The first results of the flare observations by the Siberian Multiwave Radioheliograph

S.V. Lesovoi, A.T. Altyntsev, E.F. Ivanov, V.V. Grechnev, A.V. Gubin,
L.K. Kashapova, A.A. Kochanov, A.A. Kuznetsov, N.S. Meshalkina, D.A. Zhdanov

Institute of Solar-Terrestrial Physics
Irkutsk, Russia

Outline

- Short description of the the Siberian Multiwave Radioheliograph (SMRh)
- Preliminary results of analysis of the first observations of SMRh
- The multifrequency observations
- Future plans and summary

The Siberian Multiwave Radioheliograph: introduction

- Location: Badary Valley, 220 km from Irkutsk (N51 E102).
- Utilizes partially the infrastructure of the former Siberian Solar Radio Telescope (operated until 2013).

The Siberian Multiwave Radioheliograph:specification

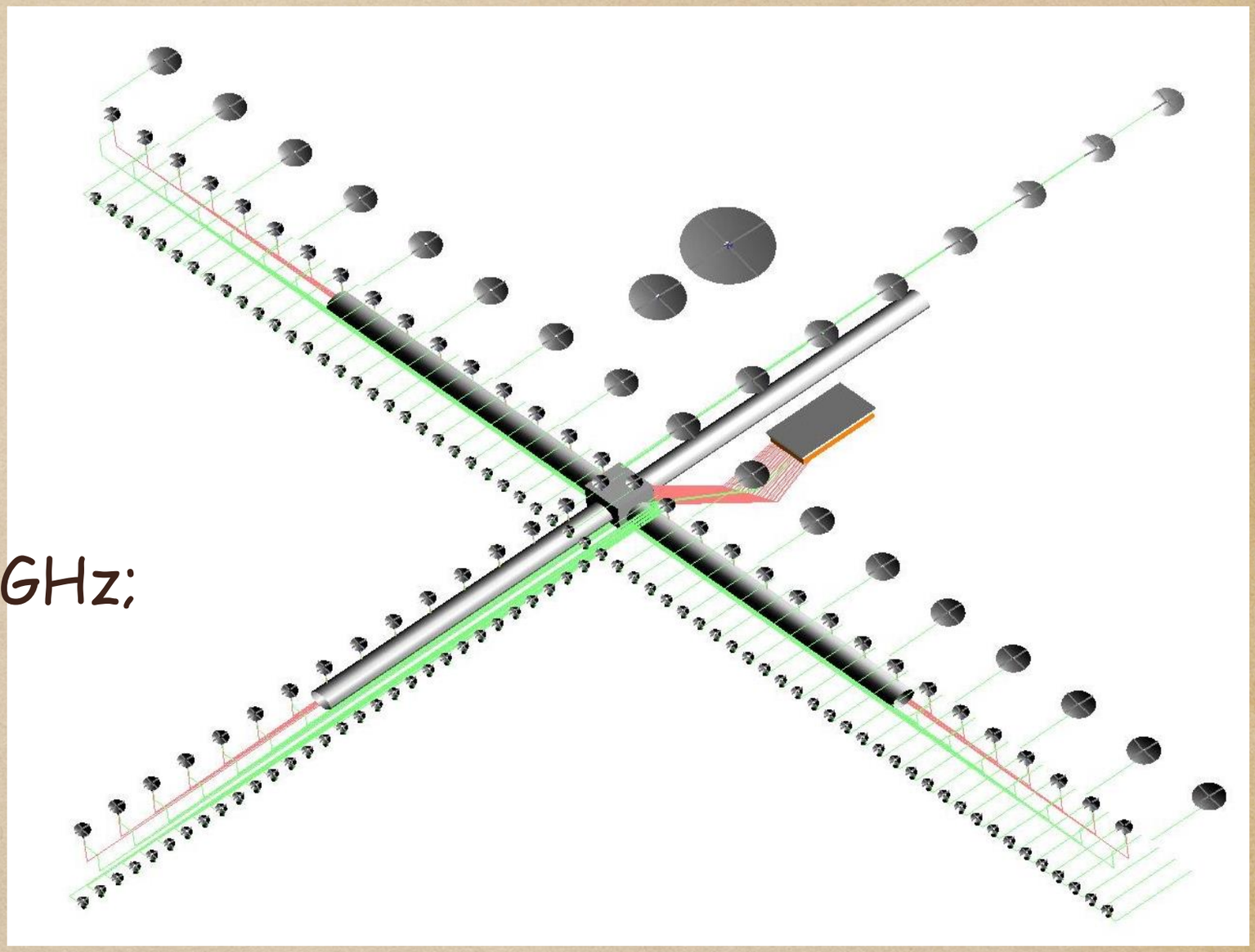
T-shaped array.

Digital correlators.

Baseline: 622 m.

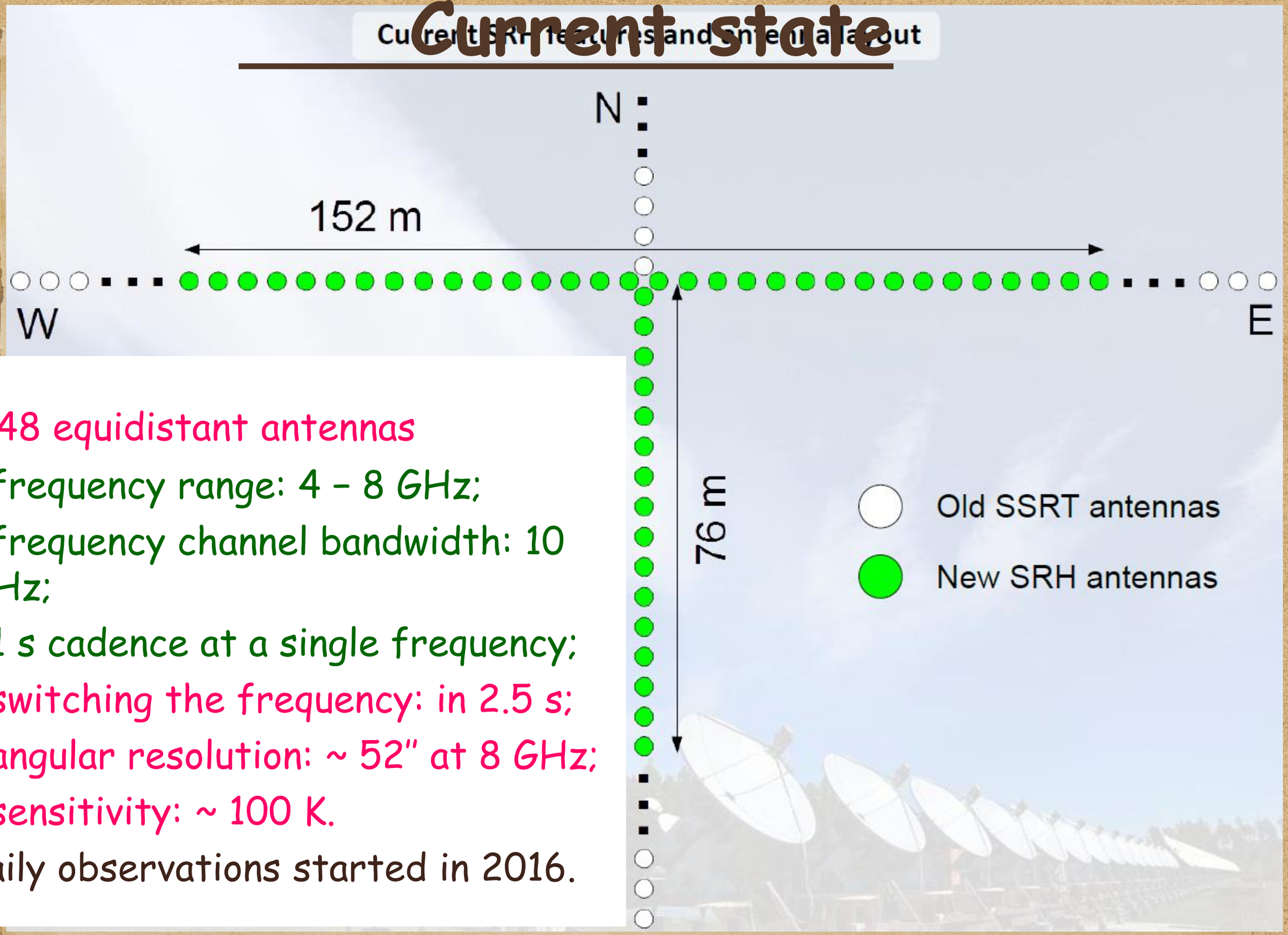
1st stage:

- 96 antennas;
- Frequency range: 4 – 8 GHz;
- Frequency channel bandwidth: 10 MHz;
- Tunable working frequency;
- Time resolution: 1 s (at a single frequency);
- Angular resolution: up to 13″ at 8 GHz.



