



Polarization observations of Novae using a Photopolarimeter

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Novae and polarization observation

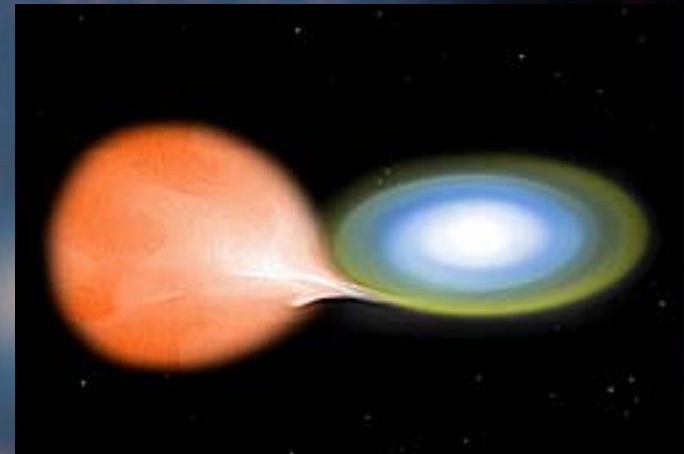
Novae: Cataclysmic variable stars
Thermo-nuclear runaway

Why novae might be polarized?

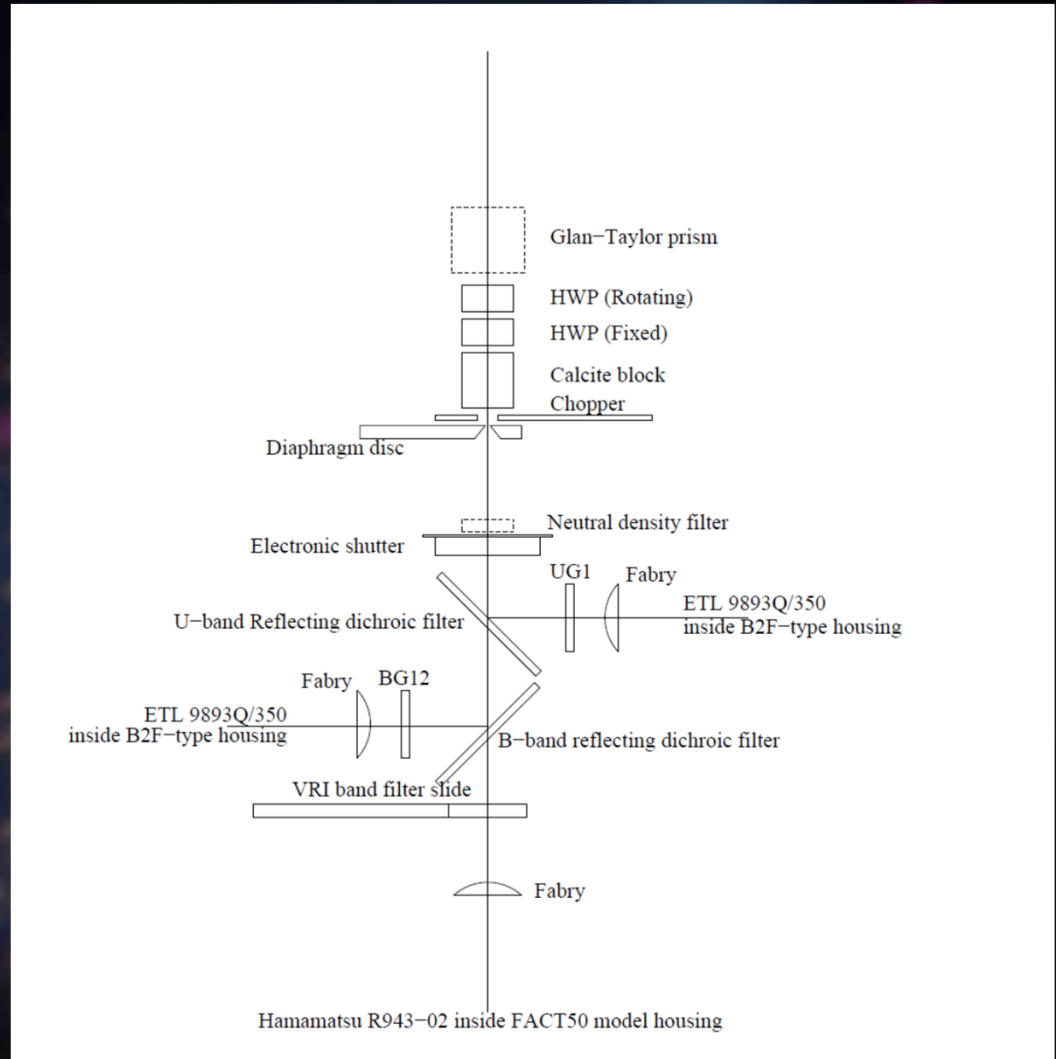
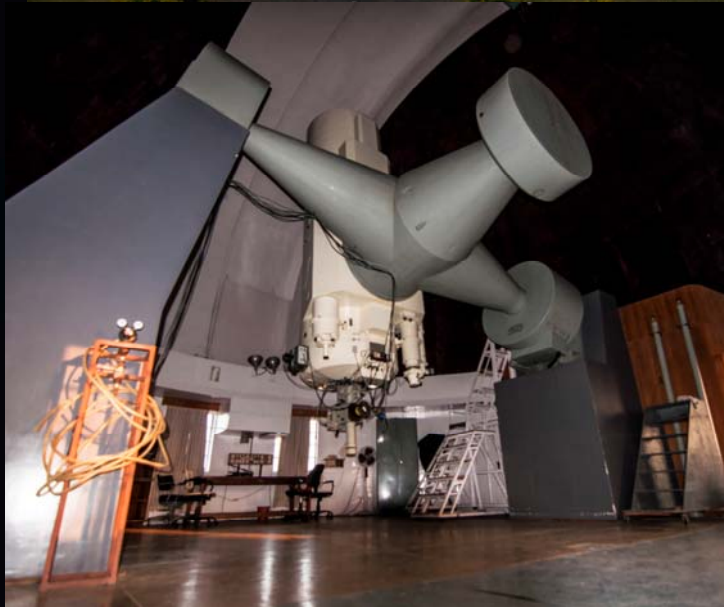
- Asymmetry in the ejecta.
- Dust Condensation.

Polarimetry of Novae:

- Distribution of material in the ejecta.
- Size and nature of the dust grains.
- Interstellar reddening.



Photopolarimeter at VBO, Kavalur, India



Data Acquisition and Reduction

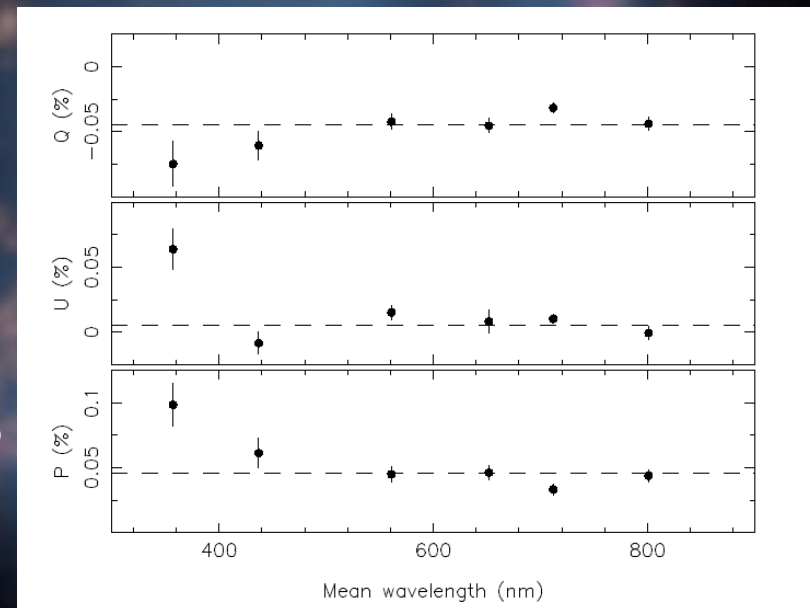
Data Acquisition- I_o and I_e are stored at different positions of half wave plate.
Several cycles of rotation of HWP.
Sky counts are subtracted.

