

# Coronal Bright Points

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# Out line of the presentation

- Small scale transient events
- Bright Points
- Are they mini active regions?
- What is the trigger of the oscillations in BP's.

# Small scale transient events

Explosive Events

XBP

Ephemeral Regions

CMFs

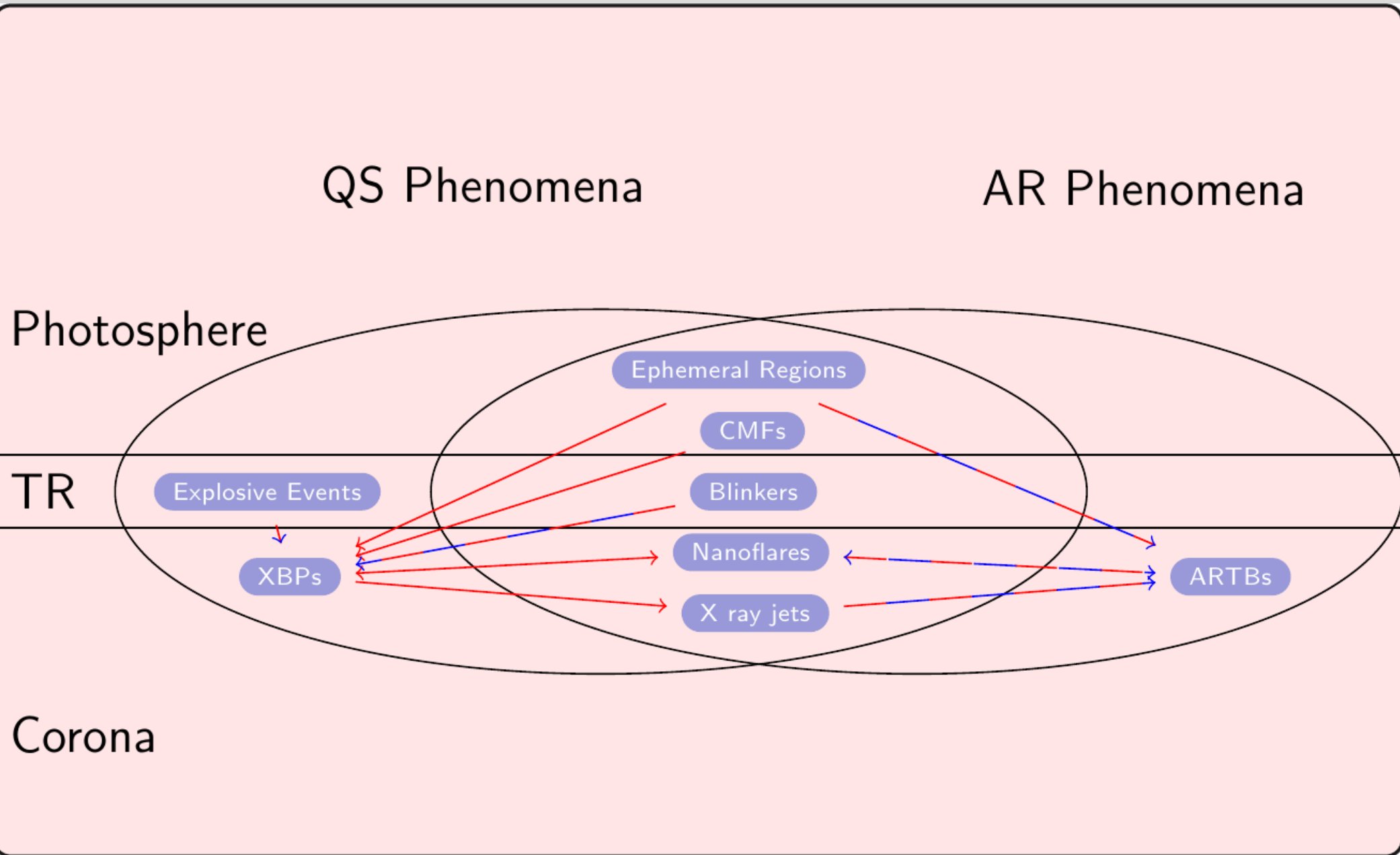
Blinkers

Nanoflares

X ray jets

ARTBs

# Small scale transient events



# Bright Points



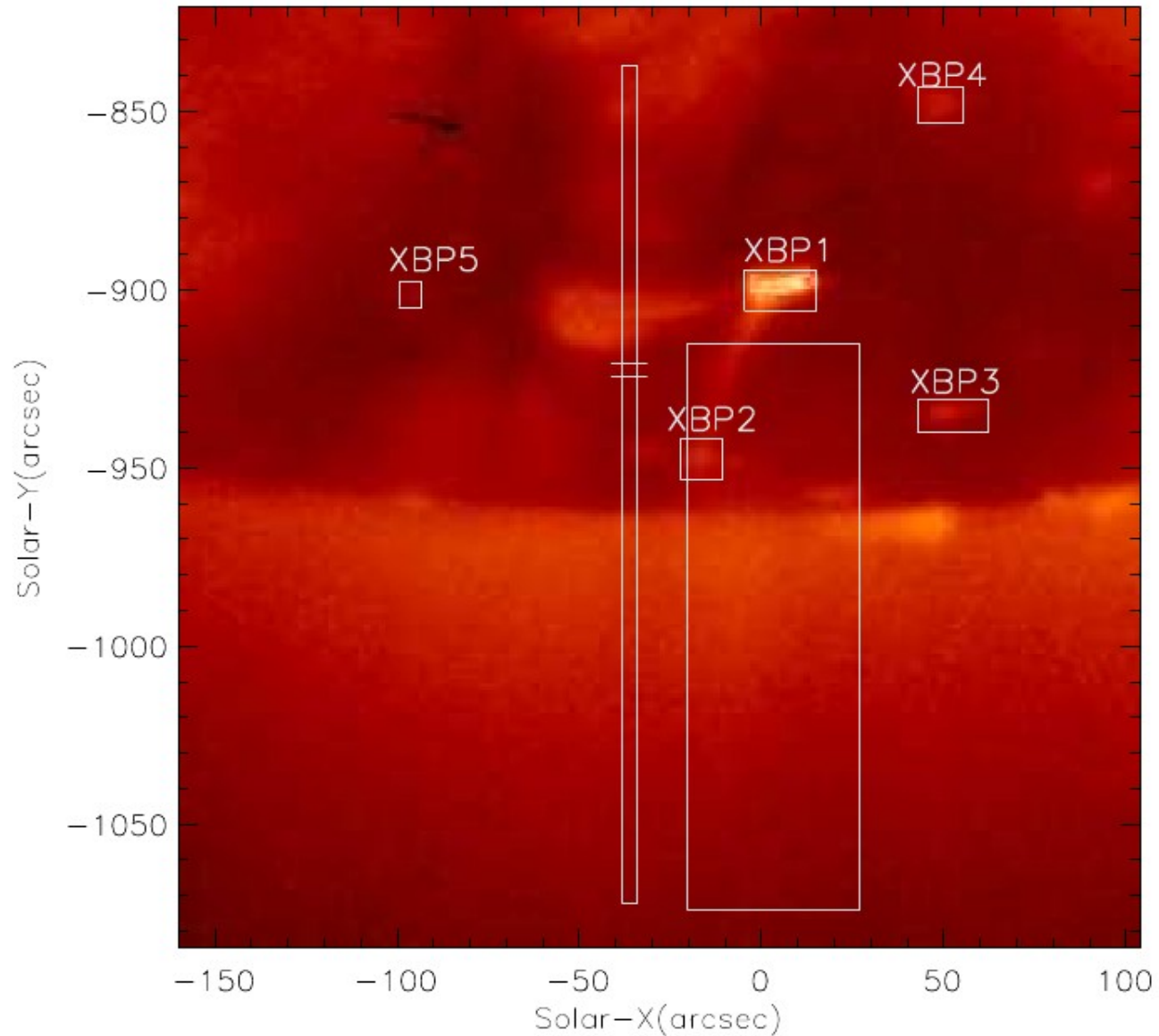
- X-Ray Bright Points are small 'point-like' X-ray emitters observed at all latitudes on the Solar Corona with a spatial size of less than 60 arcsec and lifetime ranging from a few hours to a few days
- Were first discovered from rocket borne experiments in 1969 (Vaiana et al. 1973) .
- X-Ray Bright Points (XBPs) were first studied in detail by Golub et al. (1974) using Skylab data.

