



山东大学
SHANDONG UNIVERSITY

Study on a Multipeak Flare with High Turnover-Frequency Microwave Spectra with SRH Data

Zhao Wu et al 2024 ApJ 968 5

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2024-09-09, Irkutsk



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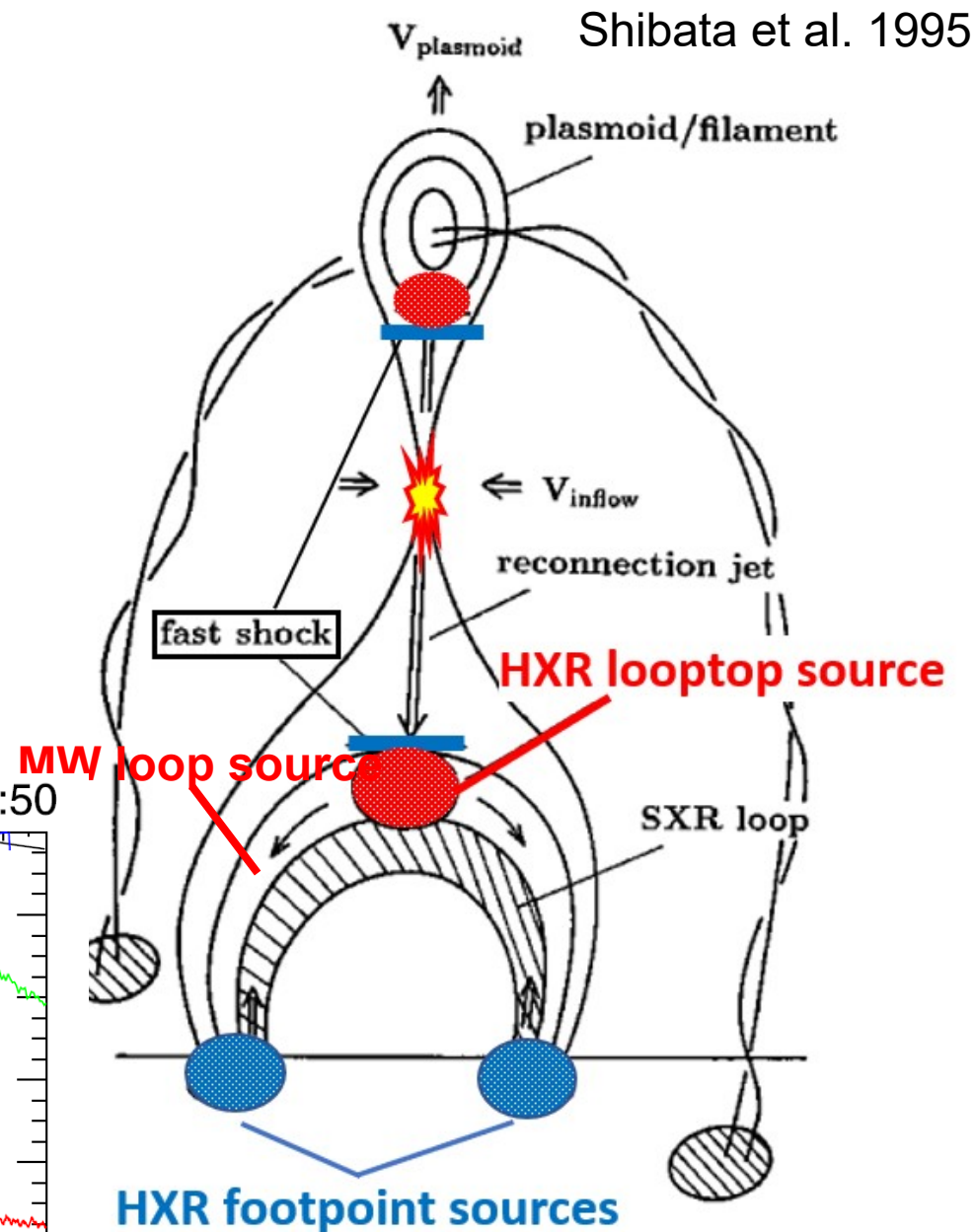
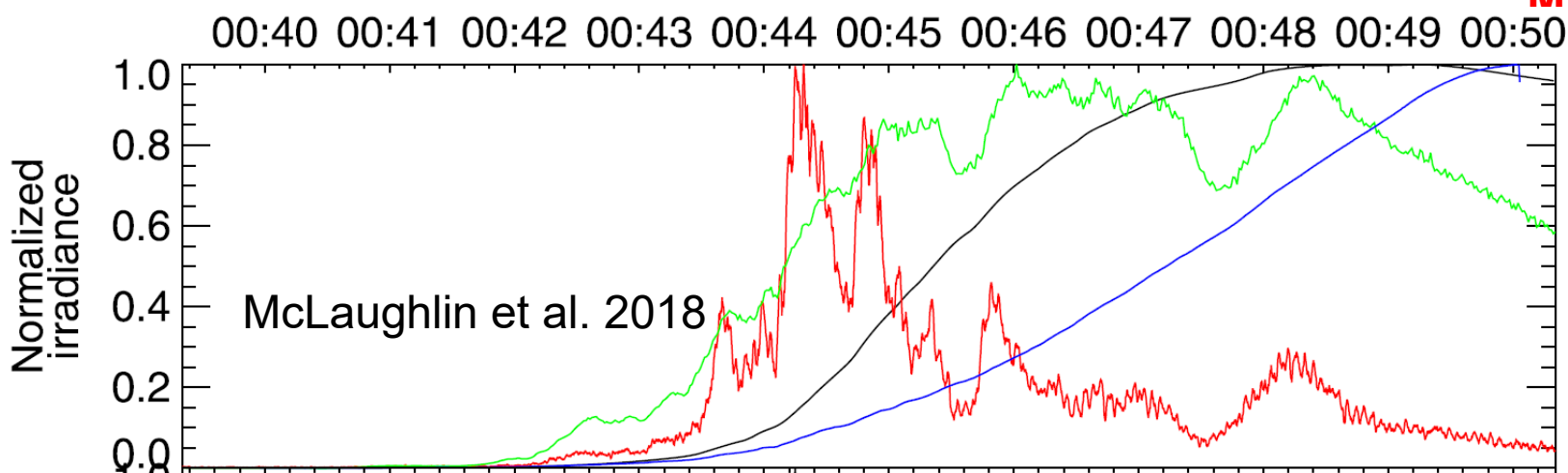
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Summary