Reduction:

$$P(\%) = \sqrt{q^2 + u^2} \times 100$$
$$2\theta = \tan^{-1}(u/q)$$

Standard polarimetric stars
for instrumental polarization
and position angle correction.

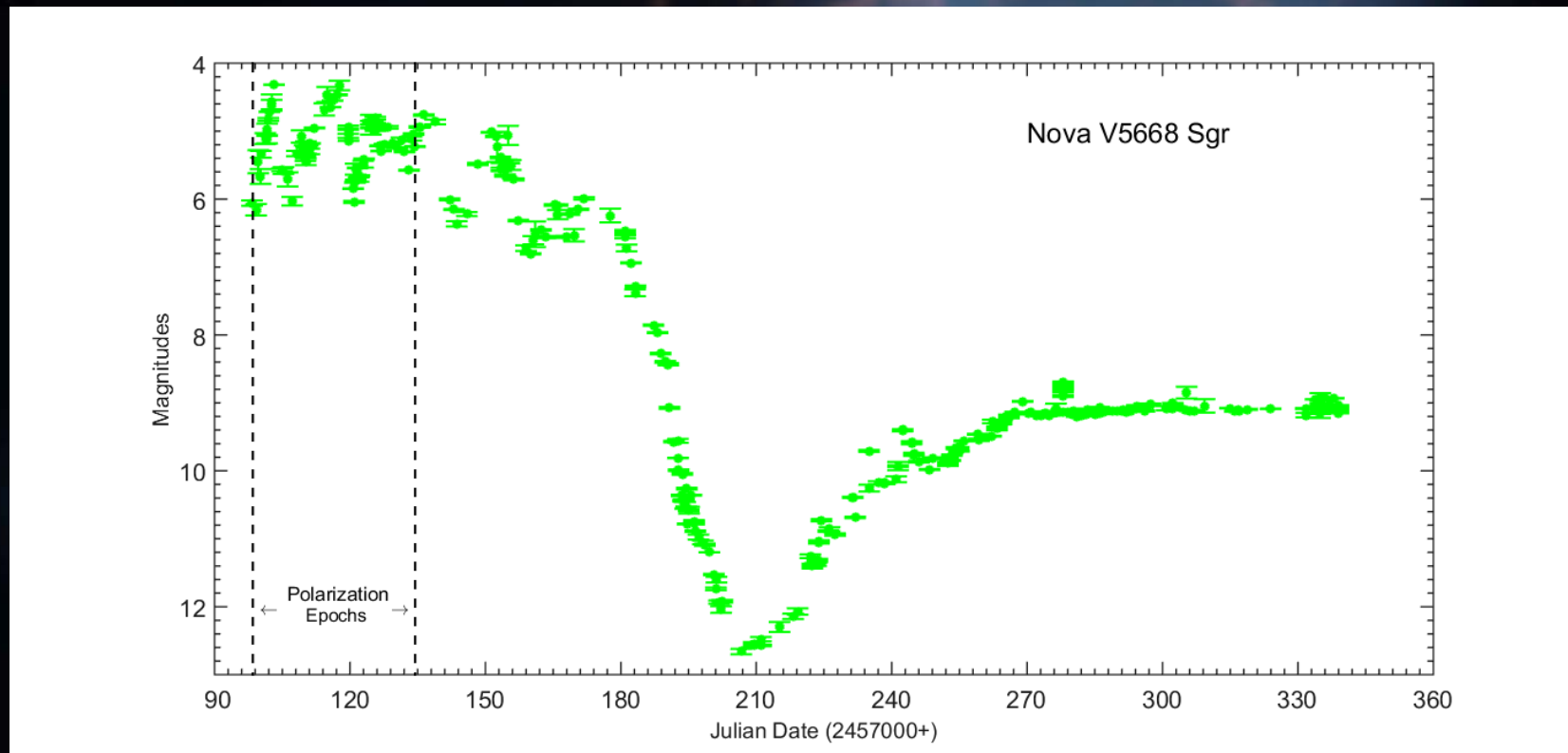
Instrumental Polarization $< 0.05\%$
P A correction is 20.072 degrees



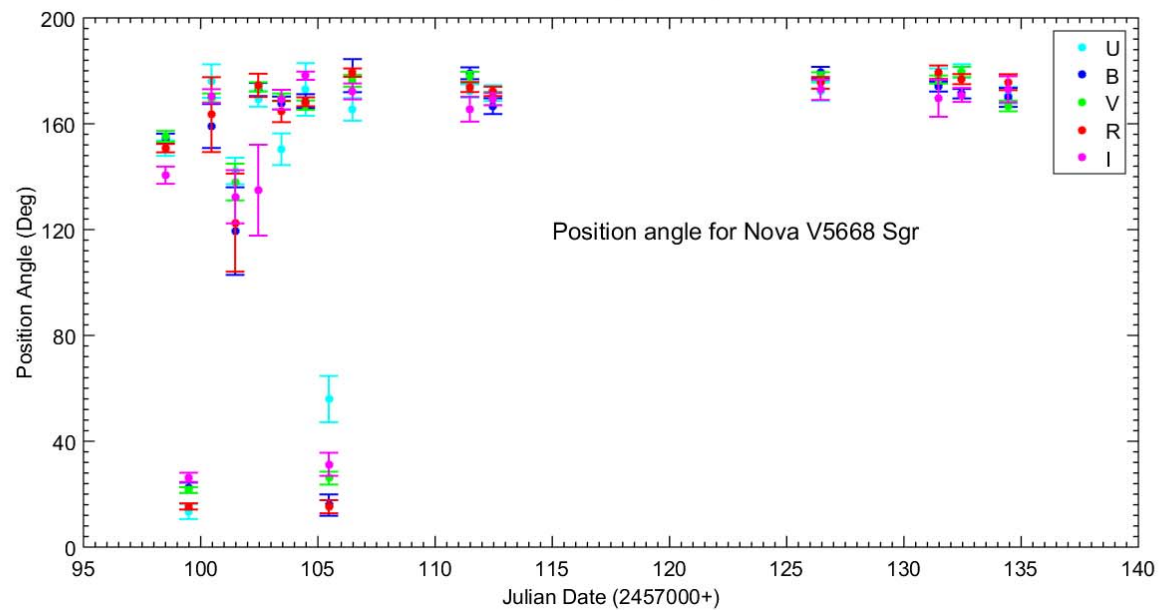
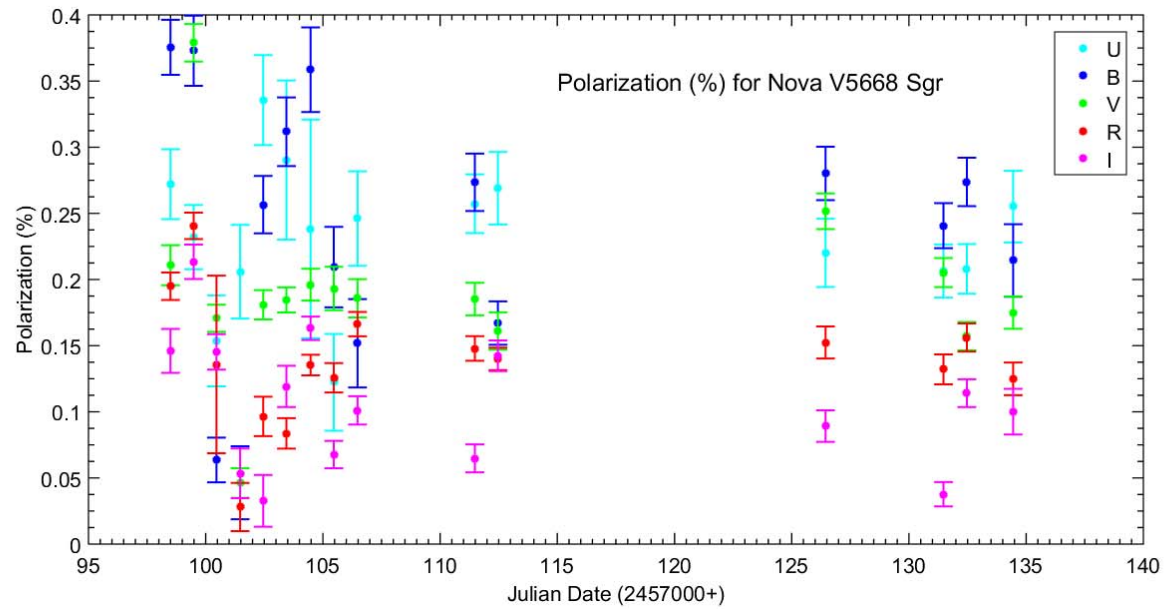
Observations

