



# XRISM and CHAO observations of HR 1099

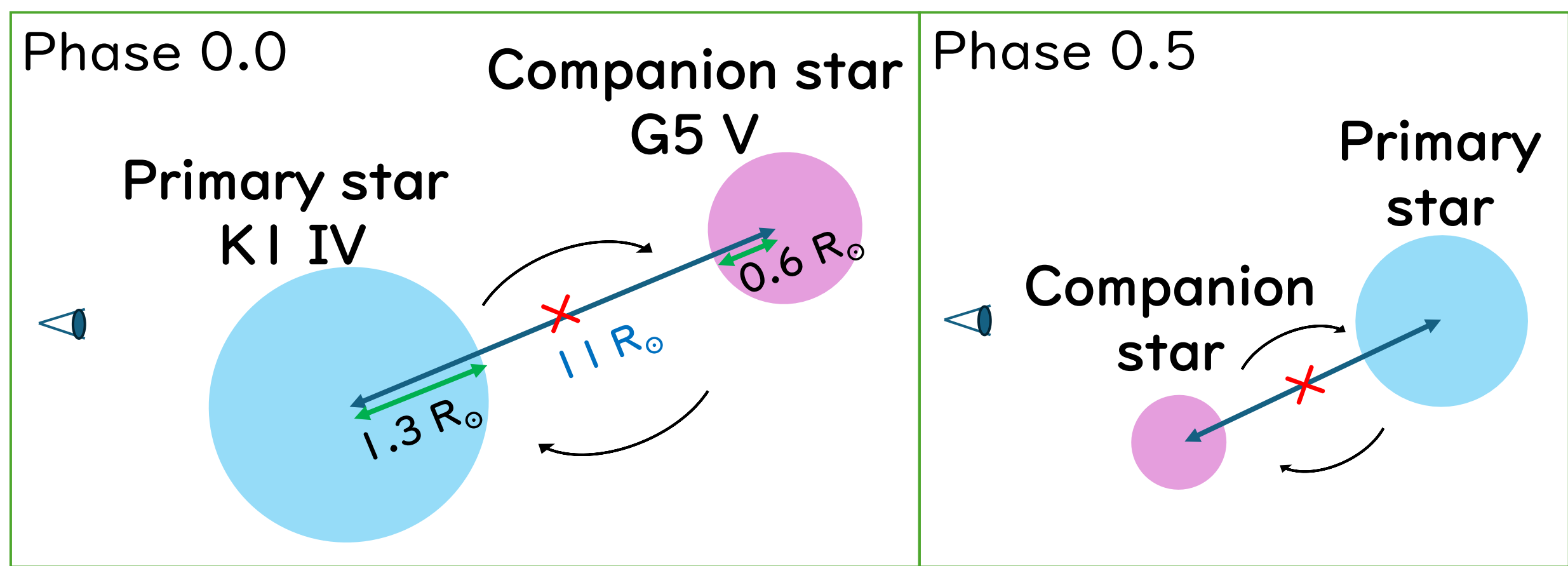
Poster board #11



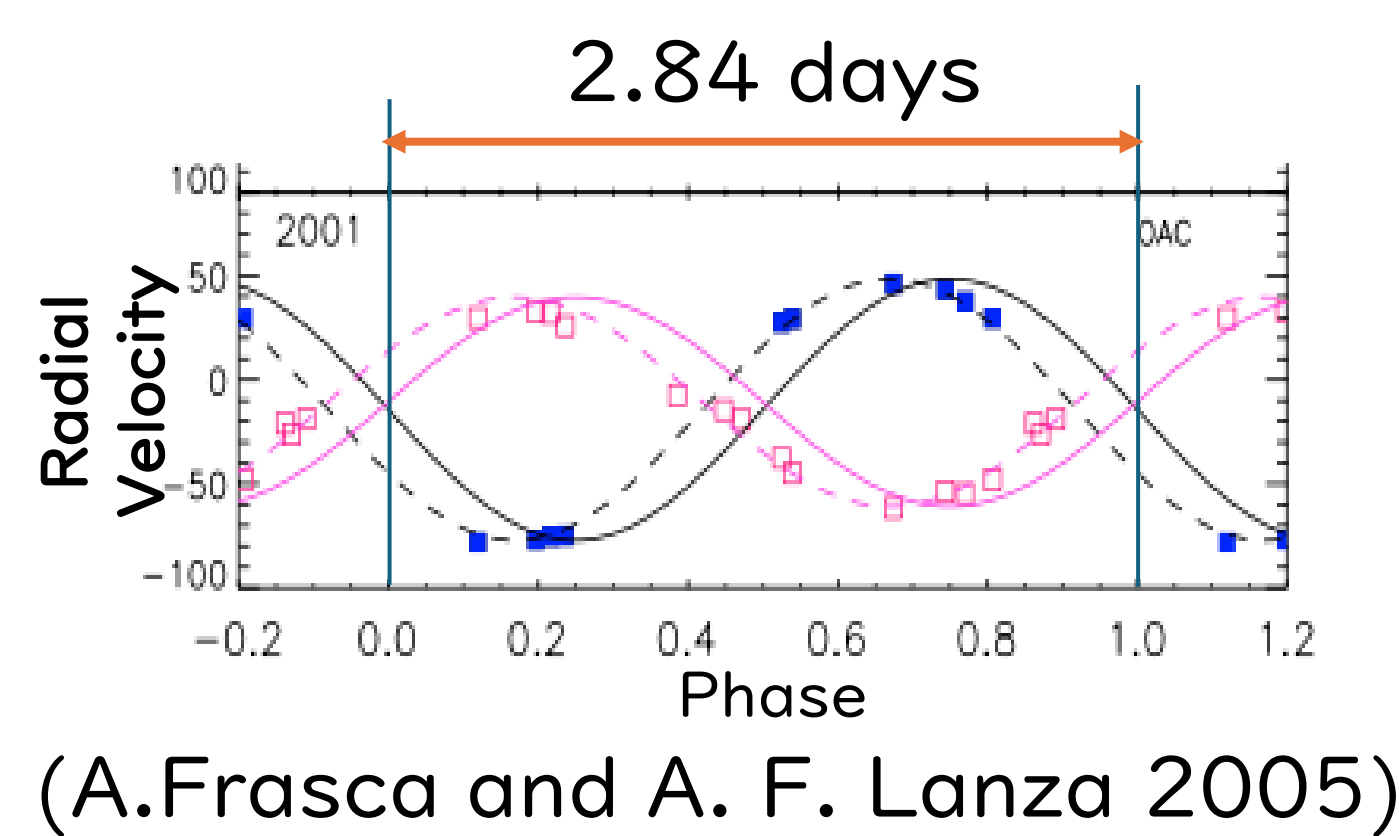
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HR 1099 (V711 Tau) is an active RS Canum Venaticorum binary with an orbit of 2.8377 days. We observed it with XRISM and optical instruments from 6 to 10 March. An X-ray flare peaked on 8 March with a luminosity of  $1 \times 10^{31}$  erg  $s^{-1}$ . The flare occurred at phase 0.0, and X-ray enhancements were seen at phase 0.5. X-ray enhancements were observed at phases 0.5, with possible redshifts of the Fe XXV line and H-alpha line of 600 km/s and 300 km/s, respectively. Further analysis of the redshift is underway. We will discuss the nature of the redshift.

