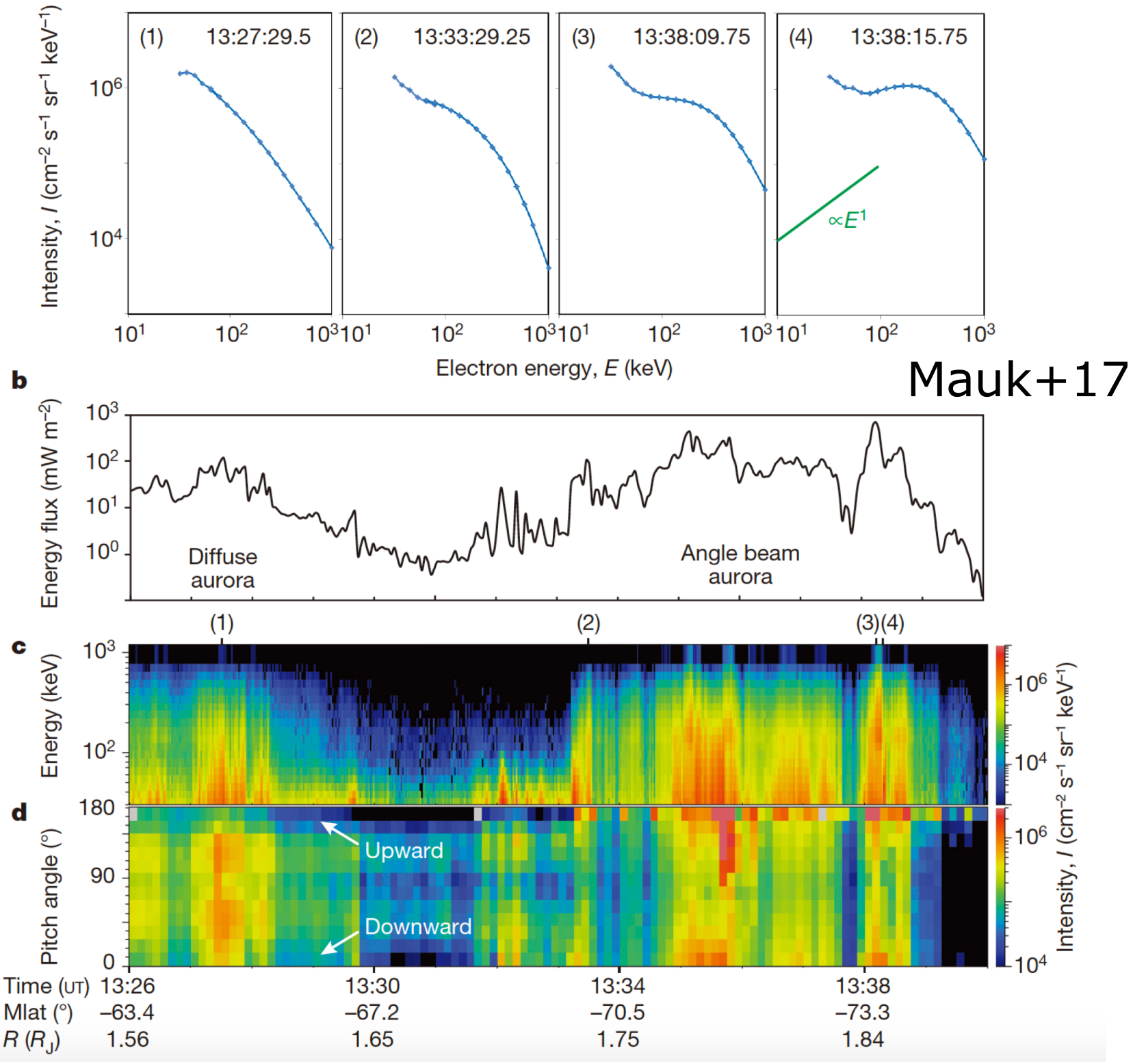
SGEPSS 粒子加速分科会

惑星における粒子加速

木村智樹（東北大）

研究動向

- Juno
  - オーロラ加速その場観測：Inverted-V加速がマイナー。確率論的加速が主 (Mauk+17)
  - DAW－電子相互作用による加速理論整備中（Saur+18）
  - 今年～4月から軌道が磁気圏尾部領域に突入→RX
- ひさき
  - NICERとの協調観測で近接連星系の恒星フレア検出 (Kimura+, in prep)
  - Junoとの協調観測継続。極域オーロラ加速＋トーラス加熱のモニタ→太陽風応答（Kita, submitted）
- Cassini
  - Grand Finale, mission closing
  - PPOに伴うオーロラ加速、磁気圏界面RX、放射線帯


(1) 13:27:29.5
(2) 13:33:29.25
(3) 13:38:09.75
(4) 13:38:15.75
Intensity, I (cm⁻² s⁻¹ sr⁻¹ keV⁻¹)
∝E¹
Electron energy, E (keV)
b
Energy flux (mW m⁻²)
Diffuse aurora
Angle beam aurora
(1)
(2)
(3)(4)
c
Energy (keV)
d
Pitch angle (°)
Upward
Downward
Intensity, I (cm⁻² s⁻¹ sr⁻¹ keV⁻¹)
Time (UT) 13:26 13:30 13:34 13:38
Mlat (°) –63.4 –67.2 –70.5 –73.3
R (R_J) 1.56 1.65 1.75 1.84

