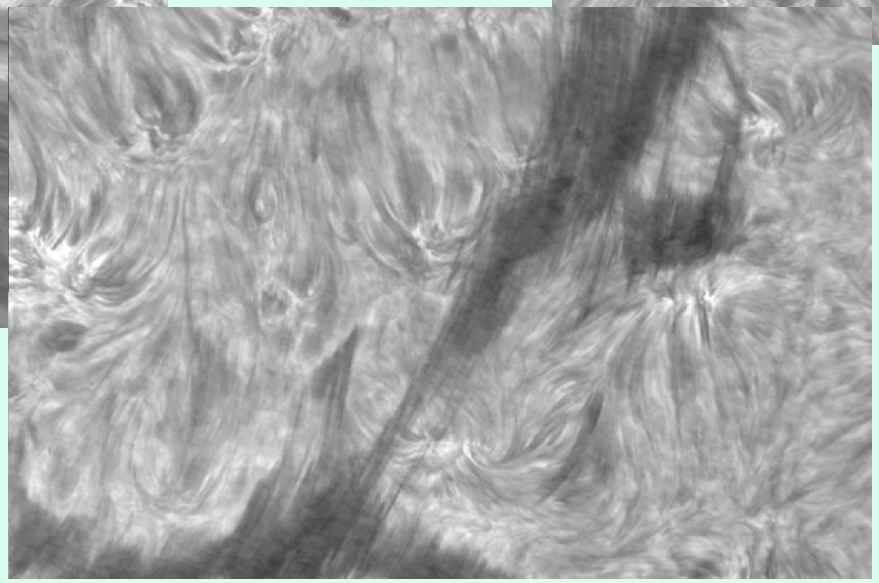


Counterstreaming along spine

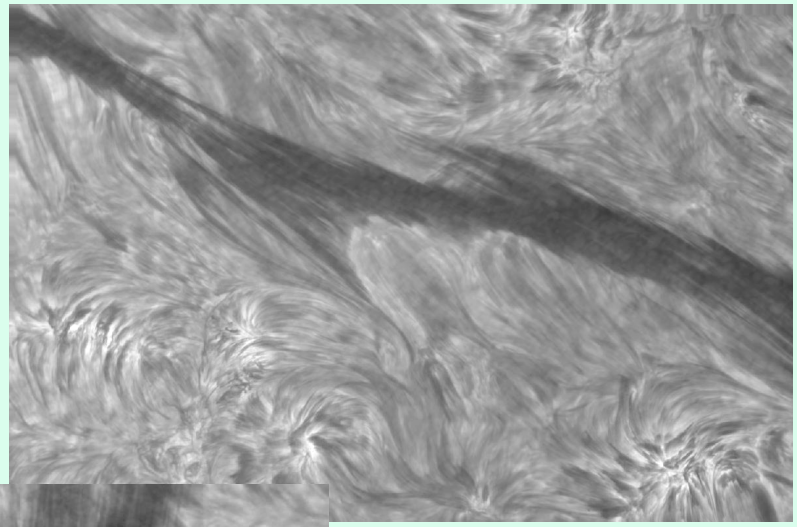
The spectrum of filaments



Active region filament

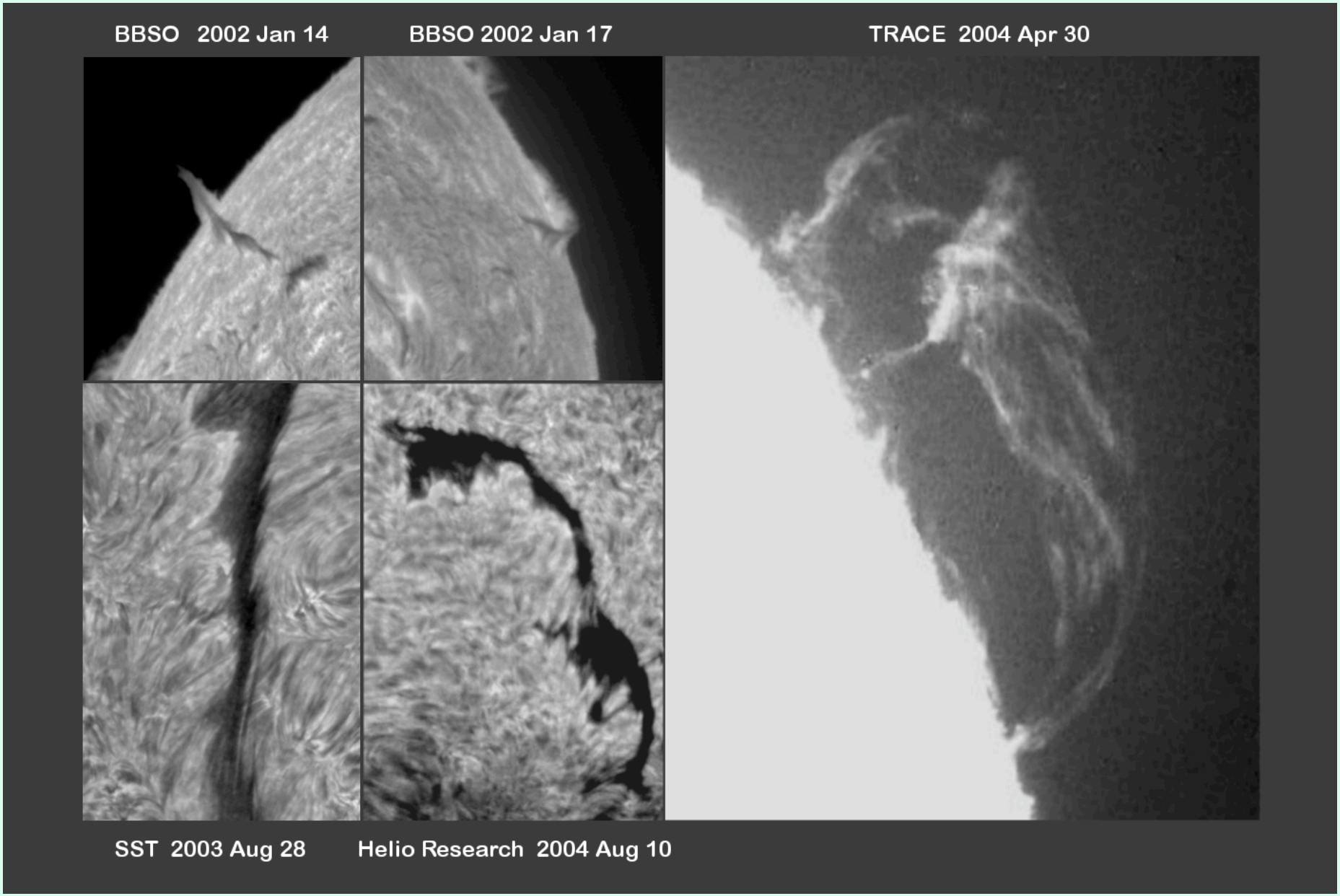


Between active region and intermediate



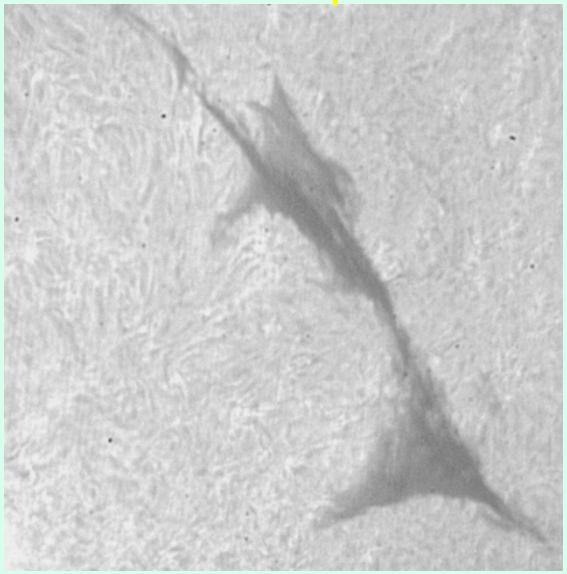
