NSRO-CDAW11
Group1：第24太陽周期の全フレアの多波長解析

増田、中島、Kim、西村、後藤、高橋

Group1の目的

☆Nishio et al. (1997)の統計結果の検証を、新しいデータセットを用いて行う。

- 34GHzのデータは用いられていない。
- SDO、STEREO、Hinodeといった新しいデータがある。
- 2011年に入り、太陽活動度が上がり、イベントが増えた。

使用したデータセット

- NoRH (17GHz, 34GHz)
- RHESSI (hard X-rays)
- SDO/AIA(EUV)
- SDO/HMI (magentic field)

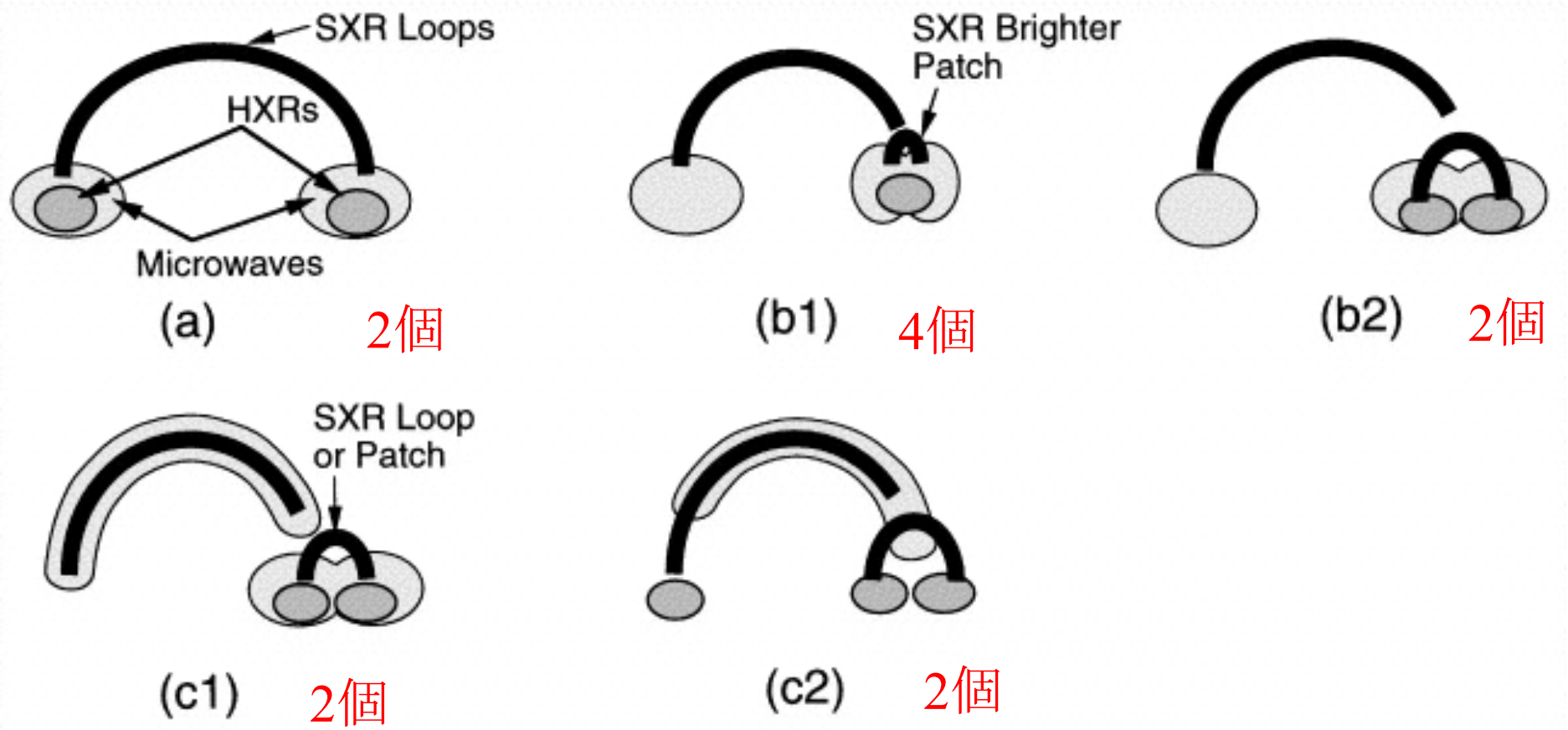
・今回、以下の6つのイベントについて検証を行った。

EVENT

1.2011-02-15　S20W11　X2.2
2.2011-03-15　N14W52　M1.0
3.2011-06-07　S22W52　M2.5
4.2011-07-30　N14E34　M9.3
5.2011-08-03　N15E09　M1.7
6.2011-09-09　N13W48　-

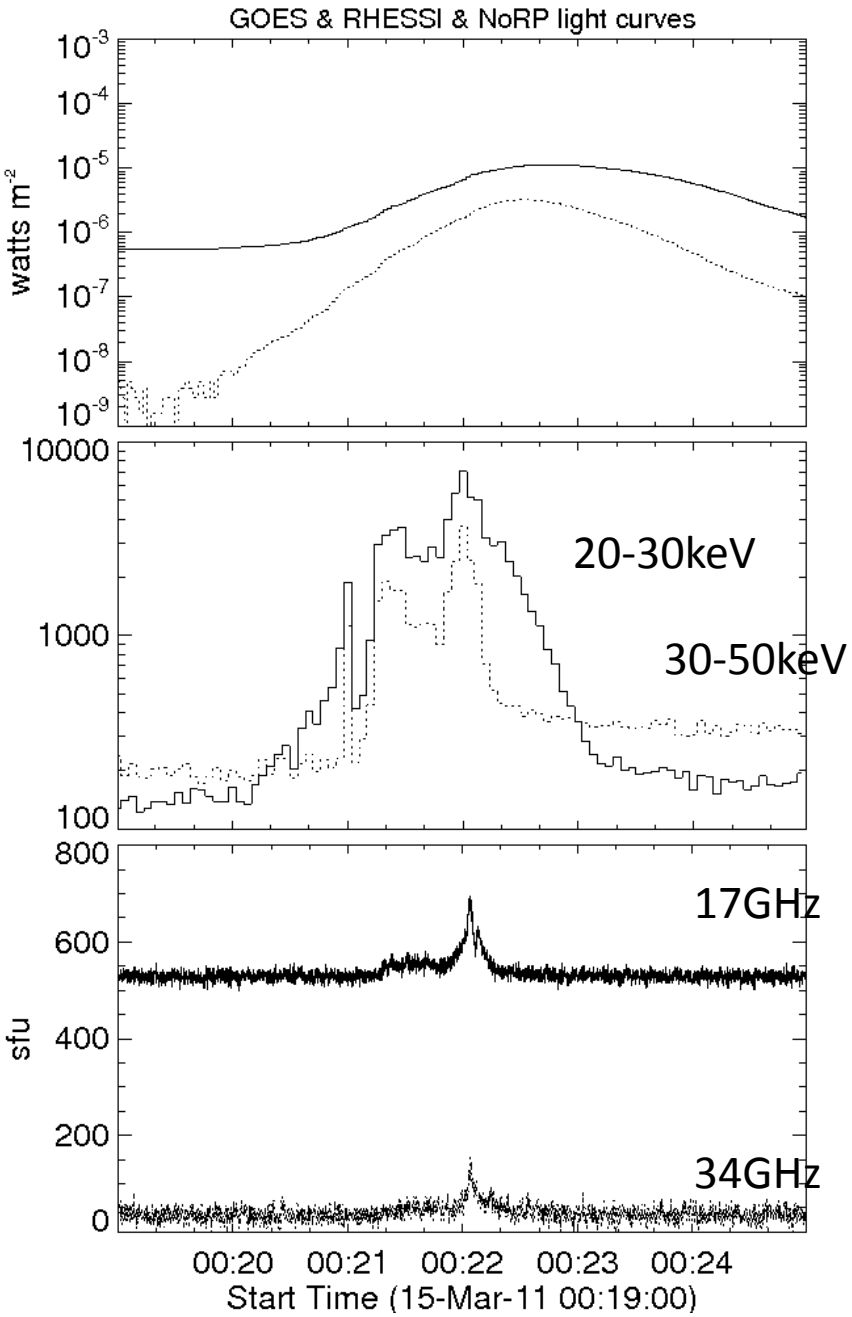
Nihsio et al. (1997)

14個のフレアを解析し、電波源(17GHz)、硬X線源、軟X線ループの空間的な構造・配置によって、分類を行った。



- Nishio et al. (1997)型フレア
  - 2011/03/15
  - 2011/07/30
  - 2011/08/03

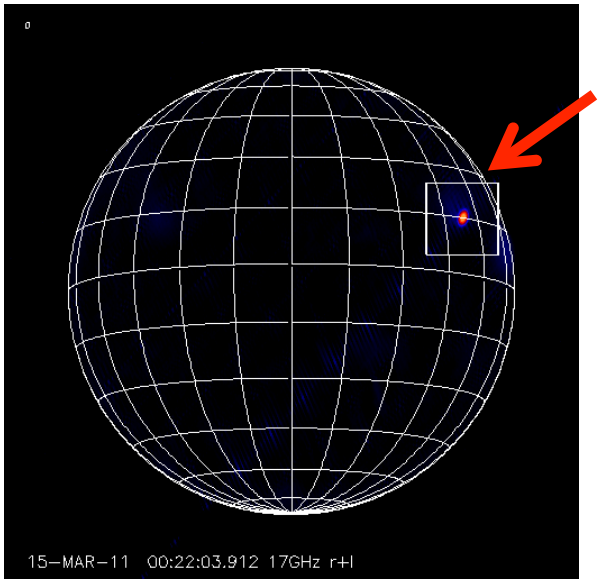
‘2011/03/15_flare’



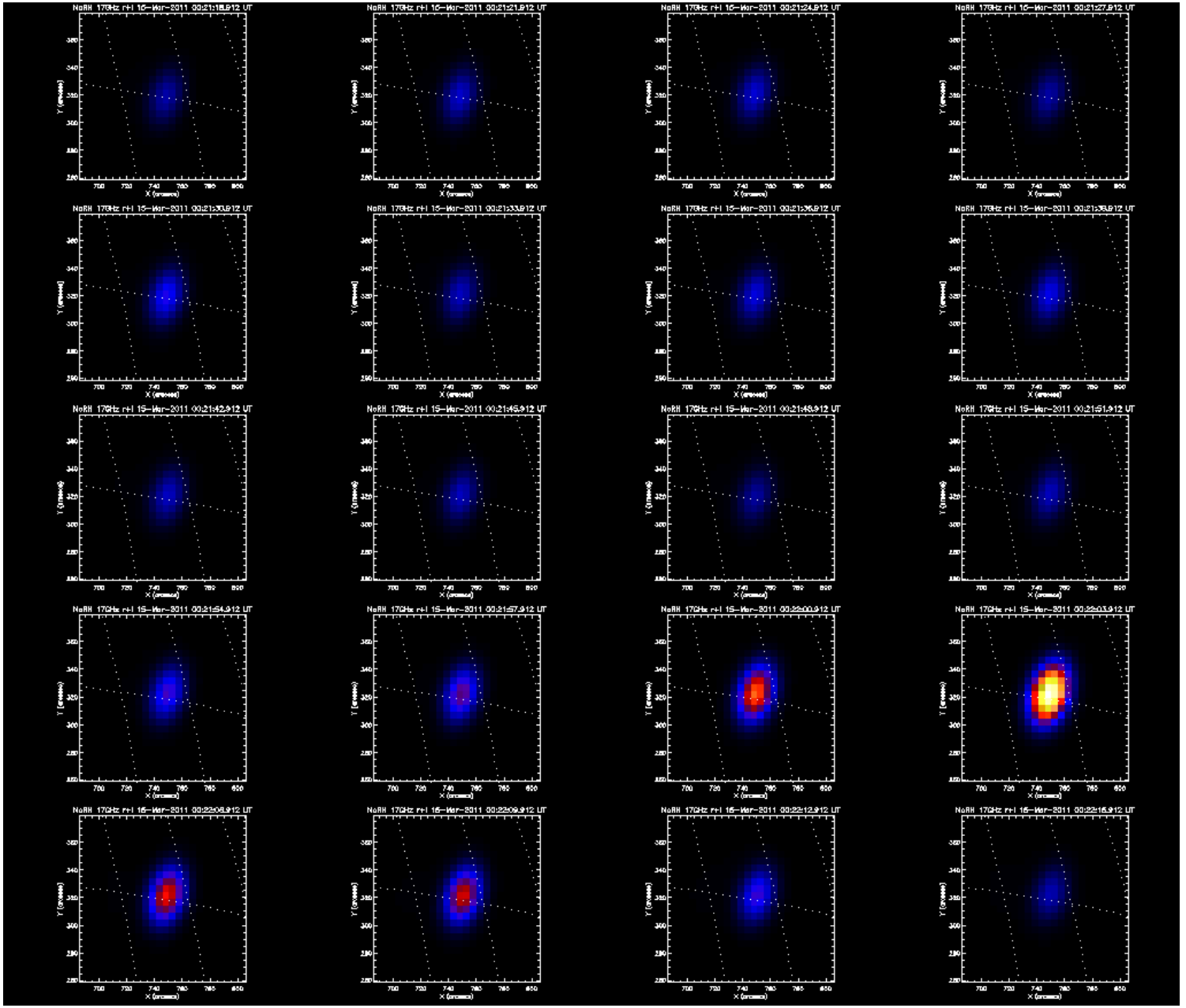
Light curves

- 2011.03.15
- M 1.0 class flare
- NOAA11169 (N11W83)

