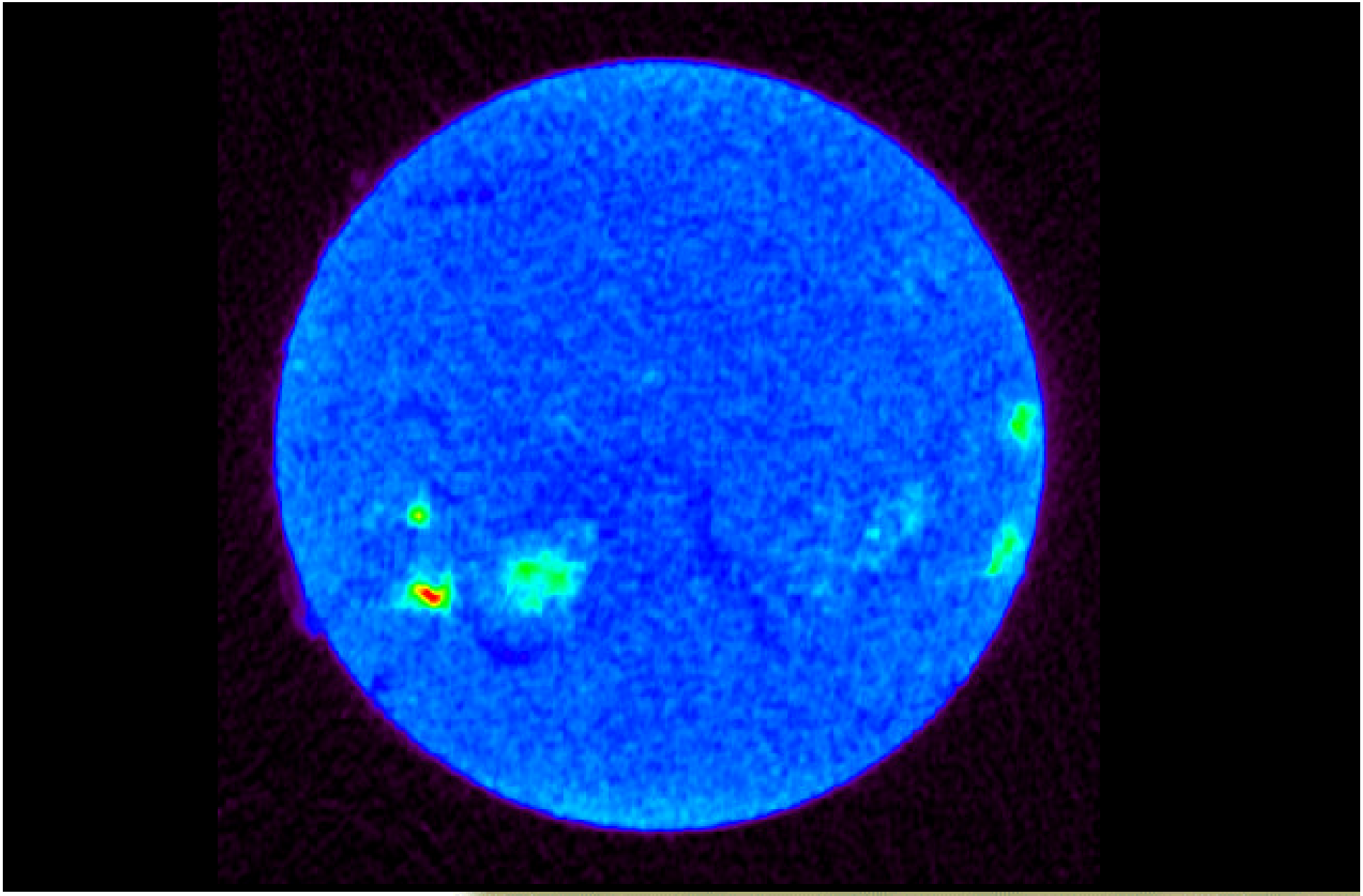


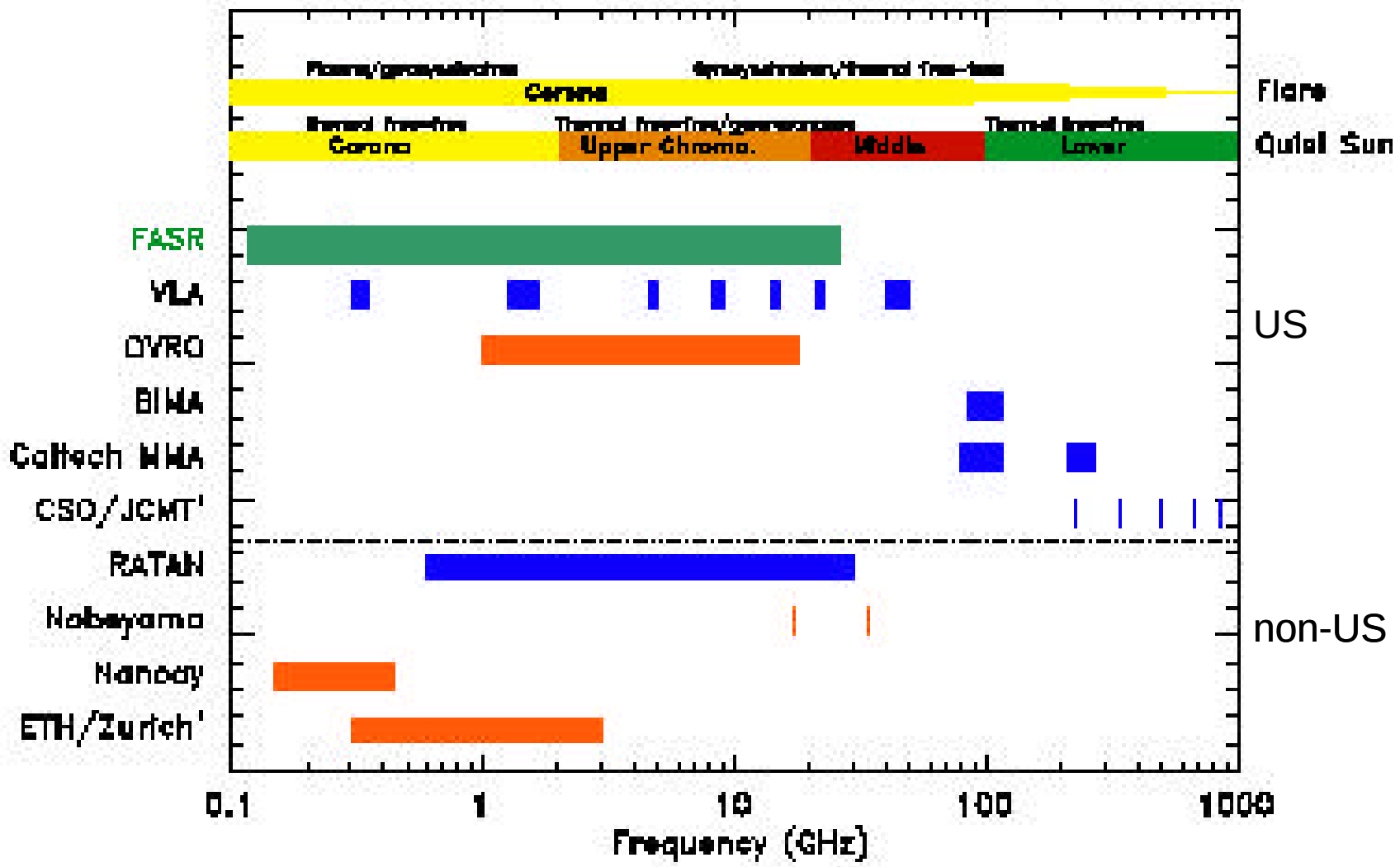
FASR

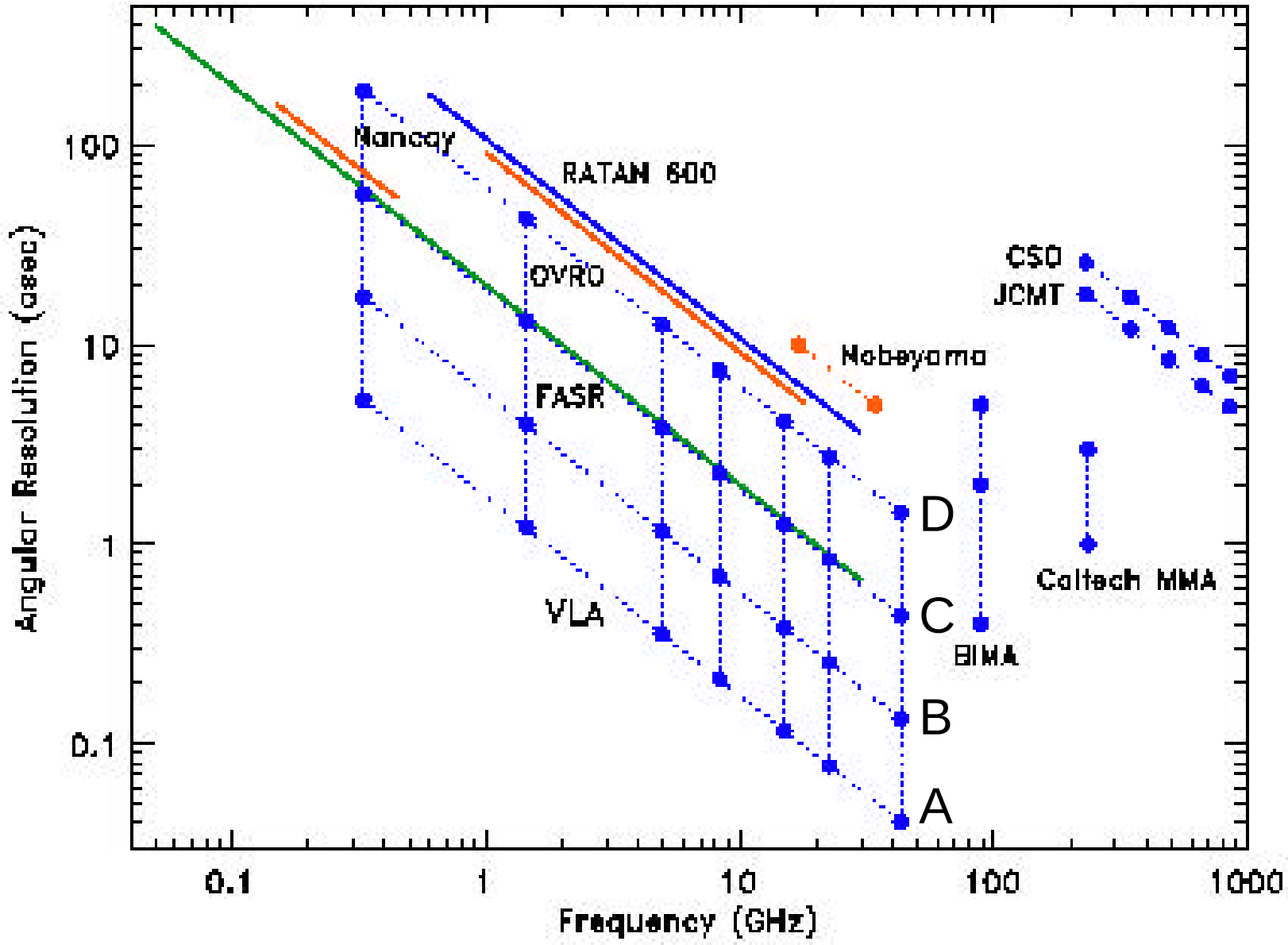
Frequency-Agile Solar Radiotelescope

What is FASR?