Intermediate

Filament Spines and Barbs from All Perspectives

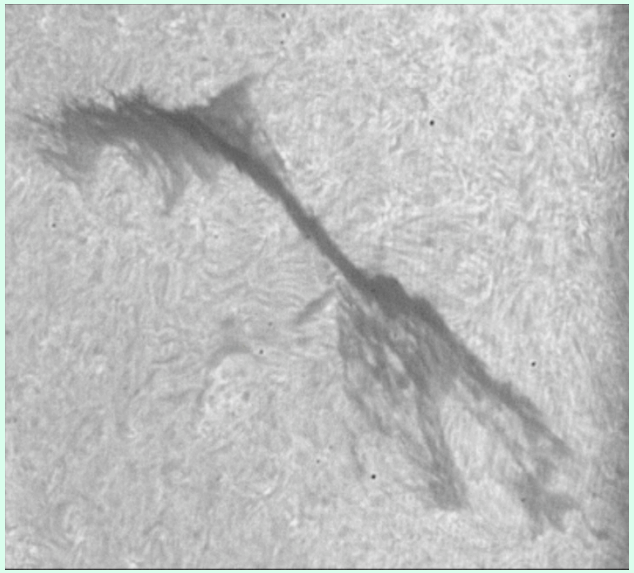


Quiescent filament: with spine + large barbs + arcs at base of barbs

2001 Sep 30



Oct 2



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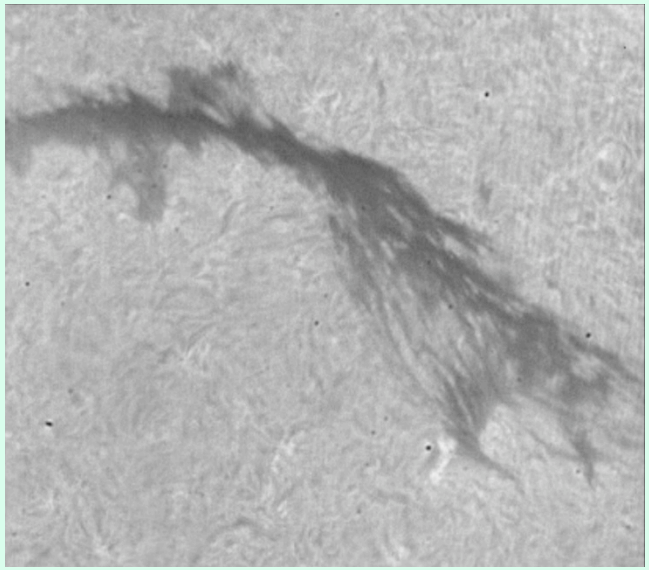