# X-ray Bright Point

1 pixel = 1.03 arcsec.

Time of observation is from  
12:00:00 UT to 13:99:00 UT  
on 15th April 2007.

The number of time frames  
observed is 401 with  
average time  
cadence 18 sec

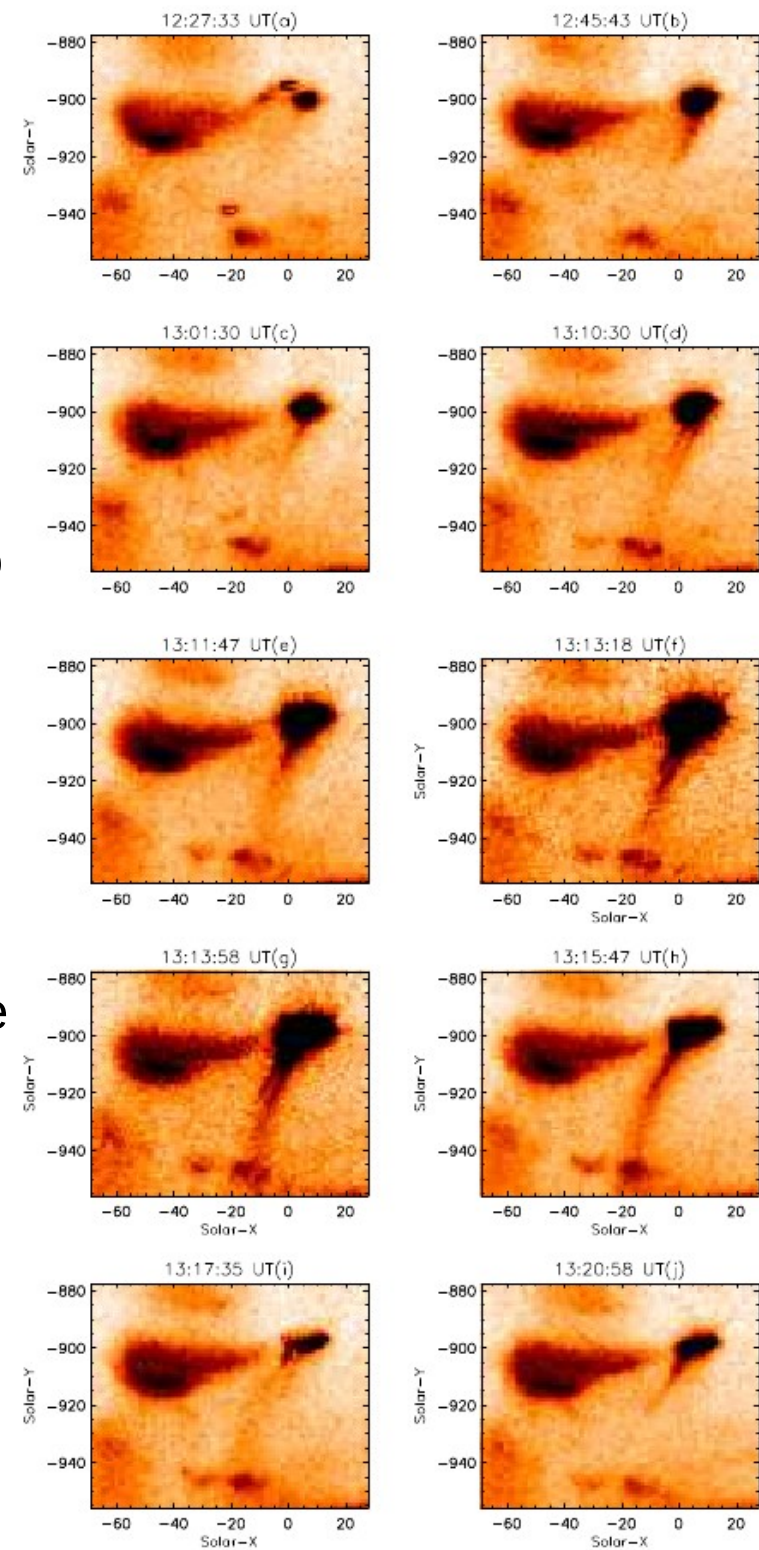


A micro-sigmoid region is often associated with eruption of multiple jets. Some of the jets observed are double stranded. Recurrence of the jets at region is associated with recurring reconnection at the bright point region. Closed loop structure interacting with the coronal open magnetic fields give rise to multiple reconnection. The bright point morphology associated to the jet changes continuously. Rust & Kumar (1996) observed a transient S-shaped brightening prior to the eruption of CMEs.