The Frequency Agile Solar Radiotelescope is a solar-dedicated instrument designed to perform broadband imaging spectroscopy.

FASR will be designed to support temporal, spatial, and frequency resolutions well-matched to problems in solar physics.


Flare
Quiet Sun
Corona
Upper Chromo.
Middle
Lower
FASR
VLA
OVRO
BIMA
Caltech MMA
CSO/JCMT'
RATAN
Nobeyama
Nancay
ETH/Zurich'
US
non-US
0.1
1
10
100
1000
Frequency (GHz)


Angular Resolution (asec)
100
10
1
0.1
0.1
1
10
100
1000
Frequency (GHz)
Nancay
RATAN 600
OVRO
Nobeyama
FASR
VLA
CSO
JCMT
Caltech MMA
BIMA
D
C
B
A

Strawman FASR Specifications

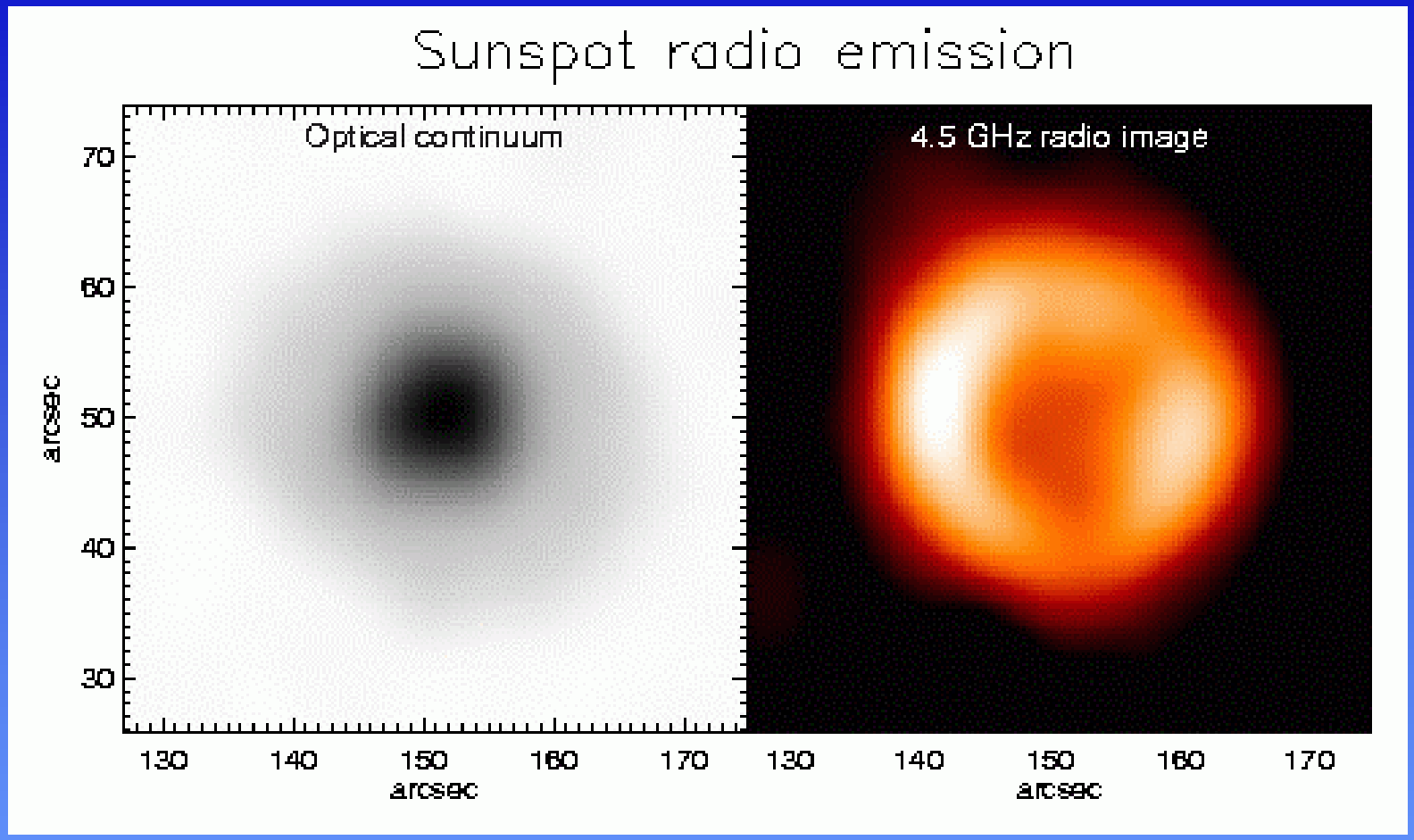
Frequency range	~0.1 – 30 GHz
Frequency resolution	1%, 0.1 – 3 GHz 3%, 3 – 30 GHz
Time resolution	<0.1 s, 0.1 – 3 GHz <1 s, 0.3 – 30 GHz
Number antennas	~100 (5000 baselines)
Size antennas	D = 3 – 5 m
Polarization	~0.1 - 3 GHz, IV/QU 3 – 30 GHz, IV/QU
Angular resolution	$20/\nu_9$ arcsec
Field of View	$19/(D\nu_9)$ deg

FASR Science

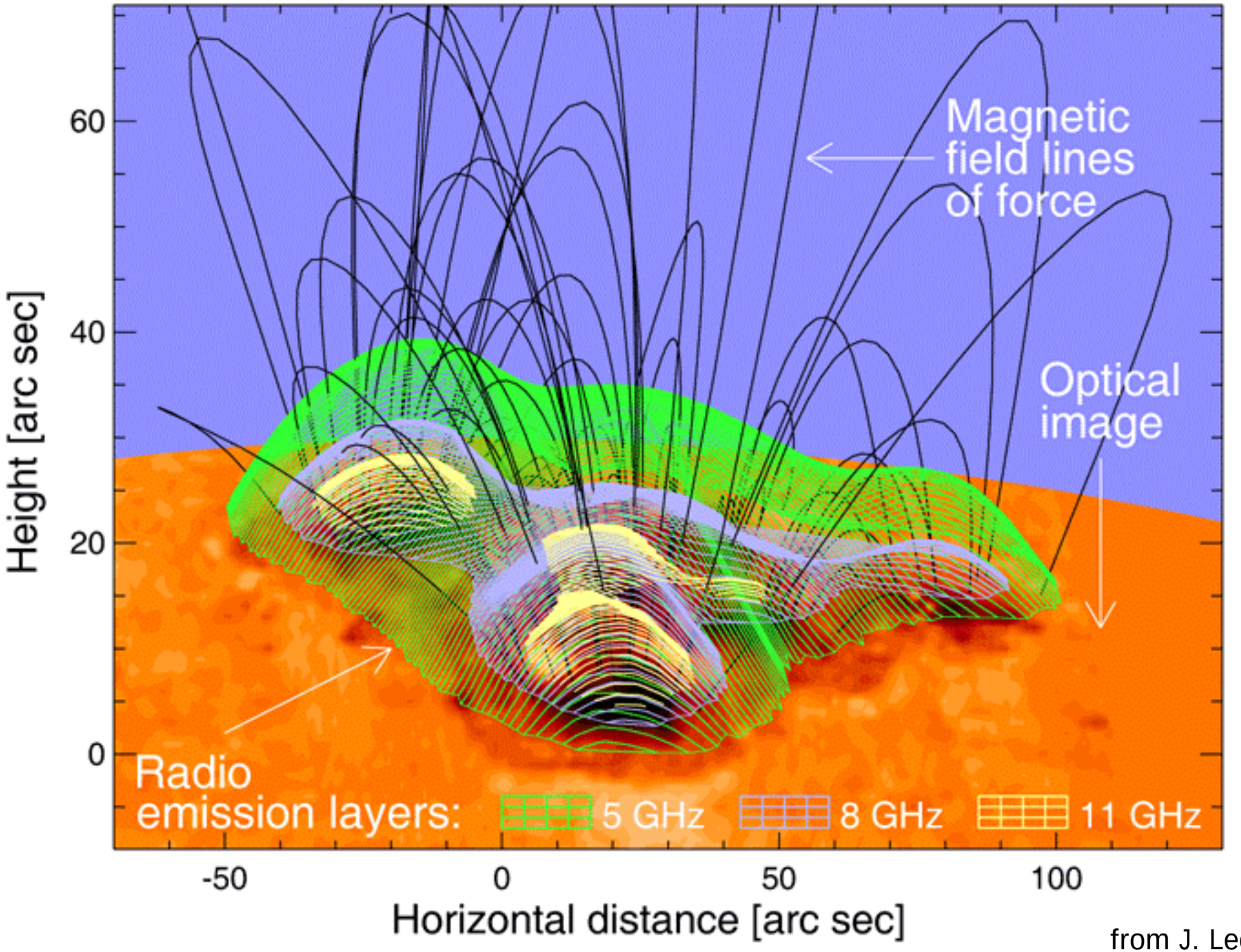
- ✓ Nature & Evolution of Coronal Magnetic Fields
  - Measurement of coronal magnetic fields
  - Temporal & spatial evolution of fields
  - Role of electric currents in corona

- Coronal Mass Ejections
  - Birth & acceleration
  - B, n_{rl}, n_{th}
  - Prominence eruptions
  - Relation to SEPs

