



INSTITUTE OF SOLAR-TERRESTRIAL PHYSICS
OF SIBERIAN BRANCH OF THE RUSSIAN ACADEMY OF SCIENCES

Study of the Microwave Source Positioning as a Possible Prediction Pattern of Major Solar Flares

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Introduction

- Regularities in the observational data which preceding solar flares is of great practical importance

Uralov A.M., Rudenko G.V., Rudenko I.G. *Publ. Astron. Soc. Japan.* 2006b, vol. 58, p. 21.

Uralov A.M., Grechnev V.V., Rudenko G.V., Rudenko I.G., Nakajima H. *Solar Phys.* 2008, vol. 249, pp. 315–335.

Nobeyama Radioheliograph 17 GHz images

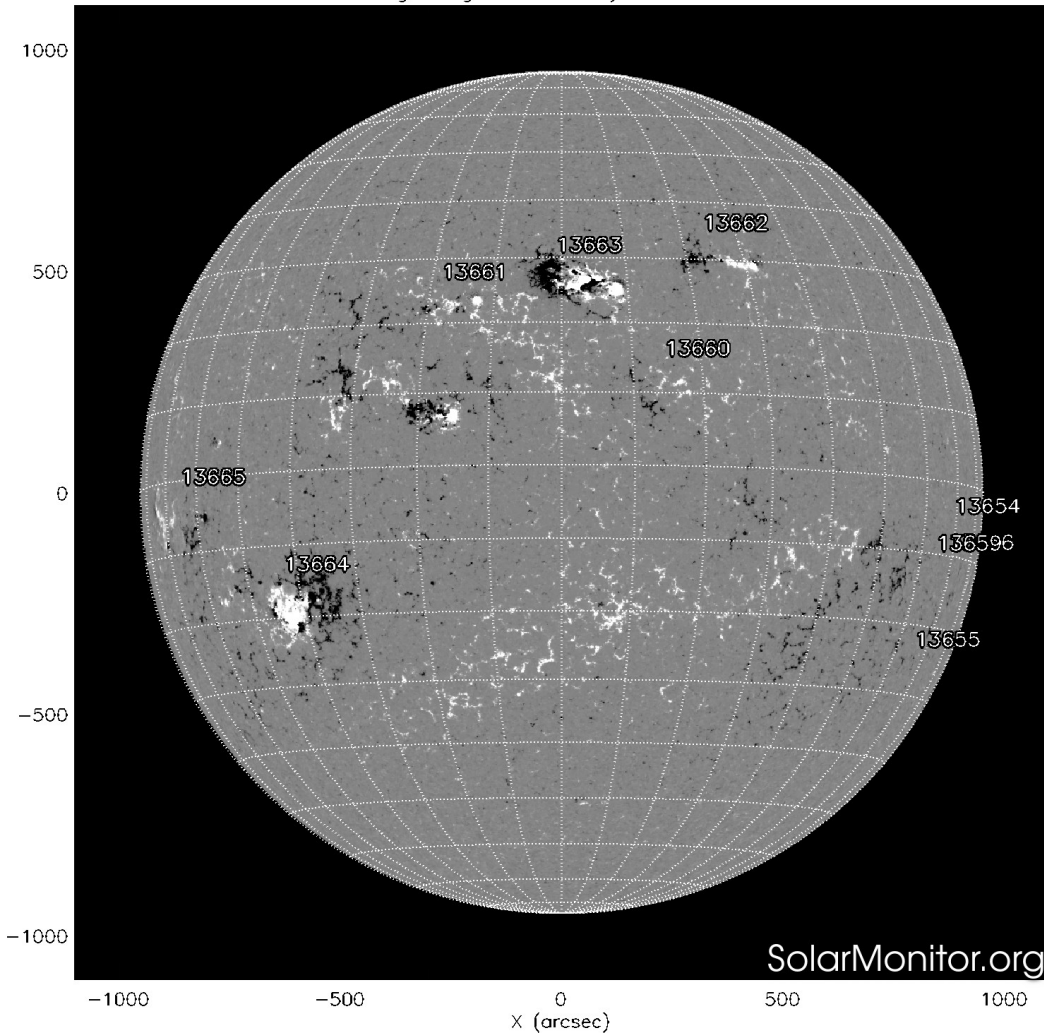
Gyroresonance sources localized on polarity inversion line of magnetic field precede powerful X-class flares

- Search for similar effect using data provided by Siberian Radioheliograph 3 – 24 GHz



Active Region 13663

SDO HMI Magnetogram 3-May-2024 21:58:42.100



5 X-class flares

35 M-class flares www.spaceweatherlive.com

X1.7 May 3, 2:11 UT

X1.3 May 5, 5:47 UT

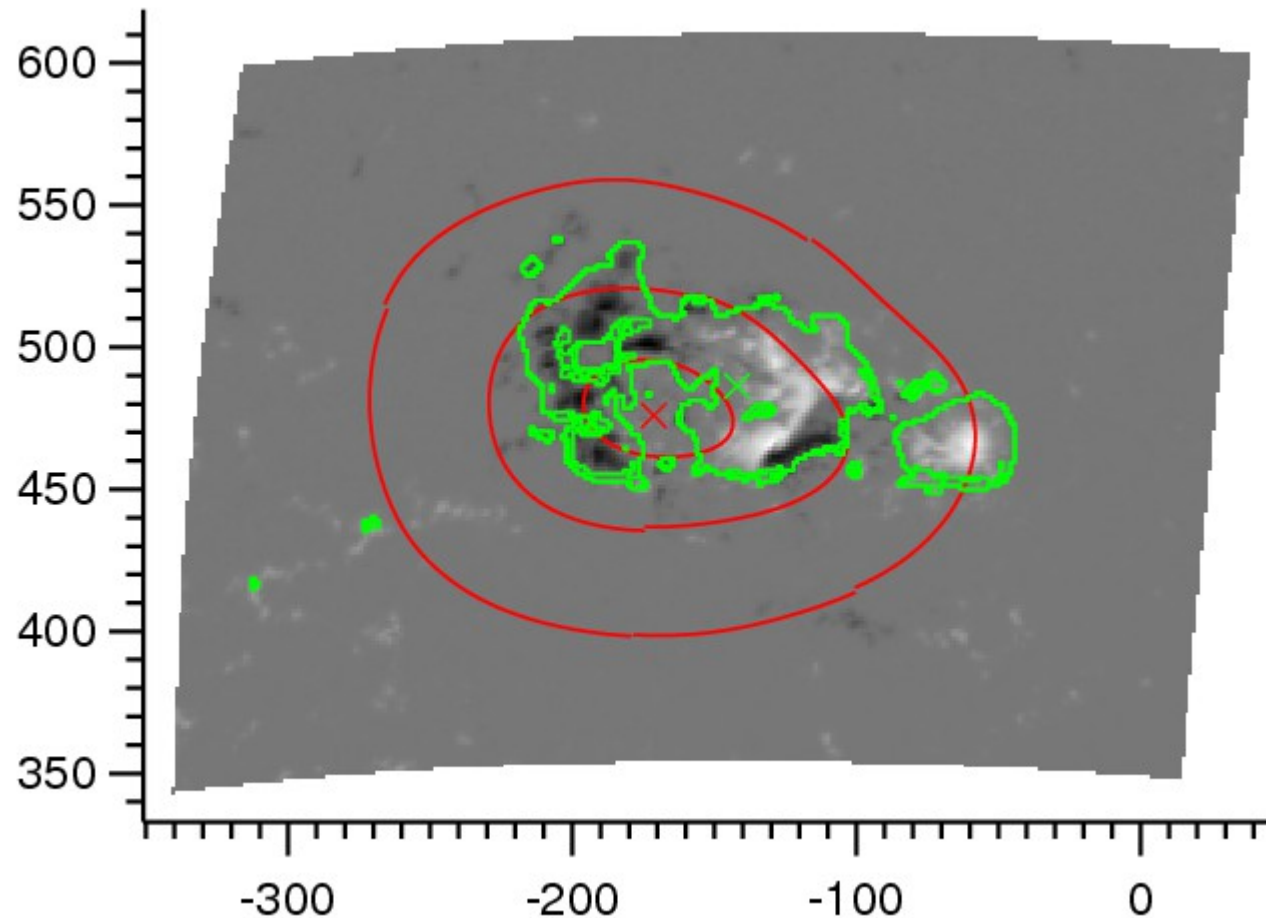
X4.5 May 6, 5:38 UT

[0:00 – 10:00] UT

Siberian Radioheliograph time range of
observations



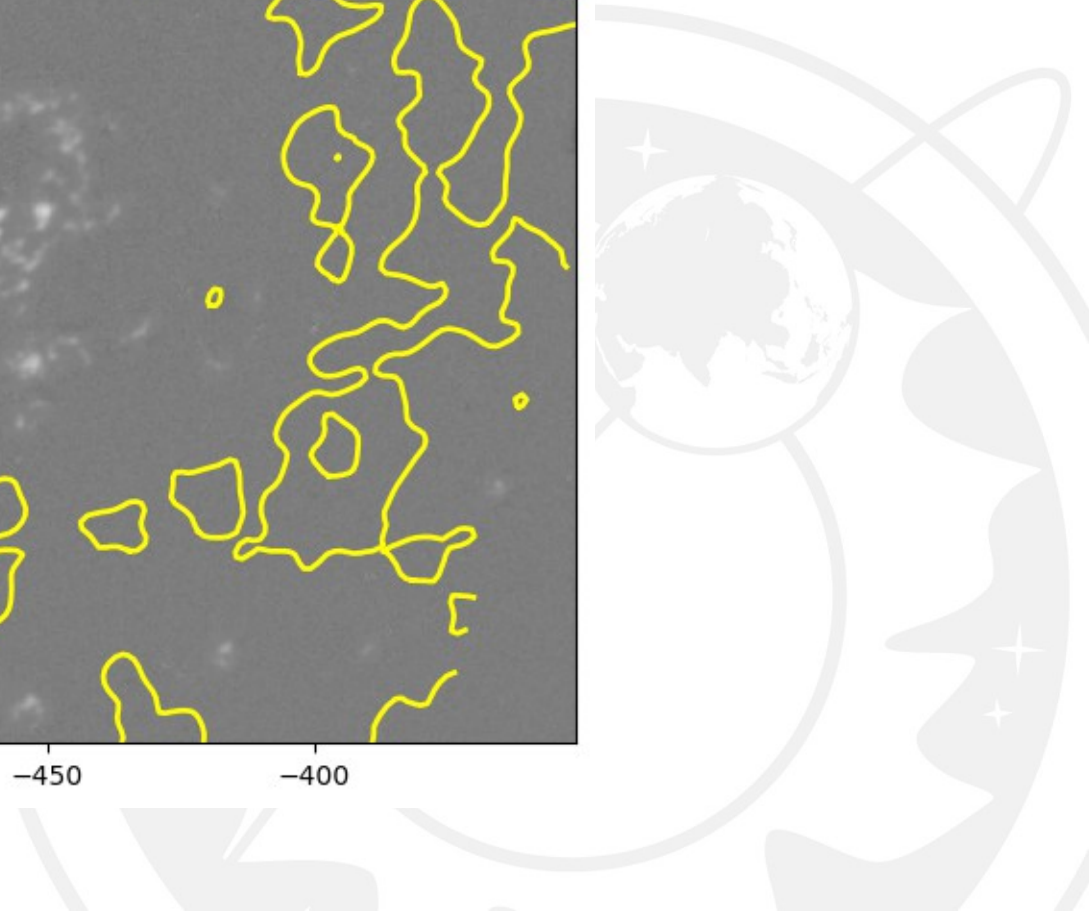
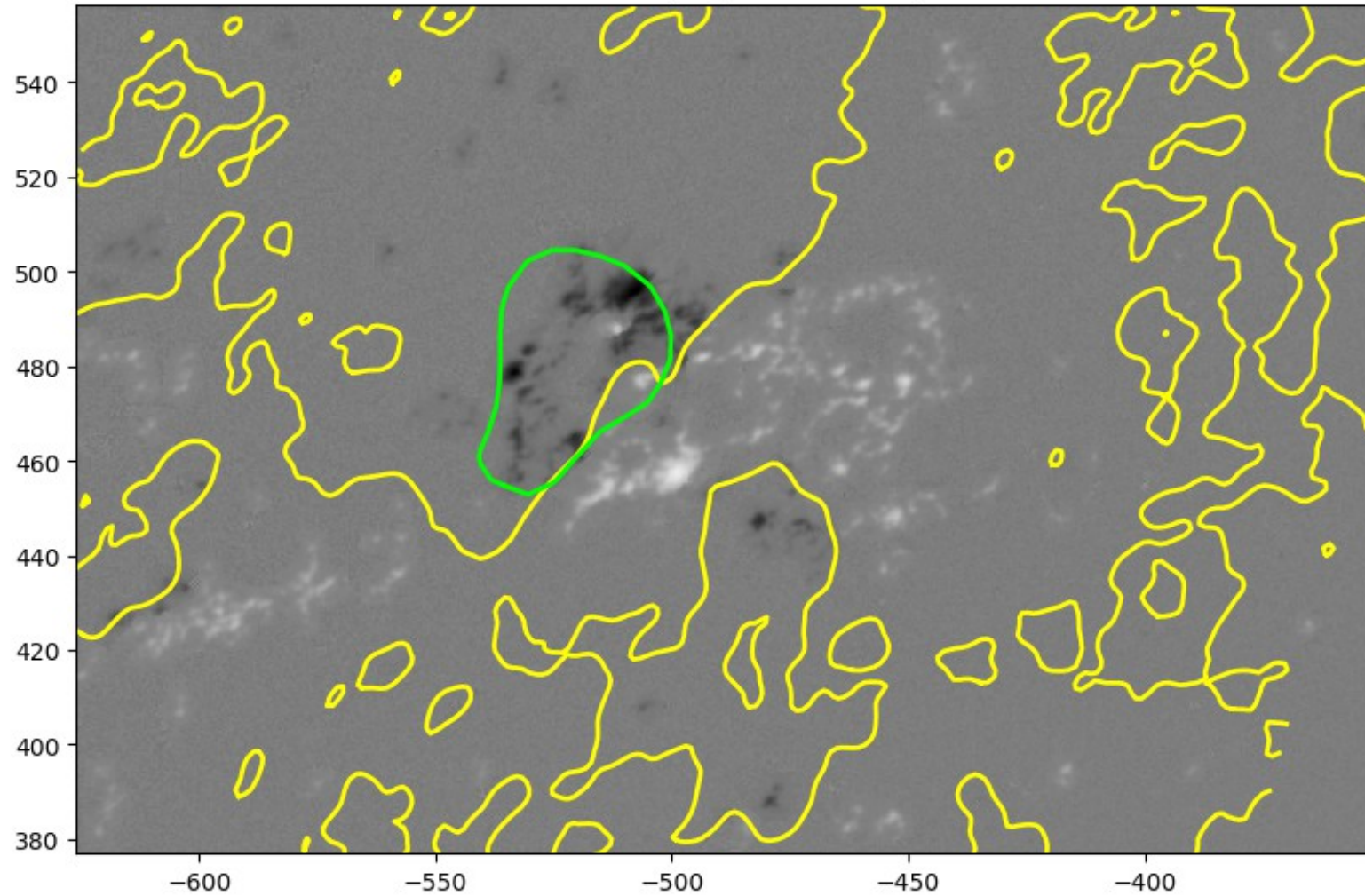
Methods and Data