1. Background and motivation

Solar Flares (CSHKP)

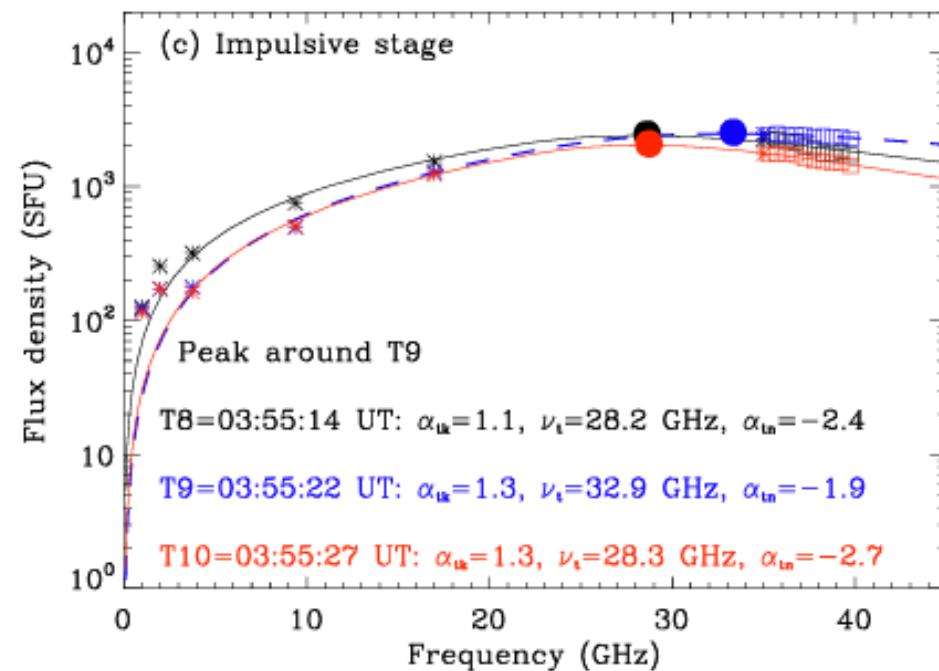
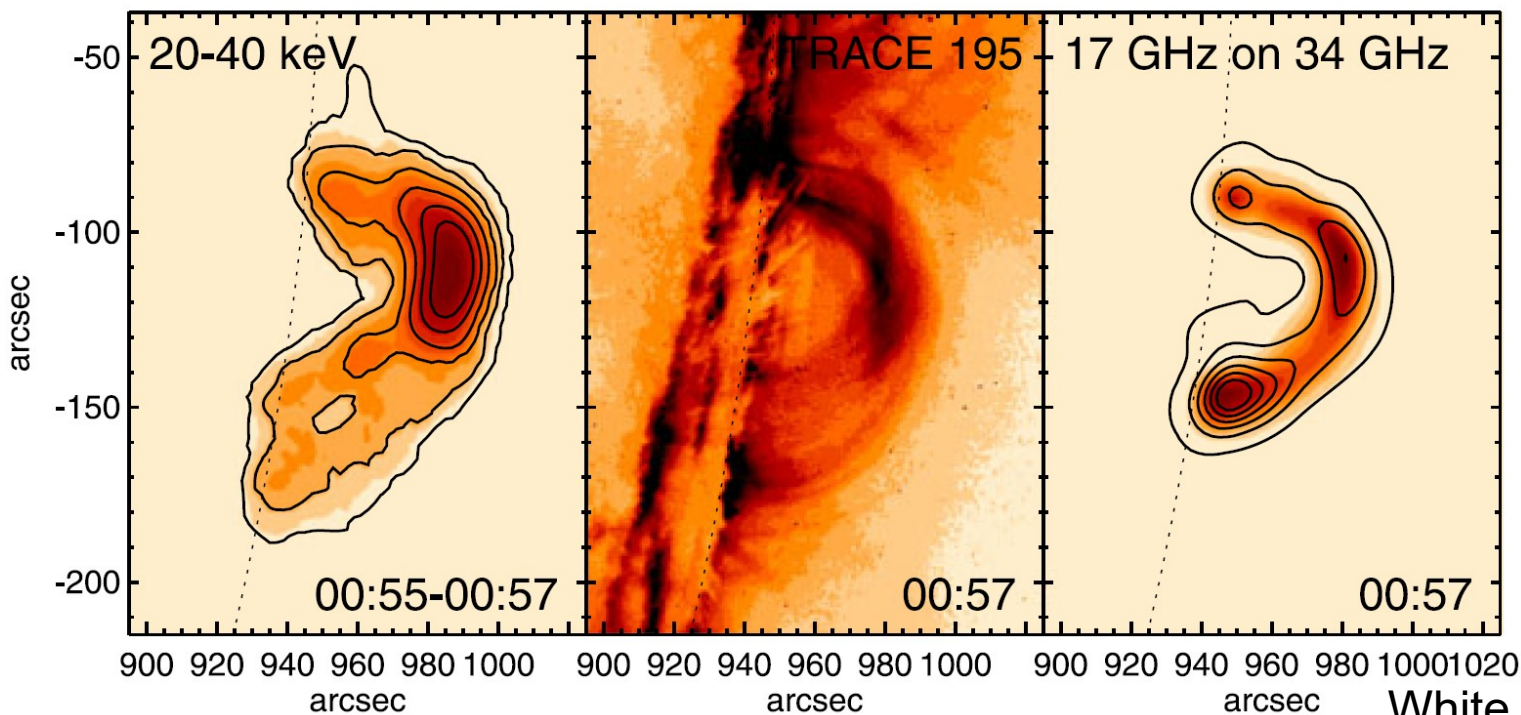
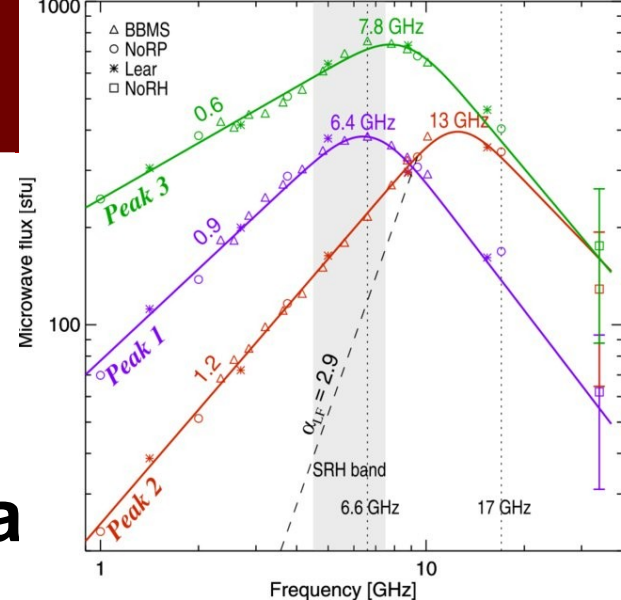
- Magnetic reconnection $\rightarrow\rightarrow$ energetic particles + thermal plasma
- Emissions: Xray, EUV, radio
- Multi-peak: intermittent reconnection, MHD modulation.....