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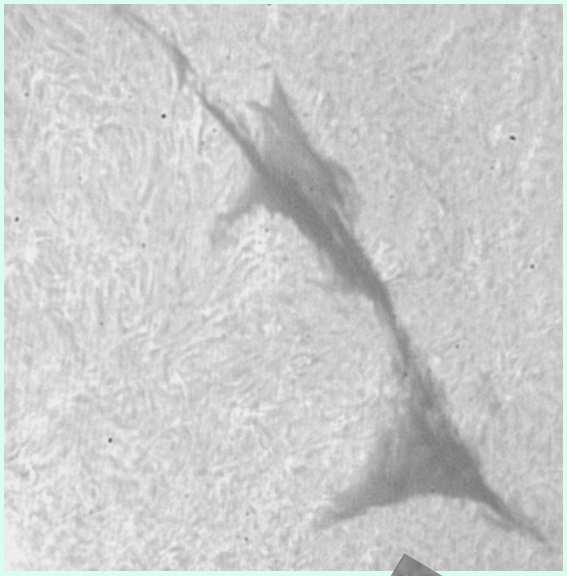
Same subject – Different Perspectives
Higher Spatial Resolution

Quiescent filament: with spine + large barbs + arcs at base of barbs

2001 Sep 30



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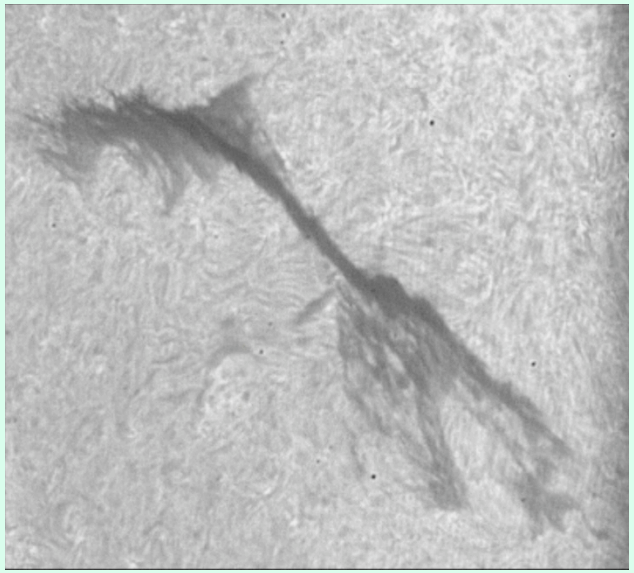

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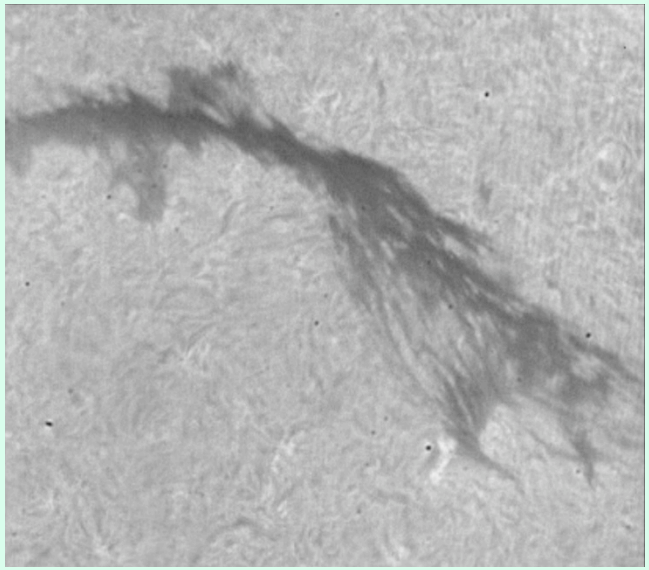
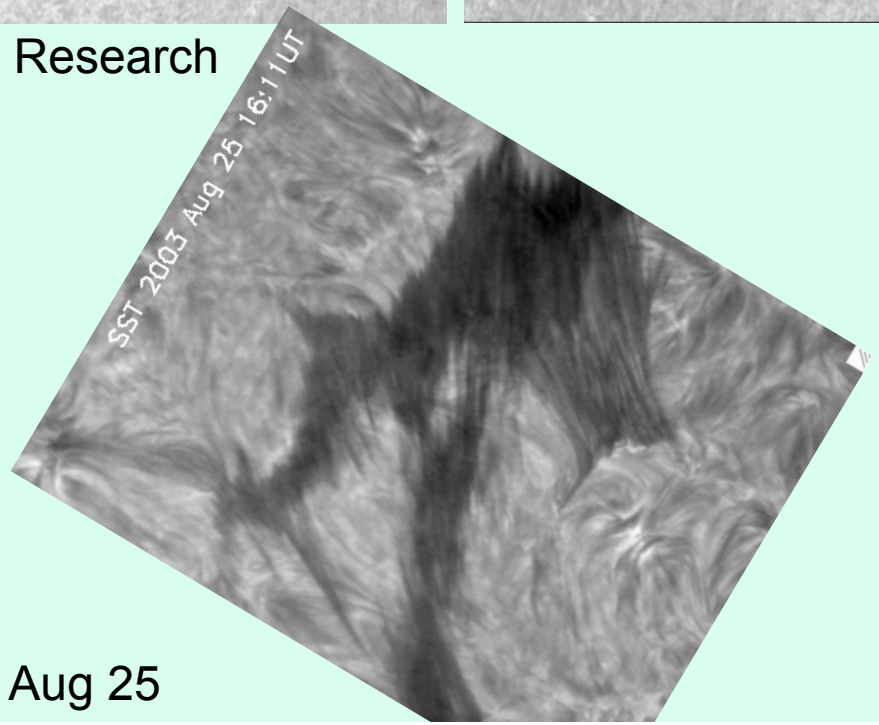