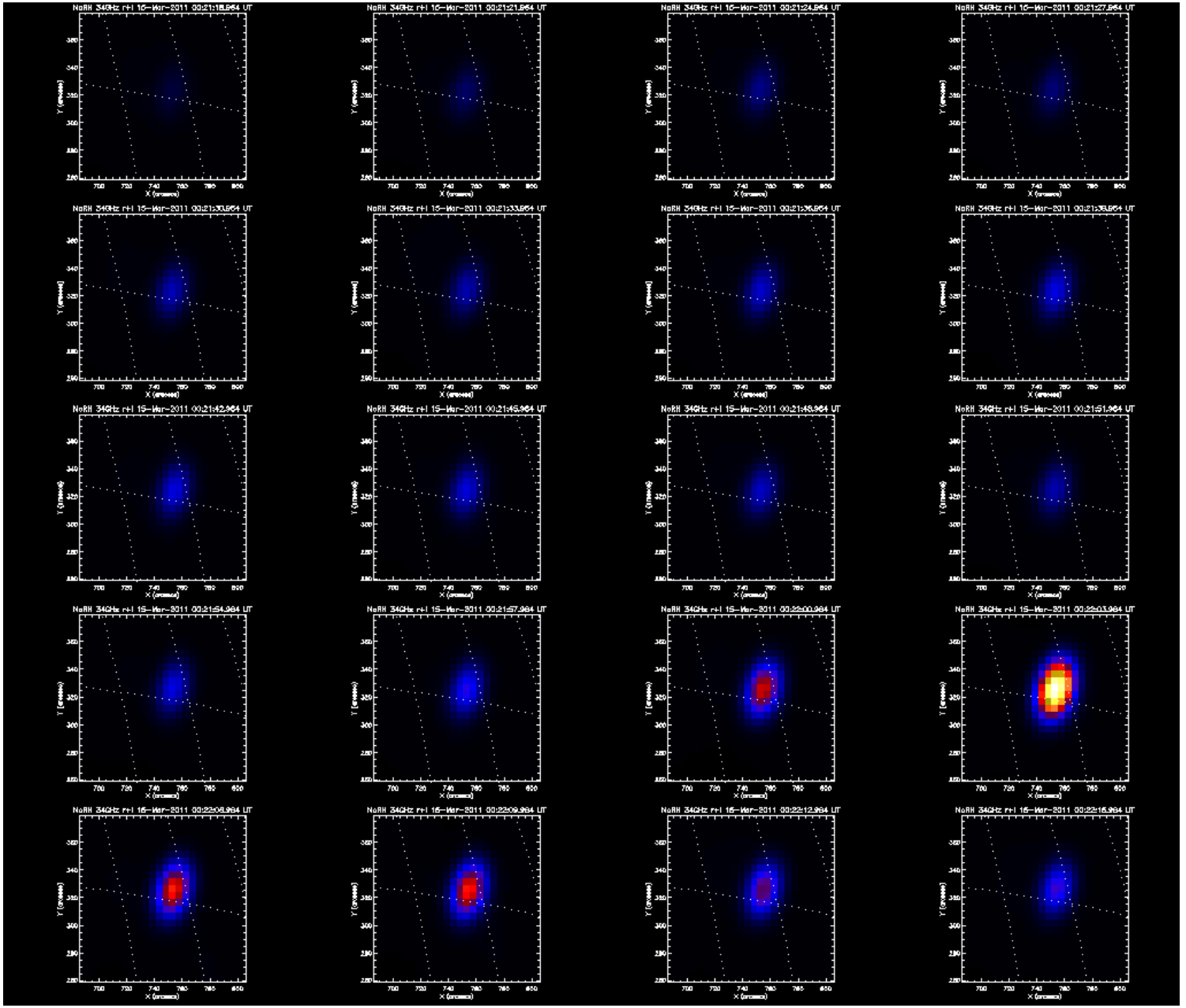
- Start 00:18
- Peak 00:22
- End 00:24



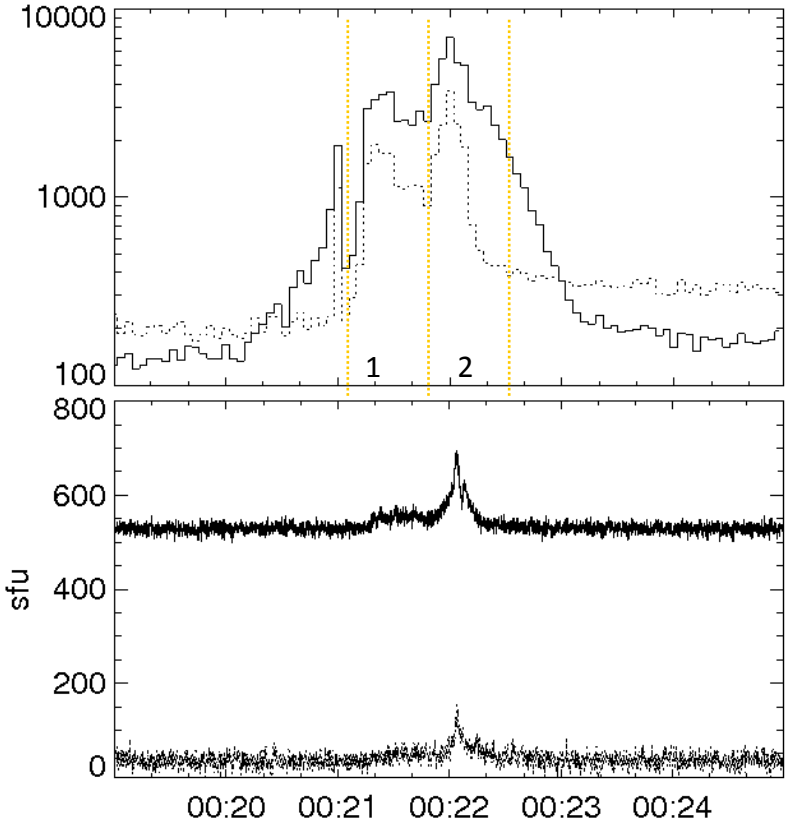
17GHz

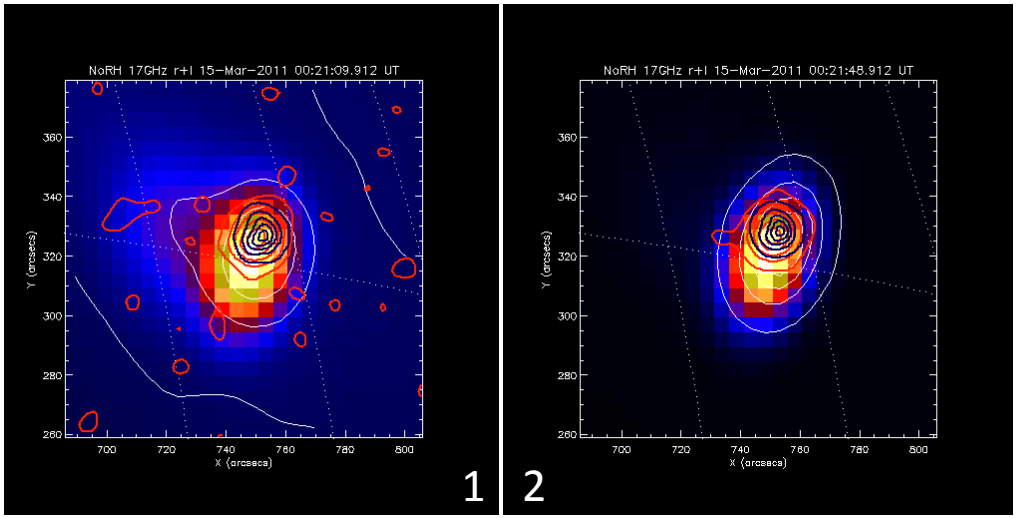


34GHz



NoRH + RHESSI





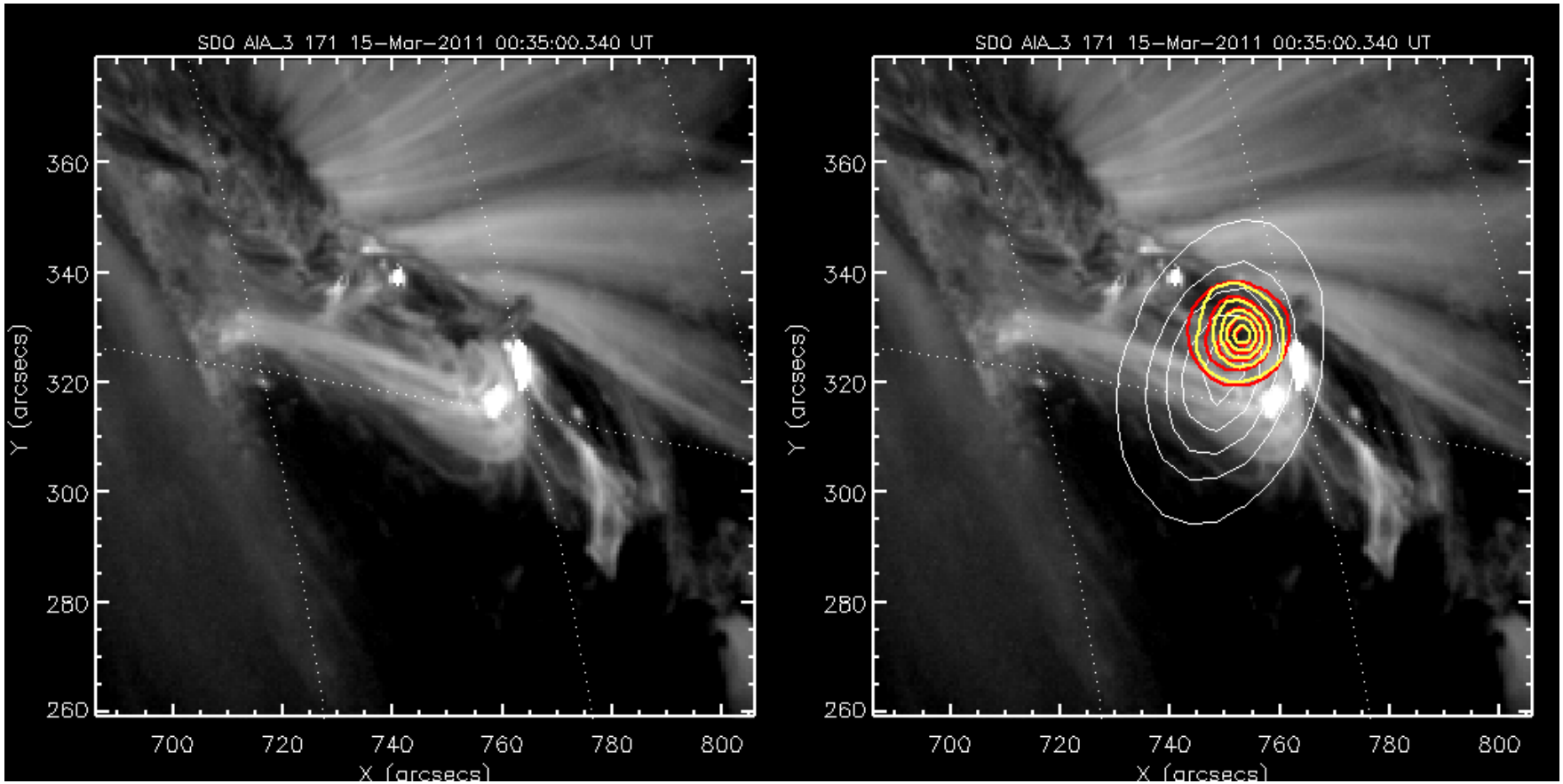
color: 17GHz

white line : 34GHz

red line: RHESSI(20-30keV)

black line: RHESSI(30-50keV)

AIA(171Å) + 17GHz + RHESSI



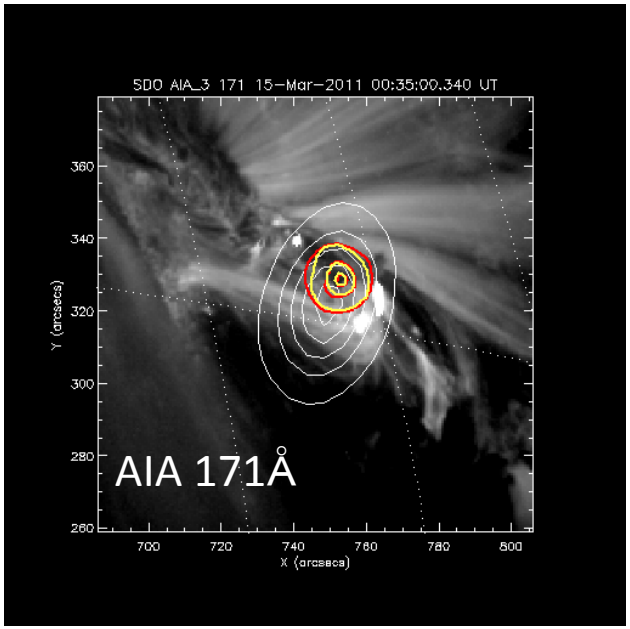
AIA (171Å) image @ decay phase

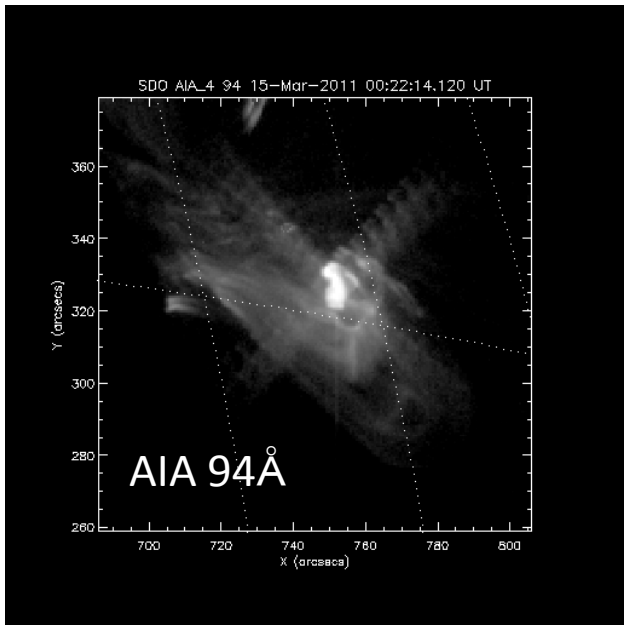
white line: 17GHz @ peak time

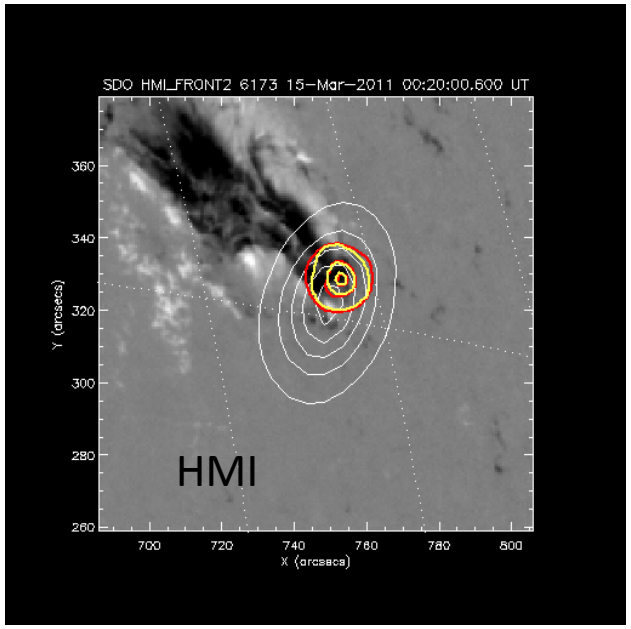
yellow line: RHESSI(6-12keV) @ peak time