1. Background and motivation

Emission from energetic particles:

- Microwave: gyrosynchrotron ; HXR: free-free
- Strong flare \rightarrow enhancement & high-turnover spectra
- MW+HXR $\rightarrow\rightarrow\rightarrow$ nature of multipeak (dynamic, energetic particles)



White et al. 2011

Yan et al. 2023

1. Background and motivation

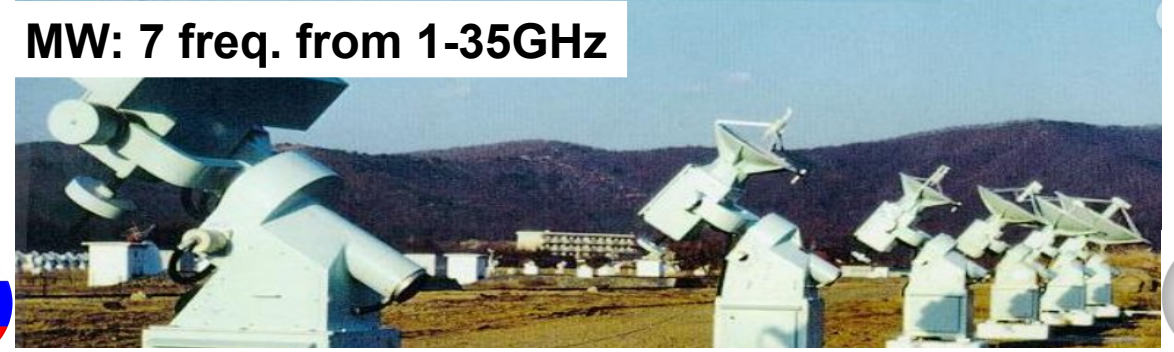
Newly available instruments in MW and HXR regime

MW: 2-24GHz



SRH (March 2022)

MW: 7 freq. from 1-35GHz



NoRP (routine observation)

MW: 35-40 GHz



CBS (since 2020)

HXR: 10-300 keV



ASO-S/HXI (since 2022)

New data → study the multipeak dynamic

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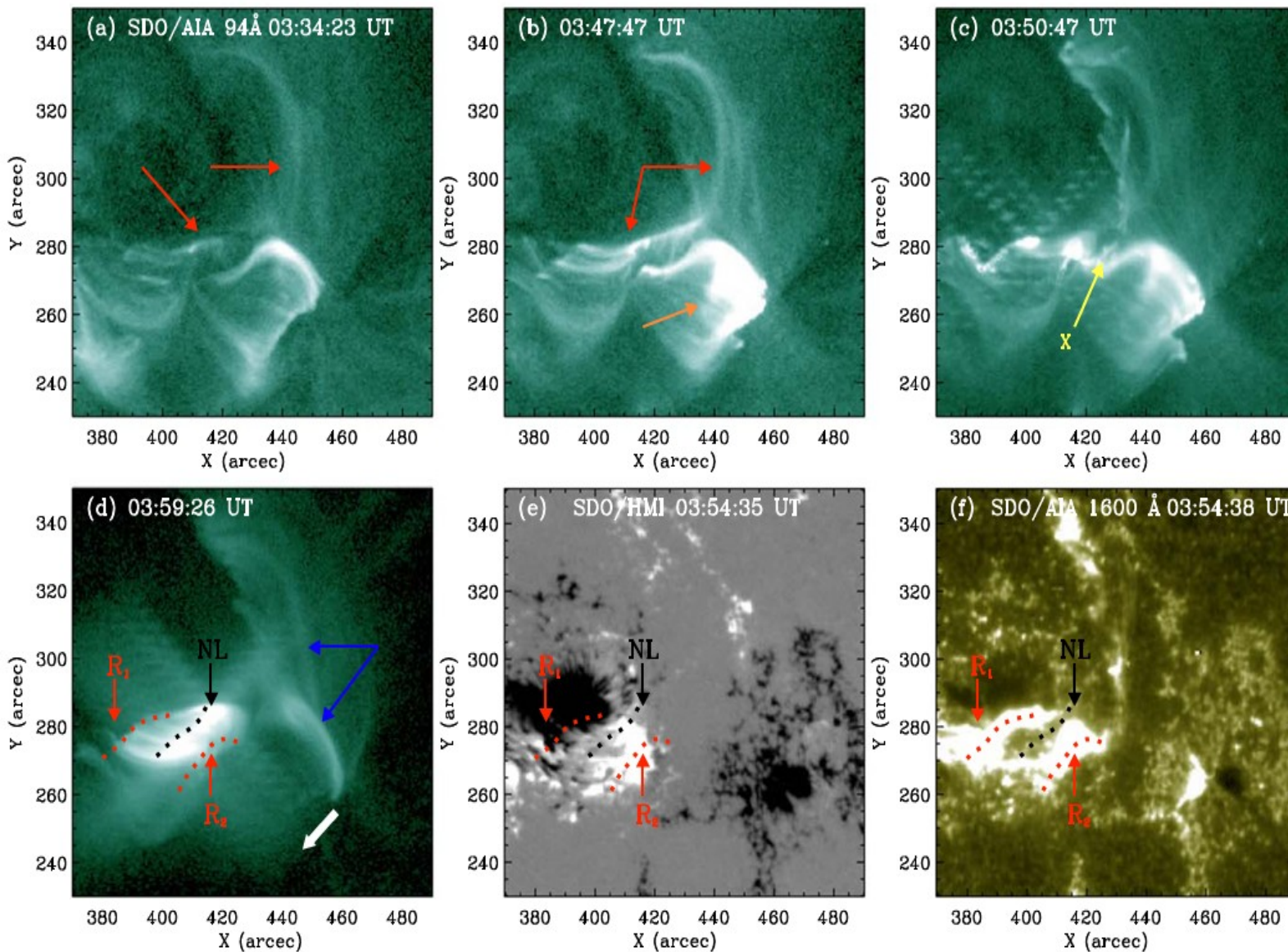
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02 **Observations of the
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03 Modeling the event