Schematic picture of the radioheliograph

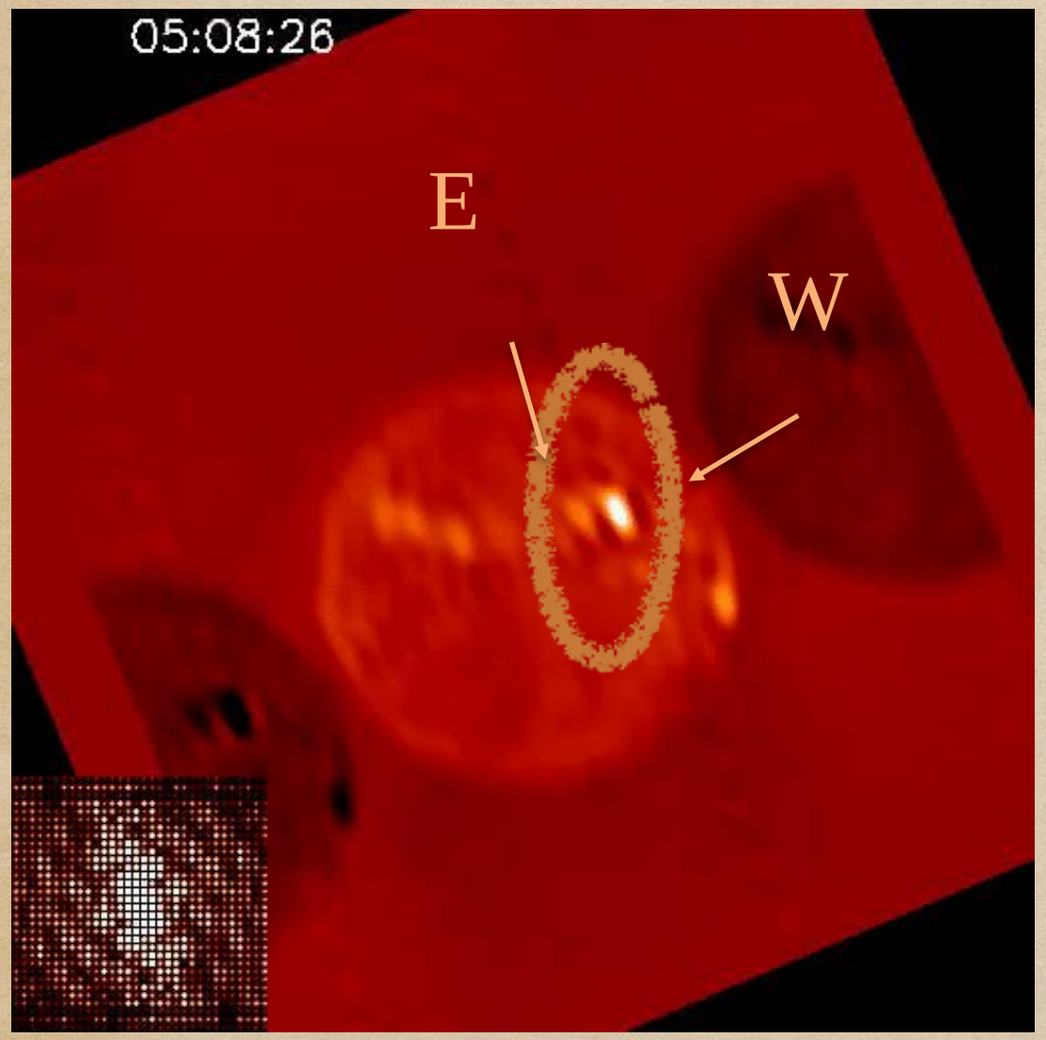
Current state

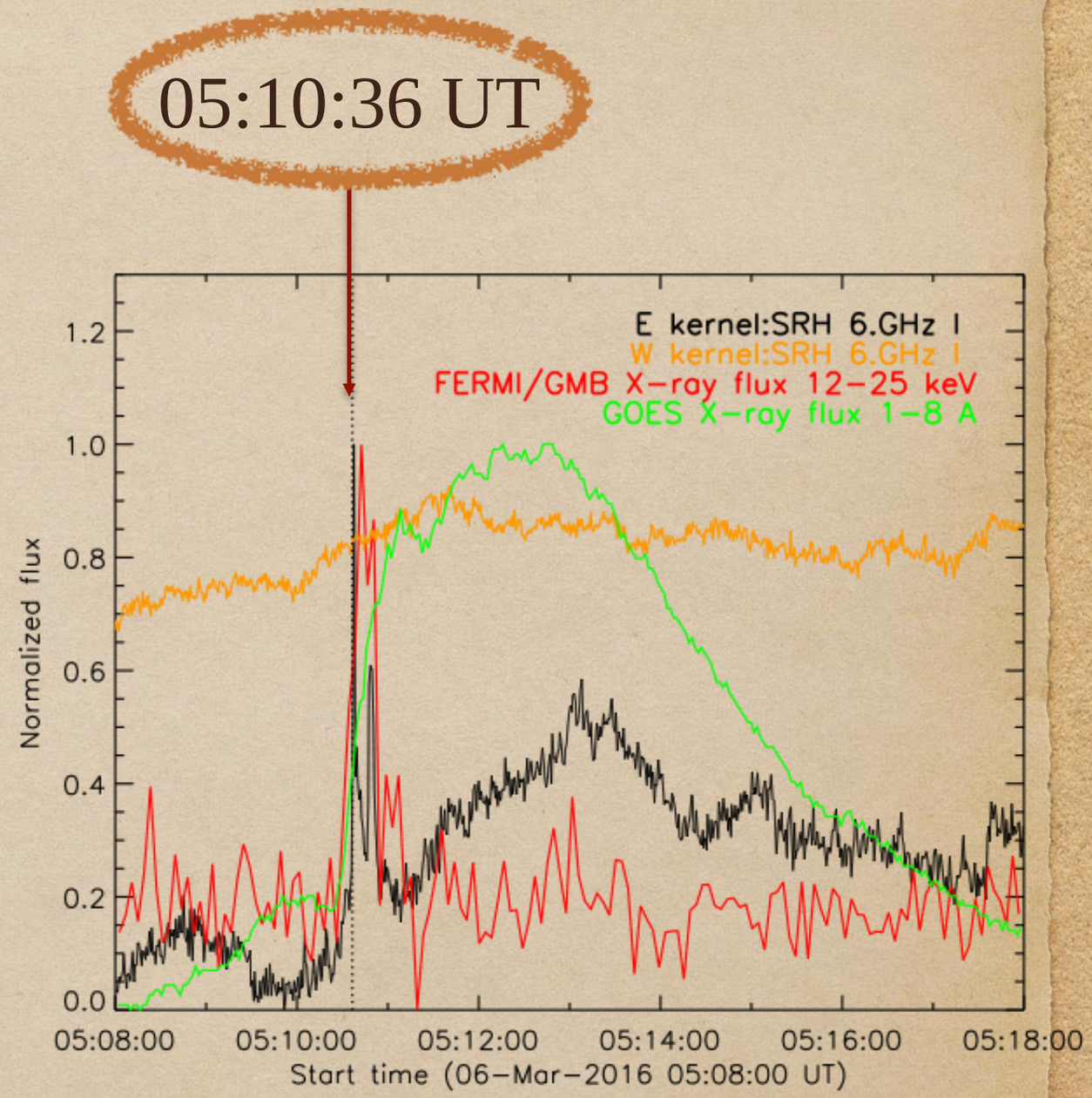


- 48 equidistant antennas
- frequency range: 4 – 8 GHz;
- frequency channel bandwidth: 10 MHz;
- 1 s cadence at a single frequency;
- switching the frequency: in 2.5 s;
- angular resolution: ~ 52″ at 8 GHz;
- sensitivity: ~ 100 K.

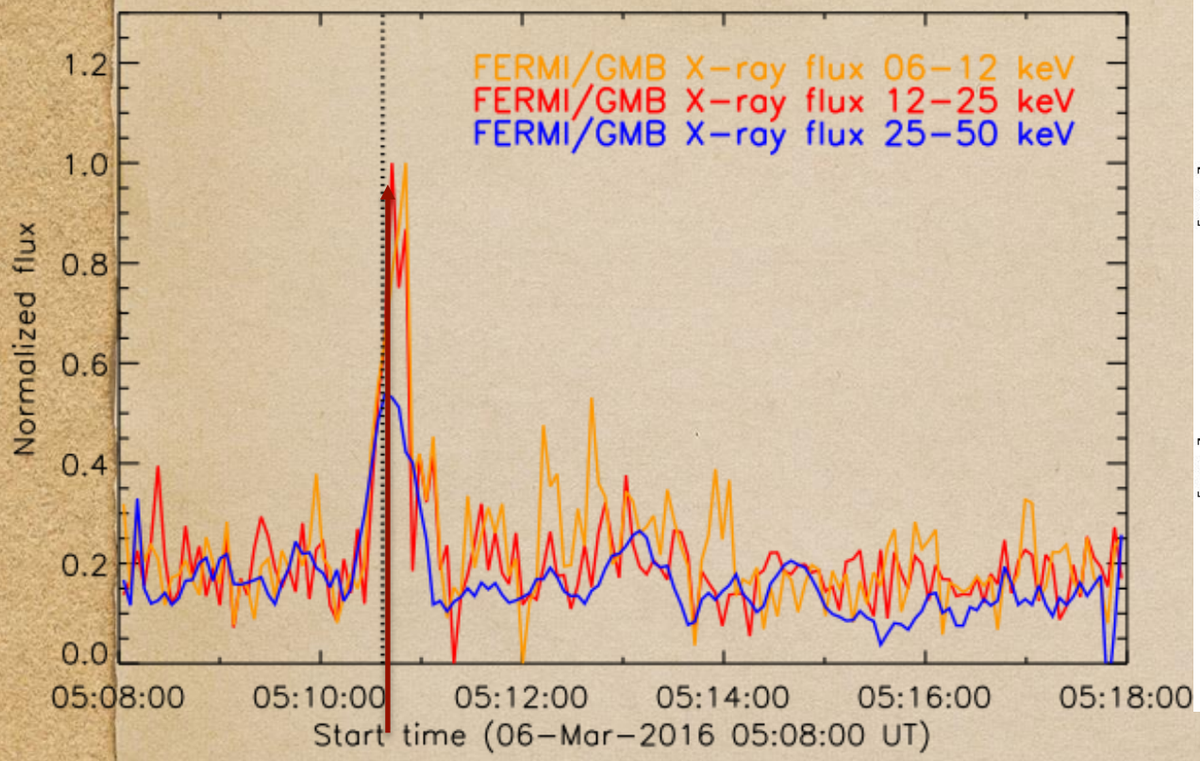
Daily observations started in 2016.

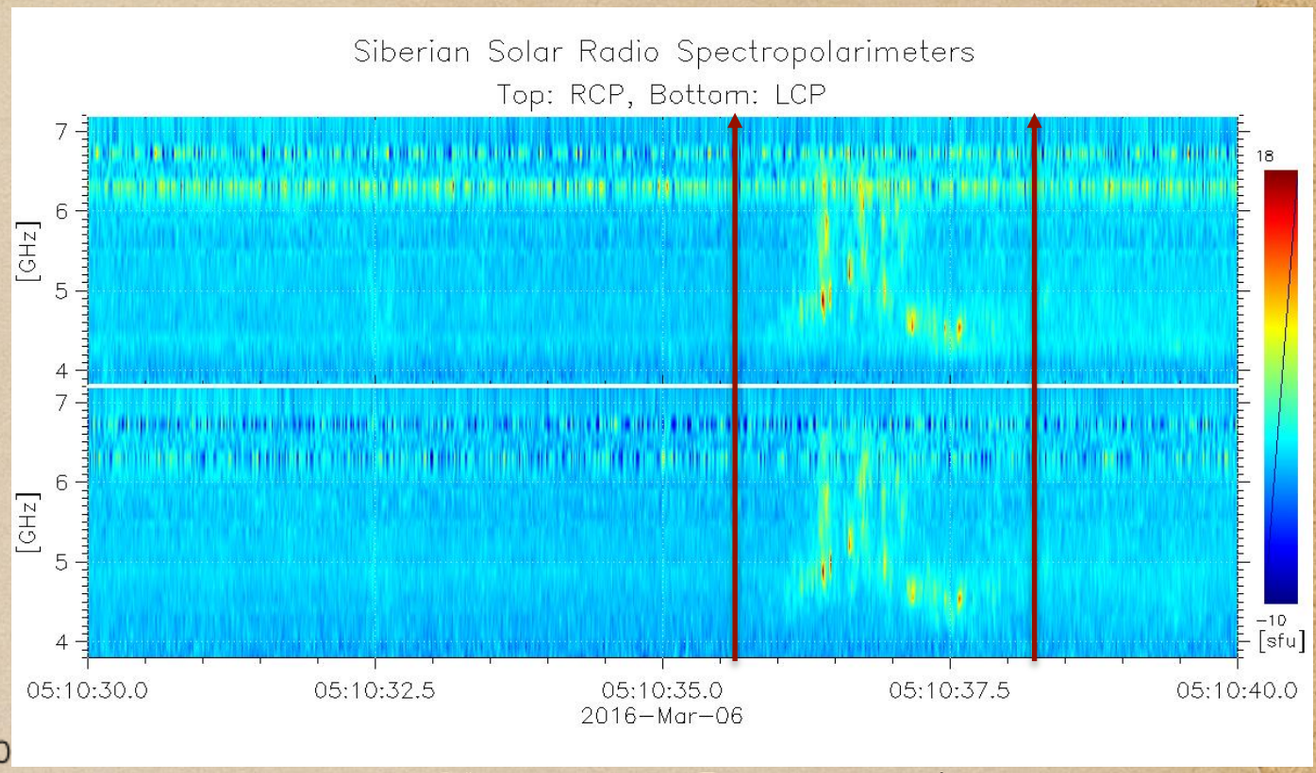
The first solar flare observed by SMRh: SOL2016-Mar-06T5:12 / B7.2