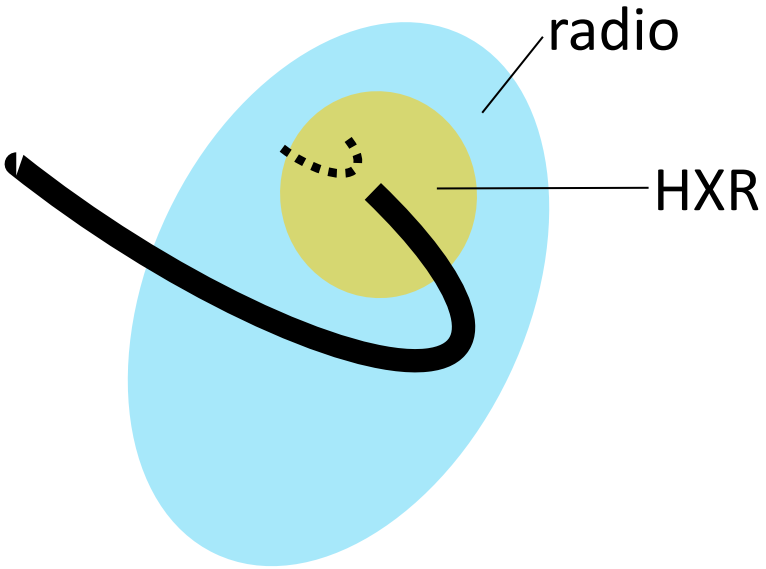
red line: RHESSI(30-50keV) @ peak time

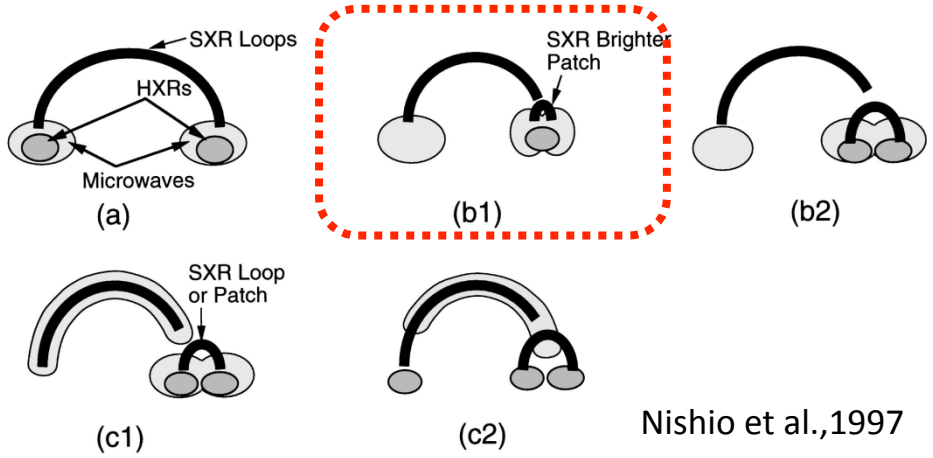
(1)2011/03/15





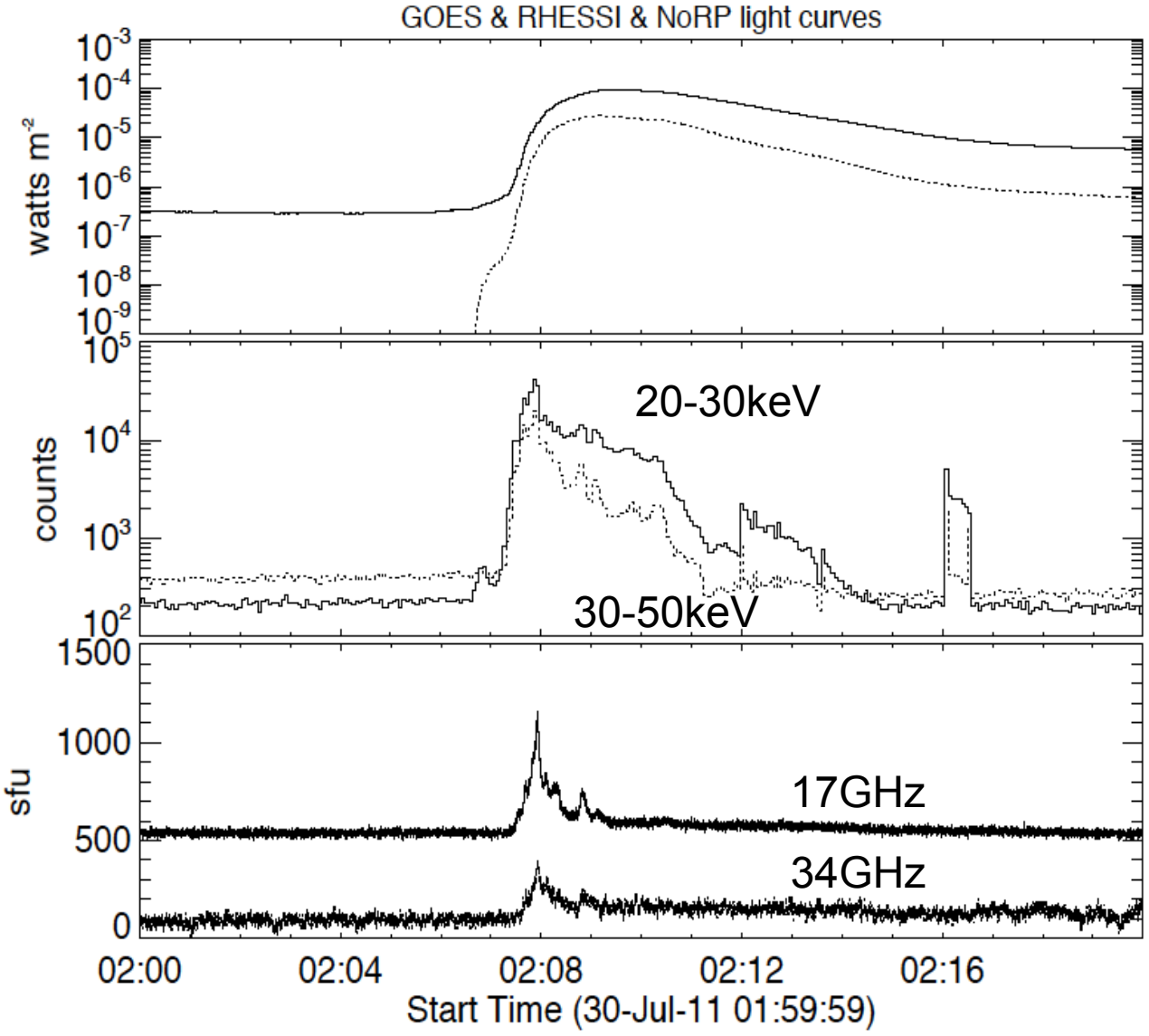


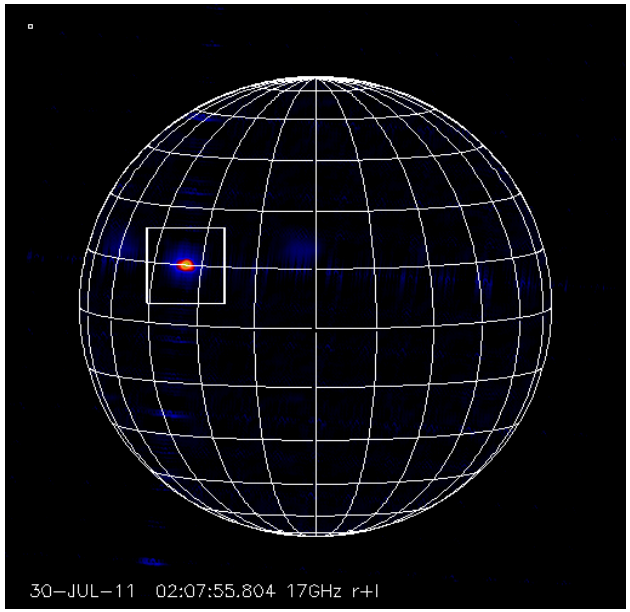




Nishio et al.,1997

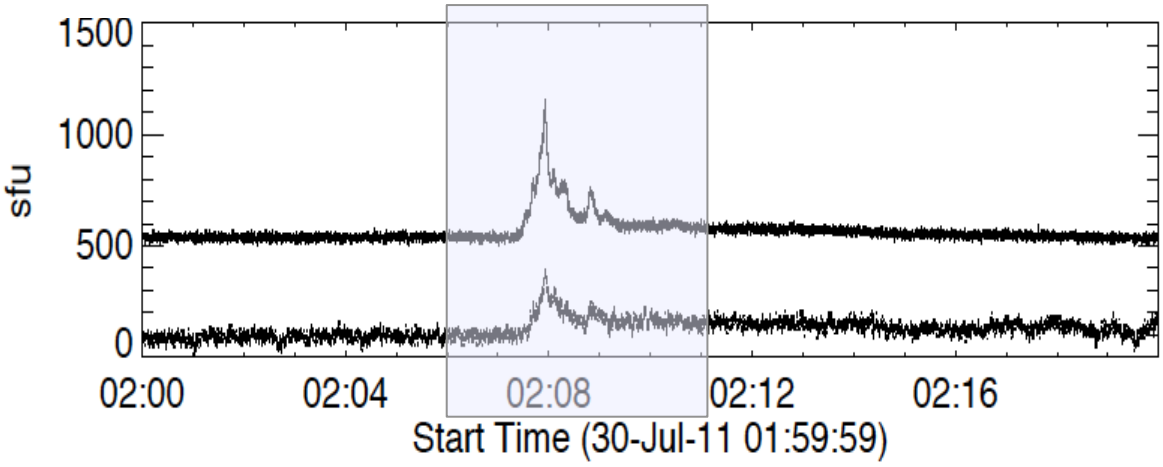
2011/07/30 0204 M9.3 flare



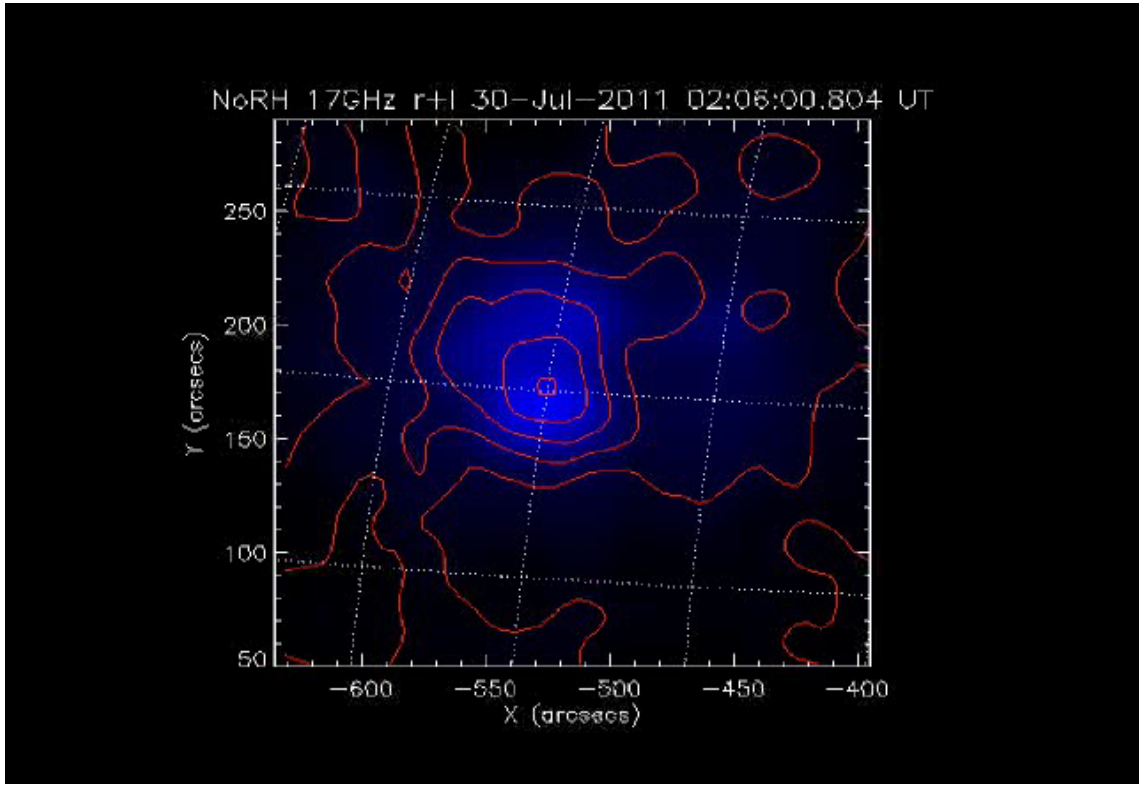


NoRH 17GHz

NoRH

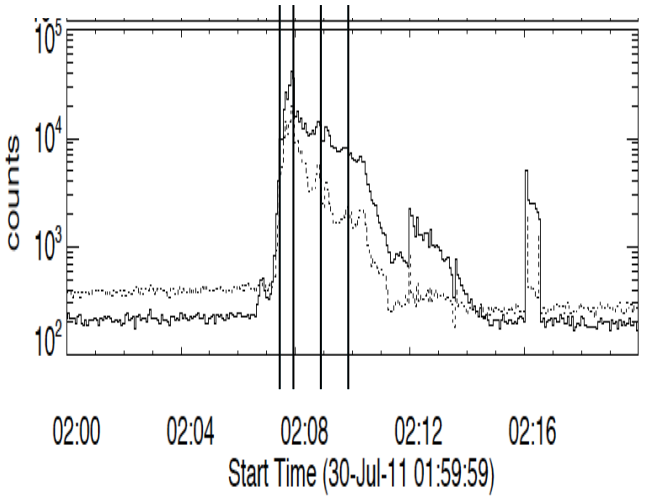


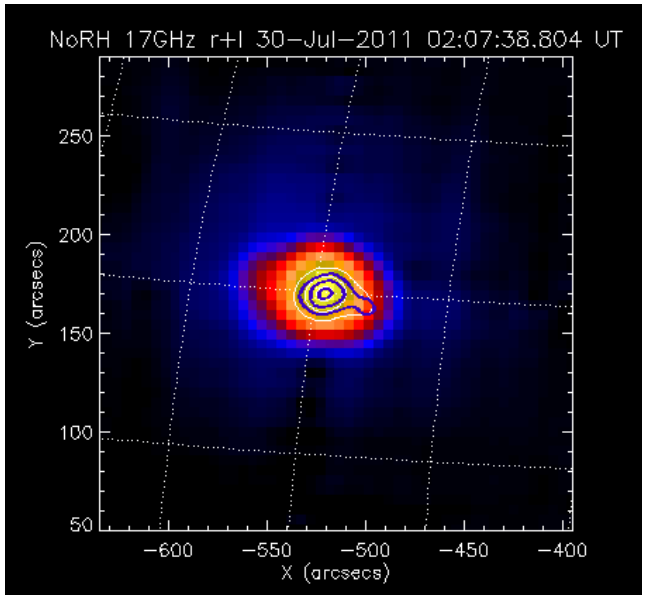
・02:06 – 02:11
(1sec. interval)
・Color: 17GHz
Contour: 34GHz

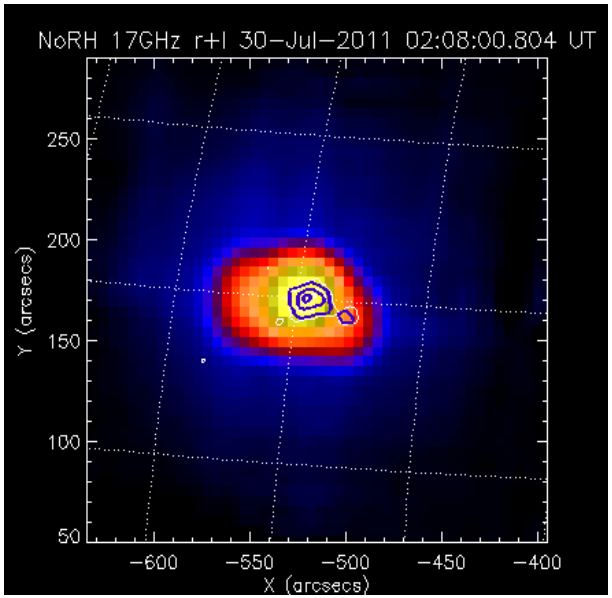


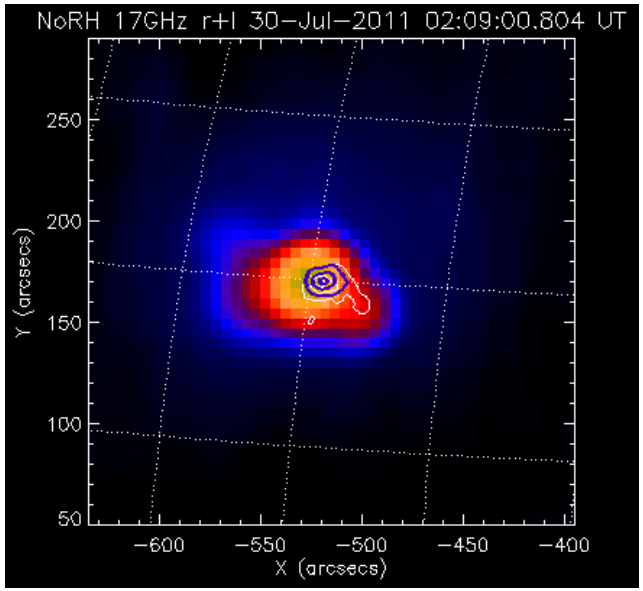
17GHz放射域の変化
(微弱な放射域が本体より分離)

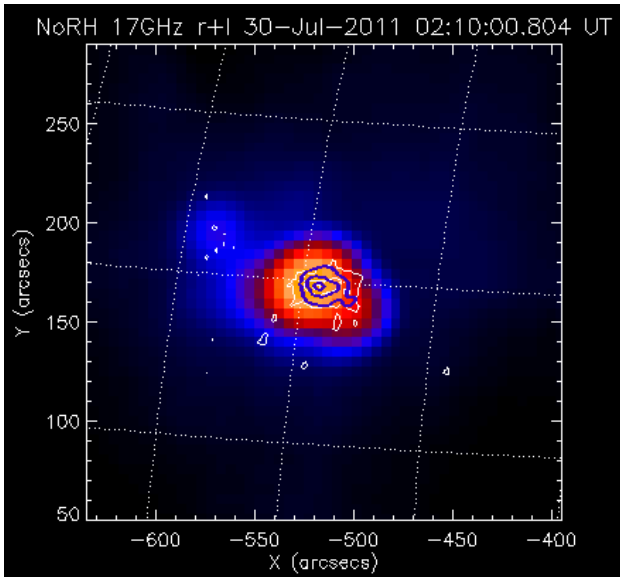
NoRH + RHESSI







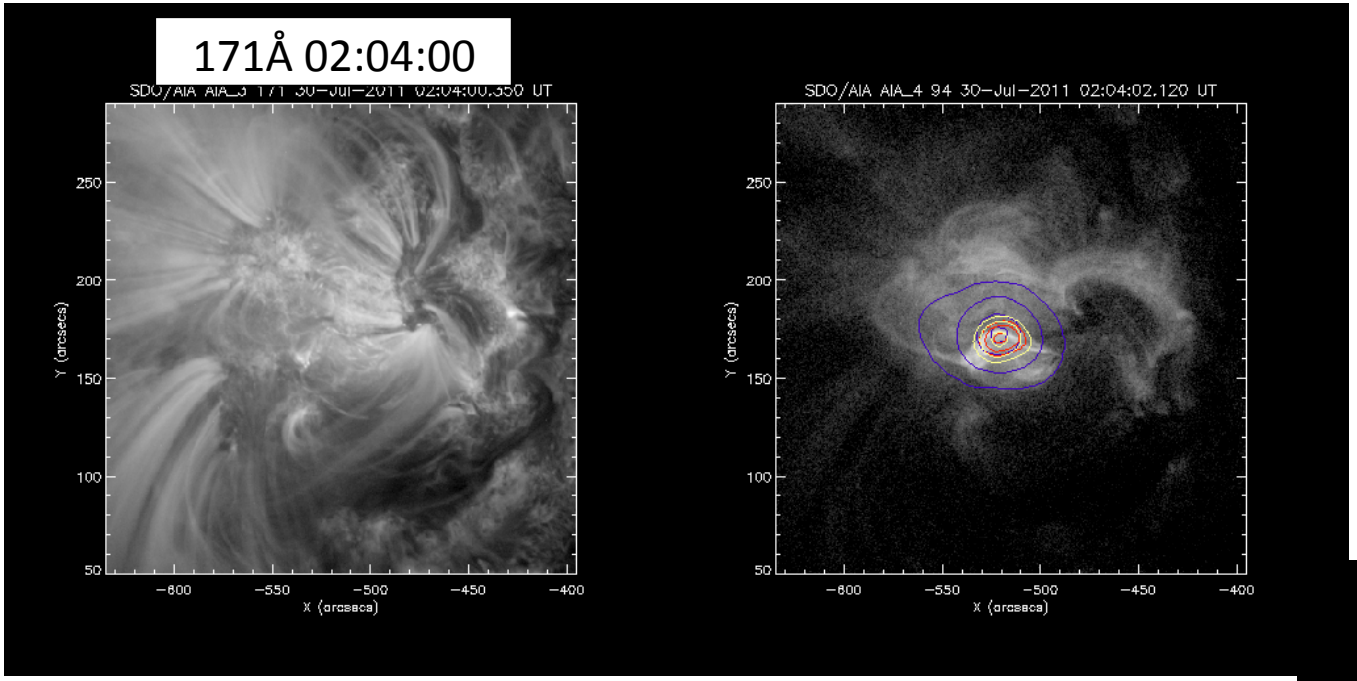




Color: NoRH 17GHz,
Contour:
Blue: HXR (20-30keV)
White: HXR (30-50keV)