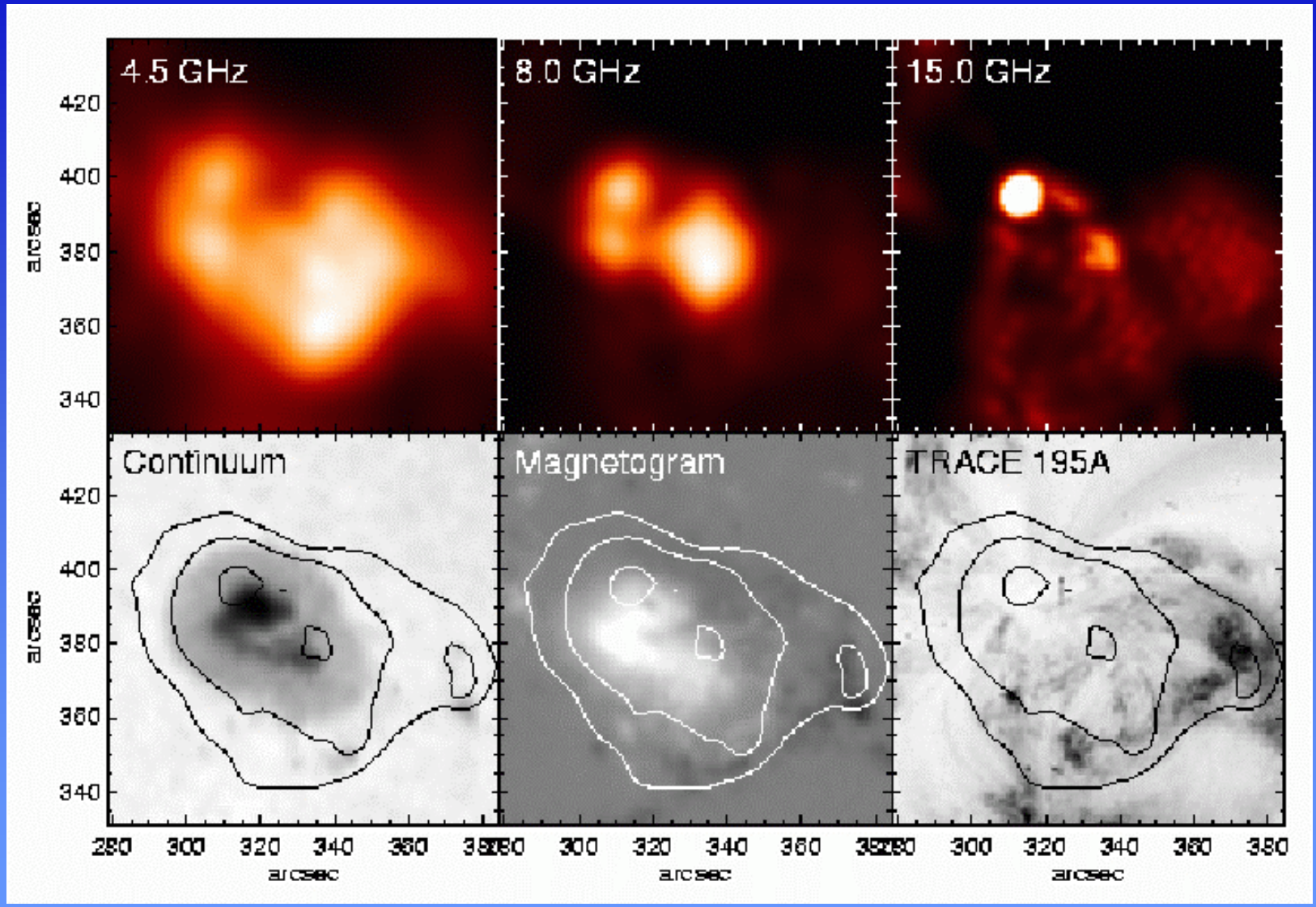
- Flares
  - Energy release
  - Plasma heating
  - Electron acceleration and transport
  - Origin of SEPs



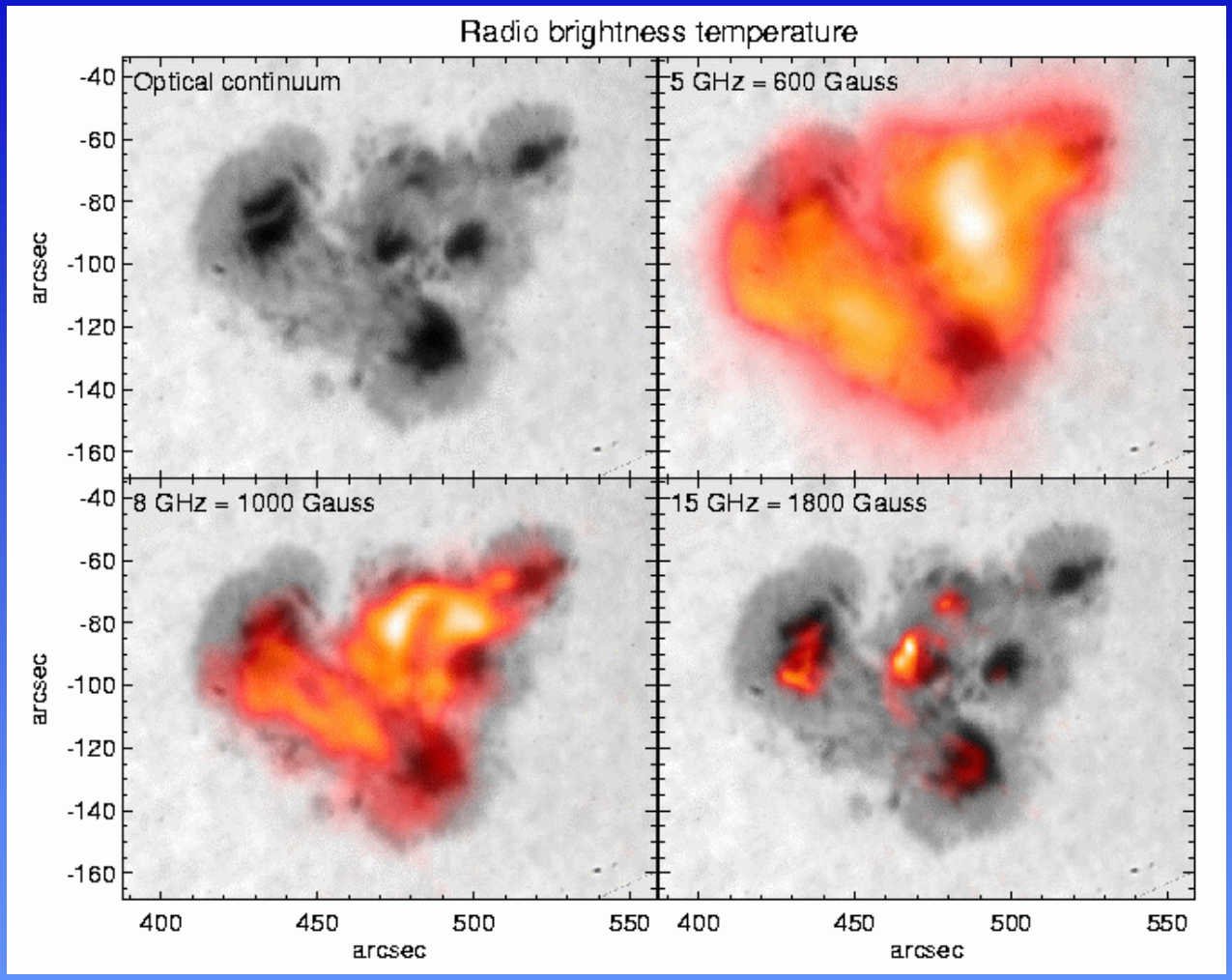
Radio emission from a simple round sunspot


Magnetic
field lines
of force
Optical
image
Radio
emission layers:
5 GHz
8 GHz
11 GHz
Height [arc sec]
60
40
20
0
-50
0
50
100
Horizontal distance [arc sec]