SOL2016-Mar-06T5:12 :fine structure

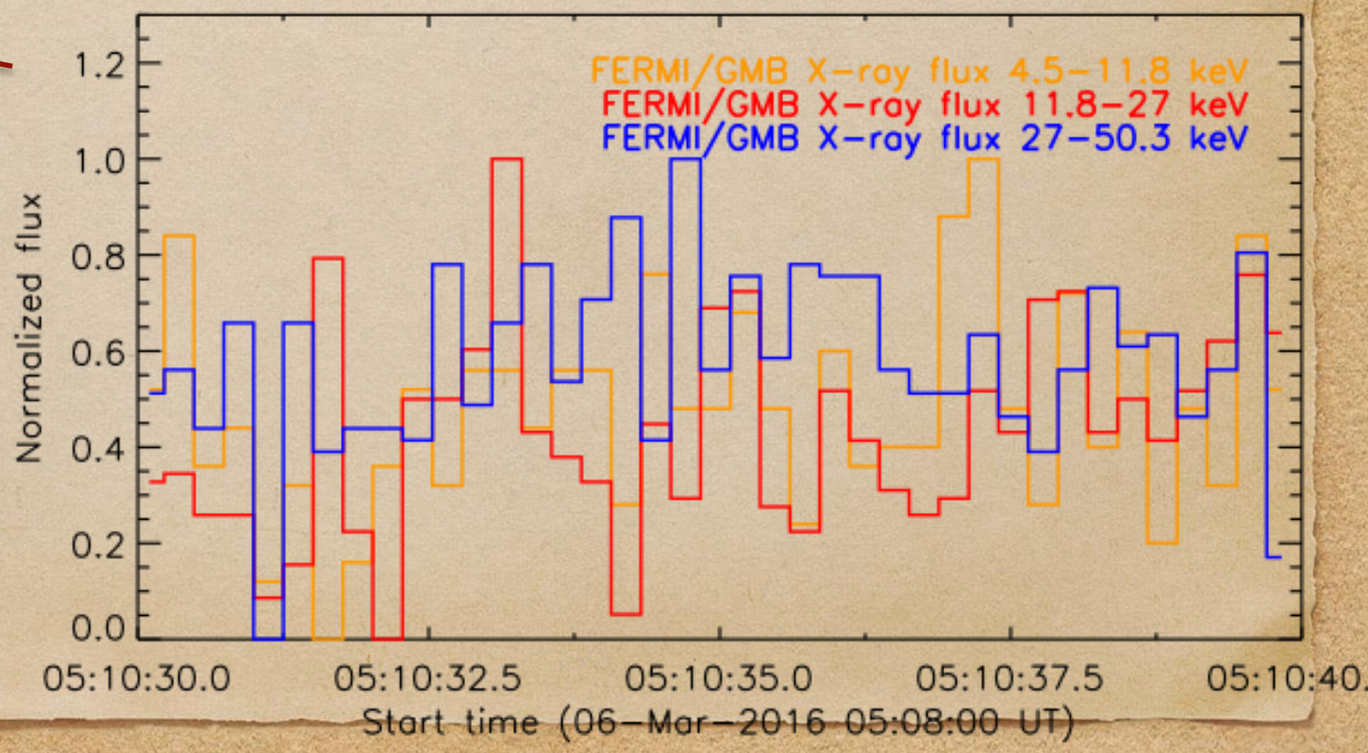




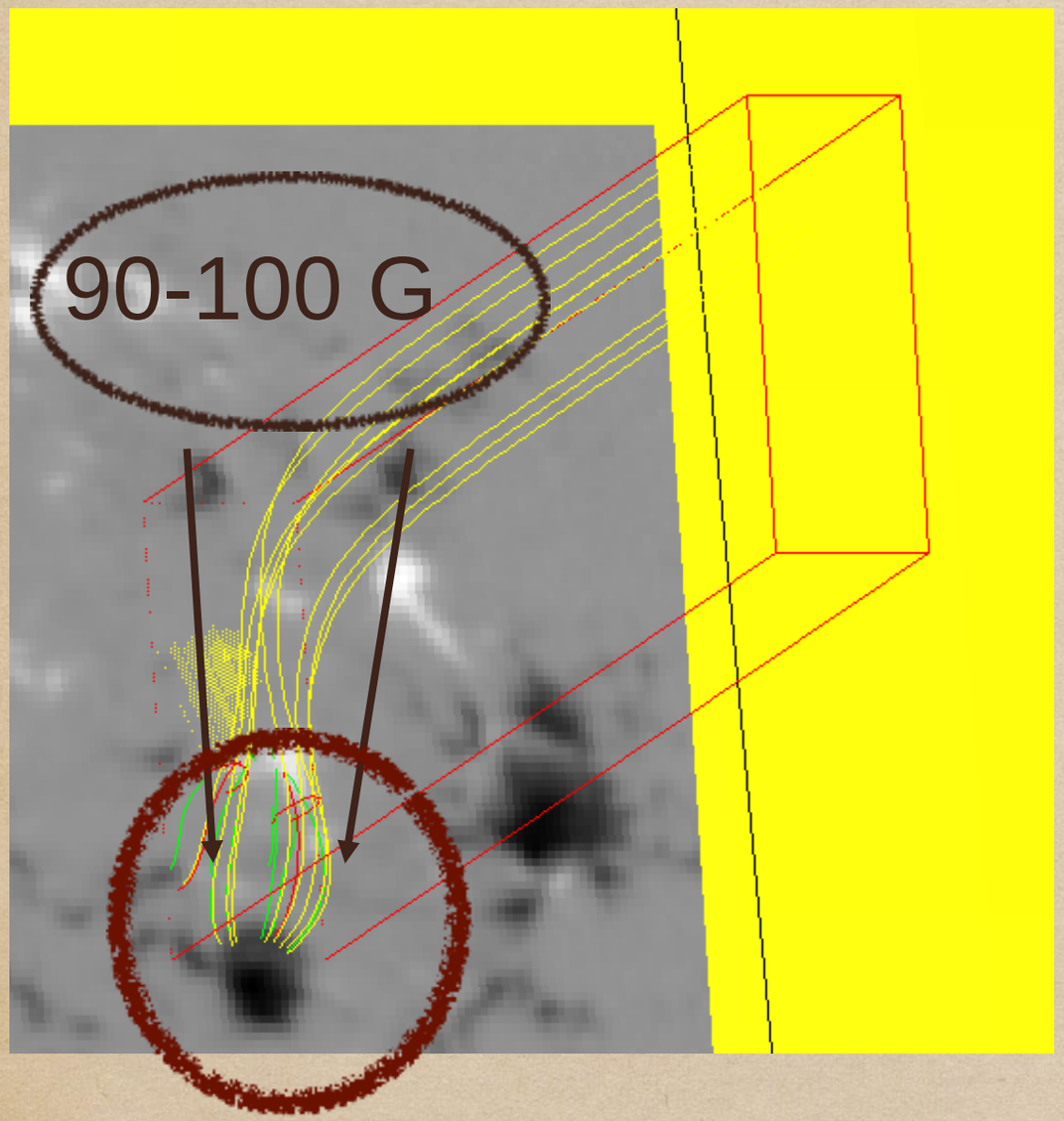
X-ray flux, FERMI/GMB

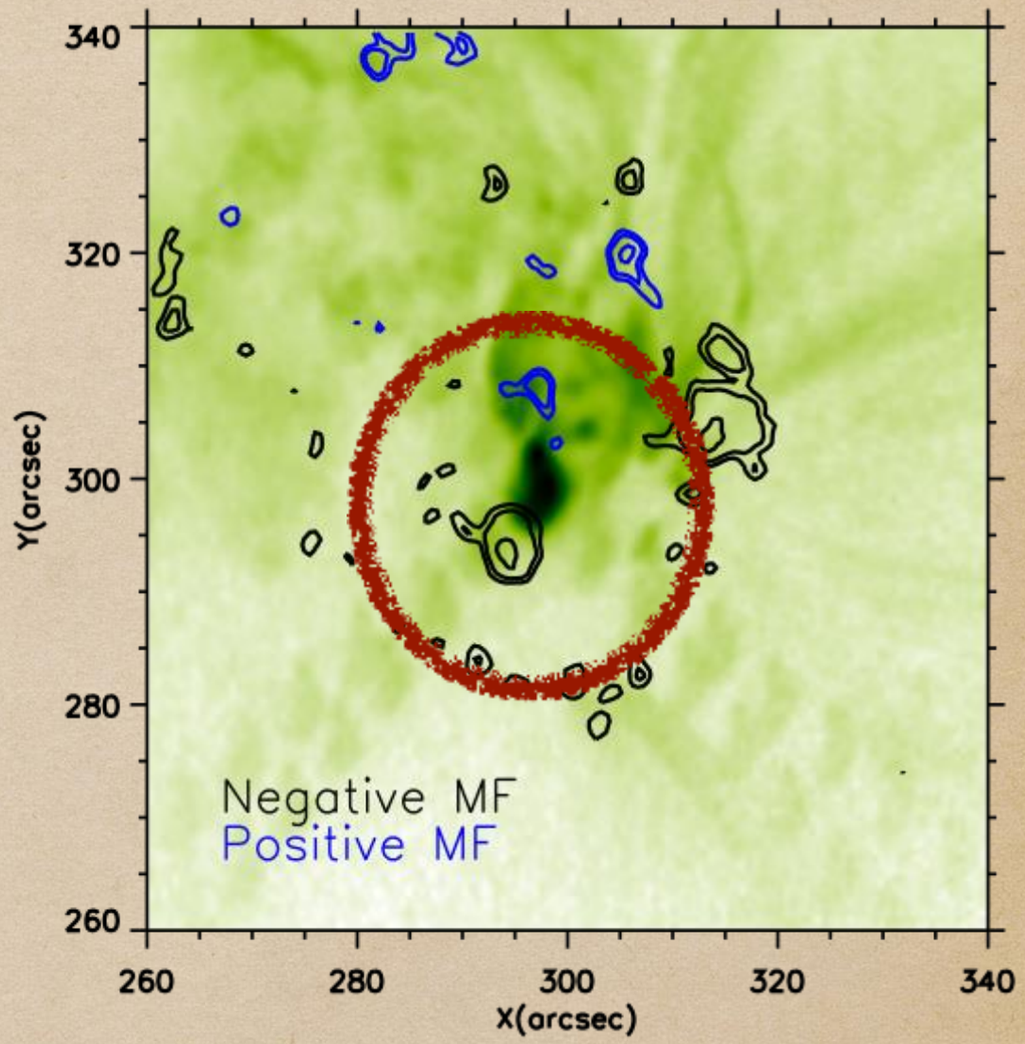
Plasma parameters
(X-ray spectra)
Te=43 MK
EM=1.7 10^{44} cm-3

Plasma emission??



