HIGH FREQUENCY DYNAMICS OF ACTIVE REGION MOSS AS OBSERVED BY IRIS

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Collaborators:

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Reference: **N. Narang**, V. Pant et al. Front. Astron. Space Sci., 2019

Magnetohydrodynamic Waves in the Solar Atmosphere: Heating and Seismology

MOTIVATION & AIM

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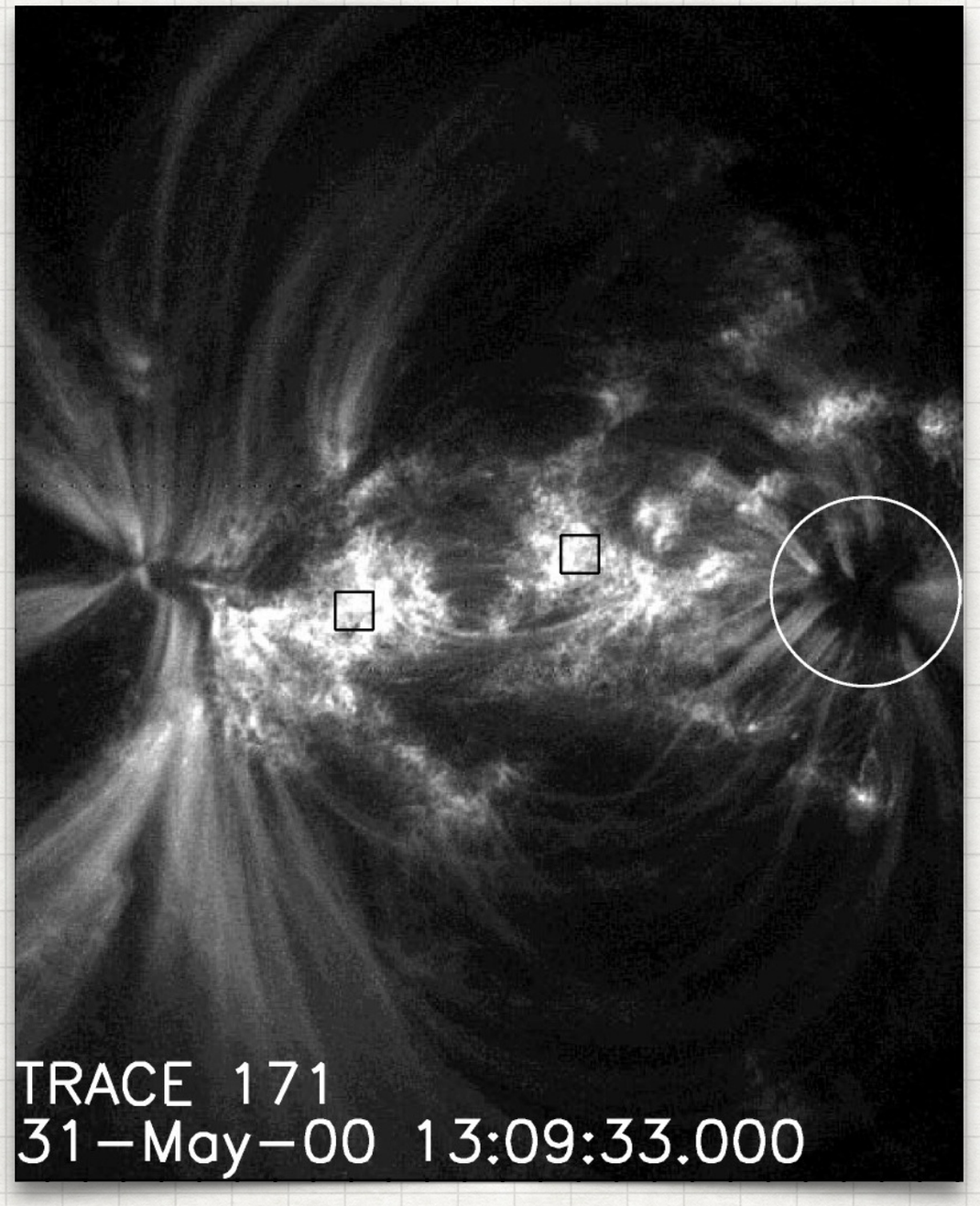
- In the present work we study the high-frequency (~ 1 minute) dynamics of an active region (AR 2376) moss as observed by Interface Region Imaging Spectrograph (IRIS, De Pontieu et al. (2014)).

ACTIVE REGION MOSS



TRACE image obtained at Fe ix/x λ171 (Schrijver et al. 1999; Berger et al. 1999)

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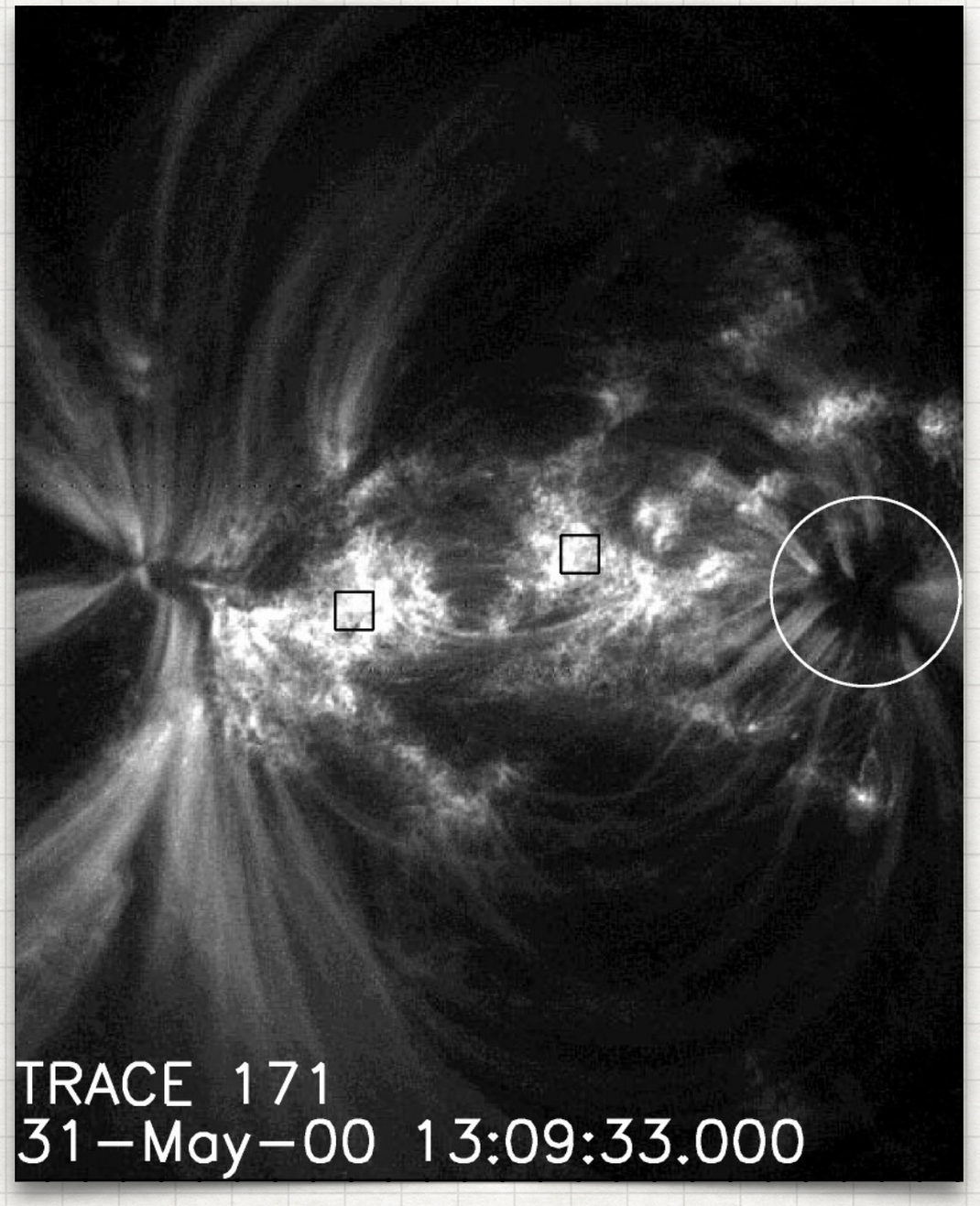

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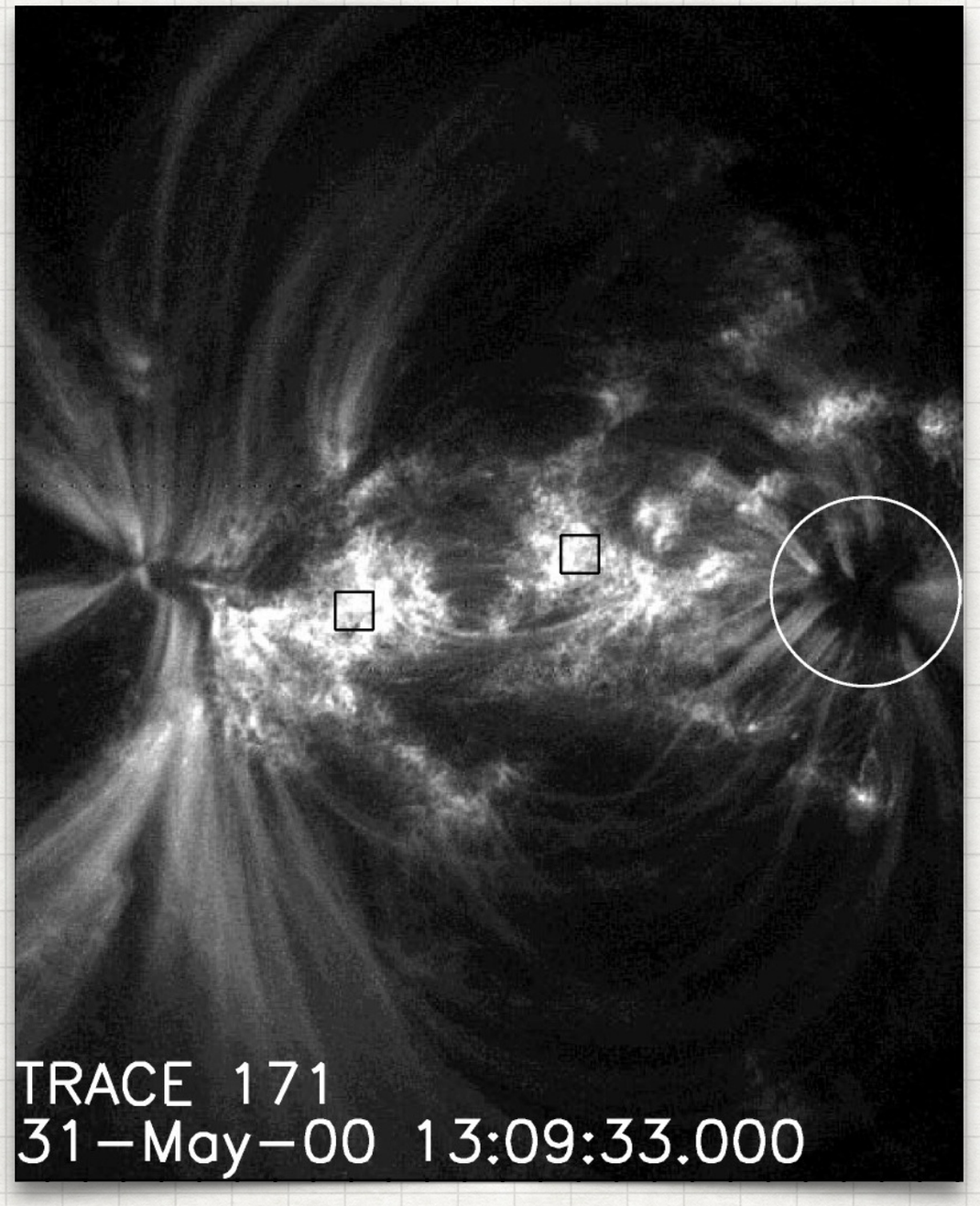

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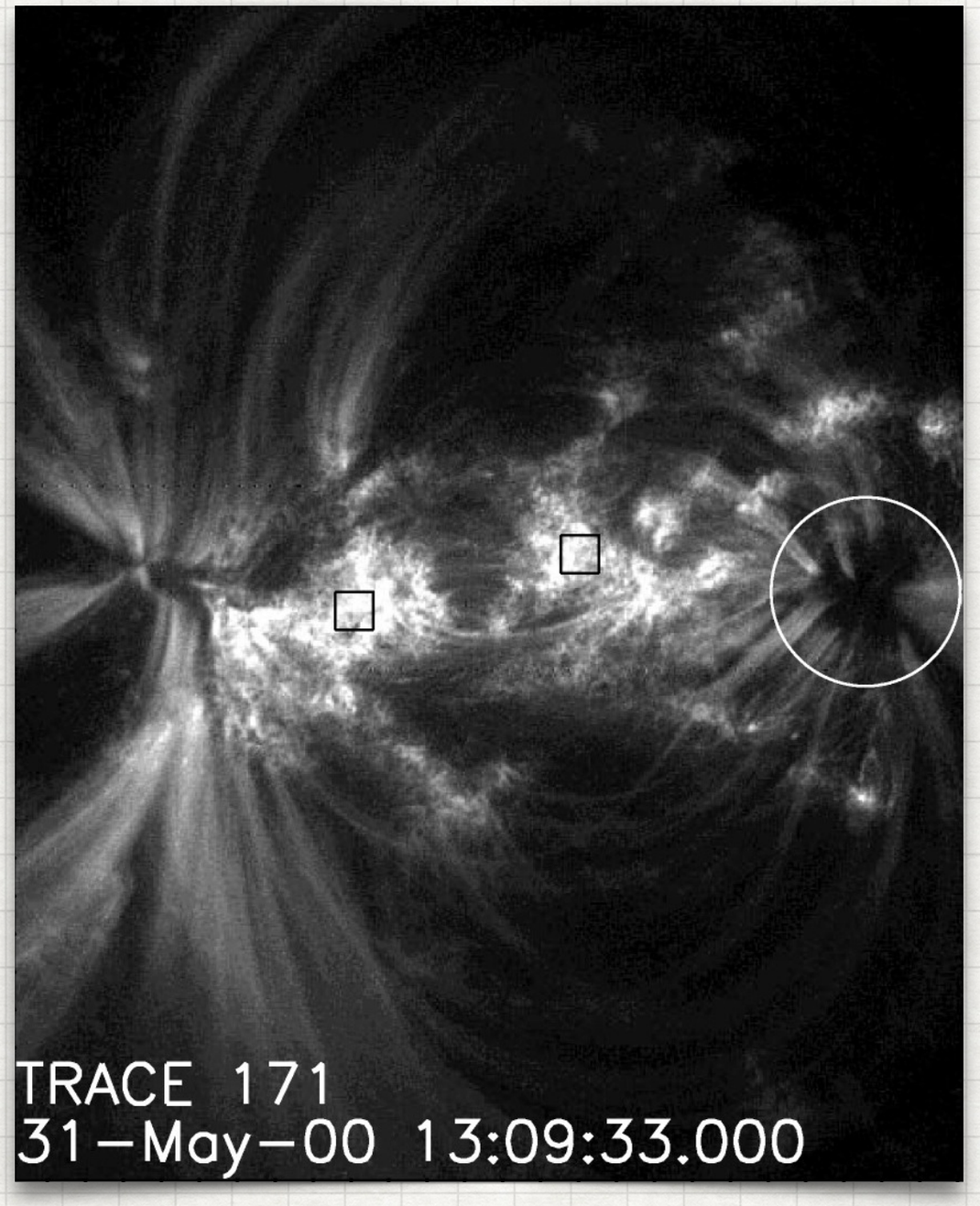

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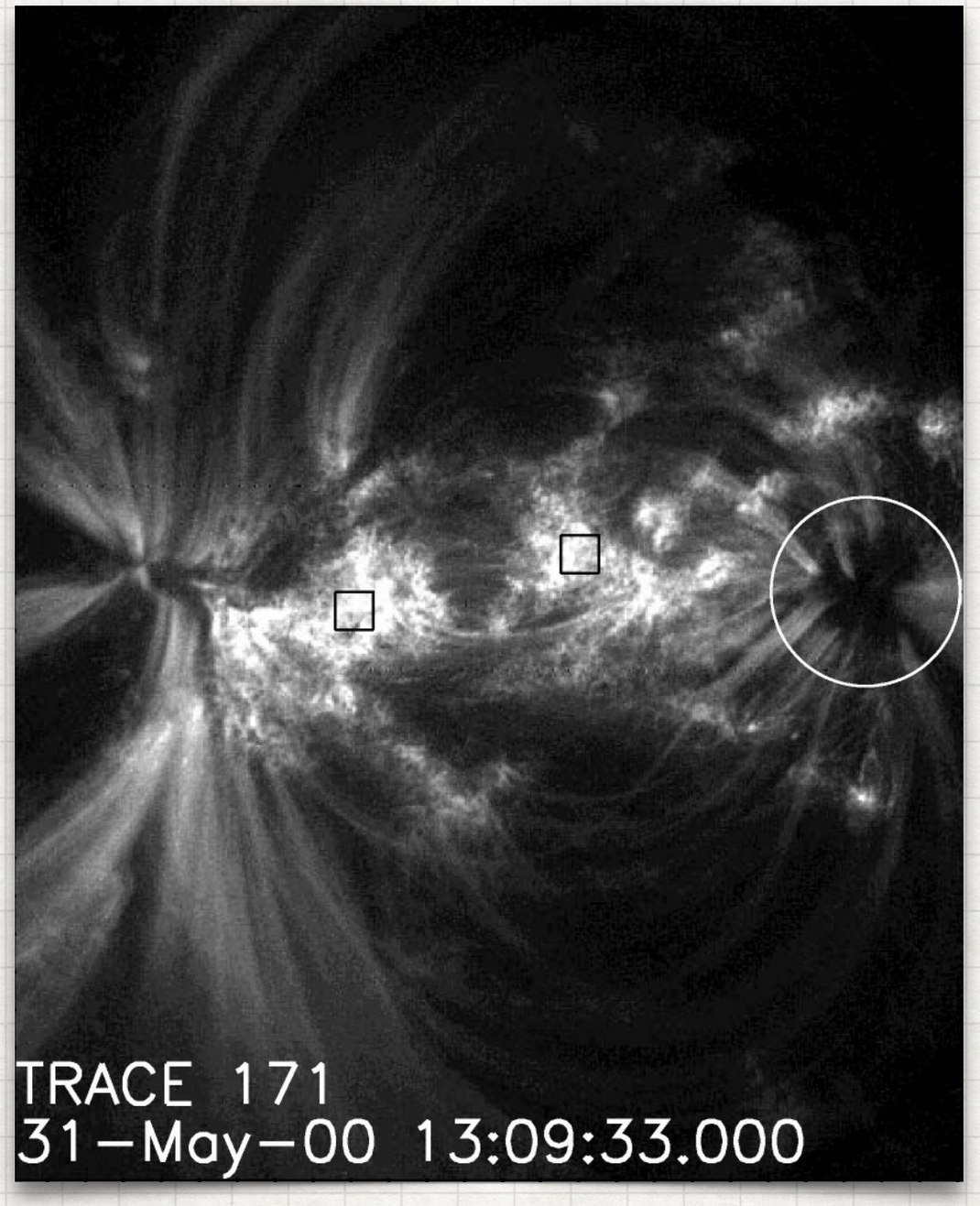