## HR 1099 (V711 Tau)

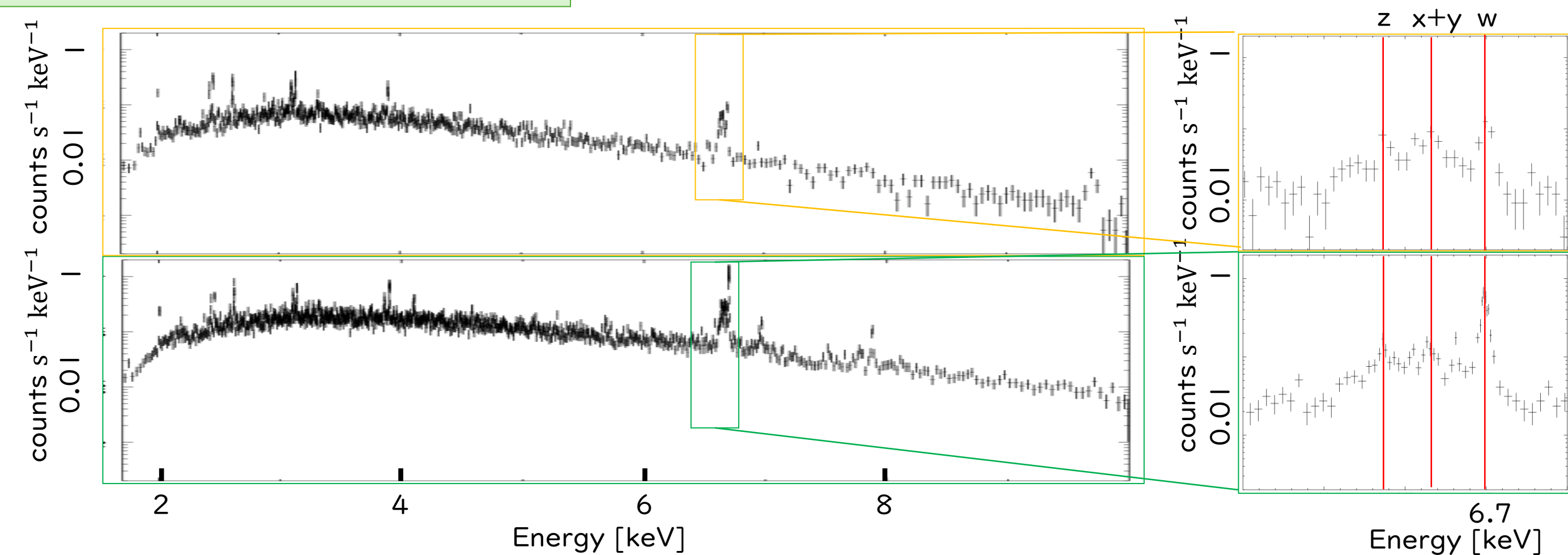


- RS CVn-type stars
- Huge starspots (groups)
- High flare frequency
- Produces huge flares
- Flare loop size is suggested to be several to several dozen times the stellar radius (Tsuboi et al. 2016)
- Inclination 38°



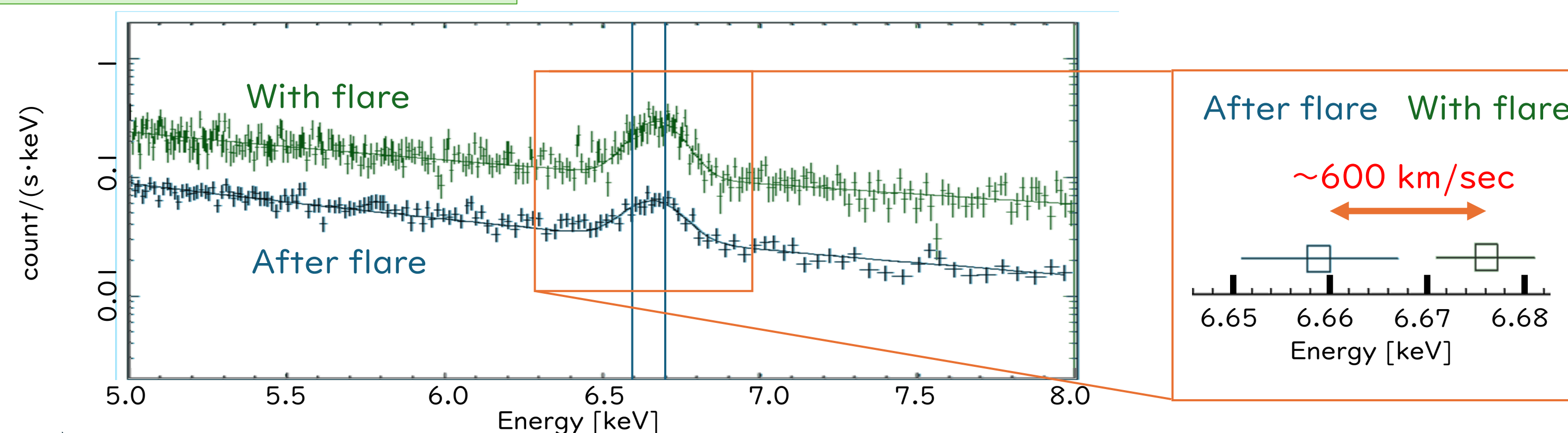
(A. Frasca and A. F. Lanza 2005)

## Resolve Spectrum



The high spectral resolution of Resolve allowed the microstructure of the Fe XXV line to be separated.