These S-shaped brightening are complex helical flux-ropes and the erupting flux rope expands to form the CME. Coronal sigmoid can be transient as well as long lasting. Canfield et al. (1999) suggested that the active regions with sigmoidal X-ray morphologies are 68 percent more likely to erupt than non-sigmoidal active regions. Extensive observations are reported in Raouafi et al. (2010) about the micro sigmoid structure and evolution and relation to the formation of the associated jets associated. In this study we see micro-sigmoid of size  $70'' \times 30''$ , which is seen in XRT images. Pre-jet and post-jet formation, the bright point showed lot of dynamics.

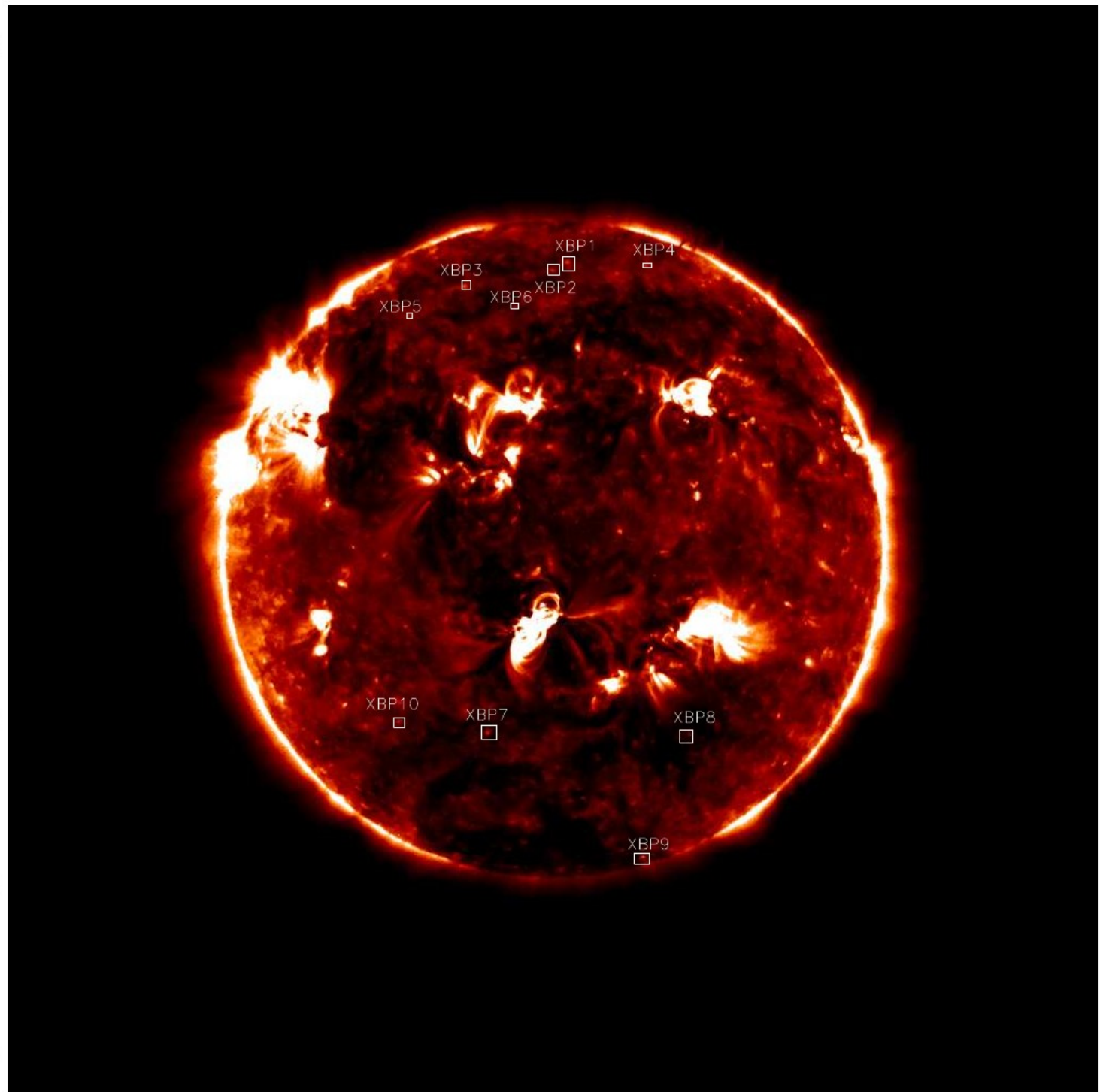
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In this analysis we also use data from Sun Watcher using Active Pixel System detector on board the PROBA2 spacecraft. SWAP provides images of the solar corona in EUV channel centered at  $175 \text{ \AA}$ , line with a narrow bandpass of  $15 \text{ \AA}$ . Pixel size is  $\approx 3.17$  and the

1500  
1000  
500  
0  
-500  
-1000  
-1500



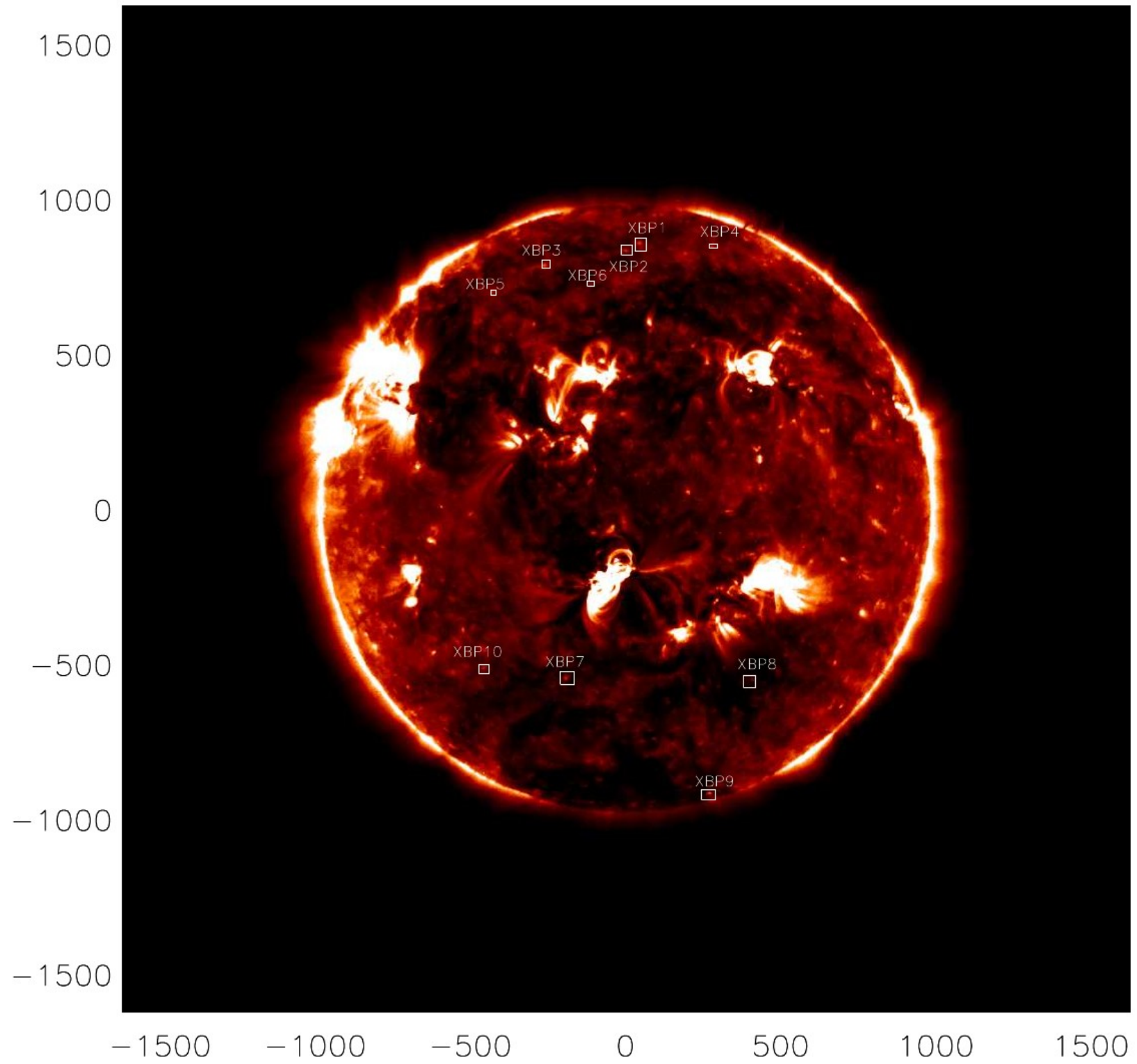
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-1500 -1000 -500 0 500 1000 1500