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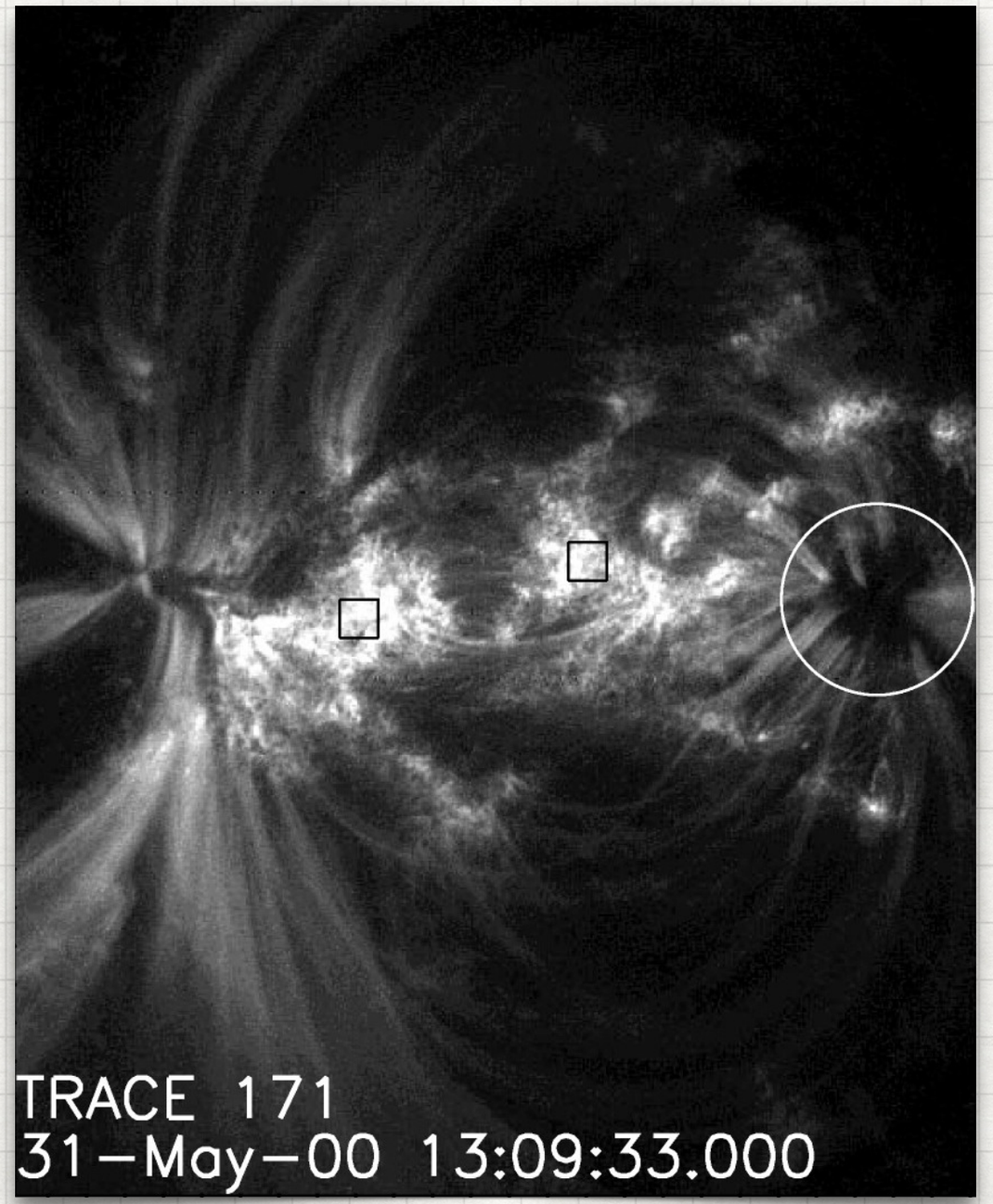

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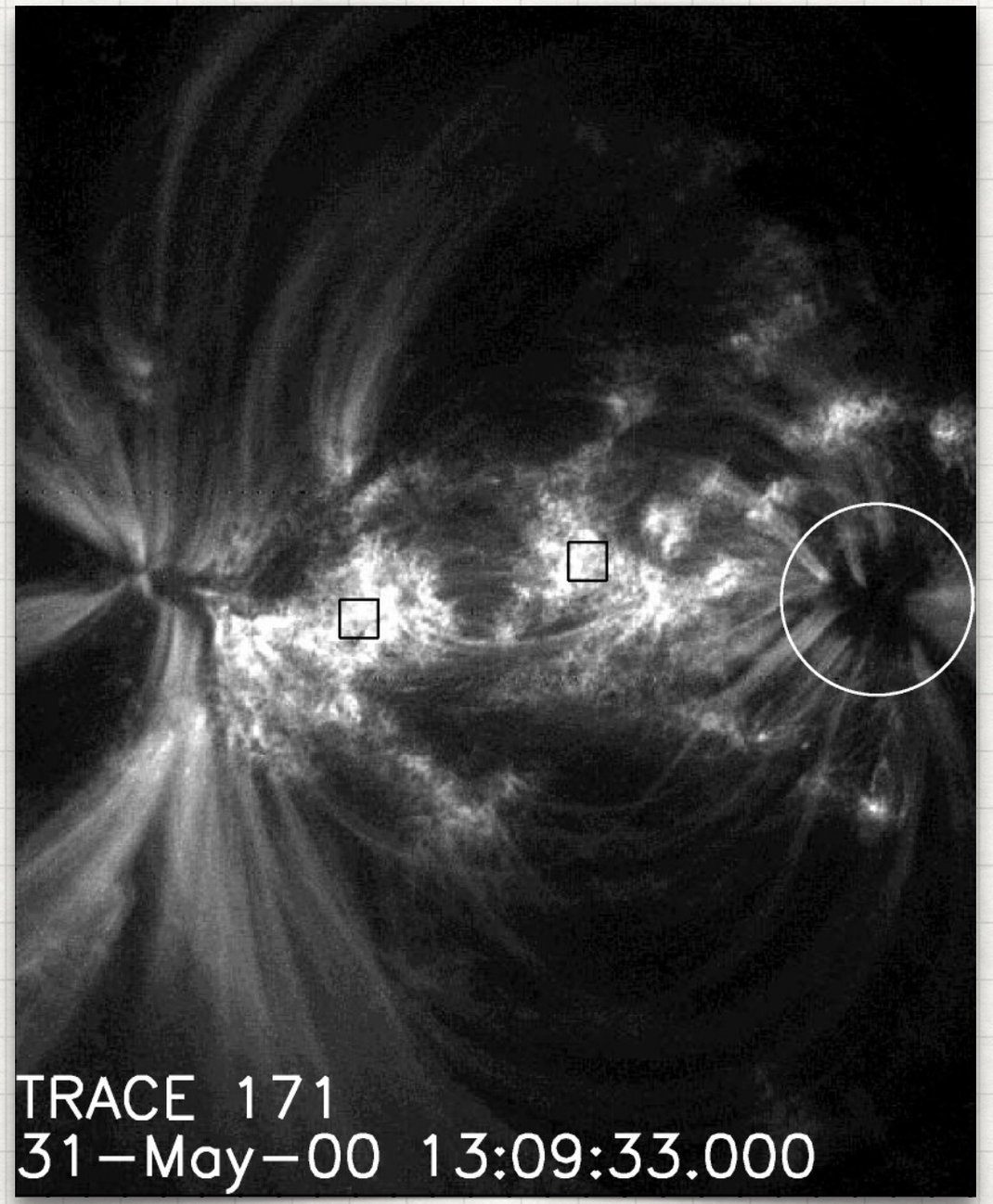

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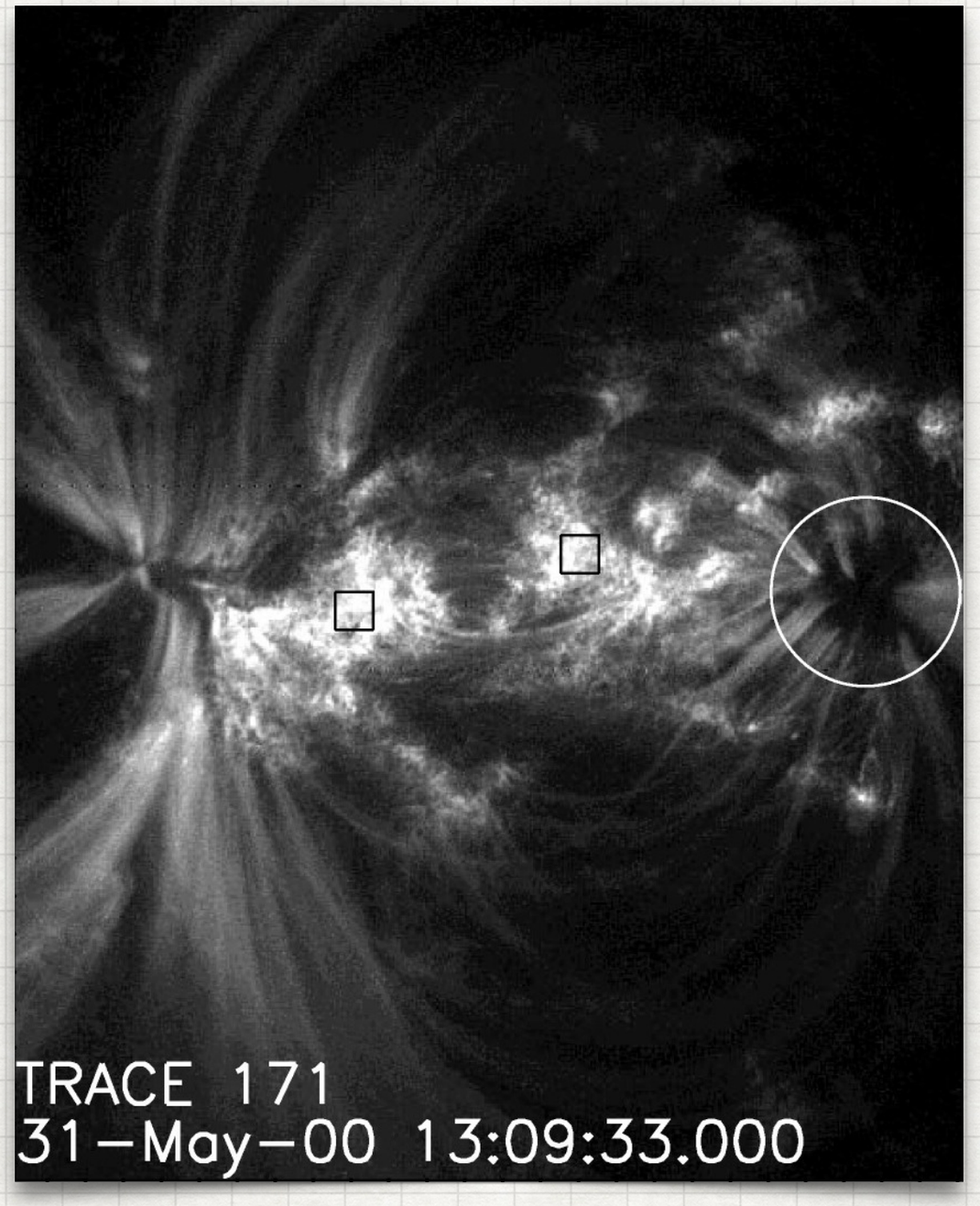

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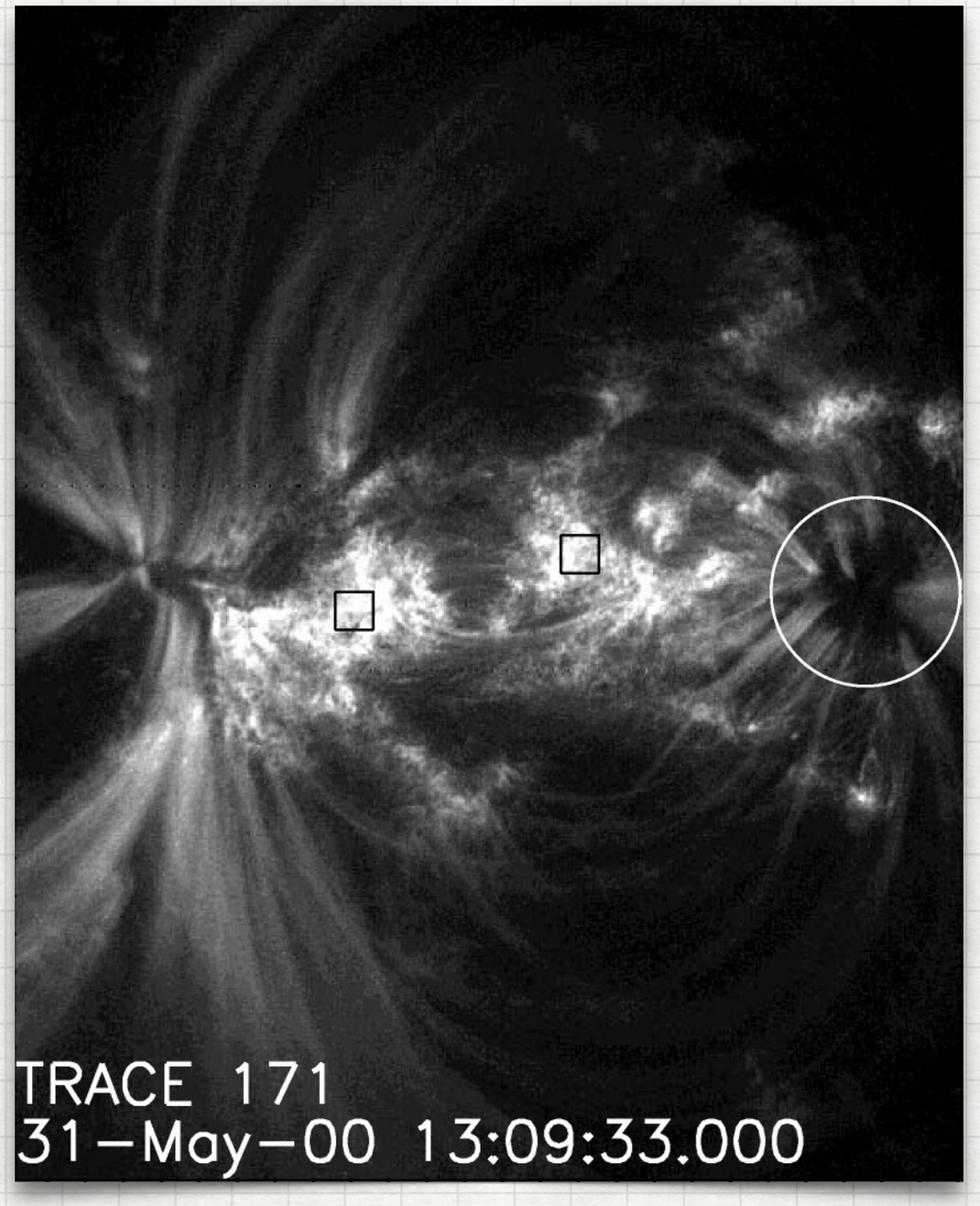

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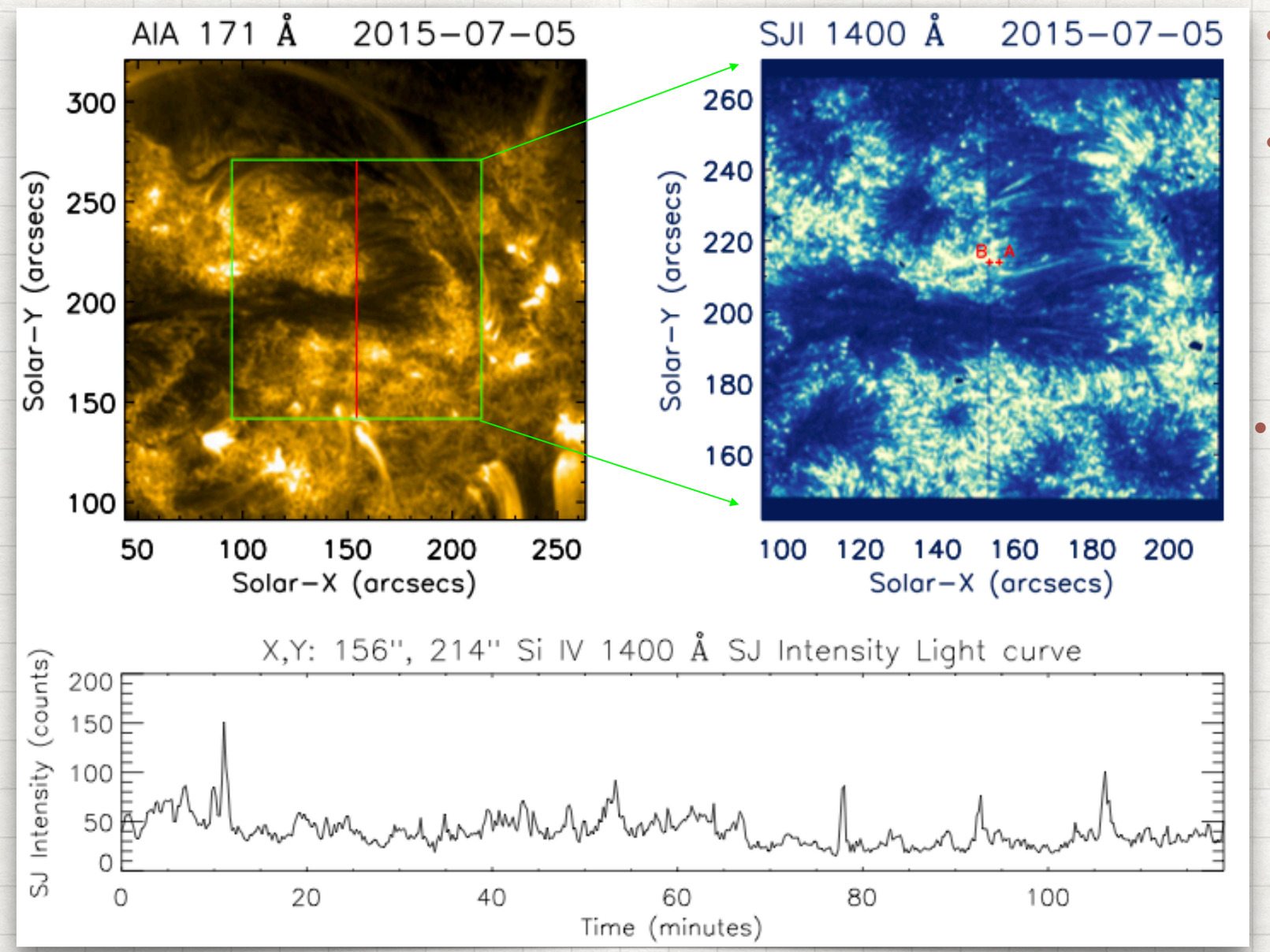
DETAILS OF OBSERVATIONS

Active region (AR 2376) moss observed from 05:16:15 UT to 07:16:23 UT



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- Slit-Jaw Images
  FOV: 119″x119″
  Cadence: 13 secs
  Spatial Resolution ~0.33″
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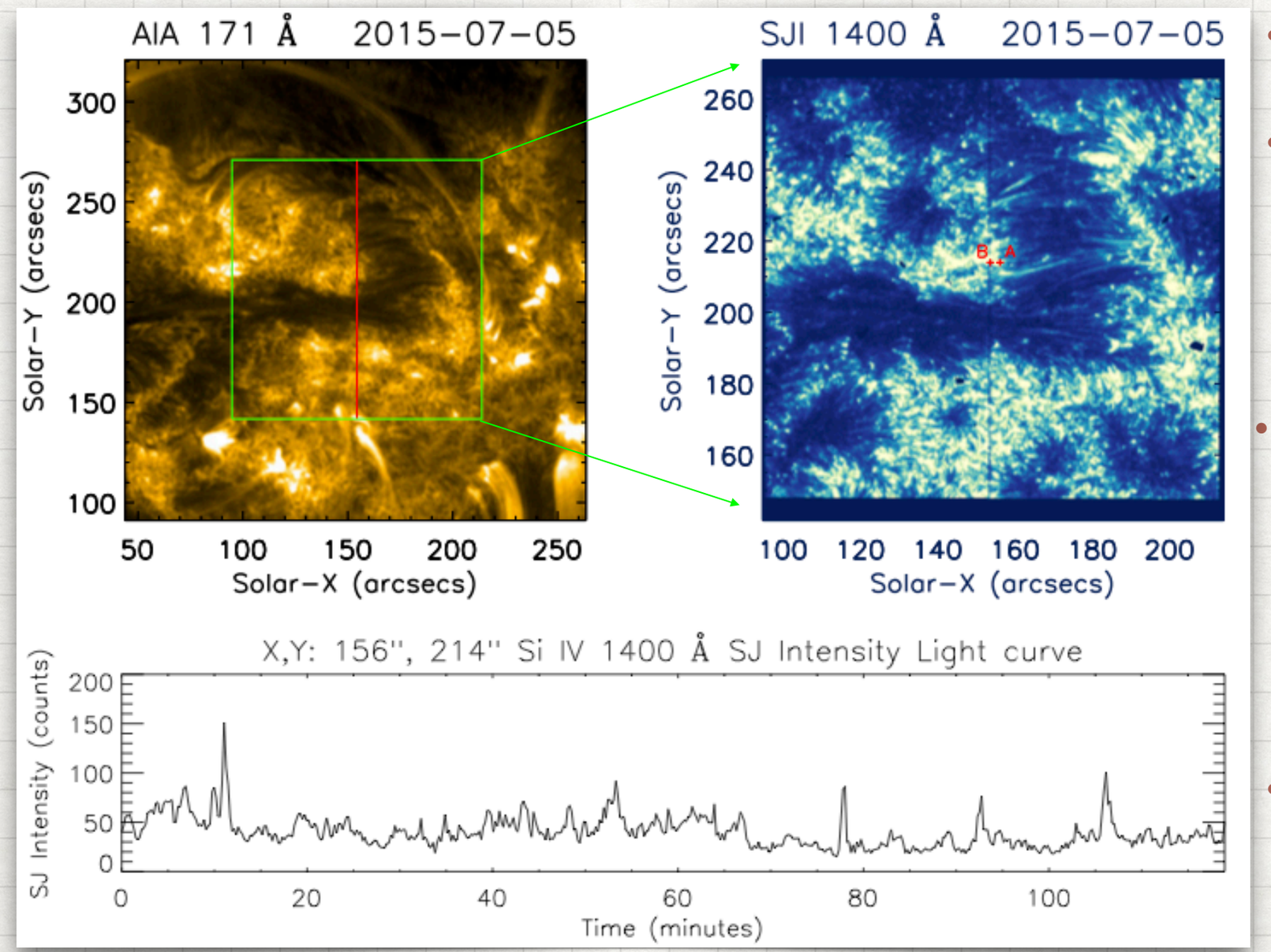

