

## A polarimetric investigation of Novae

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**Abstract.** This study investigates the polarization of Novae stars, focusing on the targets V1723 Sco and V572 Vel. Observations were conducted at the Observatório do Pico dos Dias using IAGPOL and SPARC4 polarimetric instruments. The main objective is to evaluate whether these Novae exhibit intrinsic polarization rather than polarization originating from the interstellar medium. Polarimetric measurements often reflect a combination of signals from both the source and the interstellar medium. Therefore, a crucial step in the analysis is to disentangle these contributions in order to confirm whether the observed polarization truly originates from the Nova itself. Such polarization can provide insights into the system, for example by revealing asymmetries in the geometry of the ejected material or by indicating whether the scattering within the ejecta is caused by dust or by electrons, as suggested by the spectral dependence of the polarization.

**Resumo.** Este trabalho visa investigar a polarização em estrelas do tipo Nova, com foco nos alvos V1723 Sco e V572 Vel. As observações foram realizadas no Observatório do Pico dos Dias utilizando dados polarimétricos obtidos com os instrumentos IAGPOL e SPARC4. O principal objetivo é avaliar se essas Novas exibem polarização intrínseca, e não polarização proveniente do meio interestelar. Medições polarimétricas frequentemente refletem uma combinação de contribuições tanto da fonte quanto do meio interestelar. Portanto, uma etapa crucial na análise é separar essas contribuições para confirmar se a polarização observada realmente se origina da própria Nova.

**Keywords.** novae, cataclysmic variables, Techniques: polarimetric

### 1. Introduction

Novae eruptions occur in close binary systems in which a white dwarf accretes material from a companion star, typically a main-sequence. The transferred material gradually accumulates on its surface, and when the compressed layer reaches the conditions for thermonuclear runaway, a violent explosion is triggered, producing the Nova outburst. (Hellier 2001).

Novae are generally classified as classical, with only one recorded eruption or recurrent, when multiple outbursts are observed with some degree of regularity. Recurrent Novae can be further divided into short or long recurrence time systems, depending on the timescale between eruptions (Anupama 2008). Both Novae studied in this work are classical: V572 Vel, discovered on June 25, 2025 (Seach et al. 2025) and V1723 Sco, which erupted on February 8, 2024 (CBAT 2025).

For Novae that have a non-null polarization, the subsequent step in analyzing polarimetric observations is to determine whether the detected polarization has an intrinsic origin, or whether it arises solely from the interstellar medium. Typically, the observed measurement contains two contributions: an intrinsic component from the source and another introduced as light propagates through interstellar dust. One approach to estimate the interstellar polarization in a given direction is to measure the polarization of several nearby field stars.

Once intrinsic polarization is established, the information can be used to investigate the physical characteristics of the Nova. Non-zero intrinsic polarization may, for example, reveal asymmetries in the geometry of the ejected material or indicate

whether the scattering within the ejecta is produced by dust or by electrons.

### 2. Nova Vel 2025 = V572 Vel

Nova V572 Vel was discovered on June 25, 2025, by John Seach (Grafton, NSW, Australia) at magnitude  $V=5.7$ , and independently by Andrew Pearce (Nedlands, Western Australia) at magnitude  $V=5.5$ . The object was identified as a cataclysmic variable system with an orbital period of 2.956 hours (Schaefer 2025), and spectroscopic follow-up observations promptly confirmed its classification as a classical Nova, showing prominent emission lines of  $H\alpha$ ,  $H\beta$ ,  $H\gamma$ , and Fe II (Shore et al. 2025). Early X-ray observations with Swift/XRT, obtained two days after the eruption, resulted in a non-detection—an outcome consistent with the initial optically thick shock phase commonly observed in Novae (Luna et al. 2024).

In this work, we present an analysis of linear polarization measurements of V572 Vel, obtained at two epochs with the goal of probing the geometry of the ejecta. The polarimetric data were collected on June 26 and July 21, 2025, using the IAGPOL (Magalhães et al. 1996) imaging polarimeter mounted on the 0.6-m Boller & Chivens telescope at the Observatório do Pico dos Dias (OPD), operated by the Laboratório Nacional de Astrofísica (LNA), Brazil.

Photometric monitoring in the  $I_C$  band revealed a magnitude of 4.5 on June 26 and 5.2 on July 21. This decline of approximately one magnitude over the course of a month characterizes V572 Vel as a relatively fast Nova, consistent with expectations of a more symmetric ejecta.