SOL2016-Mar-06T5:12 : magnetic topology

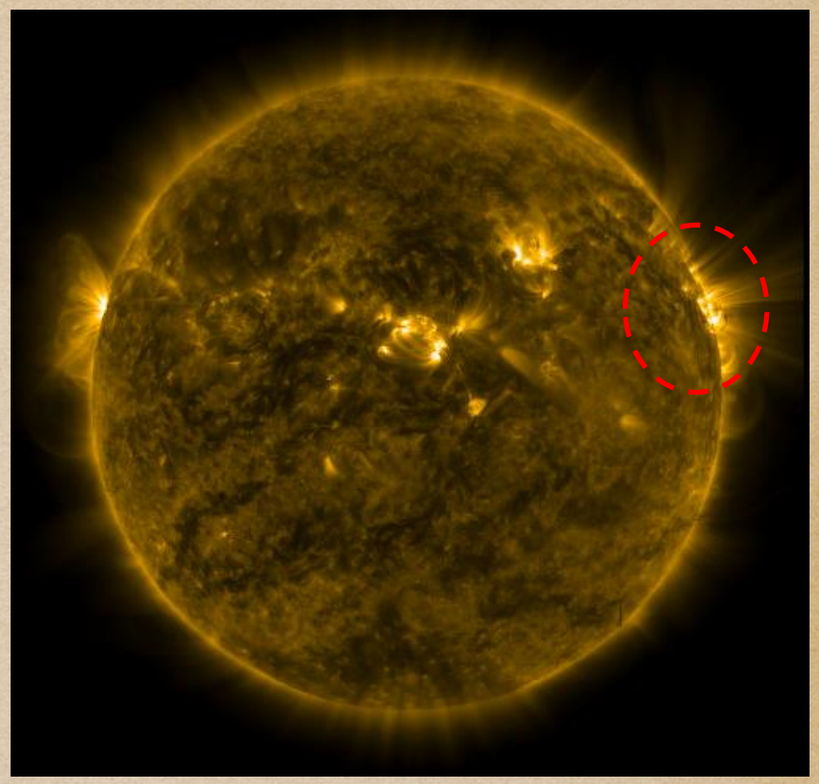




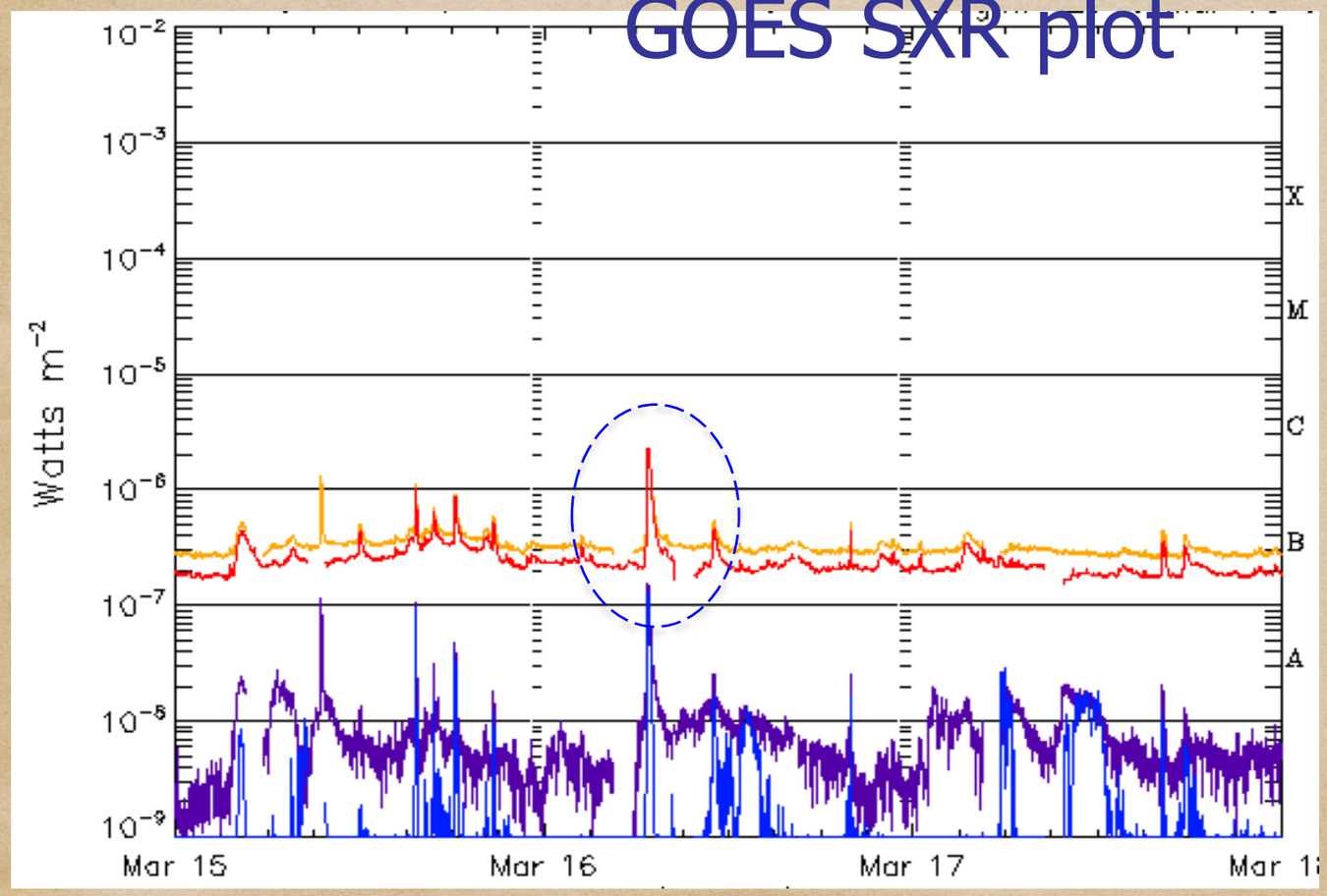
The most probable explanation - plasma mechanism

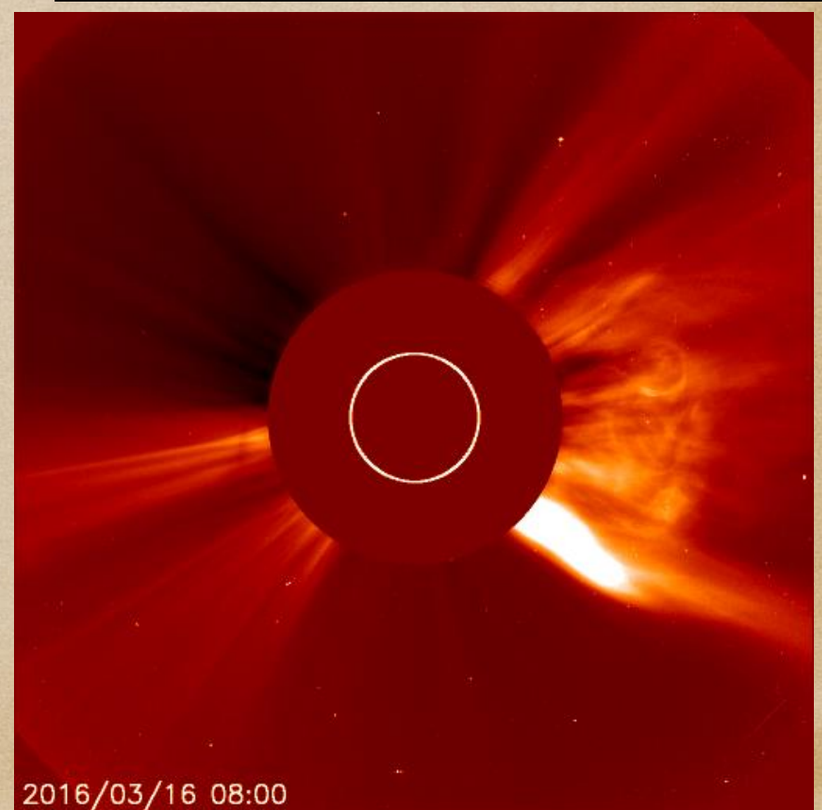
SOL 2016-Mar-16T06:46/ C2.2

- Impulsive C2.2 flare near limb
  - AR 12522, N14W83
    - with CME
- Microwave burst intensity ~15 sfu.