- Images by Siberian Radioheliograph
[3 – 24] GHz frequency range
12 GHz ~ 1400 G
16 GHz ~ 1900 G *3rd harmonic*
- Magnetic field reconstructed in a potential-field approximation using vector magnetograms provided by SDO/HMI
- SRH images are aligned to model image of radiobrightness at 3GHz

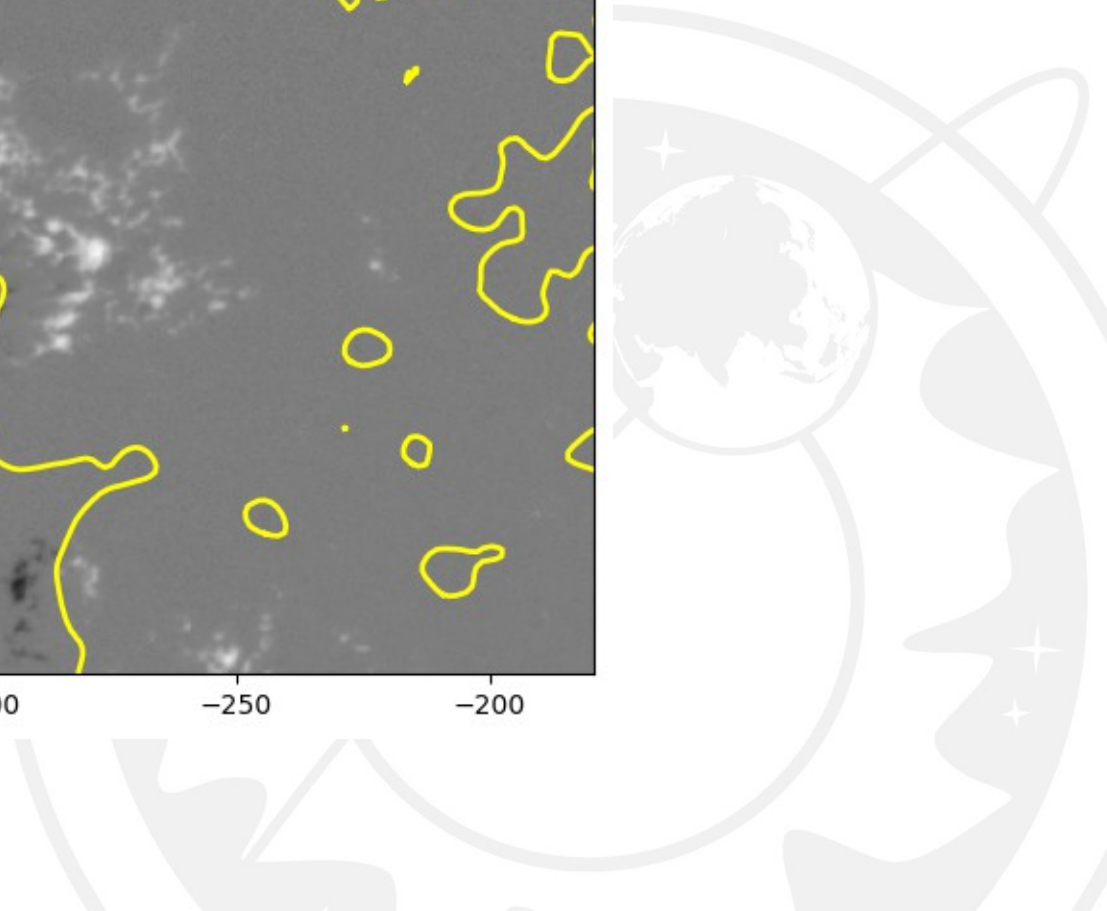
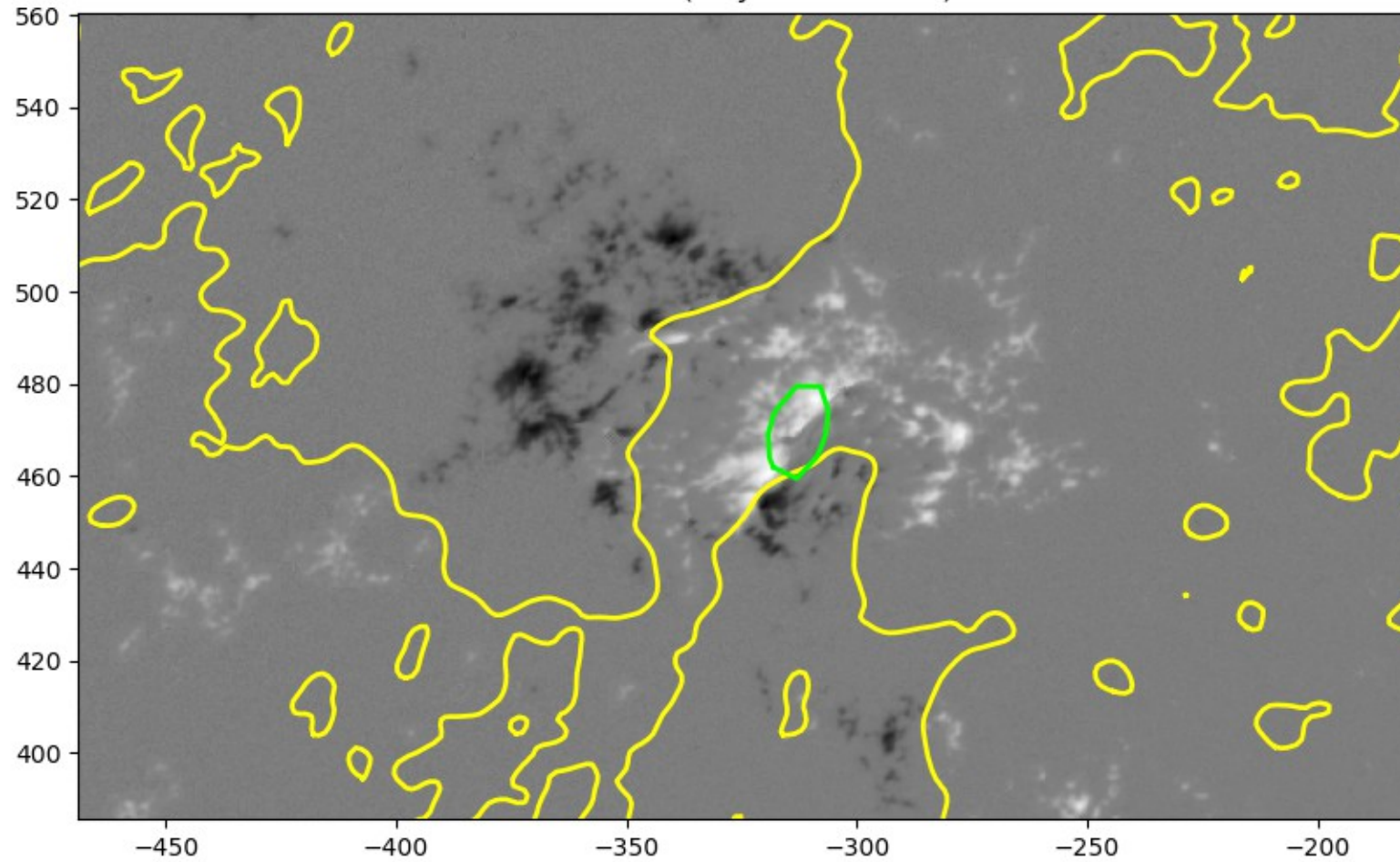


SDO/HMI, May 01, 02:00 UT
~2d X1.7 (May 03 02:11 UT)