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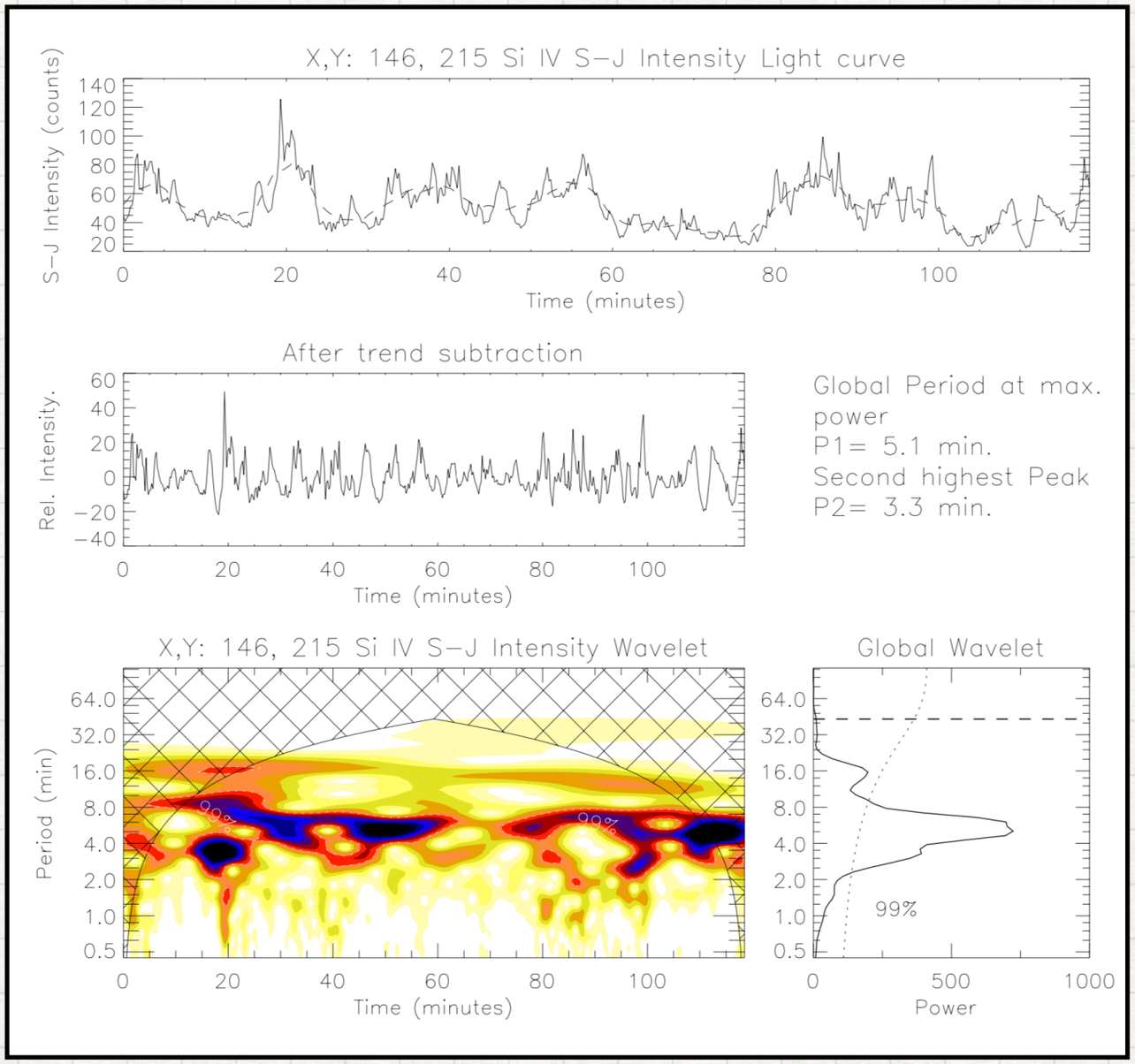
- Transition Region Emission

SJIs: Si IV 1400 Å passband

Spectral Data: Si IV 1403 Å

WAVELET ANALYSIS



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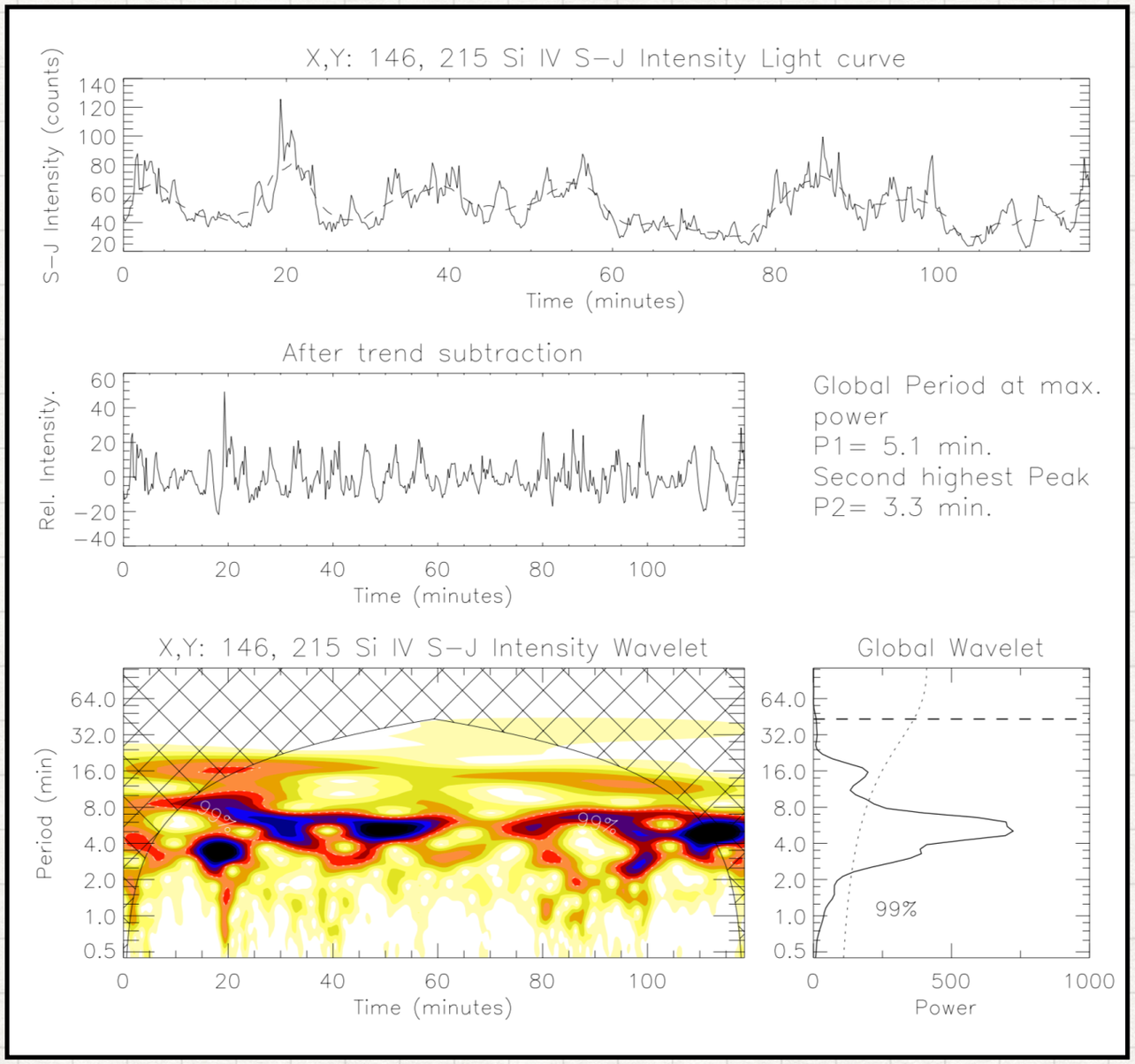

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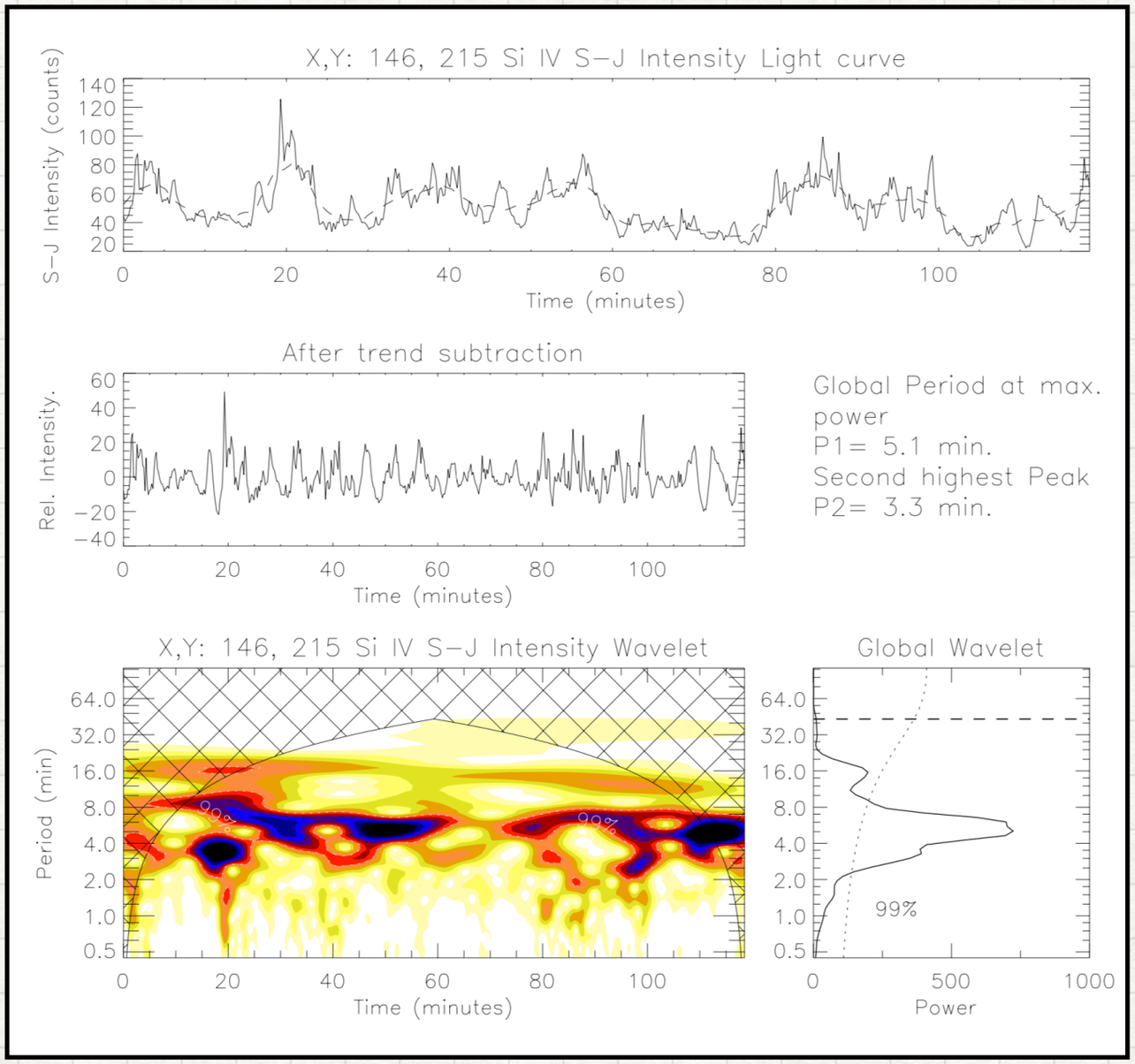

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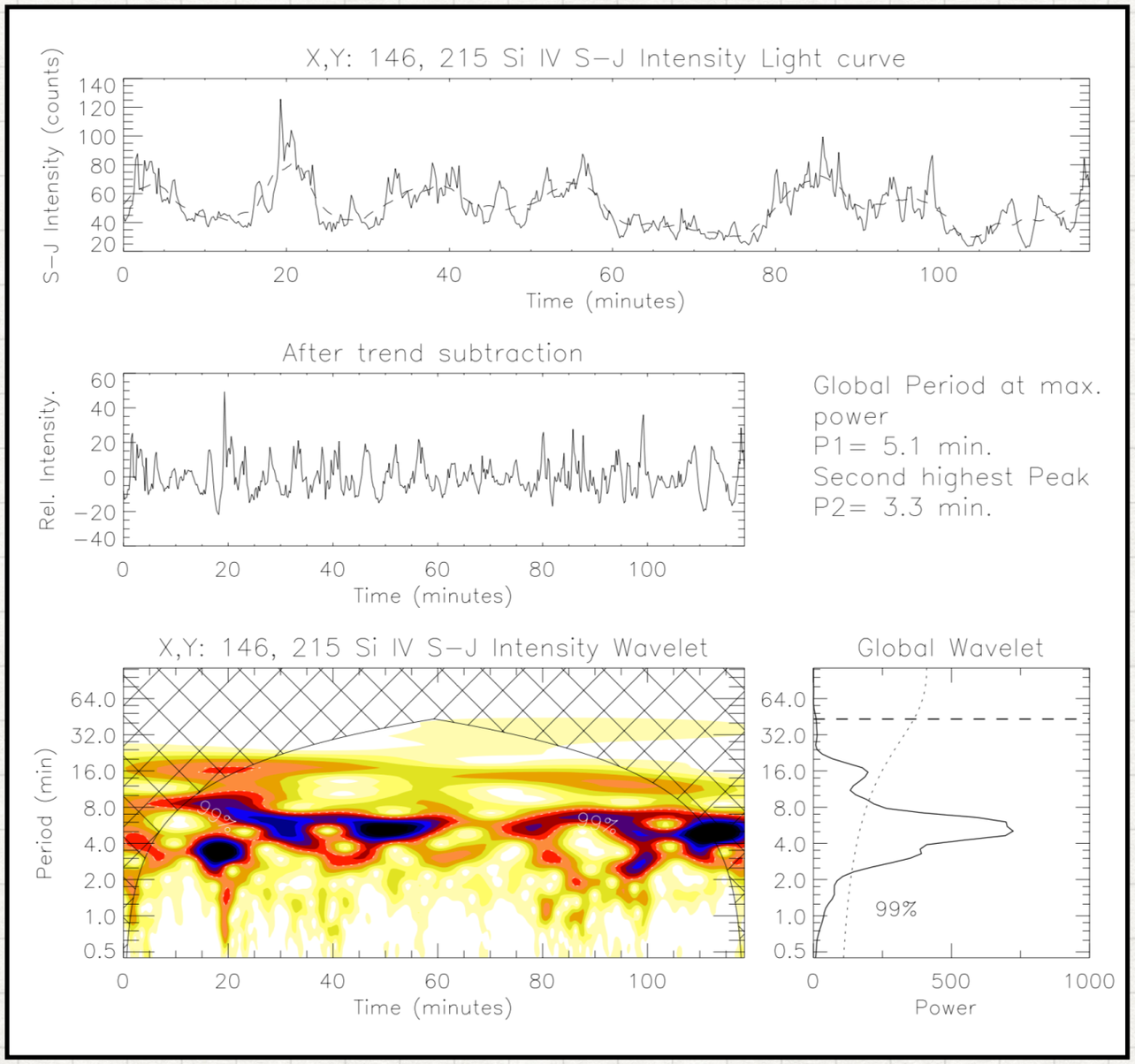

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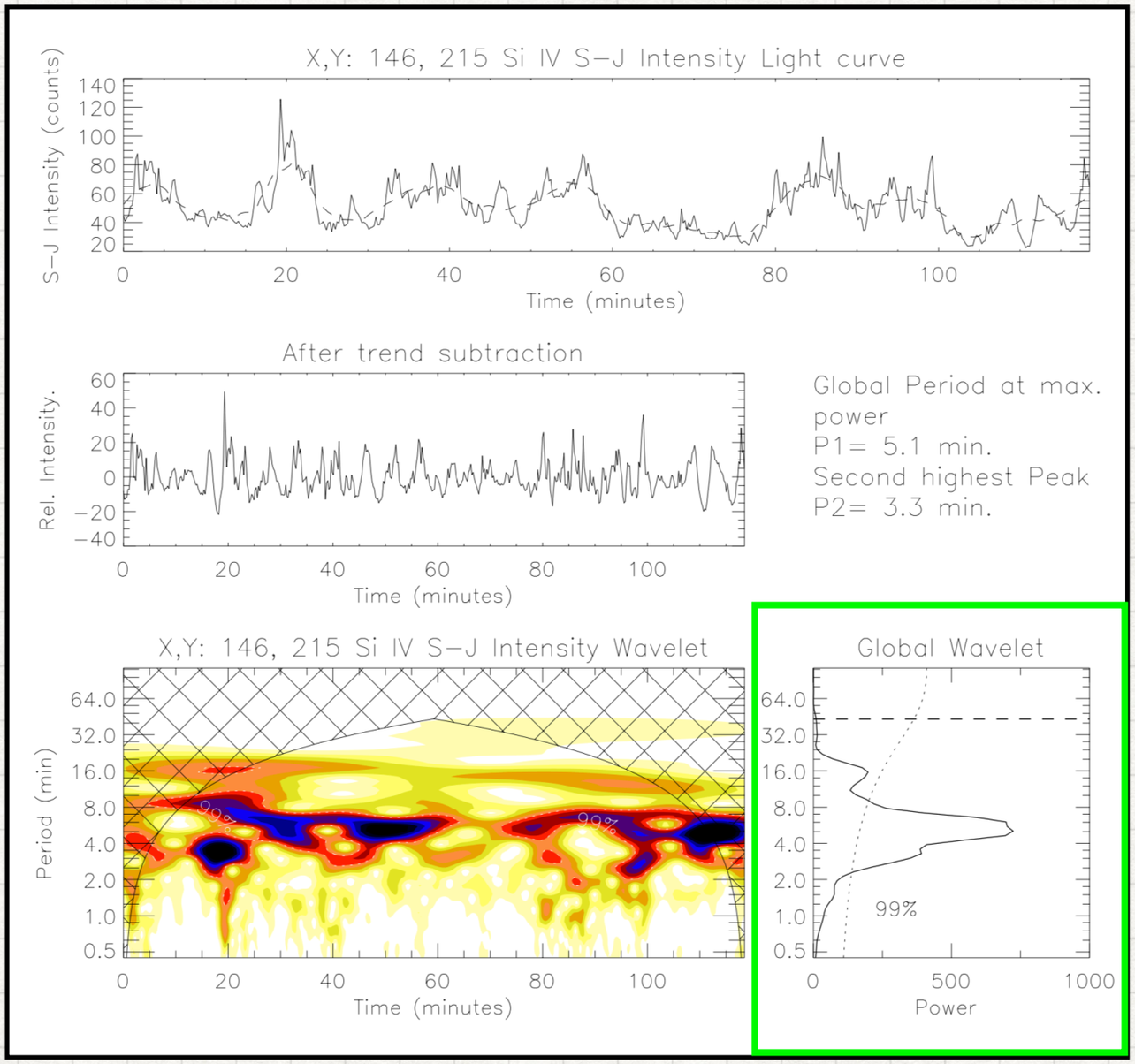

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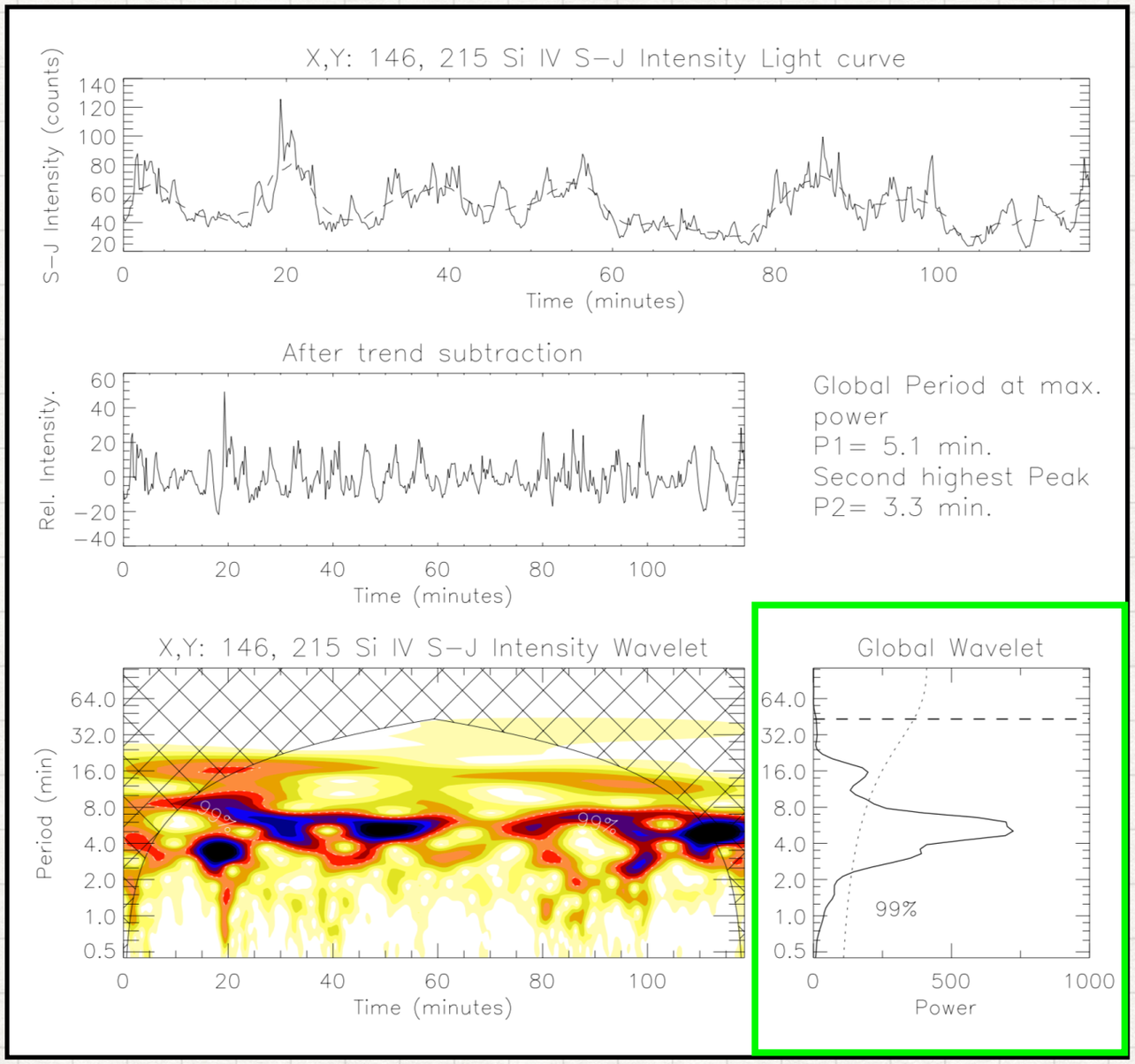