**TABLE 1.** Observed polarization of Nova V572 Vel.

26th June, 2025	Pol (%)	PA (deg)
Nova V572 Vel	$1.63 \pm 0.02$	131.9
Field Stars (86 objects)	$1.25 \pm 0.61$	132
2st July, 2025	Pol (%)	PA (deg)
Nova V572 Vel	$1.57 \pm 0.04$	132.5
Field Stars (75 objects)	$1.273 \pm 0.502$	133

**TABLE 2.** Observed polarization of Nova V1723 Sco.

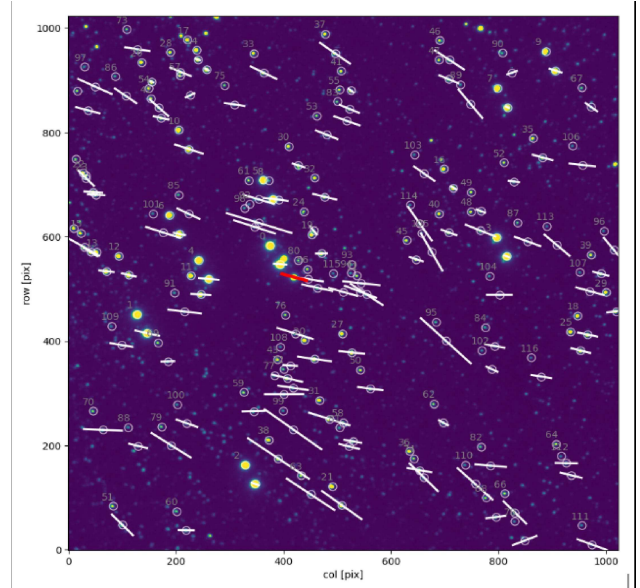
Filter	Pol (%)	PA (deg)
Nova V1723 Sco		
g	$3.02 \pm 0.09$	$71.07 \pm 0.85$
r	$3.05 \pm 0.04$	$73.48 \pm 0.35$
i	$2.84 \pm 0.05$	$74.49 \pm 0.53$
z	$2.52 \pm 0.04$	$71.39 \pm 0.49$
Field Stars (51 objects)		
g	2.12	69.52
r	2.16	73.92
i	2.18	67.77
z	2.39	59.21

Polarimetric measurements in the  $I_C$  band yielded a linear polarization of  $\sim 1.60 \pm 0.03\%$  at a position angle of  $\sim 132.2^\circ$  (Lima et al. 2025). To investigate whether this signal included an intrinsic component, we also measured the polarization of  $\sim 80$  nearby field stars within a FoV of  $11.3' \times 11.3'$ . Their mean polarization was  $\sim 1.25 \pm 0.61\%$  at a position angle  $\sim 133$ . The close agreement indicates that the observed polarization is probably interstellar in origin, with no strong evidence for intrinsic linear polarization arising from the Nova ejecta itself.

### 3. Nova Sco 2024 = V1723 Sco

V1723 Sco was discovered on 9 February 2024 by Andrew Pearce (Nedlands, Western Australia) and independently by Y. Sakurai (Mito, Japan), reaching a peak brightness of approximately magnitude 5.8 observed by T. Noguchi (Katori, Japan) (CBAT 2025). Shortly after the optical outburst, it was detected in gamma rays by Fermi-LAT (Cheung 2024), indicating the presence of strong shocks within the ejecta. In the following weeks, hard and heavily absorbed X-ray emission was observed (Cheung & Jean 2024), produced by shock-heated plasma as faster-moving material collided with slower ejecta. Approximately 118 days after the eruption, the Nova entered its supersoft X-ray phase (Luna et al. 2024), when ongoing nuclear burning on the white dwarf's surface became visible as the expanding shell thinned sufficiently.

Here we present preliminary results based on polarimetric observations of V1723 Sco obtained on 5 June 2024, 117 days after eruption, using the SPARC4 (Rodrigues et al. 2024) polarimeter mounted on the 1.6-m Perkin-Elmer telescope at OPD. From these data, we measured the linear polarization of the Nova and analyzed the polarization of nearby field stars, selecting those with the smallest uncertainties, totaling approximately 51 sources. Based on this comparison, we conclude that it is not possible to identify a clear intrinsic polarization component for the Nova, as both the degree and position angle of the polarization appear closely aligned with those of the field stars. This suggests that the observed polarization is likely dominated by an interstellar origin, plausibly produced by a foreground interstellar cloud, as becomes clearer in Figure 1.

**FIGURE 1.** Field stars polarization pseudo-vectors in band i, showing both the polarization degree and position angle. The red vector marks the polarization of Nova V1723 Sco.

*Acknowledgements.* Finep: Proc. 0/1/16/0076/00; MMC acknowledges funding from PCI-DB: Proc. 400077/2022-1. E.M. acknowledges funding from FAPEMIG under project number APQ-02493-22 and a research productivity grant number 309829/2022-4 awarded by the CNPq

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