

# TESSとの多波長同時観測による Be X線連星の研究

庭野聖史

村田勝寛, 細川凌平, 今井優理, 谷津陽一,  
河合誠之, MITSuMEチーム(東京工業大学)

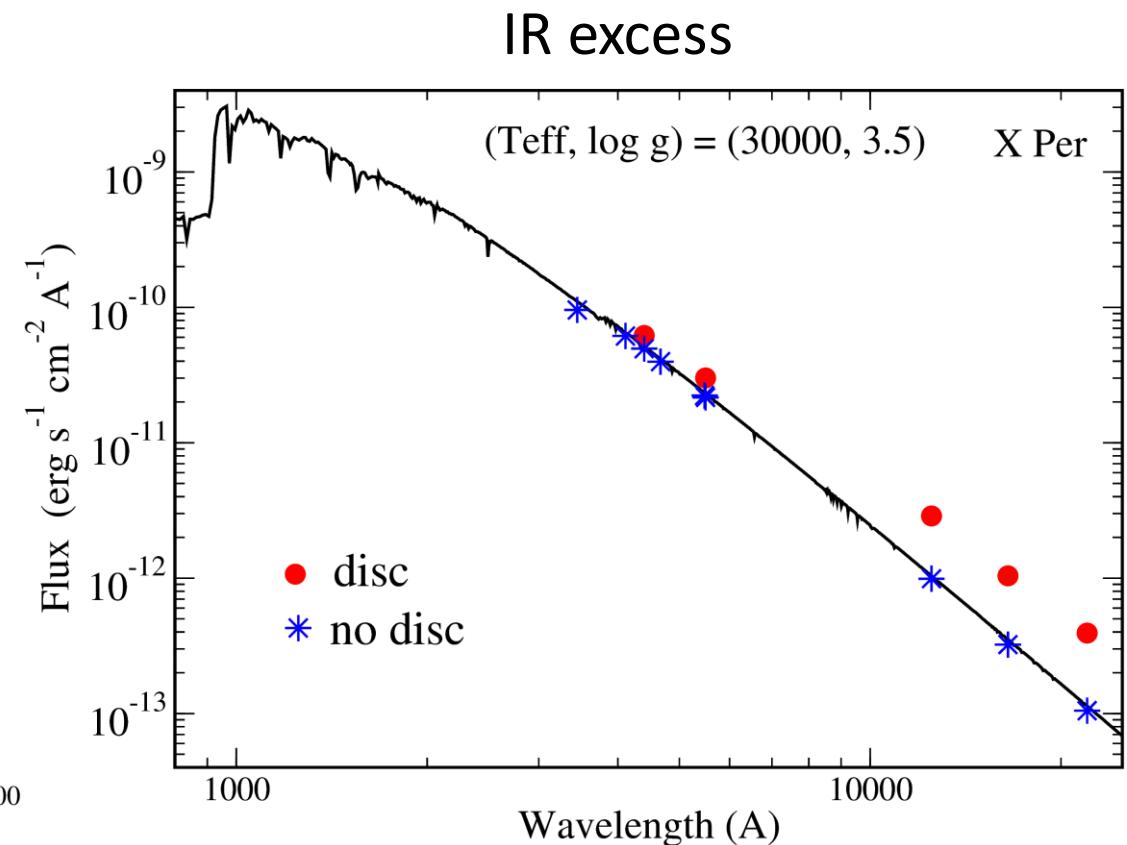
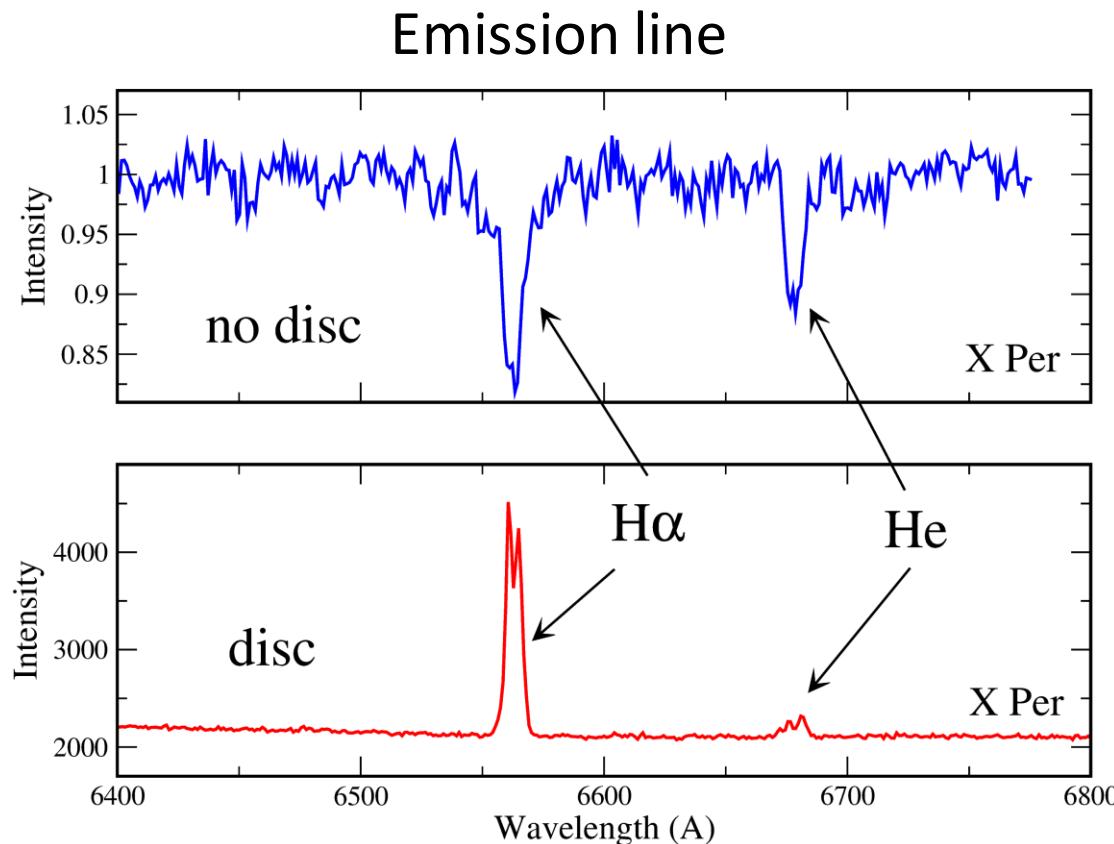
第13回光赤外線天文学大学間連携ワークショップ<sup>°</sup>