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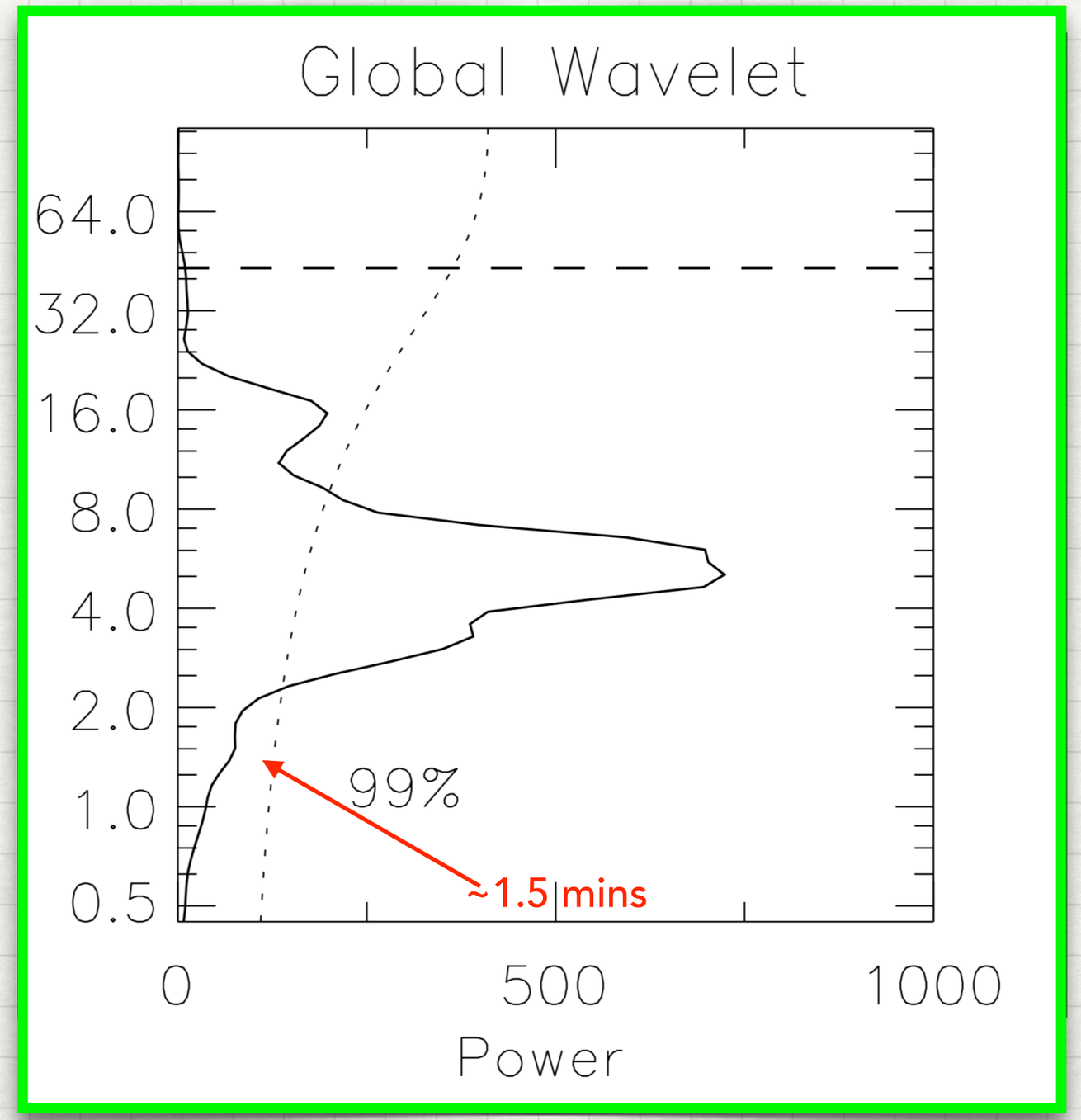

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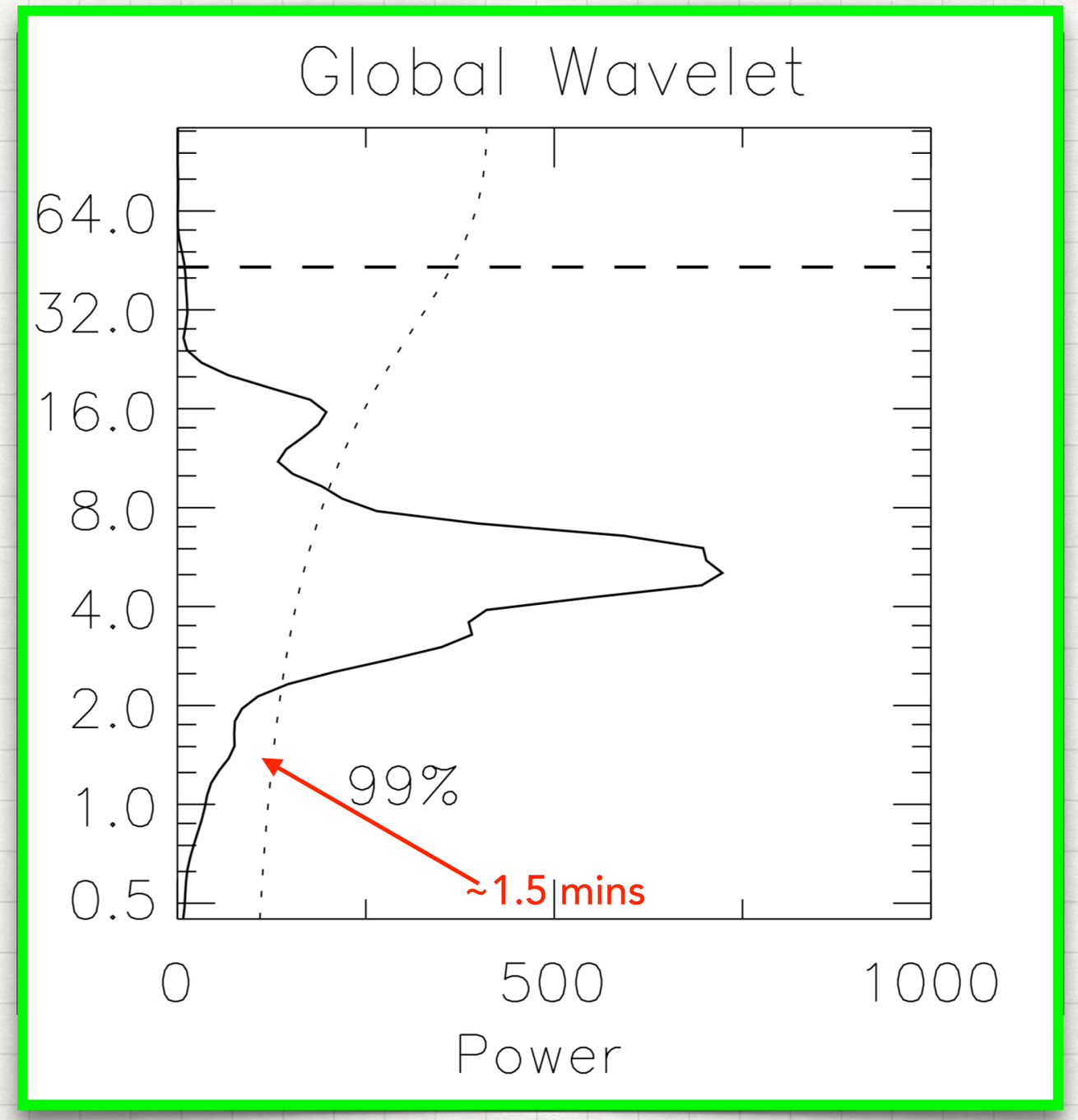

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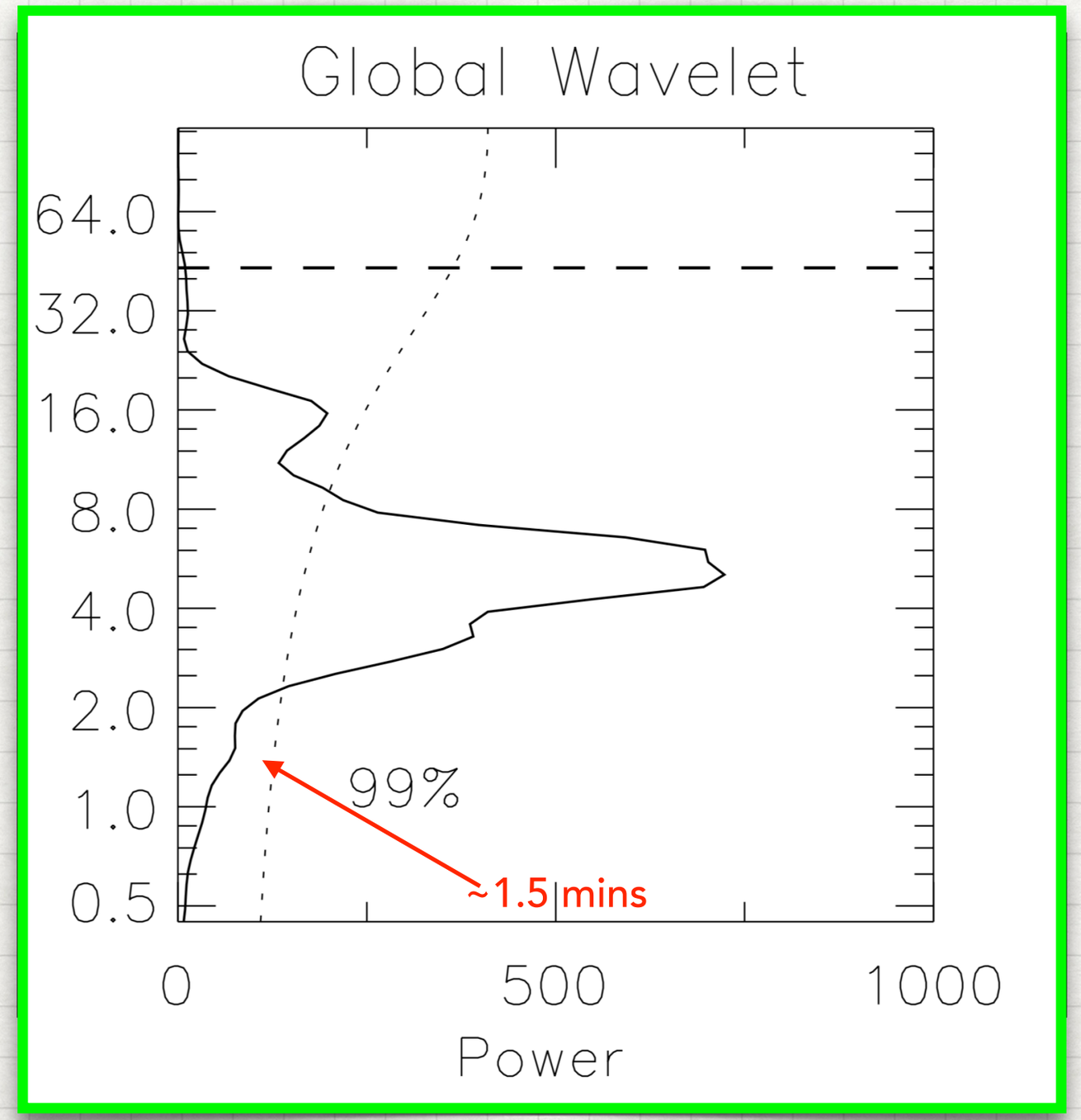

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- Our interest is to explore the dynamics of the 1-2 mins oscillations.
- To study the short periodicities (high frequency dynamics) we suppress longer periodicities (above 5 minutes).

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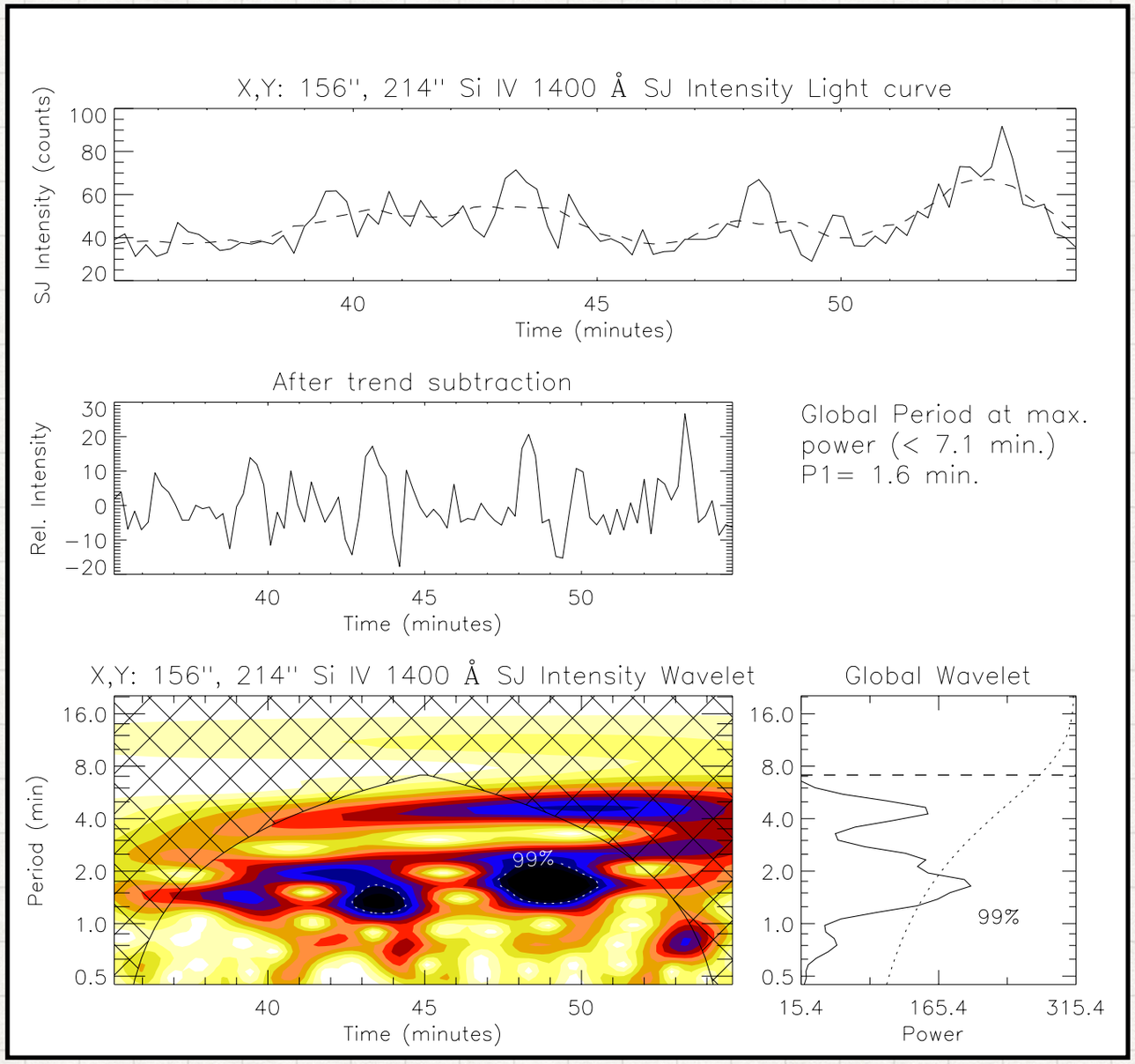

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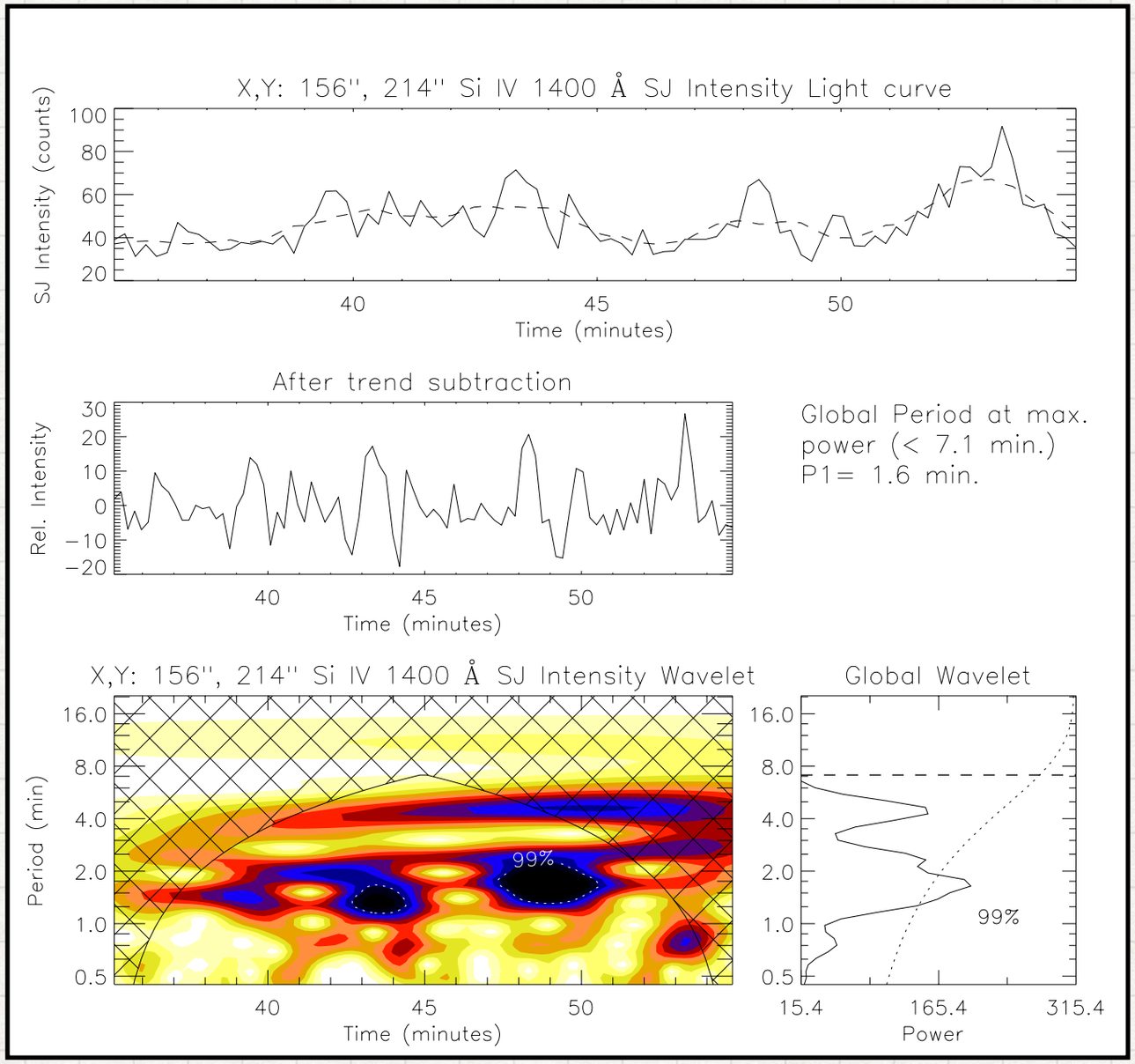