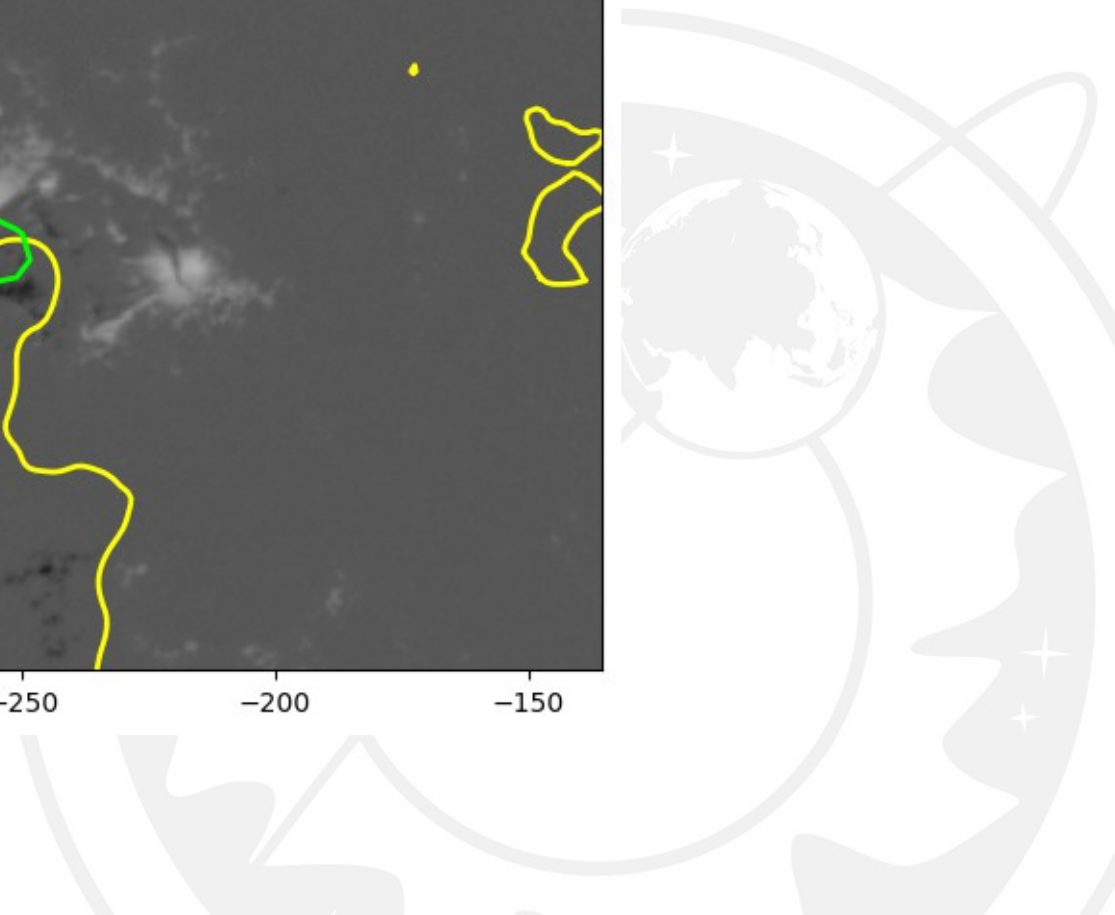
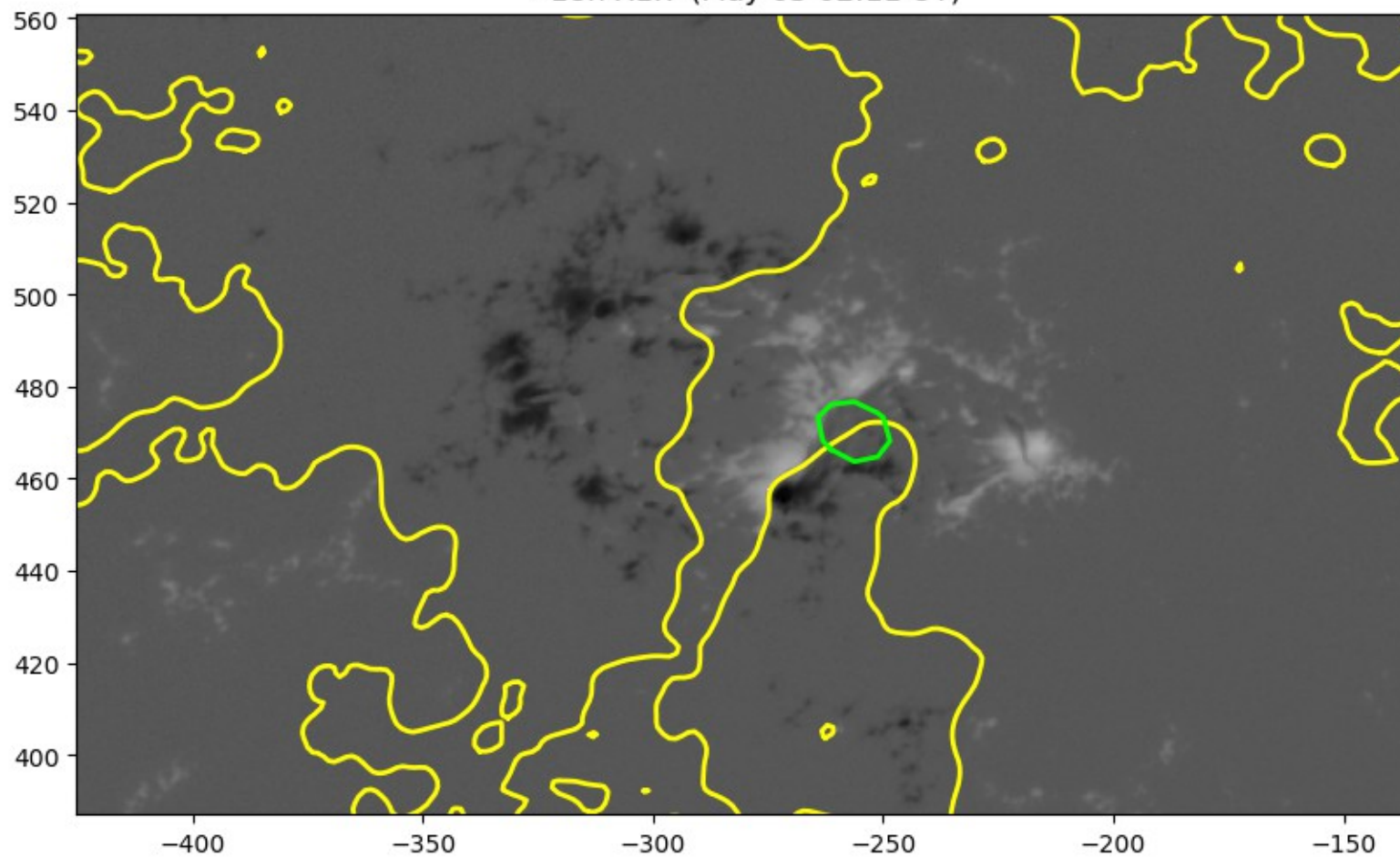


SDO/HMI, May 02, 02:00 UT
~1d X1.7 (May 03 02:11 UT)



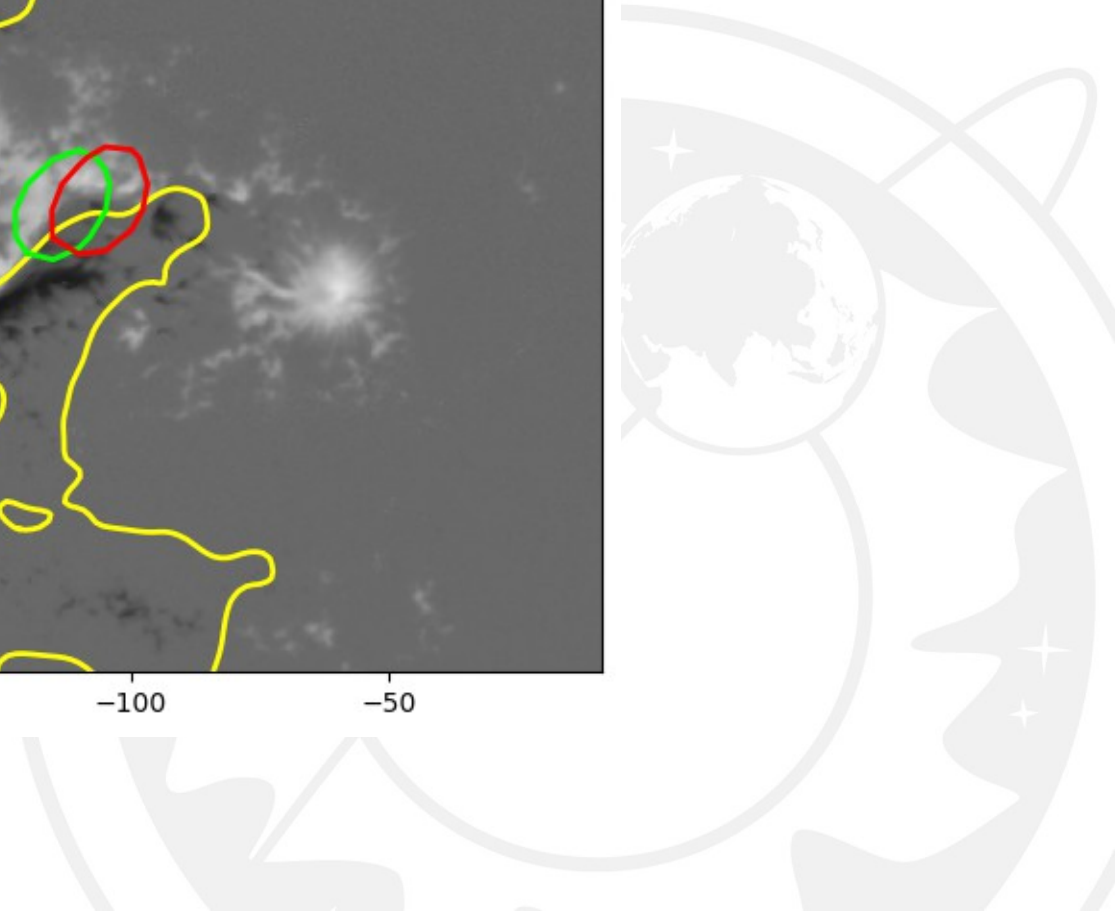
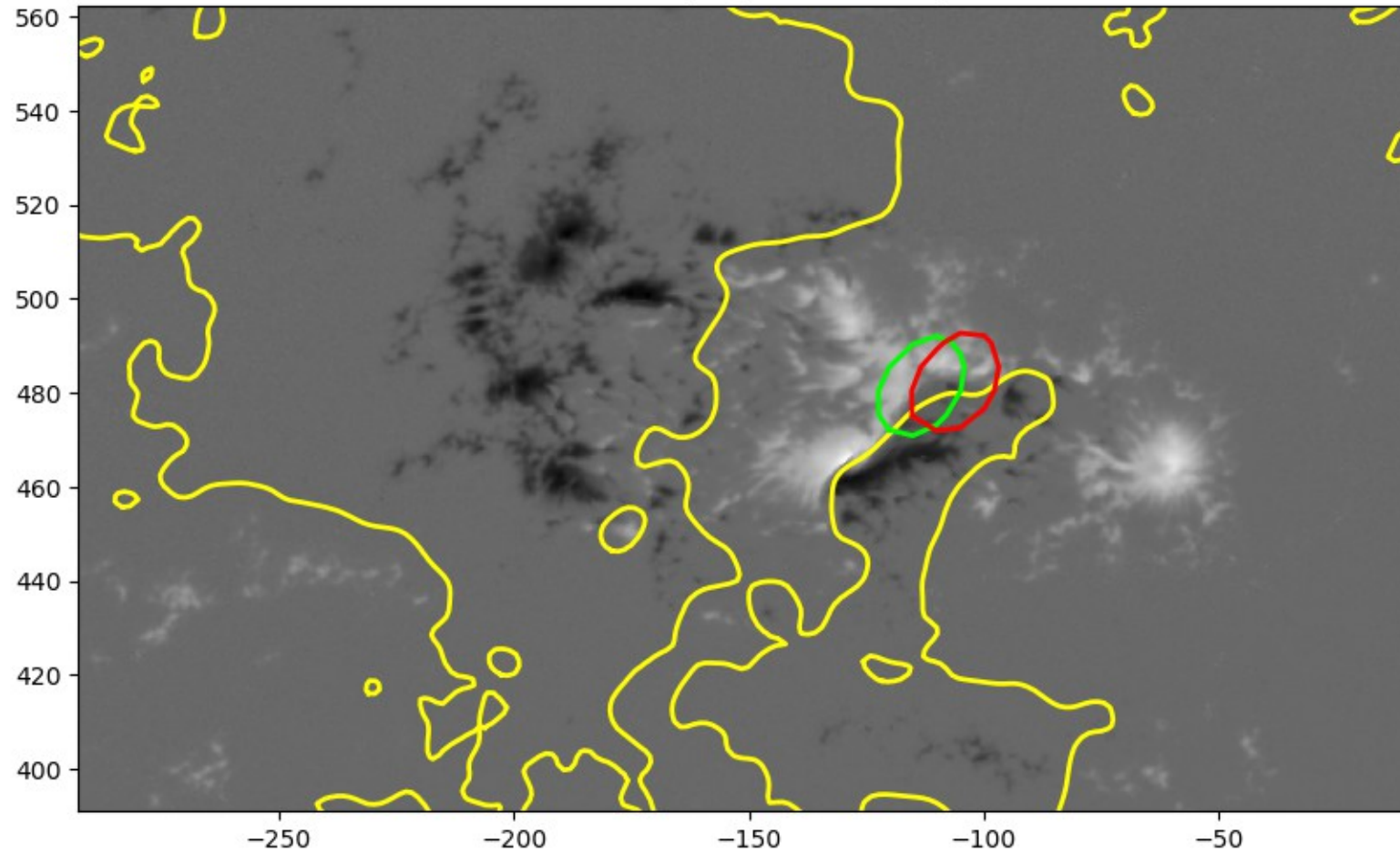