# Outline

- Introduction
  - Be star & Be X-ray binary
  - TESS
- Observations
  - Target selection
  - Swift & MAXI & ZTF & Gattini-IR
- Preliminary results
  - X-ray/OIR lightcurve & OIR color variations
  - TESS light curve
- Summary

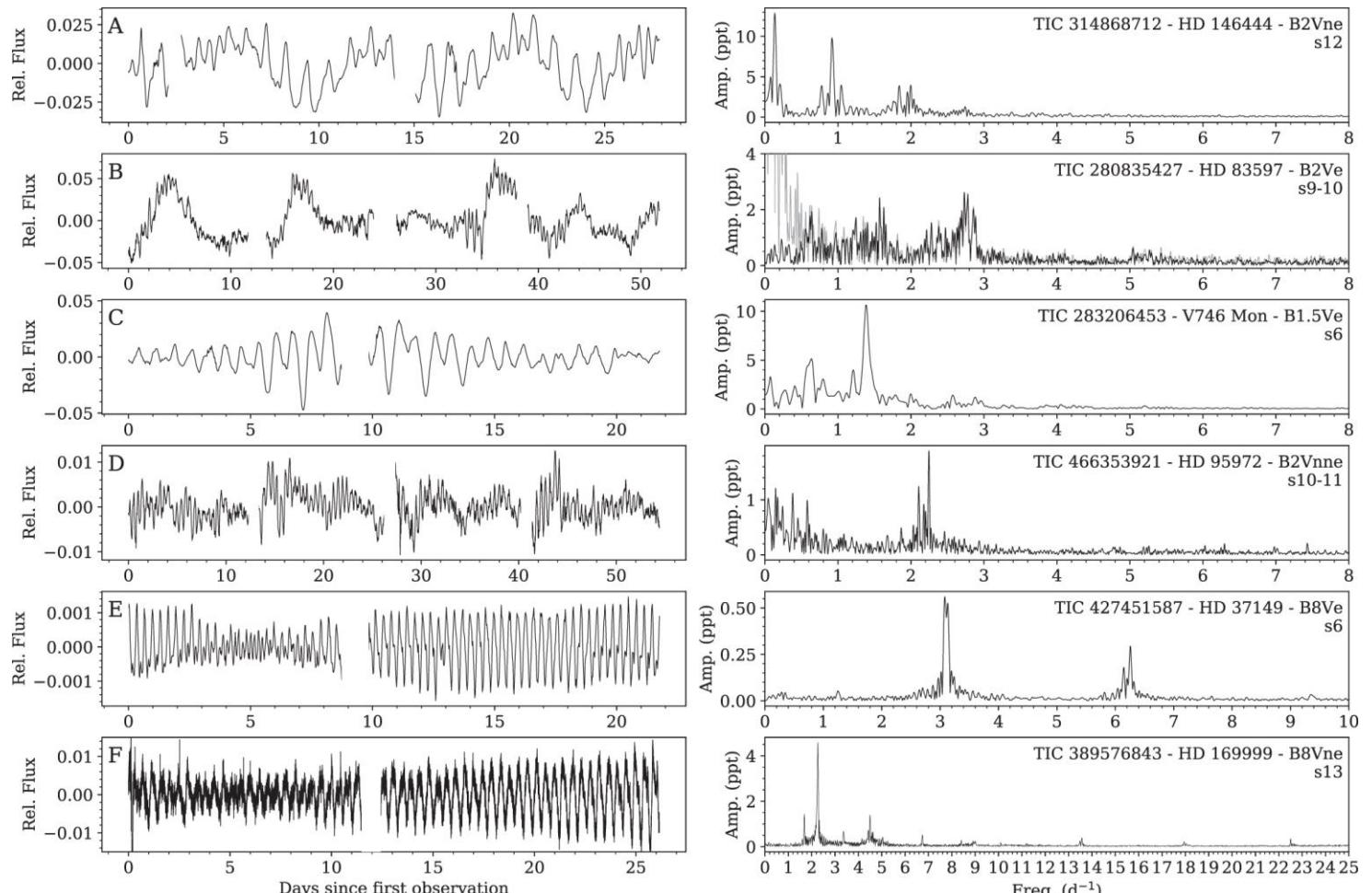
# Be star

**Be star: O-B type star & Circumstellar disc**



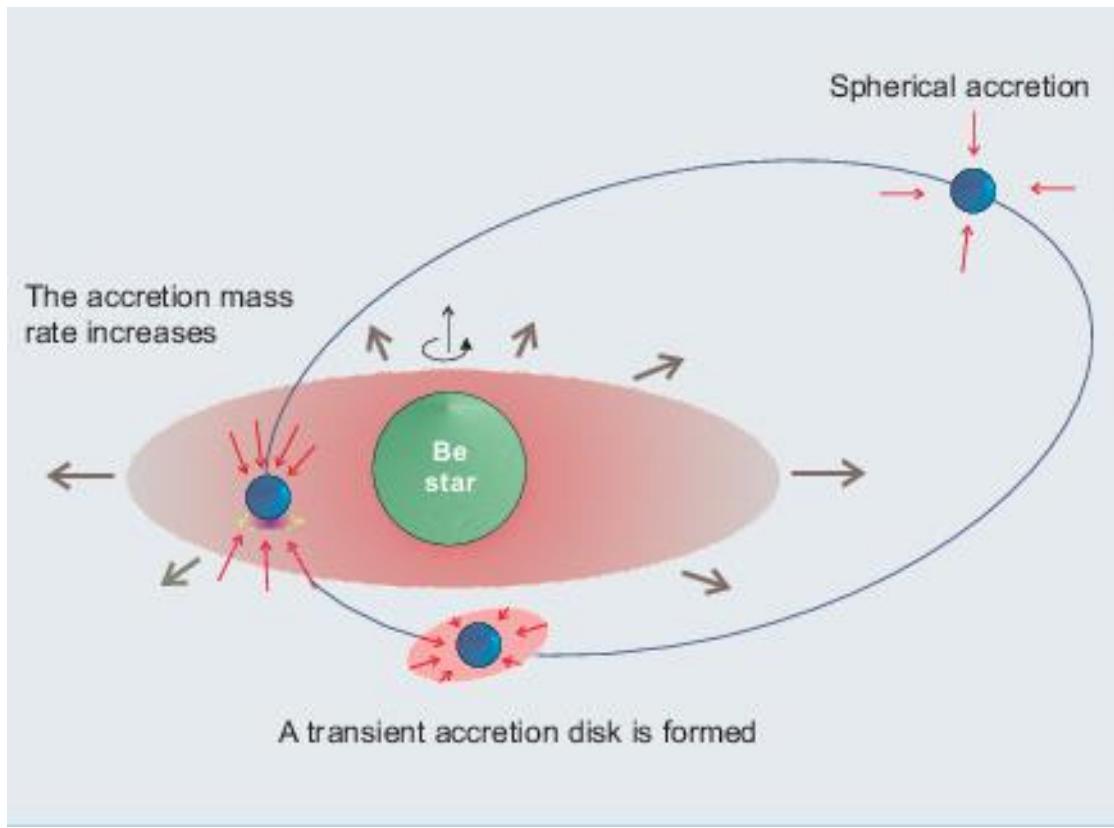
# Activity of Be stars

- Be star activity  $\leftrightarrow$  disc formation
  - Fast rotation
  - Other activity?
- Periodic flux variations
  - Origin: rotation, pulse, etc.
  - Time scale  $\lesssim$  a few days
  - Amplitude  $\sim$  a few %