Helio Research

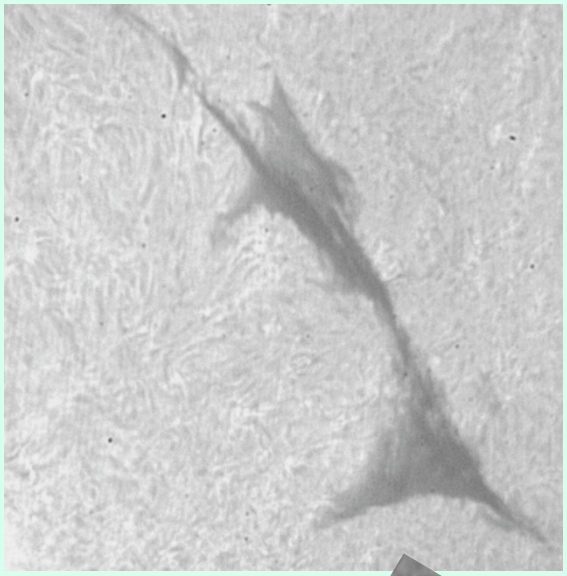


SST-

2003 Aug 25

Quiescent filament: with spine + large barbs + arcs at base of barbs

2001 Sep 30



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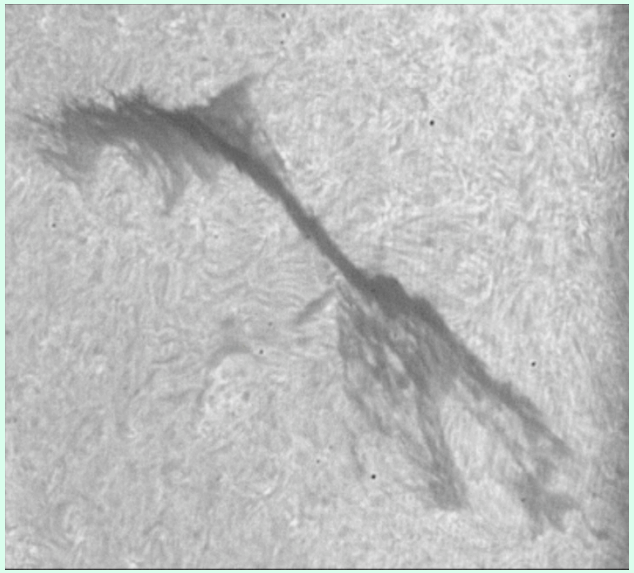

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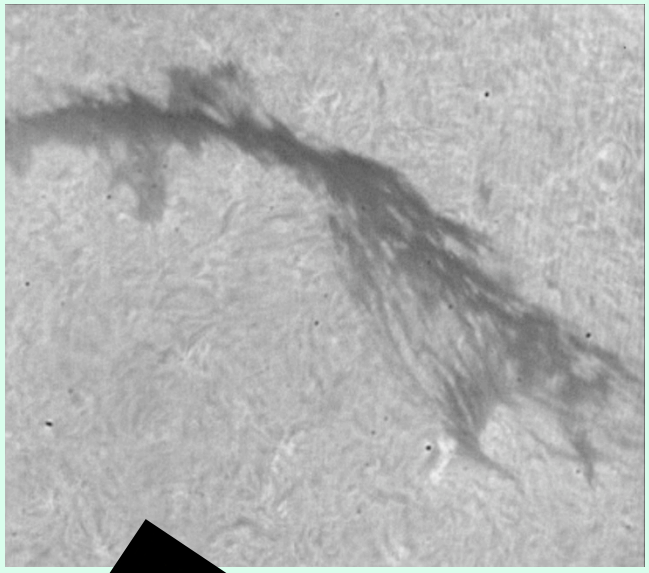