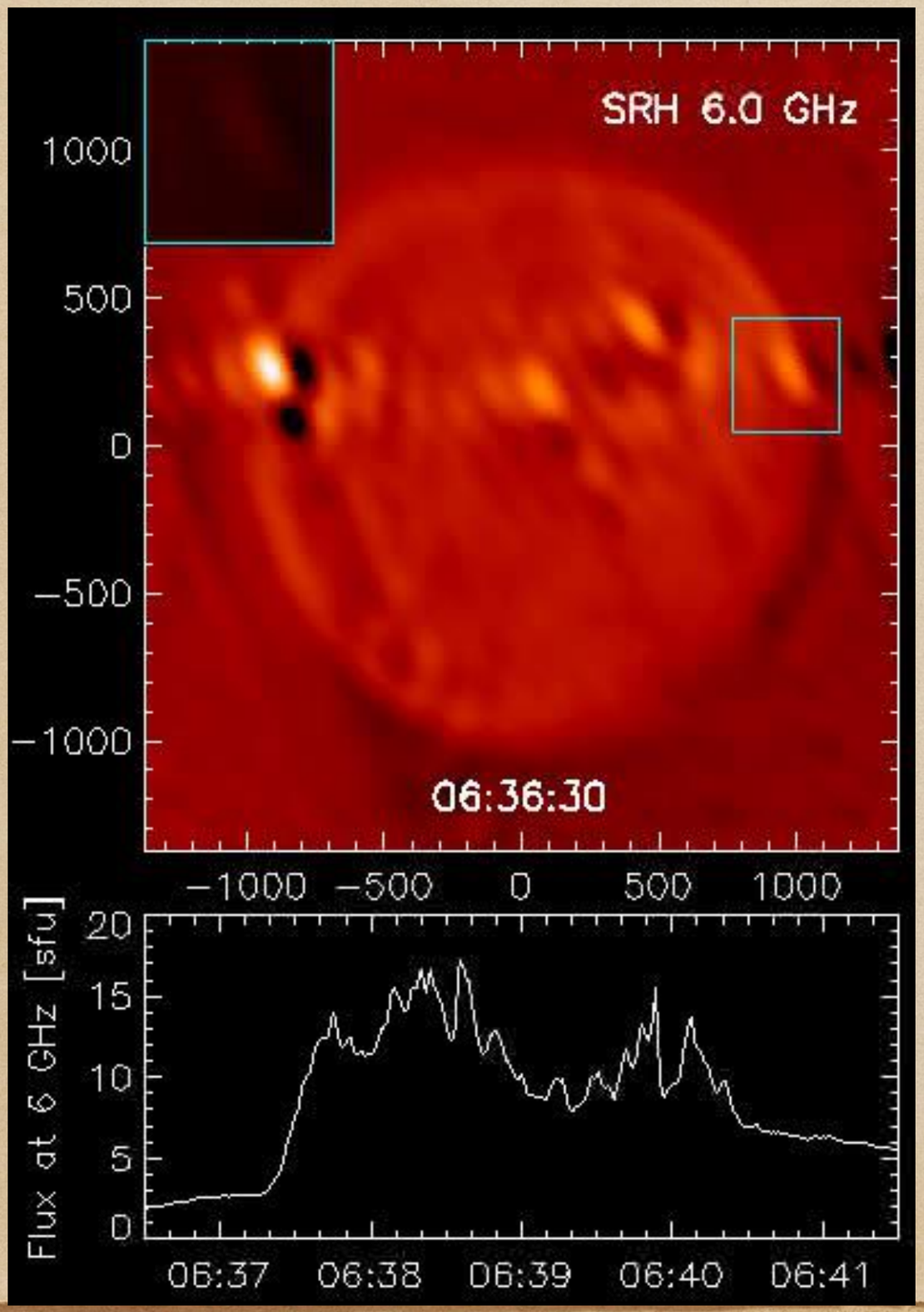


GOES SXR plot

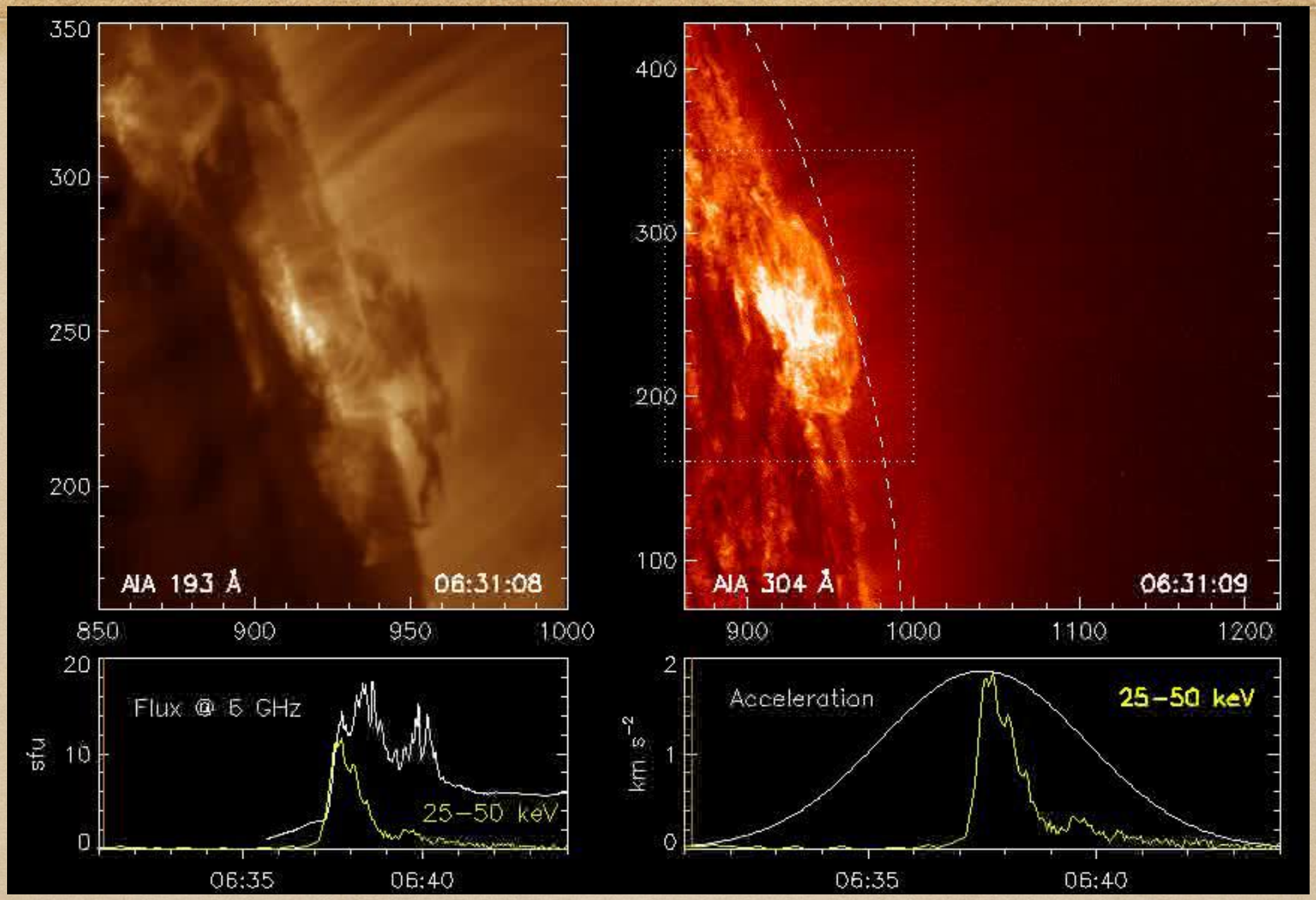




SOL 2016-Mar-16T06:46:
SMRh observations of the impulsive phase

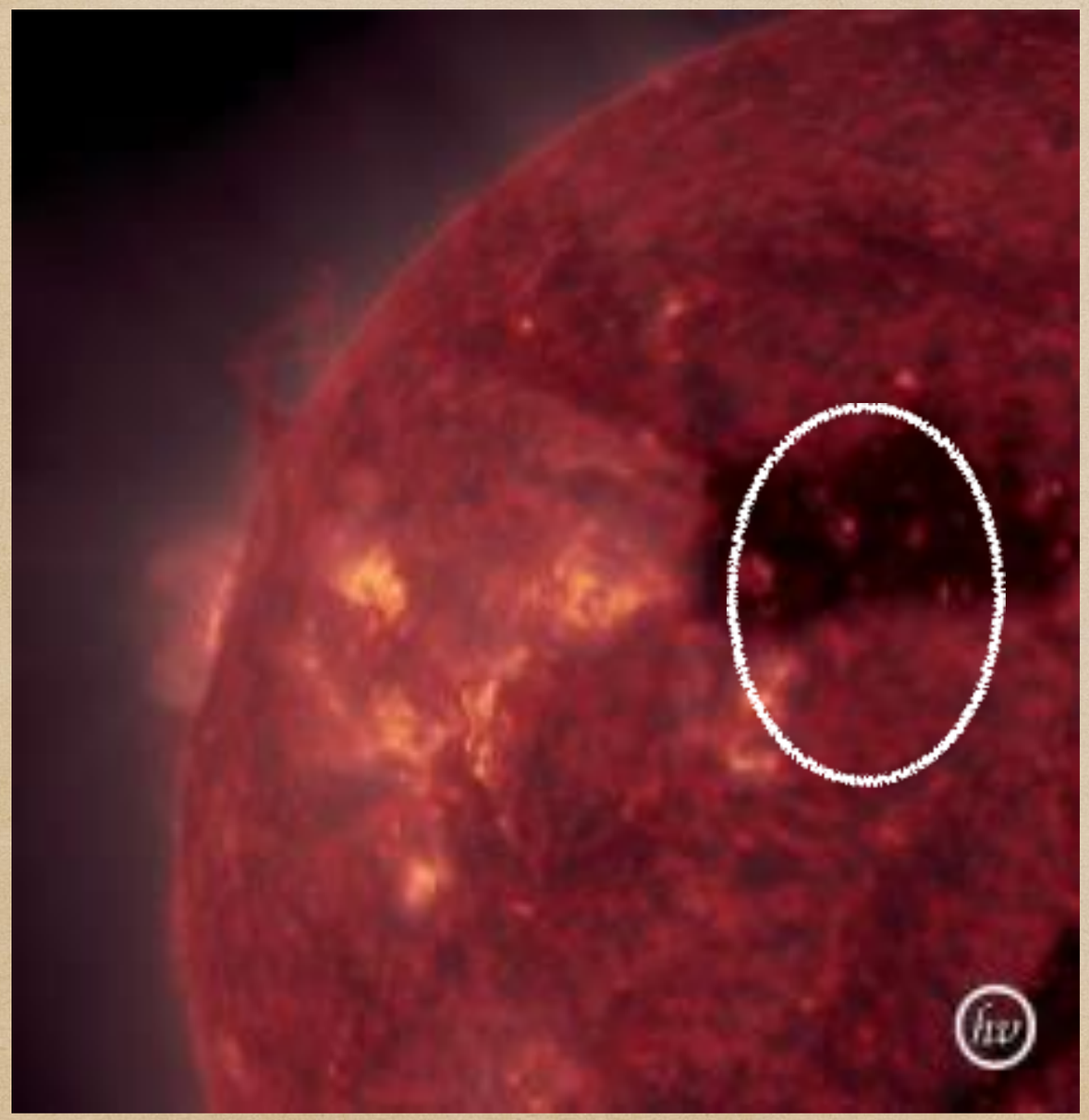


Total flux time profile over framed region



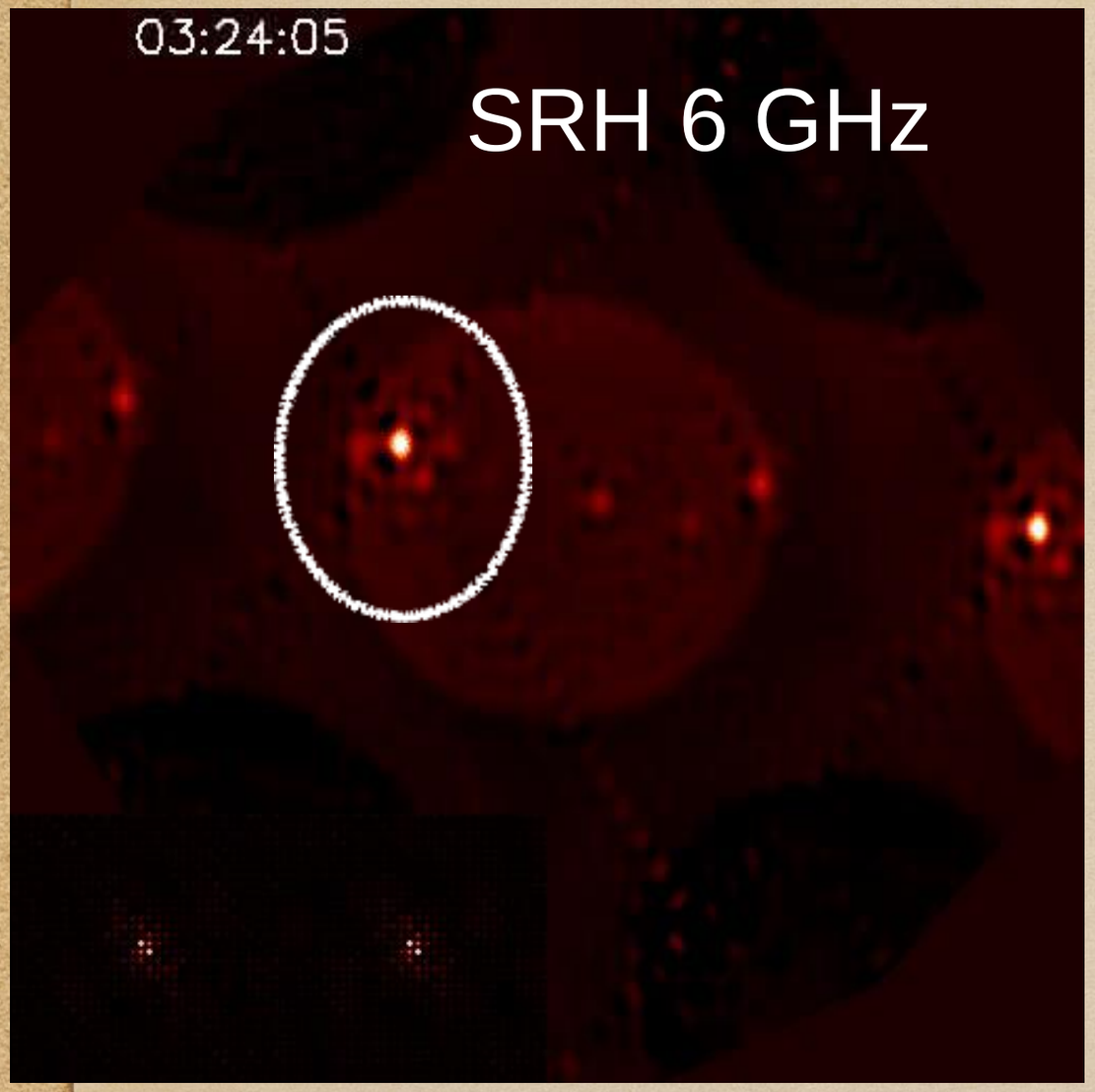
- Eruptive filament actively expanded, twisted, writhed, and brighten
- Hard X-ray and microwave bursts started at acceleration peak.
- Microwave pulsations correspond to intermittent bright patches in E