# Oscillations in BP's

We use a time-series data of full-disk images of lines 171 Å, 211 Å, and 193 Å from 13th Feb 2011 from 11:00:00 UT to 14th Feb 11:00:00 UT. The SDO/AIA has a typical resolution of 0.6 arc sec per pixel and the highest cadence of 12 s, and it observes the full solar disk in three UV (1600, 1700, 4500) and seven EUV (171, 193, 211, 94, 304, 335, 131) wavelengths (Lemen et al. 2011).

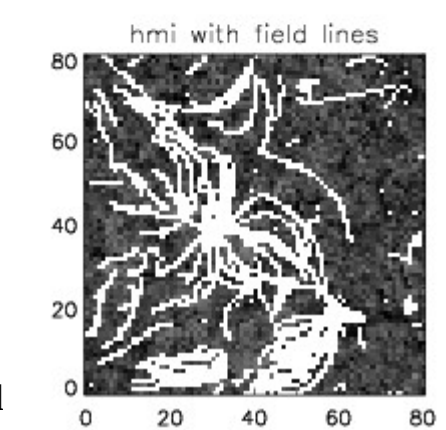
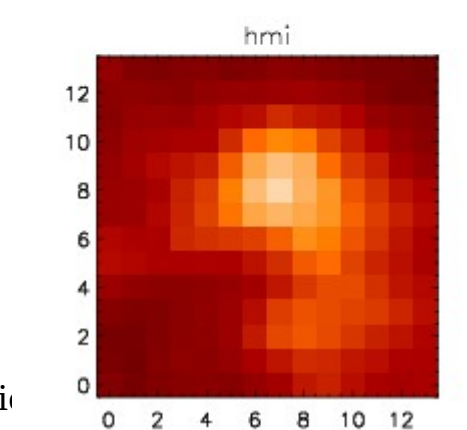
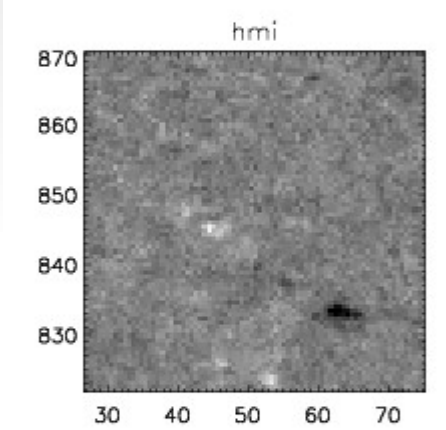
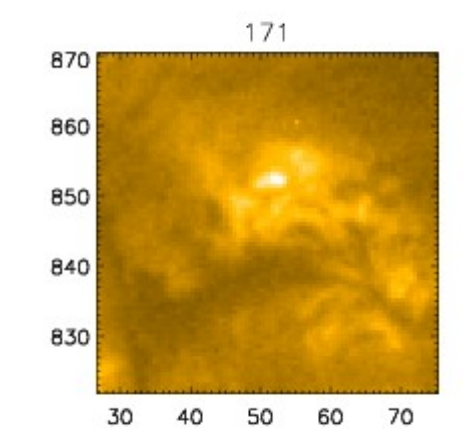
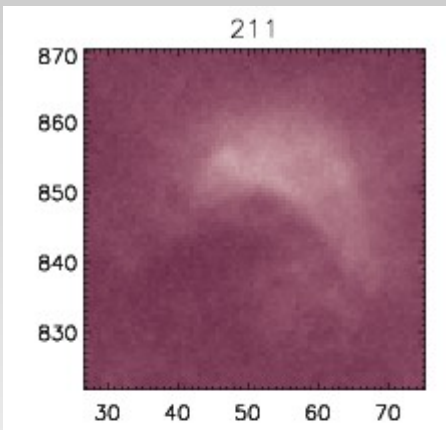
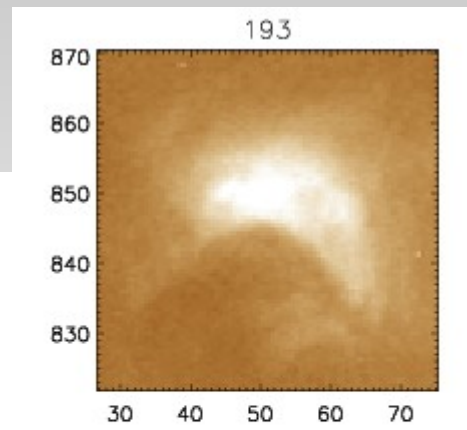
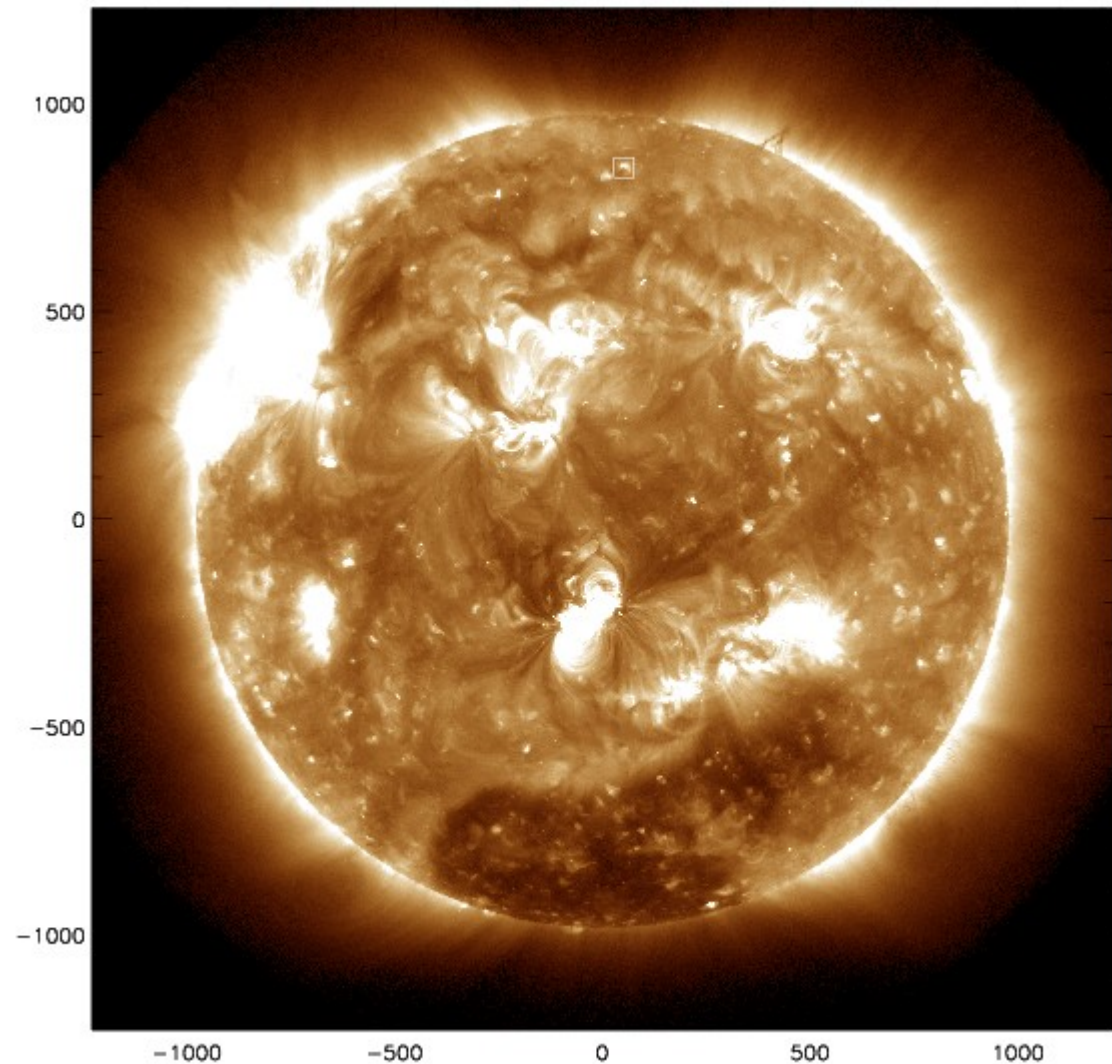
Also we use full disk hmi magnetograms. HMI has resolution of 0.5 arcsec per pixel and cadence of 45s from 13th Feb 2011 from 11:00:00 UT to 14th Feb 11:00:00 UT.