Source	Nova Sgr V5668	Nova Sco V1535	Nova Oph V3661
Ra and Dec	18:36:57 -28:55:42	17:03:26.2 -35:04:14	17:35:50.5 -29:34:24
Outburst	March 19 2015	Feb 28 2015	March 16 2016
Visual Maximum mag	4.2	9.70	10.79
Extinction E(B-V)	0.21	1.09 (Munari et al) 0.87 (Banerjee et al)	2.27 (Munari et al)
Av	0.72	2.28 3.39	11.48 13.25
Distance	1.6kpc(Banerjee et al)	9.7kpc(Munari et al) 14.7kpc(Banerjee et al)	3.7kpc(Munari et al)
Formation of Dust	90 days after discovery		
Type of Nova	FeII type Slow Nova	He/N type Fast Nova	FeII type Fast Nova

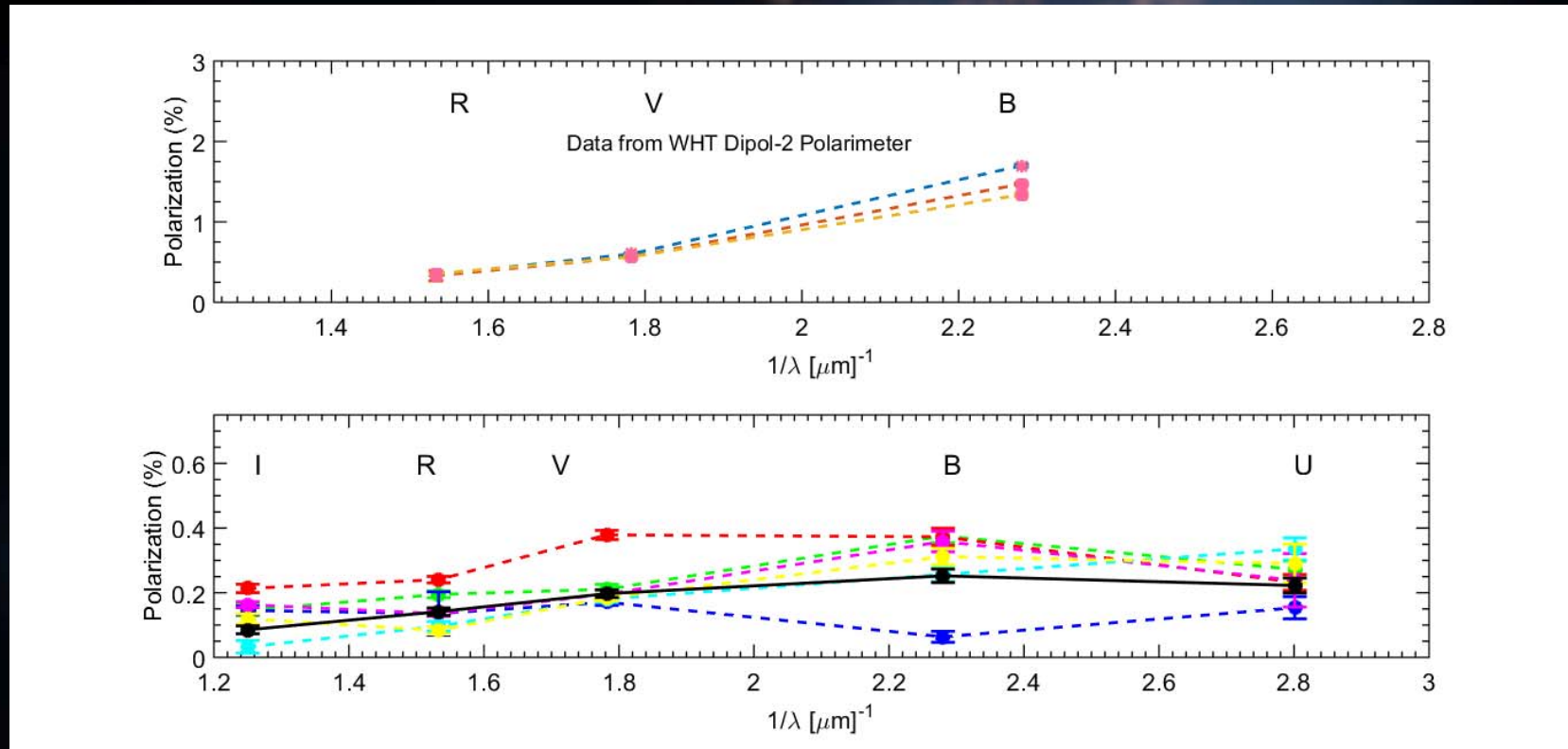
Light Curve and Polarization observation epochs Nova V5668