from J. Lee

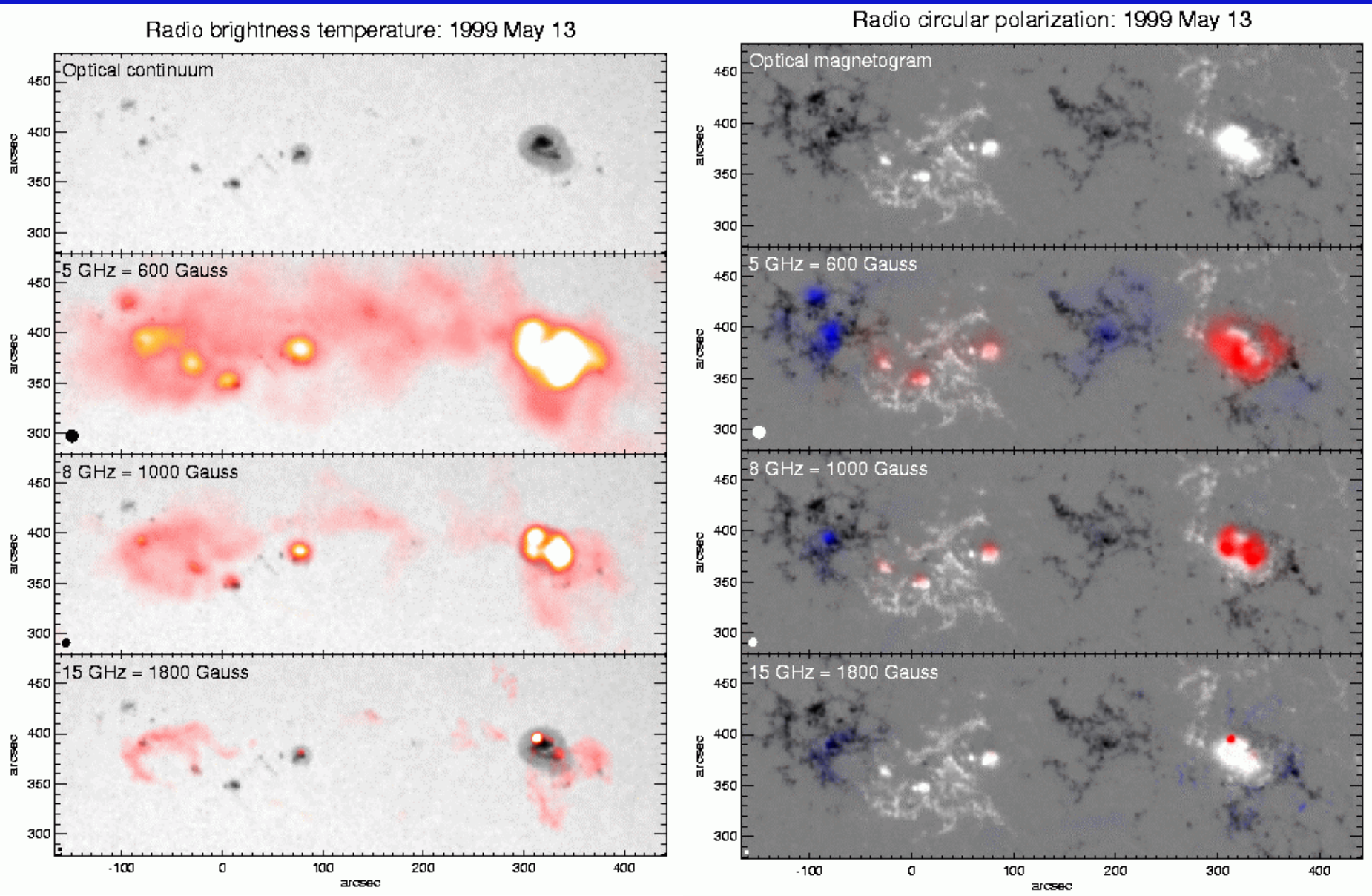


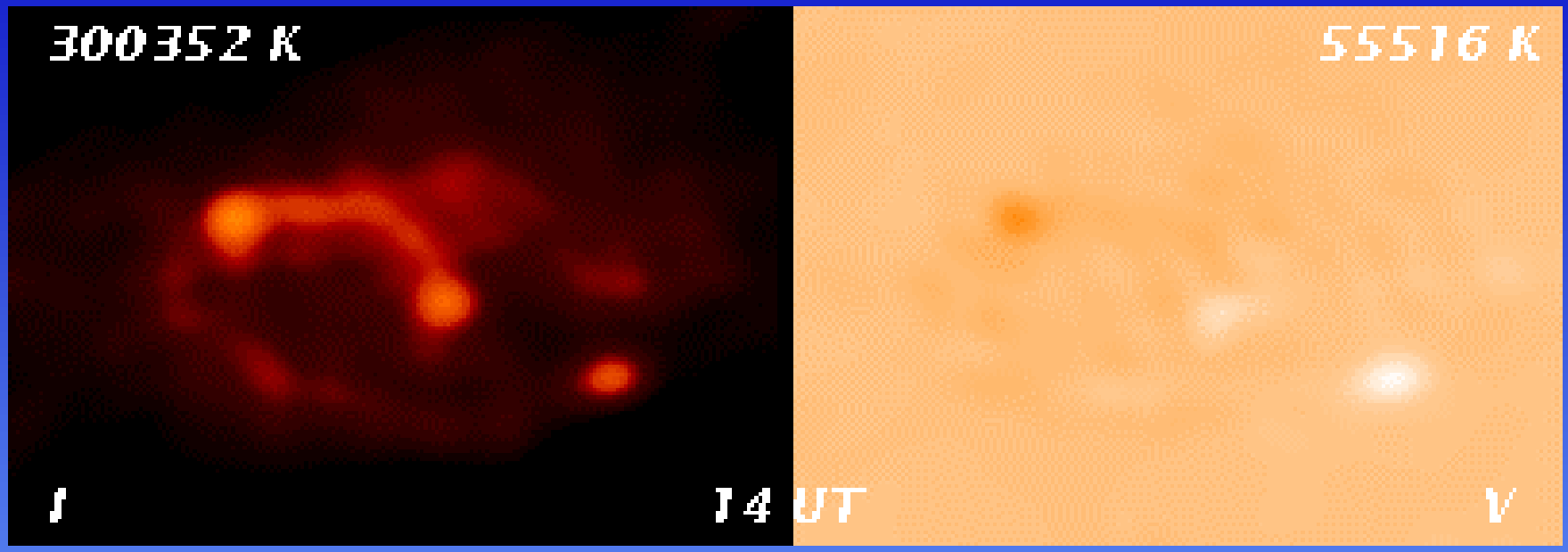
Coronal magnetograms



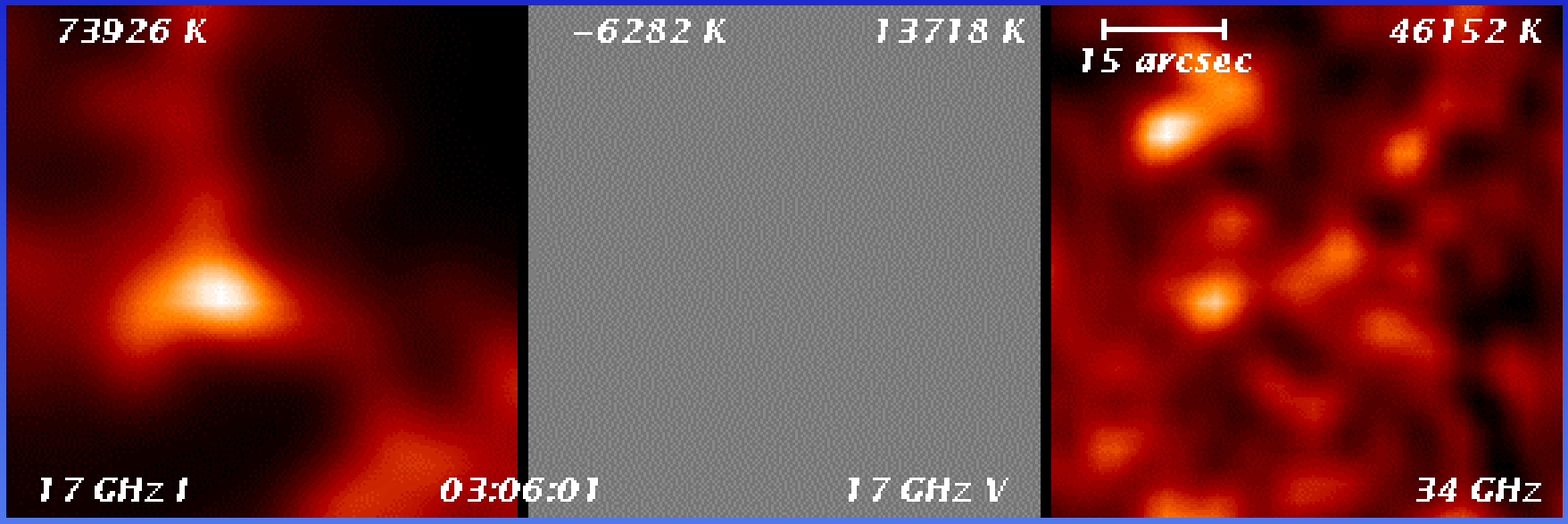
Active region showing strong shear: radio images show high B and very high temperatures

from Lee et al (1998)


Radio brightness temperature: 1999 May 13
Optical continuum
5 GHz = 600 Gauss
8 GHz = 1000 Gauss
15 GHz = 1800 Gauss
Radio circular polarization: 1999 May 13
Optical magnetogram
5 GHz = 600 Gauss
8 GHz = 1000 Gauss
15 GHz = 1800 Gauss
arcsec
Red = positive radio polarity Blue = negative radio polarity



VLA 8 GHz radio movie of a moving magnetic pore
(1 hr time resolution)



17 GHz intensity 17 GHz circ. pol. 34 GHz intensity

Magnetic field lines in the solar corona illuminated by gyro-synchrotron emission from nonthermal electrons.