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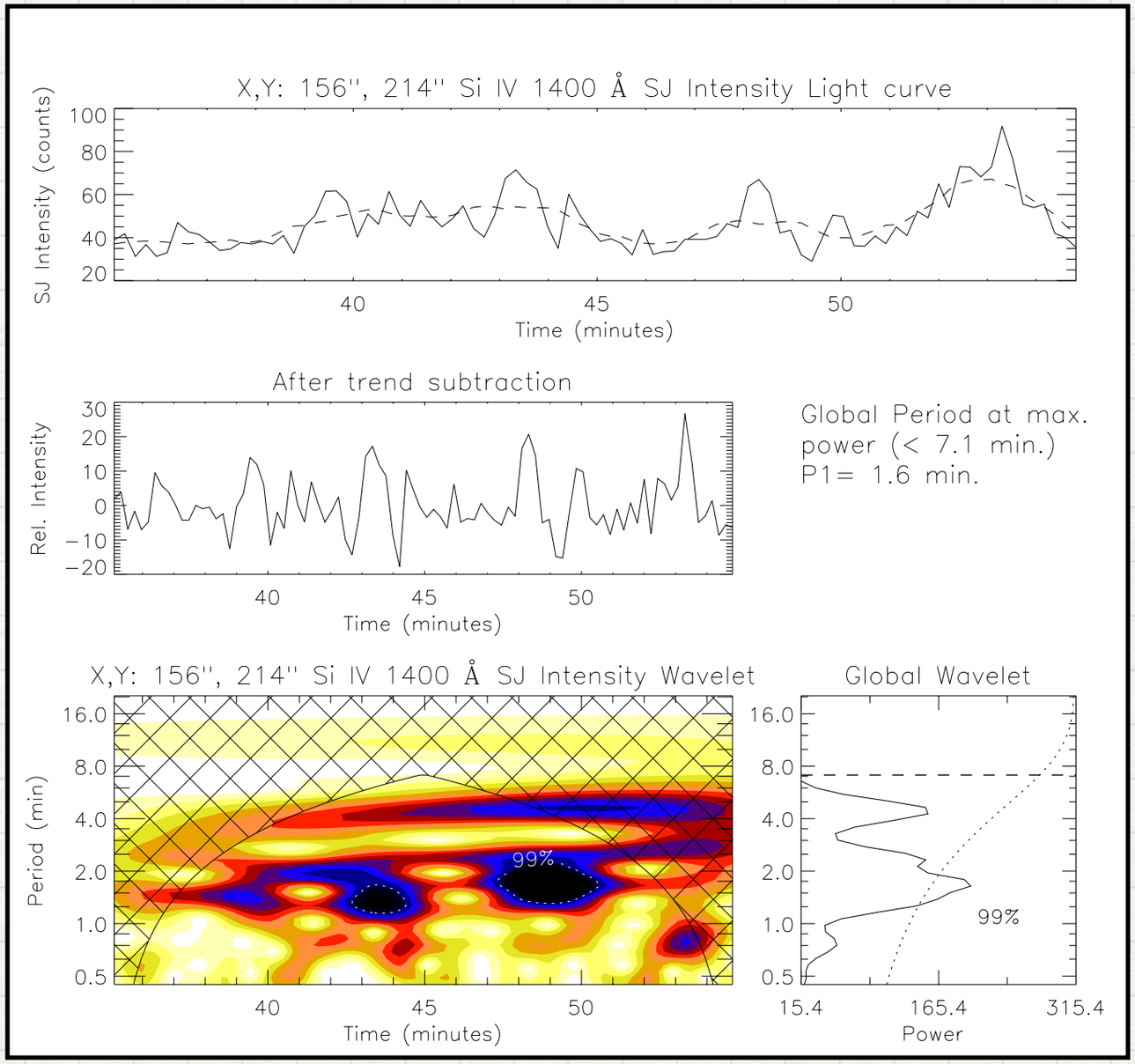

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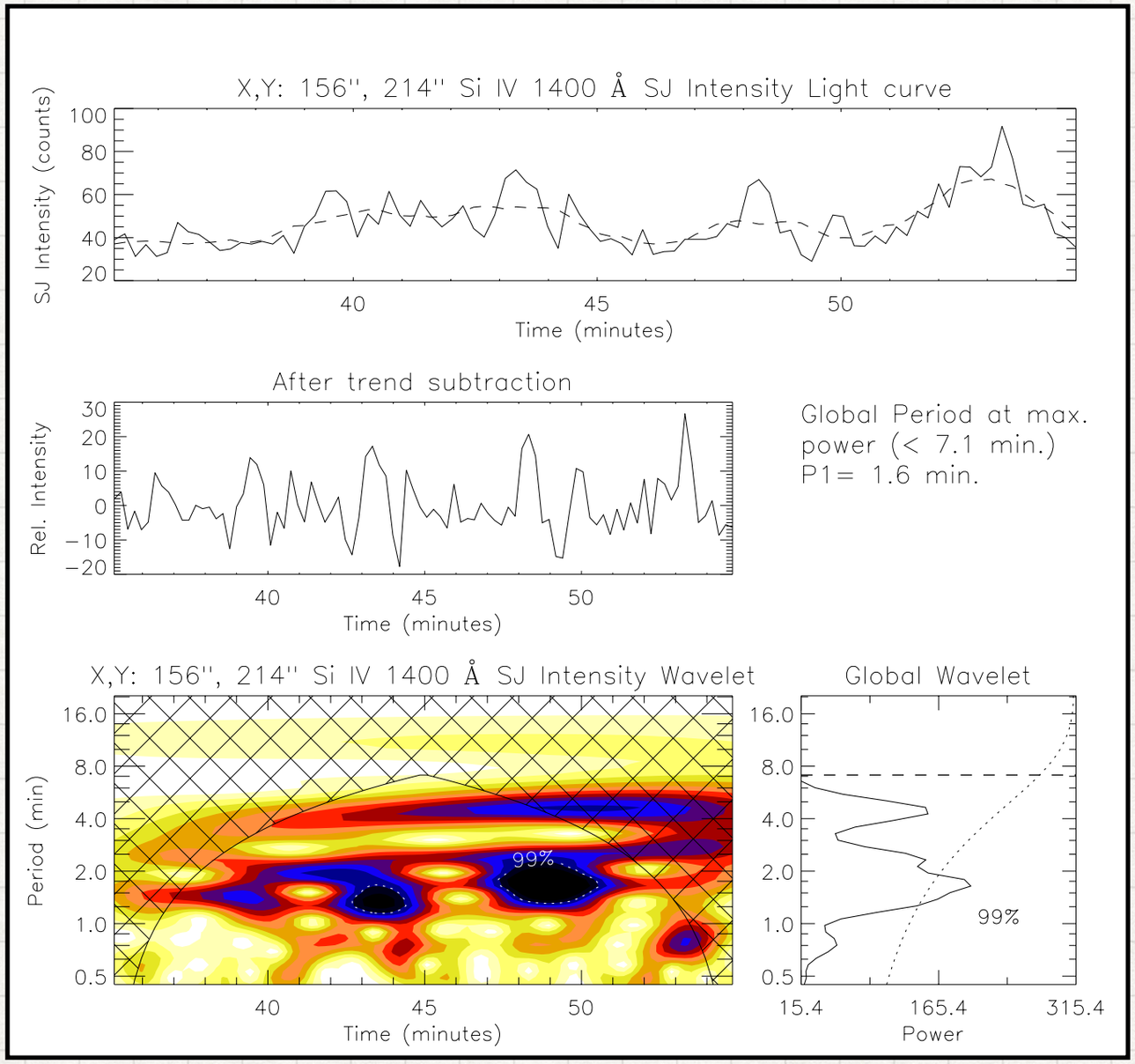

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- These periodicities occur for very short duration or could be damping fast.

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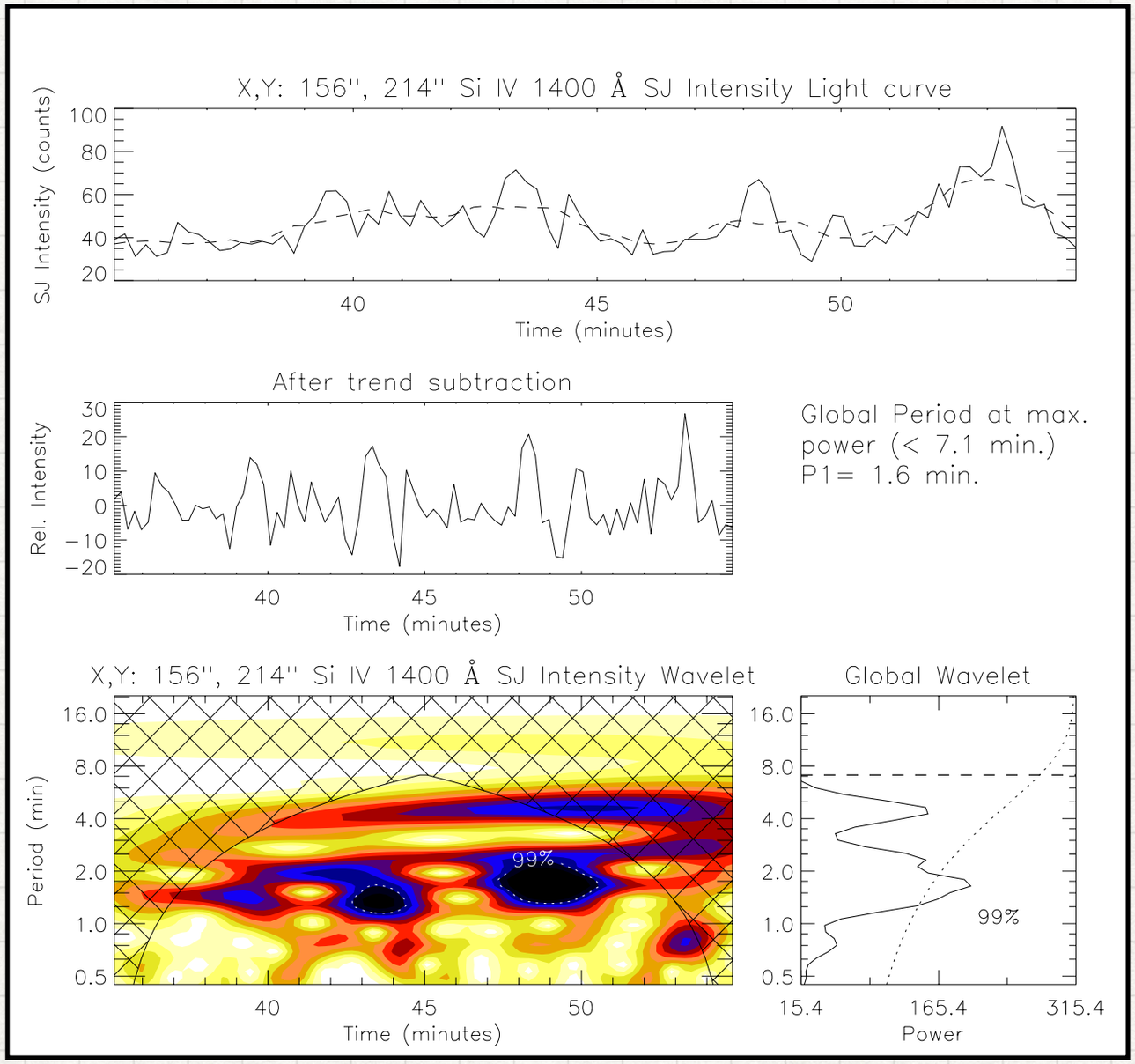

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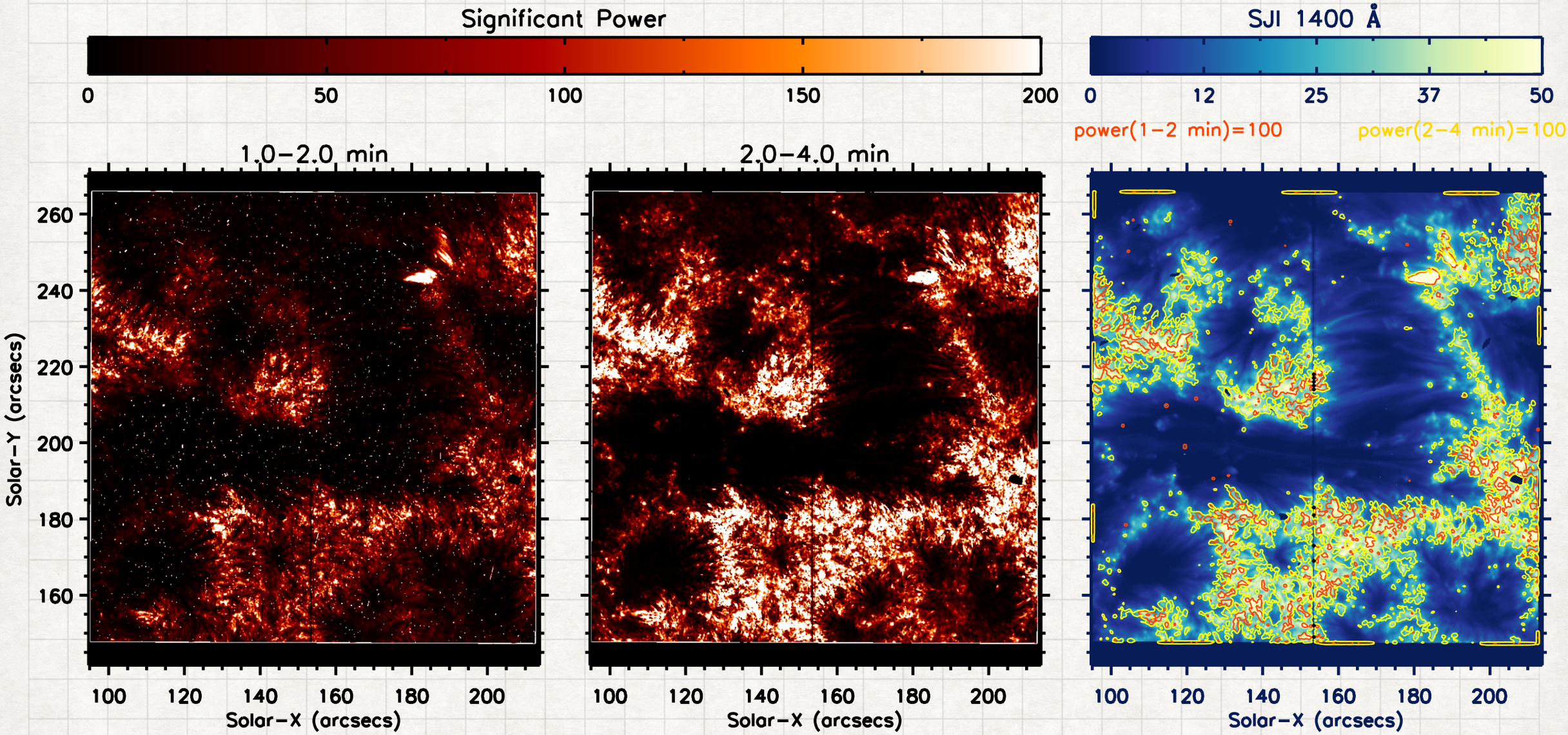
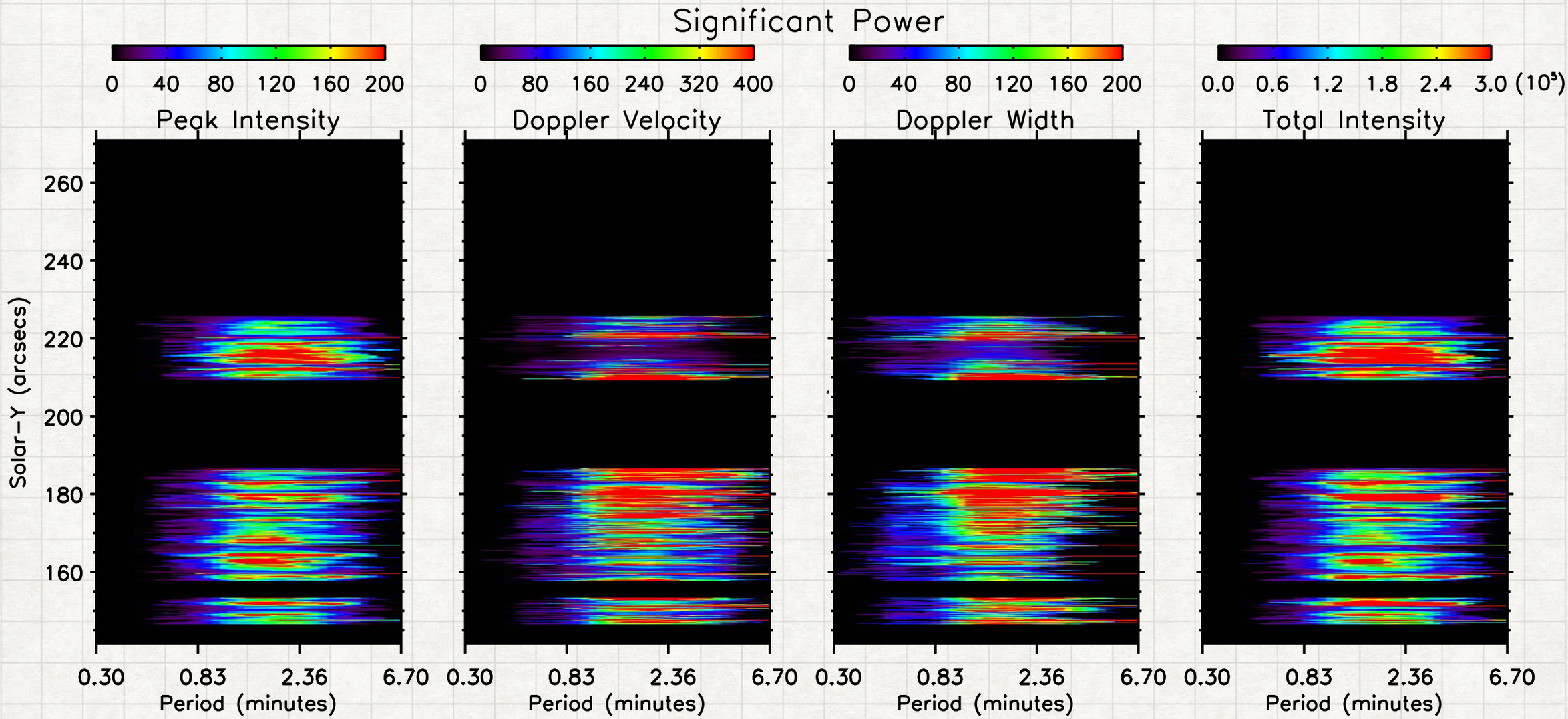
- This analysis reveals that there is a presence of significant periodicities of around 1-2 minutes.
- These periodicities occur for very short duration or could be damping fast.
- The wavelet map gives indications even of shorter periodicities below 1 minute to be present but they are not significant.

SJI POWER MAPS



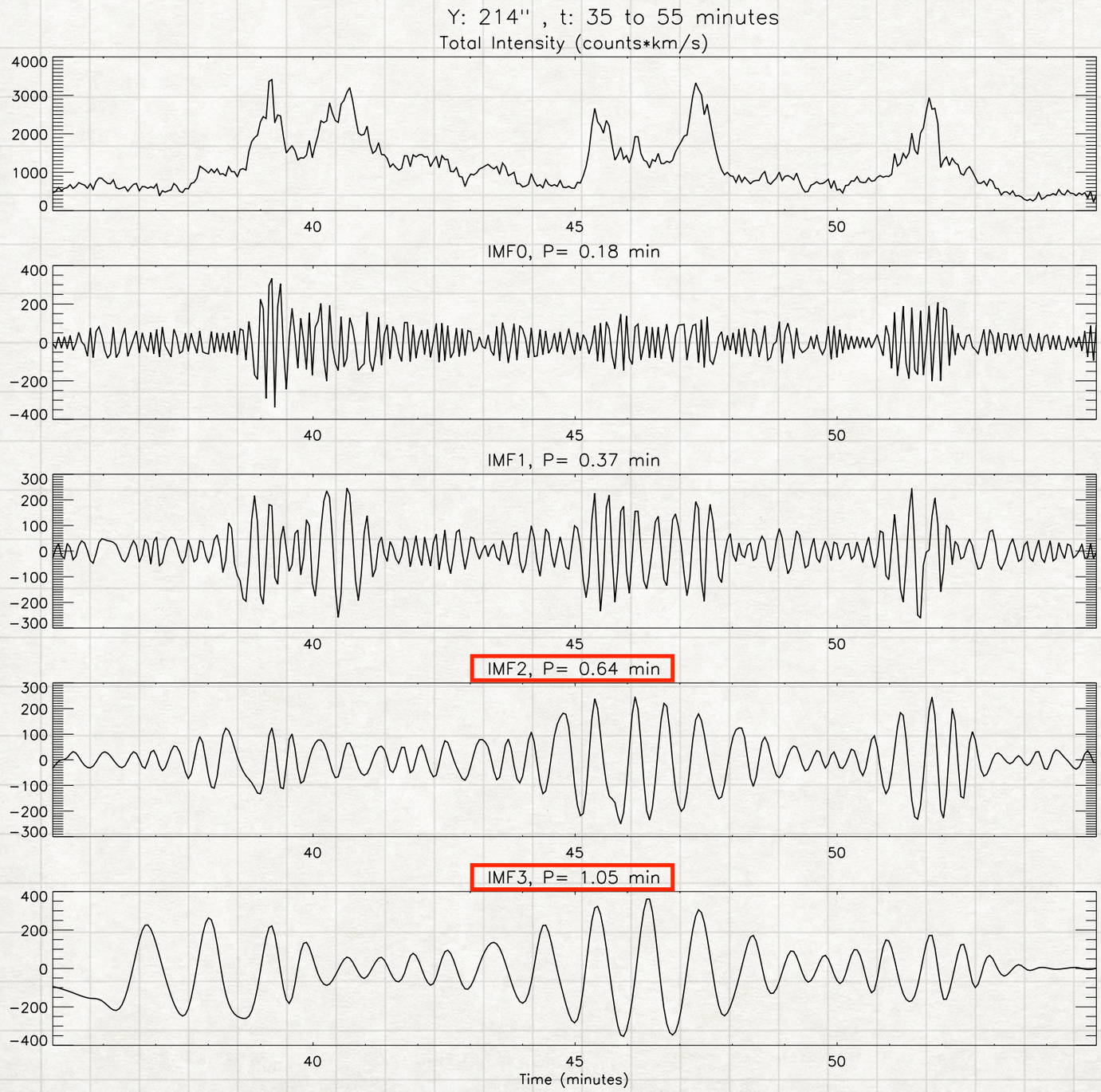
The finer and smaller spatial extents of the contours at various locations over the field of view show that these oscillations possess high power in the localized regions within the bright moss and indicate towards the fine structuring of the moss regions.