SDO/HMI, May 02, 08:00 UT
~18h X1.7 (May 03 02:11 UT)



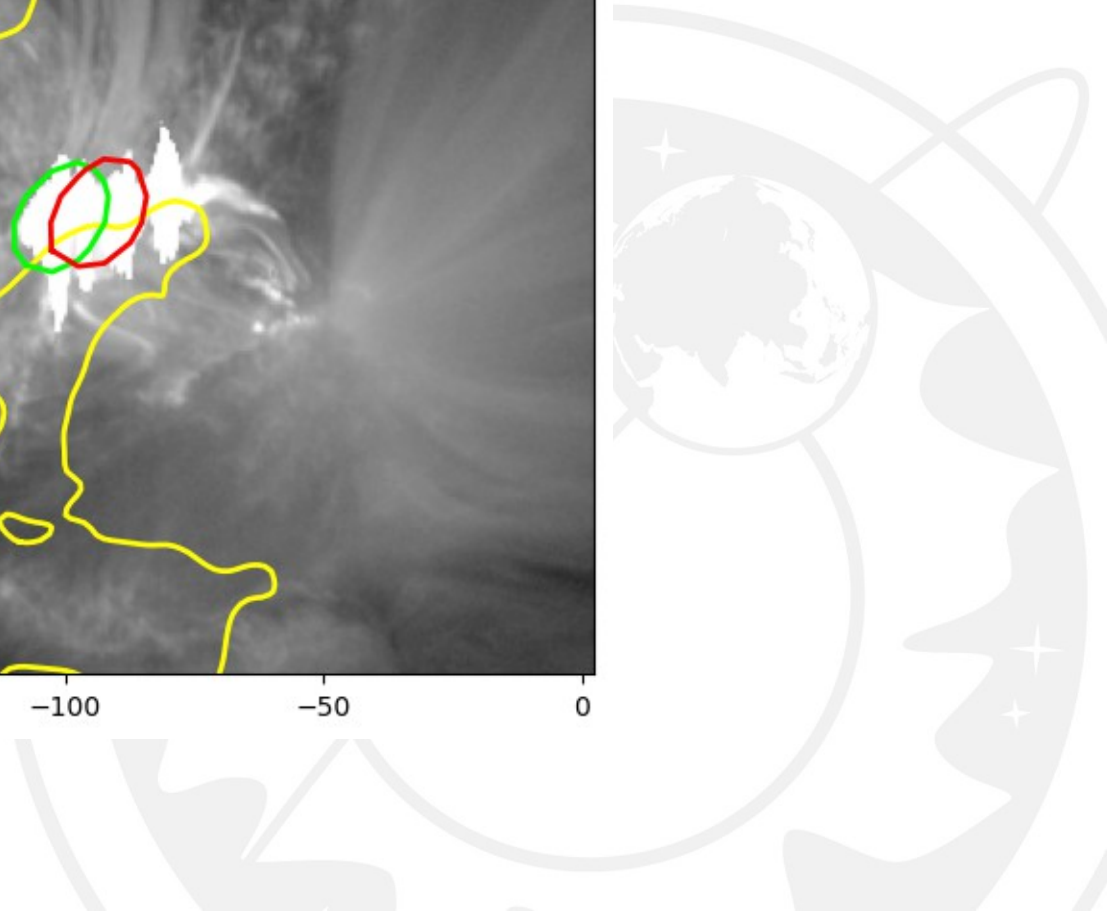
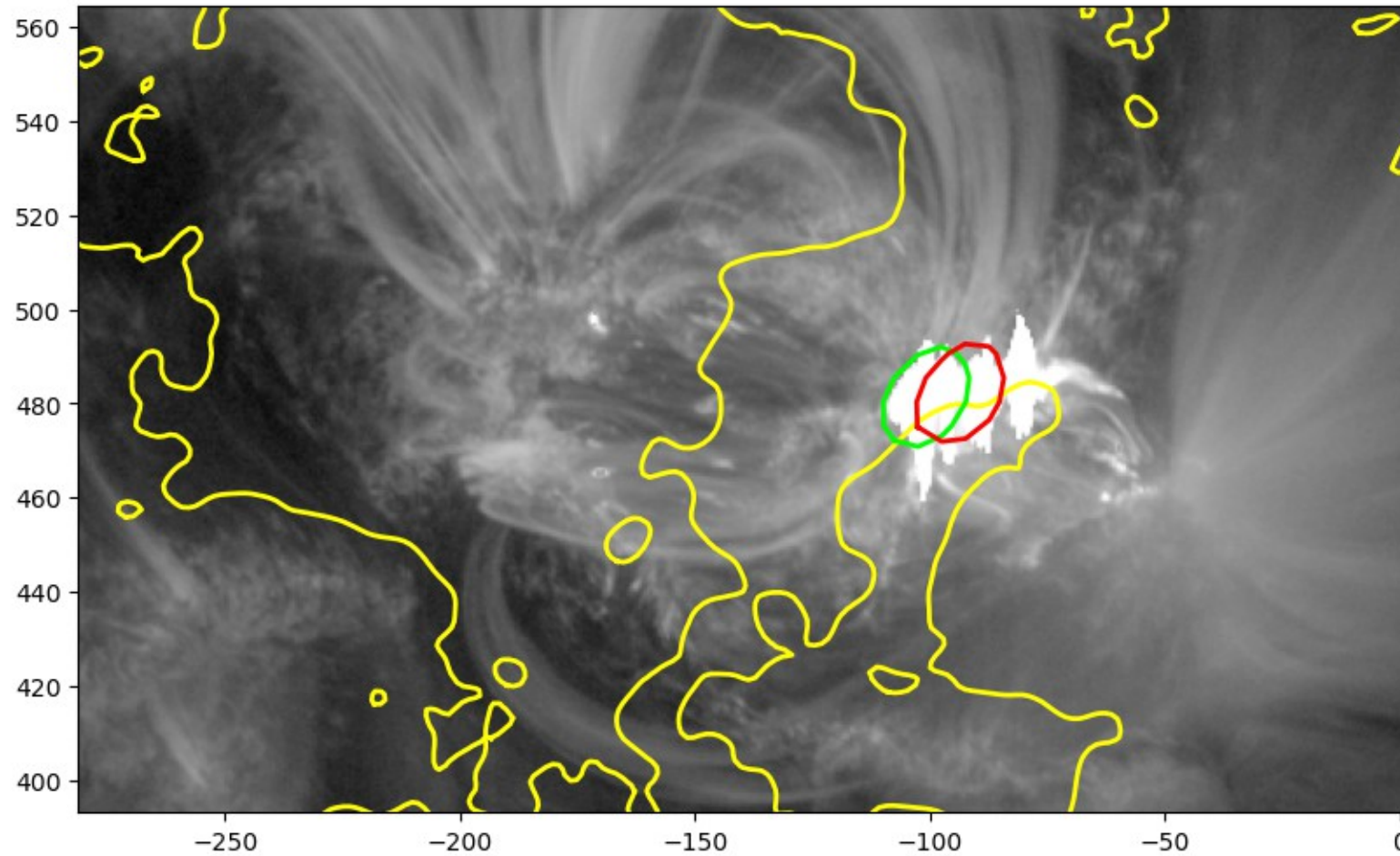


SDO/HMI, May 03, 01:00 UT
~1h X1.7 (May 03 02:11 UT)



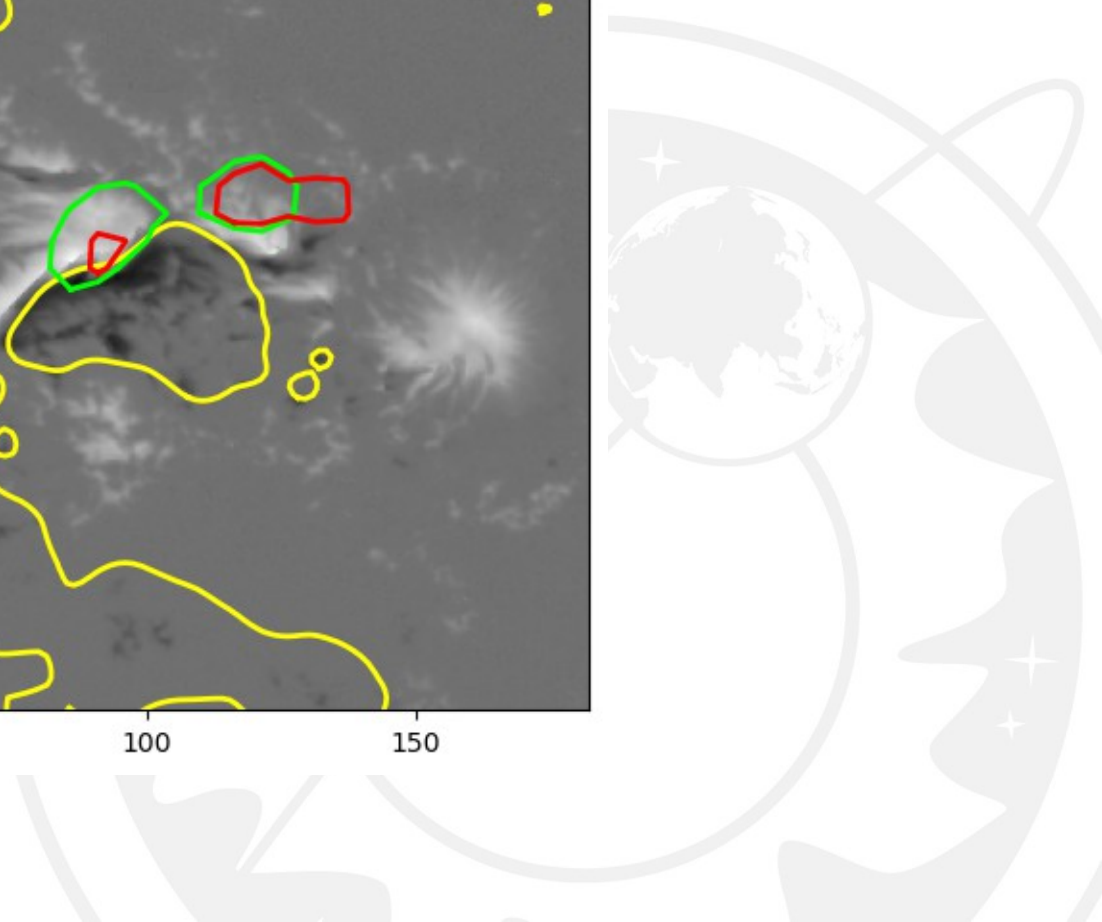
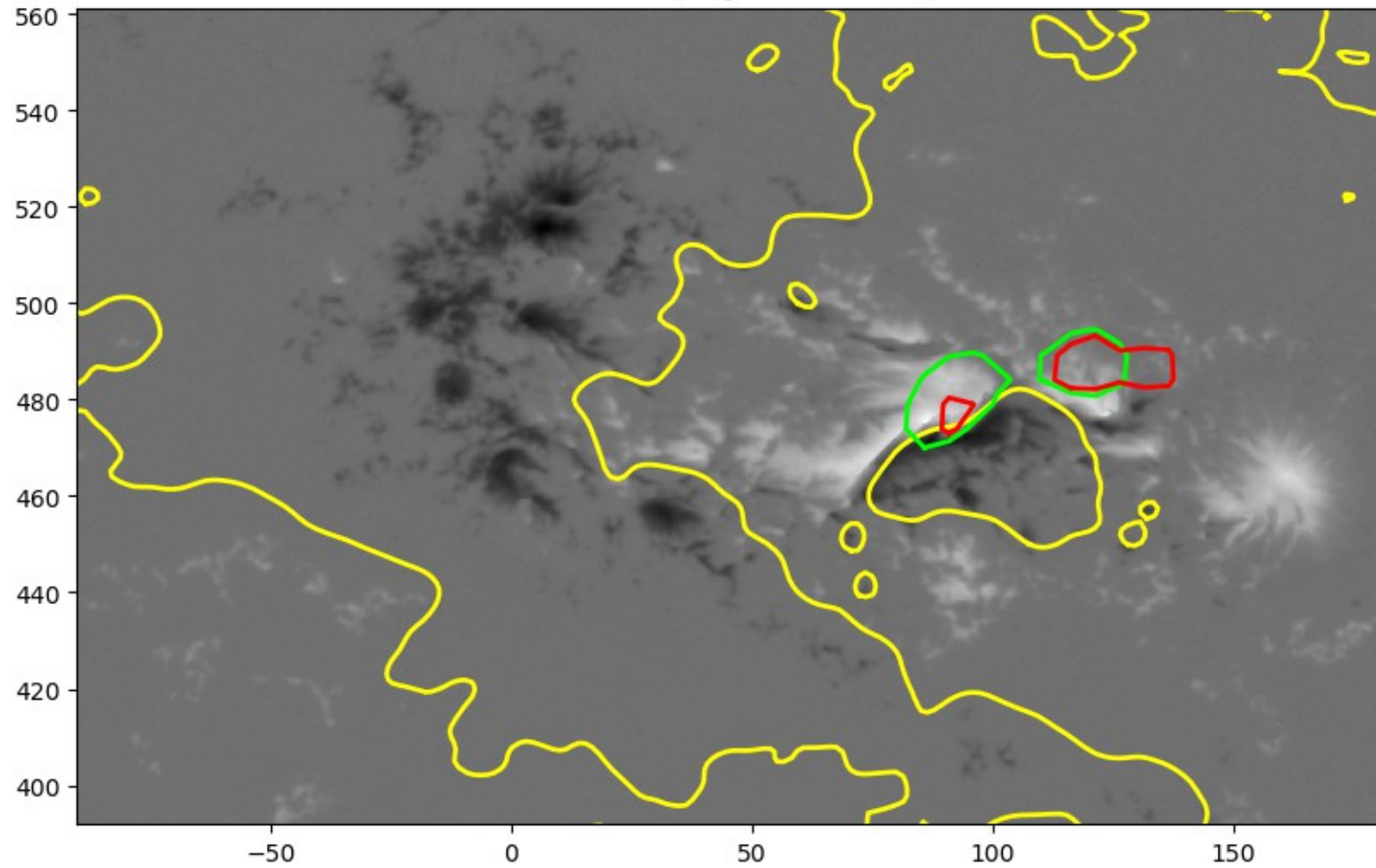