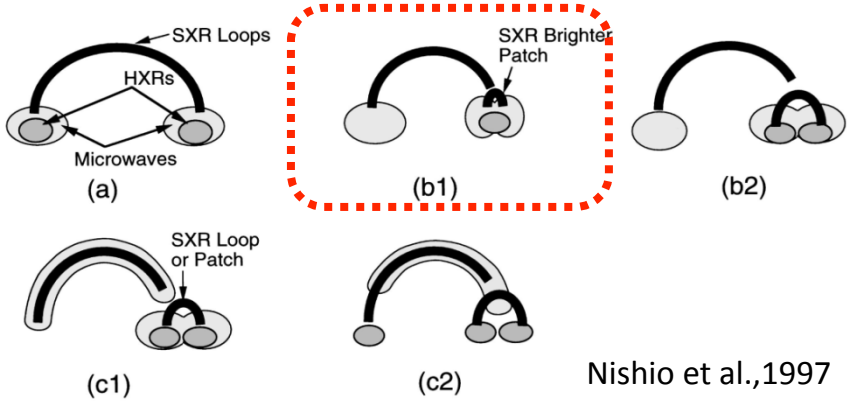
(2)2011/07/30

AIA/SDO

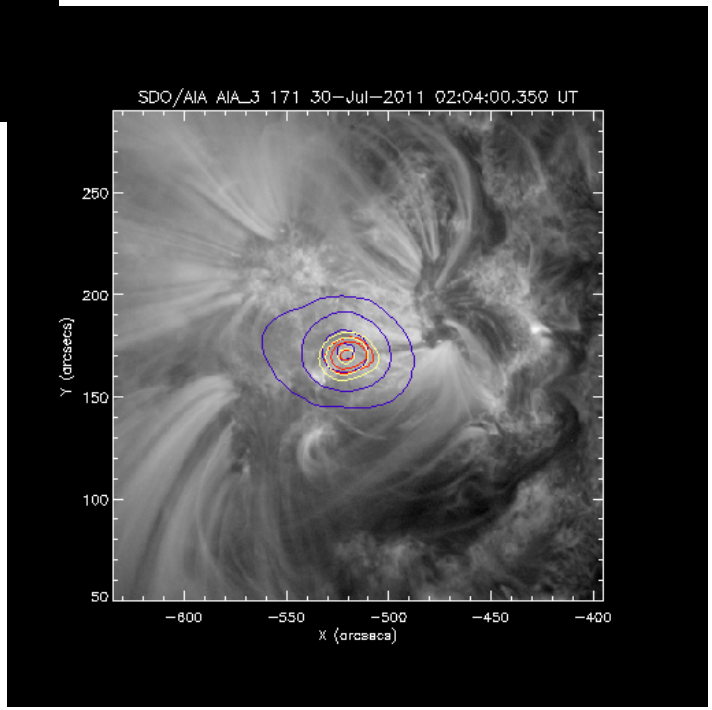


Contour:
Blue: NoRH 17GHz
Red: RHESSI (20-30keV)
Yellow: RHESSI (30-50keV)

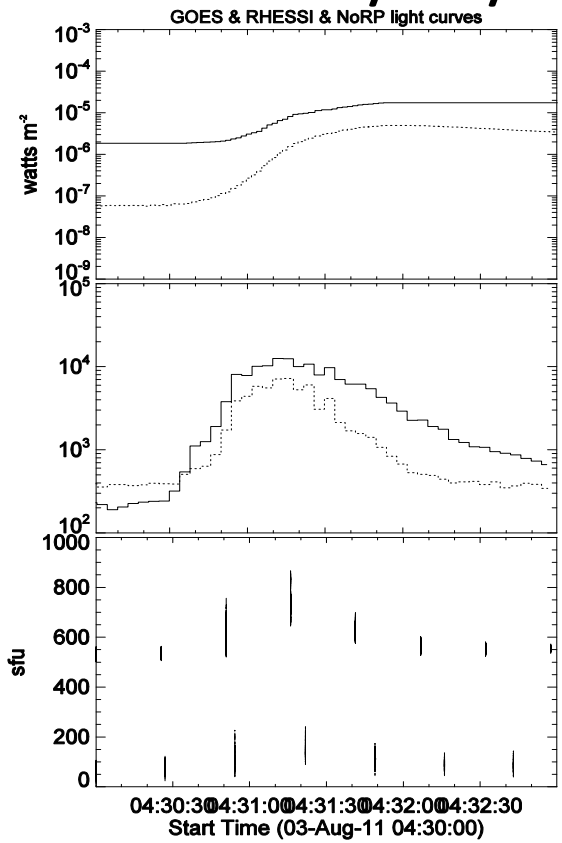
94Åで見える小ループと、周辺ループの相互作用か？

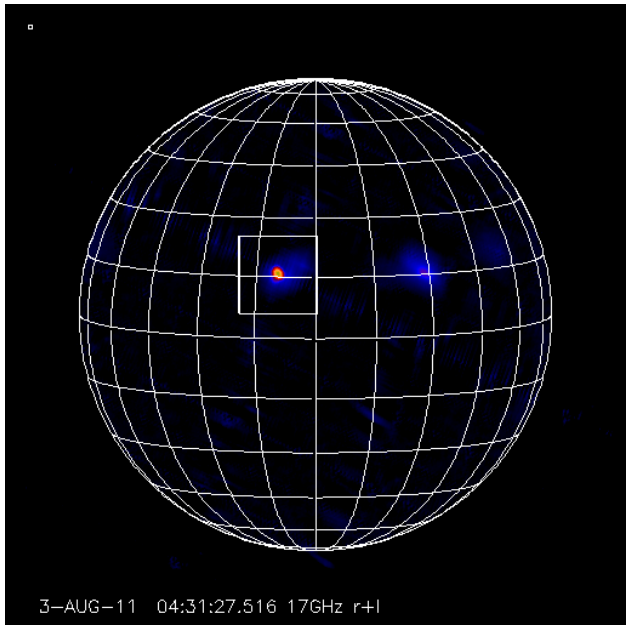


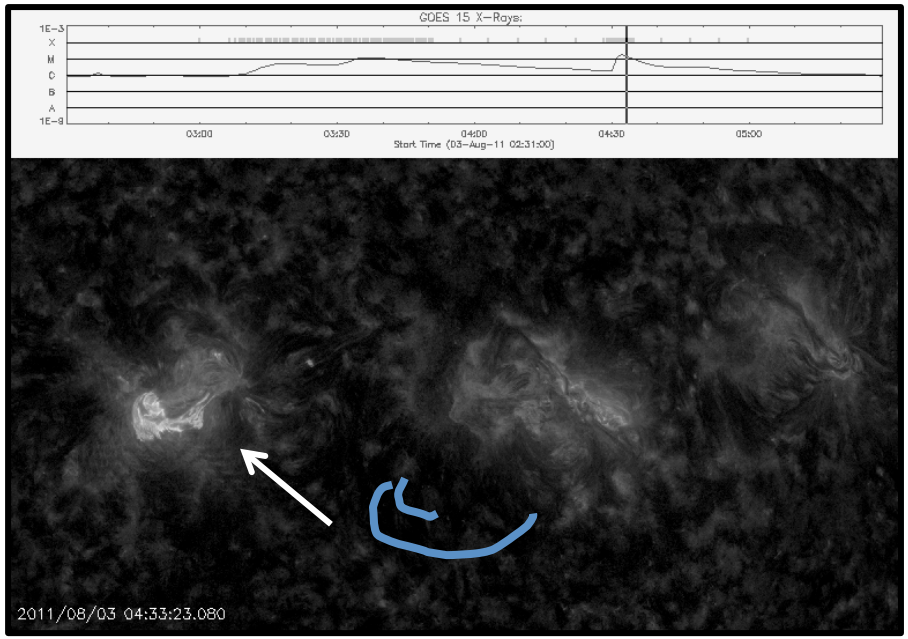
Nishio et al.,1997



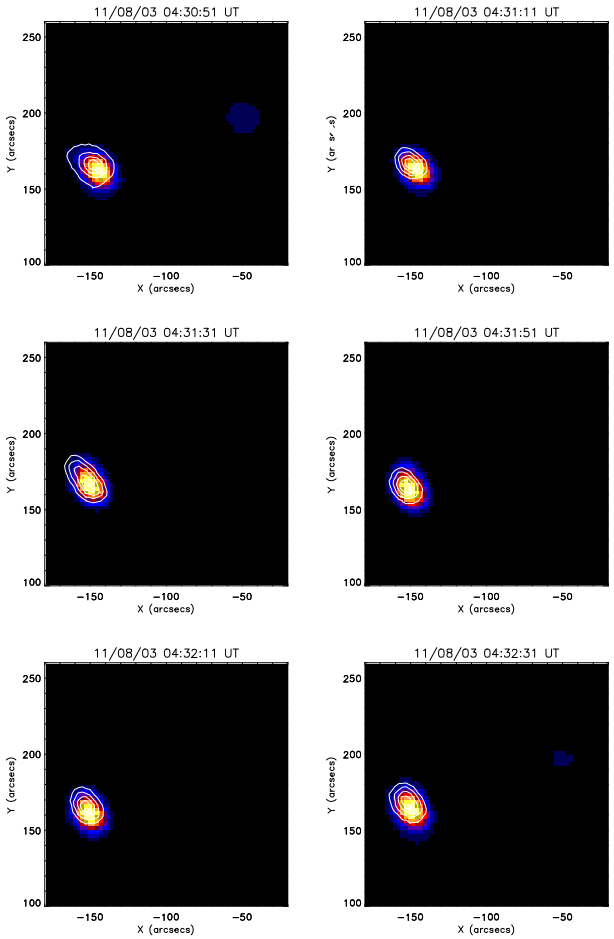
‘2011/08/03 Event’







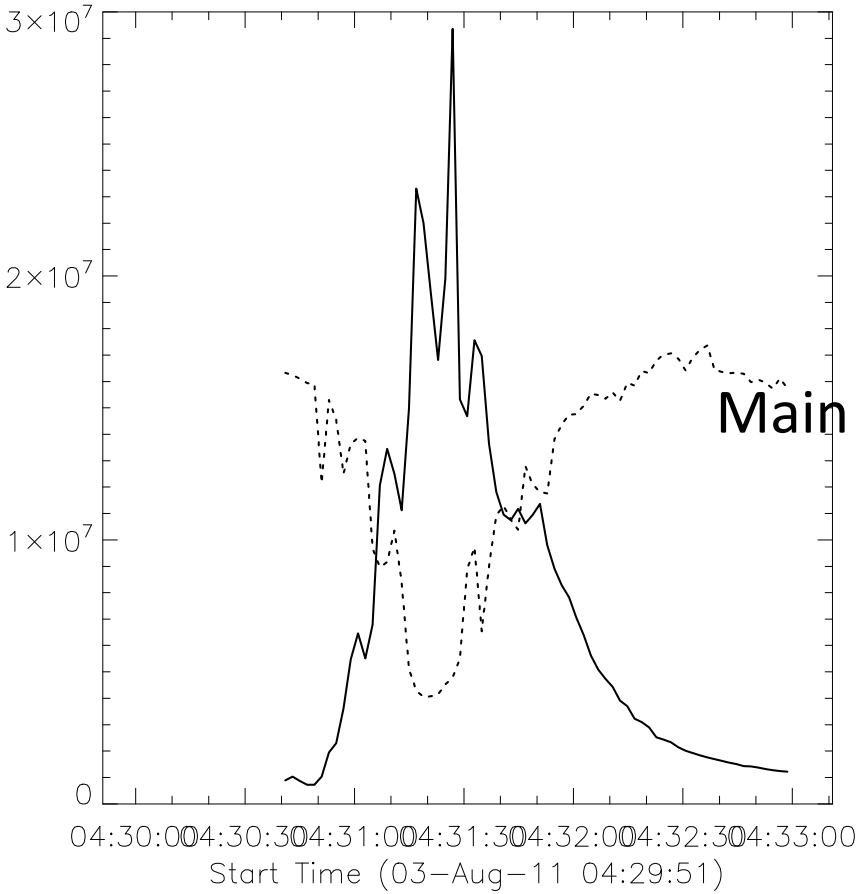
AIA image: double-loop configuration



17 GHz image: color
34 GHz image :contour
Arrow: remote source

左上から、
Initial, rising
Peak, decay_1
decay_2, decay_3

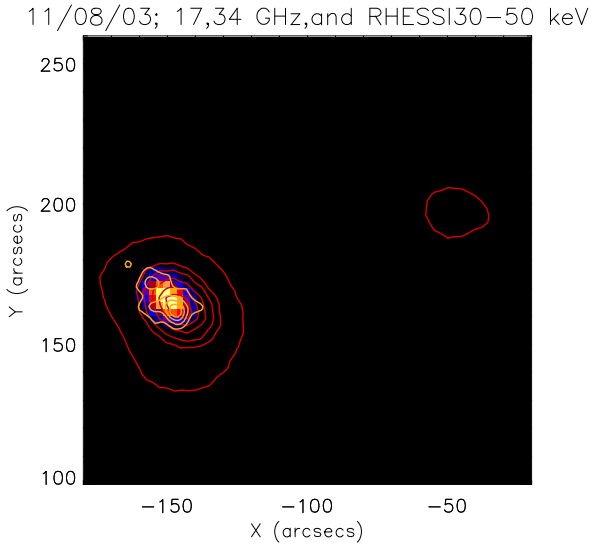
Essentially in the same location.



Main source

Remote sourc
(x100)

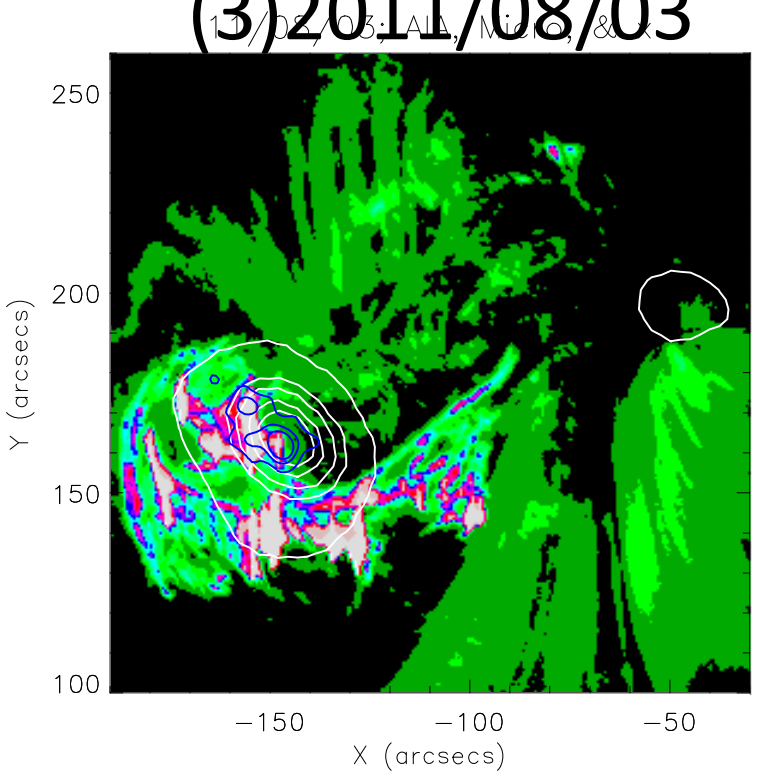
Time development of the brightness temperatures of both radio sources.