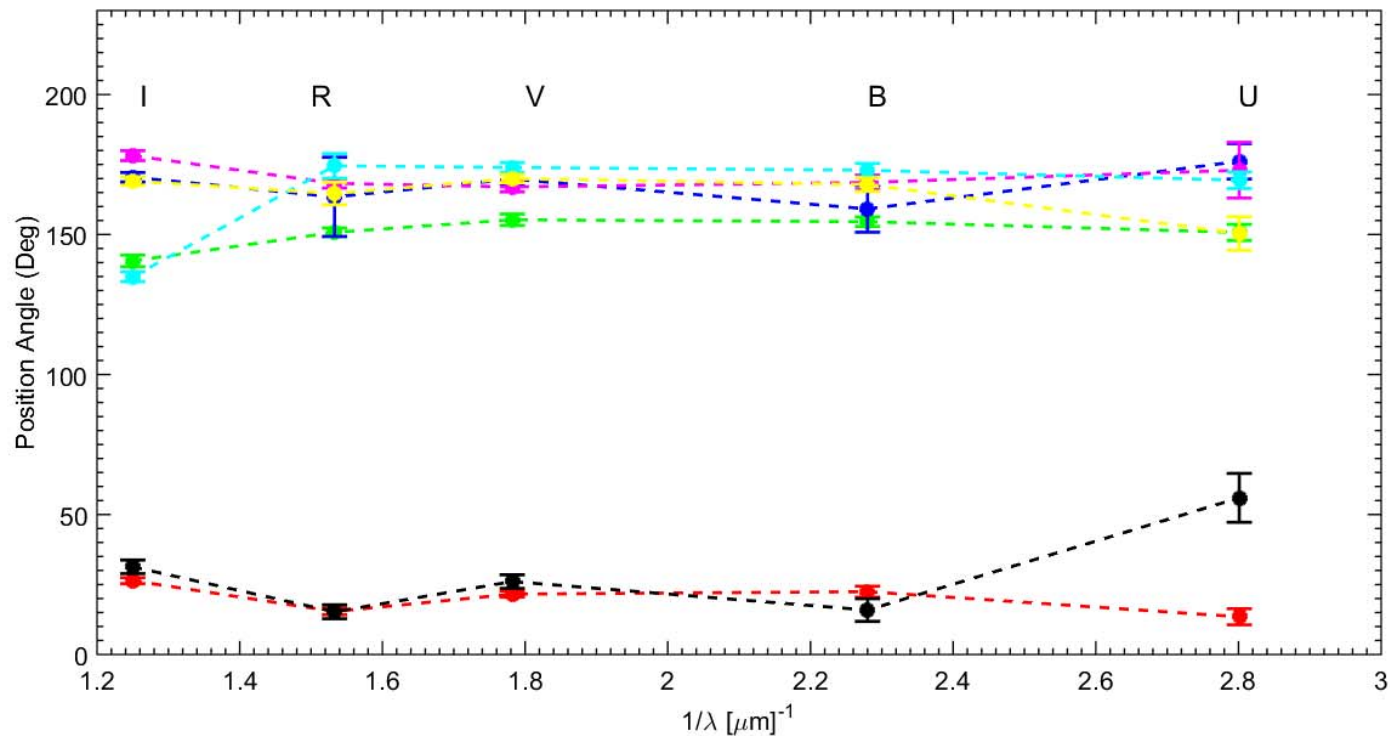
Variability in Polarization degree and Position angle