## Xtend Spectrum



Xtend, a redshift was observed.

To be confirmed with Resolve data after calibration.

## Instrument

### CHuo University Astronomical Observatory

@ Rooftop of Chuo University  
Science and Engineering Campus (Bunkyo-ku, Tokyo)  
35° 42' 30" N, 139° 44' 54" E.



Chuo-university  
Astronomical  
Telescope  
Photometric observation



Aperture: 260 mm  
Field of view: 51 × 34 arcmin  
Observation in the B, V, R, I and H $\alpha$  bands

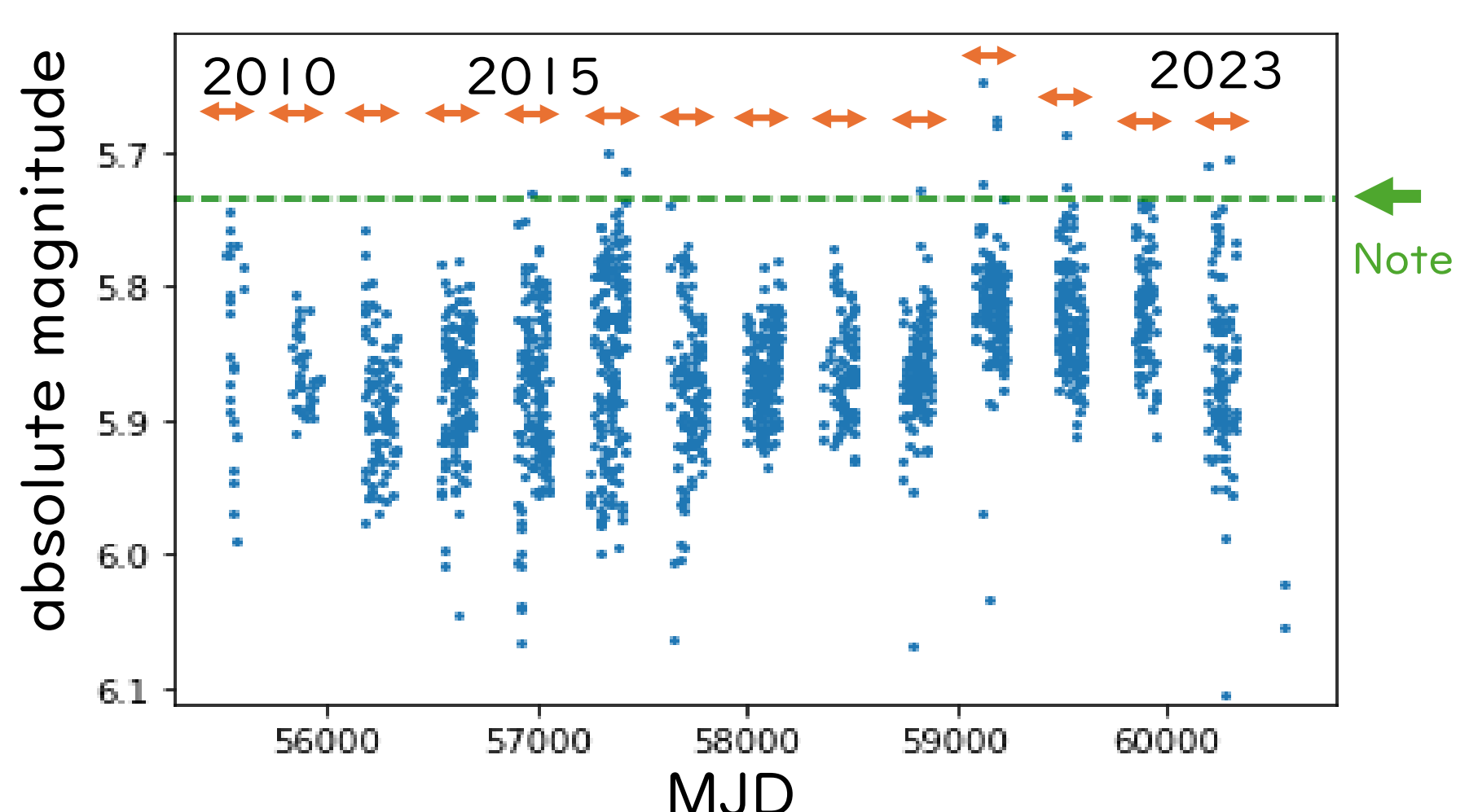
Spectroscopic  
Chuo-university  
Astronomical  
Telescope