Overlay of HXR(30-50 keV) and microwave sources

Background color: 34 GHz
Red contour: 17 GHz
Contour levels: 0.005, 0.1,0.2,0.4,0.6
Orange contour: HXR (30-50 keV)
Contour levels: 0.2,0.4,0.6

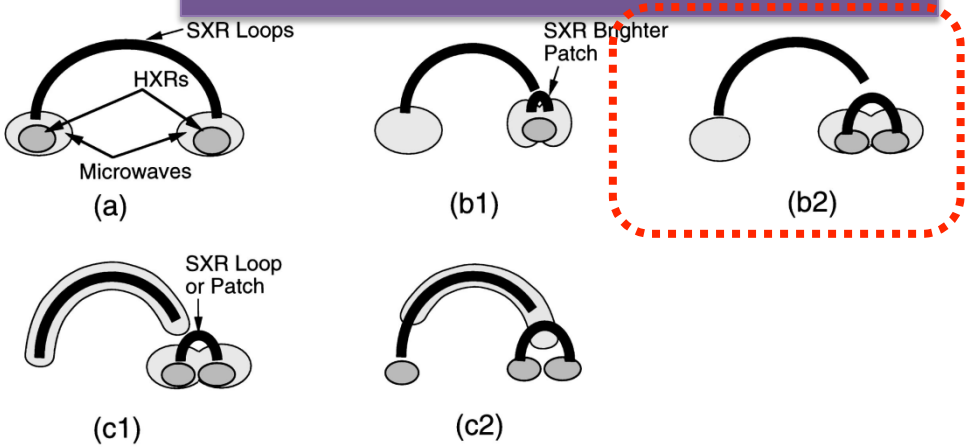
(3)2011/08/03



Overlay of AIA 171, 17 GHz, & HXR

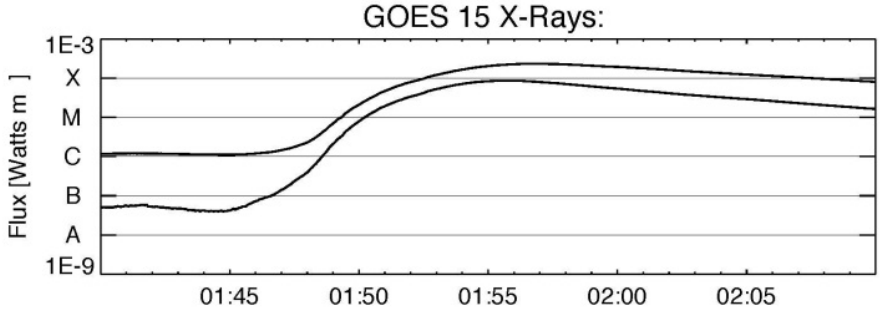
Background color :AIA/ 171
Blue color: HXR (30-50 keV)
White color: 17 GHz

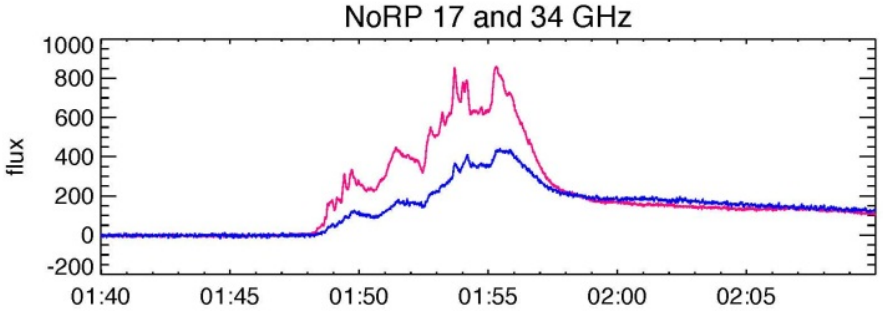
Two footpoints are located at the footpoints of the small loop.
Remote source is located probably at the remote footpoint of the large loop.

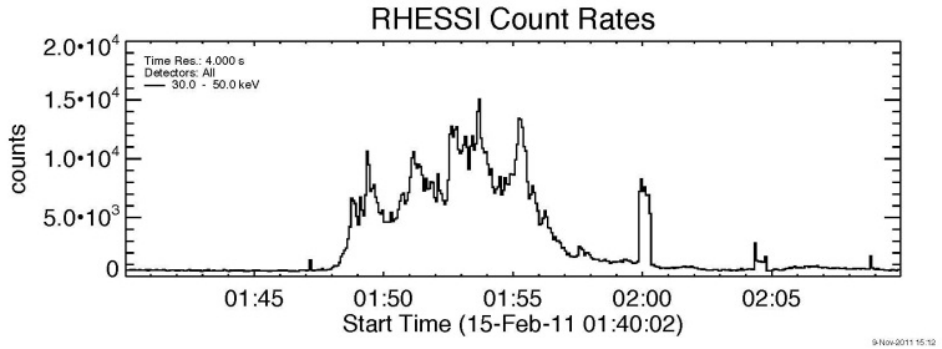


- アーケード型フレア
  - 2011/02/15
  - 2011/06/07
  - 2011/09/09

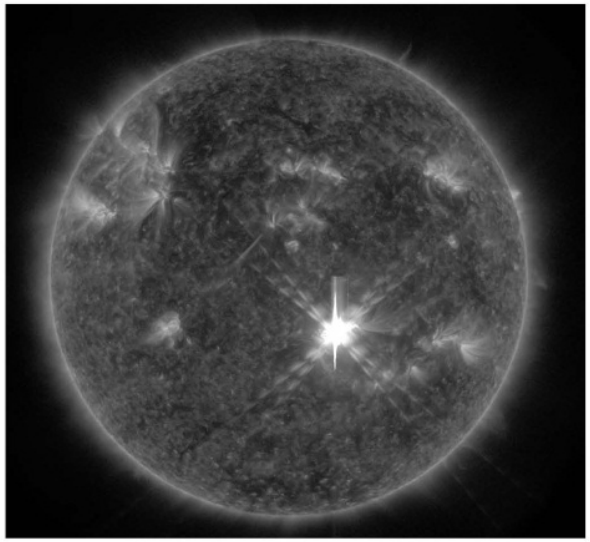
2011/02/15 X2.2





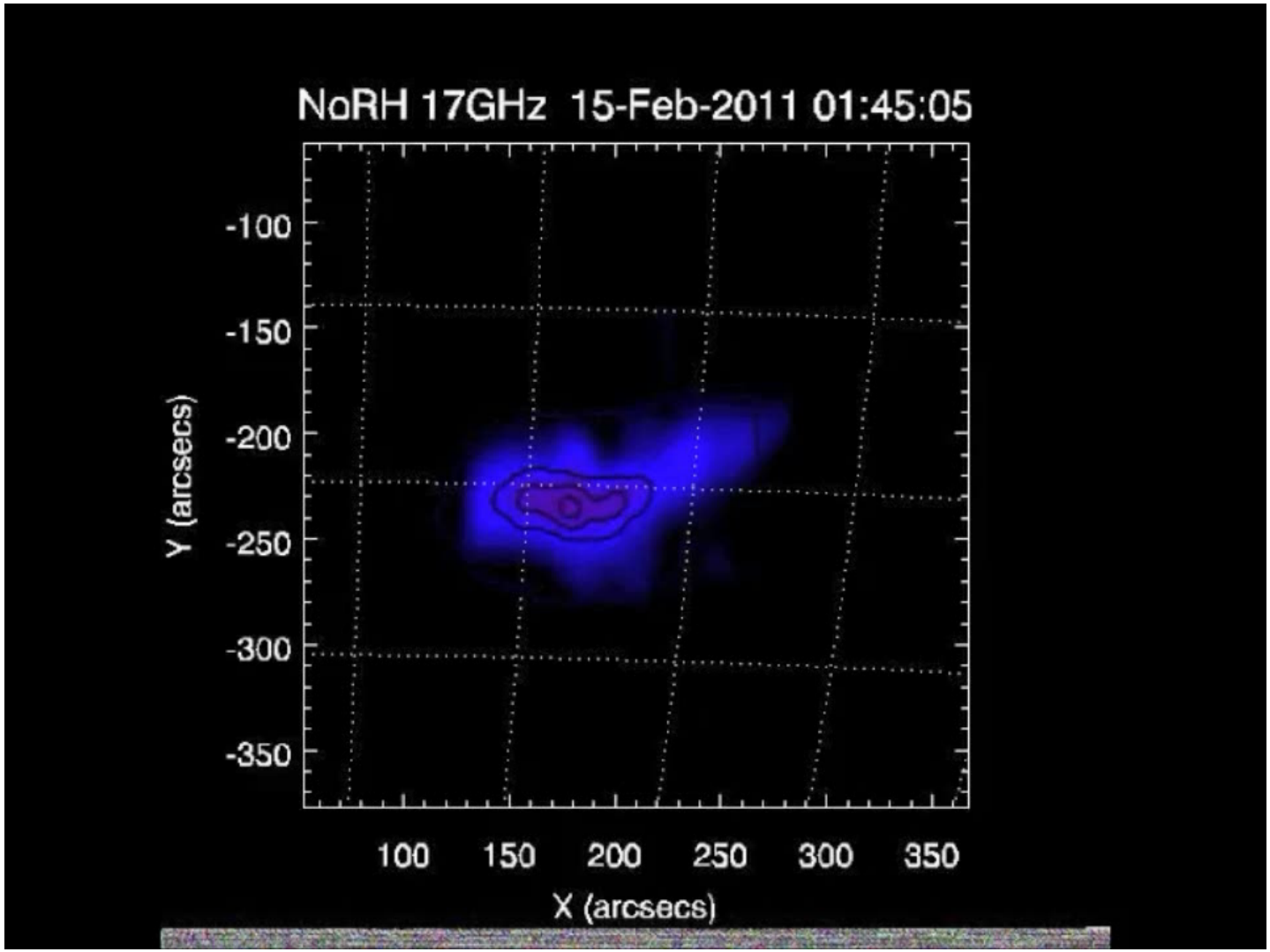


- Start 01:44
- Peak 01:56
- End 02:06

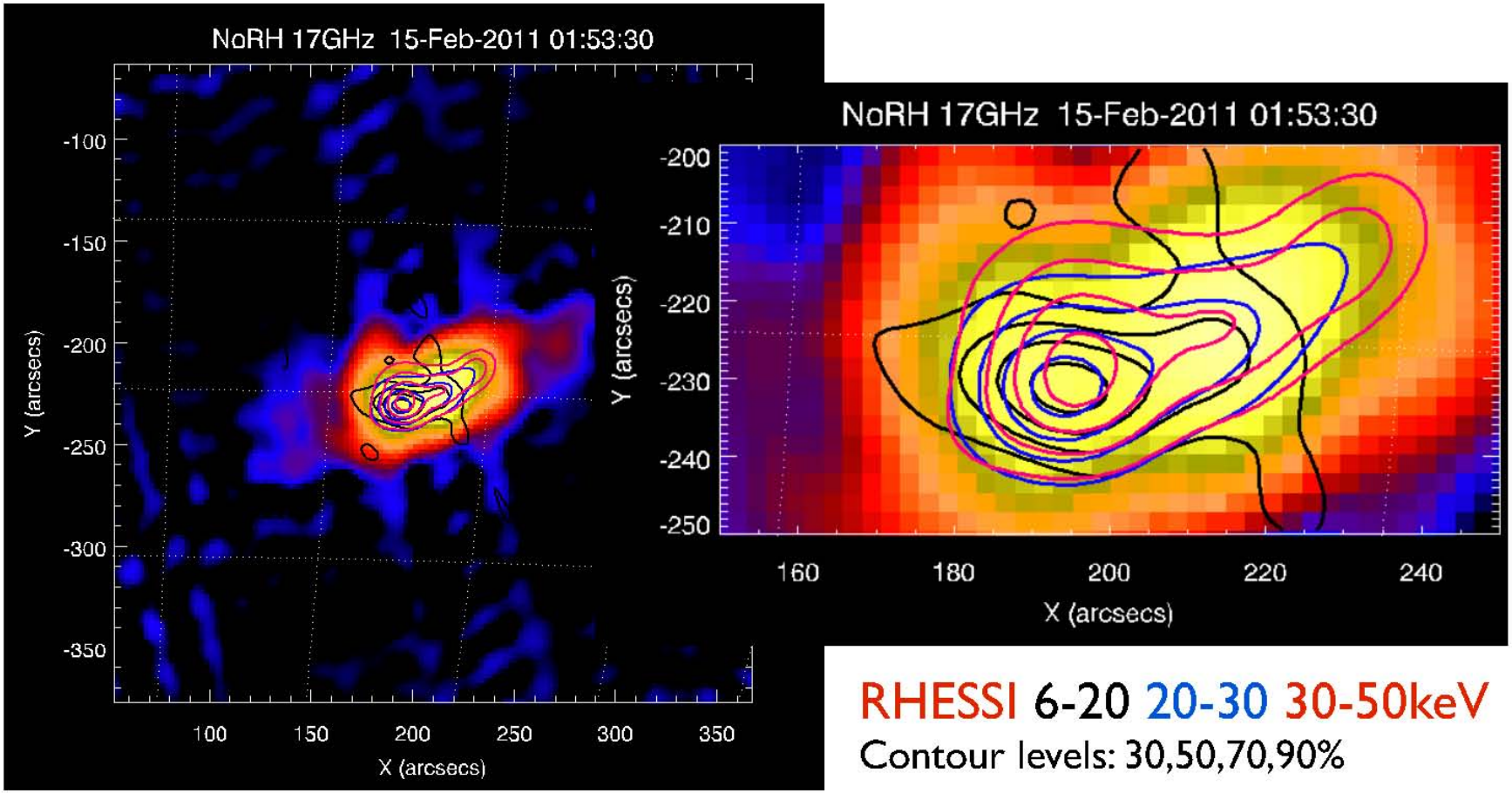


AIA131
20110215_015621

NoRH 17 and 34 GHz



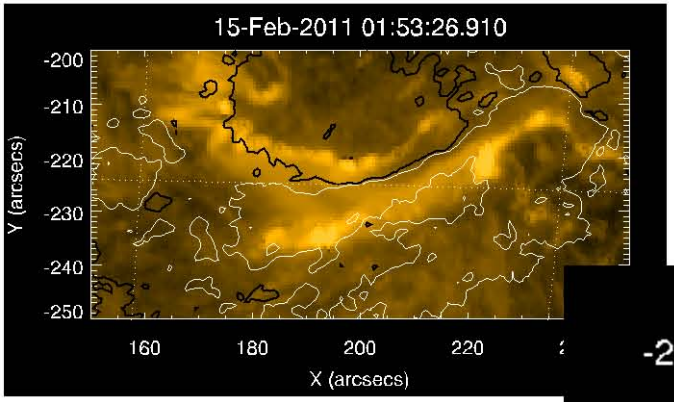
NoRH 17 GHz
RHESSI 6-20, 20-30, and 30-50 keV