SDO/AIA 171 A, May 03, 02:30 UT



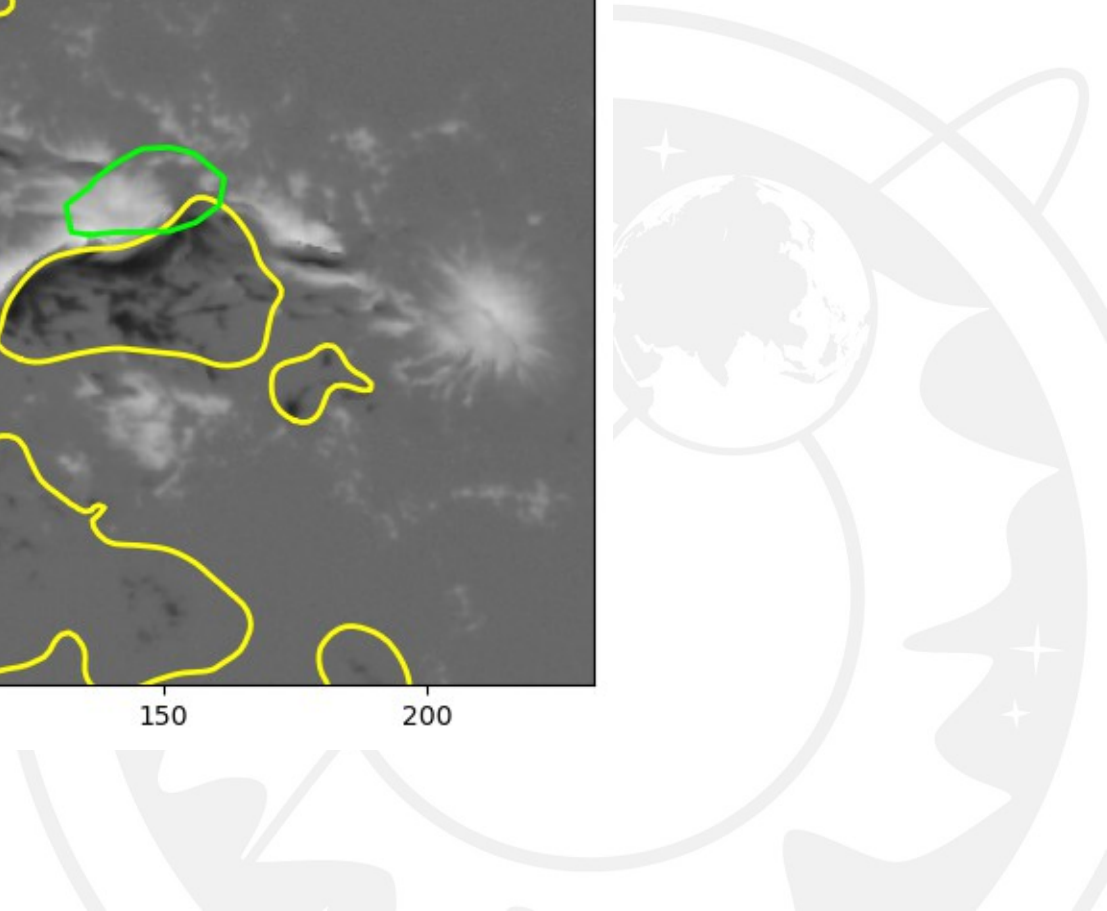
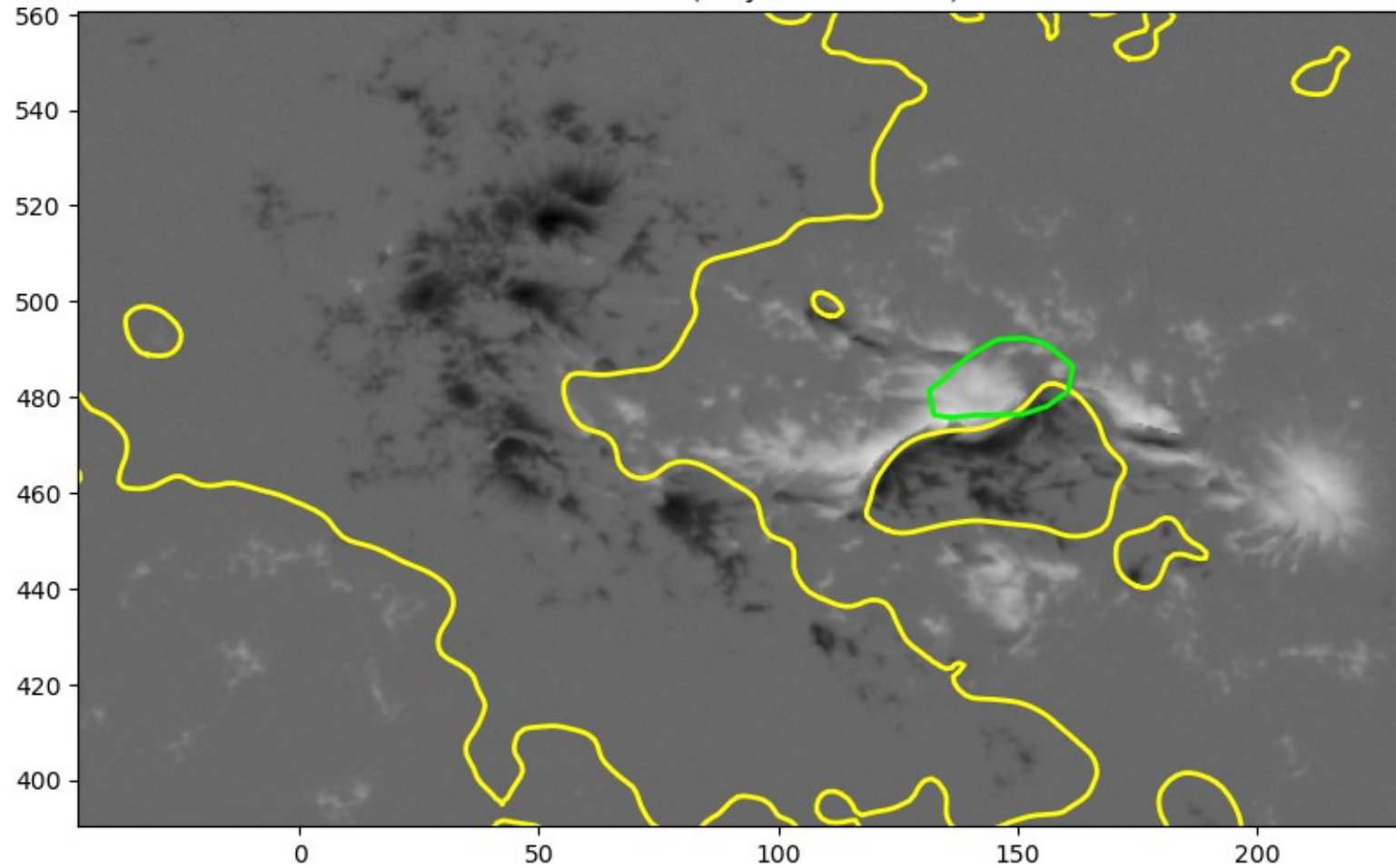


SDO/HMI, May 04, 02:00 UT
~1d X1.3 (May 05 05:47 UT)