# Be X-ray binary (BeXB)

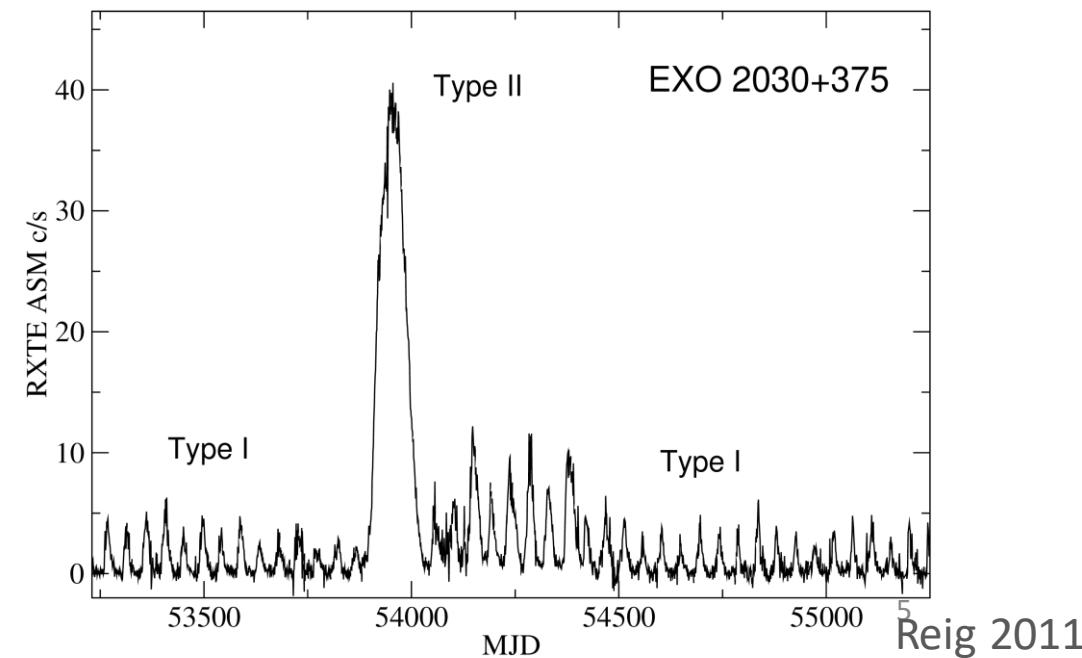
BeXB: Be star & neutron star binary



Orellana & Romero 2005

Two types of X-ray outbursts

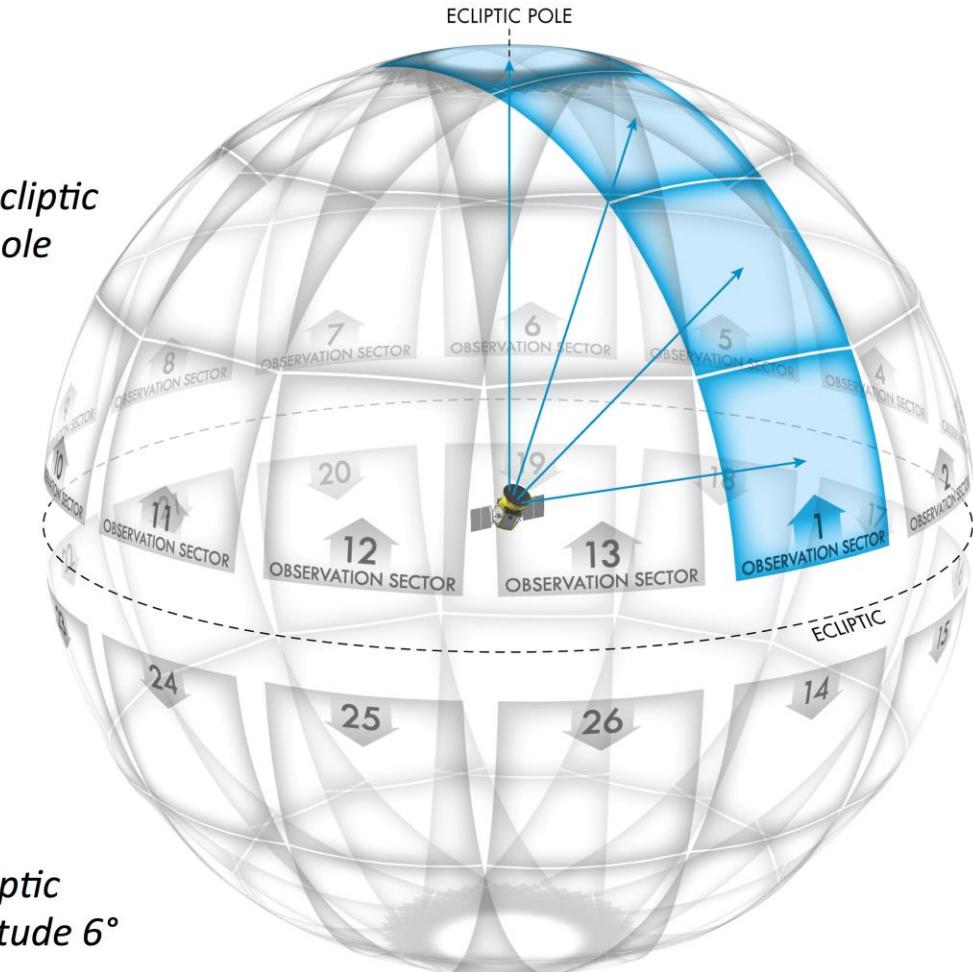
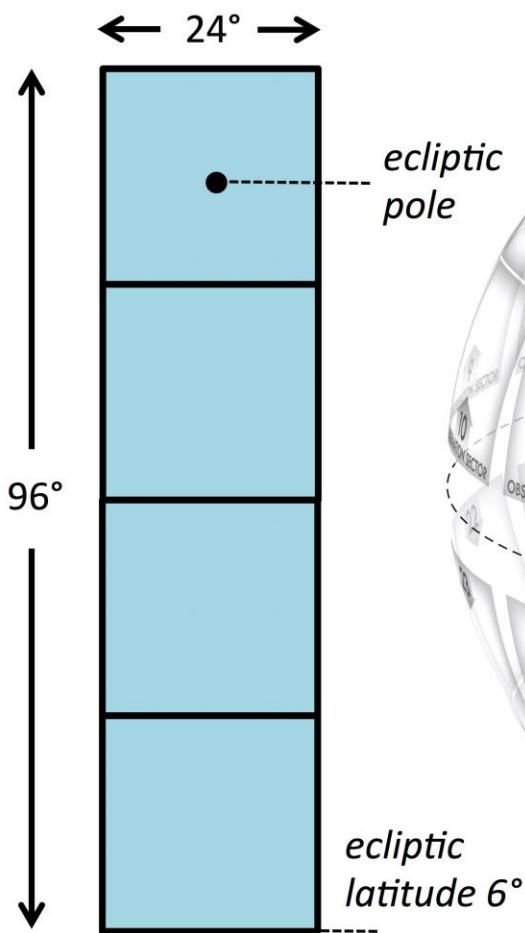
|                      | Duration               | Luminosity                       |