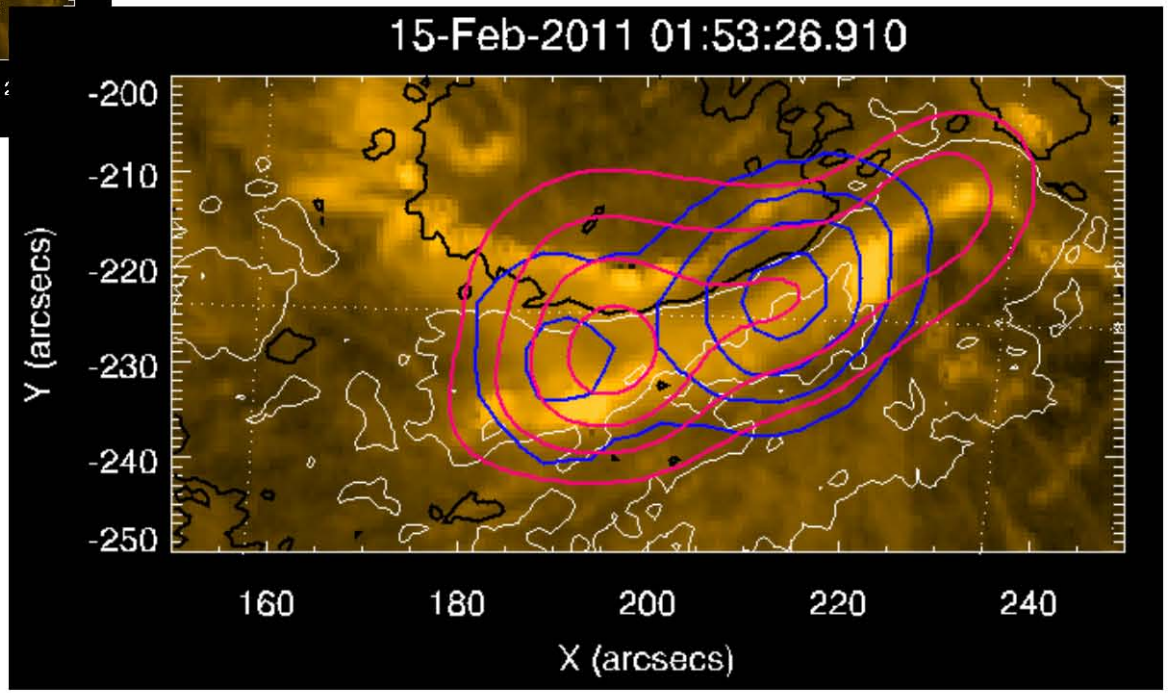


RHESSI 6-20 20-30 30-50keV

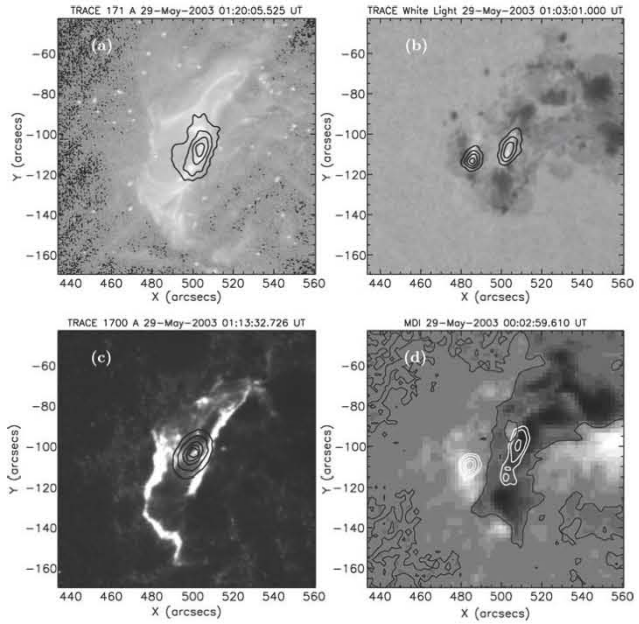
Contour levels: 30,50,70,90%

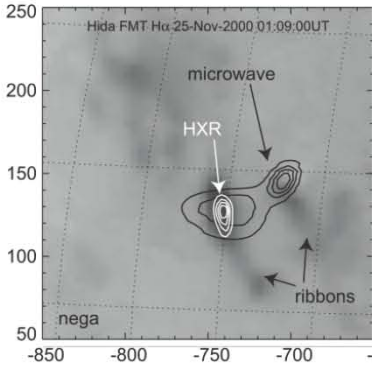
AIA171-HMI
NoRH17GHz-RHESSI 30-50keV

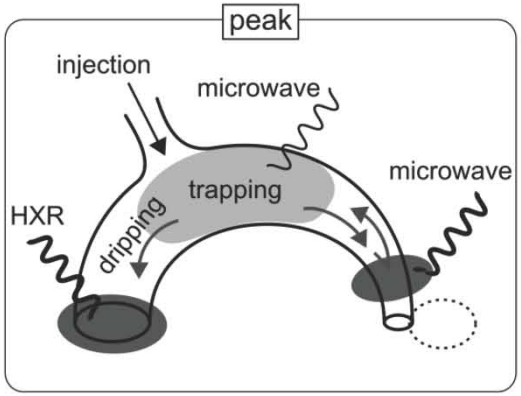




RHESSI 30-50keV
NoRH 17 GHz
Contour levels: 30,50,70 90%
HMI magnetogram
Black — White + polarity

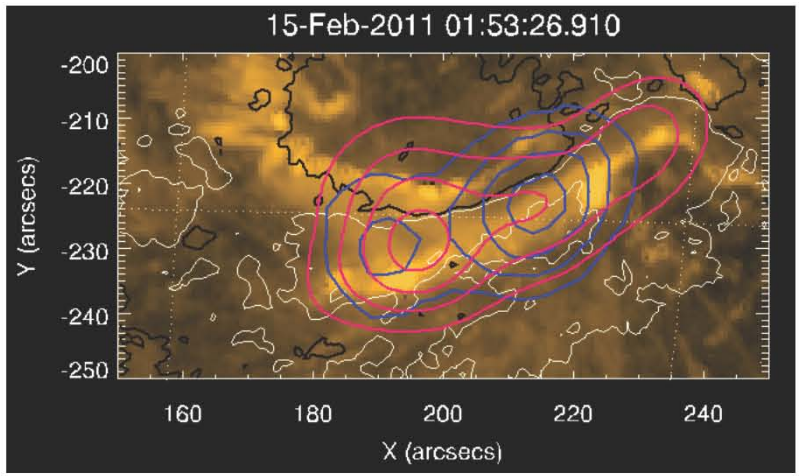




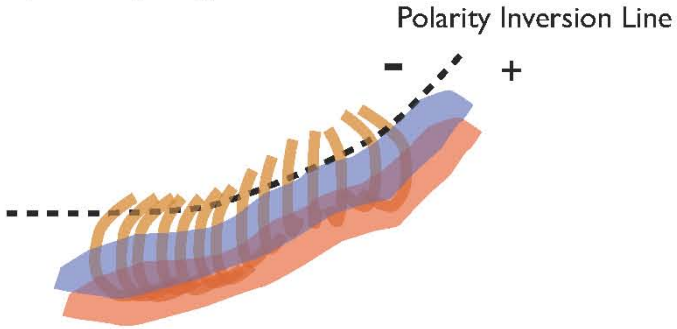


Takasaki et al. 2007

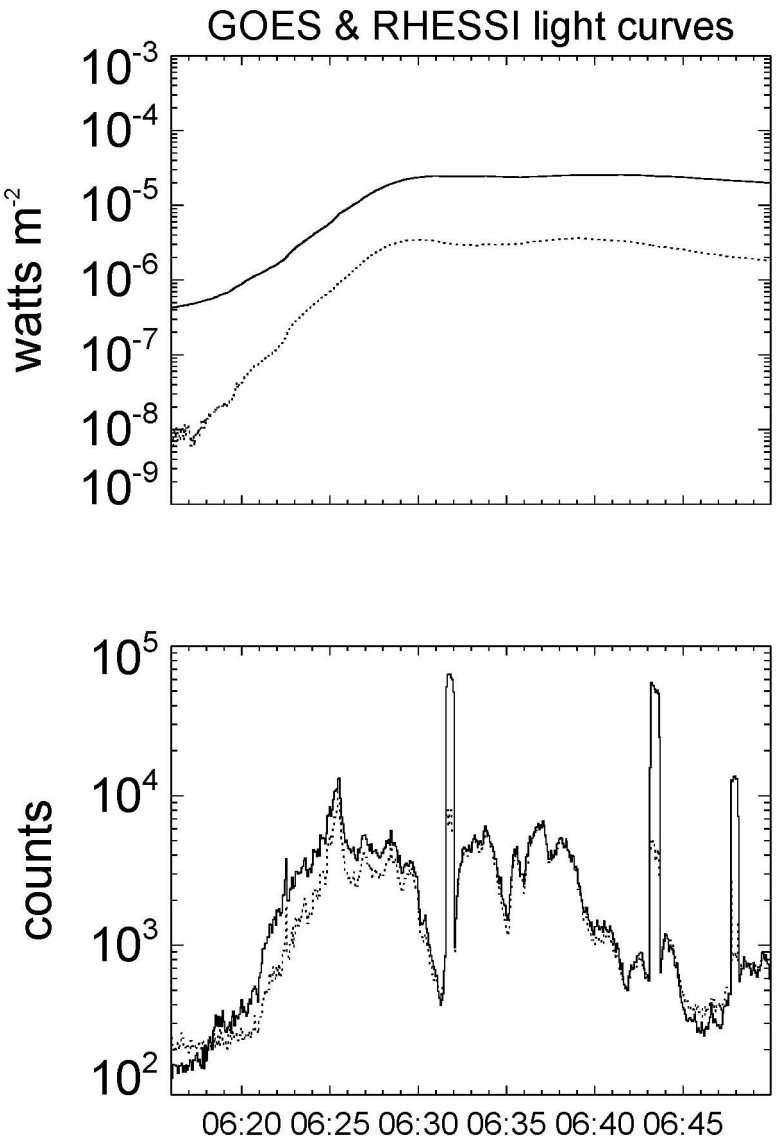
Zimovets & Struminsky 2009



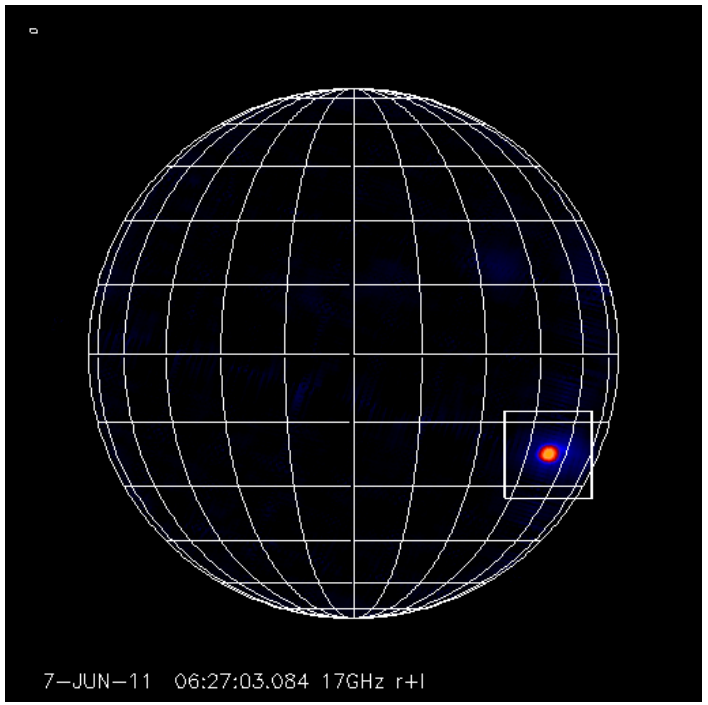
Q) Why there is no HXR and Microwave emission in negative polarity region



‘2011/06/07_flare’