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2. Observations: event overview



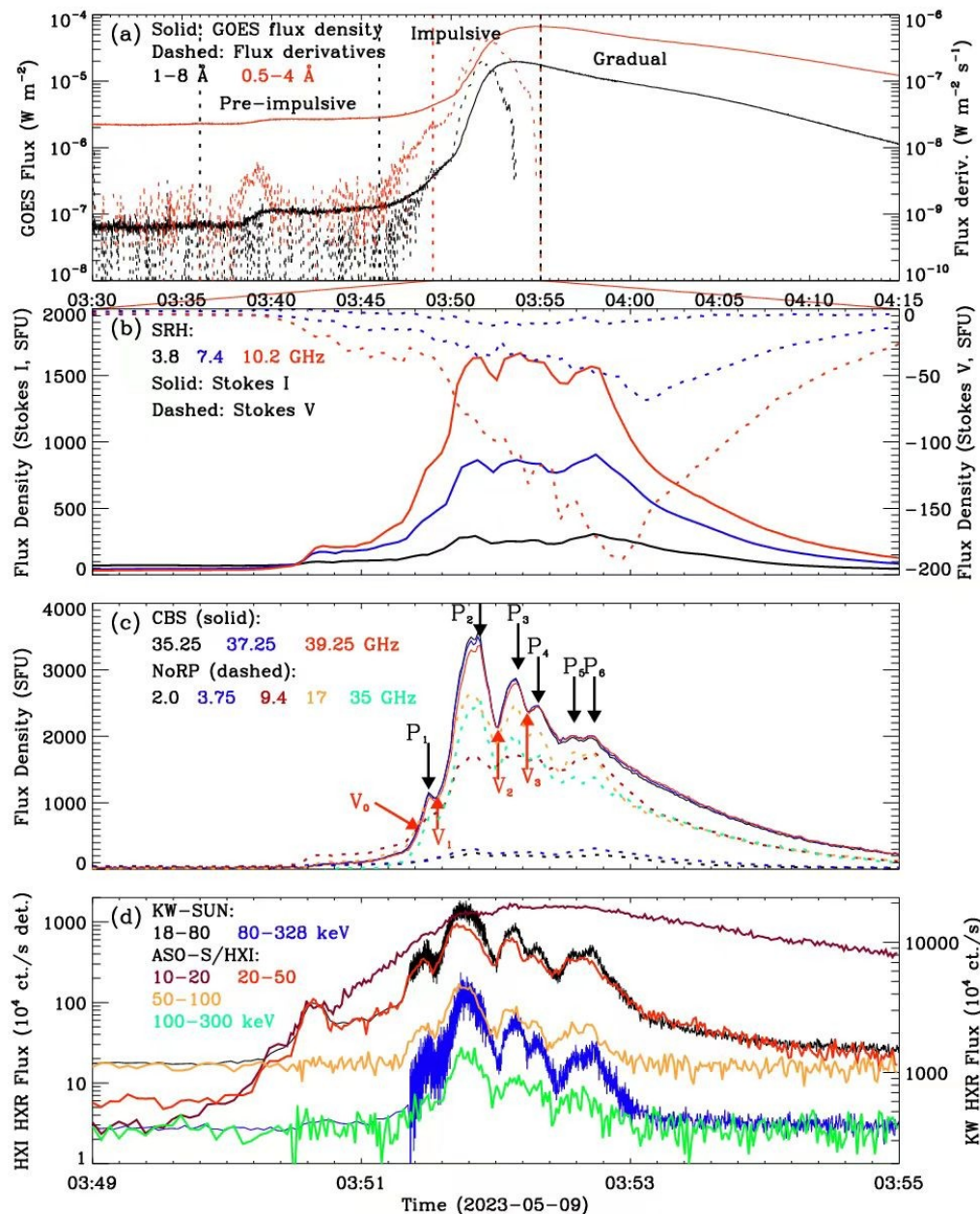
2023-05-09 , X6.5

- Disk event

- During peak:

- Reconnection along NL
- Enhance MW emission

2. Observations: event overview



- **Nonthermal emission**

- 1) **Enhance flux: Microwave & HXR**

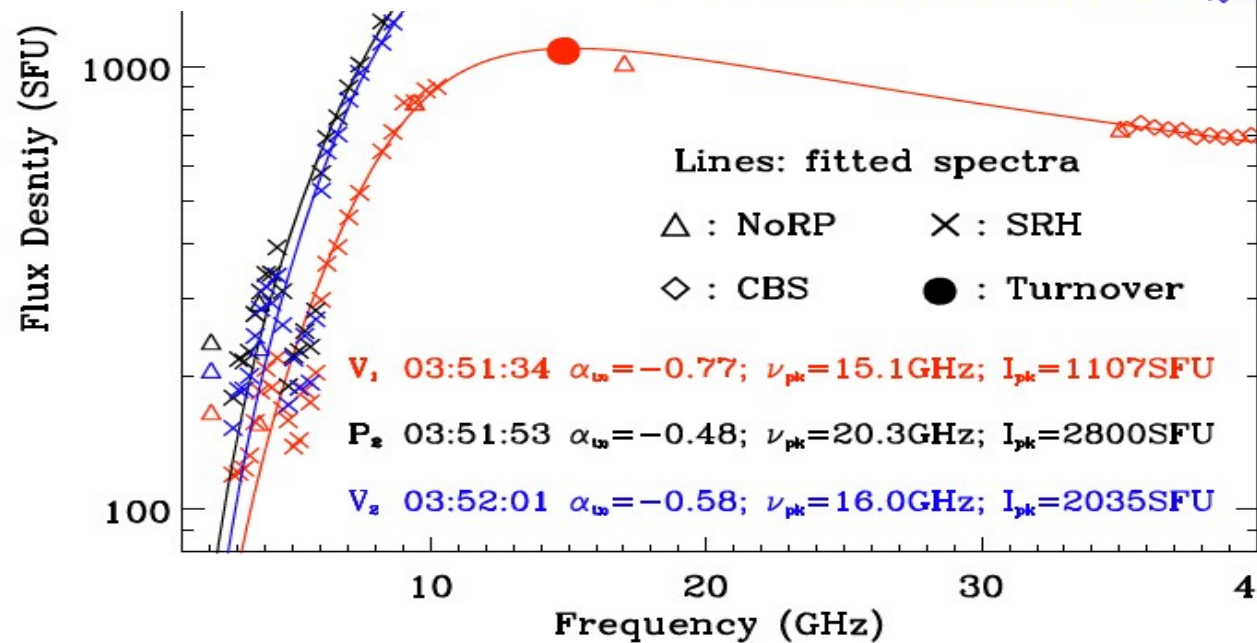
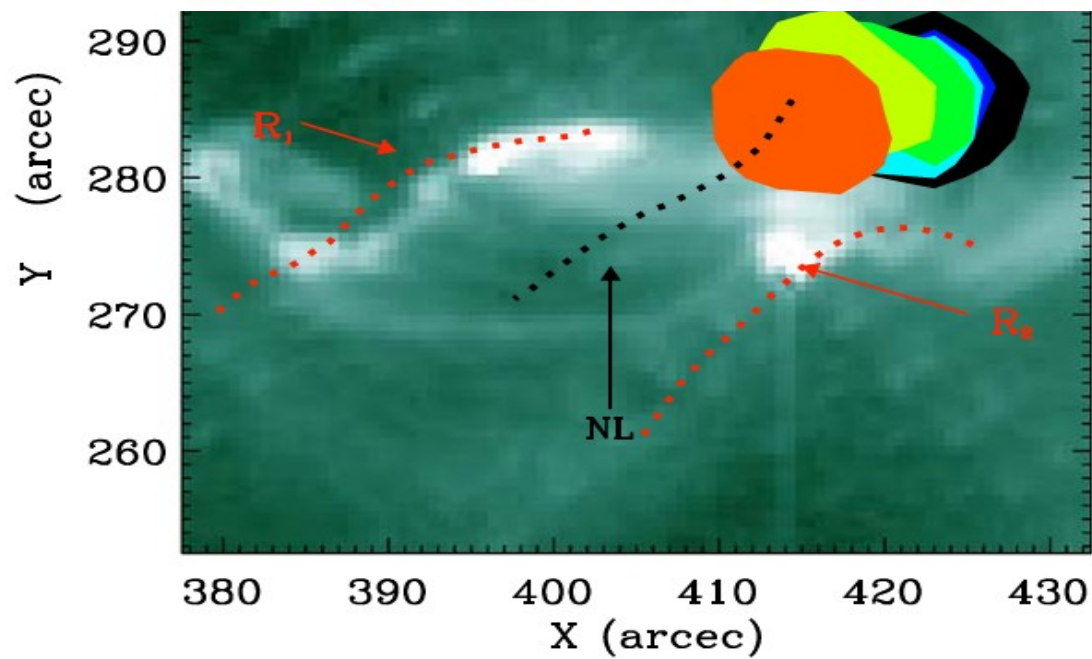
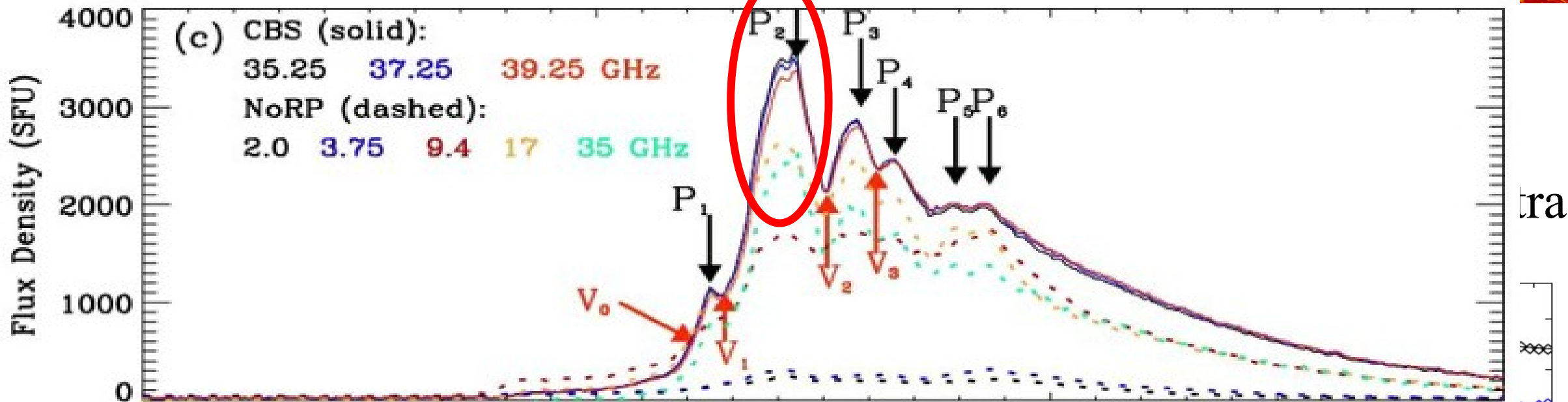
- 2) **Multipeak: 6 peaks around flux peak**