|----------------------|------------------------|----------------------------------|
| <b>Type-I/Normal</b> | $< P_{\text{orb}}$     | $\lesssim 10^{37} \text{ erg/s}$ |
| <b>Type-II/Giant</b> | a few $P_{\text{orb}}$ | > Normal                         |



Reig 2011

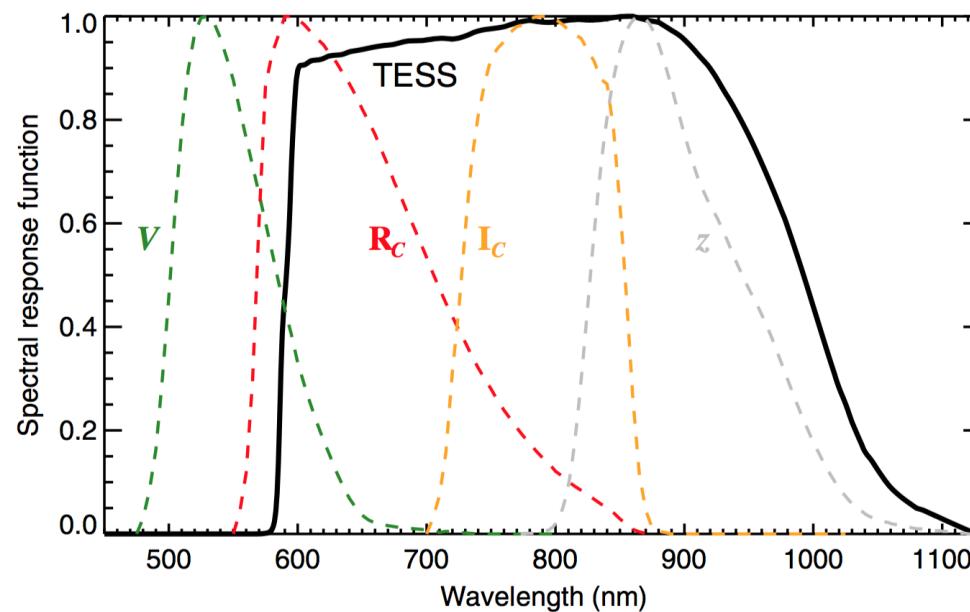
# TESS (Transiting Exoplanet Survey Satellite)