SPECTRAL POWER MAPS



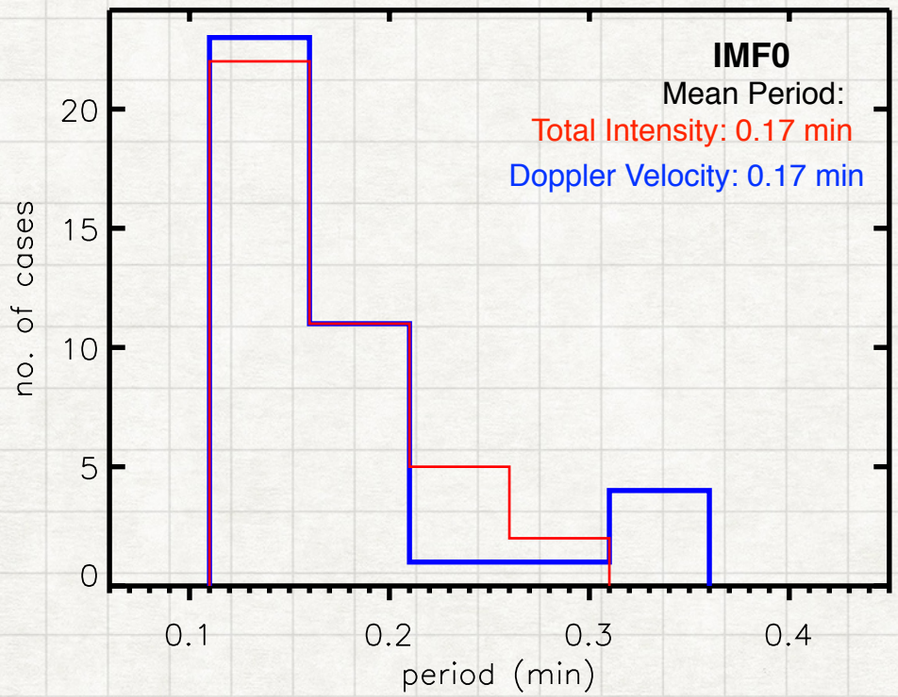
The spectral power maps confirms the presence of significant power in high frequency oscillations of range 1-2 minutes and the fine structure of the active region moss can be observed in the spectral parameter power maps as well.

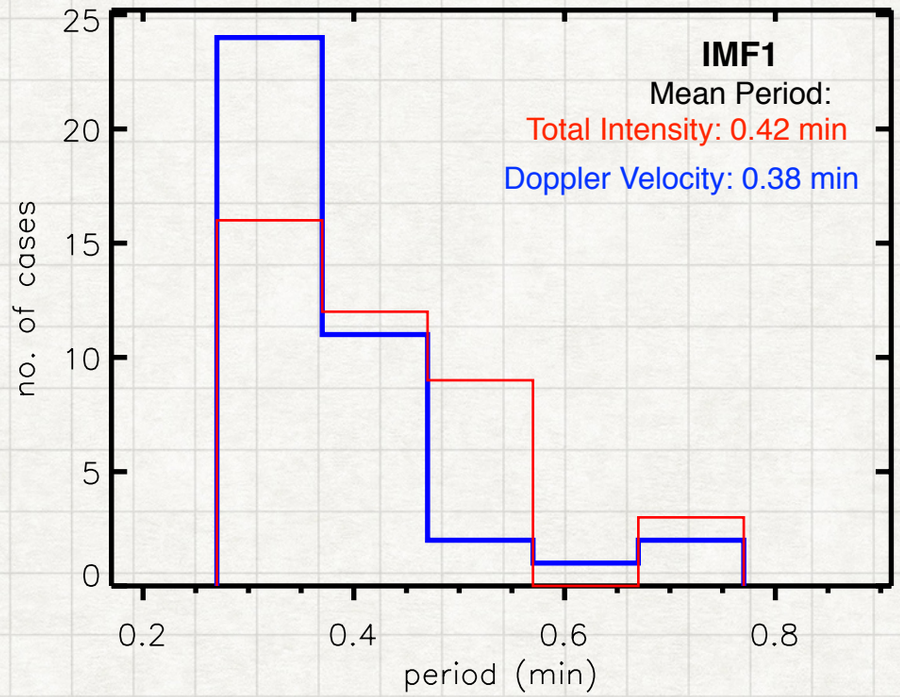
EMD ANALYSIS

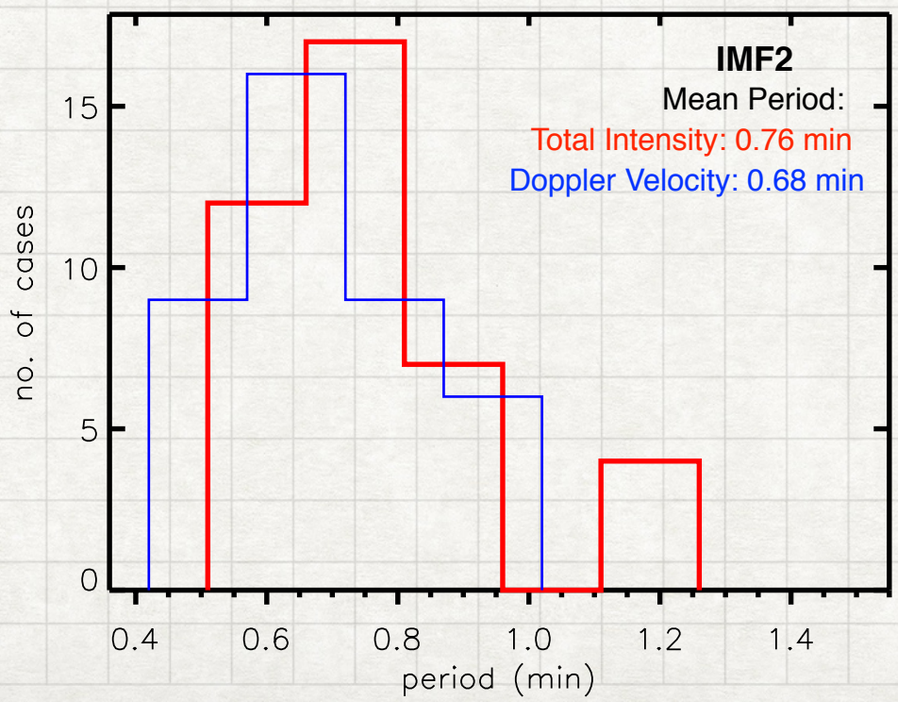


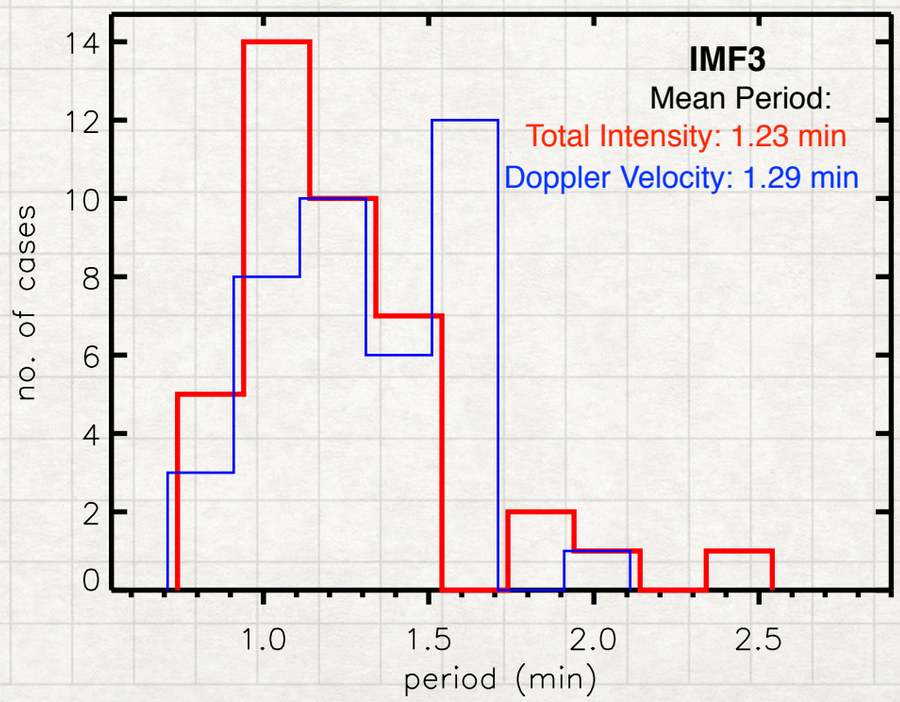
- Different IMFs (intrinsic mode functions) obtained using EMD (empirical mode decomposition) technique.
- The period for each IMF is obtained using FFT (Fast-Fourier Transform).
- The presence of periods from ~1 minute are marked in red.
- IMFs obtained from EMD confirms the presence of periodicities of ~1 minute.

STATISTICAL STUDY









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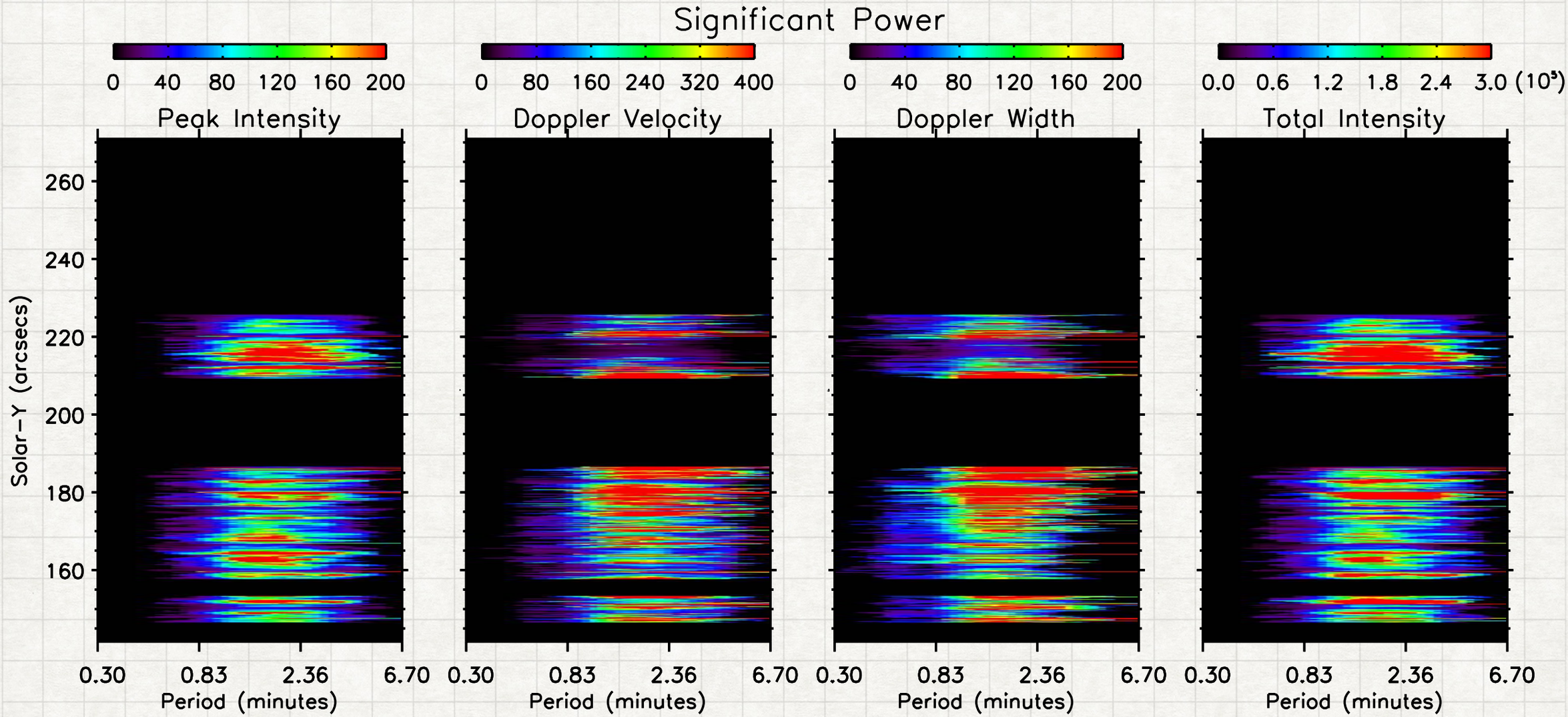

Low Power below 0.7 minutes and above 2 minutes

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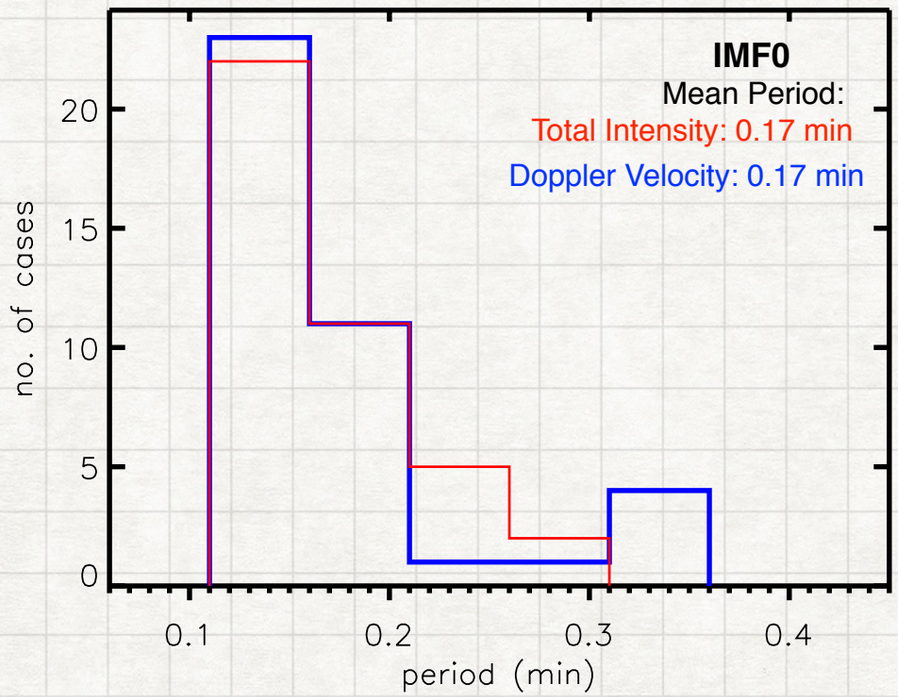
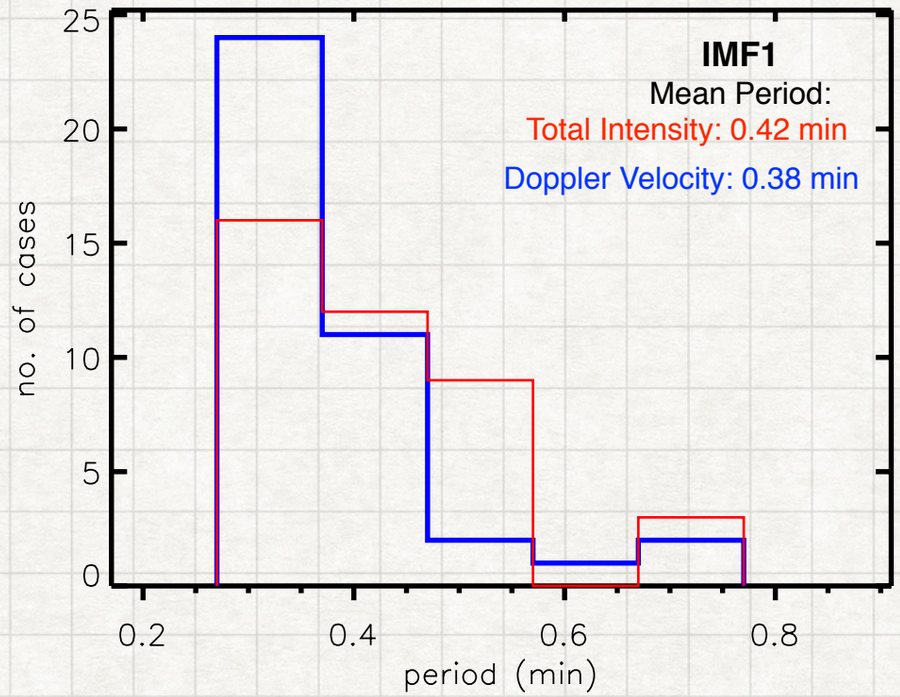
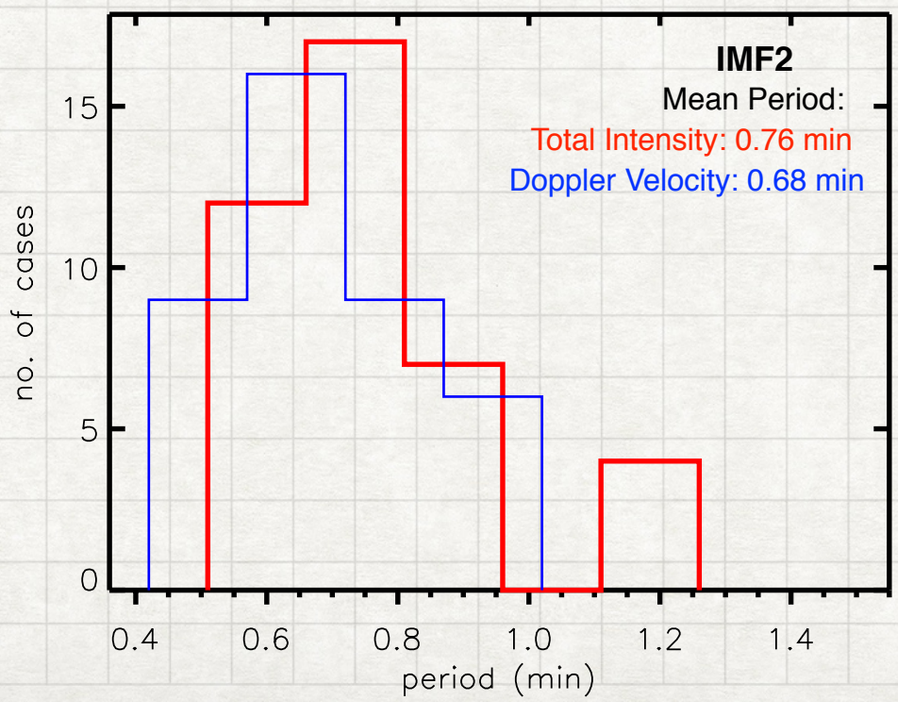
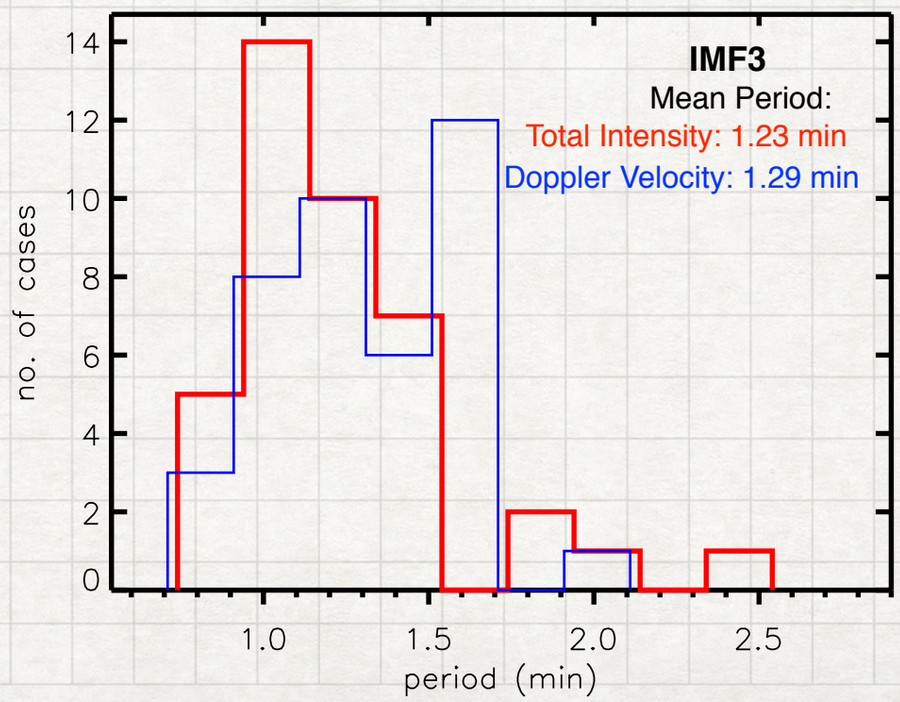
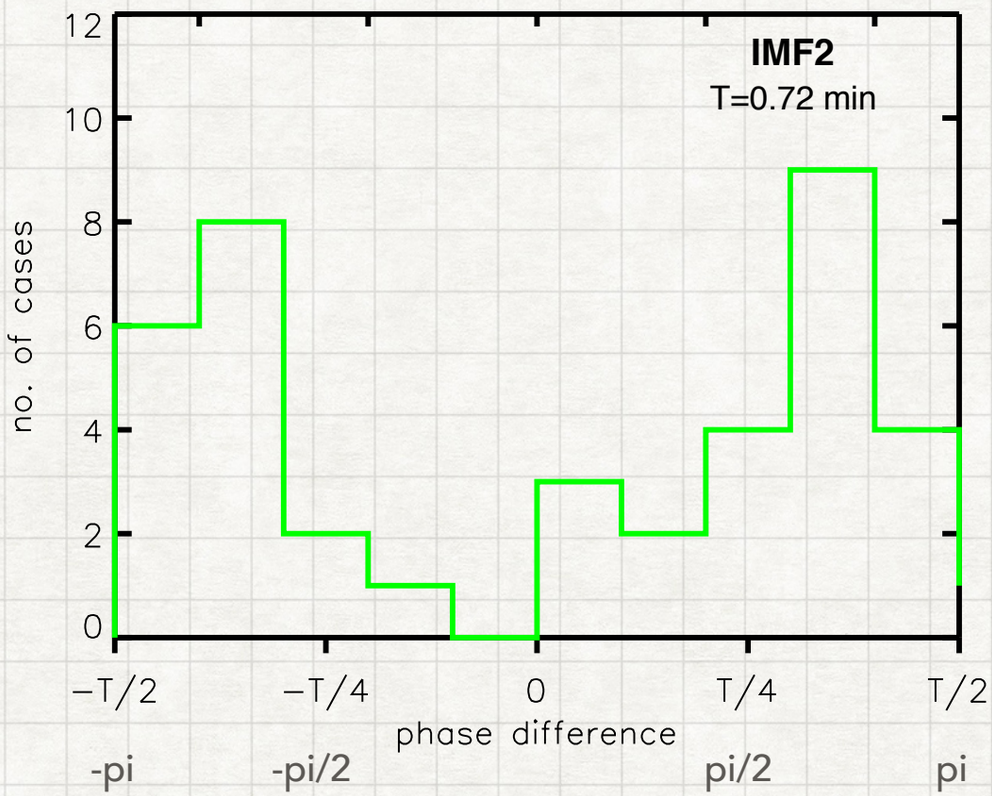