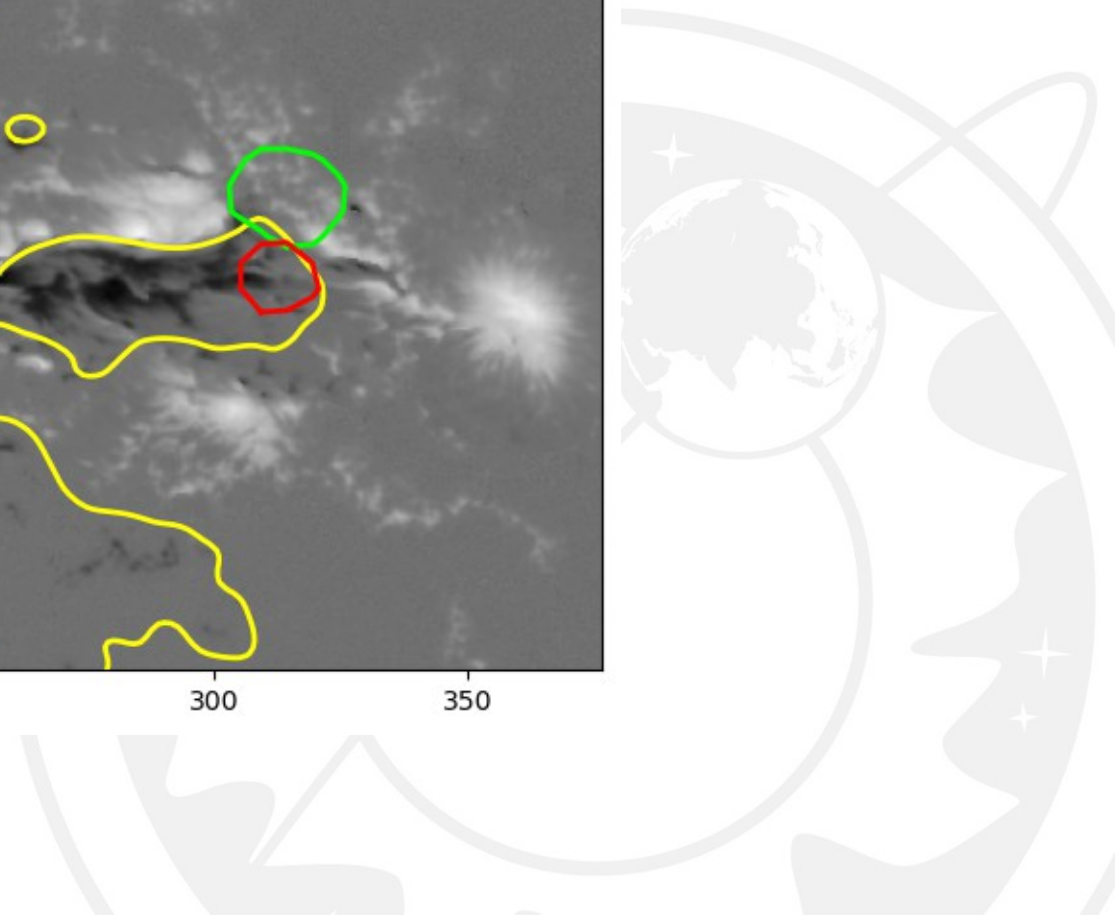
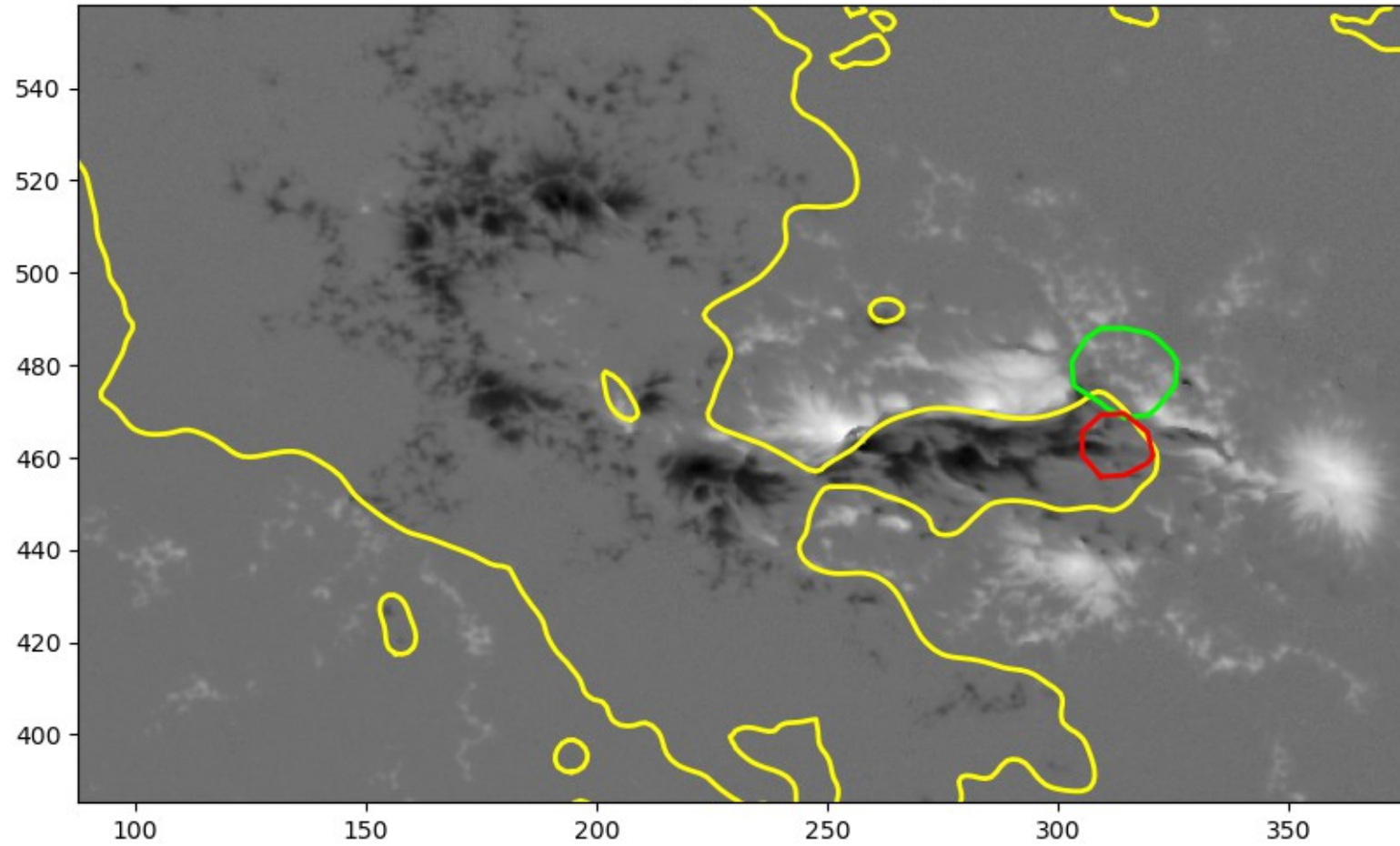


SDO/HMI, May 04, 08:00 UT
~22h X1.3 (May 05 05:47 UT)



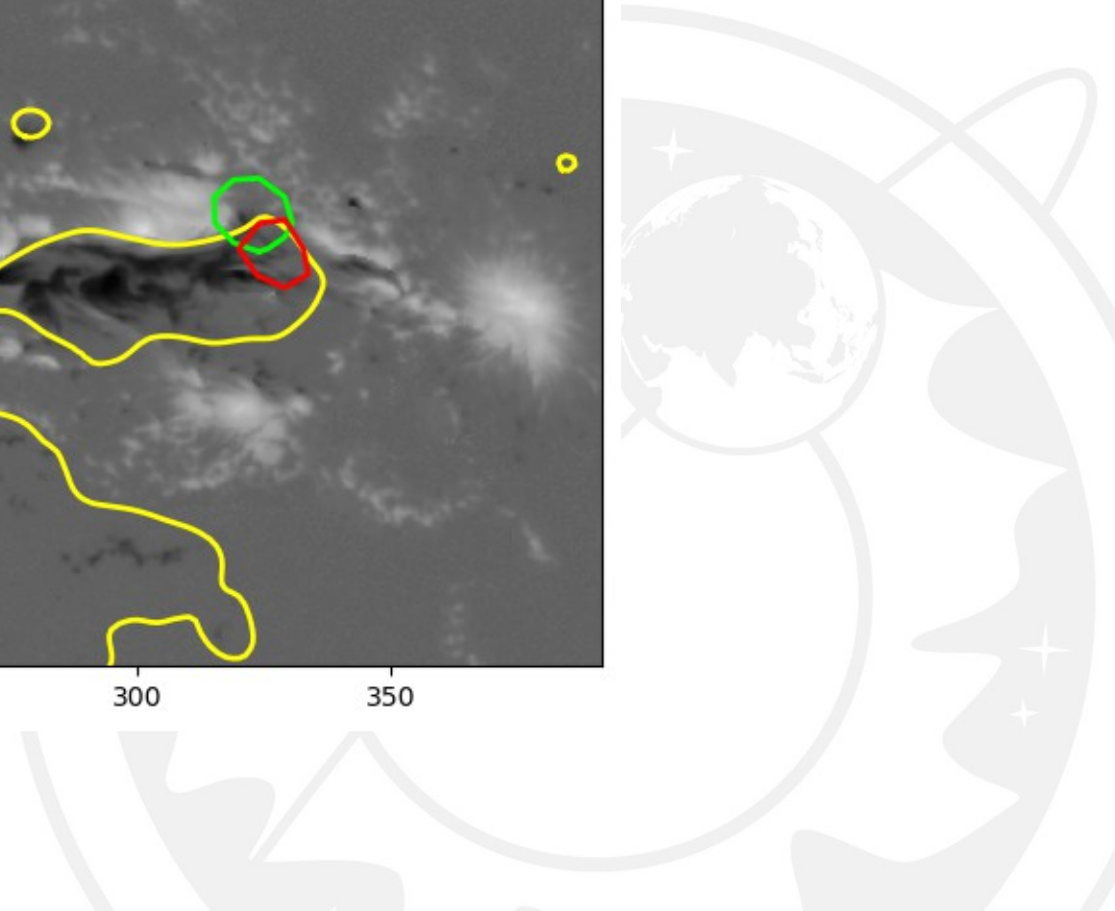
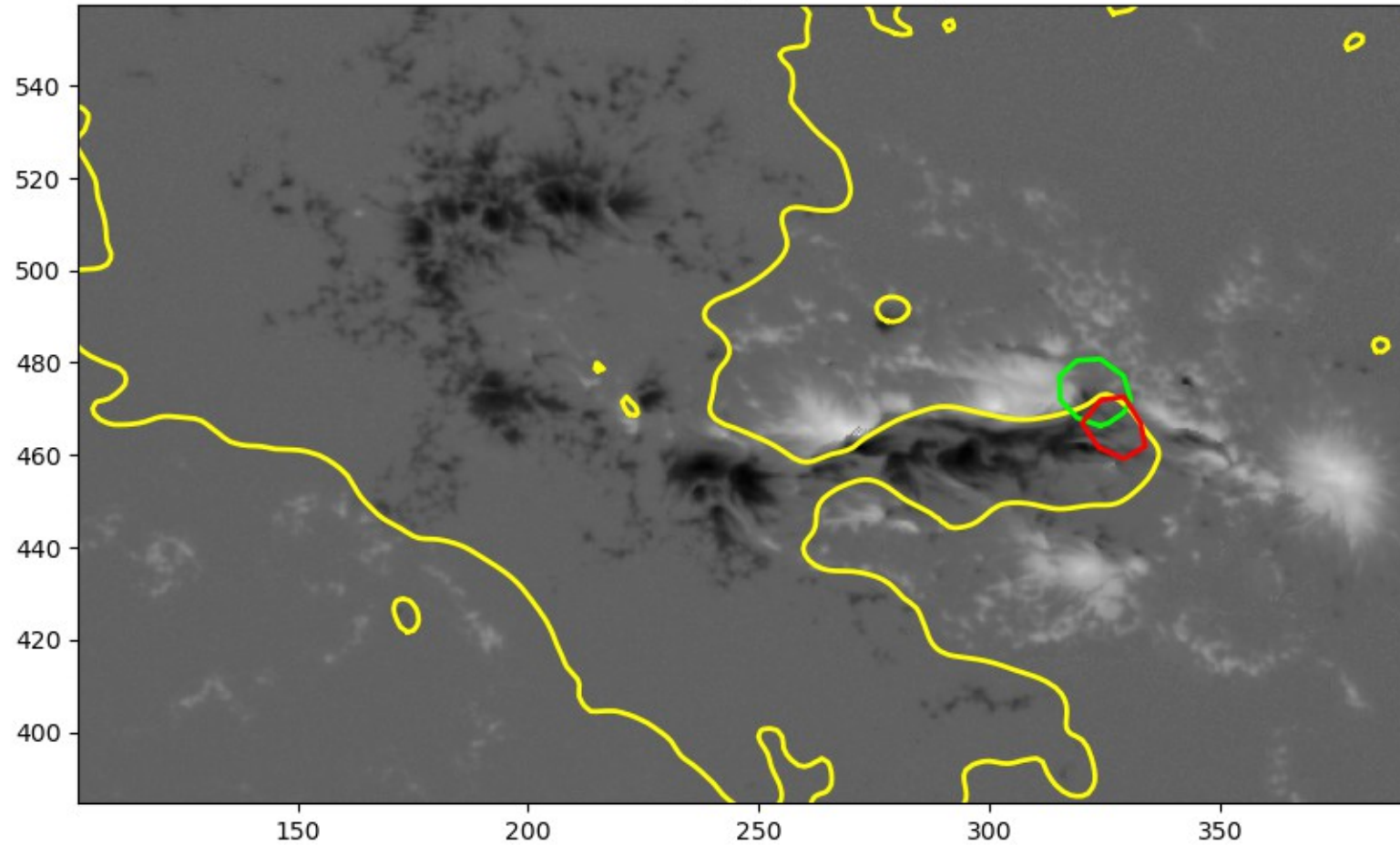


SDO/HMI, May 05, 02:00 UT
~4h X1.3 (May 05 05:47 UT)