- Large FOV
- Continuous observation
  - 27 days/field
- High cadence & precision light curve
  - 2 min or 10 min cadence
  - ~ a few % precision
- ⇒ Suitable for Be star & BeXB research

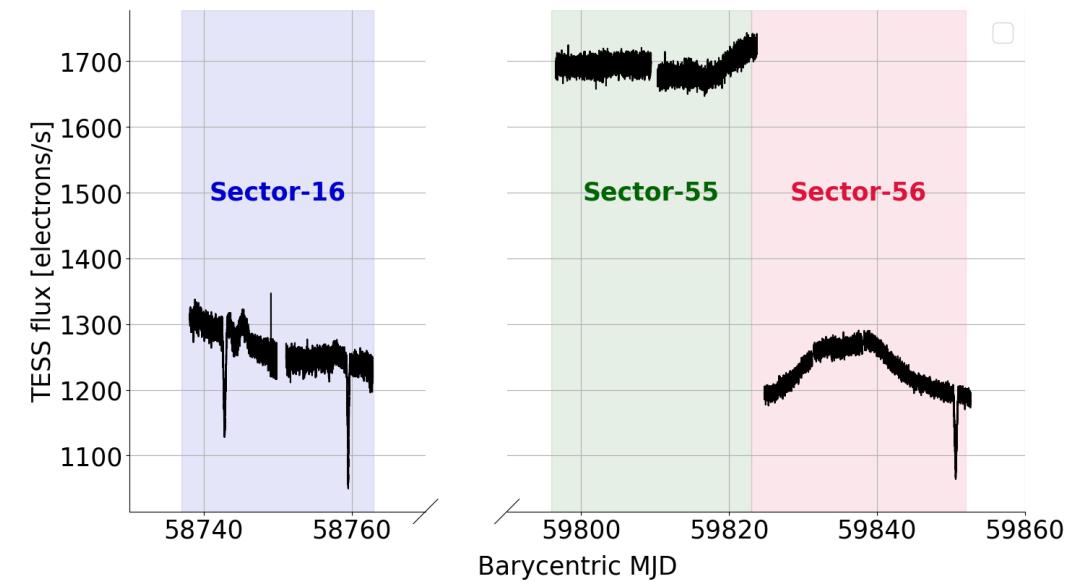


# Two issues of the TESS observation

- Only one optical filter



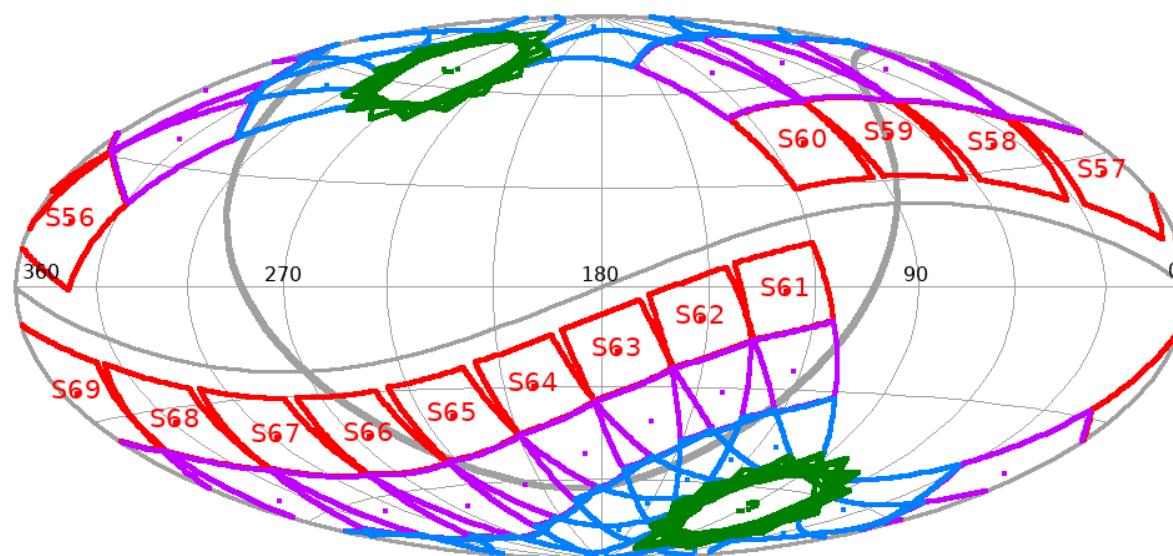
- Difficulty in flux calibration



➤ Quasi-simultaneous multiwavelength observation

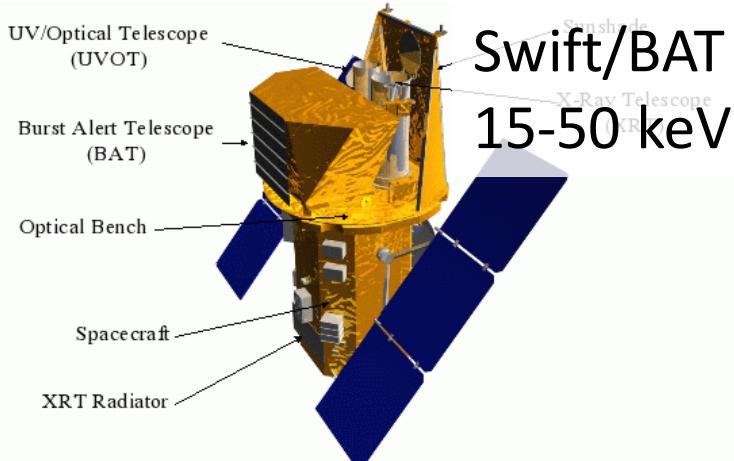
# Target selection

- Targets: Bright BeXBs in TESS FOV of the northern sky
  - Original catalog: HMXBCAT (Lie et.al. 2006)
  - Contained in fields of Sector 54-60
  - TESS mag < 13.5 in TESS Input Catalogue
- Selected sources: 17