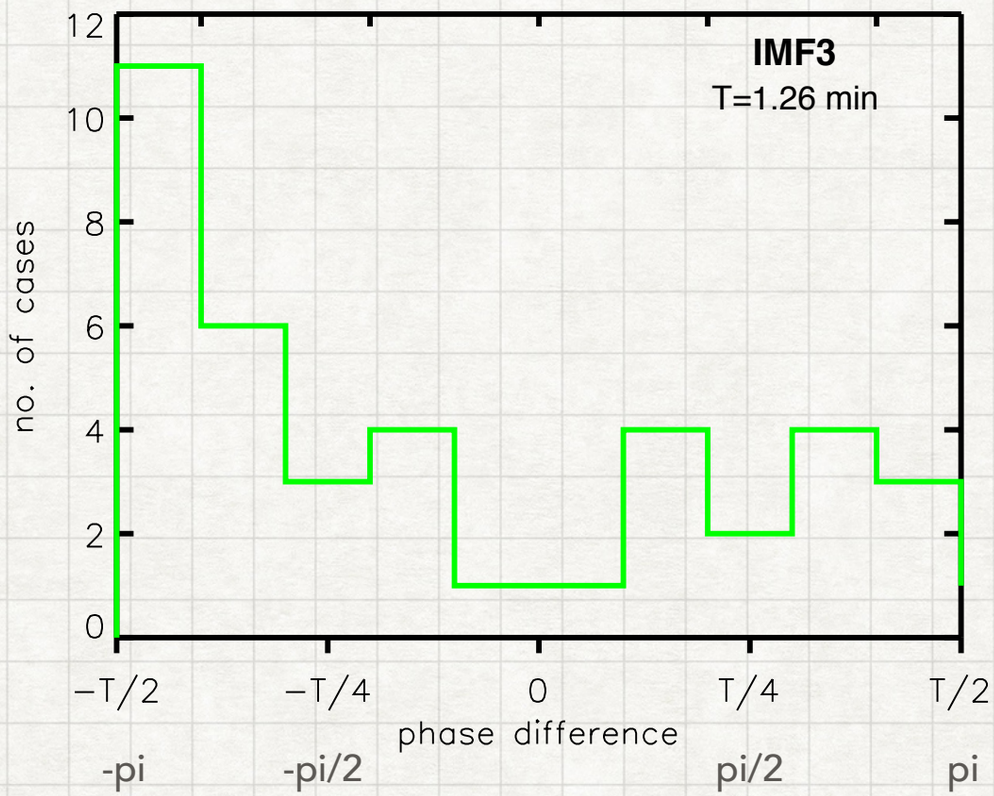






PHASE DIFFERENCE ANALYSIS





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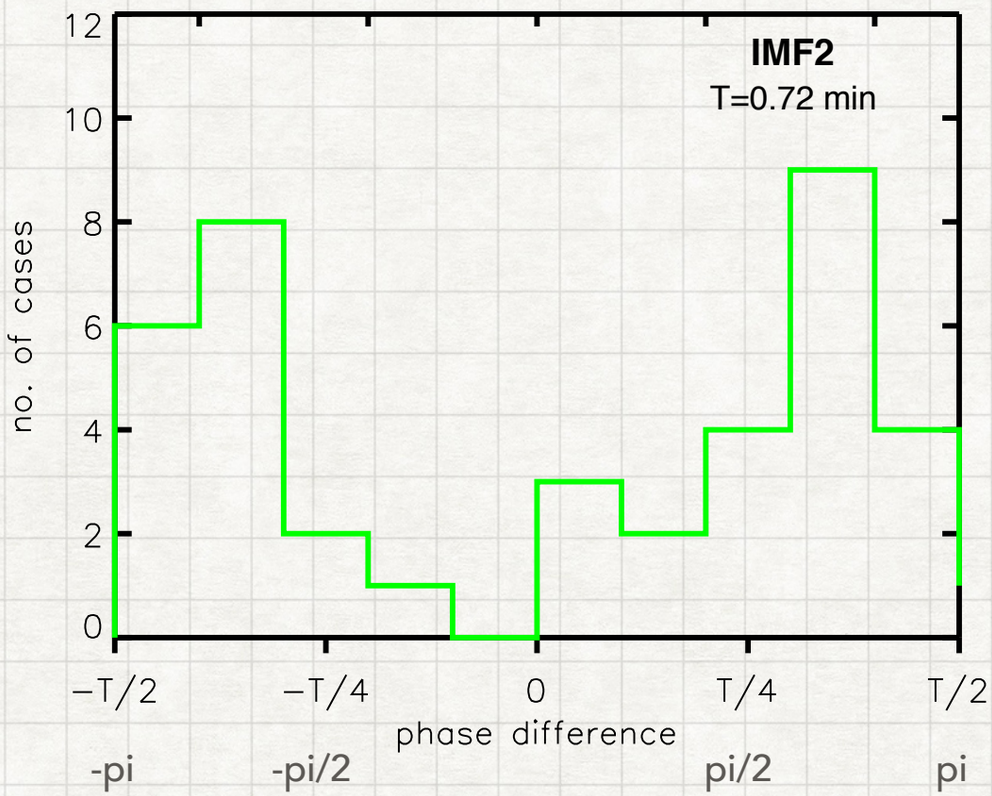
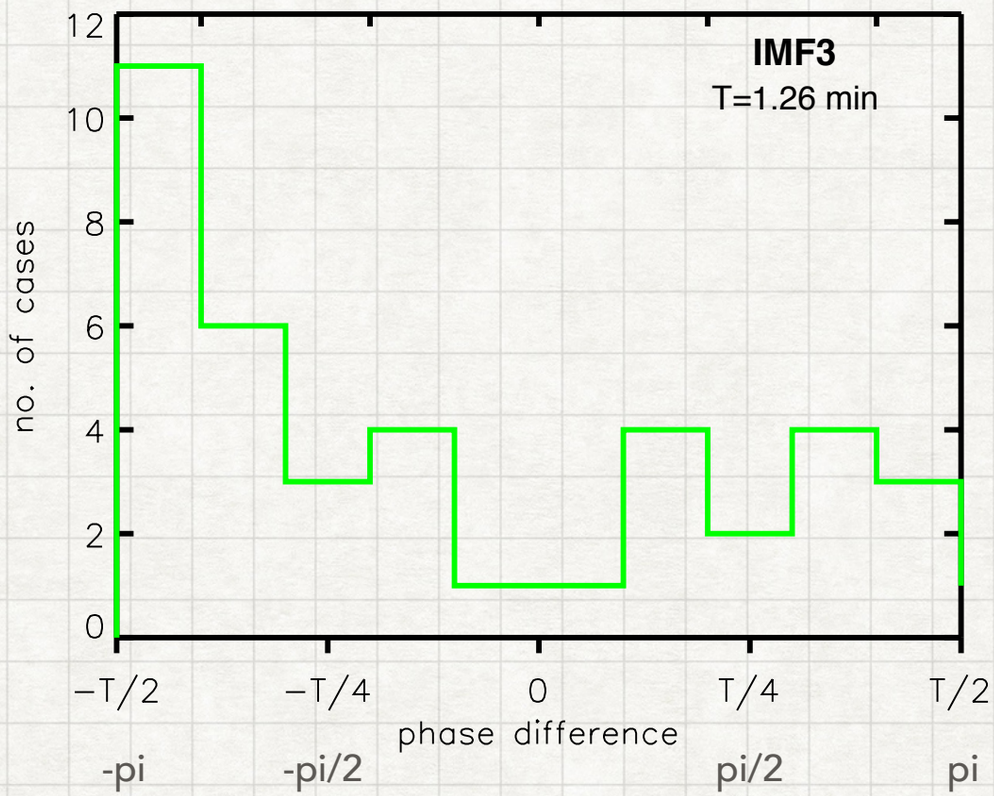




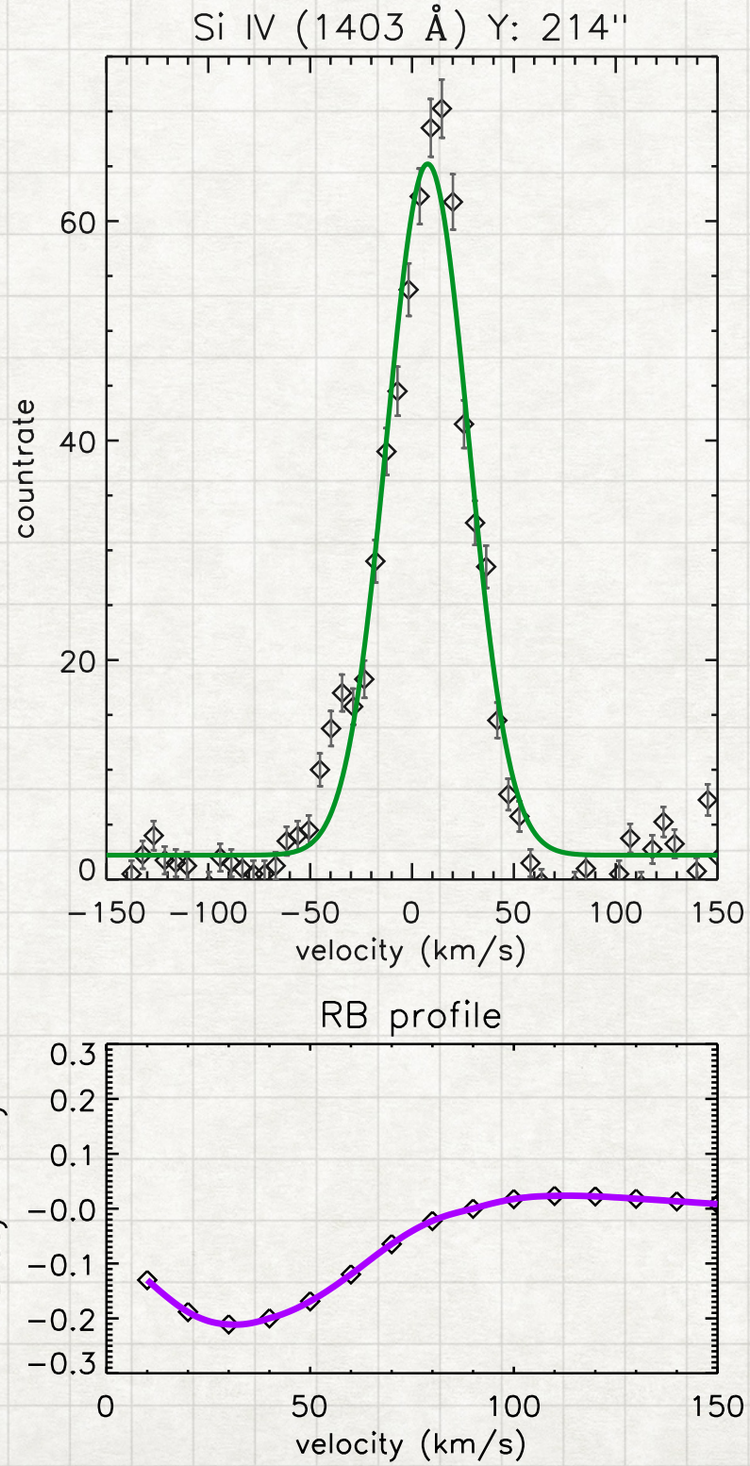
- Dominant Phase-Shifts : ±3T/8 (±3π/4) for T=0.72 min (IMF2) and ±T/2 (±π) for T=1.26 min (IMF3)
- In ideal case (Theoritically): Phase shifts of ±T/4 (±π/2) : standing slow waves
- Wang et al.,2003; Taroyan et al., 2007; Taroyan & Bradshaw, 2008 : standing slow waves in the coronal loops

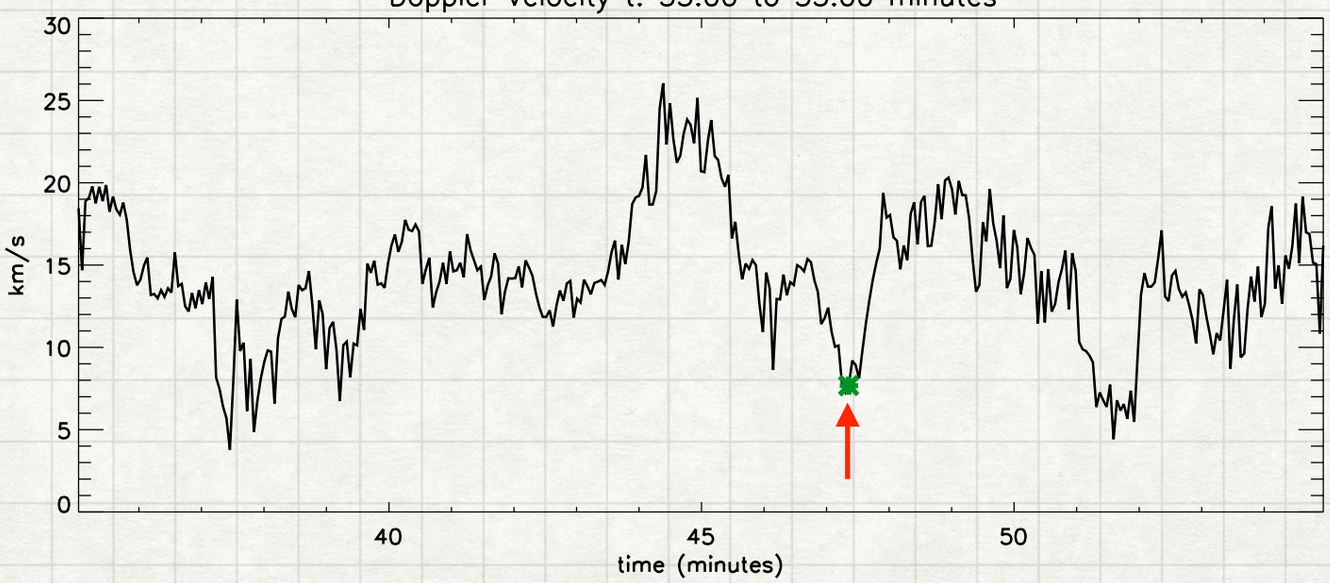
Wave Speed = 2*Loop Length/Period

Coronal Values: Period~10 min., Loop Length~60 Mm **TR Values (this study):Period=1min., Loop Length< 6 Mm**

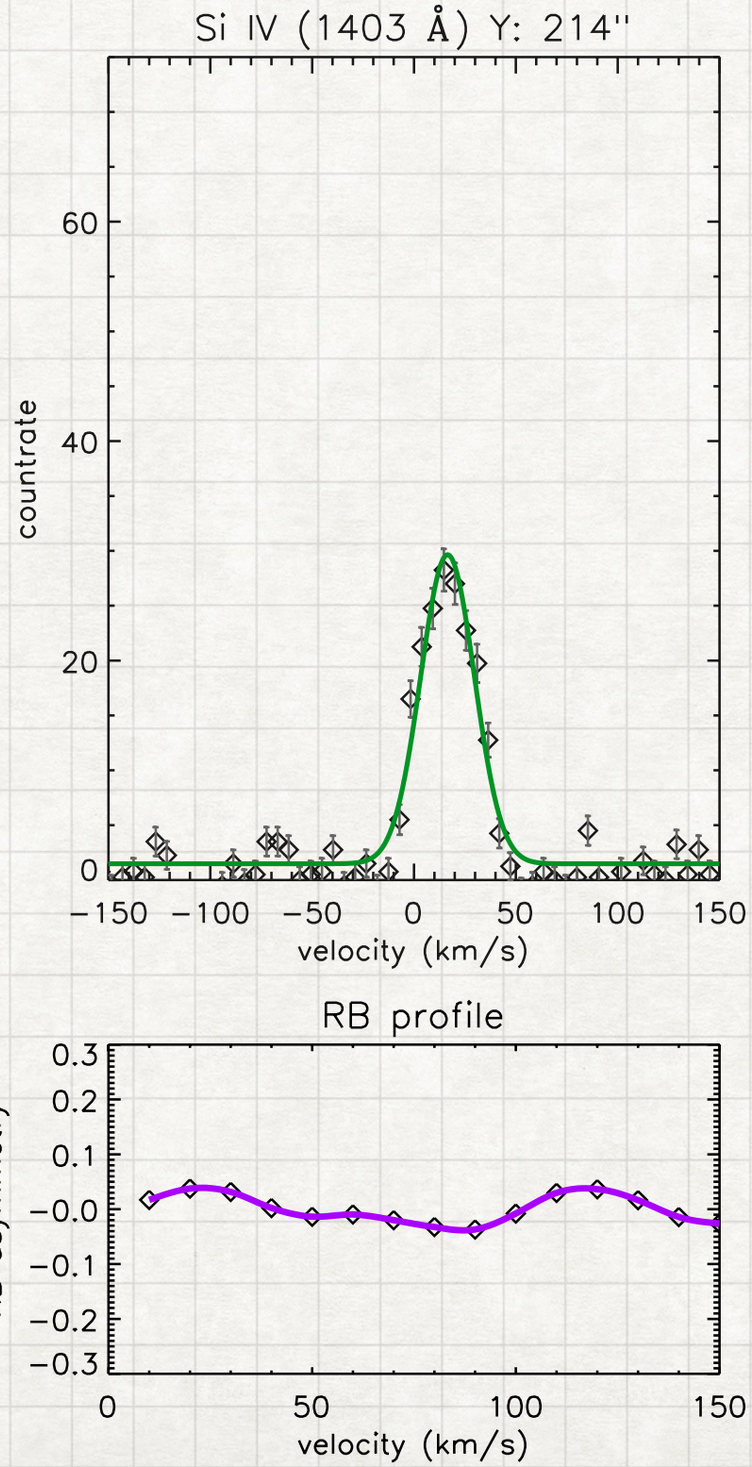
- Observations (Hansteen et al.2014, Brooks et al.2016, Huang et al.2018): TR fine loops - 0.6 to 6 Mm