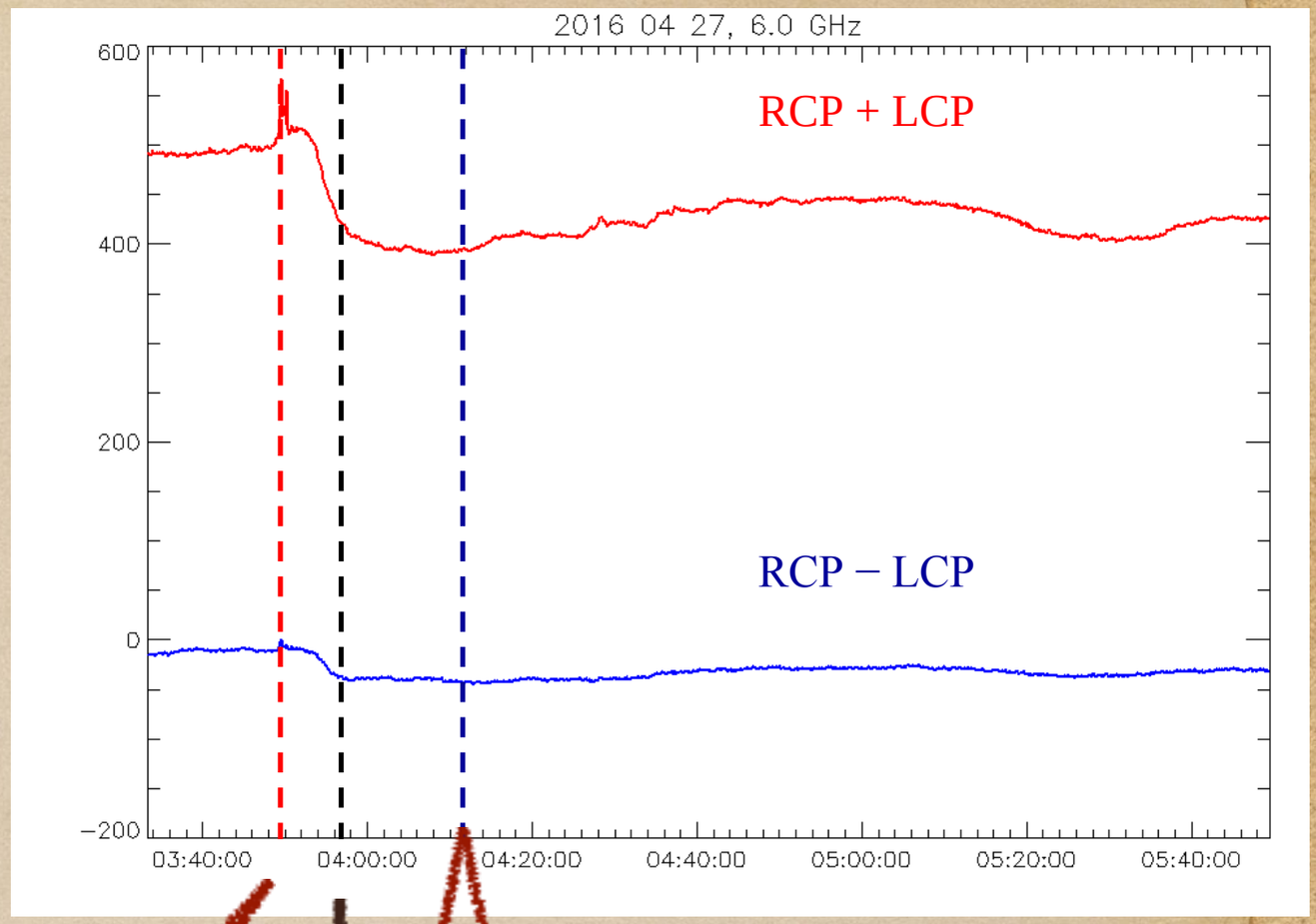
Event 2016-Apr-27
(dimming and B7 flare)



Kuz’menko et al 2009

Event 2016-Apr-27 (dimming and B7 flare)



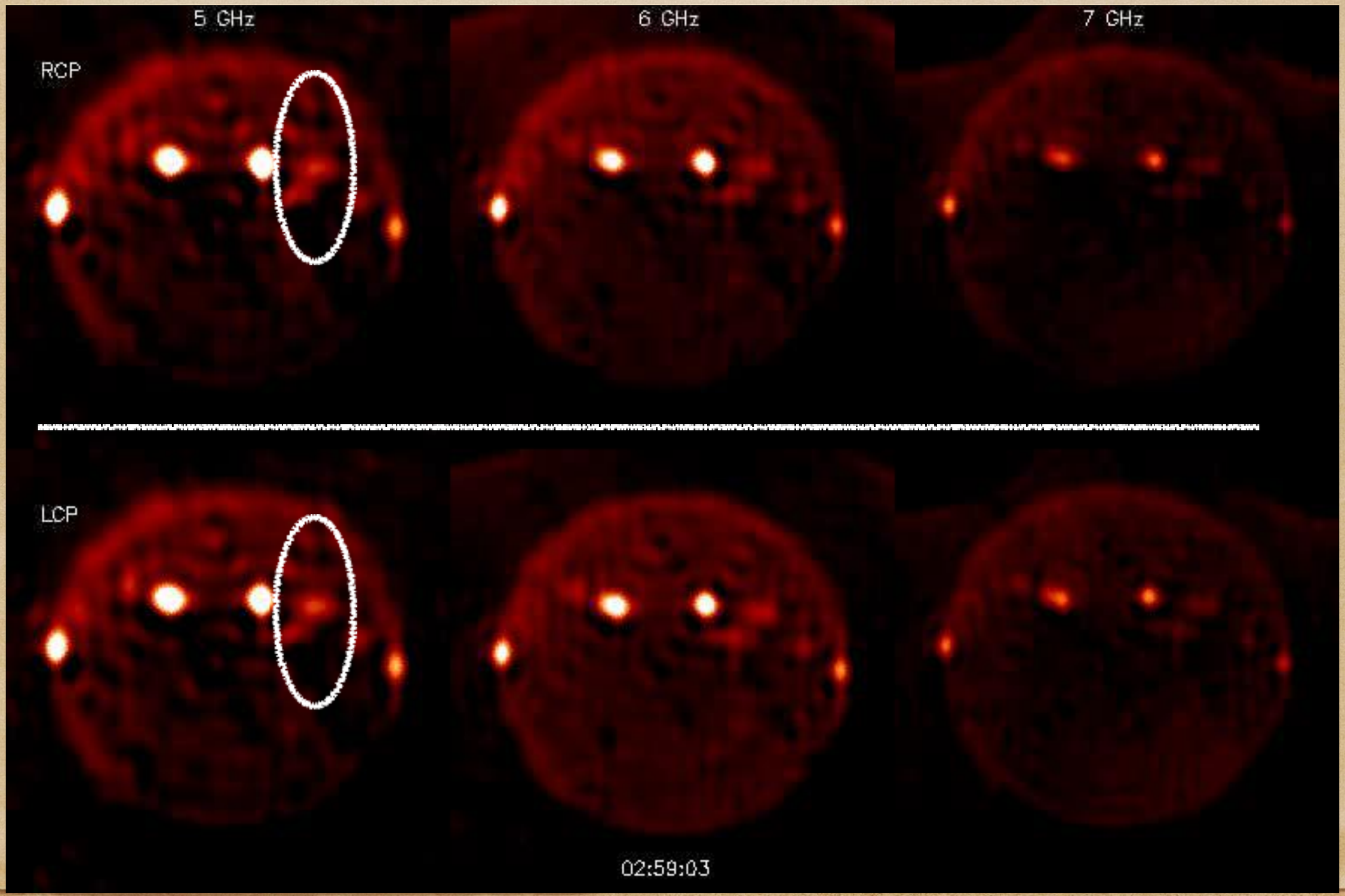


03:50UT: Flare near the sunspot

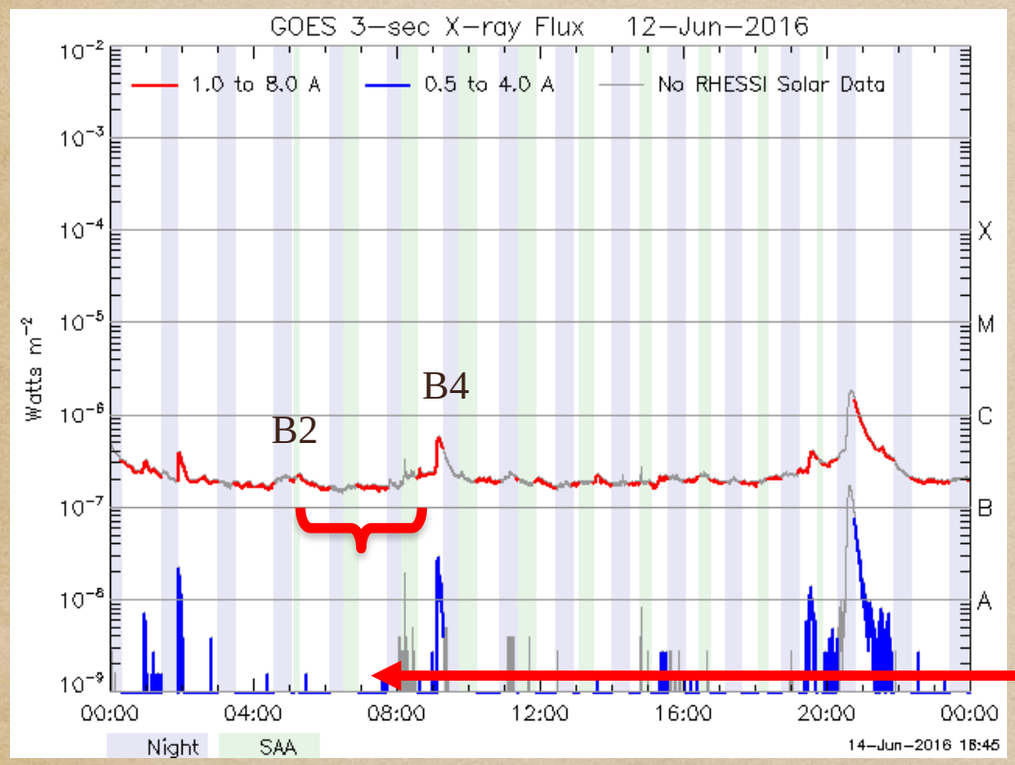
After 04:12:UT
Dimming of 2.5 hour duration.