Nobeyama RH

FASR Science

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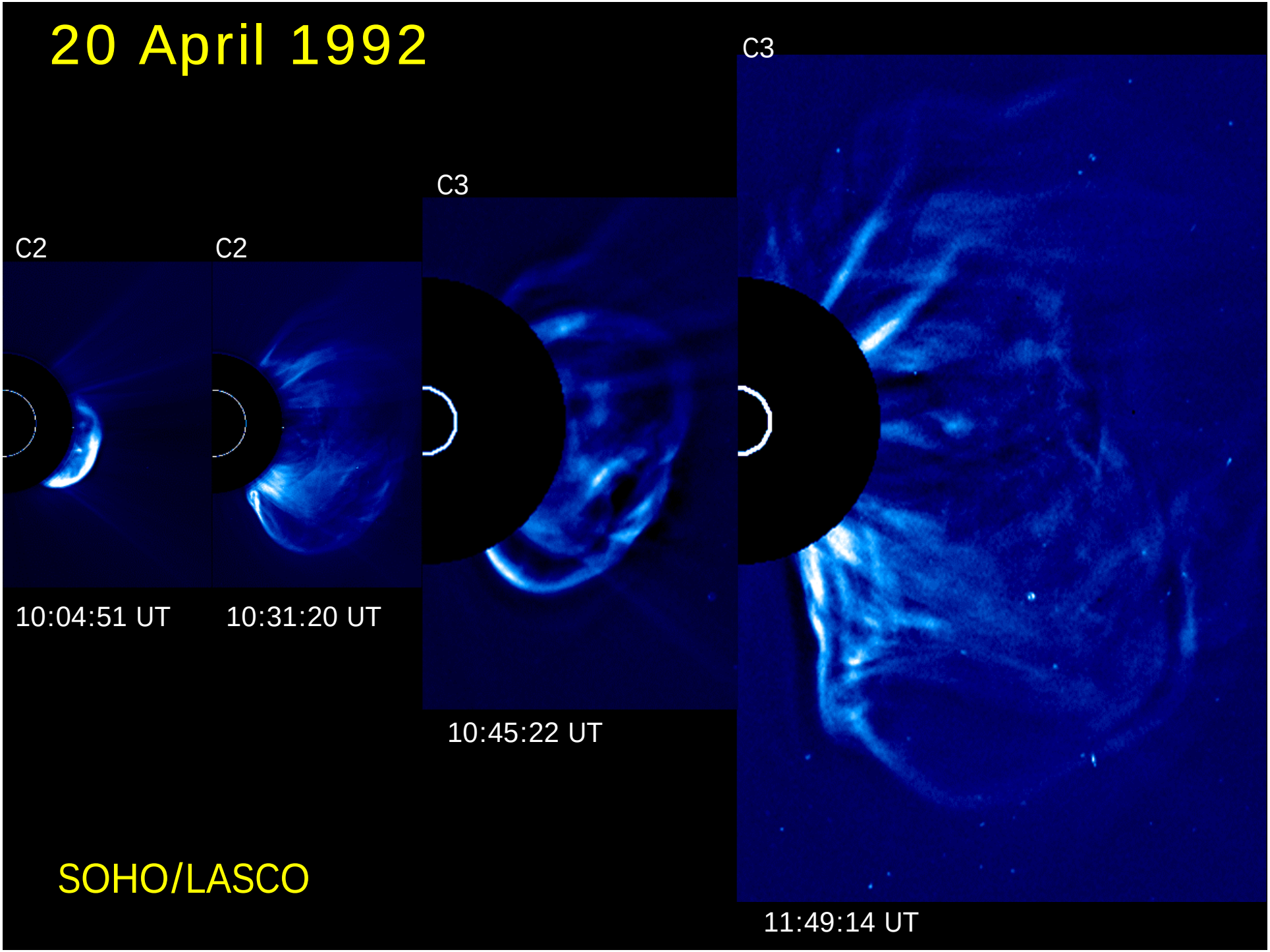
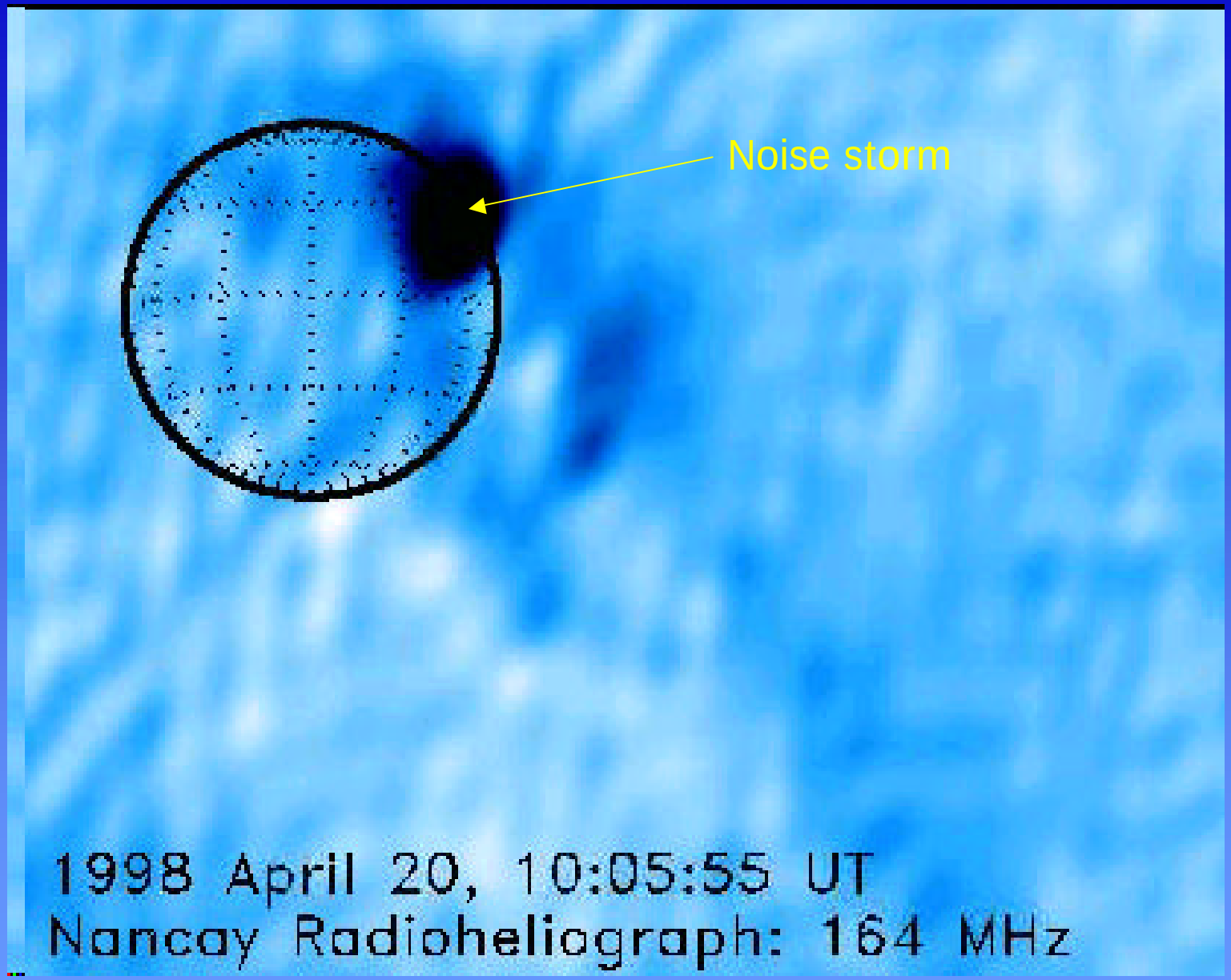
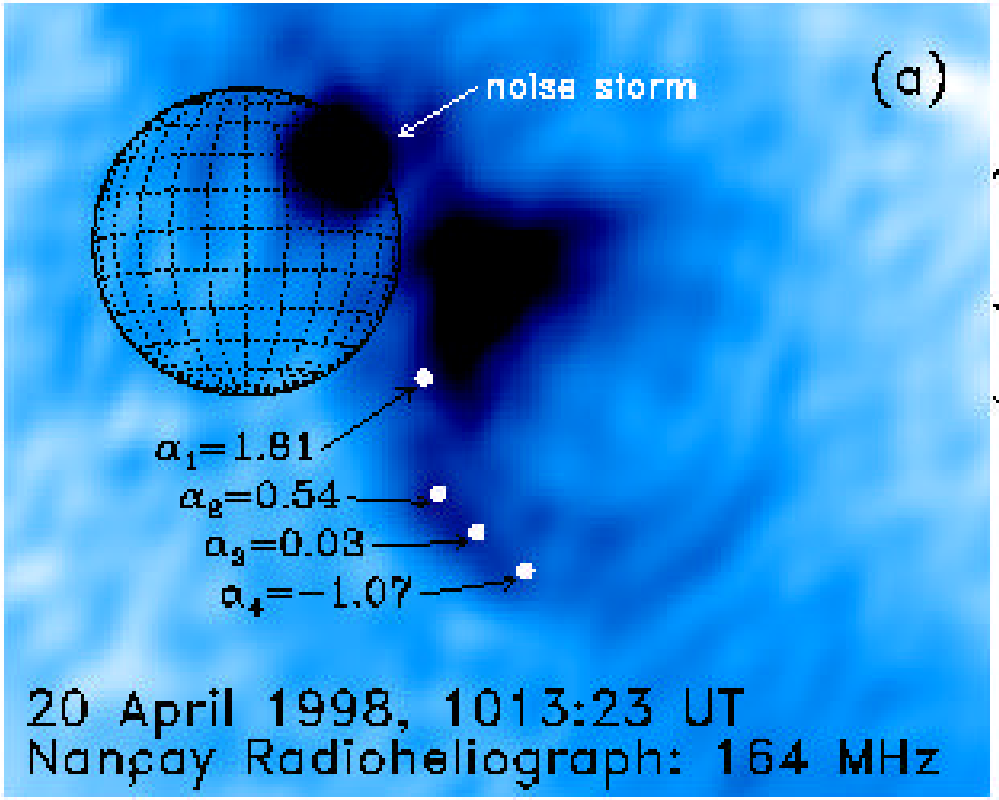
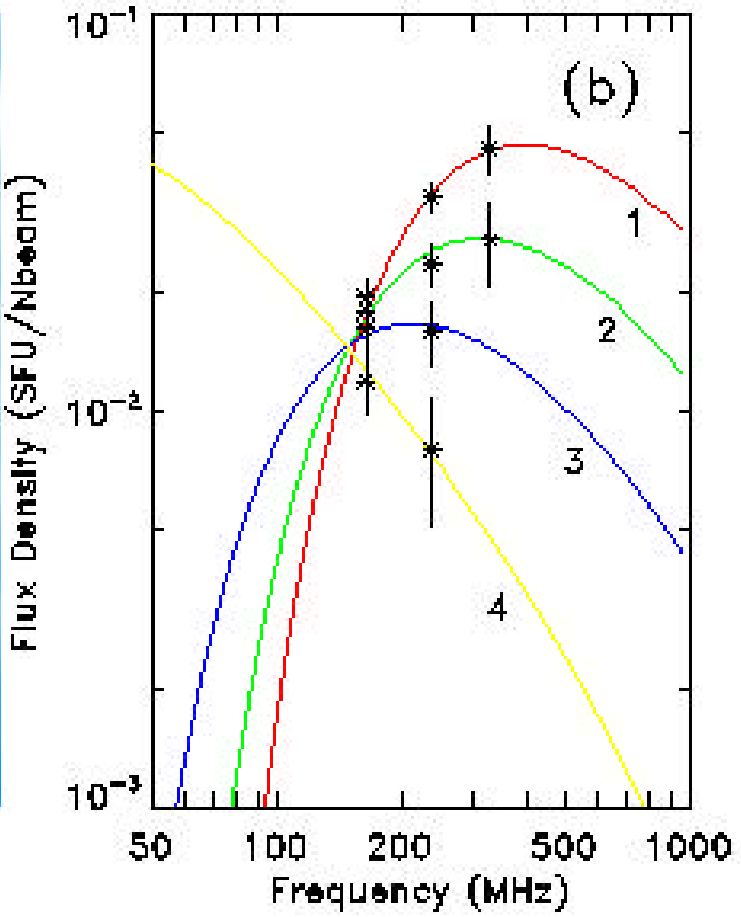

20 April 1992
C2
C2
C3
C3
10:04:51 UT
10:31:20 UT
10:45:22 UT
11:49:14 UT
SOHO/LASCO

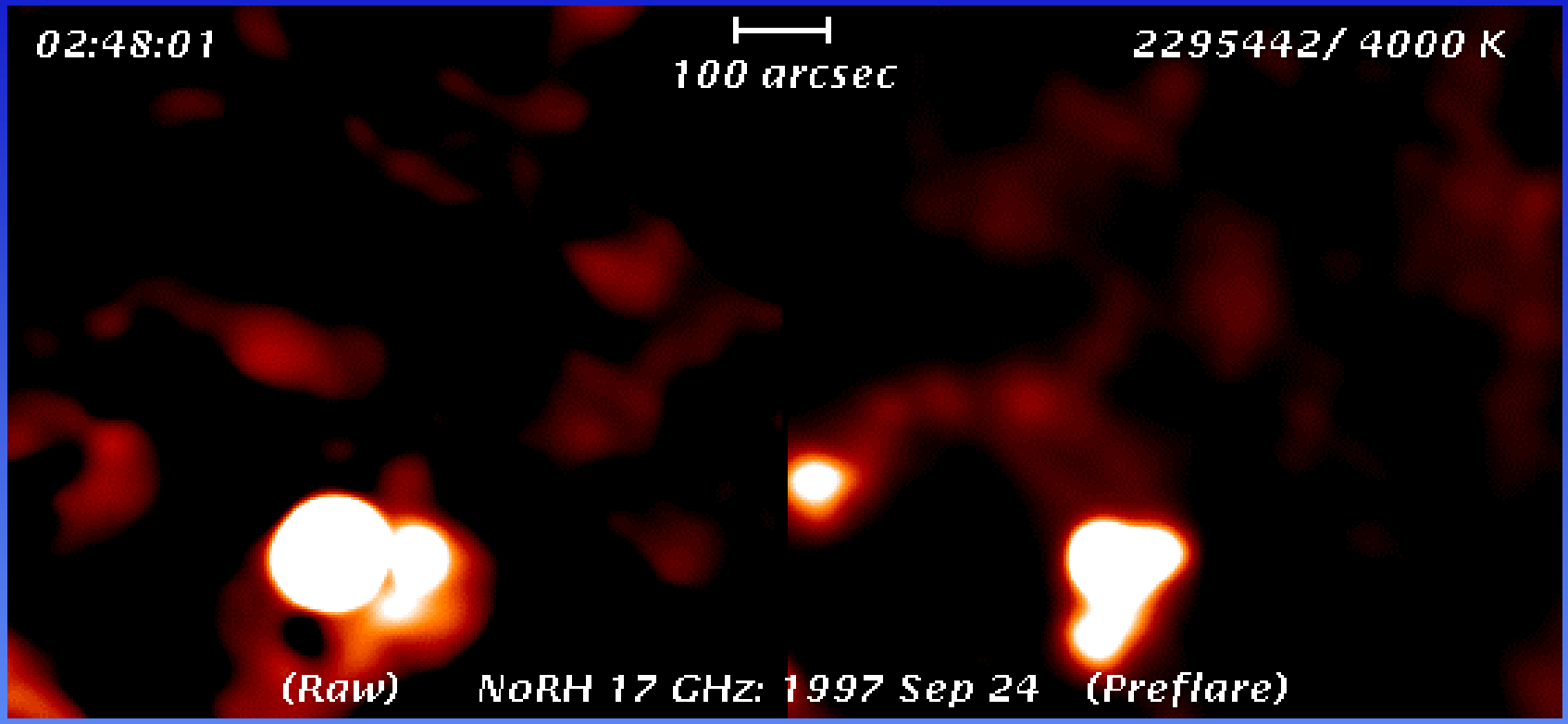


Bastian et al. (2001)





Bastian et al. (2001)



NoRH detection of an “EIT wave” at 17 GHz: possibly the signature of the expanding edge of a coronal mass ejection at the base of the corona.