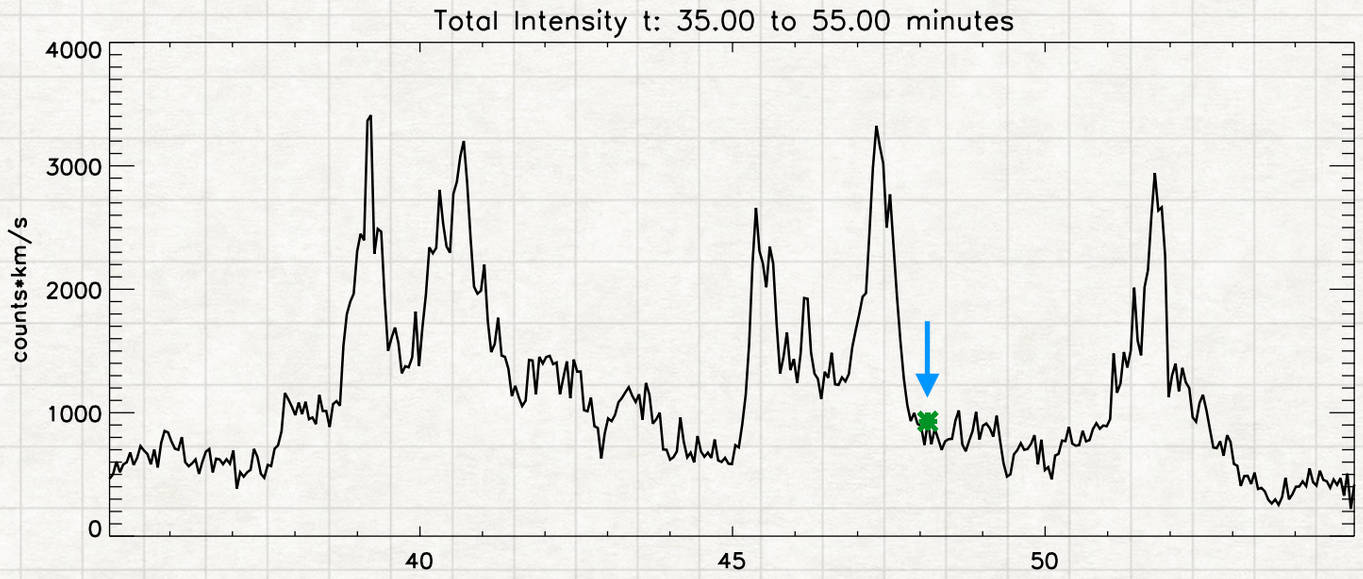
RECONNECTION

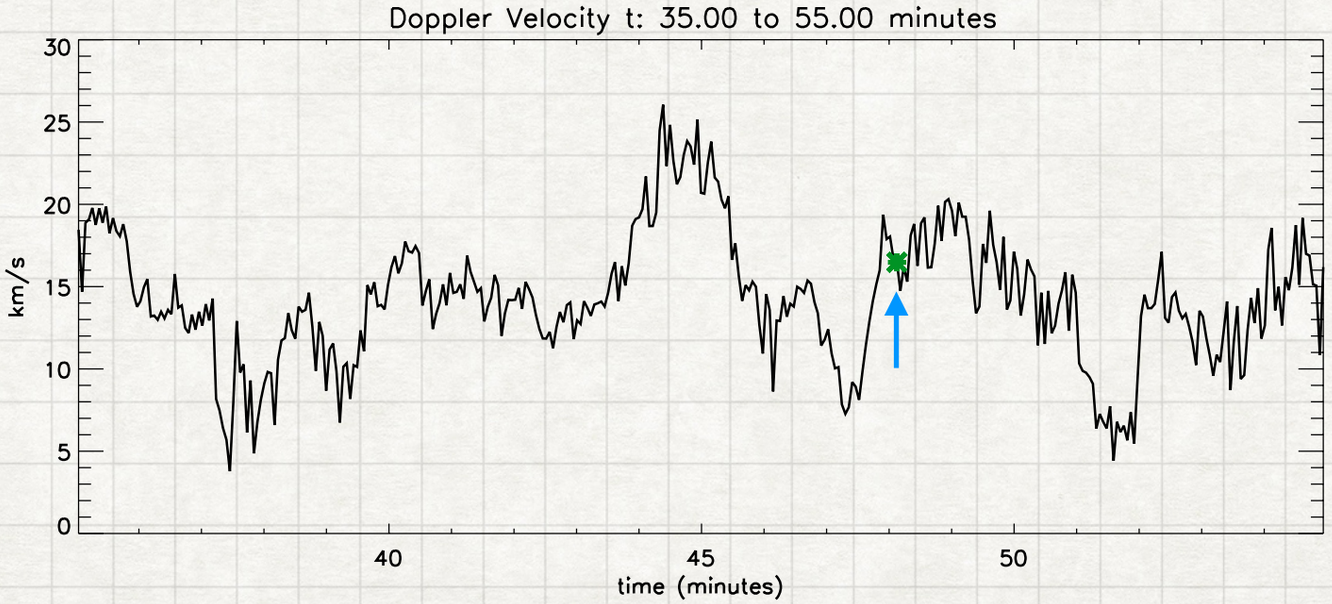




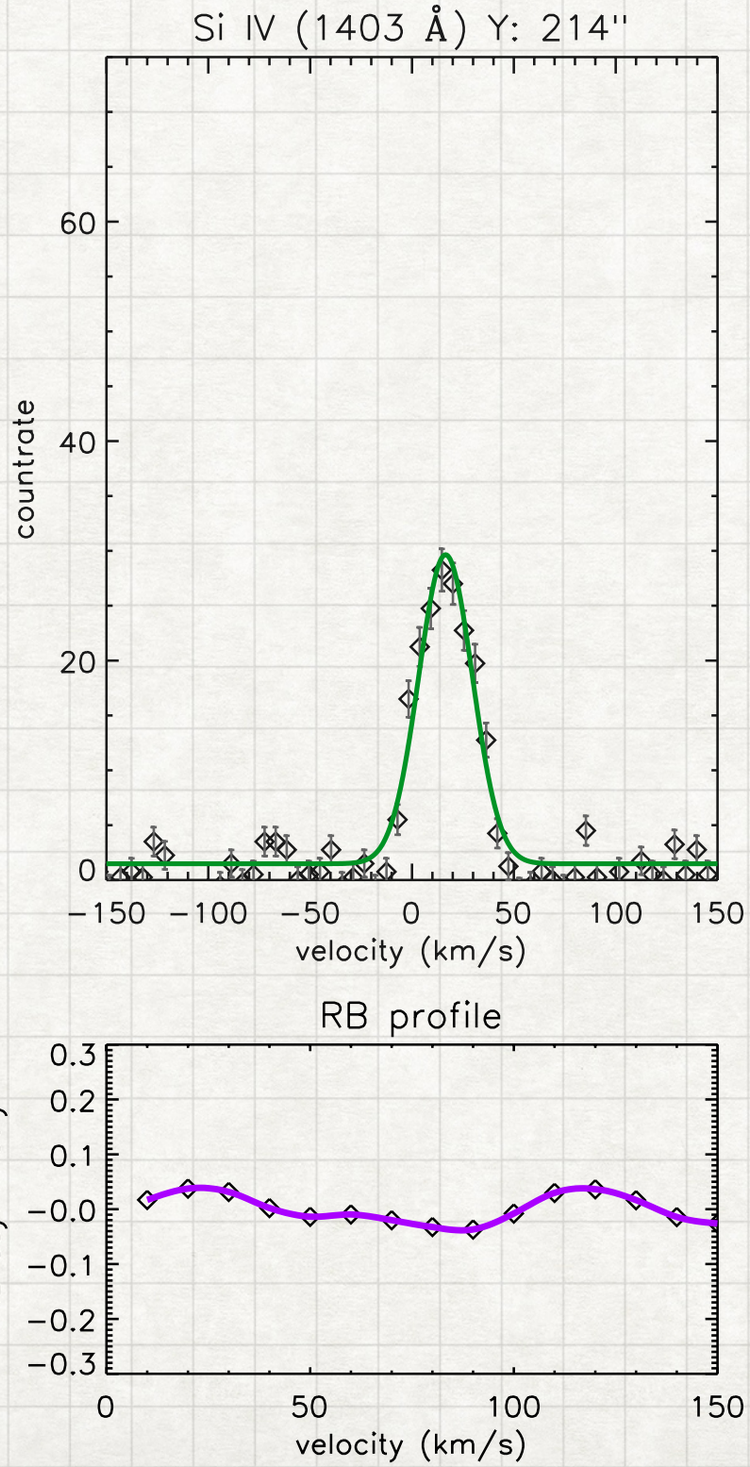
WAVES

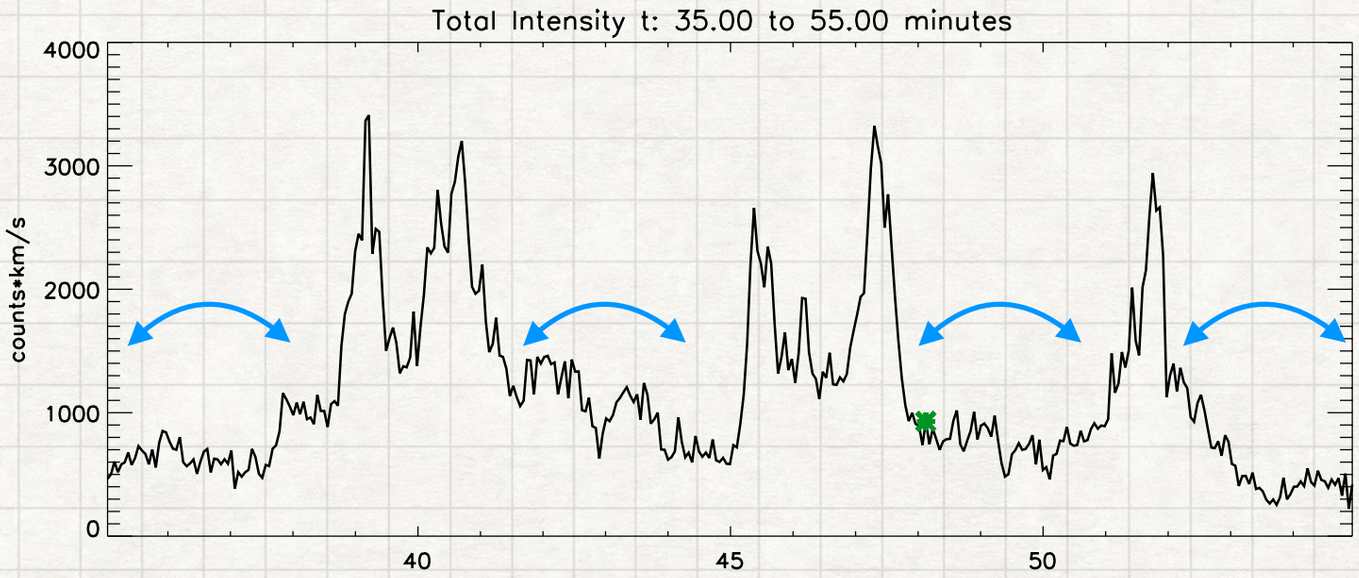

Si IV (1403 Å) Y: 214''
countrate
velocity (km/s)
RB profile
RB asymmetry
velocity (km/s)

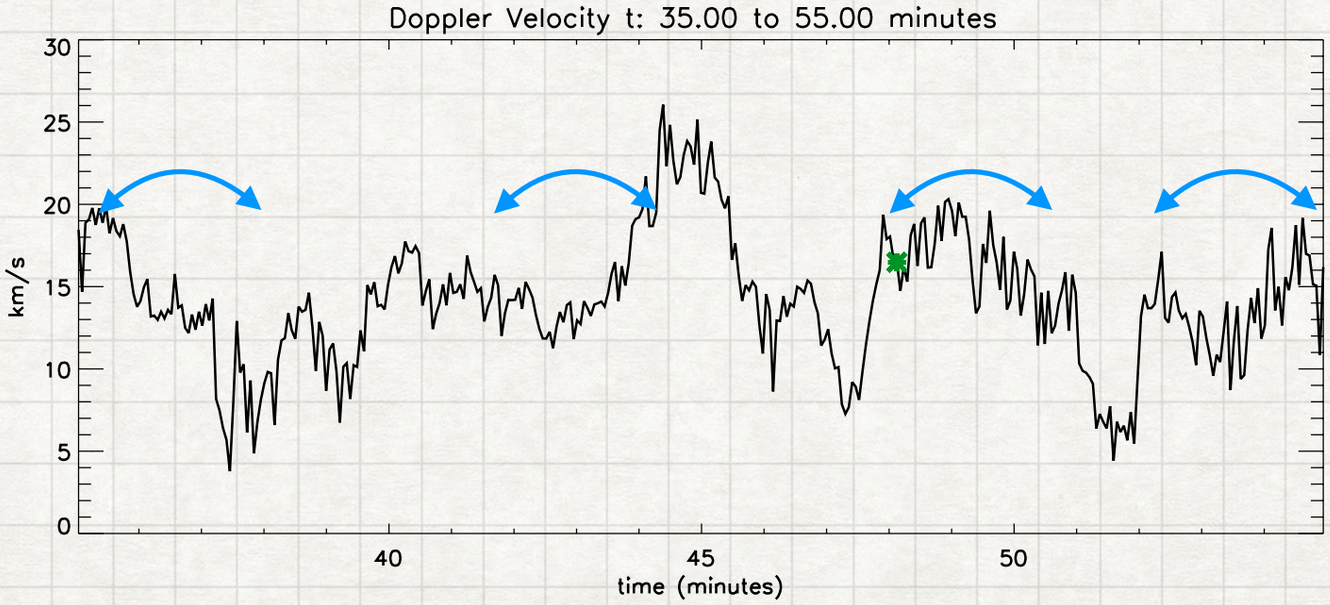

Total Intensity t: 35.00 to 55.00 minutes
counts*km/s


Doppler Velocity t: 35.00 to 55.00 minutes
km/s
time (minutes)

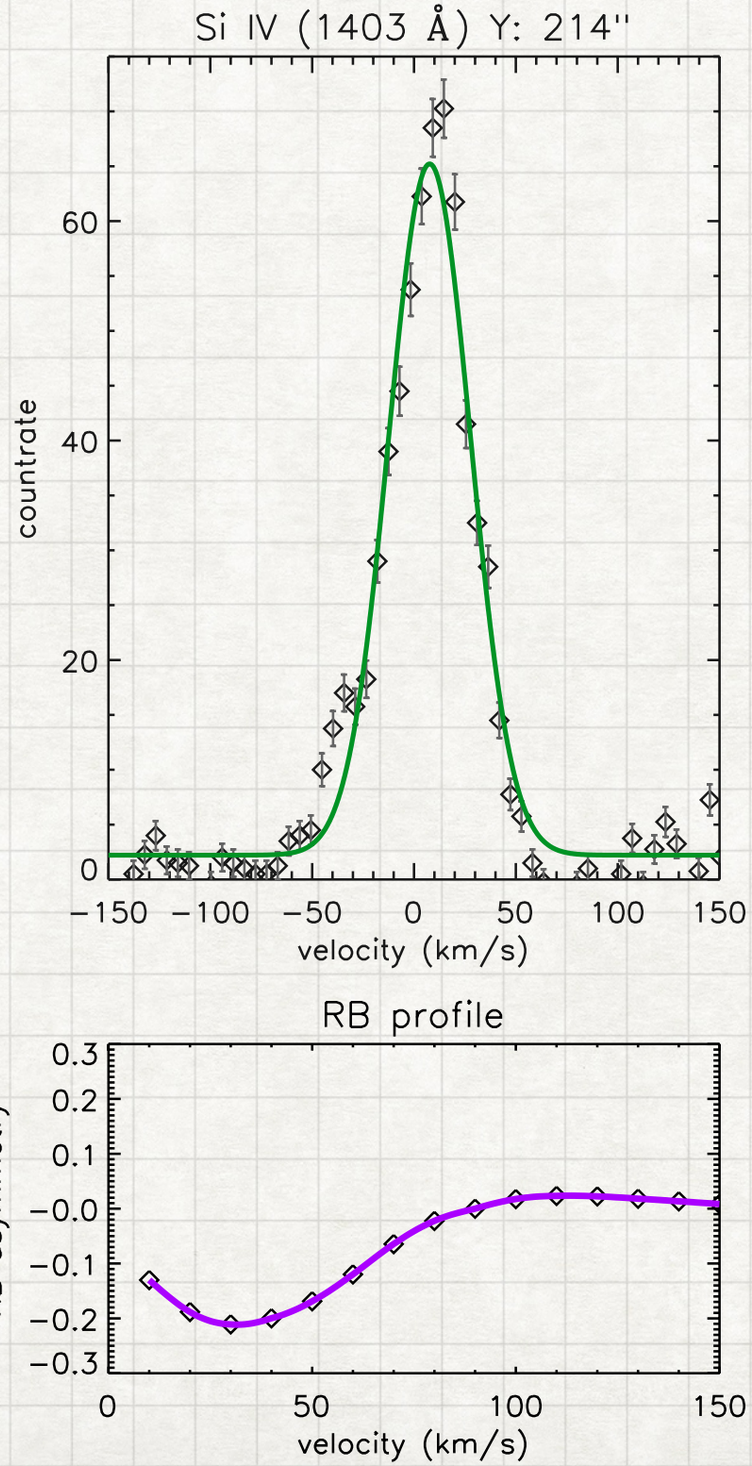
COMBINATION

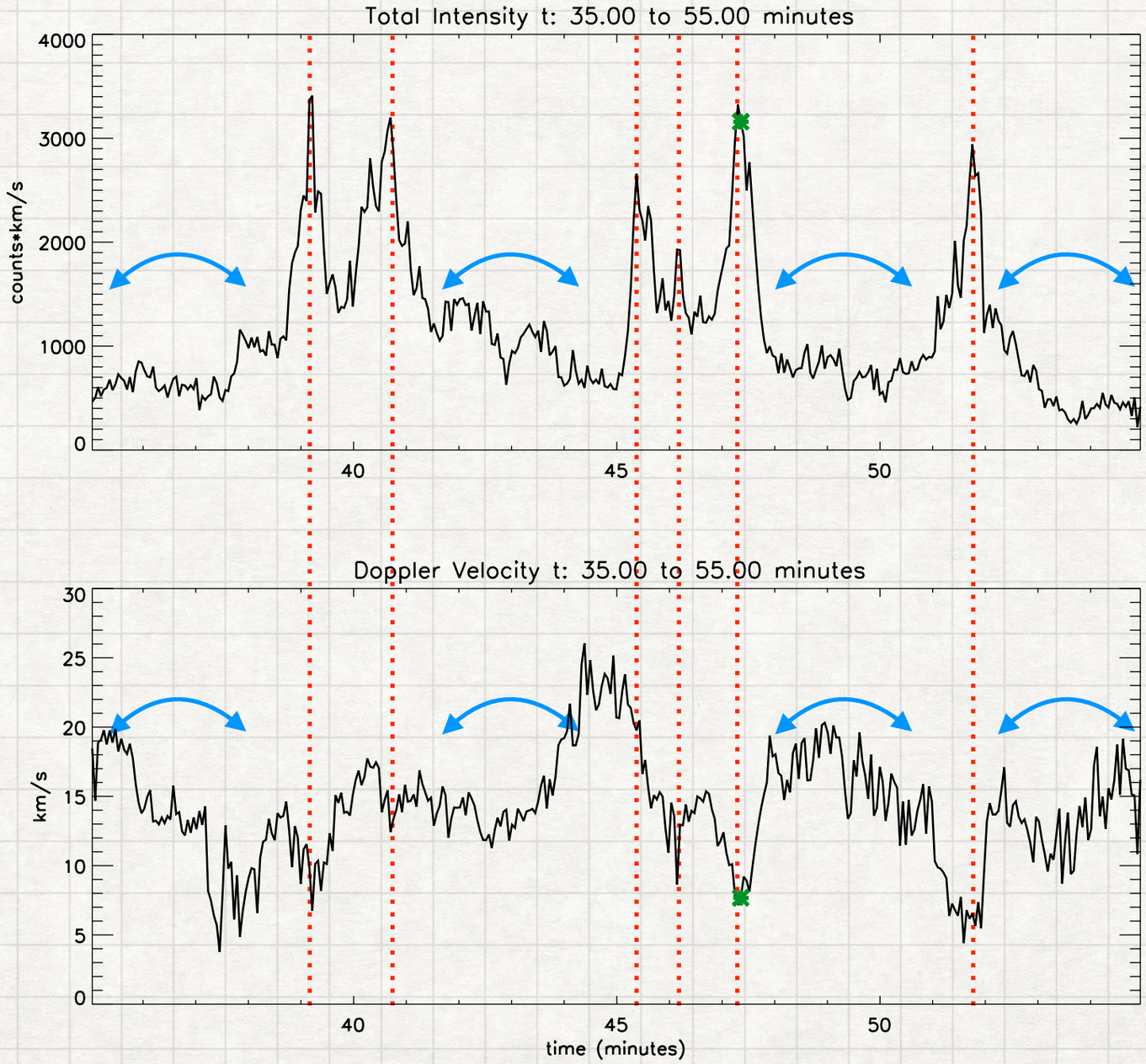






COMBINATION





SUMMARY & CONCLUSIONS

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- The fine TR loops ~1-2 Mm are conjectured to harbour such oscillations.
- Less frequent but energetic reconnection events are also observed.
- The waves and reconnection could be coupled with each other.
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- New instruments, with better sensitivity in the FUV wavelengths are desirable.
- Especially in the density and temperature sensitive lines.
- This will provide better insight on MHD modes and reconnection events.

We meditate on the adorable glory of the radiant **SUN**, *may he inspire our intelligence.*

Rigveda 3.62.10

IIA MAIN CAMPUS, BANGALORE INDIA

THANK YOU

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