# Instruments

## X-ray



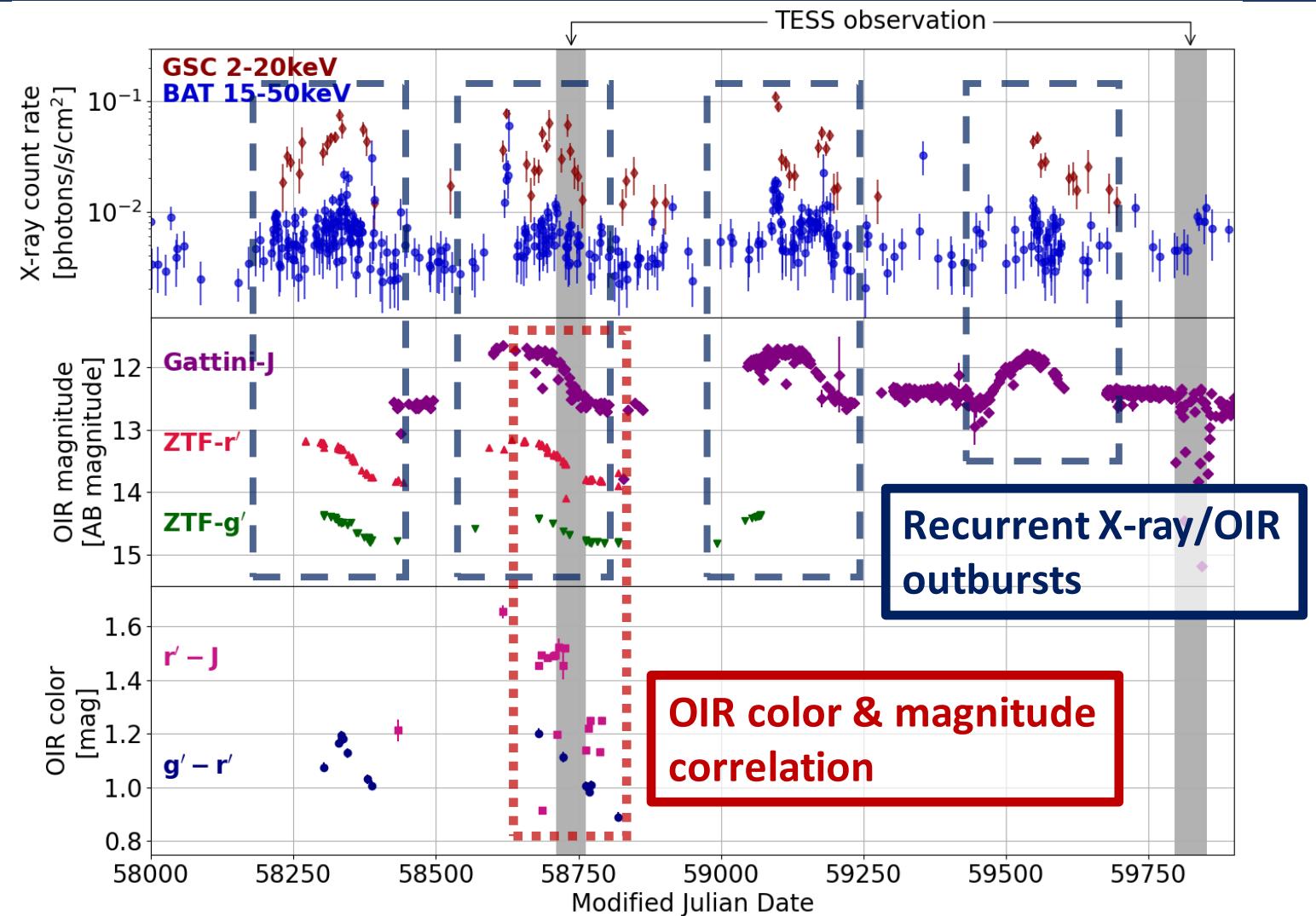
## Optical/NIR



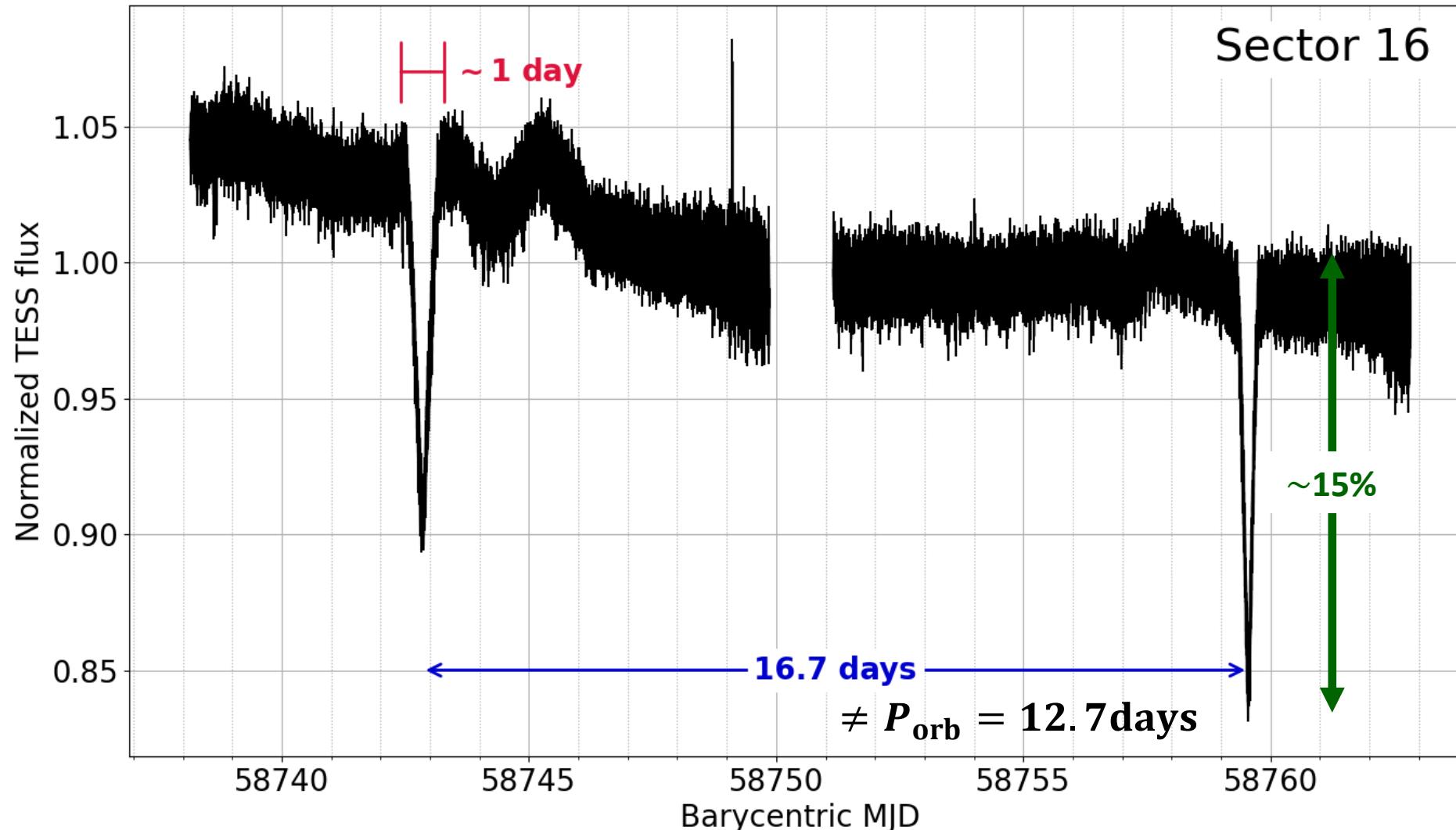
# X-ray/OIR light curve of SAX J2103.5+4545

## SAX J2103.5+4545

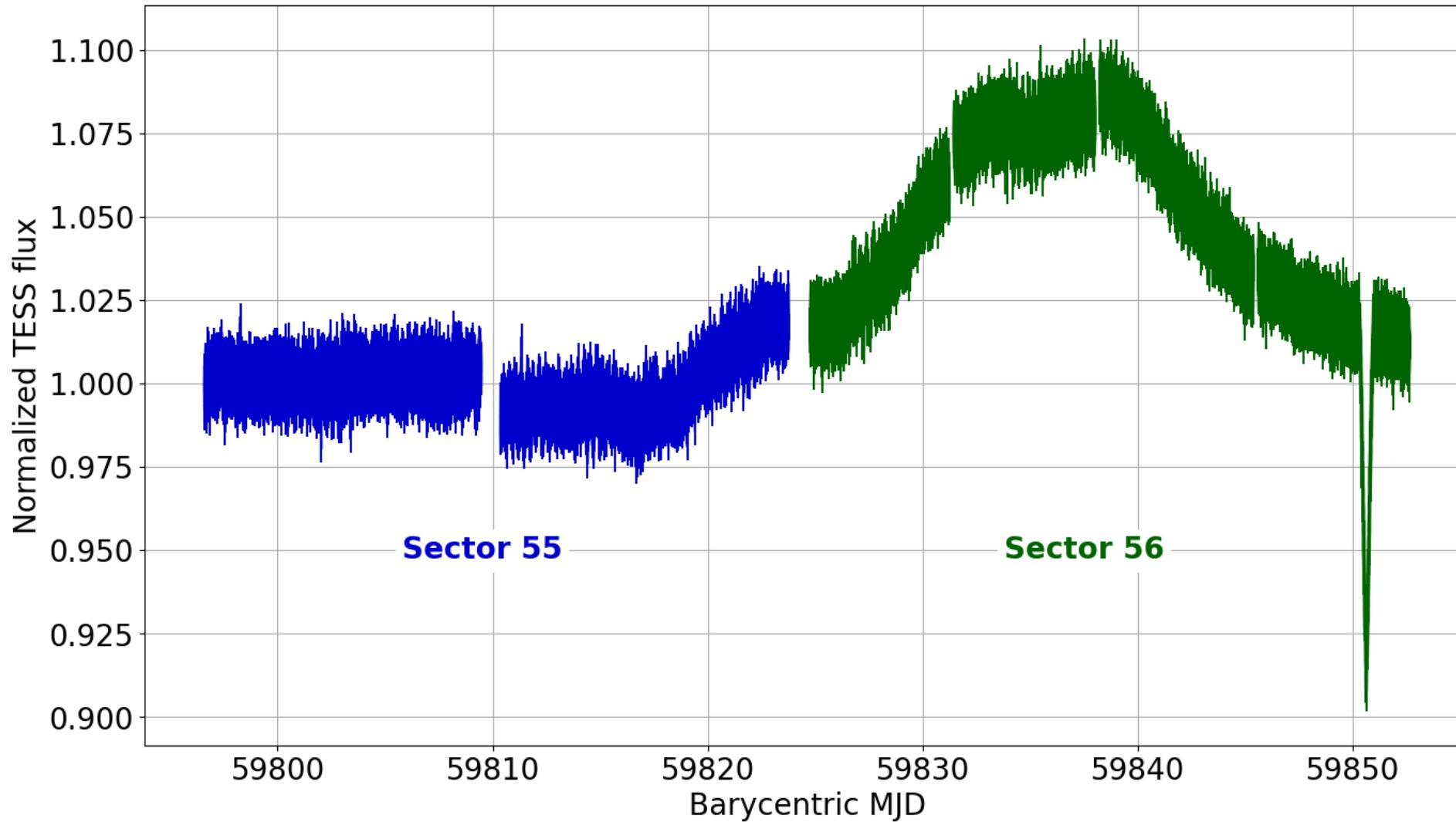
|       |                  |                  |
|-------|------------------|------------------|
|       | Type             | B0Ve             |
| Donor | Mass             | $17.5 M_{\odot}$ |
|       | Radius           | $7.7 R_{\odot}$  |
| Orbit | $P_{\text{orb}}$ | 12.7 d           |
|       | $e$              | 0.41             |