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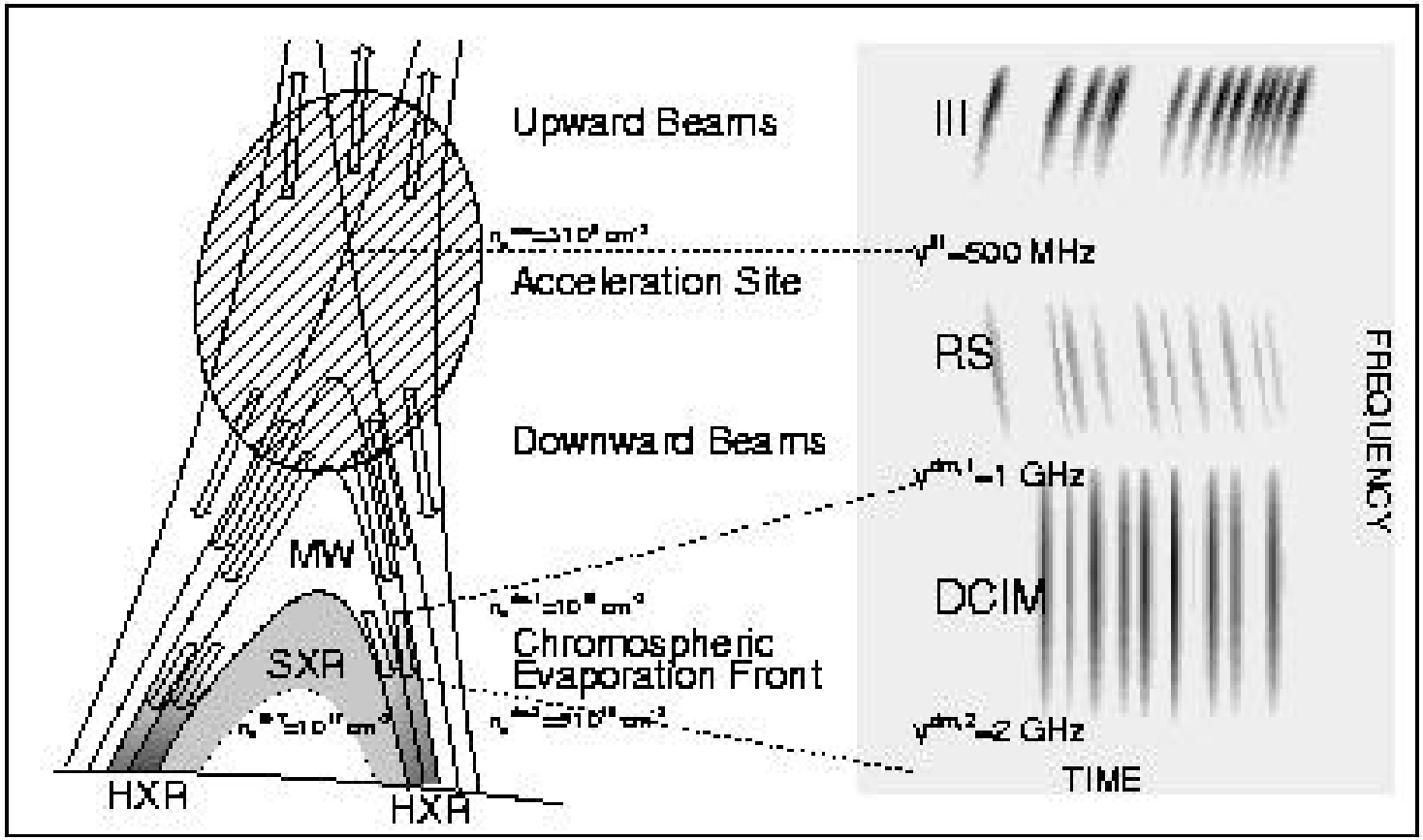
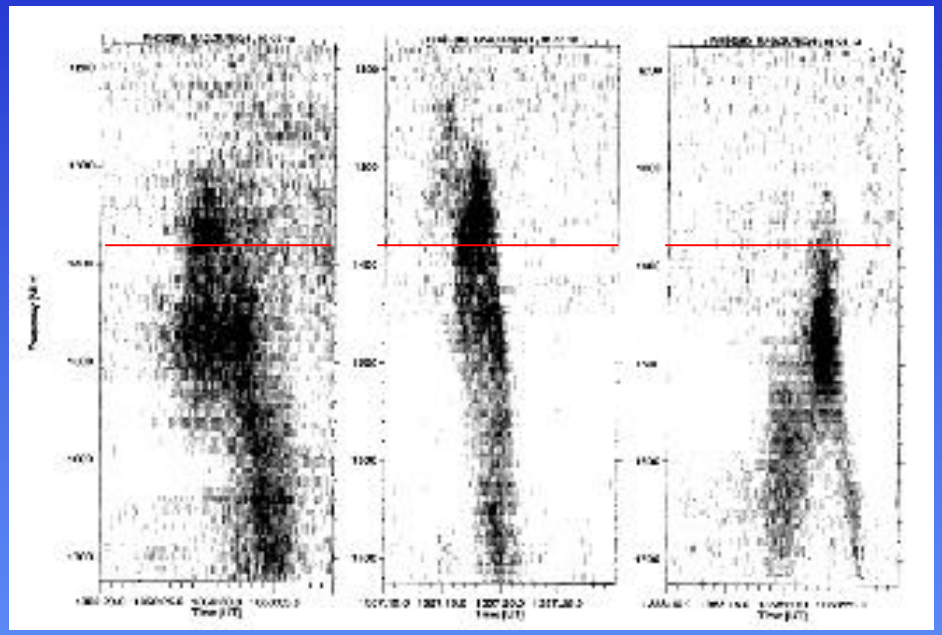
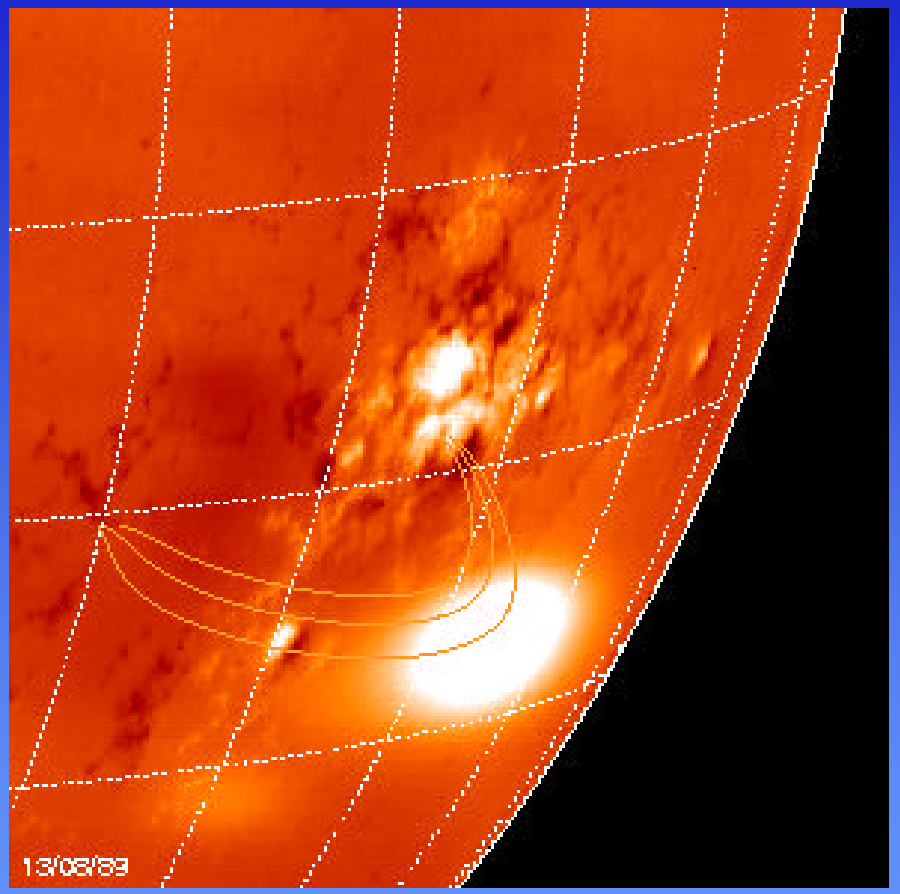