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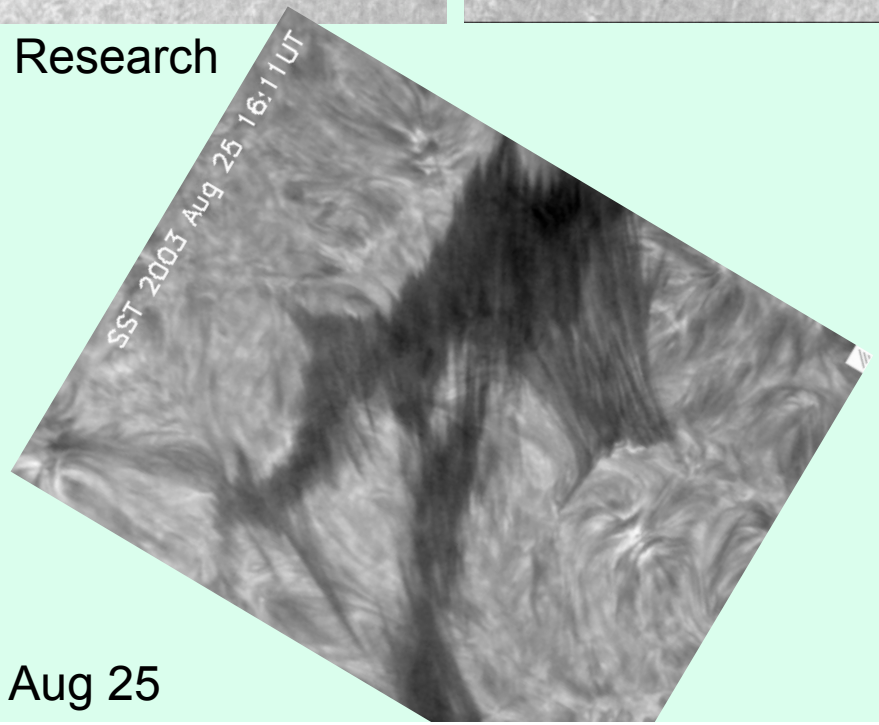
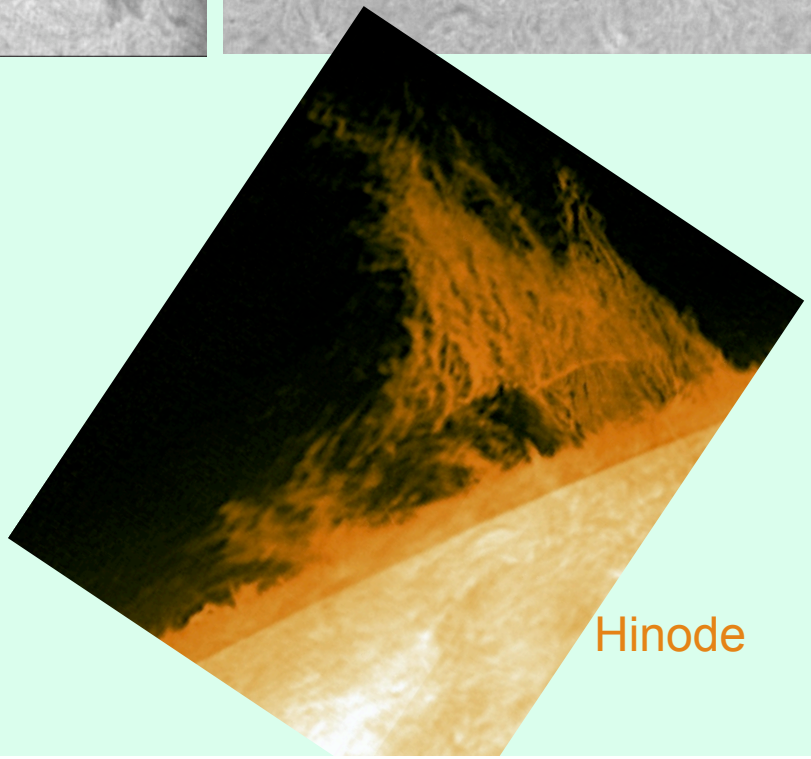