Spectroscopic observation  
Aperture: 355 mm  
Effective wavelength range: 3700-7400 Å  
Wavelength resolution: R=600

### Kyoto/Kiso Wide-field Survey

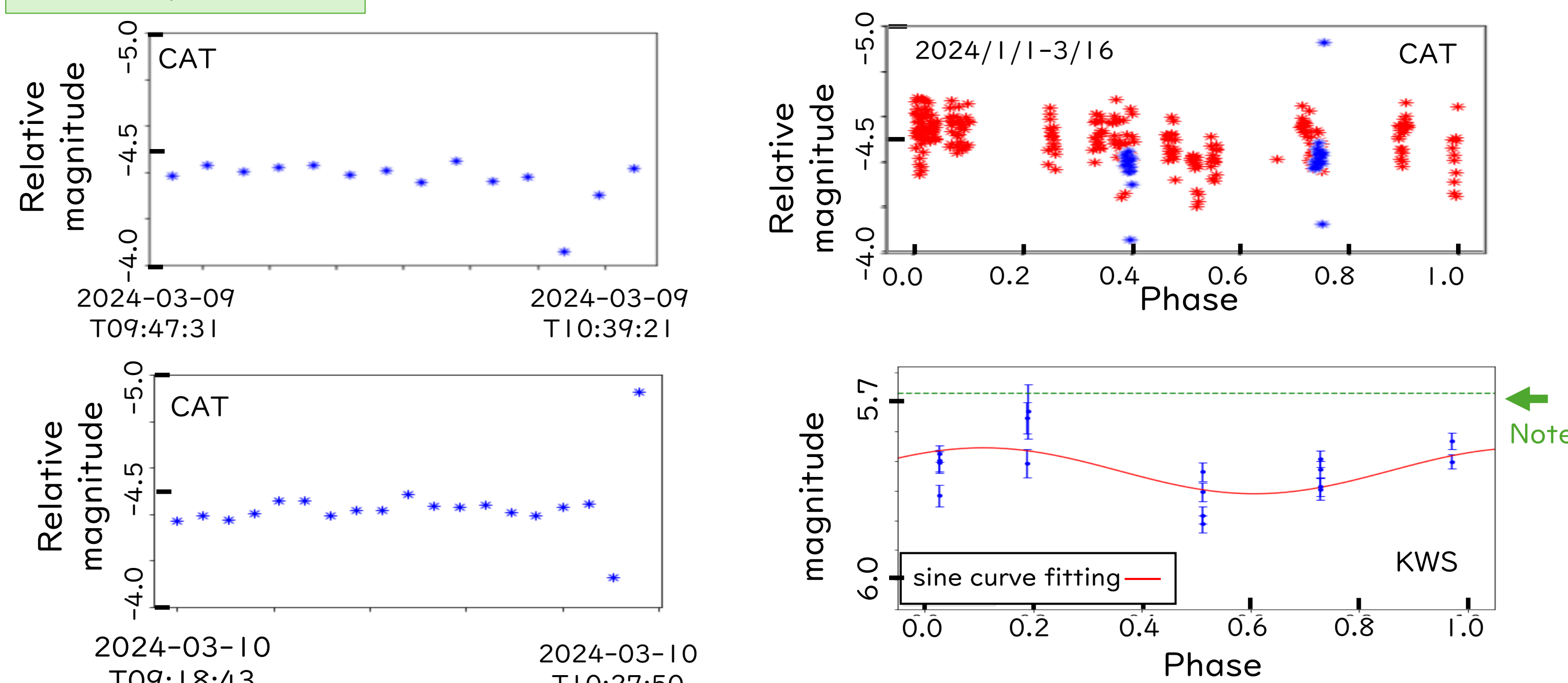
- V, B and I $\alpha$  bands
- In this case, the V band with the most data was used.
- Field of view 5° × 7.5°.
- Survey-type observation