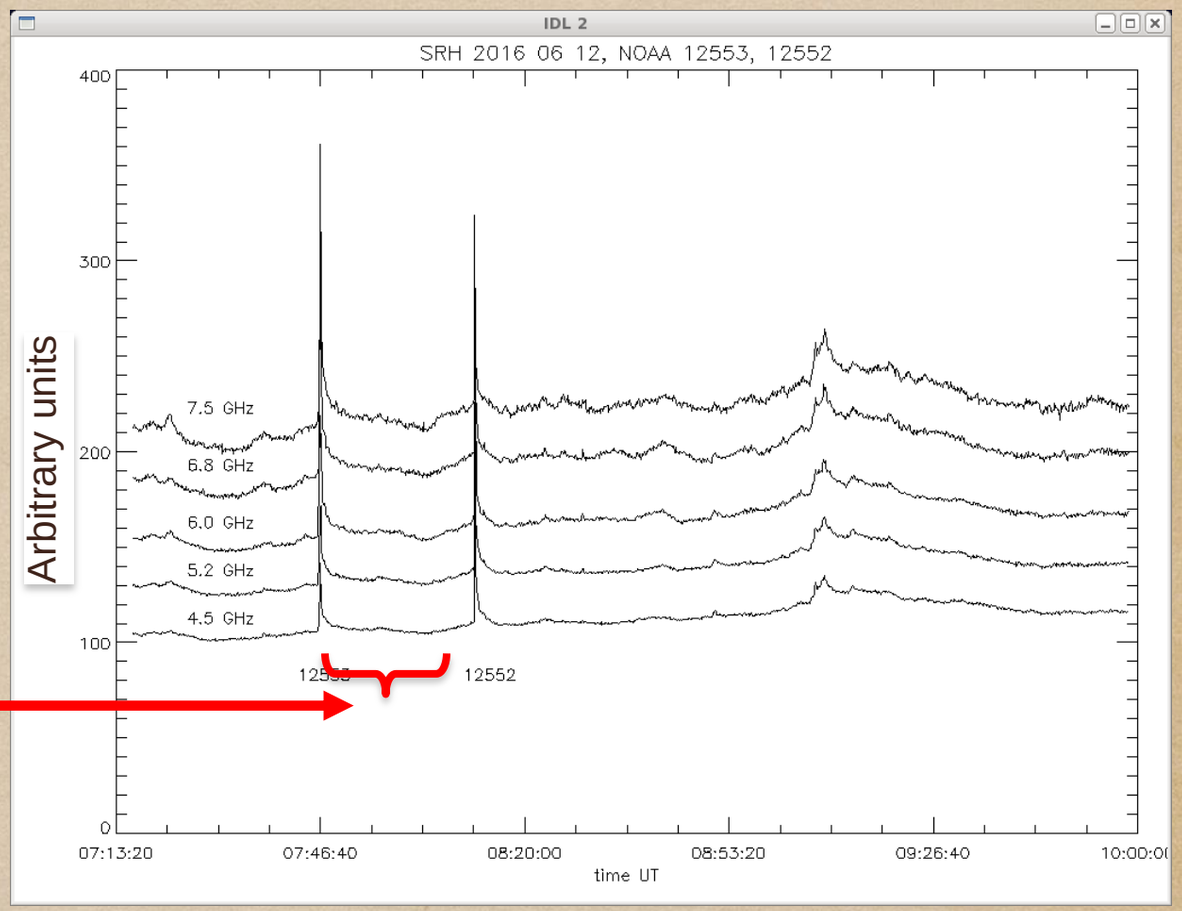
03:58UT: Flare ribbons, jet (211 Å, 304 Å), dimming.

SOL2016-May-02T03:10/B3: SMRh multi waves observations

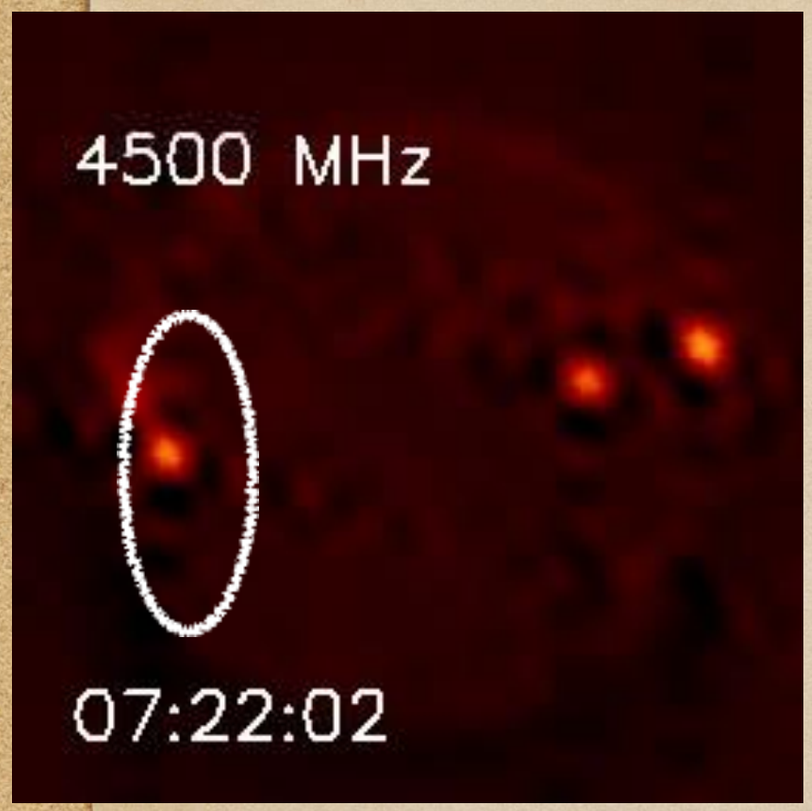


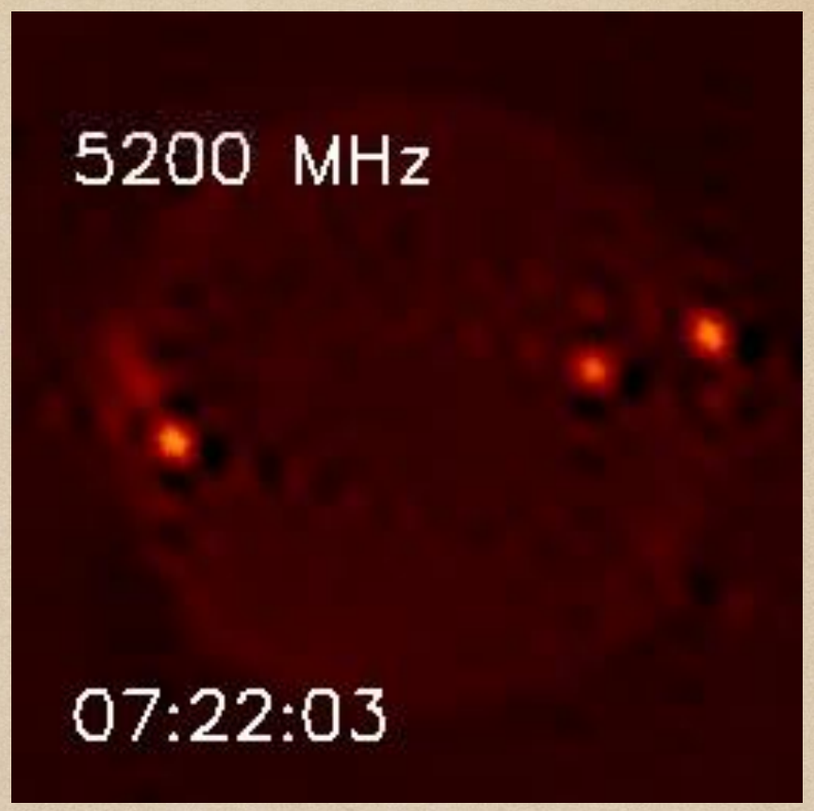
Event 2016-Jun-12 (B2 + B4 flares): GOES and SMRh observations