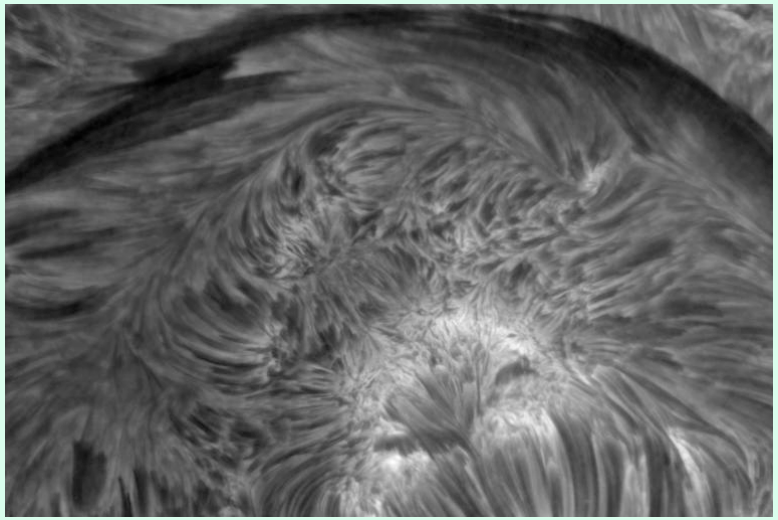
SST-

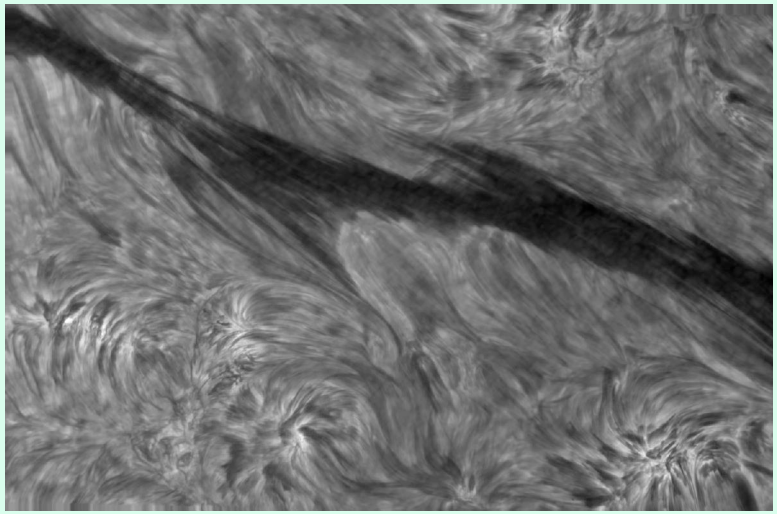
2003 Aug 25

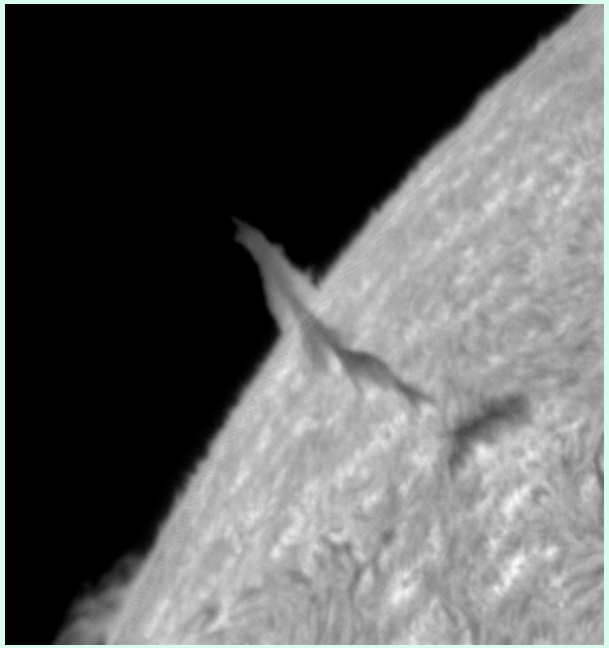


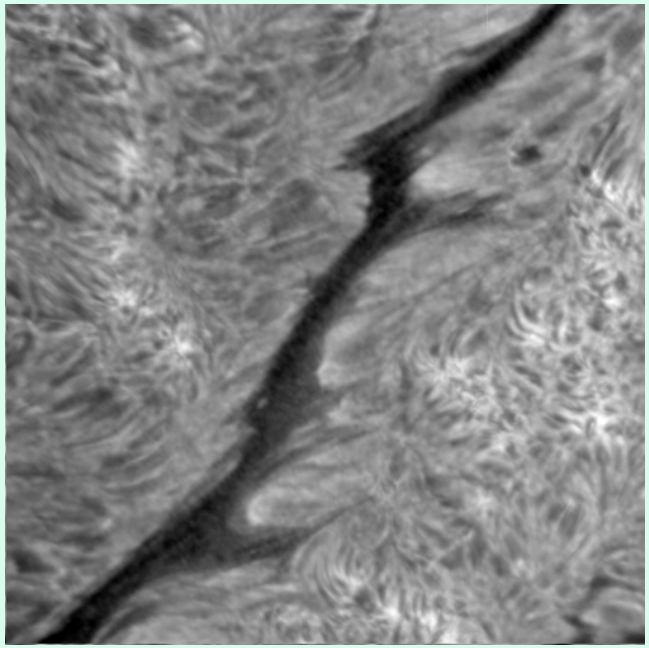
Hinode

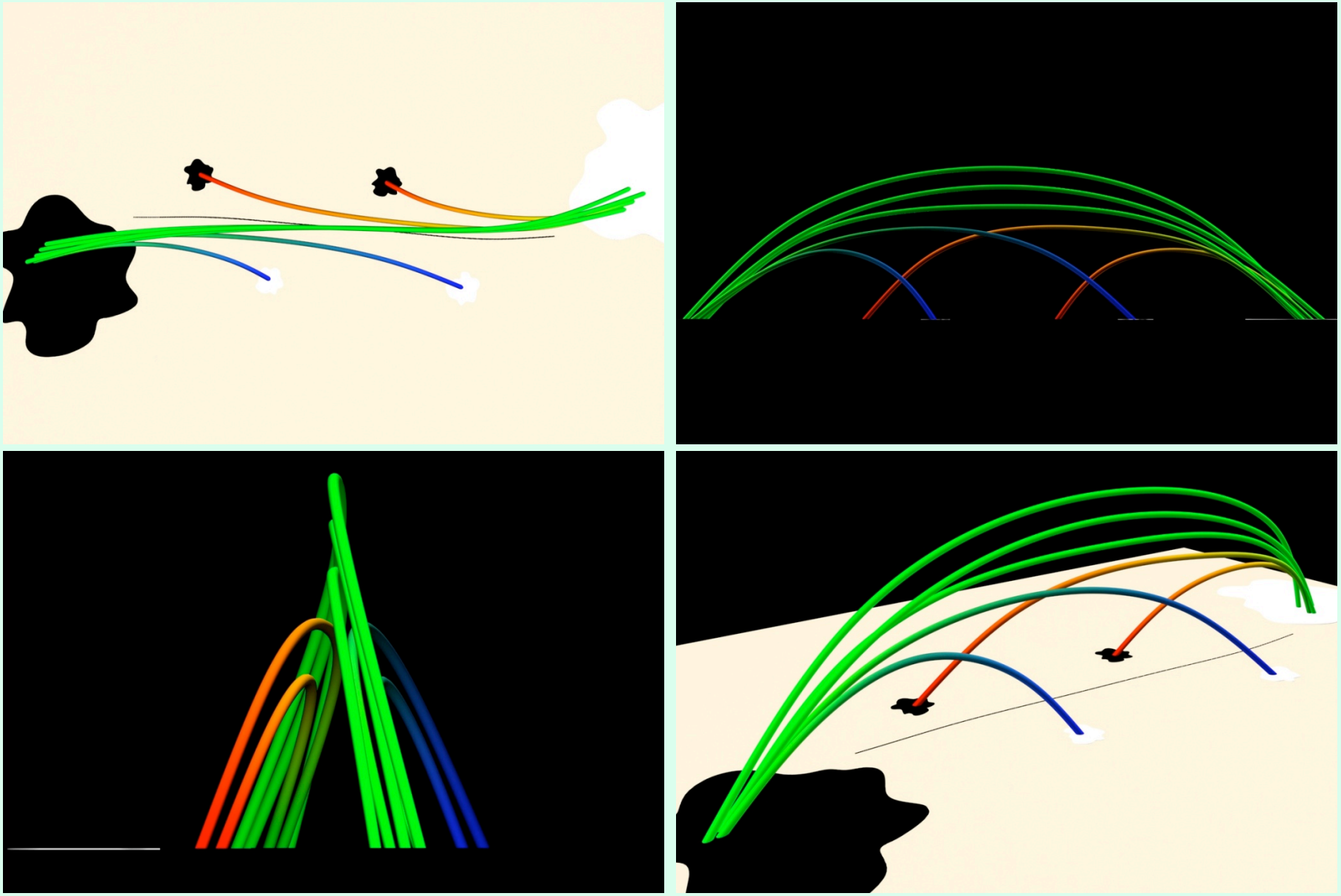
Filaments seen in different perspective











The most important properties of filament threads:

*** They are Field-aligned***

*** with continuous field-aligned flows***

•These property enables the modeling of the 3-D structure of filaments directly from observations

Concluding remarks for Cycle 24

- All filaments that consisting of spines and barbs are the same type of physical structure and require the same modeling.