# Oscillations observed in 80 min duration

**Table 1.** XBP oscillations as seen from SWAP and different AIA channels

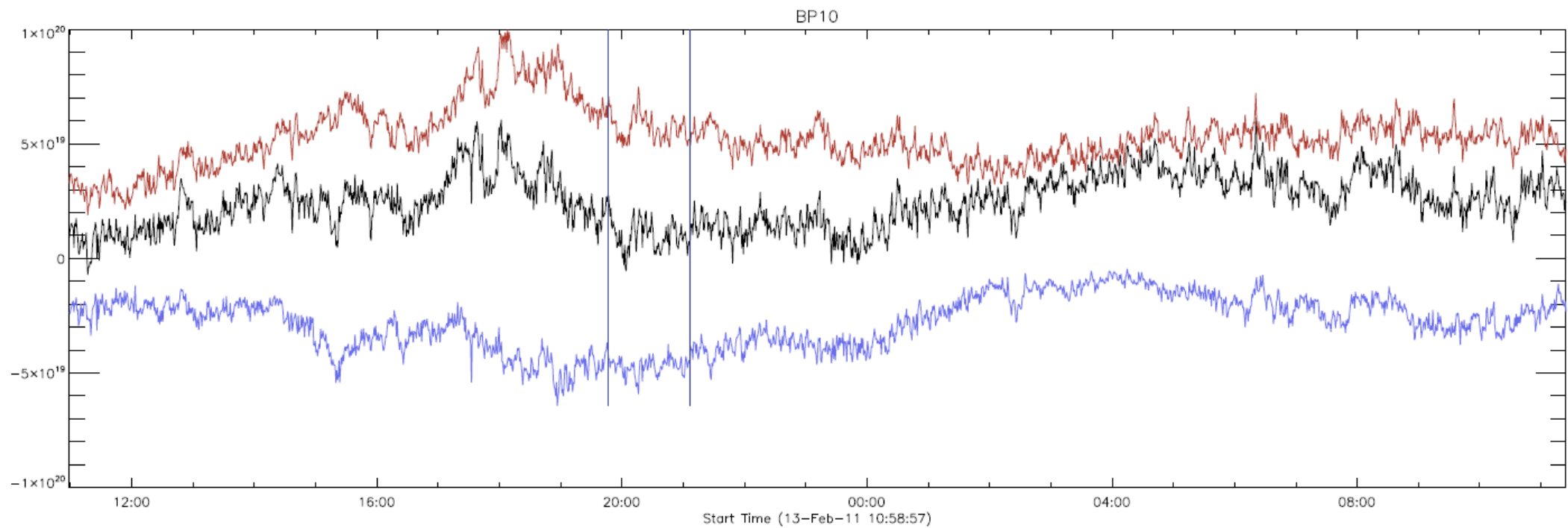
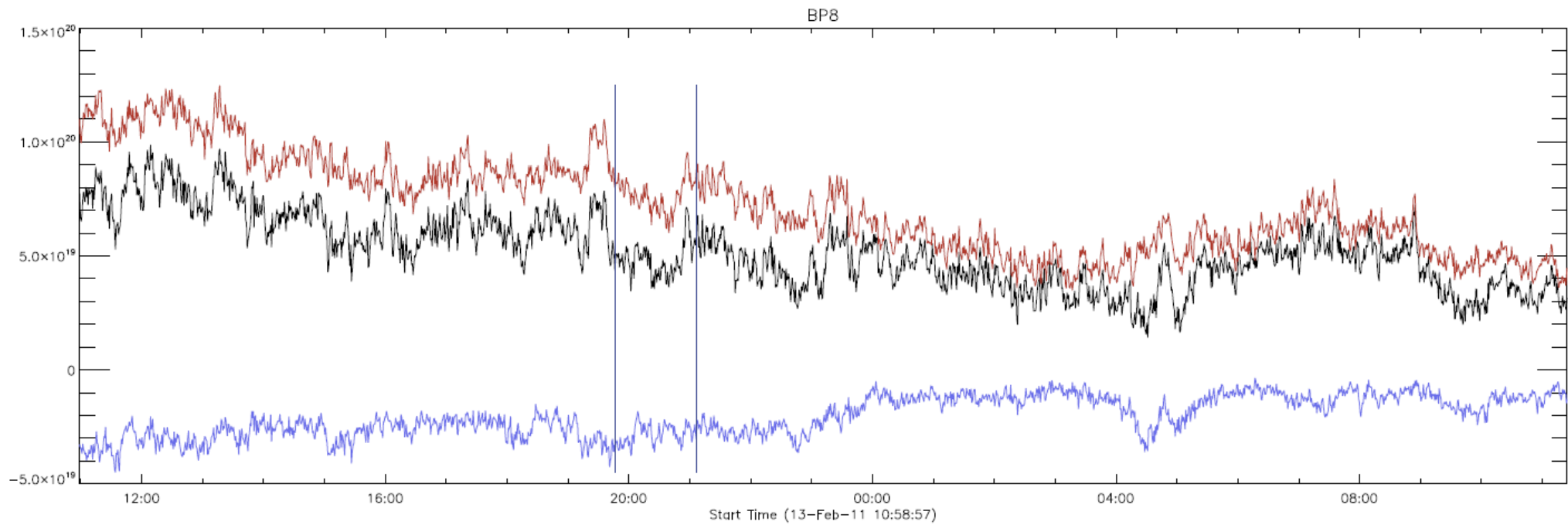
Inst channel	SWAP				AIA			
	174		171		193		211	
Period	P1 (min)	P2(min)	P1(min)	P2(min)	P1 (min)	P2 (min)	P1 (min)	P2 (min)
bp1	<b>13.8</b>	21.2	18.7	7.9	14.4	18.7	20.4	14.4
bp2	15.0	8.9	20.4	4.7	18.7	5.1	18.7	10.2
bp3	<b>17.9</b>	8.9	20.4	8.6	24.3	15.7	17.1	22.2