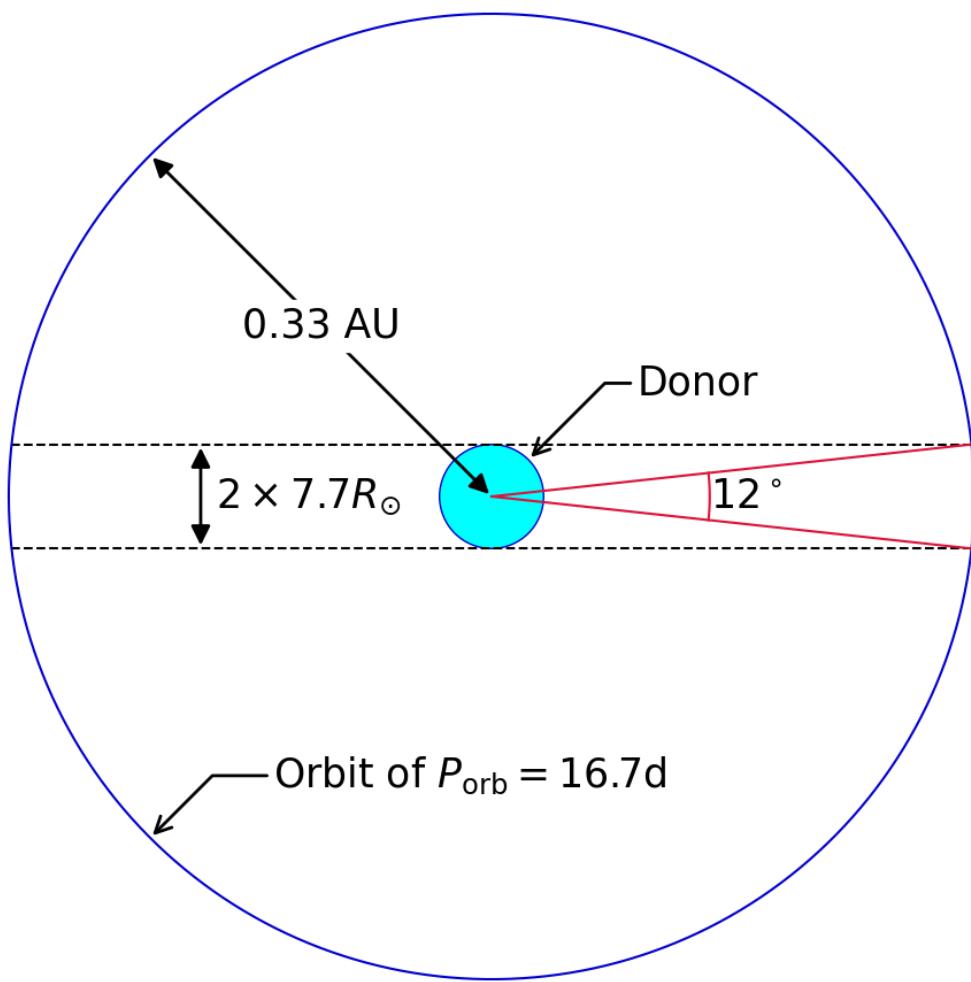
# TESS light curve of SAX J2103.5+4545



# Other TESS light curve



# Possibility of eclipse



- Dip duration:  $\approx 1$  day
- Eclipse duration:

$$16.7 \text{ days} \times \frac{12^\circ}{360^\circ} \approx 0.6 \text{ days}$$

⇒ Observed dip could be eclipse

# Summary

- We utilize quasi-simultaneous multiwavelength data with TESS for BeXB research
- Some sources show significant flux variations
  - X-ray/OIR outbursts
  - Disc originated OIR variation
  - Eclipse-like dip
- We will perform periodic analysis of TESS data and compare with long-term light curves