- However, 3 mechanisms are required, one for forming spines a second for forming barbs, and a third for forming arcs at the base of barbs.

- Filament modelling should concentrate on the physics of dynamic threads. The duration of mass in threads is short; the primary requirement is a mechanism energetic enough to drive mass through a thread at least once.

Are there any filaments that do not fit into this spectrum of filaments?

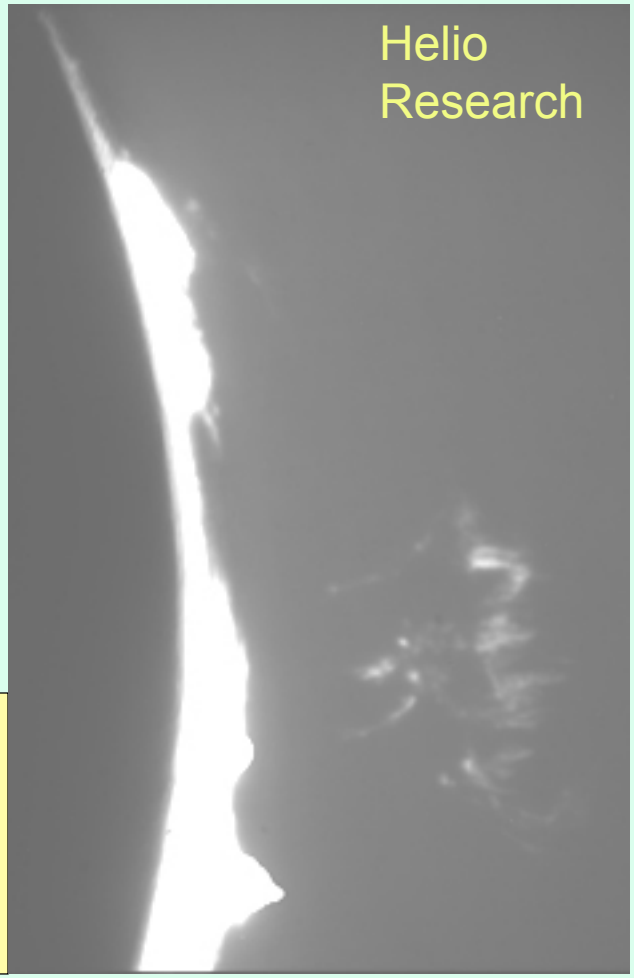
Coronal Spiders – Coronal condensations up to 1/10 solar radius(70,000)