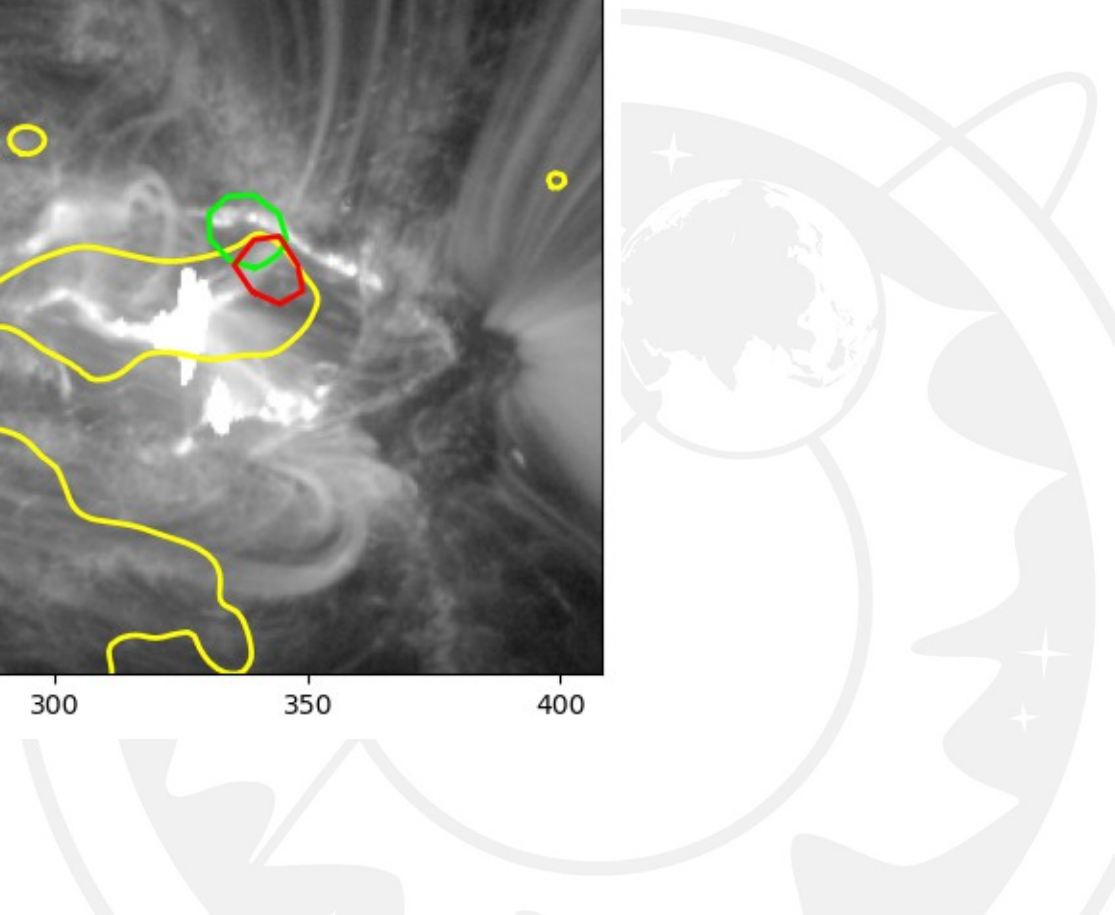
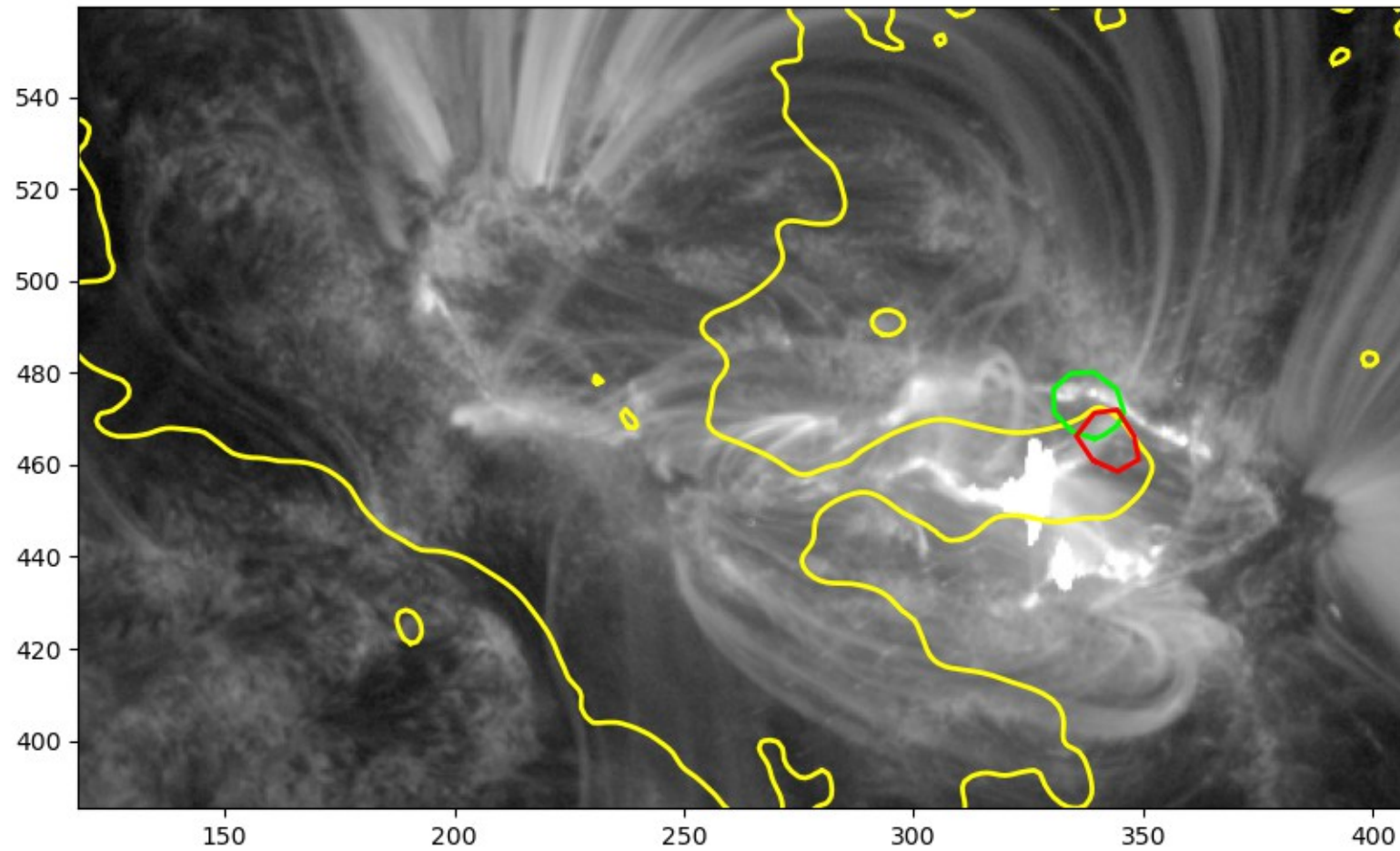


SDO/HMI, May 05, 04:00 UT
~2h X1.3 (May 05 05:47 UT)



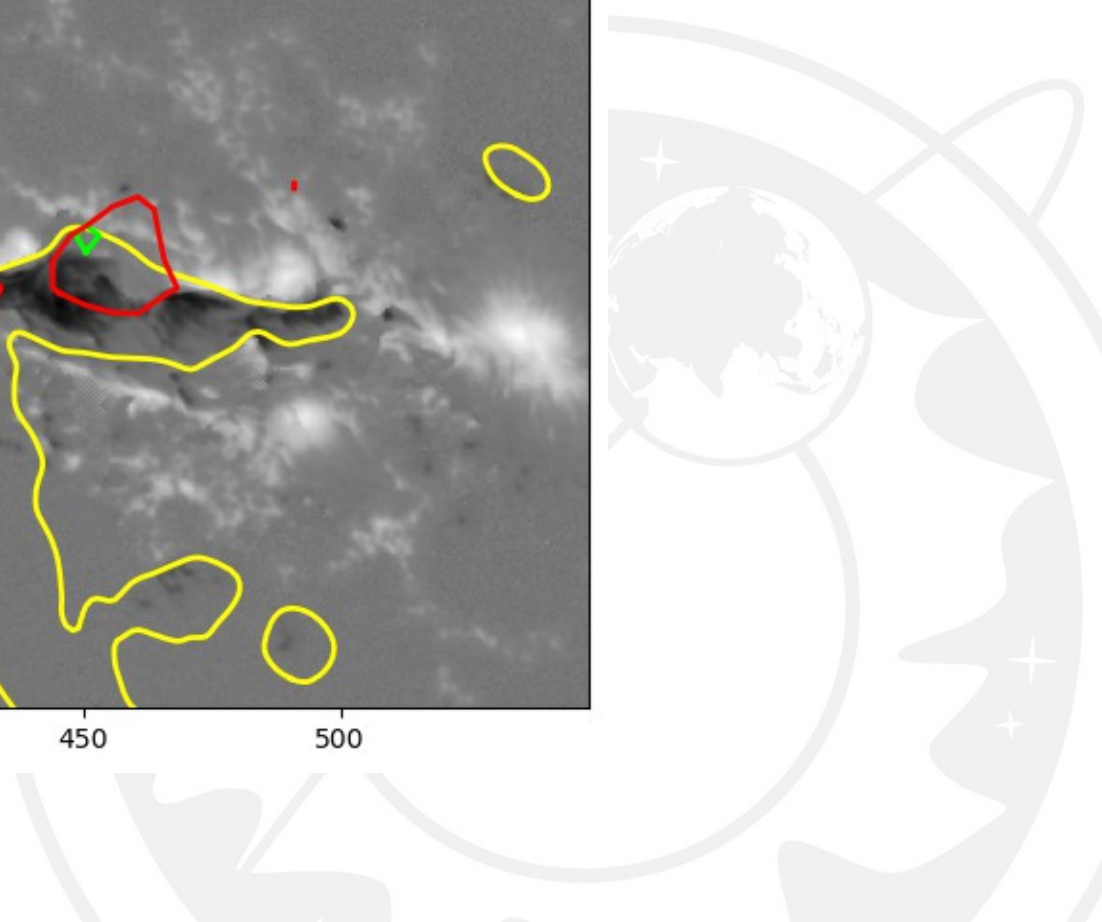
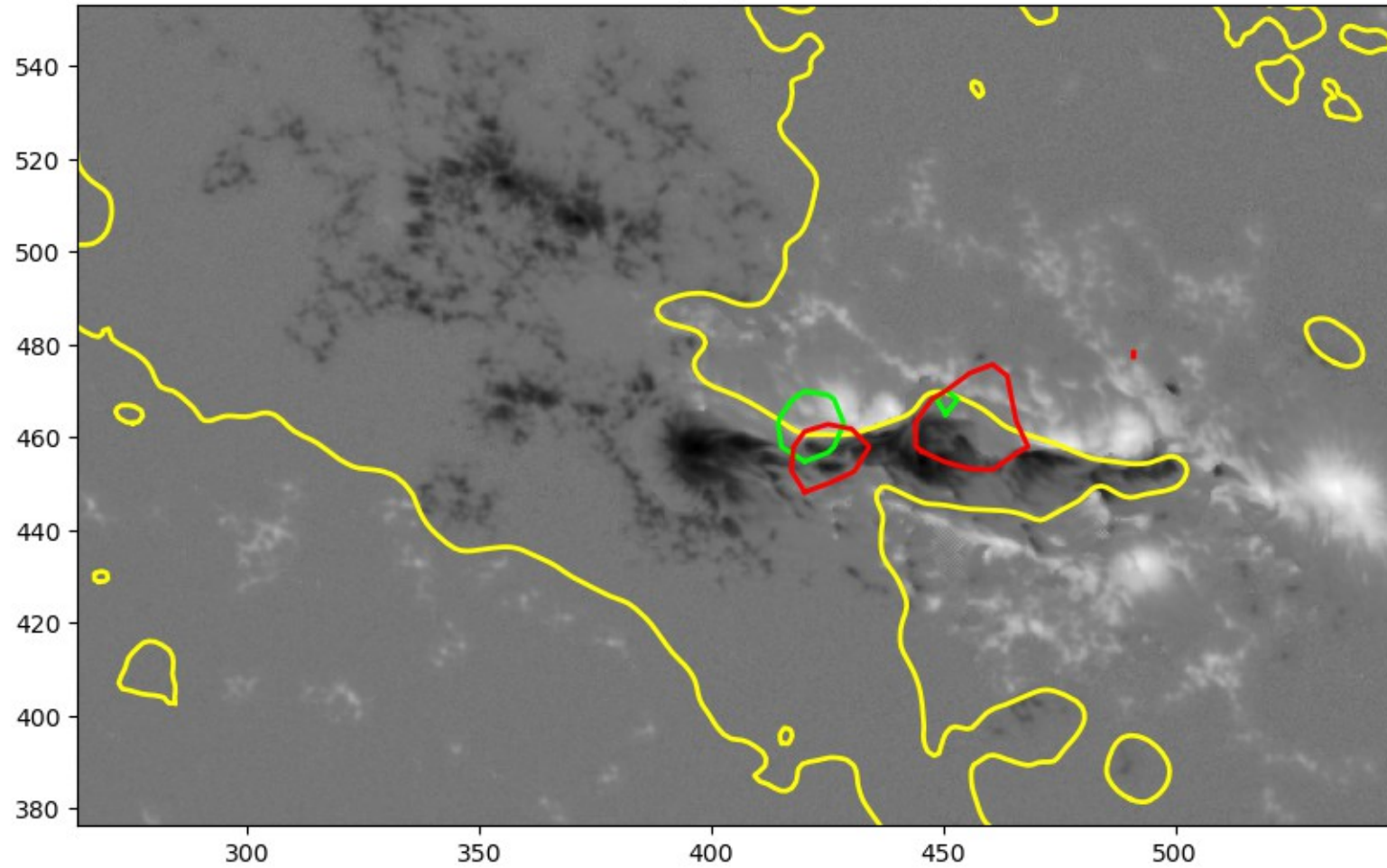