Mauk+17

Saur+18

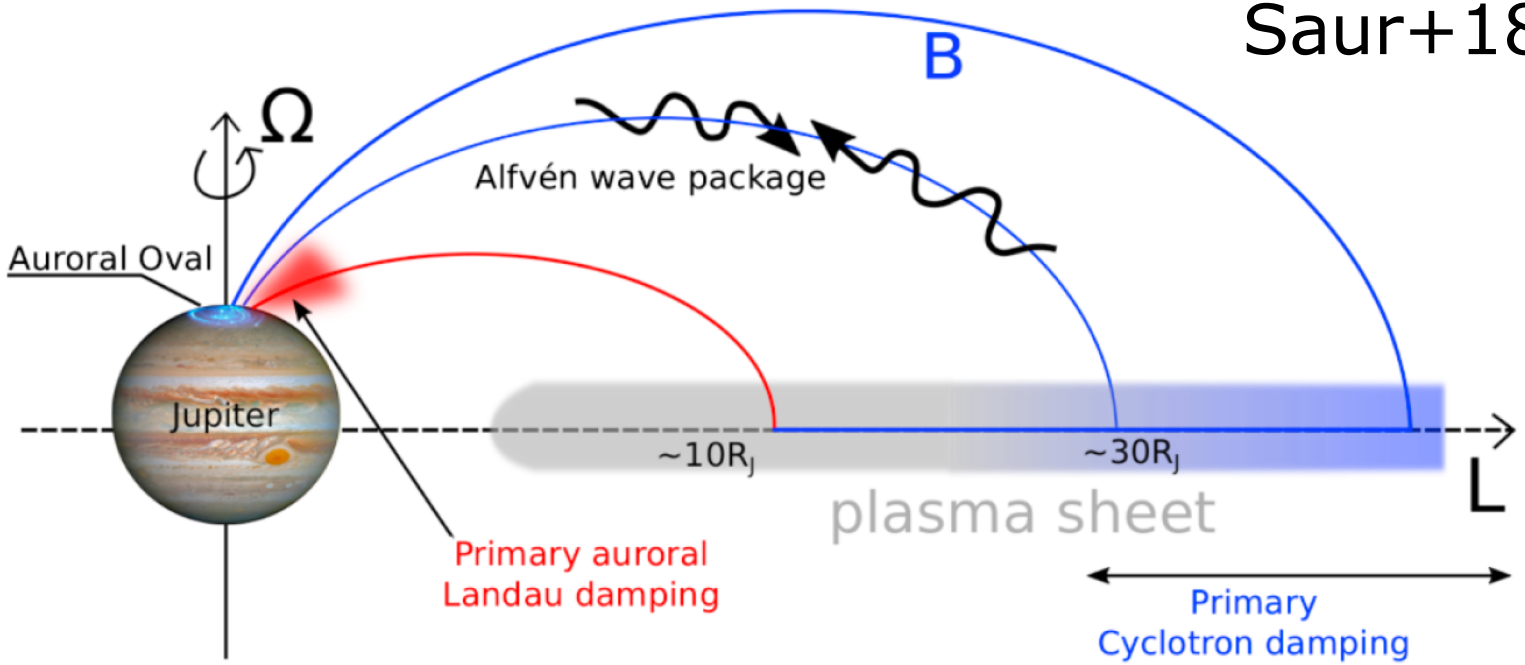
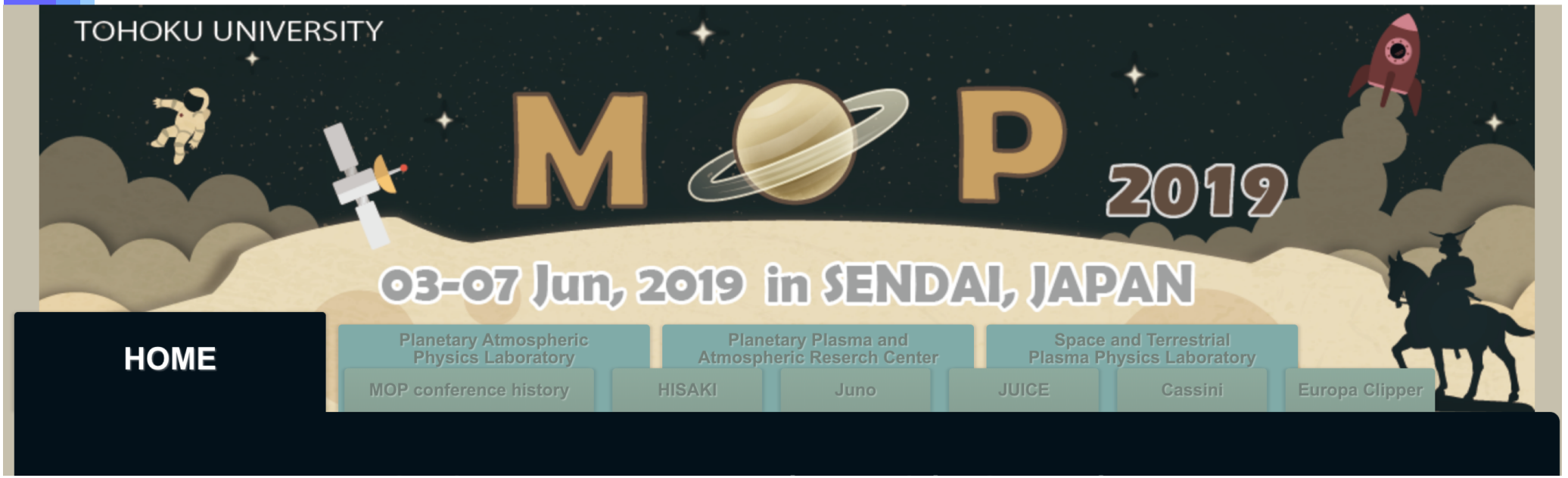


Figure 1. Sketch of Alfvén mode wave-particle interaction regions in Jupiter's magnetosphere on field lines with equatorial distances between 10 and 40 R_J. Alfvén wave packages communicate stresses between Jupiter's ionosphere and the magnetospheric plasma sheet. Inside of field lines characterized by approximately $L = 30$, Alfvén waves are dominantly dissipated via electron Landau damping in the auroral region above Jupiter's ionosphere. Outside of that L-shell, Alfvén waves are dominantly dissipated by ion cyclotron damping in Jupiter's plasma sheet. Magnetospheric transport processes render the magnetosphere and the ionosphere not in local force balance and thus trigger magnetosphere-ionosphere coupling through Alfvén waves, which causes stochastic acceleration of particles by electron Landau and ion cyclotron damping.