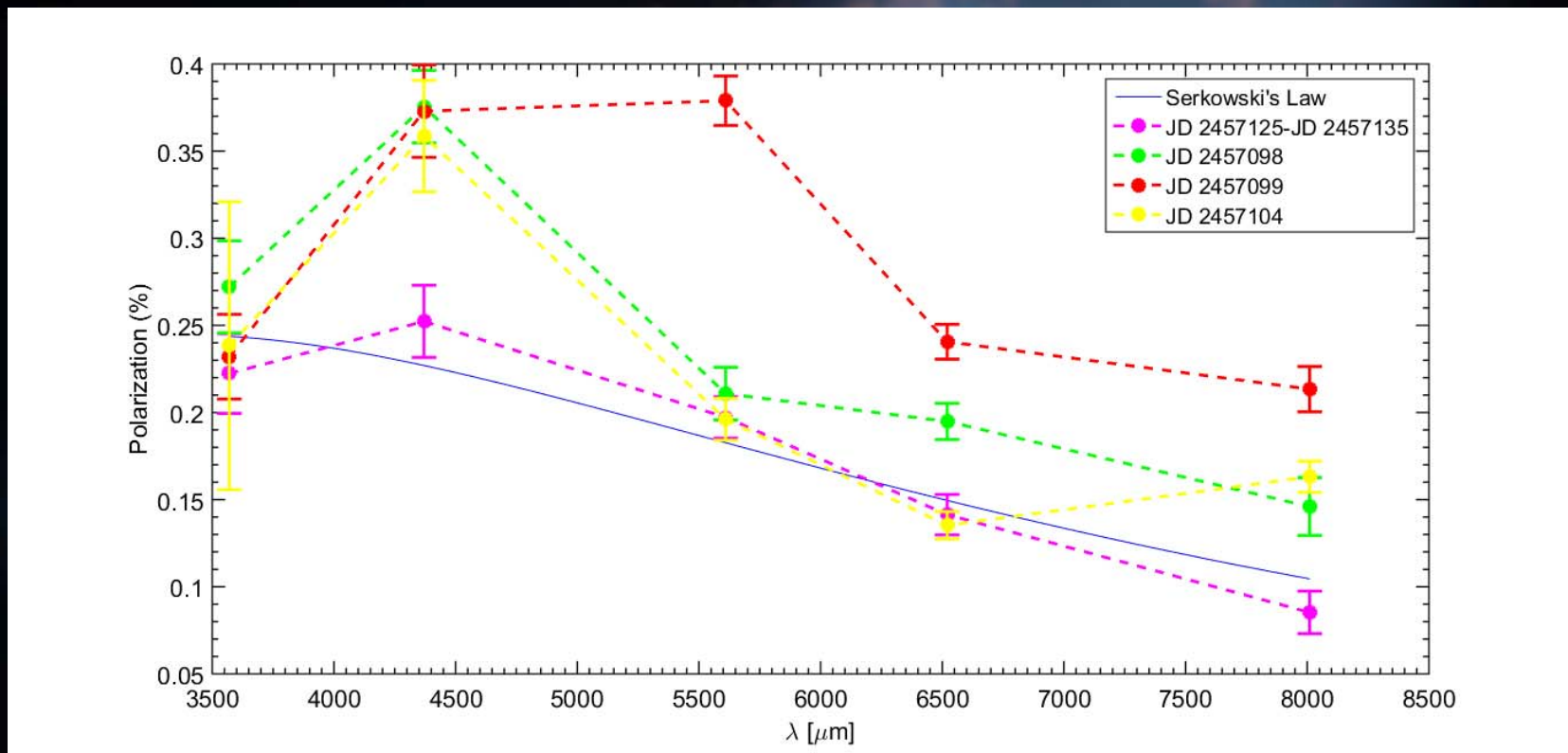
Nova V5668 Sgr- Polarization variation



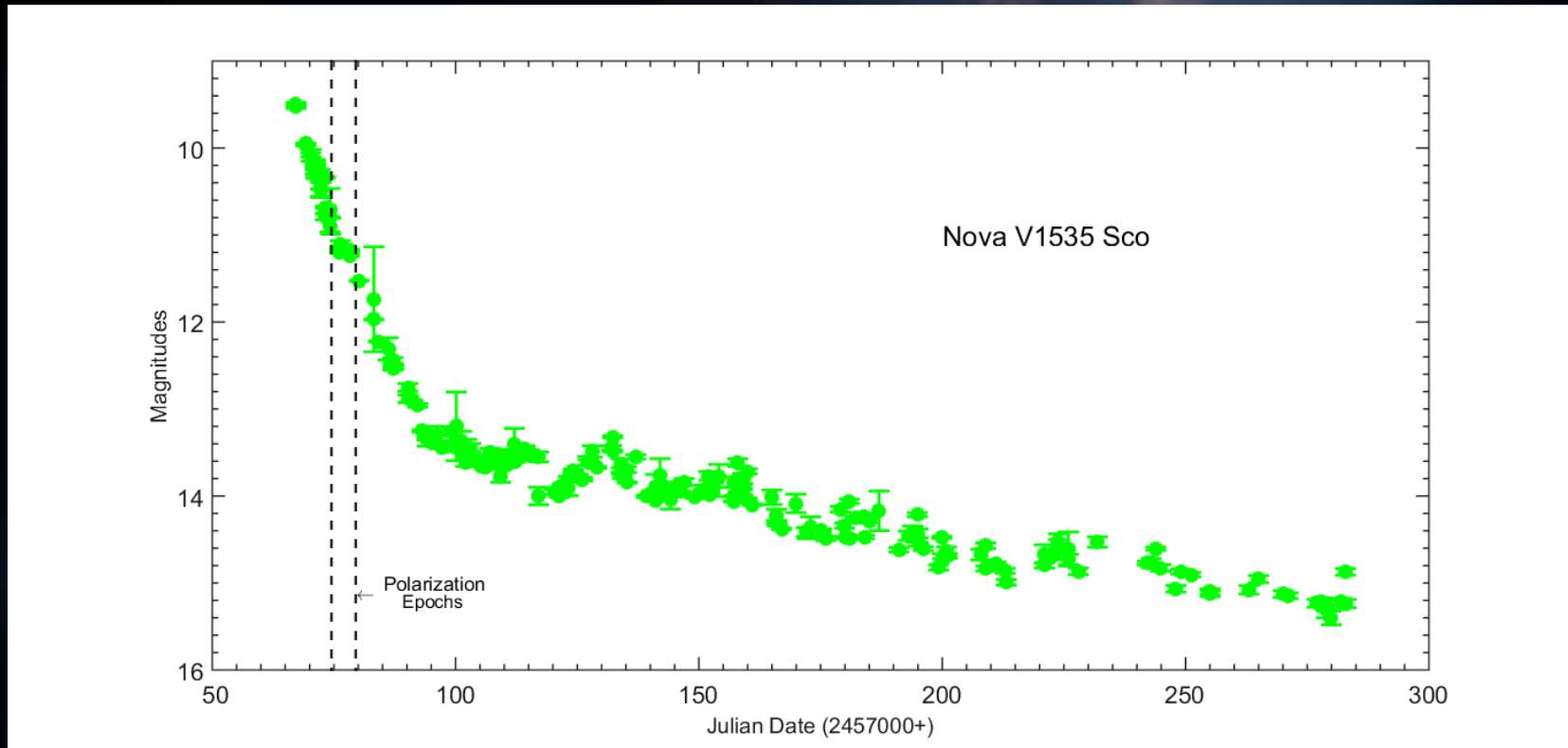
Nova V5668 - Position angle variation



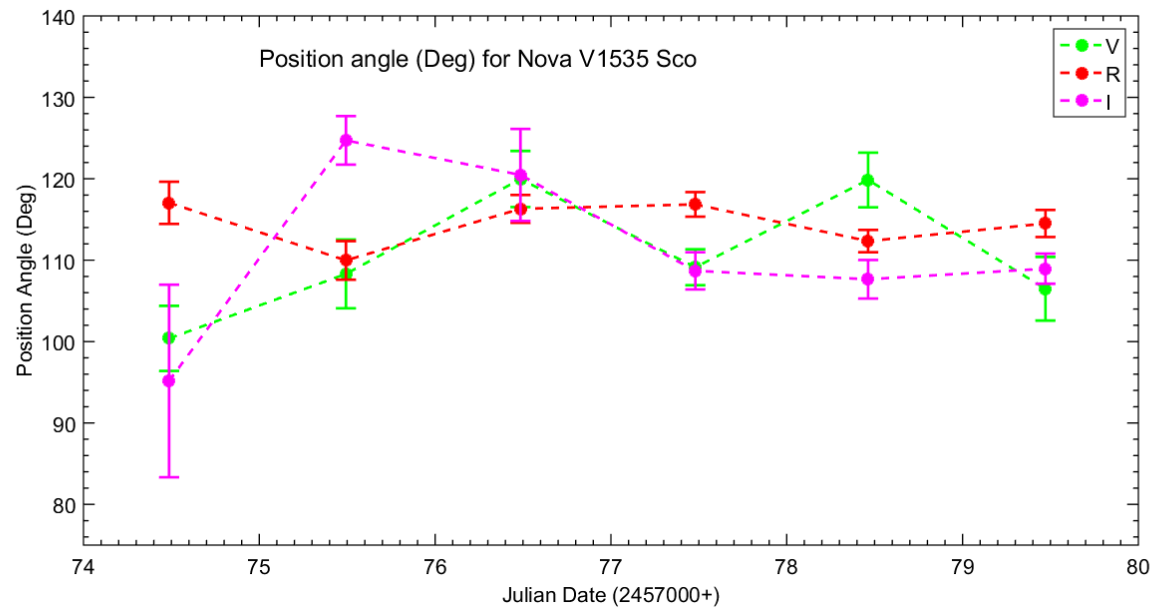
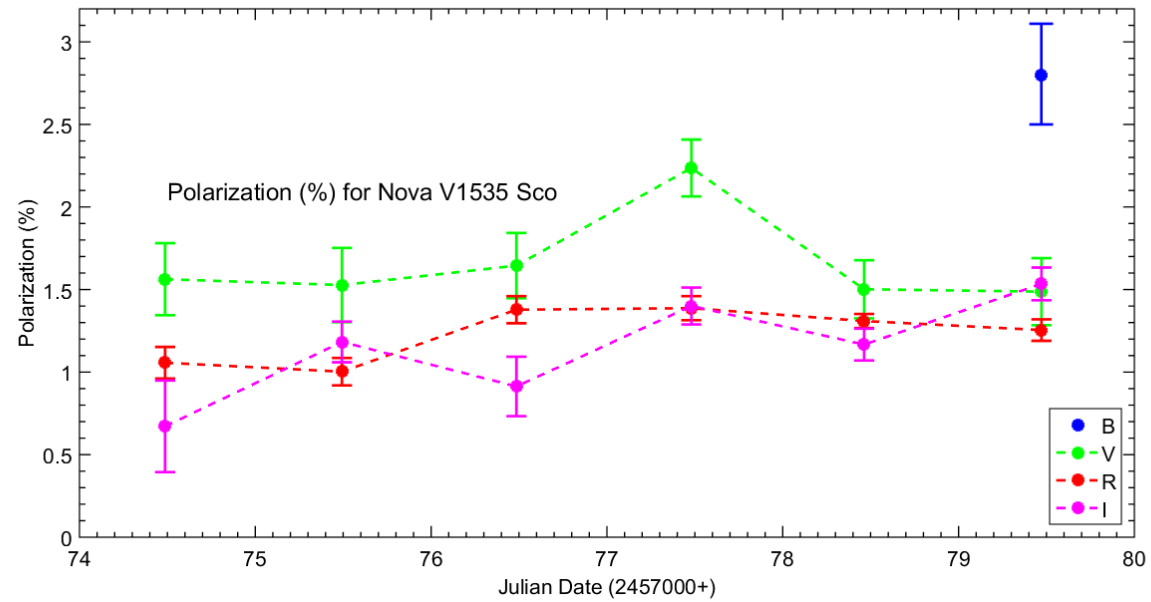
Interstellar polarization and intrinsic polarization for Nova V5668