bp4	<b>17.9</b>	8.9	17.1	9.4	20.4	8.6	20.4	8.6
bp5	<b>23.2</b>	<b>15.0</b>	20.4	7.2	22.2	4.7	22.2	3.3
bp6	<b>23.2</b>	8.9	22.2	8.6	20.4	7.2	22.2	7.2
bp7	<b>21.1</b>	13.8	20.4	11.1	17.1	8.6	18.7	8.6
bp8	<b>25.3</b>	<b>19.5</b>	18.7	6.6	17.1	26.4	18.7	26.4
bp9	<b>23.2</b>	6.3	24.3	6.6	22.2	12.1	12.1	5.1
bp10	<b>12.6</b>	3.8	14.4	6.6	20.4	8.6	20.4	8.6



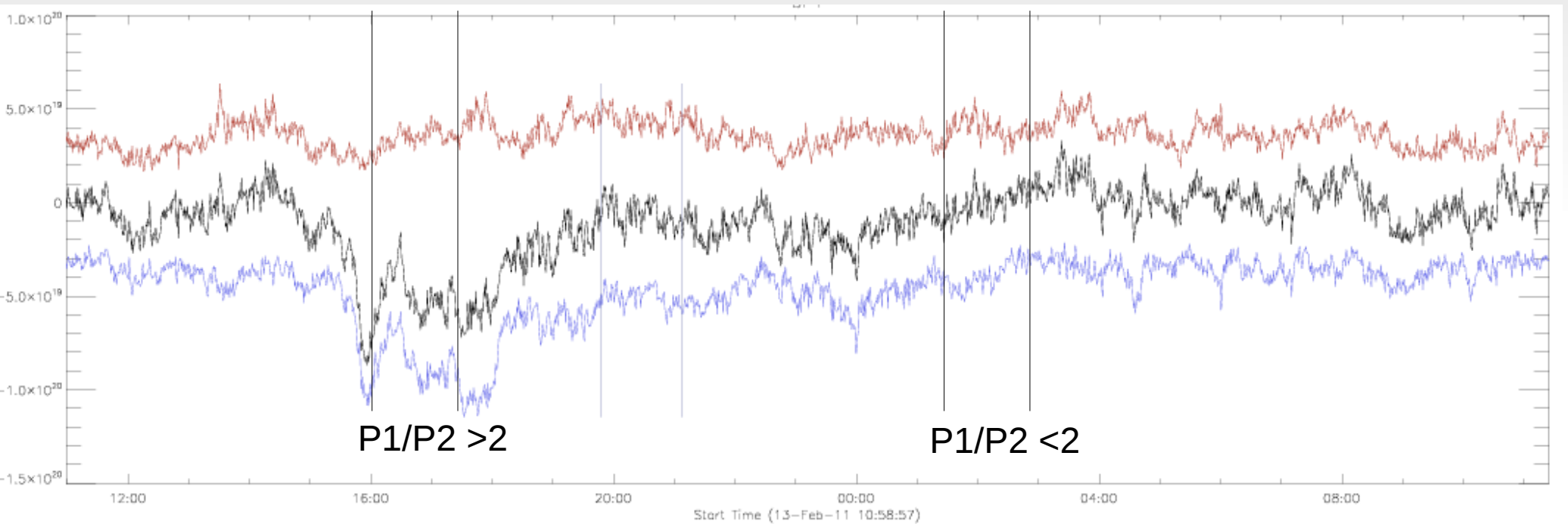
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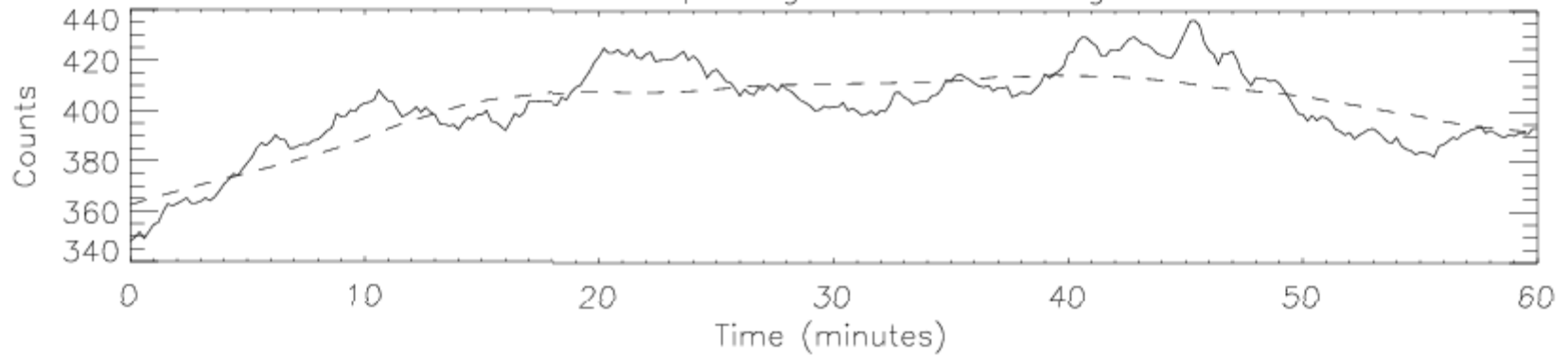
1



