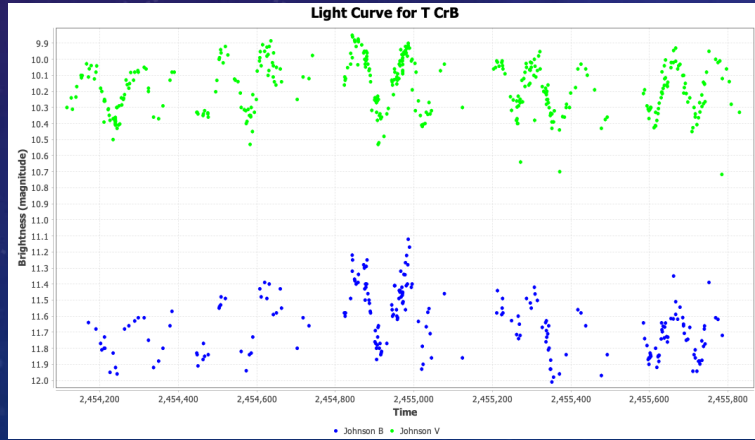
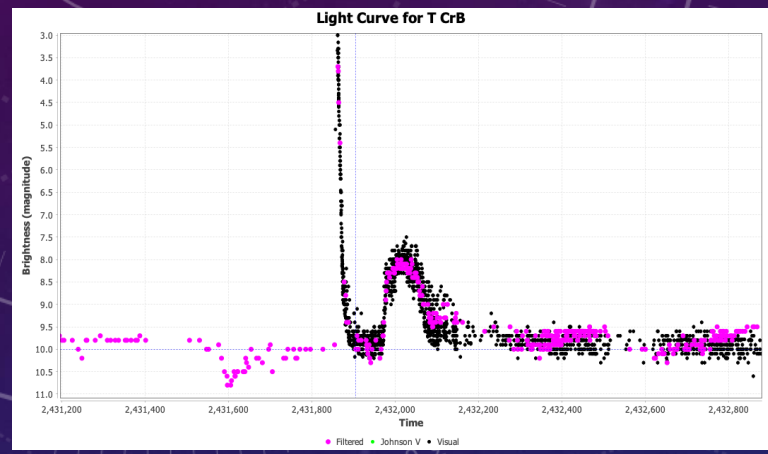


<https://apod.nasa.gov/apod/ap210822.html>



T Corona Borealis update

(and other variable vagaries)

DAVID BENN

ASTRONOMICAL SOCIETY OF SOUTH AUSTRALIA (ASSA)

AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS (AAVSO)

SEPTEMBER 2024

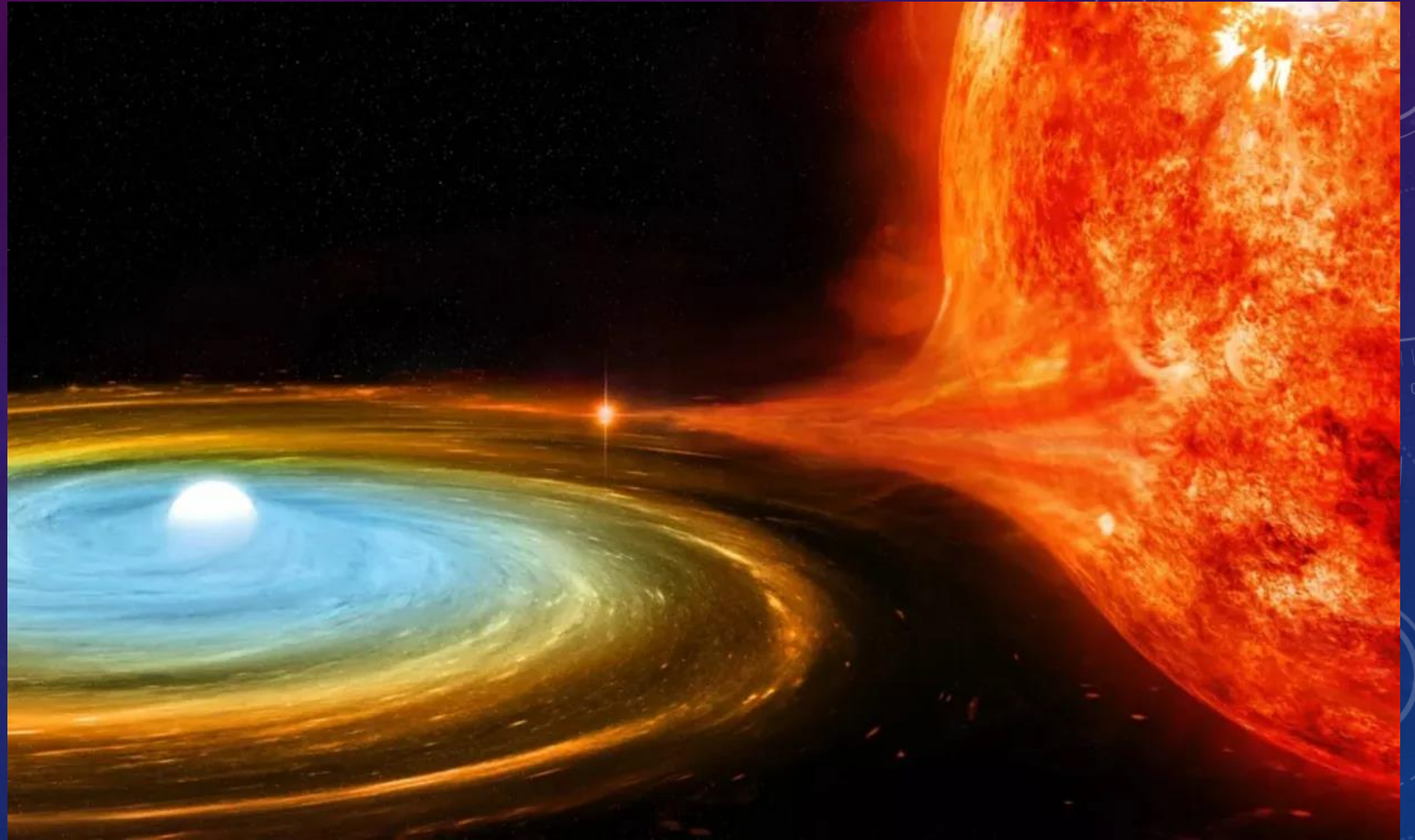
I'd like to be able to give an update on T CrB post-eruption...