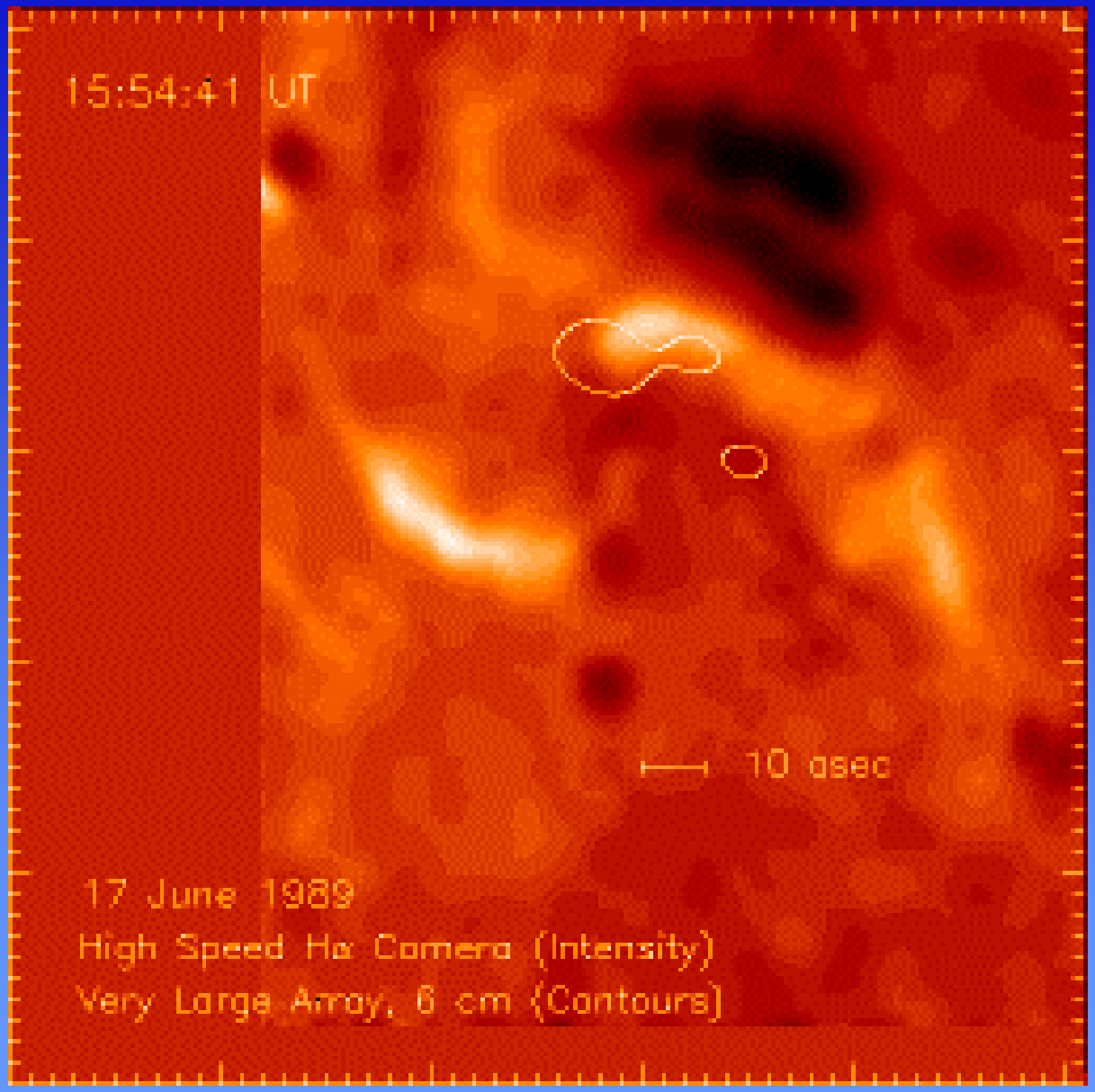
from Aschwanden & Benz 1997





Type U bursts observed by Phoenix/ETH and the VLA.

from Aschwanden et al. 1992

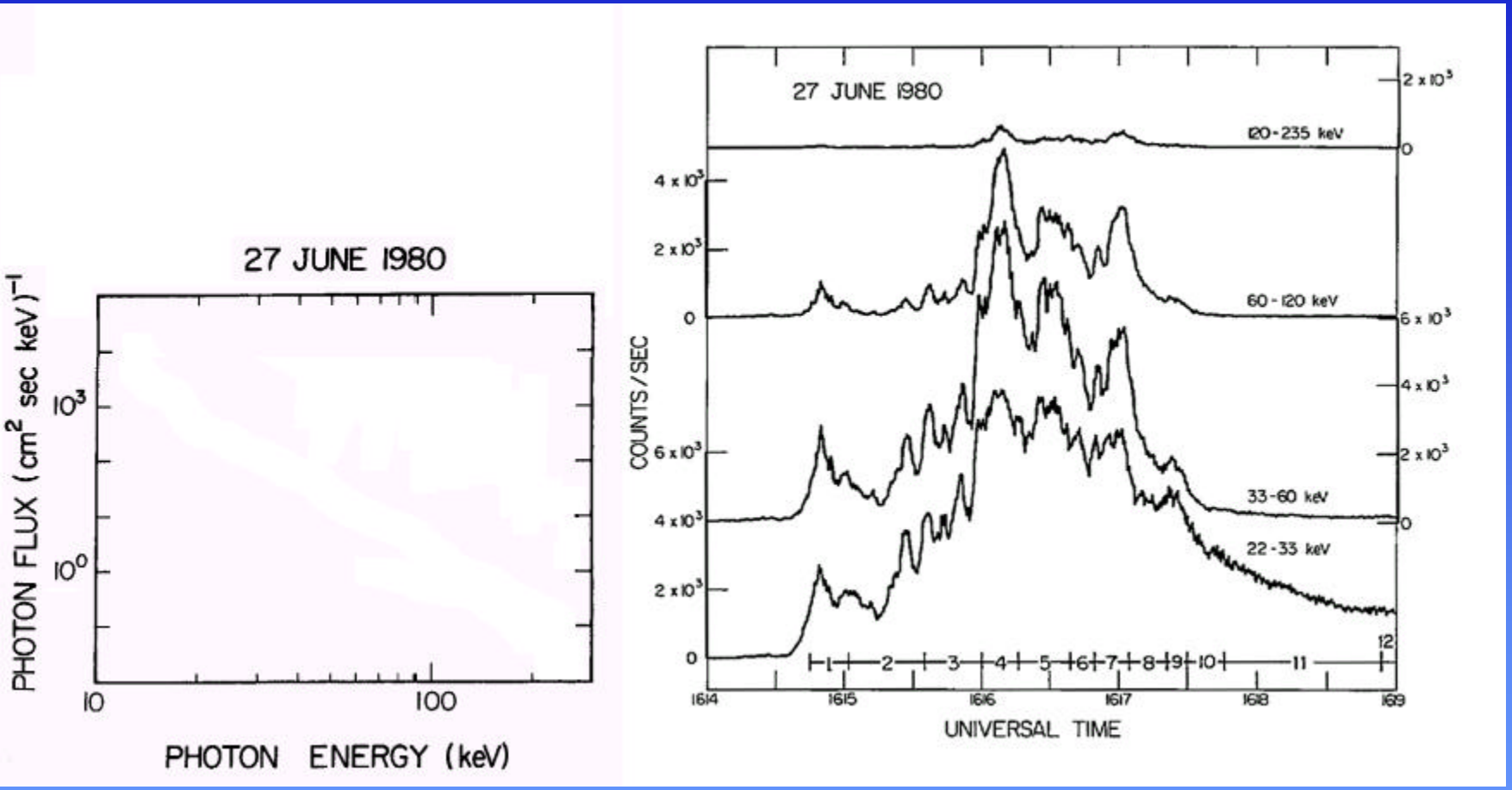


Two ribbon flare observed by the VLA on 17 Jun 89.

6 cm (contours)

Ha (intensity)

from Bastian & Kiplinger (1991)



from Lin & Schwartz (1981)

modified by D.E. Gary

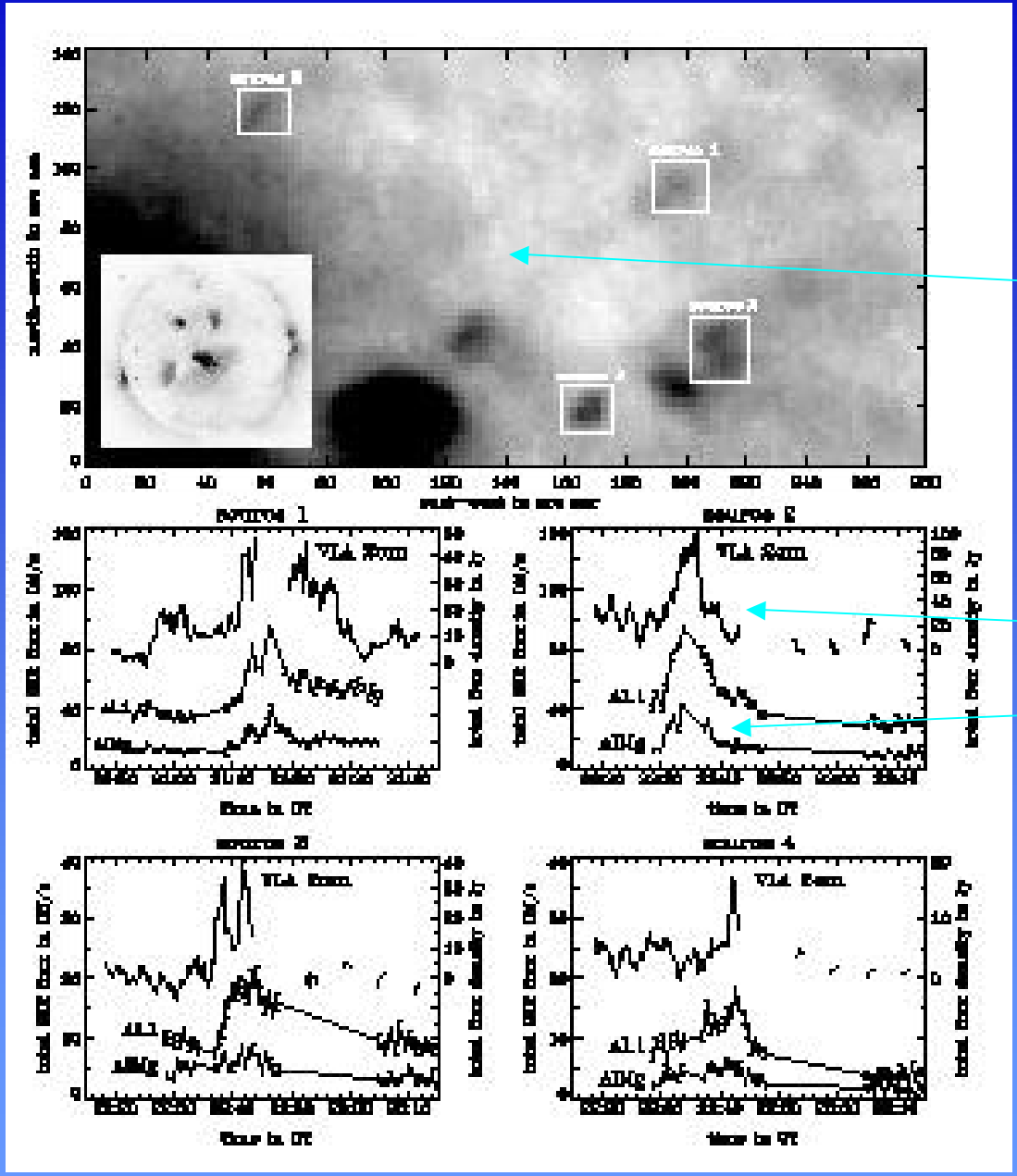
FASR Science (cont)

- ✓ The “thermal” solar atmosphere
  - Coronal heating - nanoflares
  - Thermodynamic structure of chromosphere in AR, QS, CH
  - Formation & structure of filaments/prominences