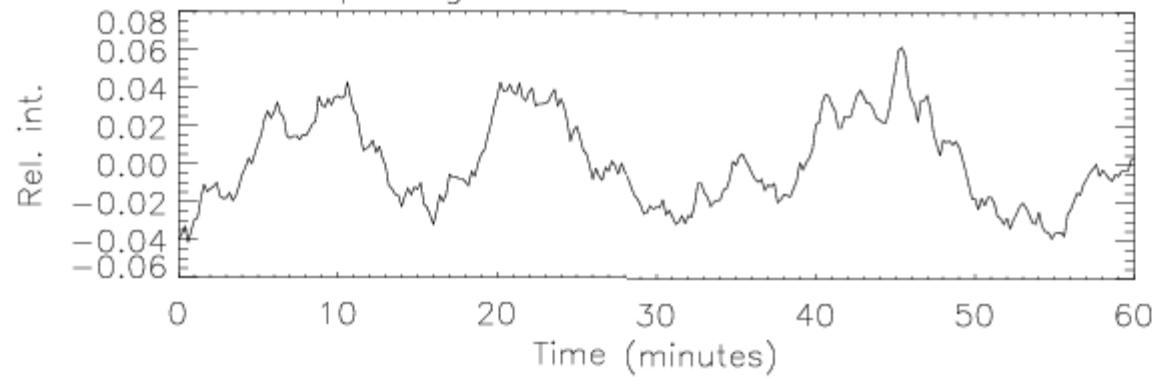
# Magnetic flux changes Vs Waves



AIA 193 bp1 Light curve – Original

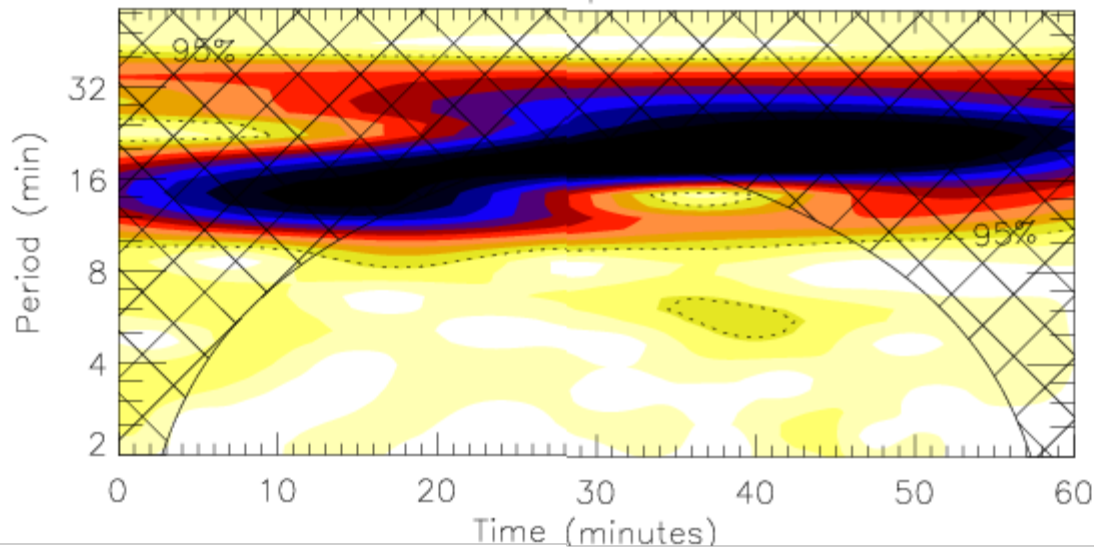


AIA 193 bp1 Light curve – After trend subtraction

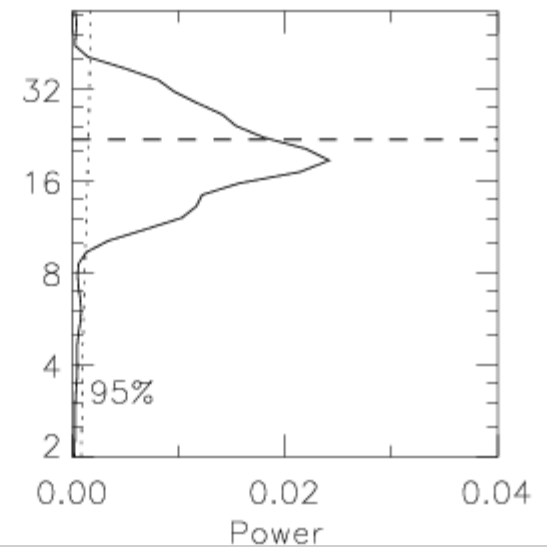


Global Period at max.  
power (< 21.9 min.)  
P1= 18.7 min.  
Second highest Peak  
P2= 6.1 min.