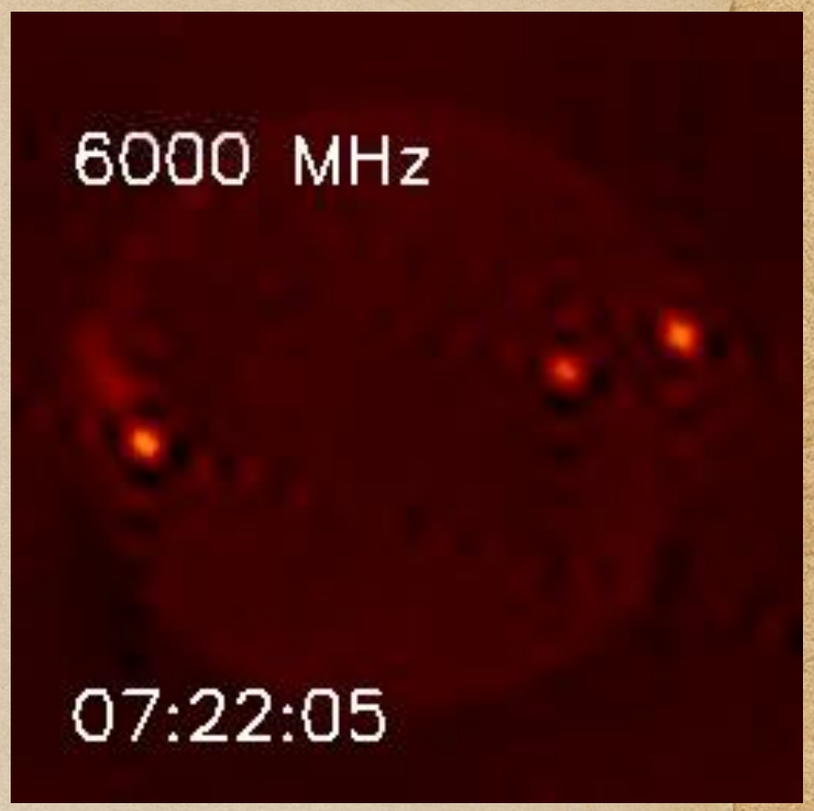


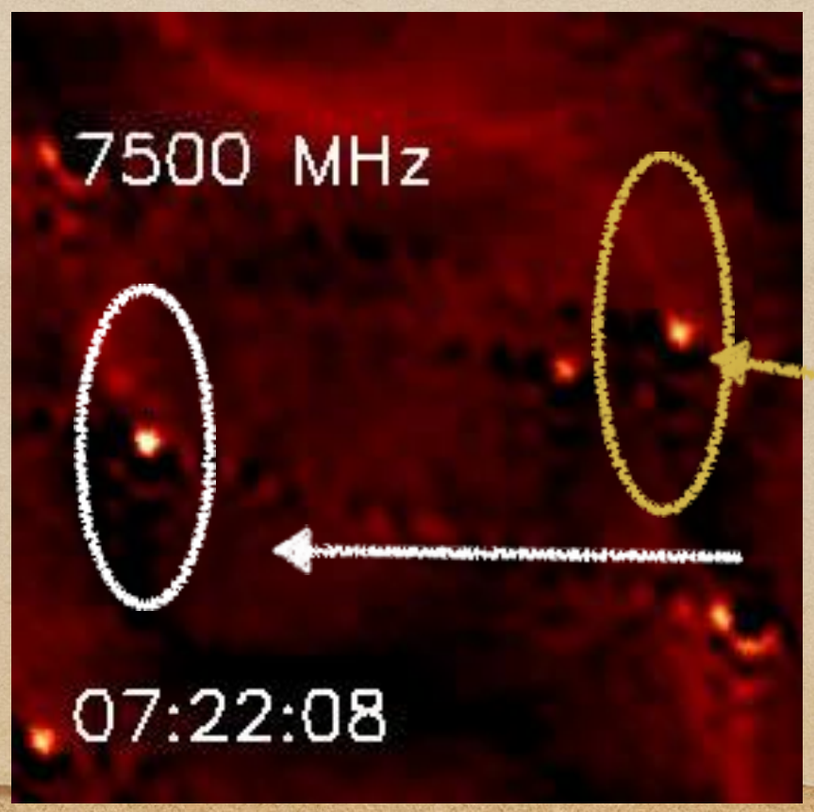


Events 2016-Jun-12 (B2 + B4 flares): MSRh observations





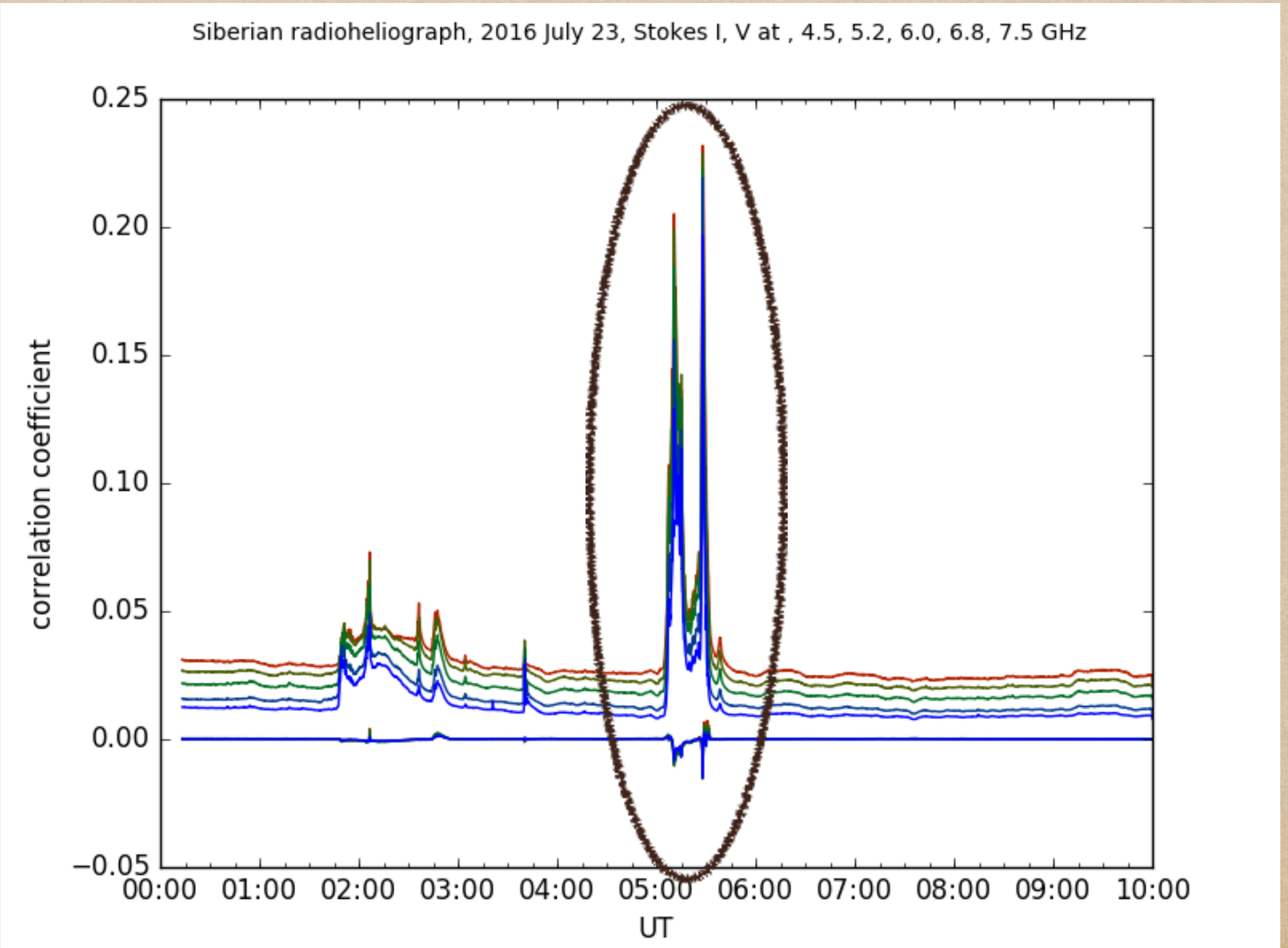




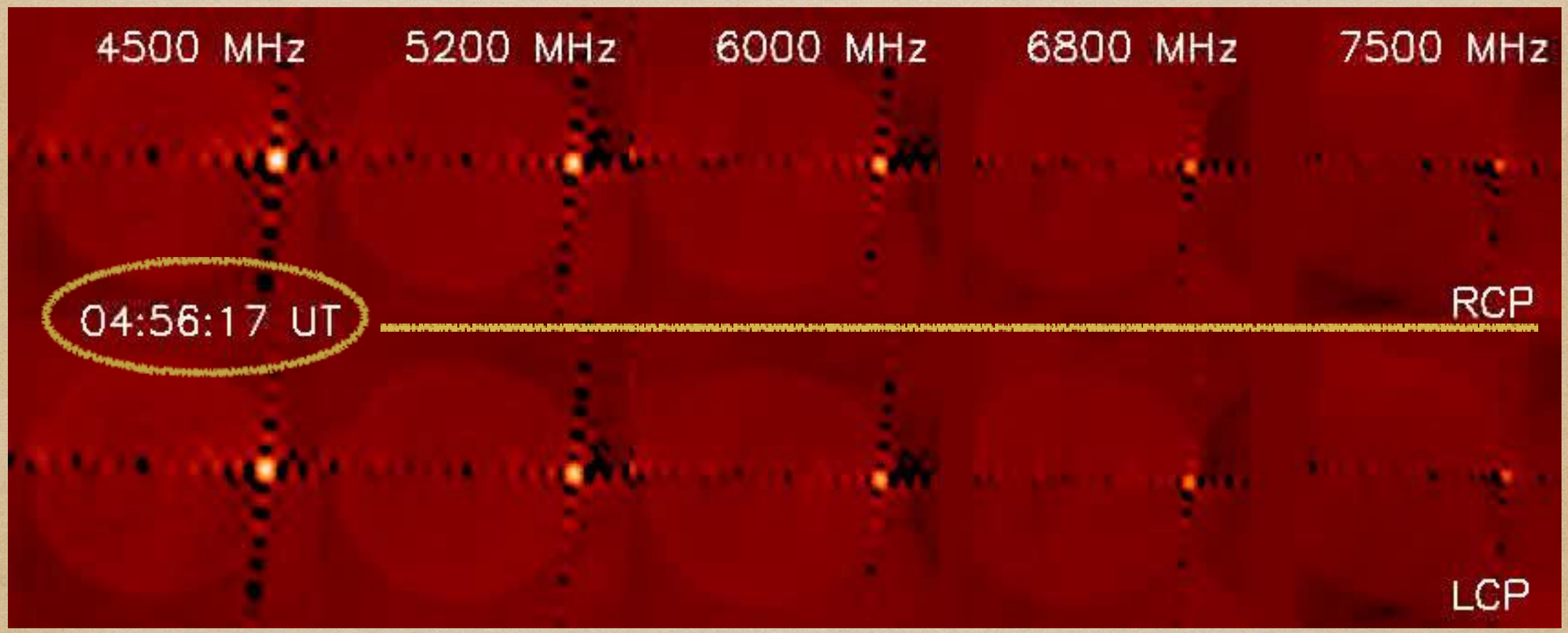
Sol2016-Jun-12T08:12

Sol2016-Jun-12T07:46

Solar flares July 23,2016



Solar flares July 23,2016



Future

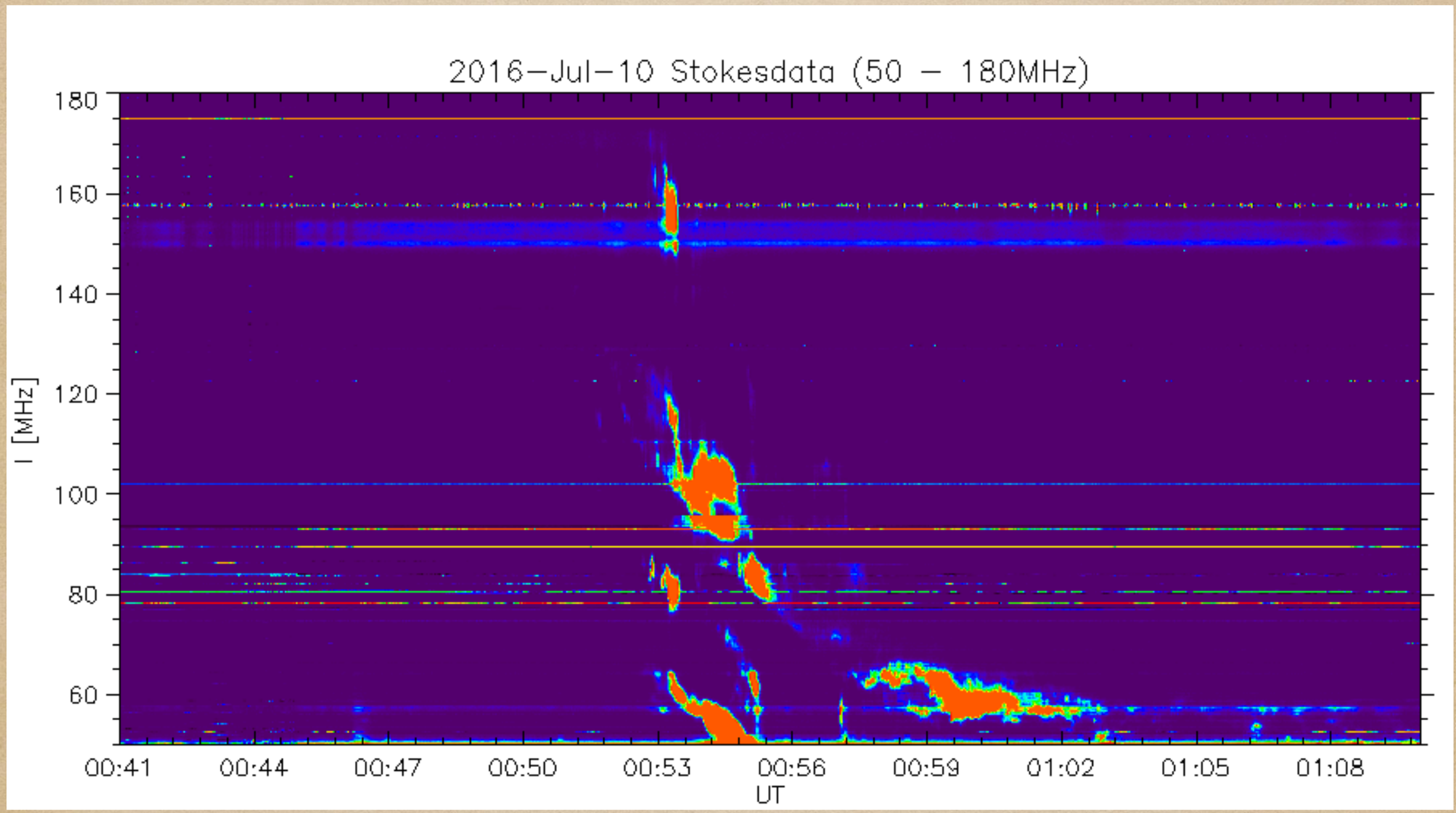
- Extending the array to 96 antennas (exp. 2016) ⇒ improving the angular resolution &improving the sensitivity
- Improving the frequency switching time (exp. 2016) ⇒ faster frequency scanning.

2nd stage (exp. 2019):

- 512 antennas.
- Frequency range: 3 – 24 GHz.

Summary

- The Siberian Multiwave Radioheliograph is carrying out regular multi frequency observations with high temporal (about seconds) resolutions and high sensitivity.
- The several interesting events were observed and now are analyzed.
- Information about observation (correlation plots) can be seen at http://badary.iszf.irk.ru/srhDailyImages.php



Credit of N.Muratova, A Muratov and D.Zhdanov