Light curve and polarization epochs Nova V1535 Sco

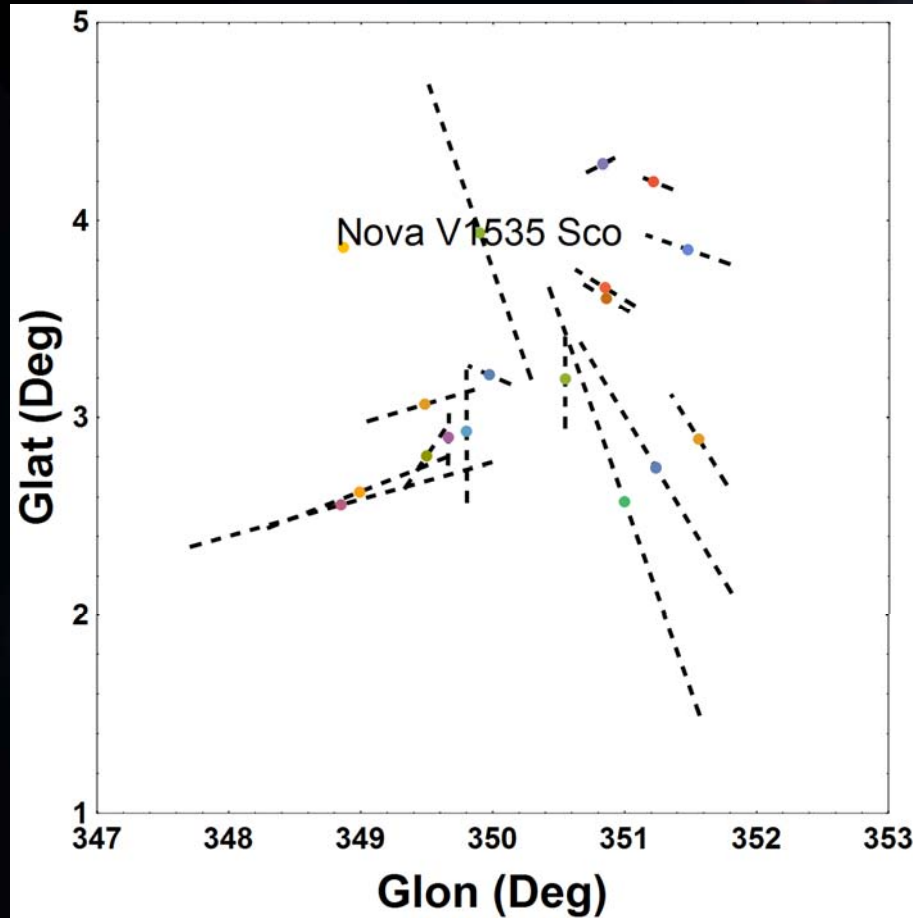


Variability in Polarization degree and Position angle



Polarization of nearby stars

Nova V1535 Sco



Star: HD155274

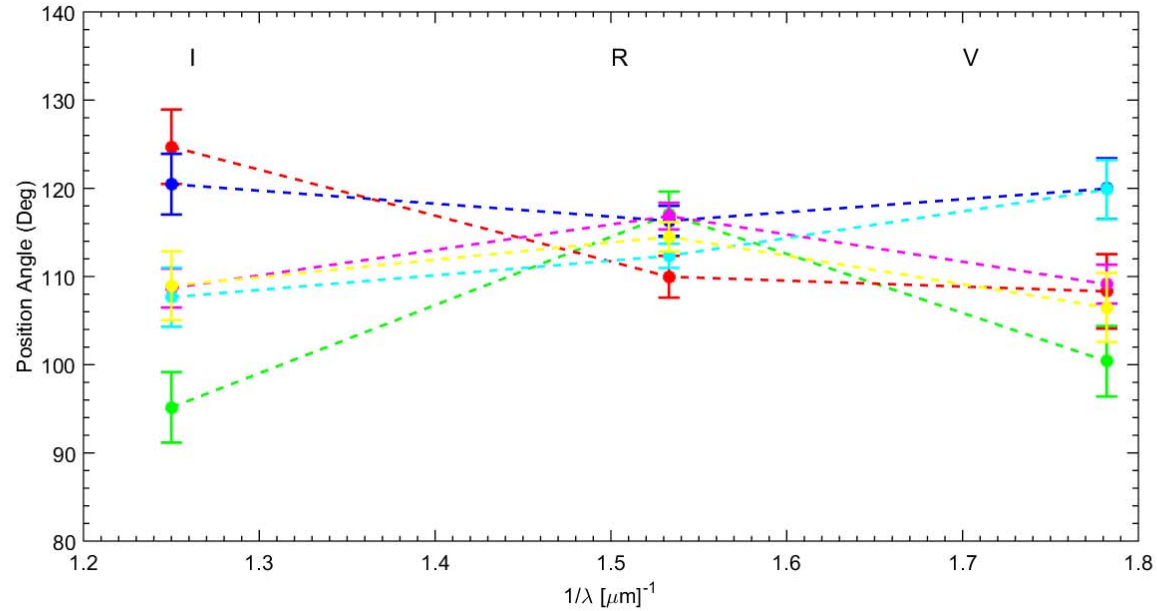
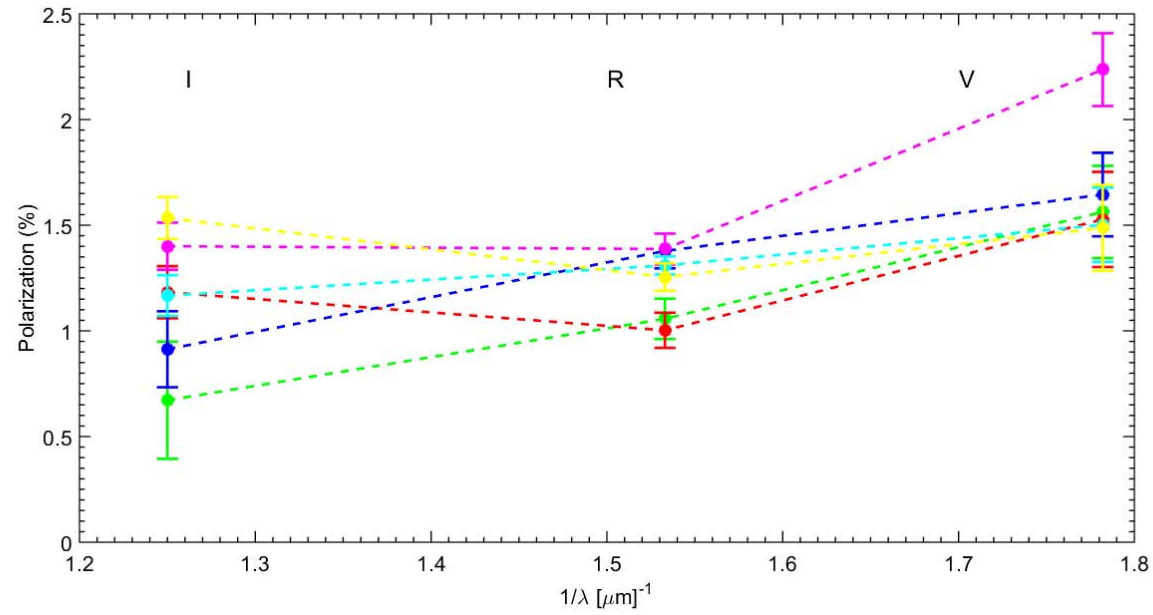
Glat: 350.9951