- 3) **High-turnover MW spectra: 17 & 35 GHz**



Multipeak during strong eruption

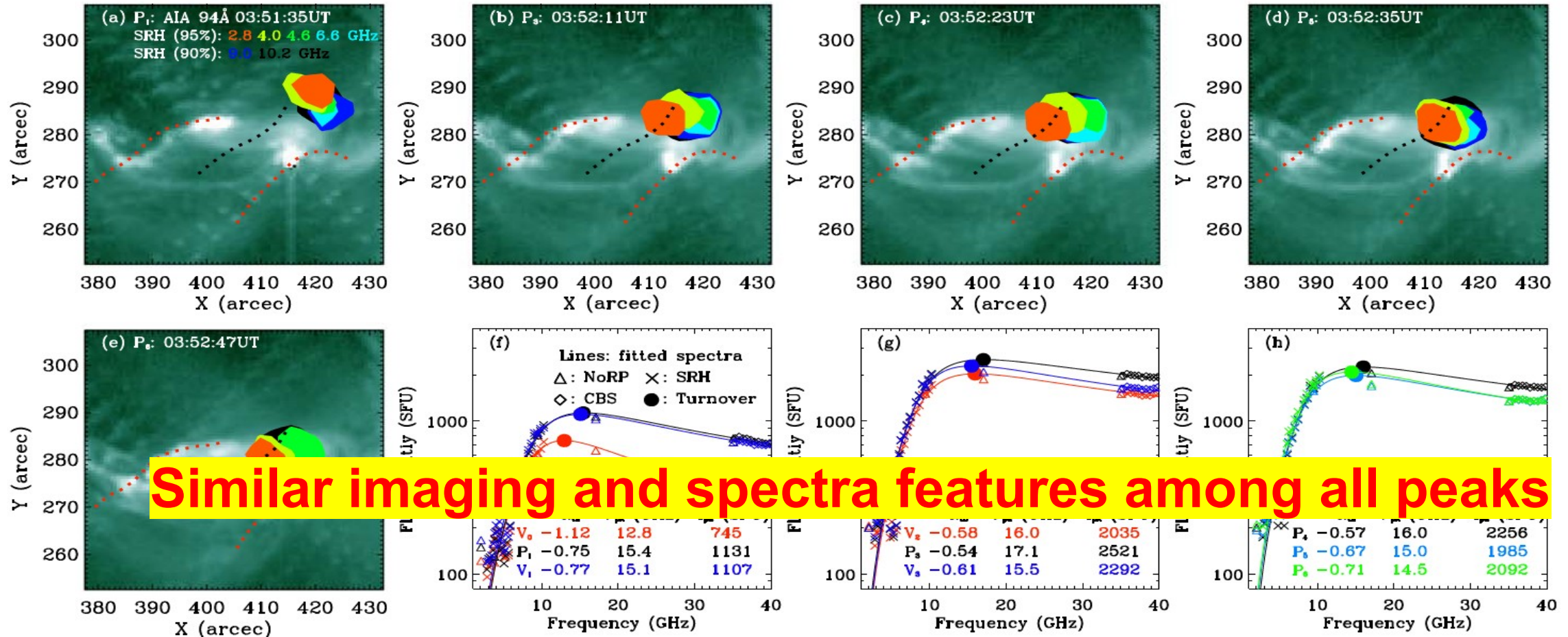
2.1 Observations: main peak



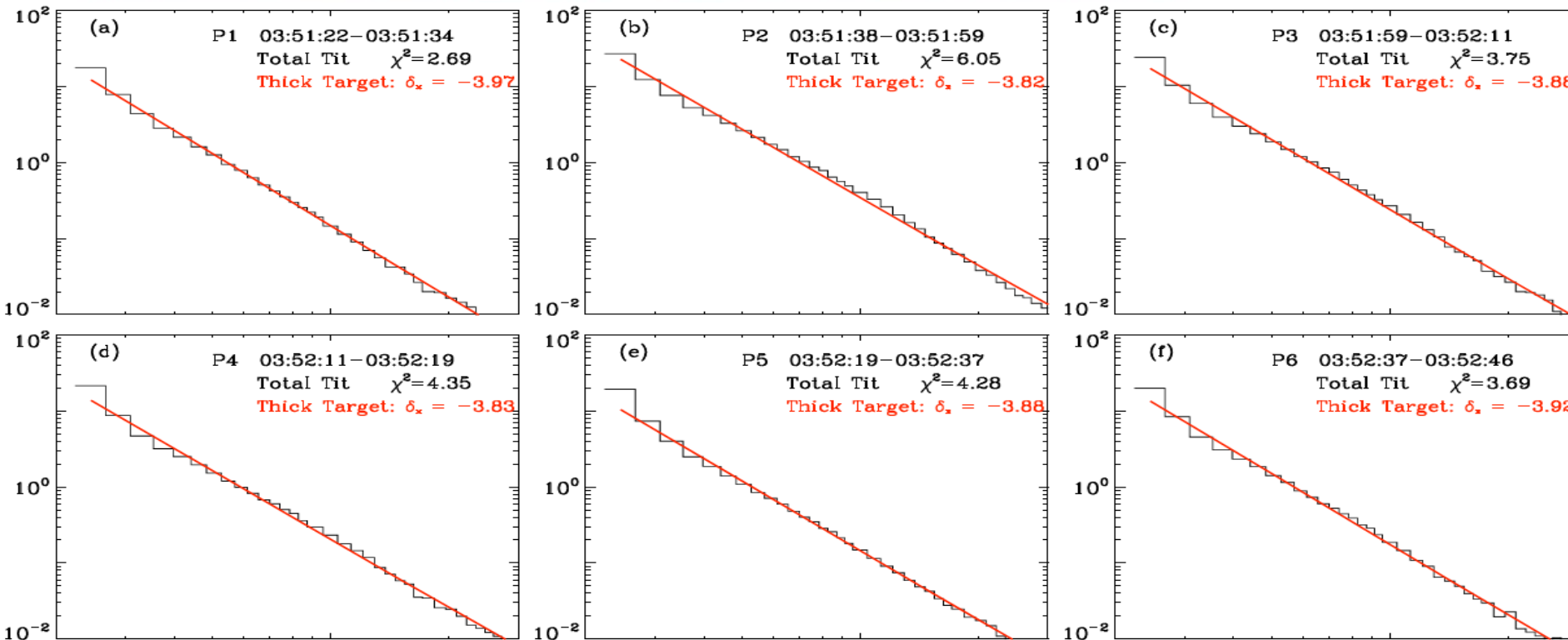
2.2 Observations: other peaks

Features @ other peak:

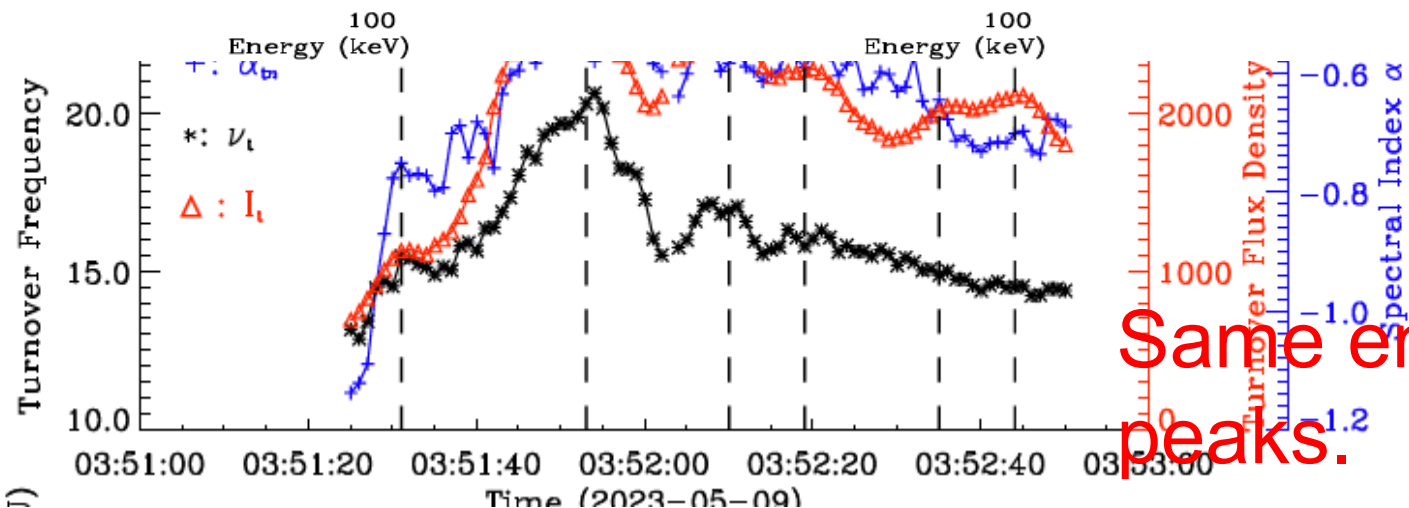
- **Image:** near loop-top source with spatial dispersion
- **Spectra:** large turnover frequency (>15 GHz); Hard optically thin spectra



2.3 Observations: spectral and source evolution



primary :
 sequential reconnection
 ra.: ~ flux density



• Spectra: hard & same with HXR

Same energy release among all peaks.



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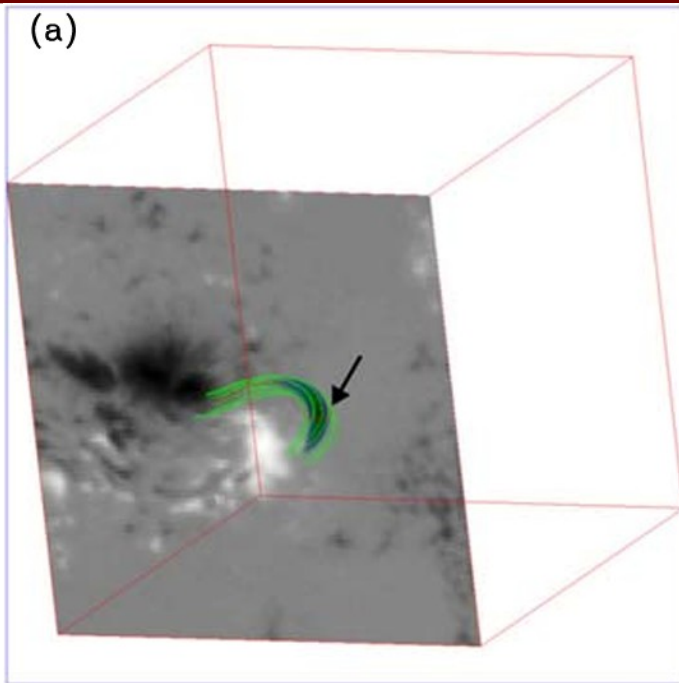
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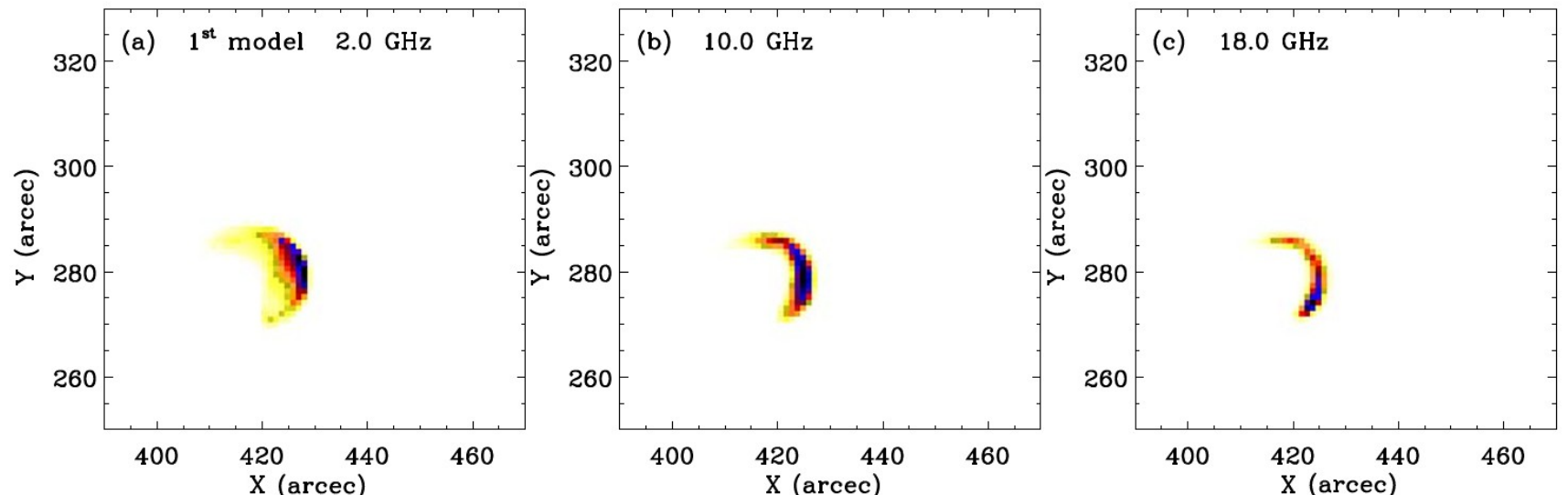
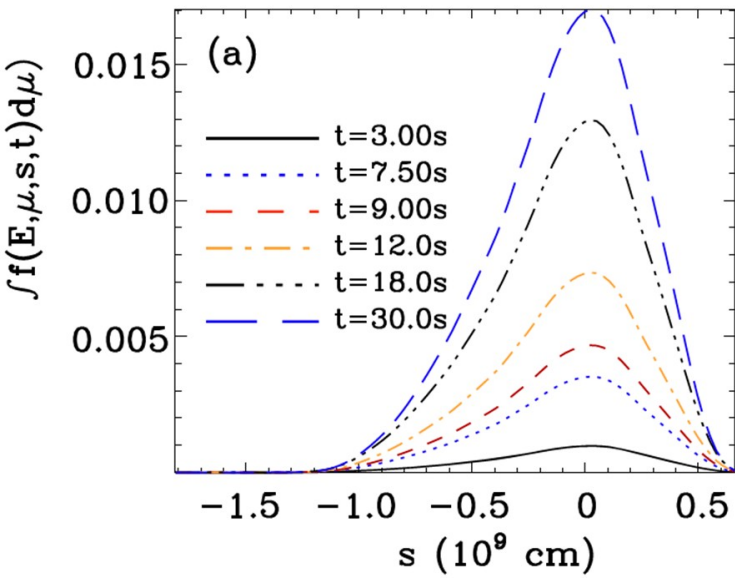
Summary