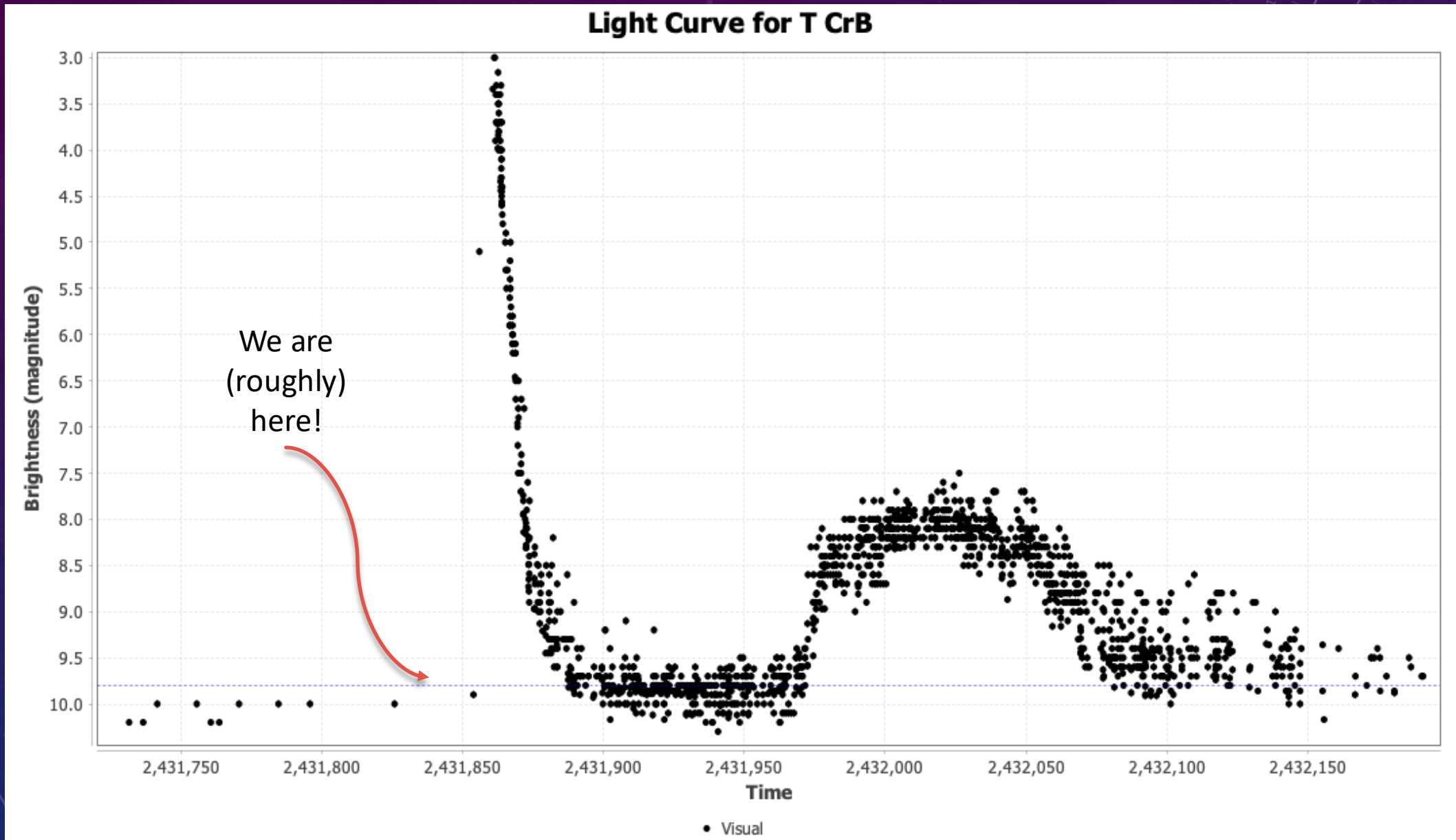
But we're still waiting

Nova: white dwarf (compact end stage object) + red giant binary star system

- Material (mostly H) funnels from red giant onto white dwarf
- Eventually, so much accumulates that a thermonuclear runaway happens
- Basically a H Bomb



By comparison with 1946 brightening...



AAVSO Variable Star Index Record

<https://www.aavso.org/vsx>

Name	V T CrB		
AAVSO UID	000-BBW-825 (241523 observations)		
Constellation	Corona Borealis	» Sequence	
J2000.0	15 59 30.16 +25 55 12.6 (239.87567 +25.92017)	» Search nearby	
B1950.0	15 57 24.55 +26 03 39.0		
Proper motion	RA: -4.410 +/- 0.058 mas/y	Dec: 12.023 +/- 0.064 mas/y	Source: Gaia DR1
Galactic coord.	42.374 +48.165		
Other names (Internal only)	<i>Please note that aliases shown in grey link to obsolete records.</i> 1SXPS J155930.1+255514 3XMM J155930.1+255512 AAVSO 1555+26 ASAS J155930+2555.2 ASASSN-V J155930.27+255511.9 BD+26 2765 Downes T CrB HD 143454 HIP 78322 HR 5958 MWC 413 N CrB 1866 Nova Coronae Borealis 1866 Nova CrB 1866 SAO 84129 SWIFT J1559.6+2554 X 15574+261 (Not		
Variability type	NR+ELL		
Spectral type	M3III+pec(NOVA)		
Mag. range	2.0 - 10.8 V		
Discoverer	John Birmingham		
Epoch	24 Sep 2011 (HJD 2455828.9)		
Outburst	--		
Period	227.55 d		
Rise/eclipse dur.	--		

VSX Variability Types

ELL

Rotating ellipsoidal variables. These are close binary systems with ellipsoidal components, which change combined brightnesses with periods equal to those of orbital motion because of changes in emitting areas toward an observer. Eclipsing binaries may also show ellipsoidal variability but the ELL objects listed in VSX are those showing no eclipses. Light amplitudes usually do not exceed 0.1 mag. in V but may reach 0.3 mag. in some cases.

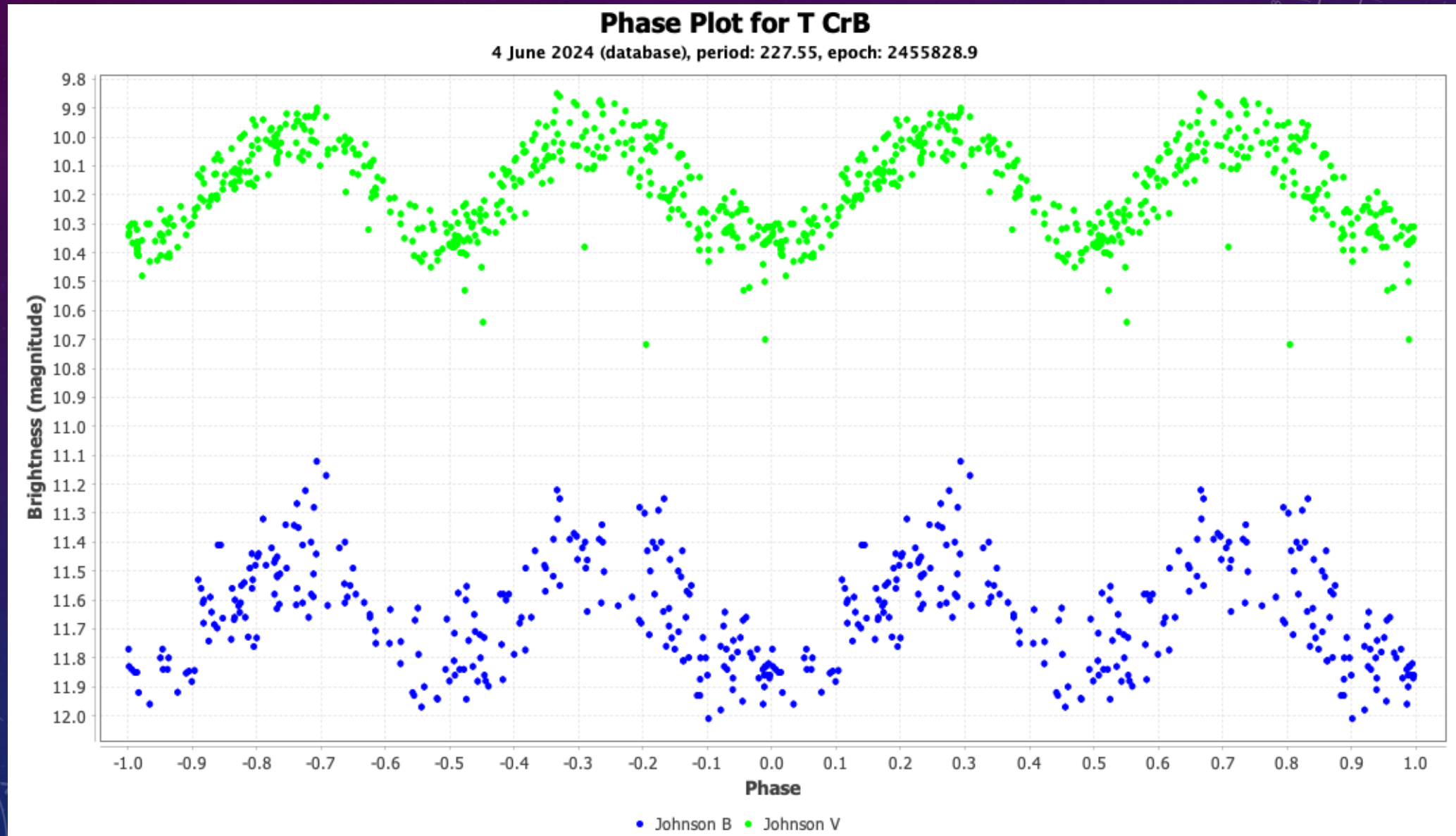
Examples: ***b Per***

NR

Recurrent novae, which differ from typical novae by the fact that two or more outbursts (instead of a single one) separated by 10-80 years have been observed.