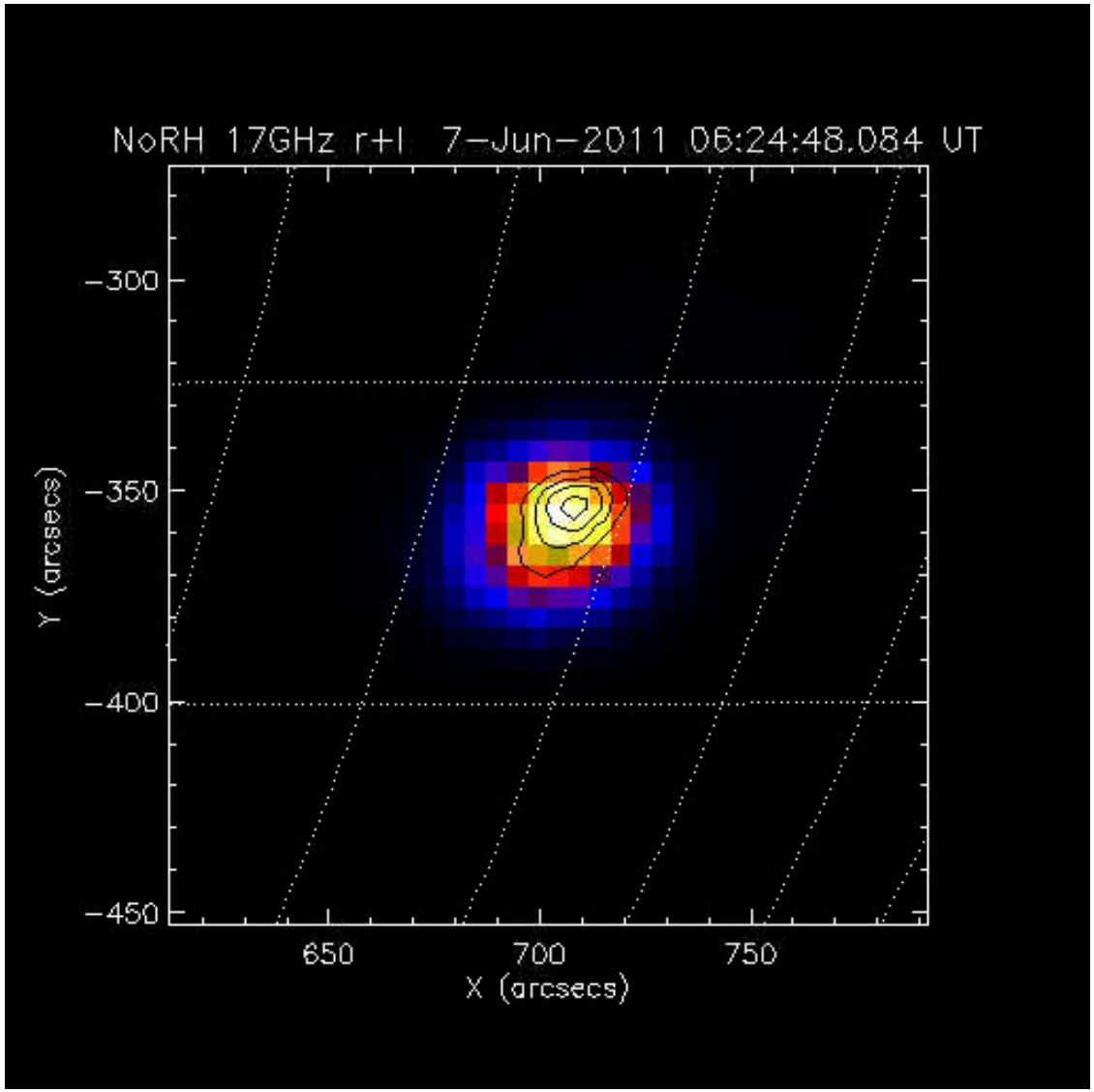


- 2011 June 7
- S22W52



solid:20-30keV
dotted:30-50keV

NoRH 17 and 34 GHz

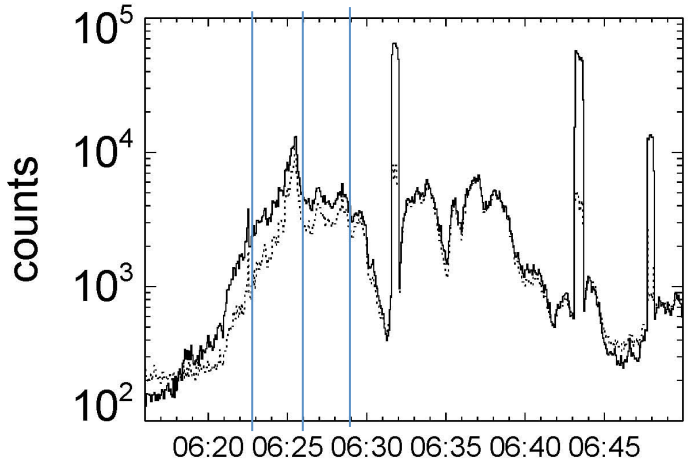


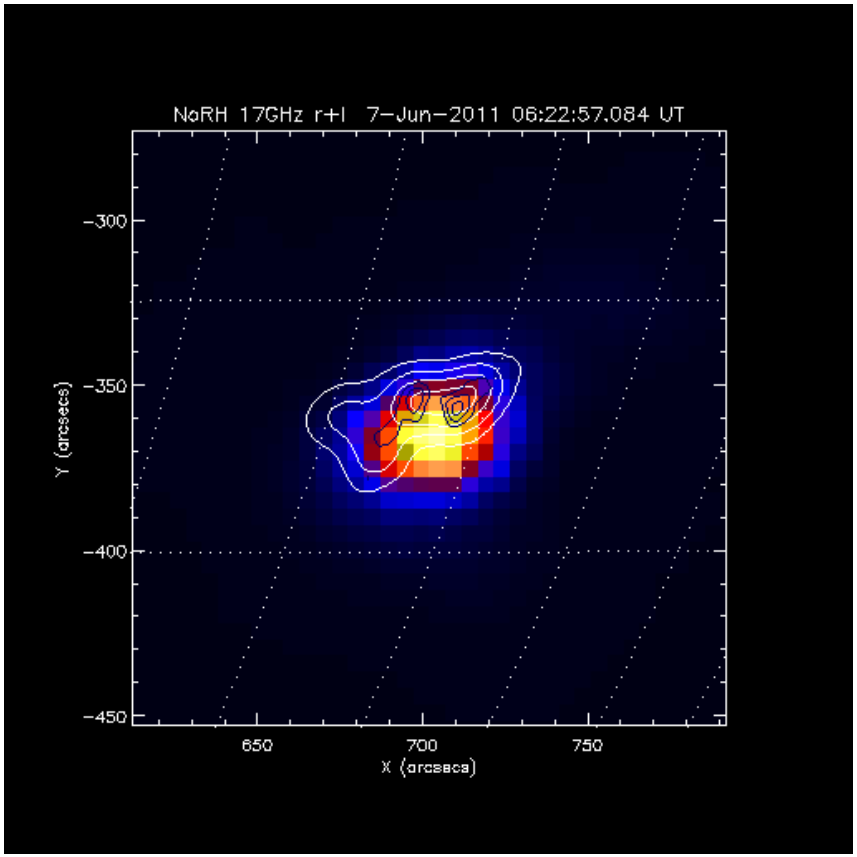
Color : NoRH17GHz

Contour : NoRH34GHz

Levels = 30,50,70,90%

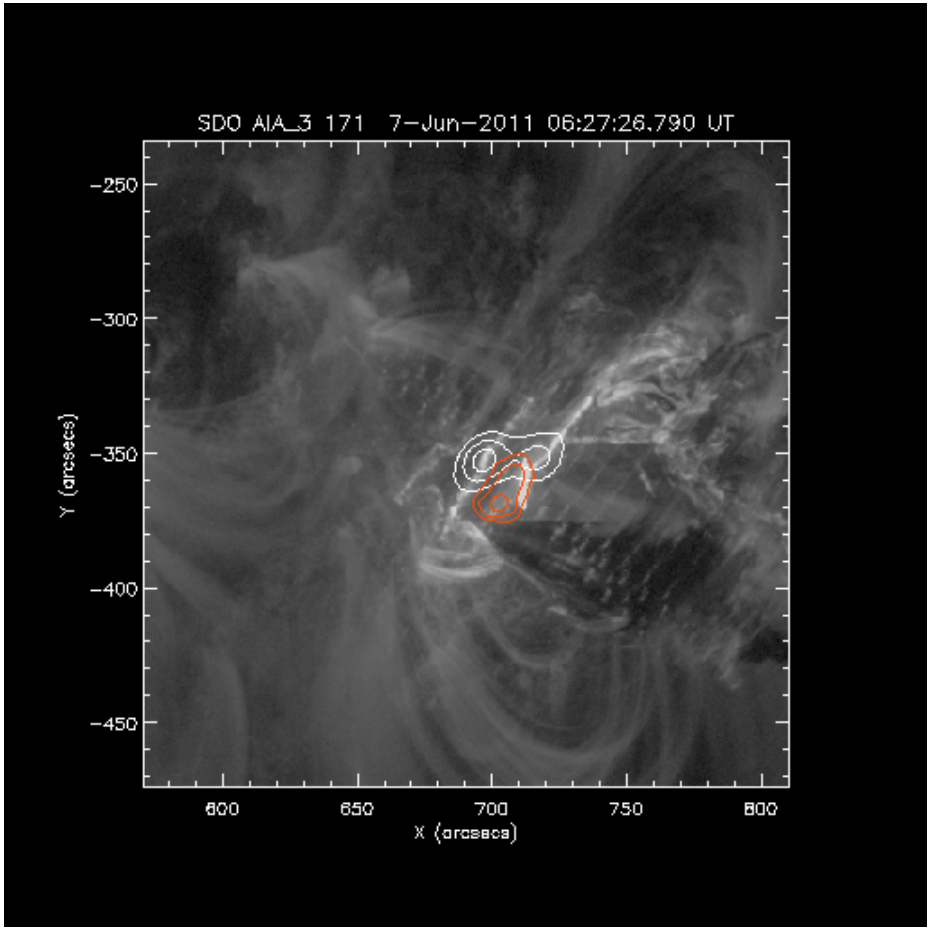
NoRH and RHESSI

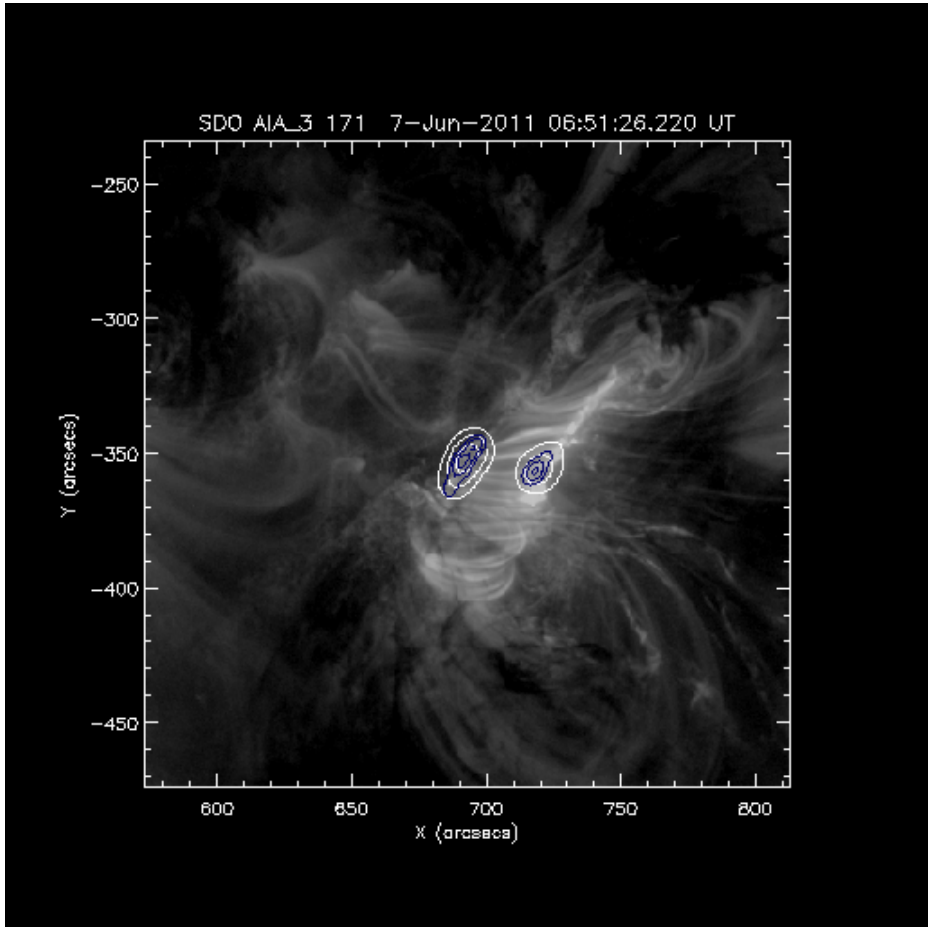




Color : NoRH17GHz Contours white:20-30keV levels=30,50,70,90%
blue:30-50keV levels=50,70,90%

AIA171 and NoRH and RHESSI



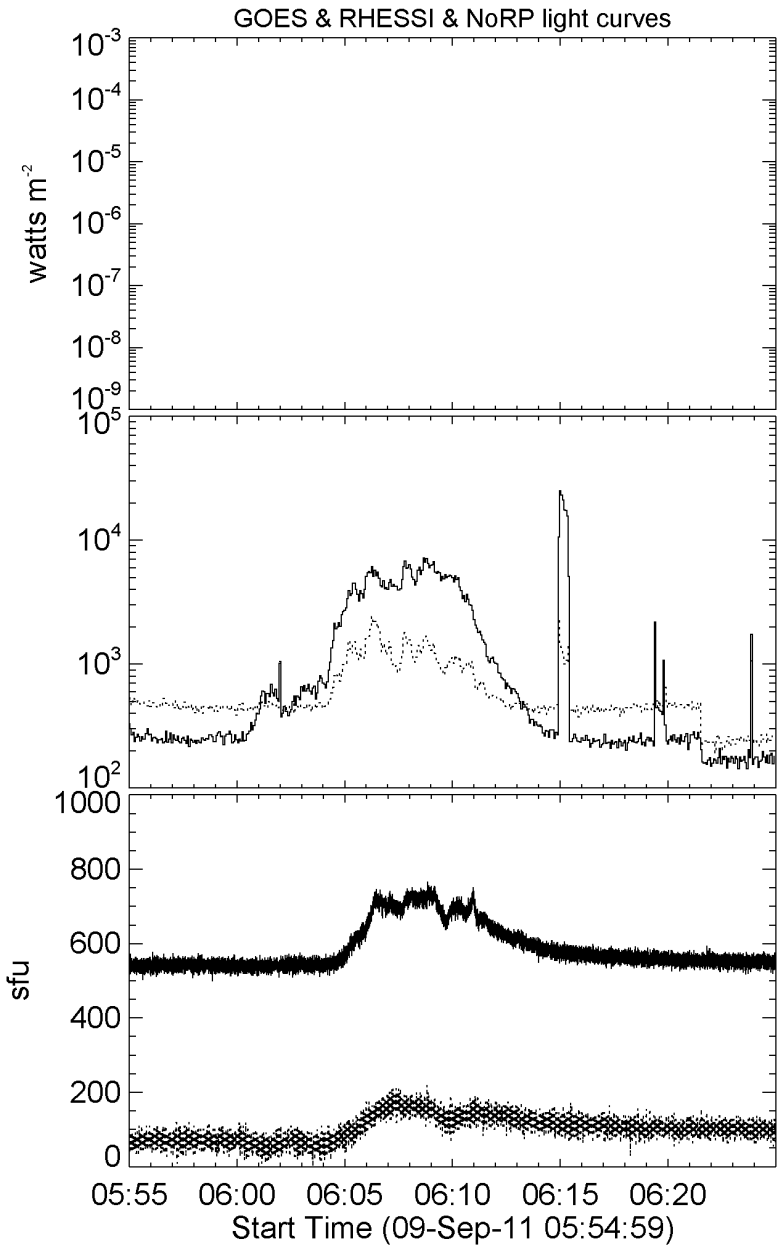


Color : AIA171Å Contours white:20-30keV

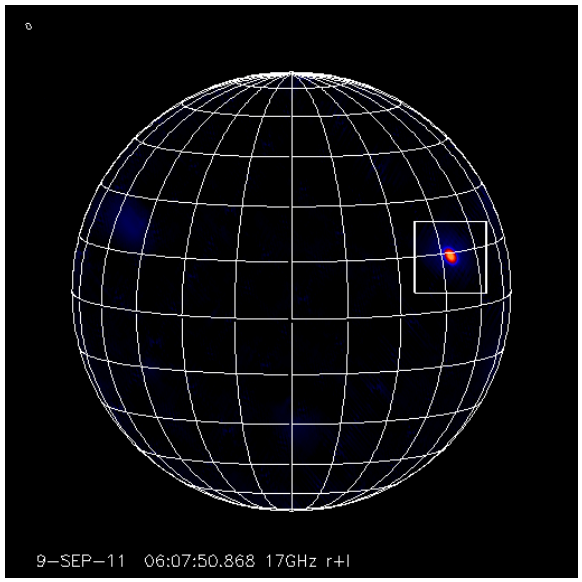
blue:30-50keV

red:17GHz levels =50,70,90%

‘2011/09/09 Event’