HR 1099 long-term V-band light curve

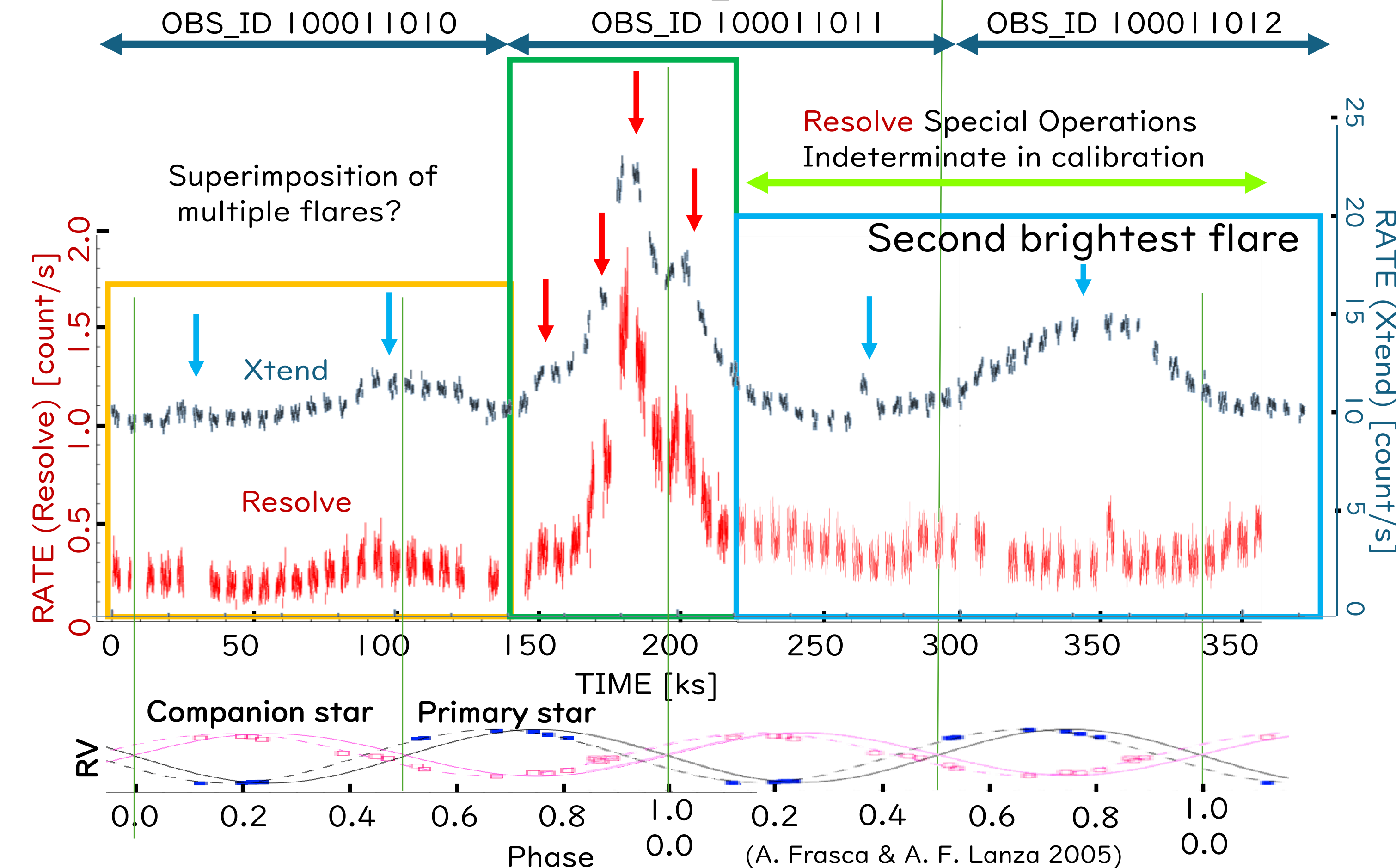