Examples: ***T CrB, T Pyx.***

"Folding" data onto 227.55 period from VSX gives this phase plot



So called ellipsoidal variations (ELL) come from changes in presented surface area during the orbital cycle

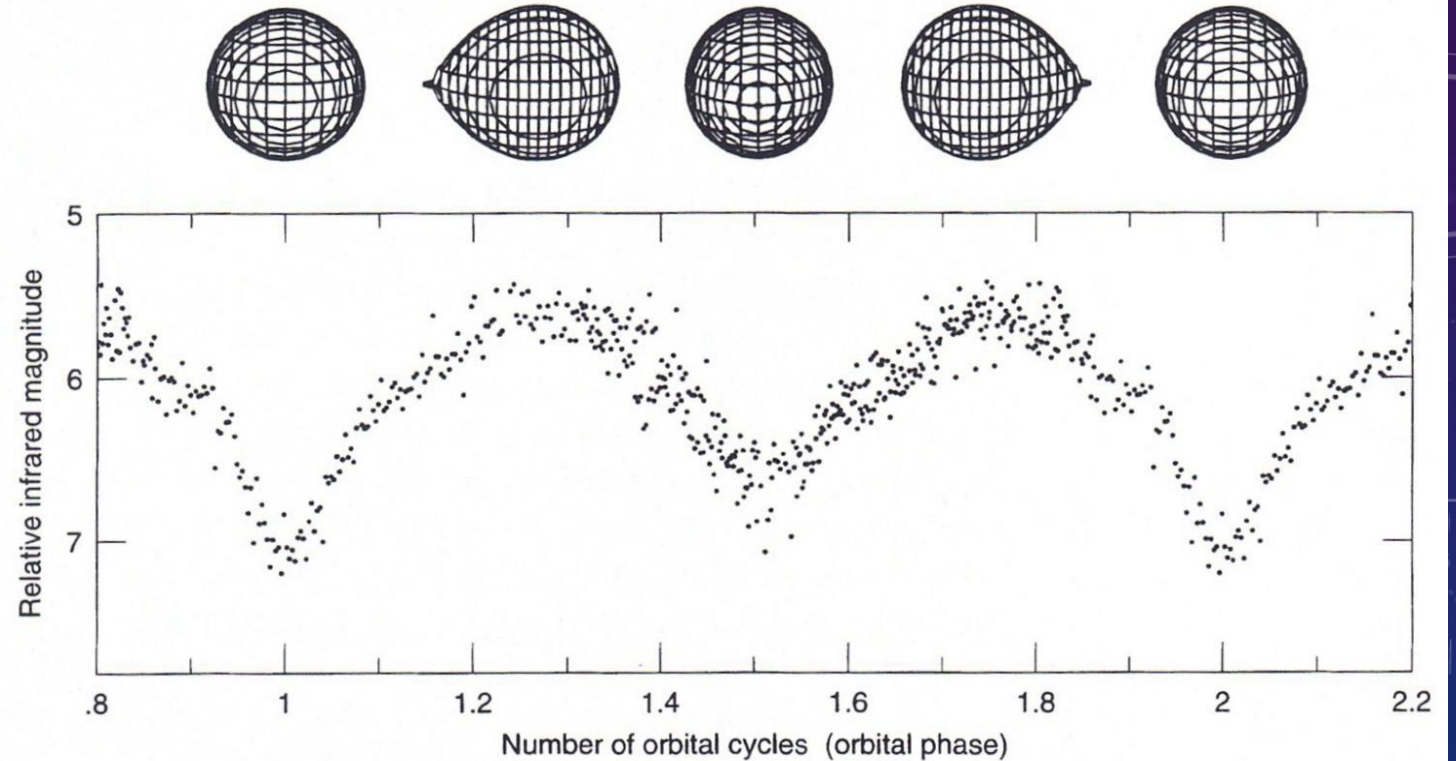
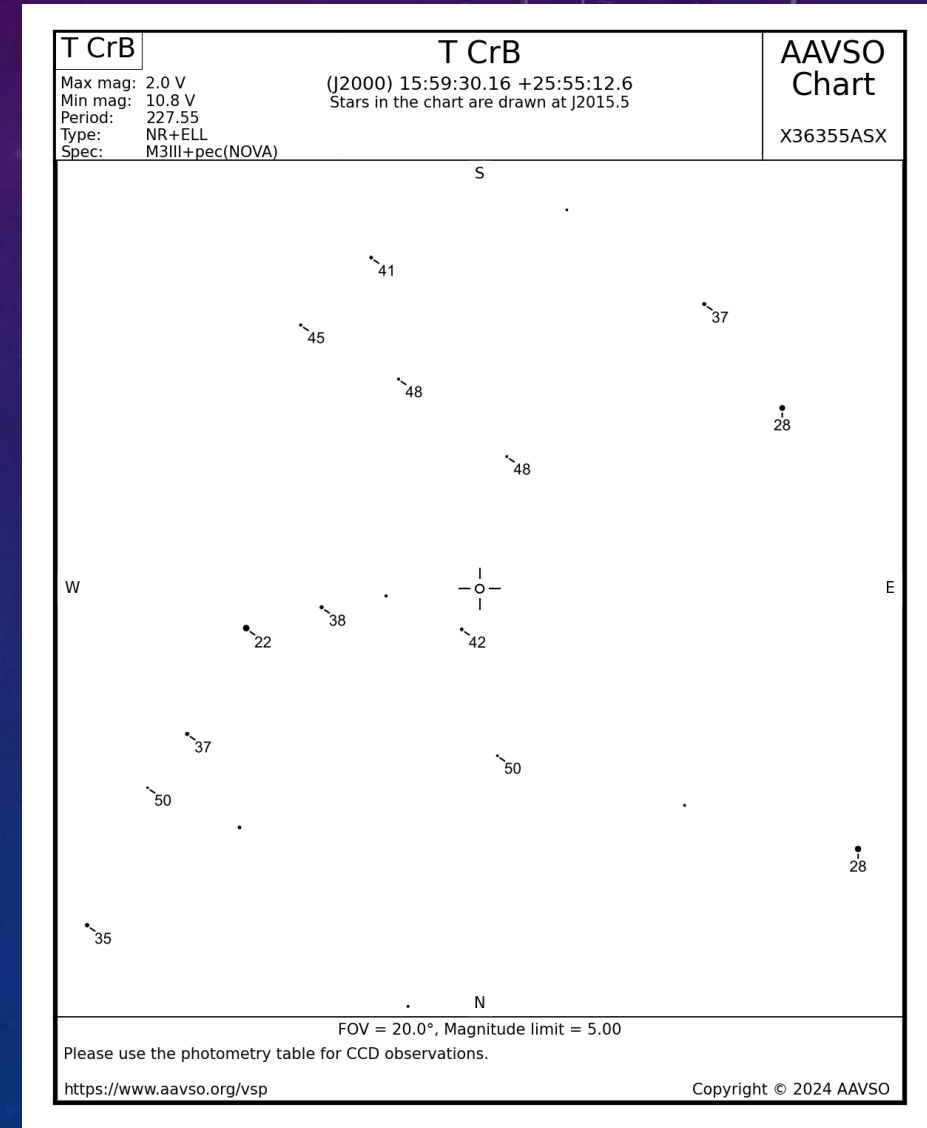
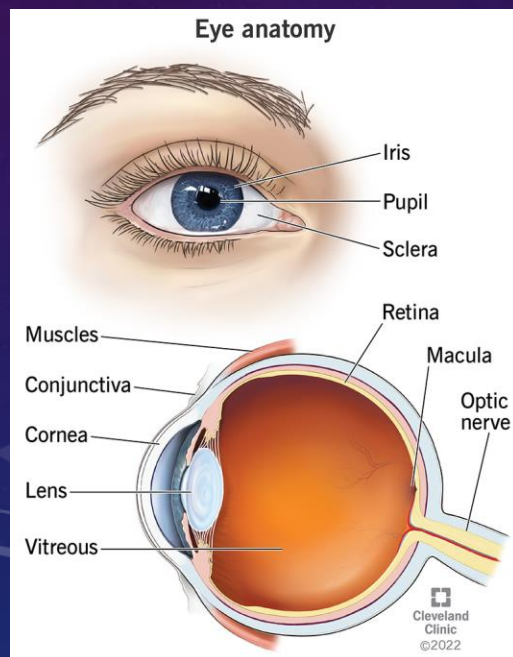


Fig. 2.6: The infrared lightcurve of XY Ari showing ellipsoidal variations. The Roche-lobe-shaped secondary is seen side-on twice per orbital cycle, presenting maximum surface area and thus appearing brighter. When it is end-on (L_1 pointing towards or away from us) XY Ari is dimmer. Schematics of the secondary at the different phases are shown above the figure. Note that XY Ari has a cooler white dwarf than NN Ser so there is no reflection effect. The figure uses the standard convention of plotting against orbital cycle, where phase increases by 1 each cycle, and the white dwarf is furthest from us at phases 0, 1, 2, and so on.⁴

source: Hellier, *Cataclysmic Variables: How and Why they Vary*

Been out most clear nights for months, often more than once, with 7x50 binos, asking: "are we there yet?"