- Solar Wind
  - Birth in network – nanoflares?
  - Tomography of inner heliosphere (if low-freq)
  - Turbulence & waves in inner helio (if low-freq)
  - Magnetic field constraints (… maybe – hard)

20 Feb 1995

"network flares"

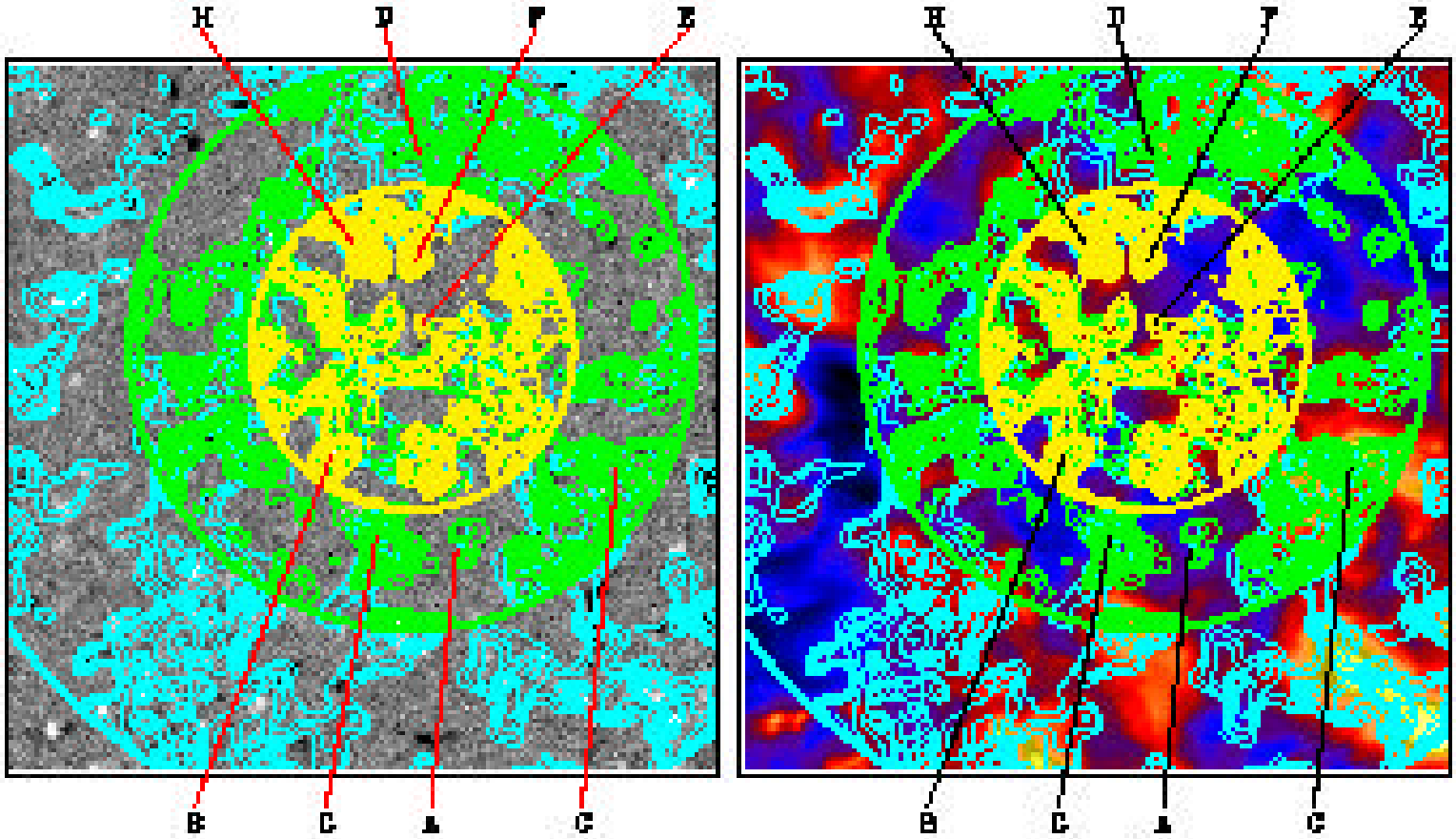


Yohkoh SXT

VLA 2 cm

SXT

from Krucker et al (1997)



Intensity

RHS: SOHO/EIT

LHS: MDI

Contours

Yellow: VLA 2 cm

Green: VLA 3.6 cm

Blue: VLA 6 cm

Benz & Krucker (1999)

FASR Science (cont)

- The “thermal” solar atmosphere
  - Coronal heating - nanoflares
  - Thermodynamic structure of chromosphere in AR, QS, CH
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- ✓ Solar Wind
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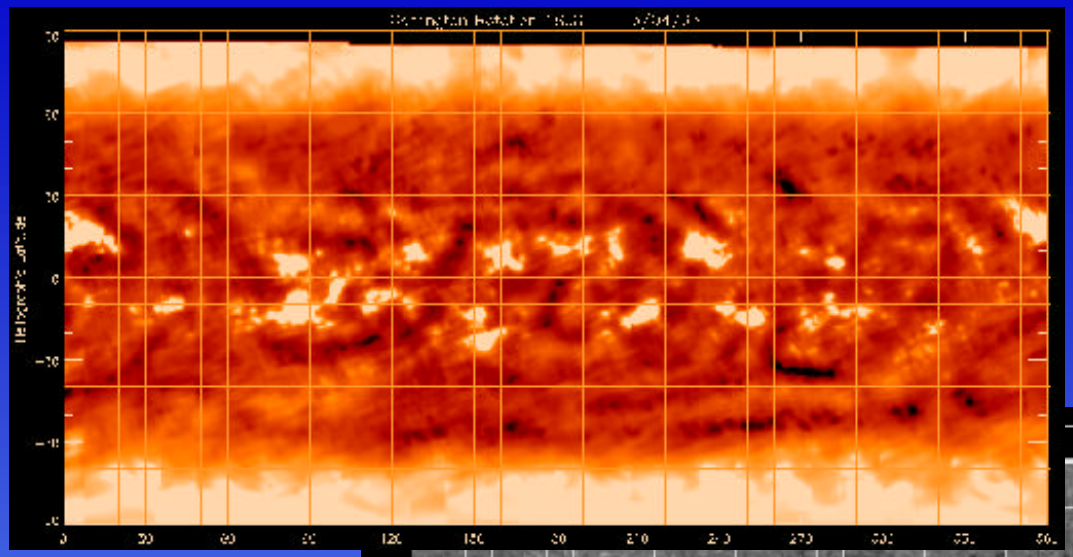
  - Magnetic field constraints (… maybe – hard)

FASR Science (cont)

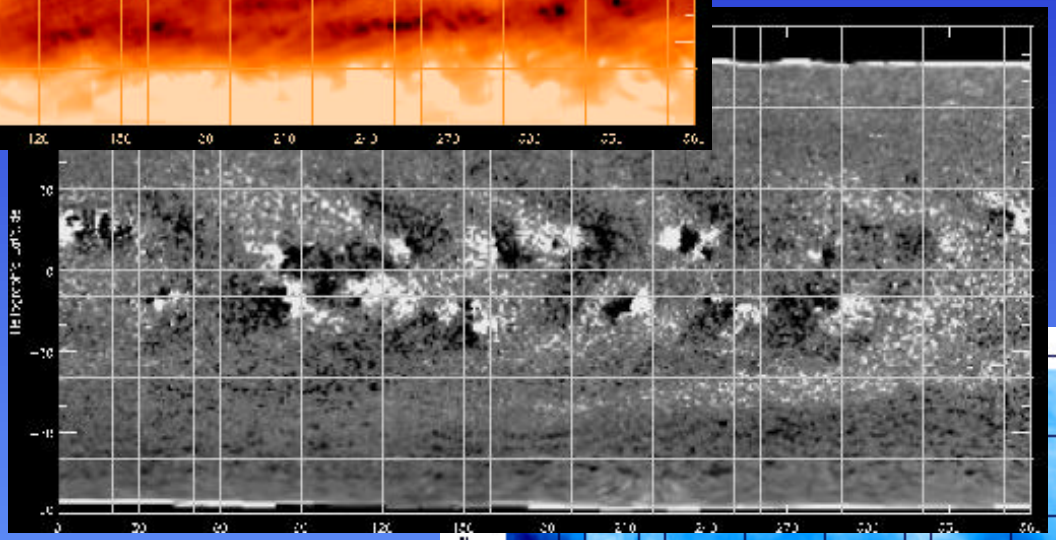
Finally, as a comprehensive, dedicated solar instrument sensitive to magnetic fields, eruptive phenomena, their locations, and physical properties – *and capable of providing many of these in real time or near-real time* - FASR is an excellent *LWS/Space Weather* instrument.

Moreover, as a stable, well-calibrated instrument FASR will make important contributions to synoptic studies: long term monitoring of magnetic, thermal, and irradiance properties of the Sun.

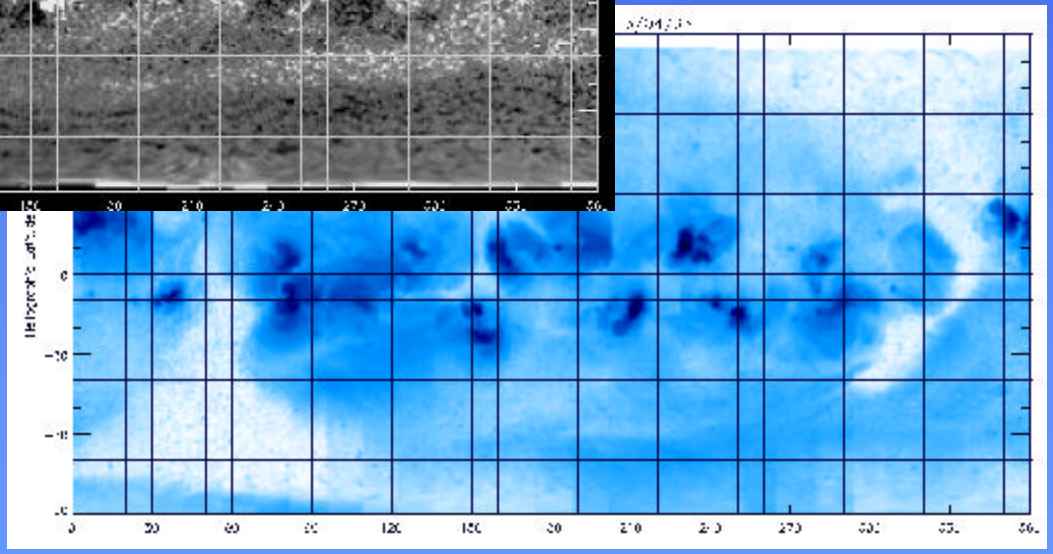
Synoptic studies



17 GHz



B gram



SXR