SDO/AIA 171 A, May 05, 06:00 UT



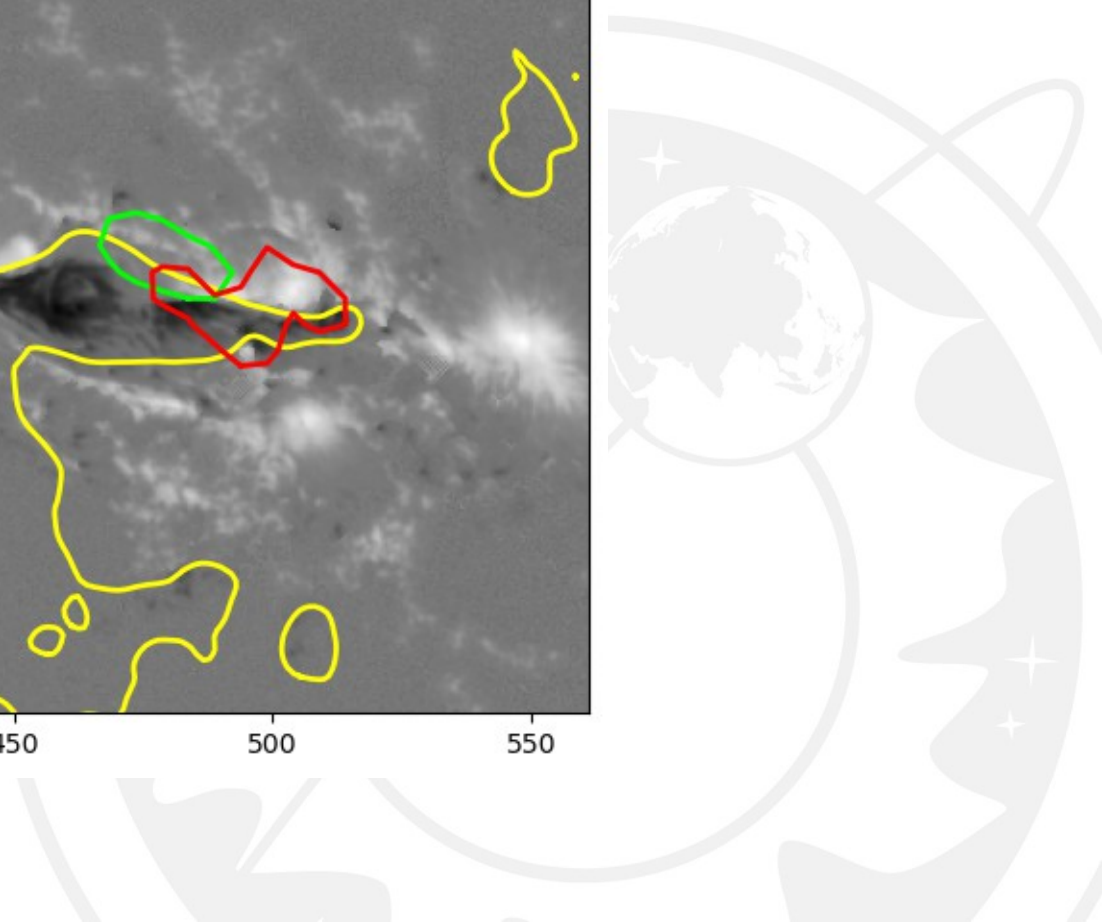
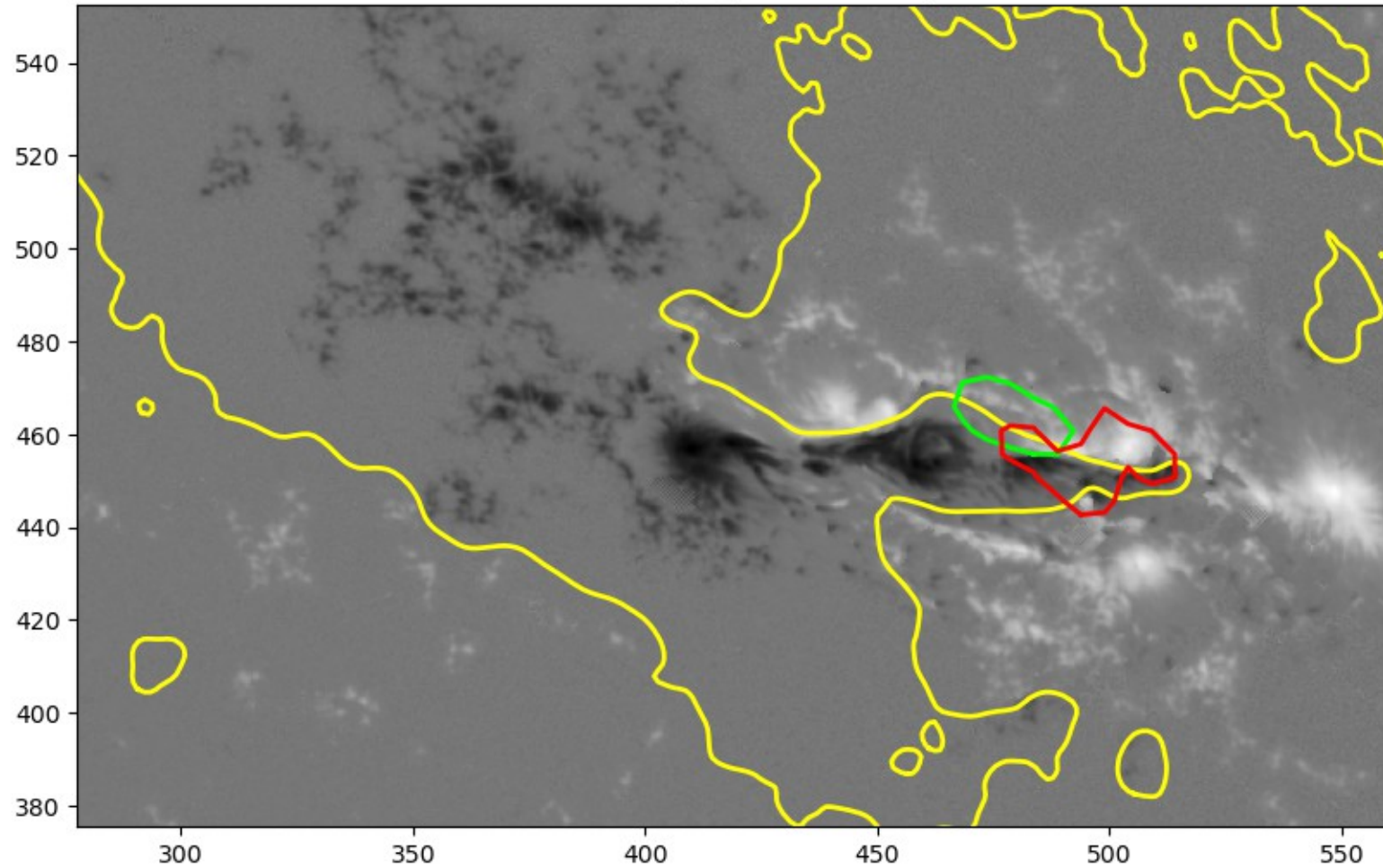


SDO/HMI, May 06, 02:00 UT
~4h X4.5 (May 06 05:38 UT)



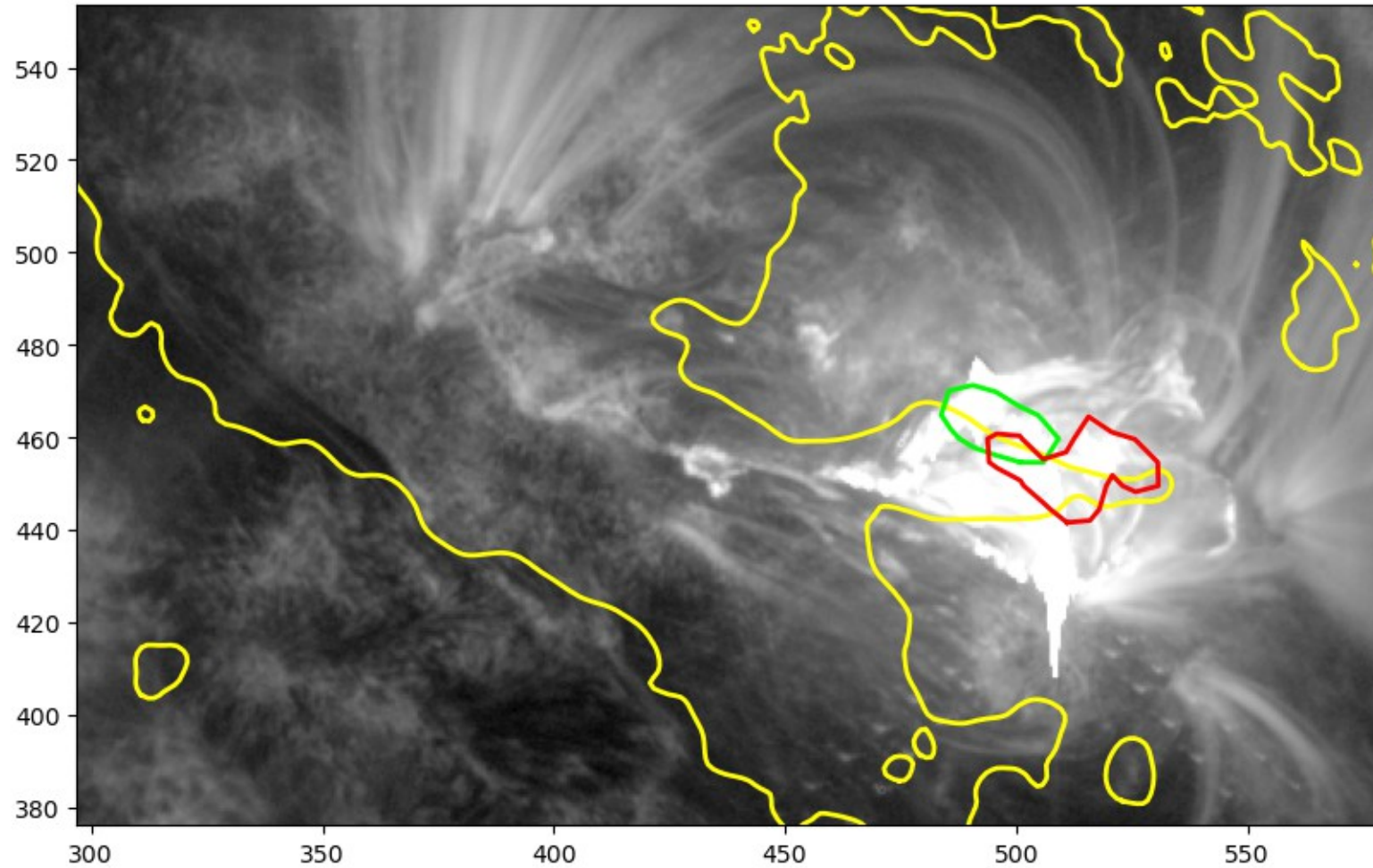


SDO/HMI, May 06, 04:00 UT
~2h X4.5 (May 06 05:38 UT)





SDO/AIA 171 A, May 06, 06:30 UT





Summary

- At the start of flaring activity 12 GHz microwave source appeared close to the PIL in the region of emergence of new magnetic flux
- 12 and 16 GHz microwave sources remained above the PIL during all subsequent days when X- and M-class flares were observed
- The microwave sources were localized in close proximity to the area where X-class flares occurred