Dimensions typically in the range of 10,000 to 50,000 km

(Allen, U. A. Bagenal, F. and Hundhausen, A. AAS SPD #28, #01.53, 1997; New Perspectives on Solar Prominences, ASP Conf. Series, Vol 150, p 290, 1998)

Some faint high filaments

(Martin and Engvold, presented at AAS 2006 Jan meeting)



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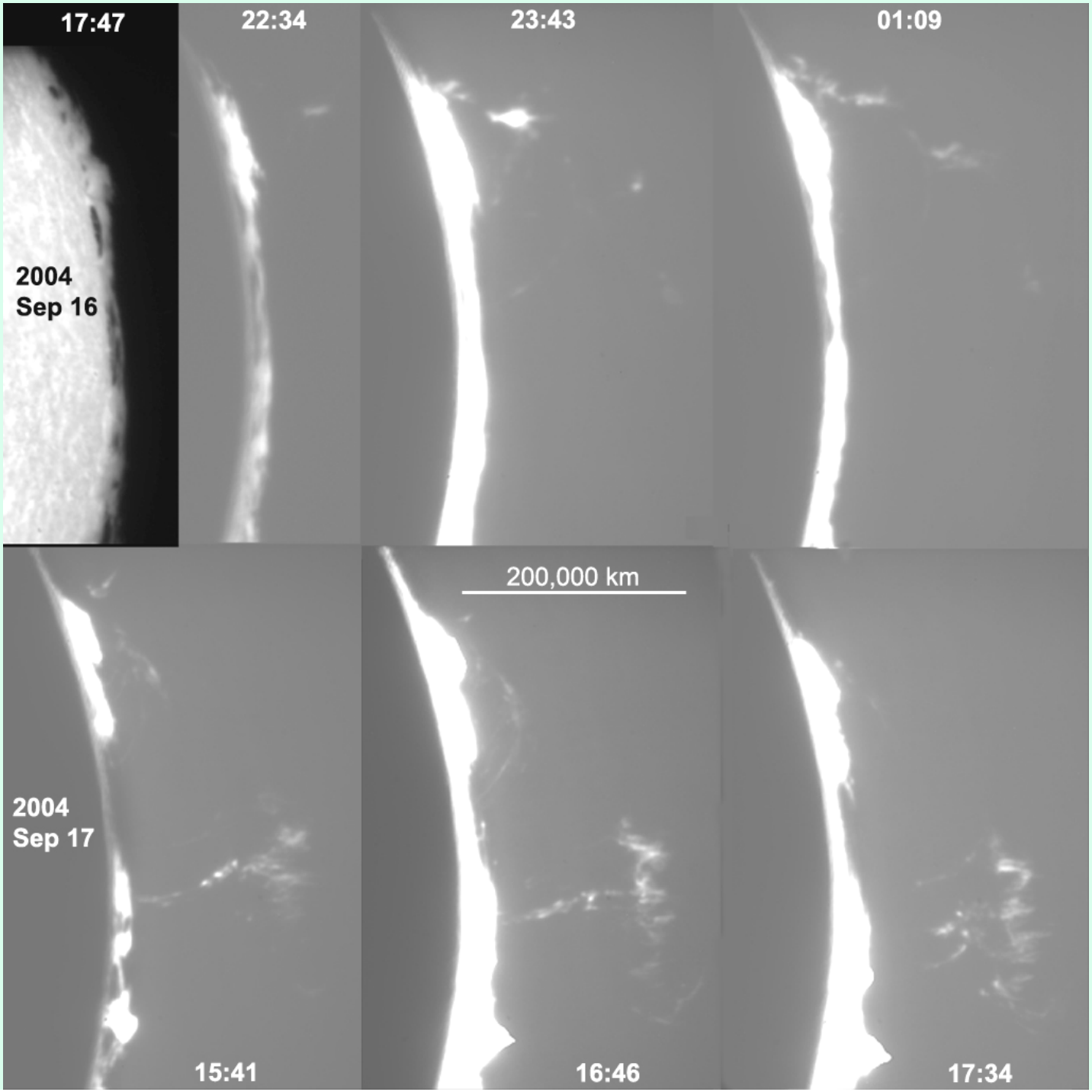
Research



The End