Glon: 2.5775

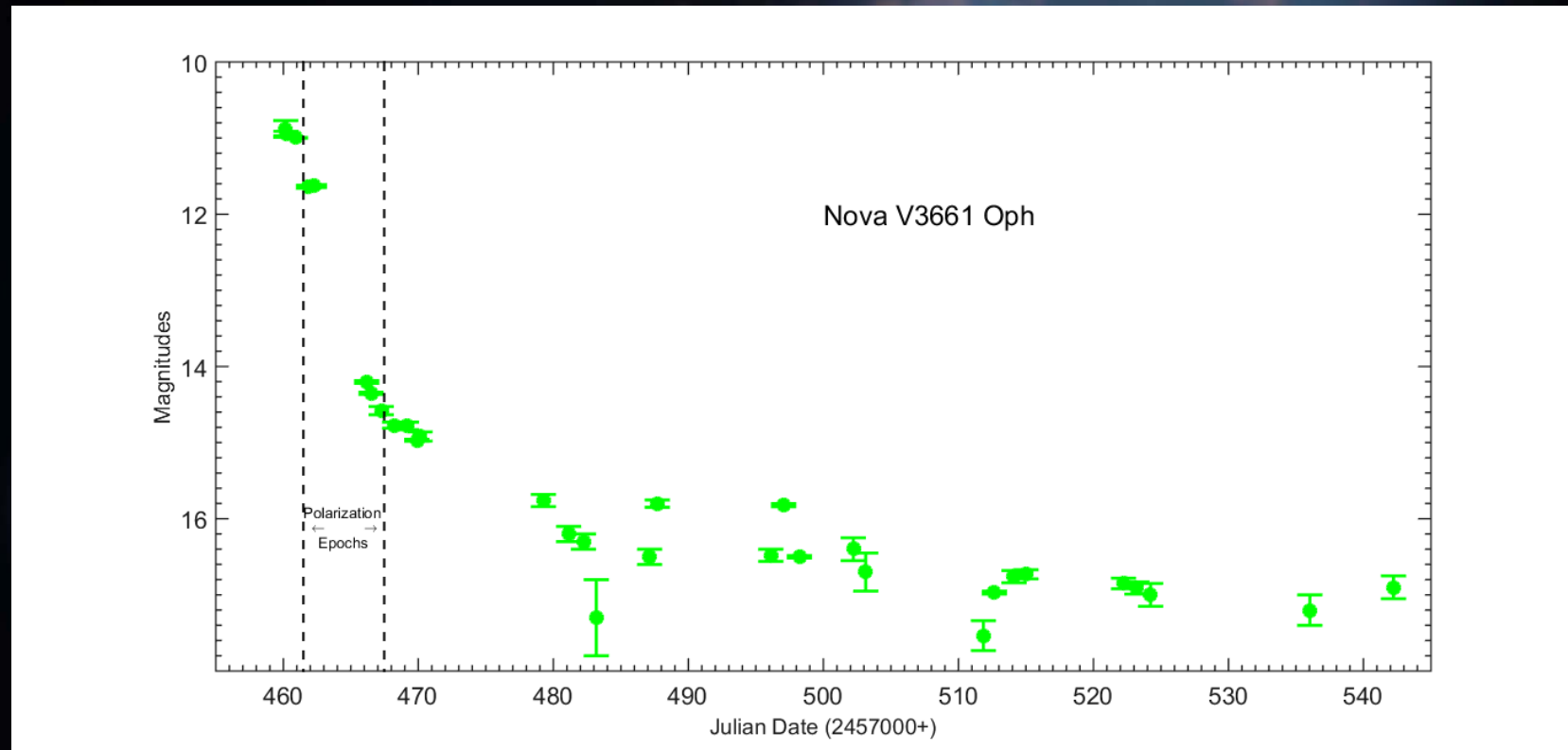
Distance: 722

Pol and error: 3.270 ± 0.1

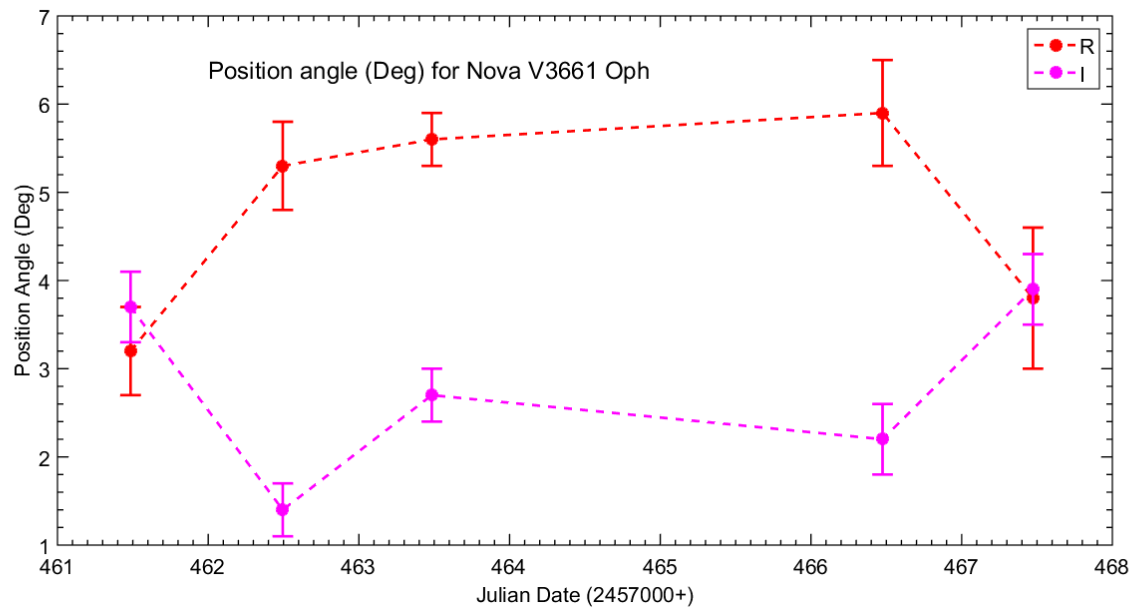
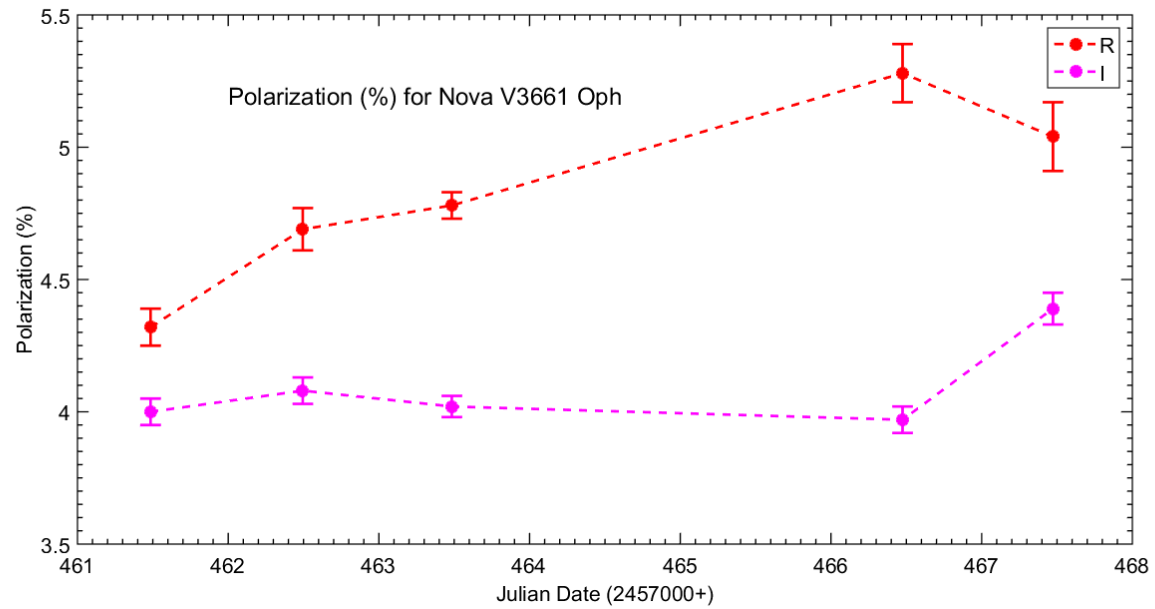
Pa and error: 109.4 ± 0.9