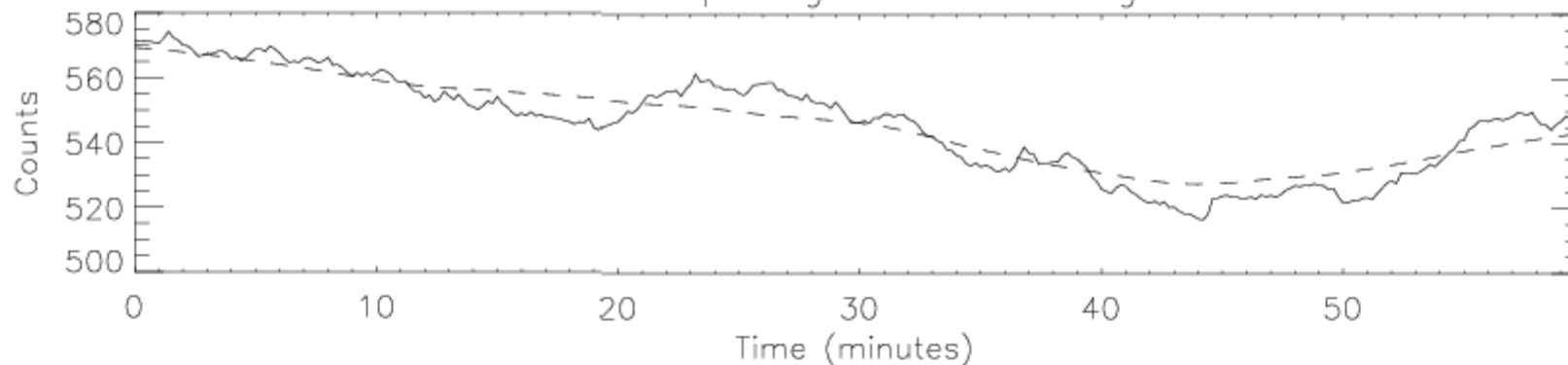
AIA 193 bp1 Wavelet



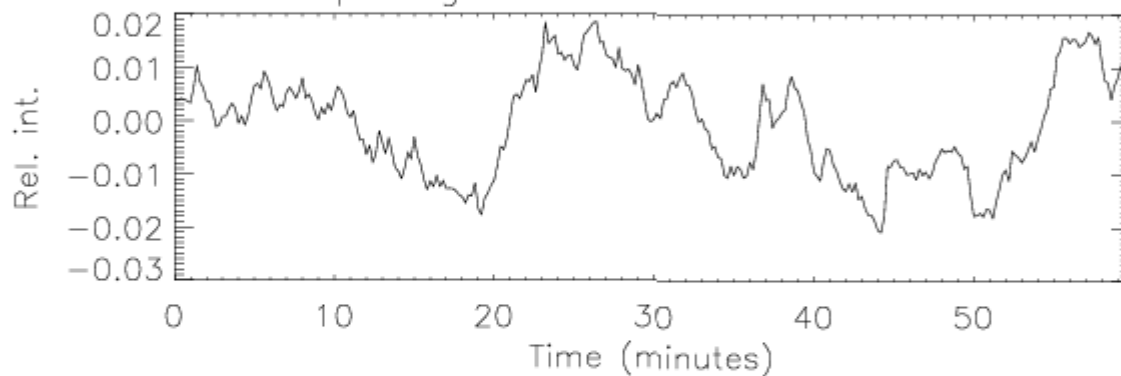
Global Wavelet



AIA 193 bp1 Light curve – Original

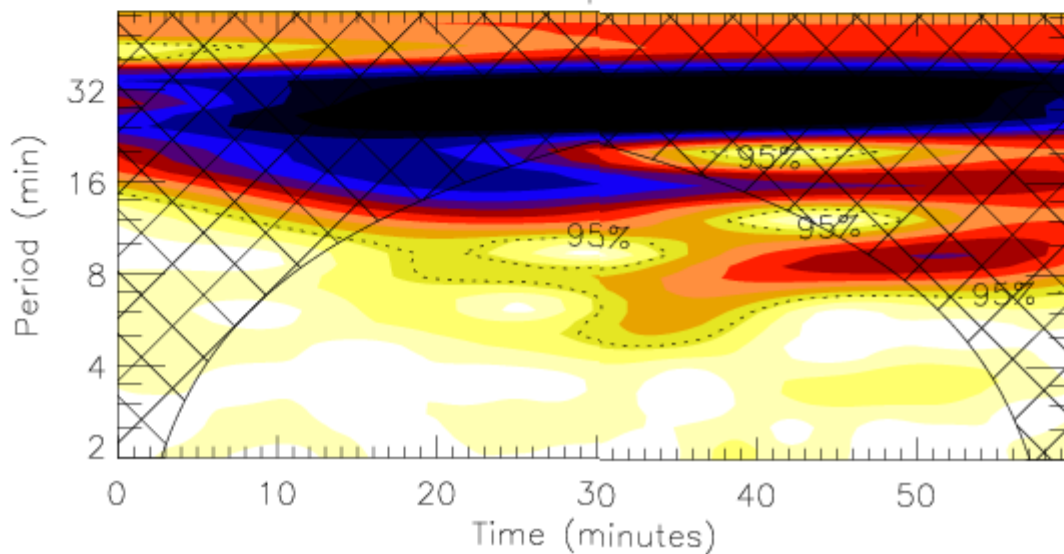


AIA 193 bp1 Light curve – After trend subtraction

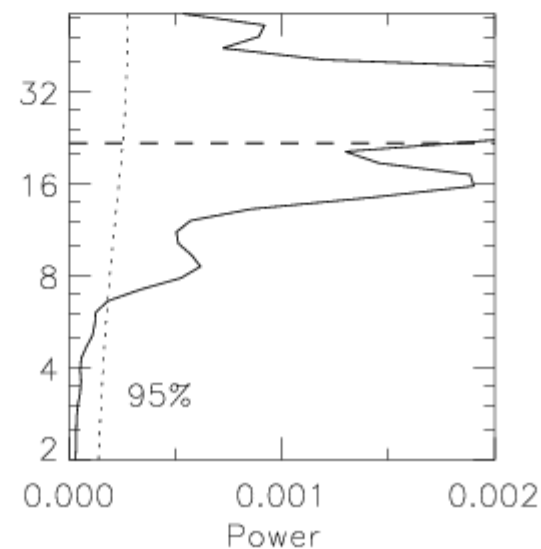


Global Period at max. power (< 21.8 min.)  
P1= 15.7 min.  
Second highest Peak  
P2= 8.6 min.

AIA 193 bp1 Wavelet



Global Wavelet



# conclusions

- Bright points have multiple connectivities, and evolve similar to active regions. They are more likely mini-scale active regions
- Intensity oscillations in the Bright Points are excited either due to linkage of photospheric power through magnetic field lines or due to recurrent reconnection.
- Magnetic flux changes implying repetitive reconnection or divergence of field change the P1/P2 ratio and may trigger oscillation pattern.

**Thank you for your attention**