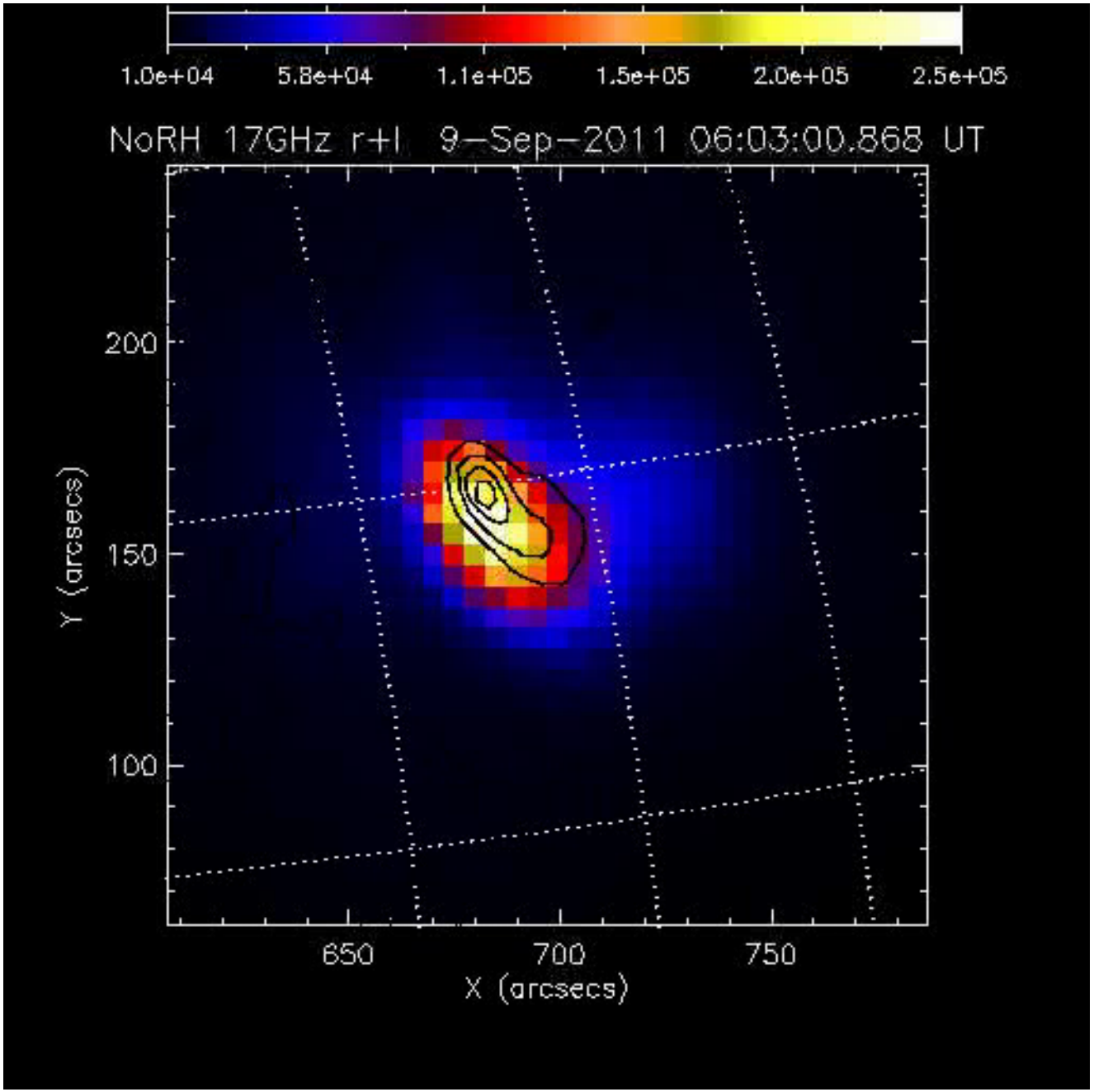


No GOES data

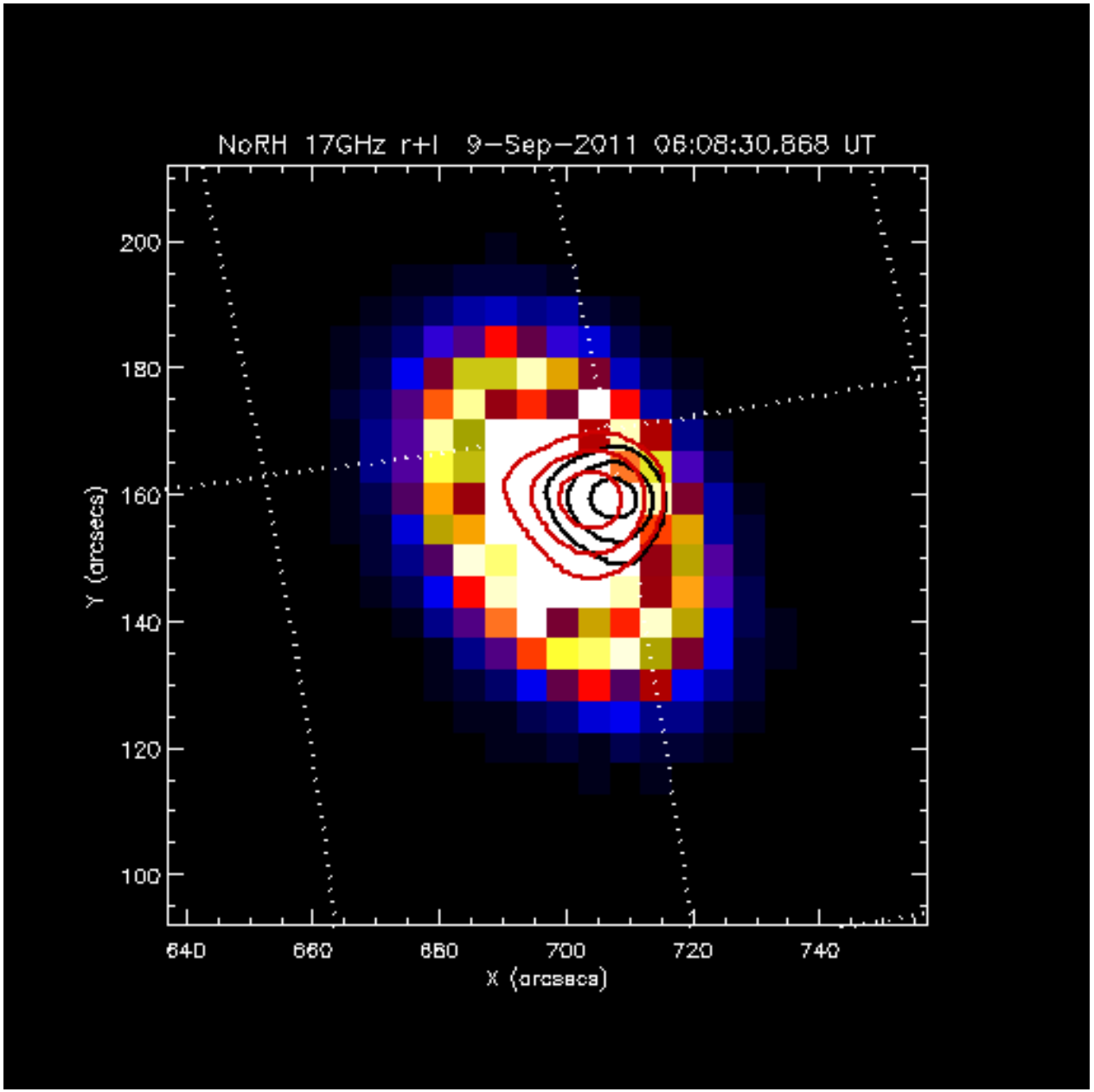


solid: 20-30 keV
dotted: 30-50keV

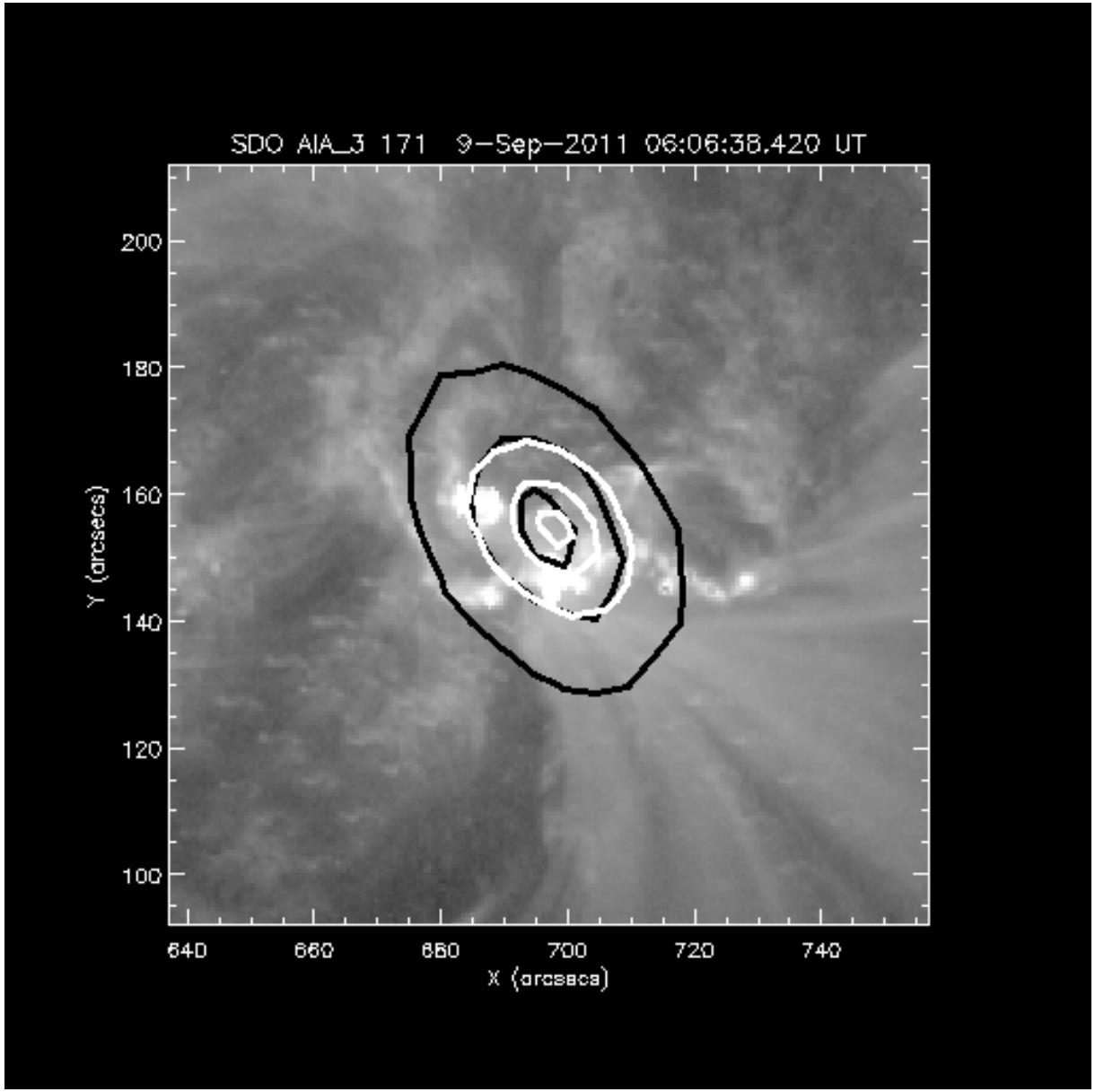
solid: 17GHz (+500sfu)
dotted: 34GHz



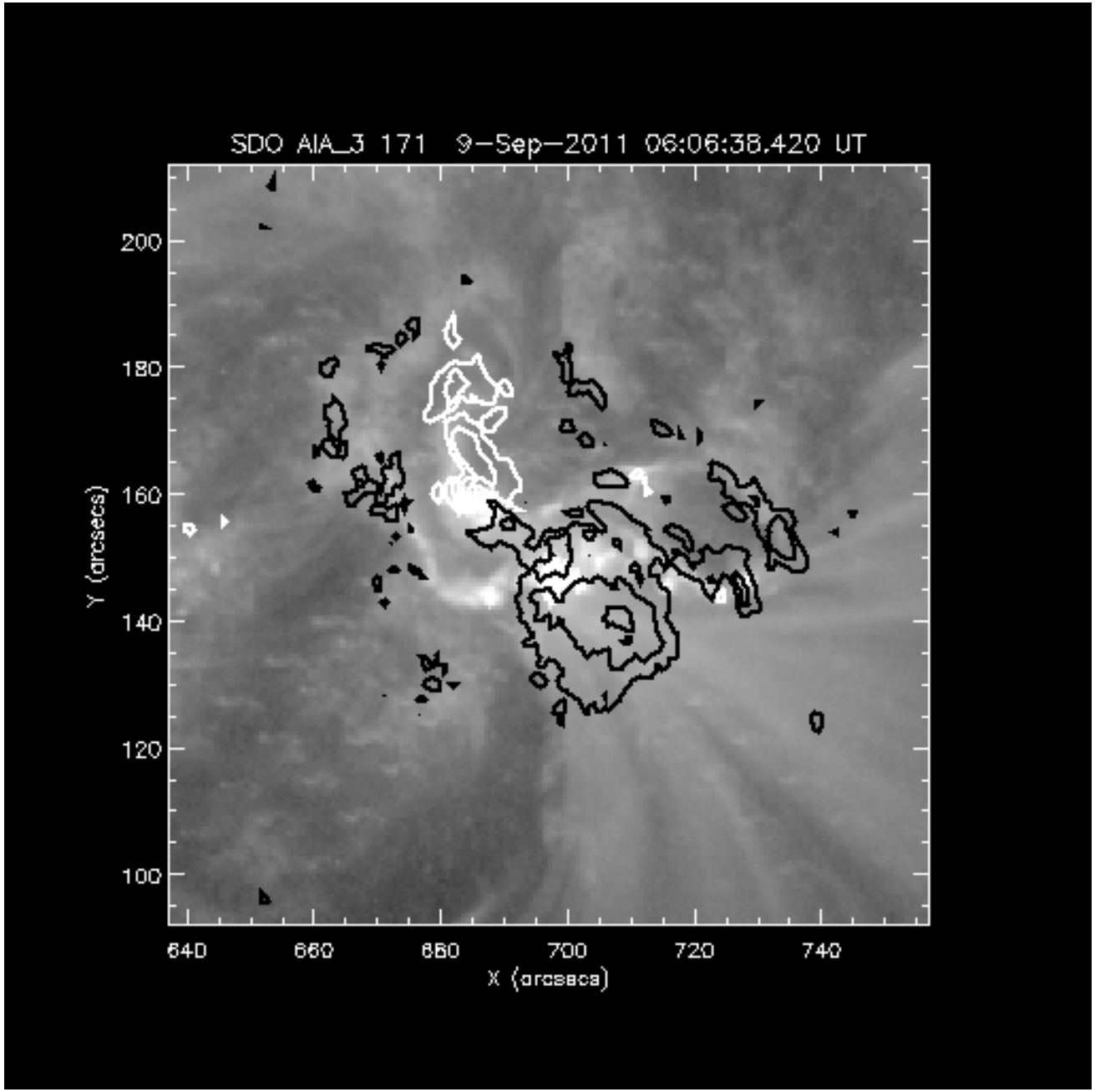
Color: 17GHz
Contours: 34GHz
Levels=30,50,70,90%



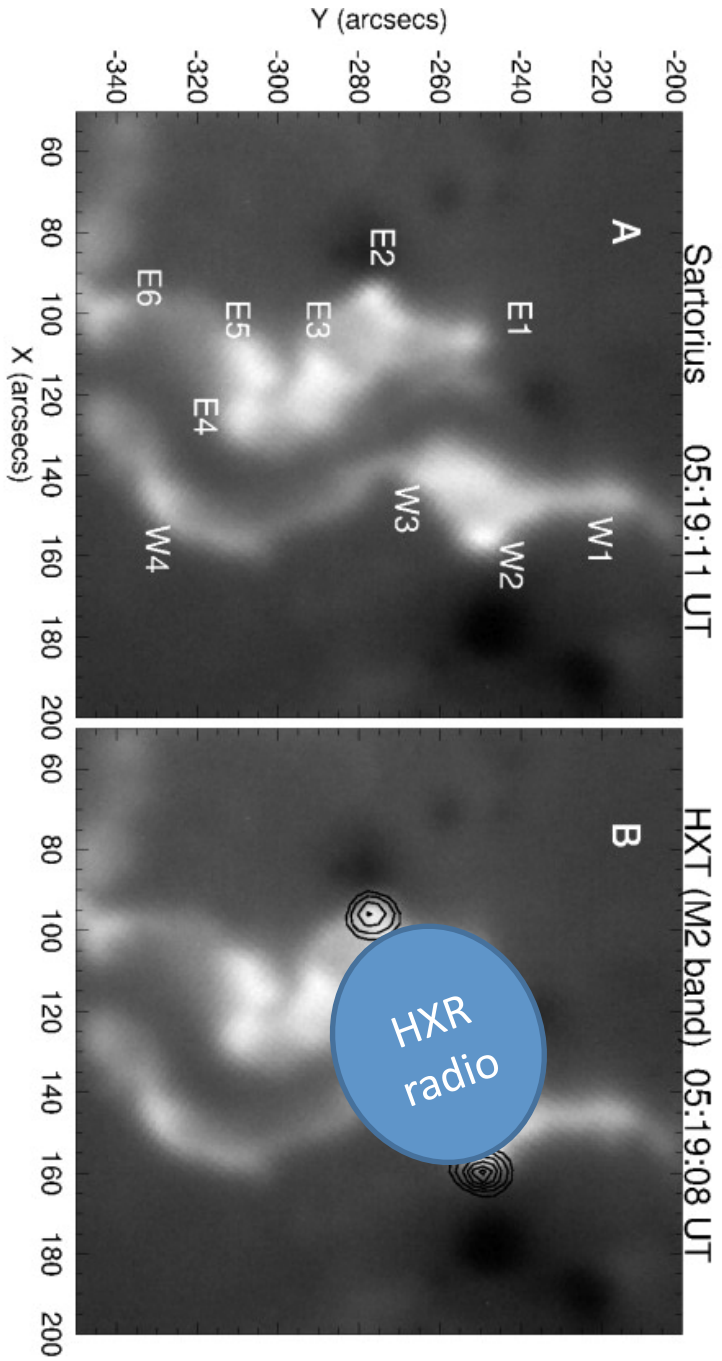
Color: 17GHz
Contours
black: 20-30keV
red: 30-50keV
Levels=50,70,90%

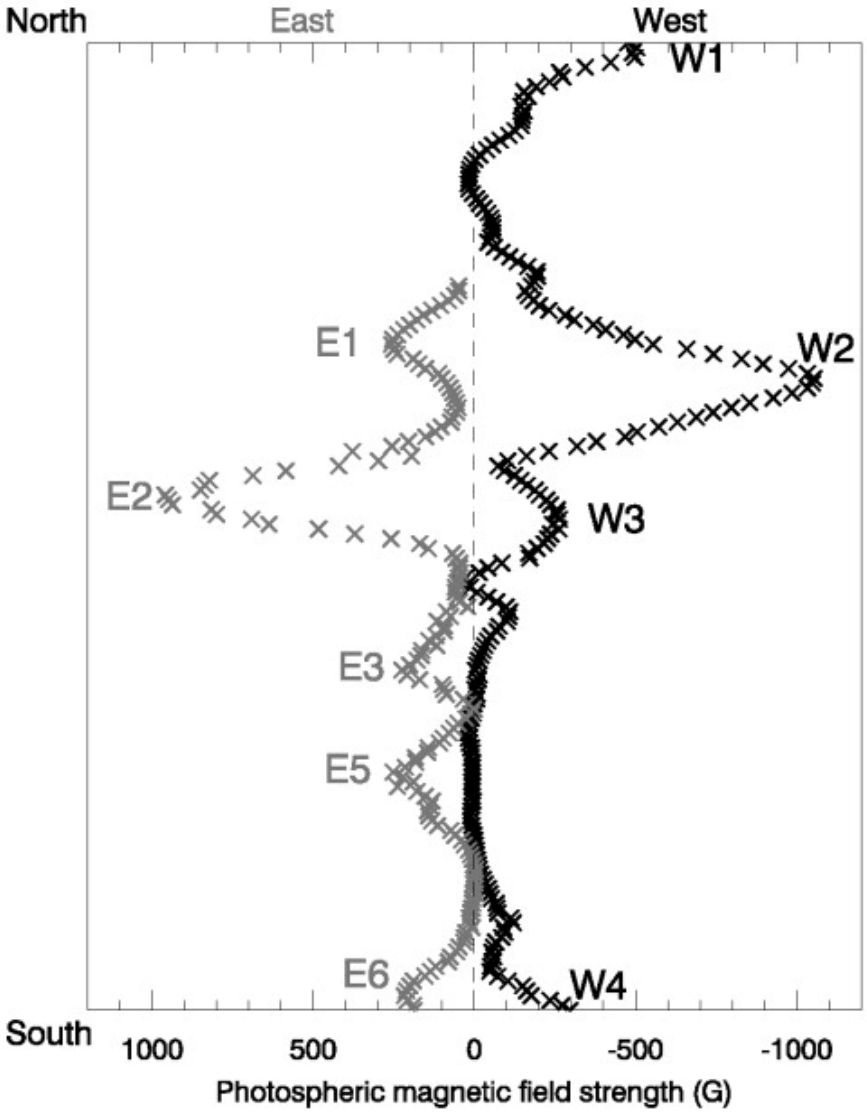


Color: AIA 171A
Contours
black: 17GHz
white: 34 GHz
levels=10,50,90%



Color: AIA 171A
Contours
black: negative
white: positive
levels=±400, 800, 1200G





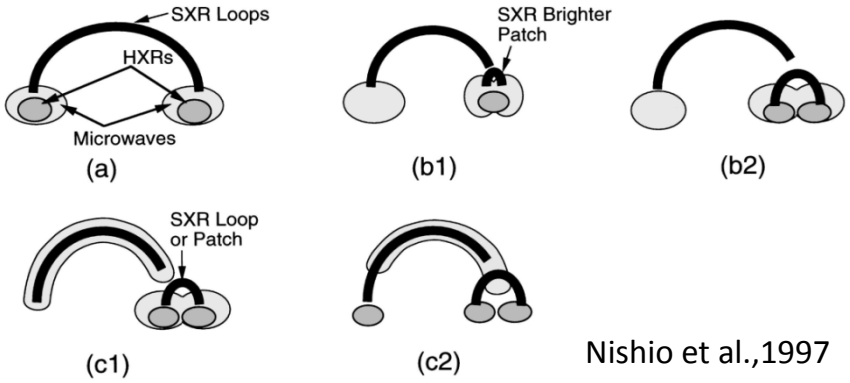
Asai et al. 2002

まとめ

- 新しいデータセットを用いて、Nishio et al. (1997)の統計結果の検証を行った。
- ６つのイベントについて解析を行い、３つのLoop-Loop interaction構造のフレアを確認、
- 分類は

  (b1)２個

  (b2)１個



Nishio et al.,1997

今後…

- イベント数を増やす
- STEREOやひのでなど、今回使用しなかった観測機を用いて検証を行う。
- アーケード型フレアの統計解析