研究会の開催情報

- Magnetospheres of Outer Planets
  - 6月3–7日、東北大学主催
  - Cassiniサマリ,
    Junoステータス報告,
    ひさきサマリが今年の目玉

http://pparc.tohoku.ac.jp/sympo/mop/



宣伝、共同研究のお誘い

- 2018年11月－2019年1月にかけて、Hisaki-NICER観測キャンペーンで近接連星系の恒星フレアを検出しました。
- ご興味ある方はぜひご指導いただけますと幸いです。

JpGU 2019 太陽物理学の最前線

PEM19-P05

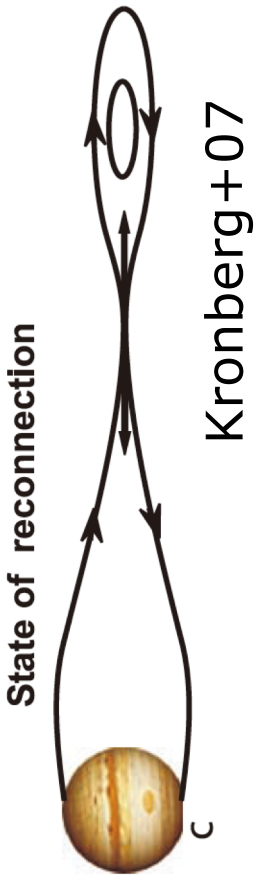
Stellar flare of a close binary system monitored by the Hisaki satellite during the NICER-Hisaki Observing Campaign 2018-2019

Tomoki Kimura[1], Wataru Iwakiri[2], Atsushi Yamazaki[3], Go Murakami[3], Fuminori Tsuchiya[1], Kazuo Yoshioka[4], Shin Toriumi[3], Hajime Kita[3], Masaki Kuwabara[3]

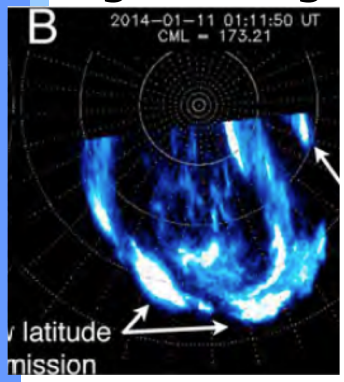
1:Tohoku U., 2:Chuo U., 3:JAXA/ISAS, 4: U. Tokyo