More recently, photometry (will get to that in a bit)...





~10pm in June

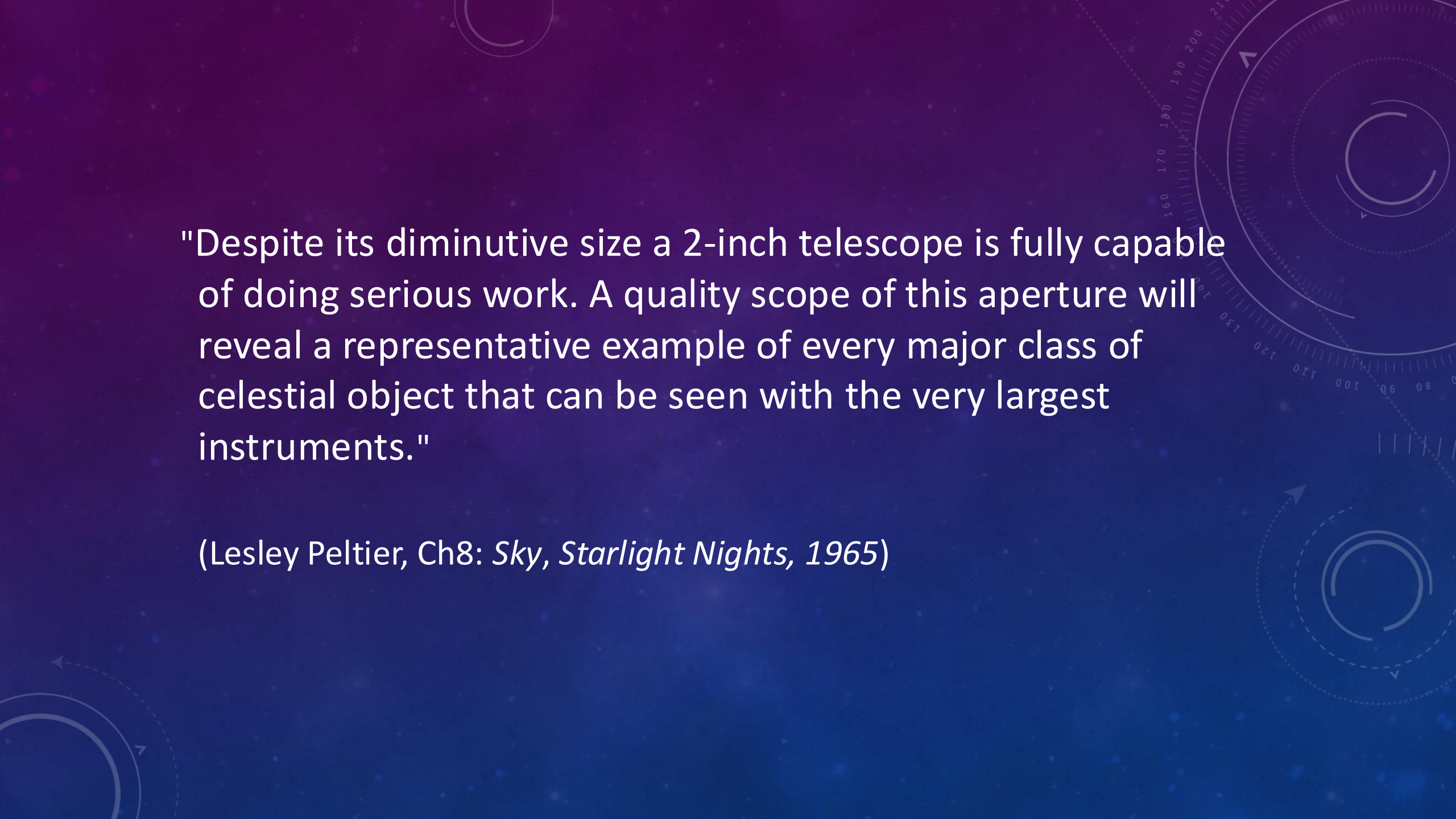
~7pm in September



~7pm
last night

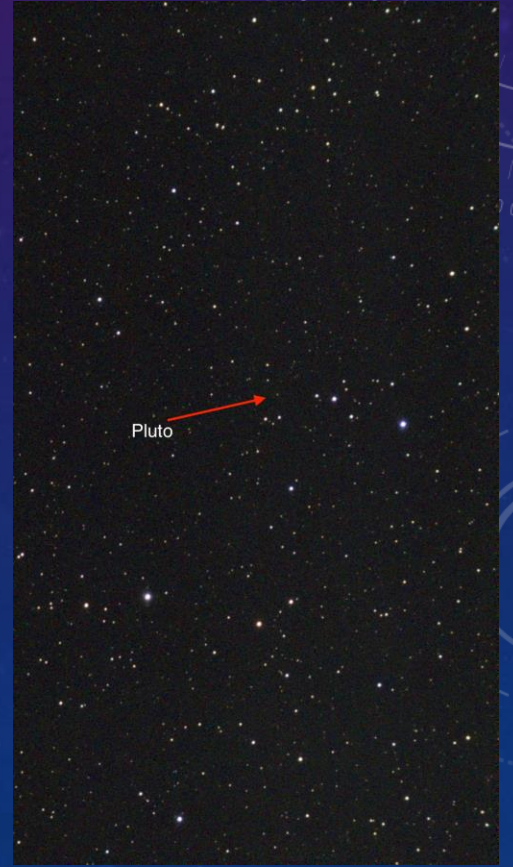


CrB

The background is a dark blue gradient with a field of small white stars. Overlaid on this are several technical diagrams in a lighter blue color. These include circular scales with numerical markings (e.g., 160, 170, 180, 190, 200, 210) and arrows, suggesting astronomical or scientific instruments. There are also concentric circles and dashed lines, some with arrows indicating direction or rotation.

"Despite its diminutive size a 2-inch telescope is fully capable of doing serious work. A quality scope of this aperture will reveal a representative example of every major class of celestial object that can be seen with the very largest instruments."

(Lesley Peltier, Ch8: *Sky, Starlight Nights*, 1965)





PermID:
 ProvID:
 TrkSub: 400
 Speed: 0.201"/min
 PA: 227 deg

Date: 2024 08 27.43767
 RA: 15 59 30.06
 Dec: +25 55 12.1
 Mag: 9.8 V
 Exp: 10.000s (1x10s)

Sol: 96 deg

Obs: D. Benn
 Msr: D. Benn
 Stn: 247
 Tel: 0.05-m f/5 refractor
 PSc: 2.38"/px
 FOV: 60.9 x 60.9 arcmin
 Cam: 42.6 x 76.0 arcmin