3. Modeling the event



Model with GX simulator:

1. Electron concentration: Injection around the looptop
2. Spatial dispersion: concentration @ loop-top

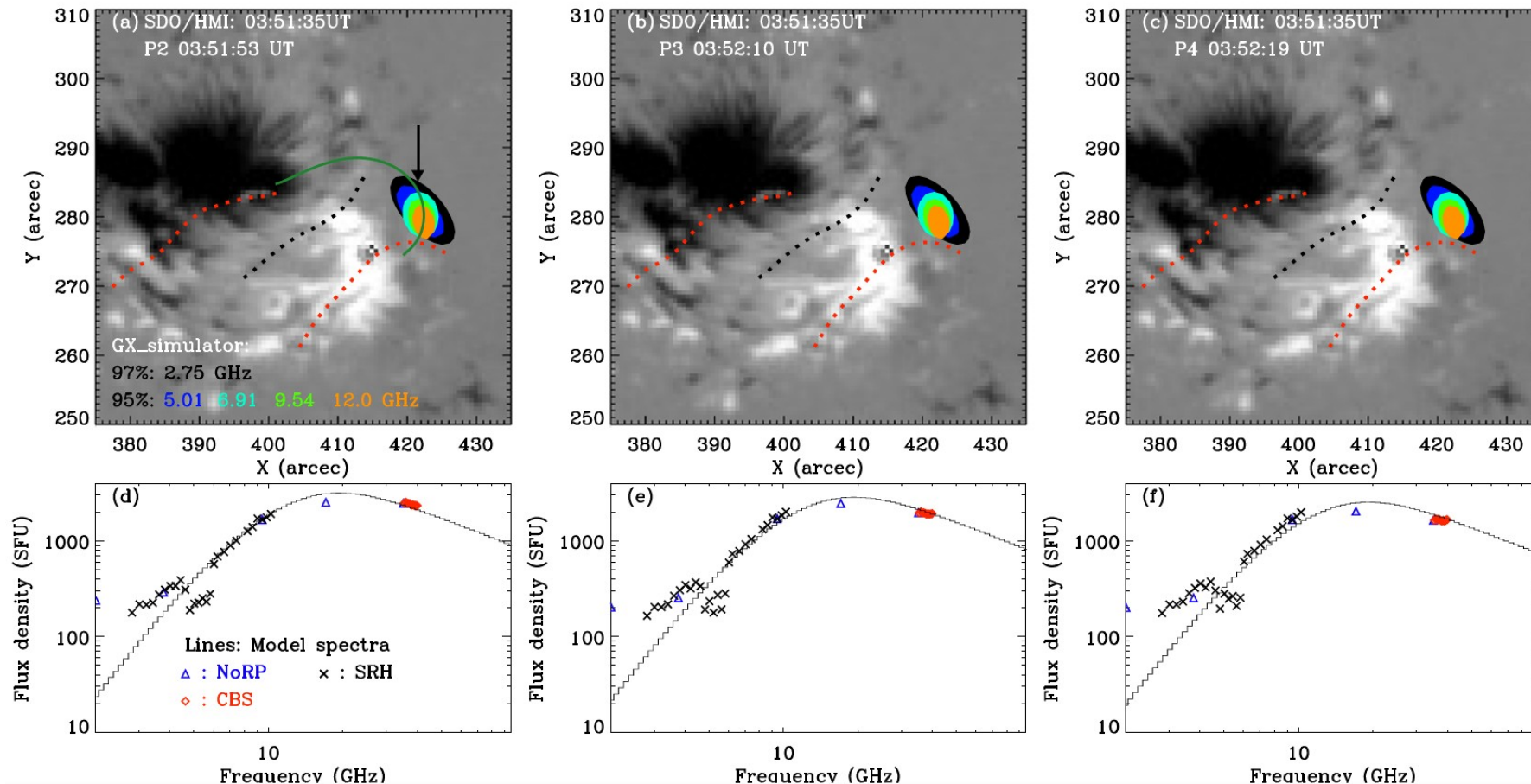


3. Modeling the event:



Modeling of all peak: same electron distribution; different number density

1. Modeled sources: loop-top & spatial dispersion
2. Modeled spectra: agree with observations (NoRP+CBS+SRH)



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3. Summary



- **New imaging + spectral instruments →→ multi-burst during strong flare**

1) Observations of Multipeak:

- Similarity among peaks:
looptop sources with spatial dispersion; high-turnover frequency microwave spectra
- Evolution:
hard spectra →→ enhanced self-absorption

2) Modeling of Multipeak:

Spectral & imaging features can be fitted with similar coronal and electron distributions



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Thank You

**Study on a Multipeak Solar Flare with a High Turnover Frequency microwave
Spectra**

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