Stellar flares

Planets

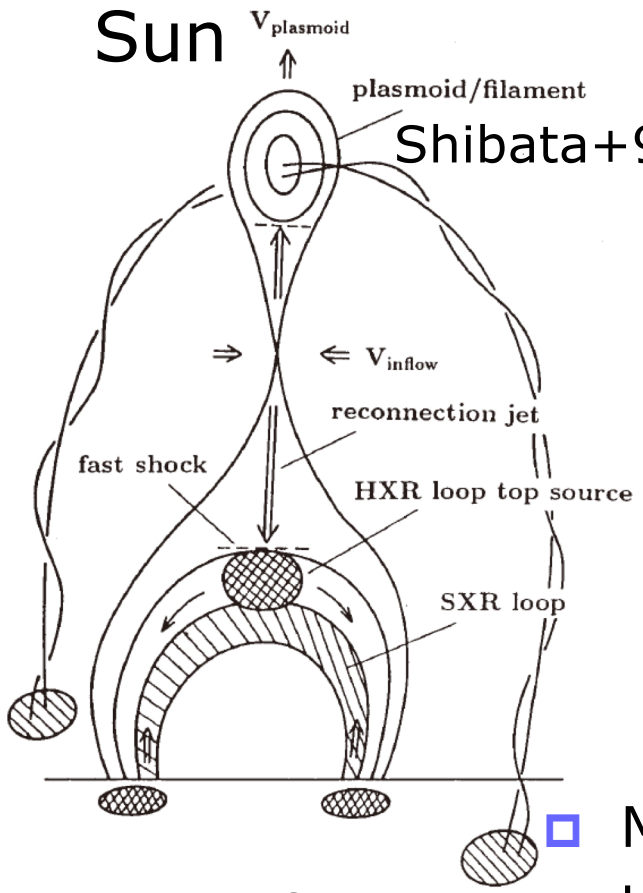


Auroral brightening



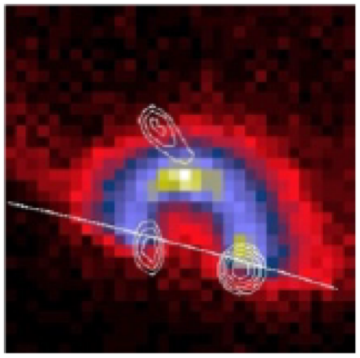
Kimura+15

Sun



Shibata+95

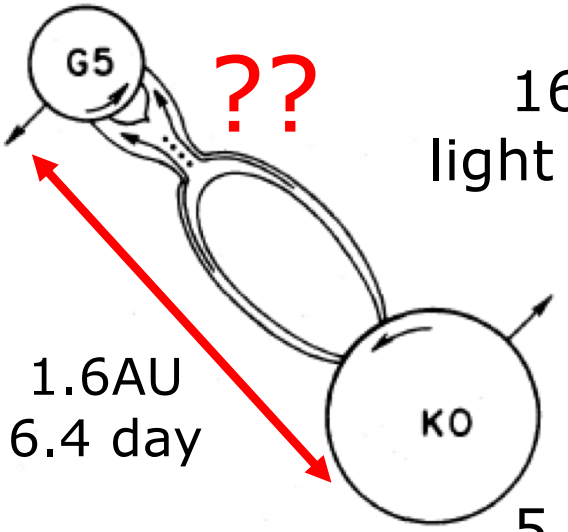
Solar flare X-ray



Masuda et al. (1994)