E
 N

T CrB

Enhancing +38

00:01:10

Filter

Adjust

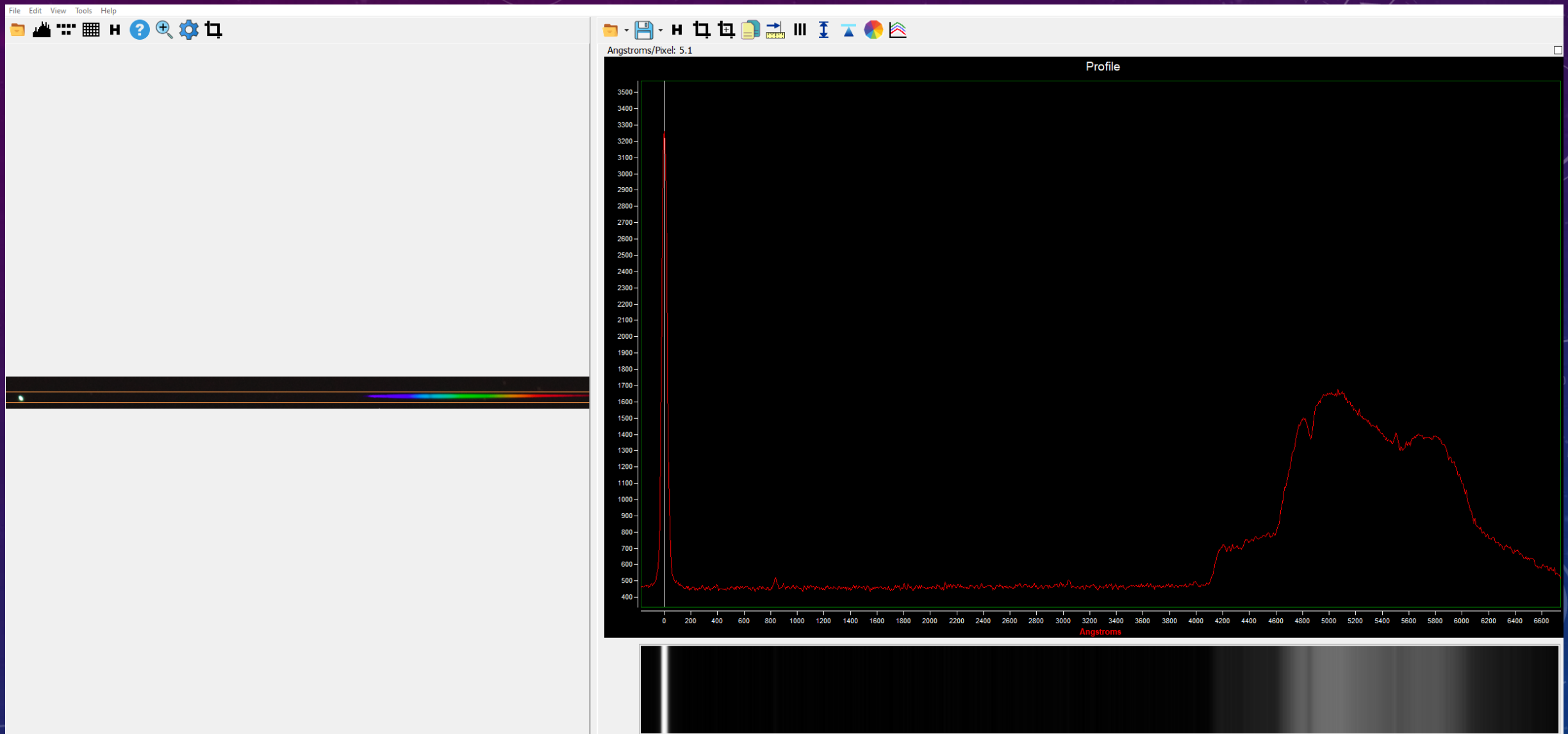
Mark

Focus

8s

T CrB Max mag: 2.0 V Min mag: 10.8 V Period: 227.55 Type: NR+ELL Spec: M3III+pec(NOVA)	T CrB (J2000) 15:59:30.16 +25:55:12.6 Stars in the chart are drawn at J2015.5	AAVSO Chart X37093BM
FOV = 1.0°, Magnitude limit = 14.50 Please use the photometry table for CCD observations. https://www.aavso.org/vsp		
Copyright © 2024 AAVSO		

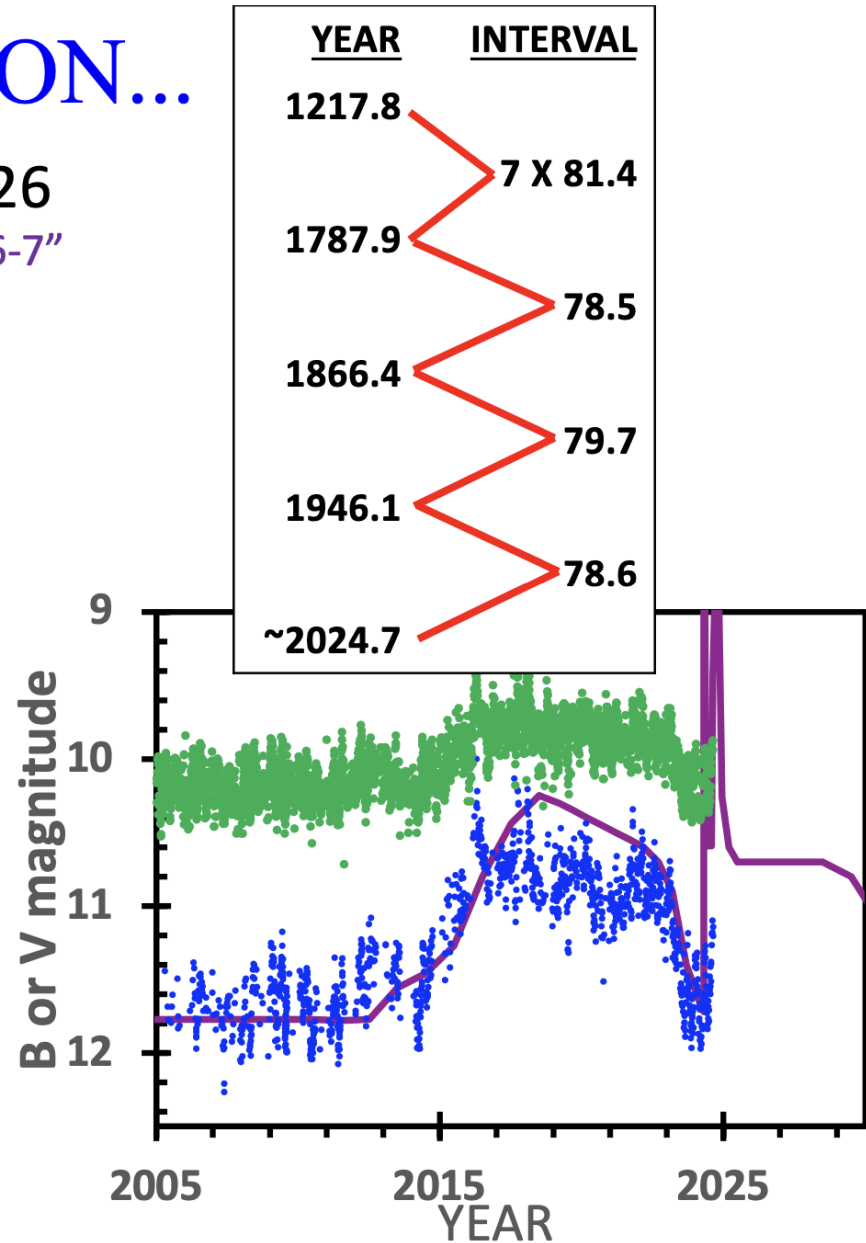




More calibration steps required for proper spectrum, and to see lines corresponding to chemical elements

T CrB IS GOING TO ERUPT SOON...

- ★ Next eruption is ~80 years after 1946, i.e. ~2026
 - One day after the 1946 eruption: Lindley predicted “2026-7”
 - Many others have made the same calculation
 - Better version now gives ~2024.7
- ★ High-State in 2015 implies 2025.5 ± 1.3
 - Will high state be the same duration as in 1940’s?
- ★ Pre-eruption dip in April 2023 → 2024.4 ± 0.3
 - Any night now...
 - Any month now...
 - Before the end of this year...



"Back in May 2023, I predicted that T CrB will erupt in the year 2024.4 ± 0.3 , on the basis of the start time for the pre-eruption dip being observed around March-April 2023, and with the measure from my B-band light curve from before the 1946 eruption that the pre-eruption dip started 1.1 ± 0.3 years before the start of the 1946 eruption.

The formal uncertainty comes from the fact that the roll-over to fading is not sharply defined either in 1945 or in 2023.