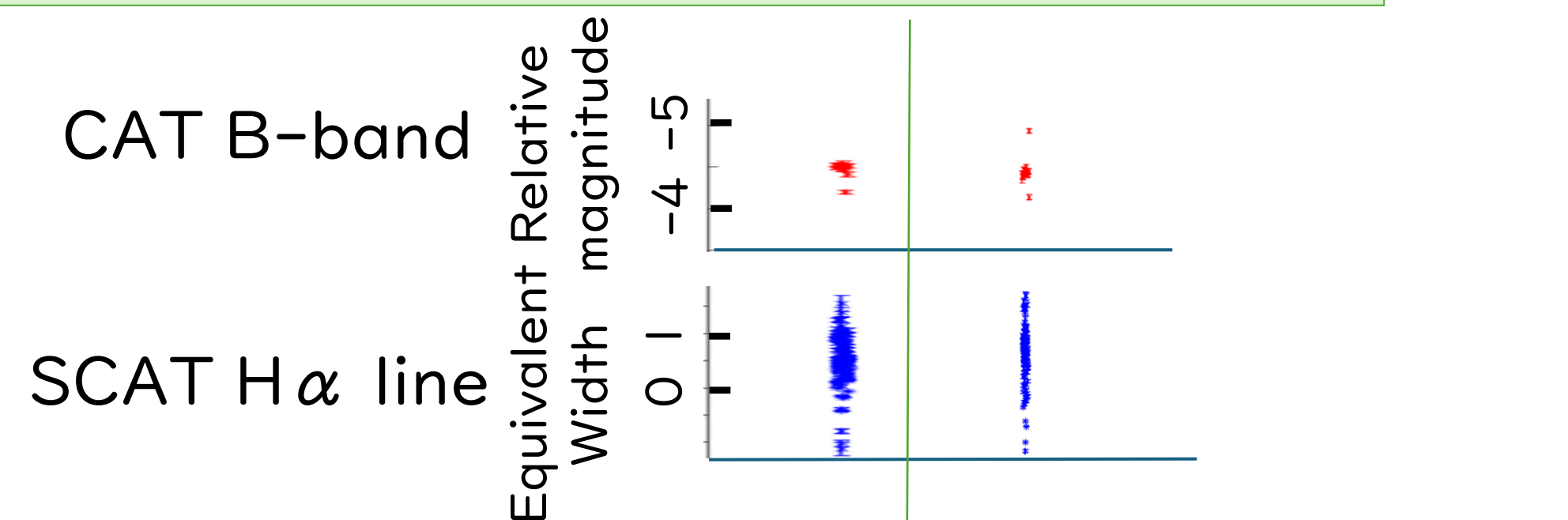
Note 1: Maximum magnitude