1.6Rs
5700K

UX Ari



168
light year

1.6AU
6.4 day

5.6Rs
4600K

Simon+80

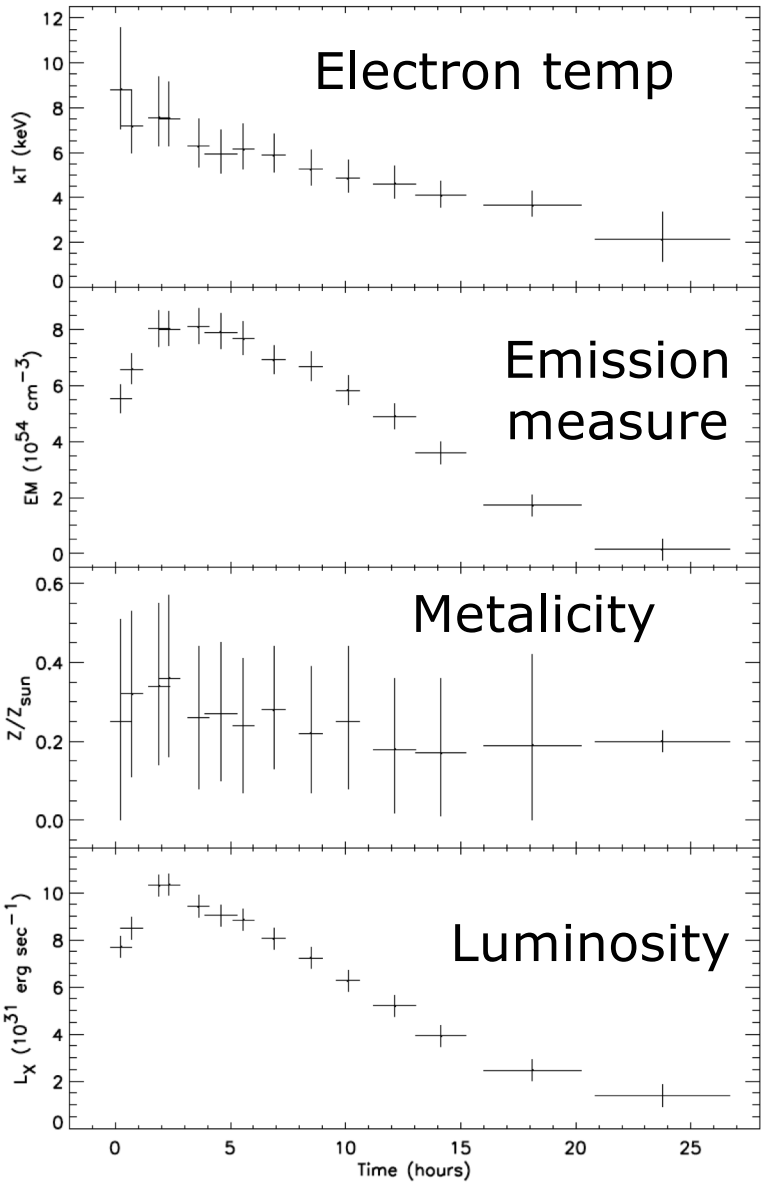
- Magnetic reconnection (RX) is an ubiquitous field-plasma energy conversion process in universe
- How RX dynamics is implemented on each body?: planets, sun, stars, ...
- Solar/planetary/stellar flares visualize RX processes at bodies→remotely observable

UX Ari

- Close binary system of G and K stars

Characteristics of UX Ari	
(RA,DEC) J2000	(51.648, 28.715)
Distance	168 lightyear
Spectral type	G5V & K0IV
Orbital period	6.4 days
Semi major axis	1.6 AU
Radius	1.6 & 5.6 Rs
Temperature	5700 & 4600 K

- Flares have been observed frequently at X-ray, and some at UV & Radio (Simon+78,80, Lang&Wilson 88, Gudel+99, Franciosini+01)
- X-ray observations
  - Peak luminosity: 10^{25}W
  - flare loop temperature: ~1-10keV
  - Metalicity: 0.2-0.3



X-ray flare of UX Ari observed with BeppoSAX (Franciosini+01)

Problem

- How do magnetic RX and subsequent flare evolve?
  - Temporal sequence: acceleration, conduction, chromospheric evaporation, flare loop, ...
  - Size: loop bridges two stars or more compact?
  - Energetics: B-field energy, conduction, radiation
  - Chemistry: ion balance, atomic abundance
- These are still unclear because of no observation at multi wavelength that quantifies plasmas of different atoms, temperatures, and locations

Purpose of this study

- Discuss spatio-temporal evolutions of stellar flare at UX Ari based on simultaneous multi-wavelength observation with Hisaki (EUV) and NICER (soft X-ray)
- We report current status of Hisaki EUV observation and physical chemistry modeling

Dataset

- Hisaki EUV spectrometer "EXCEED"

Wavelength range	550 – 1450Å
Spatial resolution (for Jupiter mode)	17" (~1Rj around opposition)
Field of view	360" (~20Rj)
Spectral resolution (FWHM)	~1.0 nm (140" slit)
Effective area	2cm^2 @100nm

- Observation period
  - Nov 15-16, 2018; Jan 10-24, 2019
- dumbbell-shaped slit
- 10 min resolution for light curve analysis