There is an additional uncertainty arising from the validity of the assumption that the timing of the eruption, with respect to the start and stop of the preceding high state (and the start of the pre-eruption rise), be the same in 2024 as in 1946. This additional uncertainty is difficult to quantify, but it cannot be too large."

(email from Brad Schaefer, 2 Sep 2024)

Magnitude rose about 10 years before 1946 eruption.

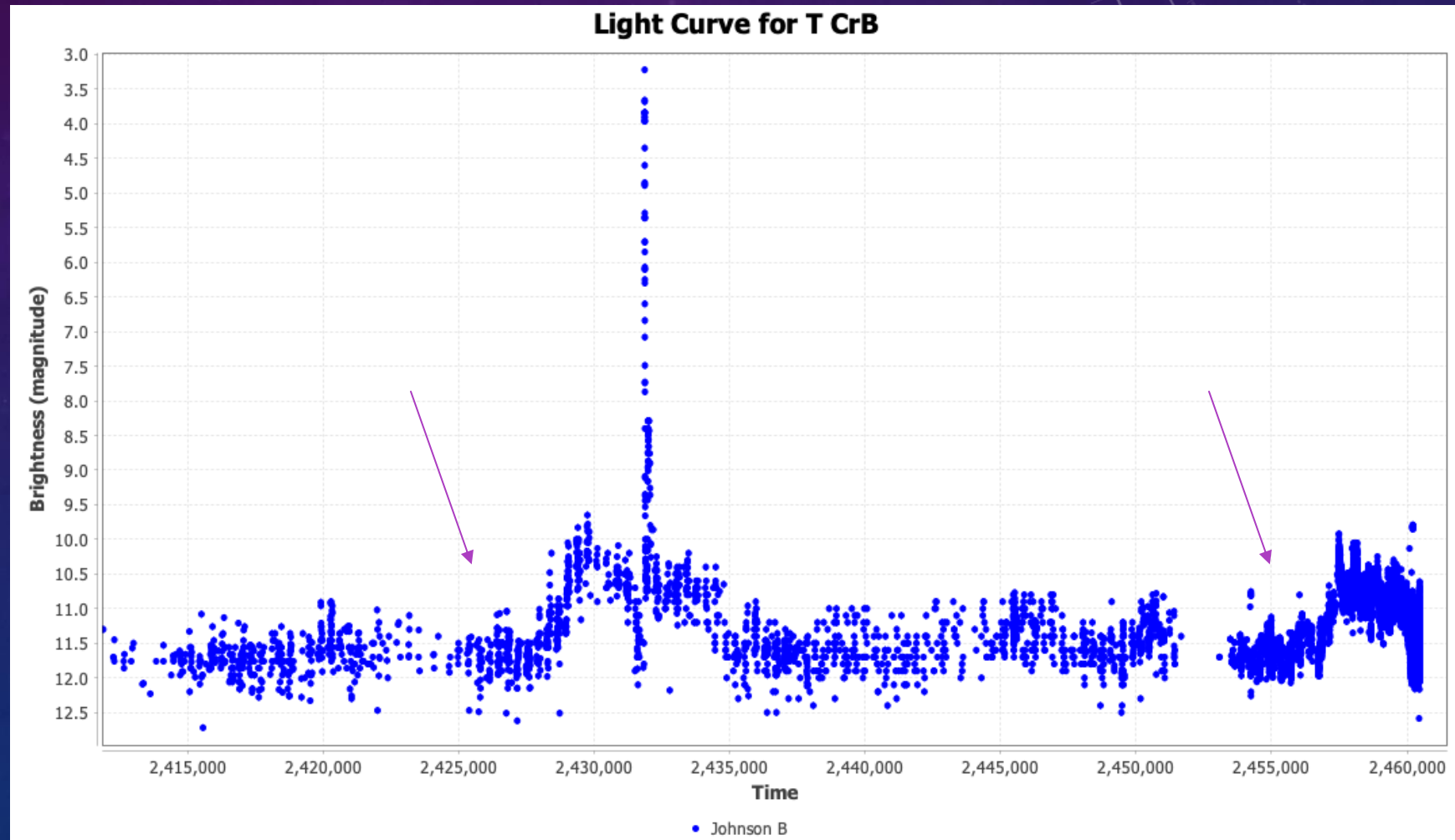
Latest rise started late 2014 or early 2015.

Magnitude dipped 1 year before 1946 eruption.

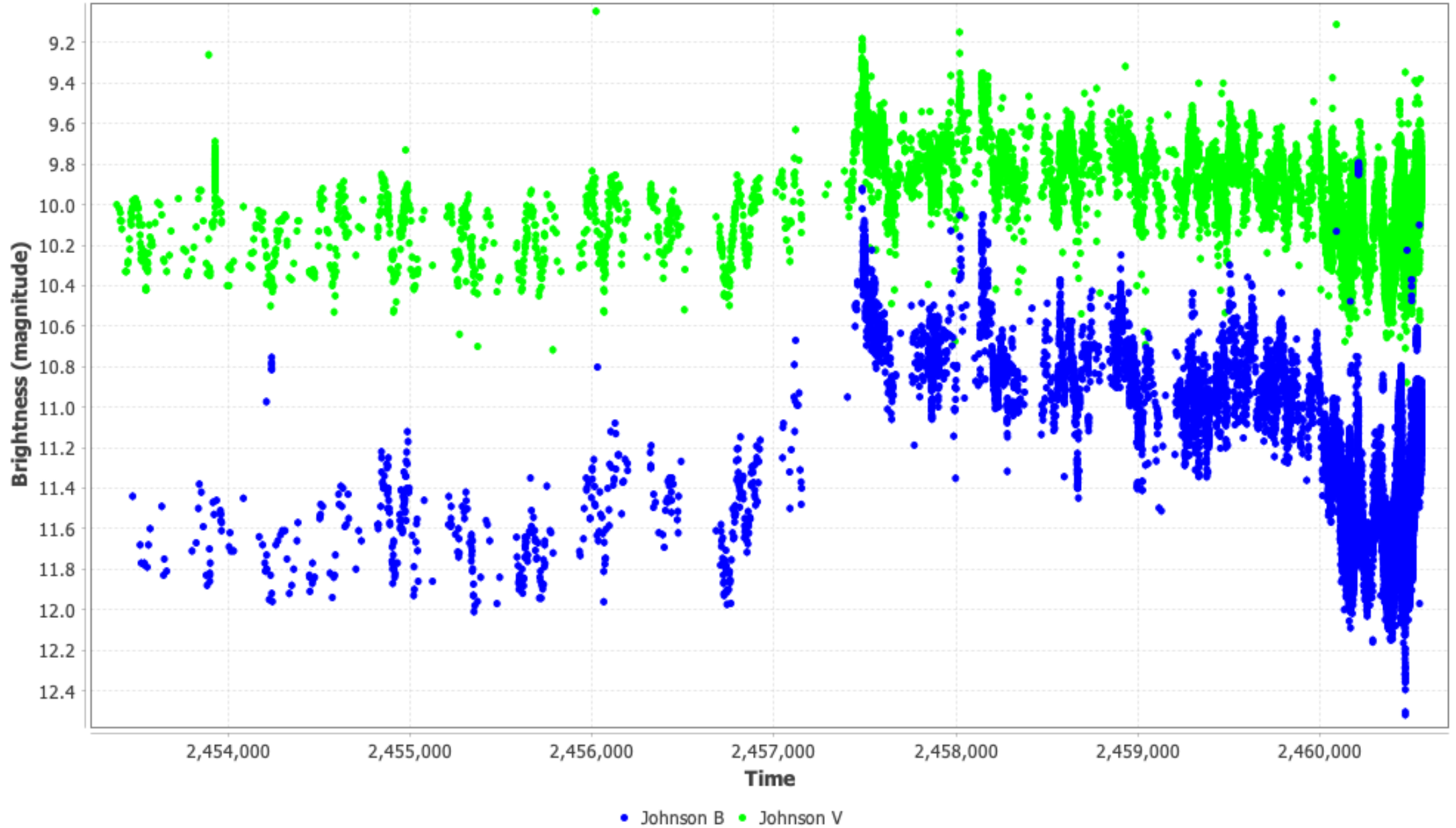
Current dip started March/April 2023.