## CAT/KWS



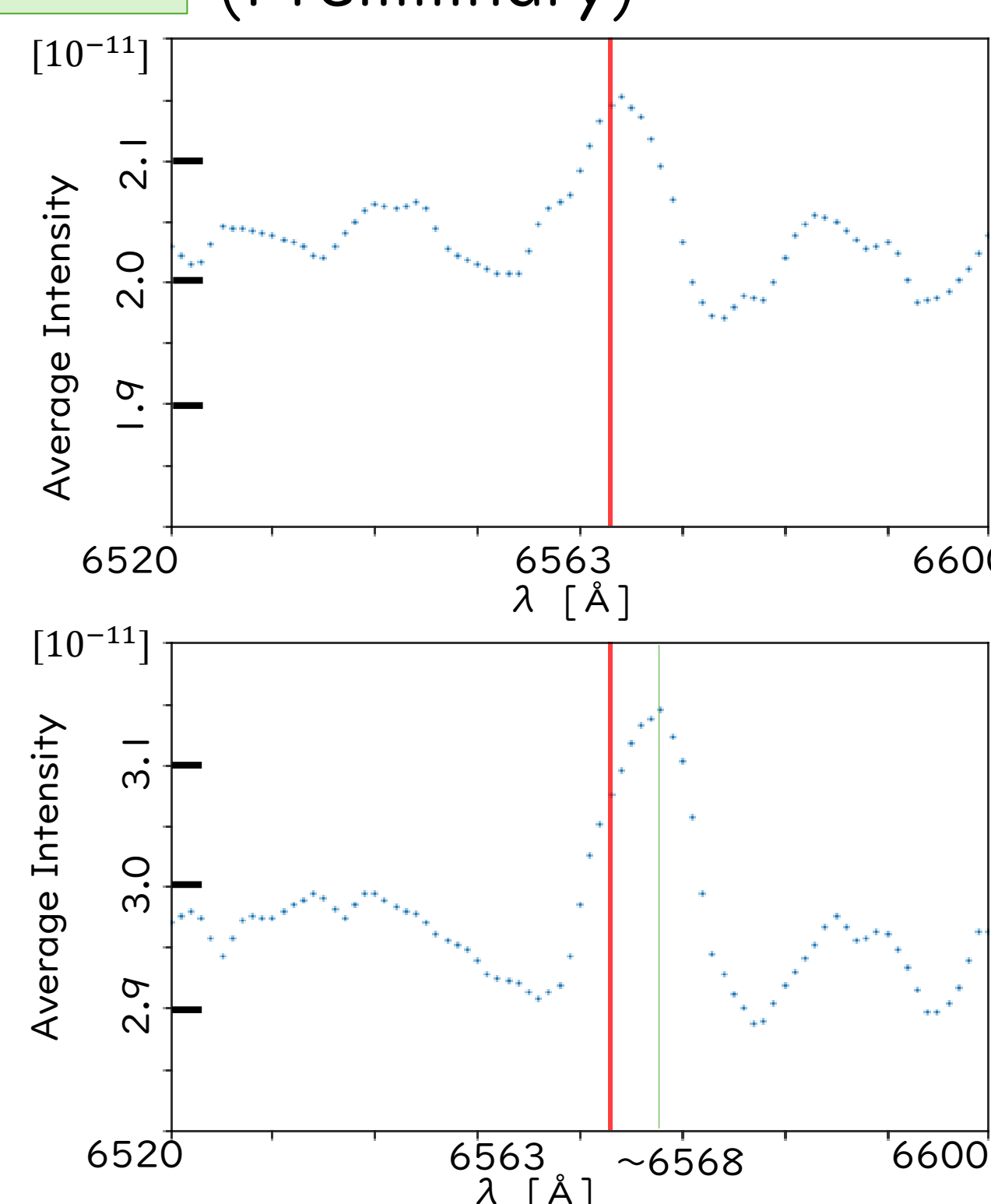
- Starspots are not concentrated in the period from 1/1/2024 to 16/3/2024
- Given the KWS observations, starspots are visible all the time.
- In Second brightest flare, no brightening was observed in the photometric observations.

## XRISM and CHAO simultaneous observations



The Xtend, which can detect a wide range of soft-band X-rays, was able to detect even the smallest fluctuations.

## SCAT (Preliminary)



H $\alpha$  line: 6563 Å

$$H\alpha \text{ line } \frac{v}{c} \cong \frac{\Delta E}{E} = \frac{\Delta \lambda}{\lambda}$$

$$v = \frac{5 \text{ \AA} \times 3 \times 10^5 \text{ km/sec}}{6563 \text{ \AA}} \cong 250 \text{ km/sec}$$

Red shift?

When the magnitude of this redshift was, in X-rays?

$$\Delta E = \frac{250 \text{ km/sec} \times 6.7 \text{ keV}}{3 \times 10^5 \text{ km/sec}} \cong 5 \text{ eV}$$

## Summary

- HR1099 Flares (XRISM w. CHAO)
- Observation
  - XRISM : 3/7-11 (Quiescent, Primary Flare, Post flare)
  - CHAO : 3/9, 10 (Covering Primary and Post flare phase in part)
- Timing analysis
  - Superposition of multiple flares (Xtend)
- Spectra analysis
  - Detection of Resolve and Xtend Fe-K lines
  - Possible redshift of ~600 km/s at the post flare phase
    - Seen in X-rays (Xtend) and H alpha
- Future: Analysis of calibrated Resolve spectra and SCAT H $\alpha$  data