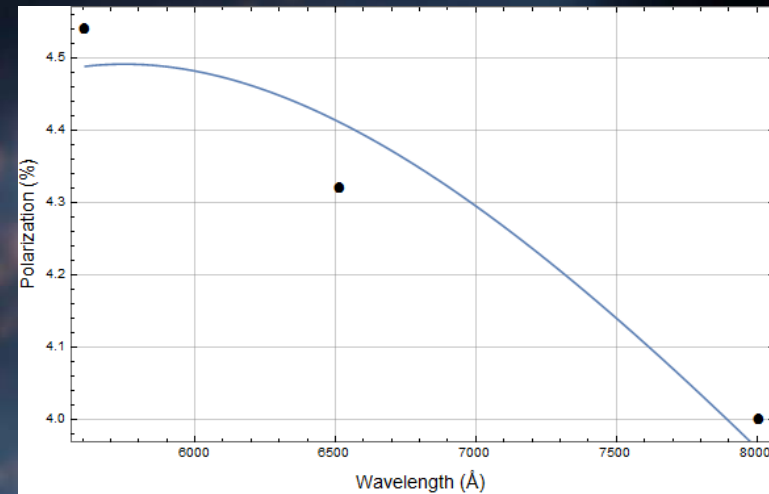
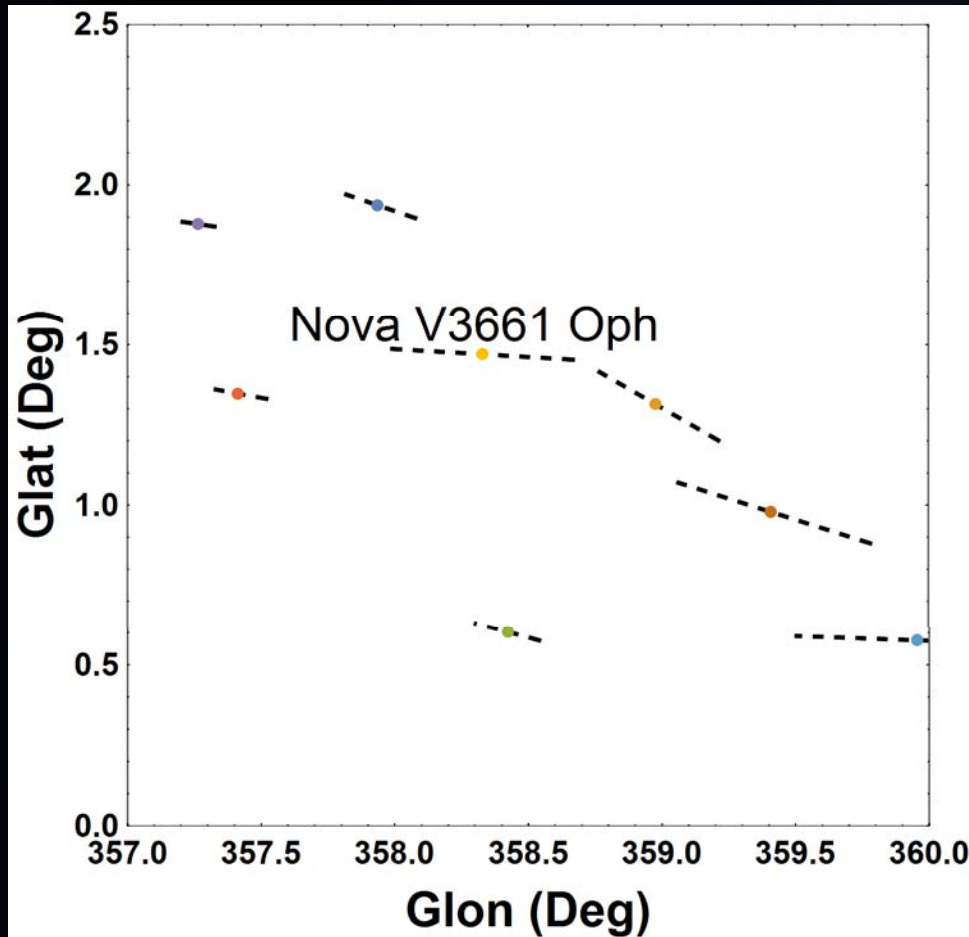
Light Curve and Polarization epochs Nova V3661 Oph



Variability in Polarization degree and Position angle



Polarization of nearby stars and Serkowski's law fit Nova V3661 Oph



$$p(\lambda) = p_{\max} \exp \left[-K \ln^2 \left(\frac{\lambda_{\max}}{\lambda} \right) \right]$$

The Serkowski's fit for JD 2457461 to determine interstellar component

The Galactic latitude and Longitude map showing the nearby stars.

Nova V3661 Oph

- The polarization values and the position angles do not show any temporal variations.
- The position angle observed for the nova is constant and consistent with the position angles of the nearby stars.
- The Serkowski's fit for one epoch for VRI filters (R-square=0.91) gives $P_{\max}(\%)=4.49\pm 0.091$ and $\lambda_{\max}=5748\pm 265\text{\AA}$.
- The Wilking law fit for the same epoch gives (R-square=0.75) $P_{\max}=4.50\pm 0.12$ and $\lambda_{\max}=6043\pm 292\text{\AA}$.

Conclusions and Discussions

➤ Nova V5668 Sgr

- ❑ Temporal variation during early phase
- ❑ PA is consistent with the observations by Eamonn Harvey (National University of Ireland) using DIPOL2 polarimeter.
- ❑ The multiple peaks in the light curve are attributed to strong dust production. (Ref. Gamma-ray Novae: Rare or Nearby by Paul J. Morris et al.)

➤ Nova V1535 Sco

- ❑ Small amount intrinsic component in V?
- ❑ The detection of high polarization values in B.

➤ Nova V3661 Oph

- ❑ Mostly interstellar!!!

Thank you 😊