Magnitude changes not identical, but similar.

Most obvious in B data.



Light Curve for T CrB



"The prediction of 2024.4 ± 0.3 *has its* (sic) most likely (68% 1-sigma probability) from 2024.1 to 2024.7, **which is February to the end of August.**

Given that T CrB has not erupted yet, we are **getting near the end of the 1-sigma prediction interval.**

So far, this is **all normal enough.**

The remaining probability distribution is a **tail extending out a number of months.**

The most likely remaining eruption date is 'soon', **any night now**, within the next month or two. It is likely that T CrB will go up **before the end of the year."**

(email from Brad Schaefer, 2 Sep 2024)

WHEN IT GOES UP, MOST SCOPES WILL BE WATCHING

★ Telescopes in space:

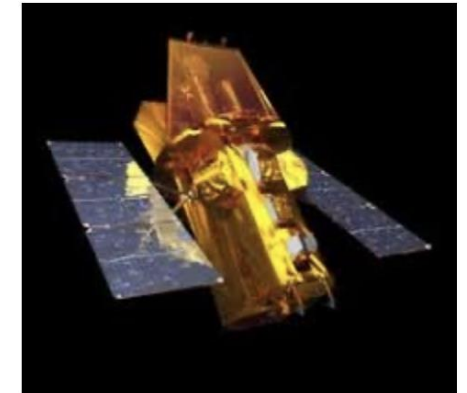
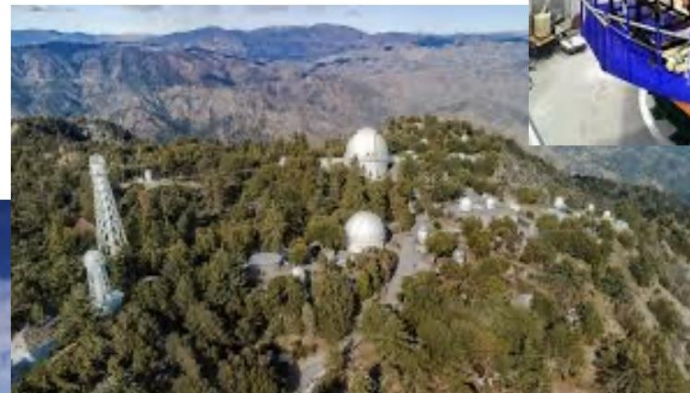
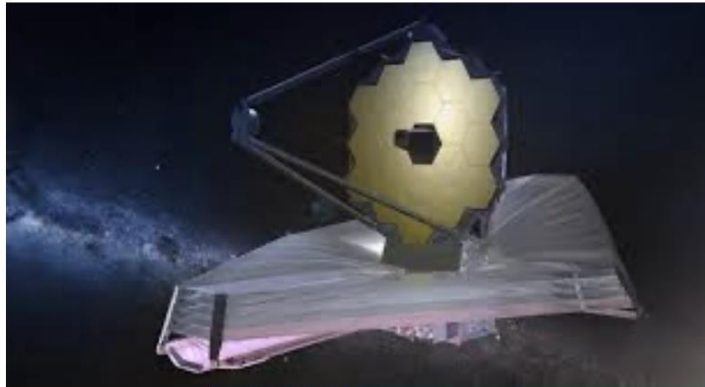
– HST, JWST, Swift, Fermi, Chandra, NeoSat, XMM, INTEGRAL, NuStar, Euclid

★ Ground-based telescopes:

– CHARA, VLA, ALMA, ... plus a gazillion small scopes getting photometry & spectroscopy

★ Neutrino detectors!

– IceCube, SuperKamiokande, Km3Net, Antares



"In the meantime, even before the eruption, there has been a lot of work plus some good understanding for the pre-eruption dip and the pre-eruption high state.

We now know from the **excellent spectroscopy from amateurs worldwide** that the pre-eruption dip is actually the end of the pre-eruption high state. (*Why* it should end is not known.)

Without certainty, the pre-eruption high state appears to be an ordinary symbiotic nova eruption, with all the usual physics.

Still, the identical timing from the 1860s and the 1940s and the 2020s is mysterious."

← (email from Brad Schaefer, 2 Sep 2024)

SOLUTION TO MYSTERIES...

★ Open mysteries:

- What is nature of unique High-State around the eruption?

I claim that the High-State is just a normal Symbiotic Nova eruption

- What is nature of unique pre-eruption dip before the eruption?

Recent spectroscopy proves that it is just the *end* of the High-State

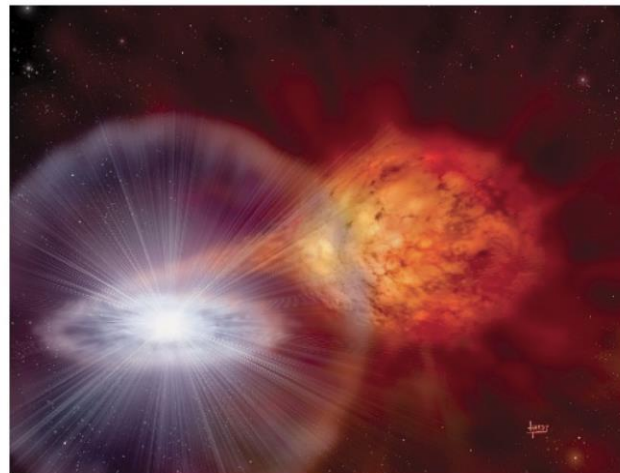
- What is nature of unique second eruption after the primary eruption?

U. Munari makes reasonable claim that it is caused by irradiation on the Red Giant star

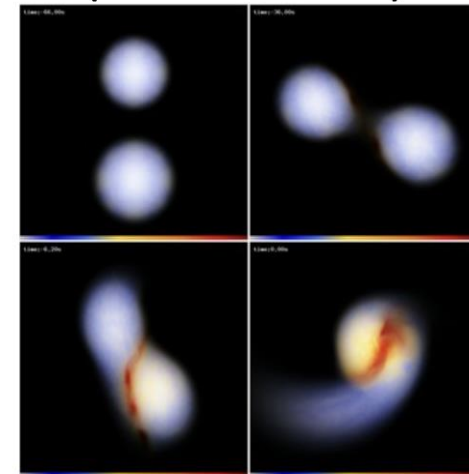
★ Will T CrB become a Type Ia supernova?

- Is it a neon nova?

SINGLE DEGENERATE:
(1 white dwarf)



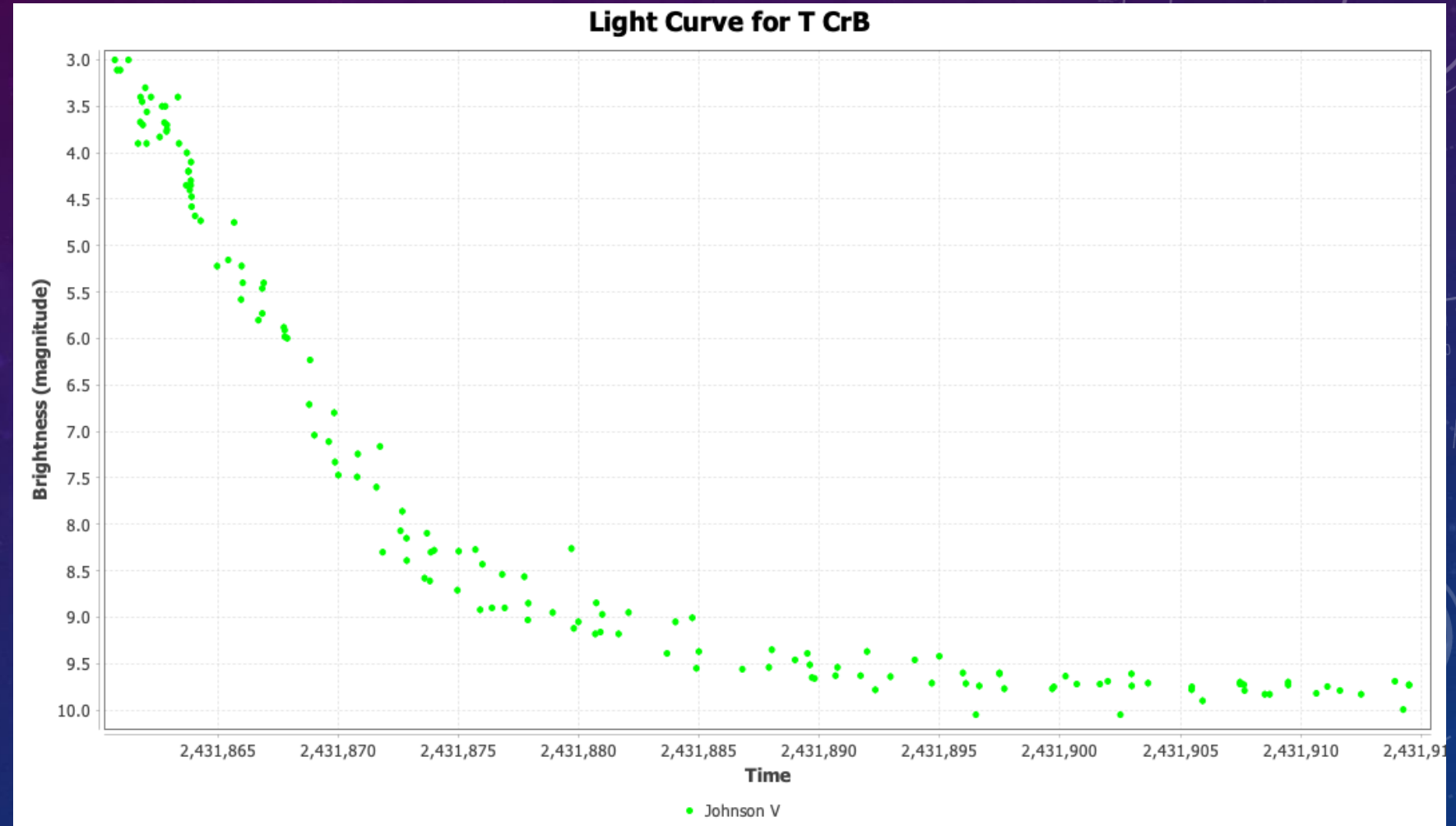
DOUBLE DEGENERATE:
(2 white dwarfs)



versus

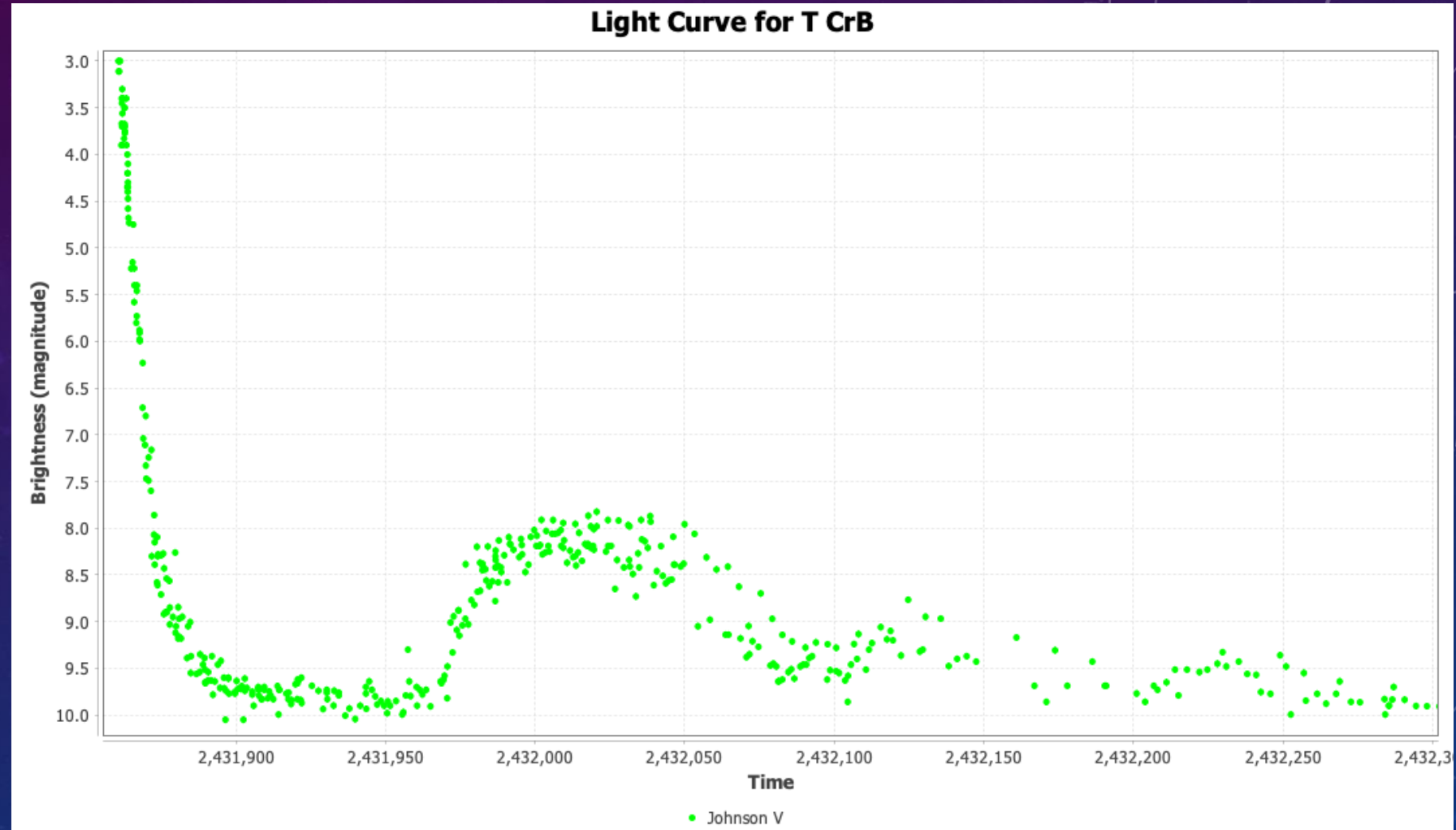
WHAT CAN YOU EXPECT TO SEE?

- Rapid rise to mag 2 or 3 within several hours
- Naked eye or easy binocular object for a week
- A decline of 6 or 7 magnitudes with 20 days or so
- A gradual return to quiescence within 50 days or so

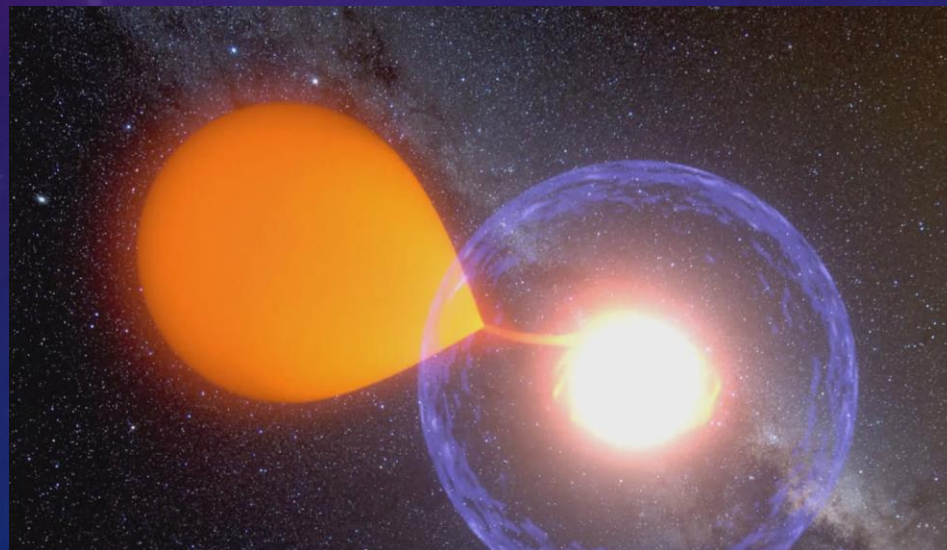


WHAT CAN YOU EXPECT TO SEE?

- Post-eruption rise high state after ~100 days
- High state for ~120 days
- Gradual return to quiescence within ~200 days



QUESTIONS?



<https://newatlas.com/star-system-hibernation-nova/44994/>