Boletim da Sociedade Astronômica Brasileira, **37**, no. 1, 87-88

Determination of the Polarization of the Dark Cloud [DB2002b]G299.48+5.89

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Abstract. The dark cloud [DB2002b] G299.48+5.89, catalogued by Hartley (1986), has an angular diameter of 3 arcmin. Determining its distance is essential for converting observational quantities into physical parameters, such as mass, density, and size, and for assessing gravitational stability and star formation processes. Polarimetric analysis further provides key information on the magnetic field, which plays a fundamental role in star formation. In a previous work, using interstellar extinction and distance estimates from the *StarHorse2* catalog, it was an initial increase in extinction at (750 ± 25) pc was identified that is not associated with the cloud. A subsequent transition in color excess from $E(b-y) = 0.2$ to 0.4 mag indicates that the cloud is located at (950 ± 25) pc from the Sun. Polarimetric observations in the V and I bands support this result, showing a clear increase in polarization degree from $P \simeq (0.33 \pm 0.13)\%$ to (1.1–1.4)% and a rotation of the polarization angle from $\Theta \simeq 63°$ to 53°–60° at the same distance. The consistency between extinction and polarization transitions confirms the location of [DB2002b] G299.48+5.89 at (950 ± 25) pc.

Resumo. A nuvem escura [DB2002b] G299.48+5.89, catalogada por Hartley (1986), possui um diâmetro angular de 3 arcmin. A determinação de sua distância é essencial para a conversão de grandezas observacionais em parâmetros físicos, como massa, densidade e tamanho, além de permitir a avaliação da estabilidade gravitacional e dos processos de formação estelar. A análise polarimétrica fornece ainda informações fundamentais sobre o campo magnético, que desempenha um papel crucial na formação estelar. Em um trabalho anterior, utilizando estimativas de extinção interestelar e distâncias do catálogo *StarHorse2*, foi identificada uma elevação inicial da extinção em (750 ± 25) pc, não associada à nuvem. Uma transição posterior no excesso de cor, de $E(b-y) = 0.2$ para 0.4 mag, indica que a nuvem está localizada a (950 ± 25) pc do Sol. Observações polarimétricas nas bandas V e I corroboram esse resultado, mostrando um aumento no grau de polarização de $P \simeq (0.33 \pm 0.13)\%$ para (1.1–1.4)% e uma rotação do ângulo de polarização de $\Theta \simeq 63°$ para 53°–60° nessa mesma distância. A consistência entre as transições de extinção e polarização confirma a localização da nuvem [DB2002b] G299.48+5.89 em (950 ± 25) pc.

Keywords. Interstellar medium – Polarization – dust

1. Introduction

A dark cloud is defined as a region in interstellar space with a density ranging from 10 to 1000 particles/cm^3 and a temperature between 10K and 100K (Hartley et al. 1986). This work intends to continue the study of the dark cloud [DB2002b] G299.48+5.89 by (Saraiva et al. 2025), this cloud is located in (RA, DEC): (12h 23m 35s; -56° 31' 8") and has a diameter of 3 arcmin (Dutra & Bica 2002) as seen in figure 1. In previous research, the distance to DC299.5+05.9 was determined, by reddening, to be (950 ± 25) pc. With polarimetric observational data obtained at the Pico dos Dias Observatory (OPD/LNA), the distance is to be reanalysed. It is also aimed at studying the magnetic field and a possible interaction between this cloud and the Coalsack nebula.

2. Methodology

Polarimetric data were obtained from observations carried out at OPD/LNA using the Perkin-Elmer telescope equipped with the IAGPOL polarimetric module (Magalhães et al. 1986). The data reduction was performed using the *Solvepol* pipeline (Ramírez et al. 2017). Subsequently, these data were combined with the *StarHorse2* catalog (Anders et al. 2022), using the following parameters:

Additionally, the method of (Reis & Corradi 2008) was reused to reanalyse the starlight absorption, looking for abrupt changes indicated by transitions in the colour excess. With the polarimetric and reddening data in hand, it was possible to conduct a comprehensive study.

Table 1. Selection criteria and parameter definitions

Parameter	Description
FlagOut < 1	Quality flag threshold
Fidelity > 0.5	Minimum fidelity requirement
$\sigma < 0.5$	Maximum polarization uncertainty
$P/\sigma > 5$	Signal-to-noise ratio in polarization
$d < 3$ kpc	Distance limit
A_V (using A_{V50})	Stellar extinction
$E(b-y)$	Color excess
P	Degree of polarization (%)
θ	Polarization angle (degrees)
P/A_V	Polarization efficiency relative to extinction

3. Discussion

A rotation of the polarization angle is observed, showing a transition from (53 ± 4)° to (60 ± 2)°, along with a variation in the polarization degree from (1.10 ± 0.06)% to (1.40 ± 0.06)%. This behavior indicates the presence of a component distinct from the general magnetic field, with dust grains more efficiently aligned in the region where the cloud is located, as seen in.

The step-like features observed in the $E(b-y)$, P, and P/A_V diagrams indicate that the cloud is located at a distance of

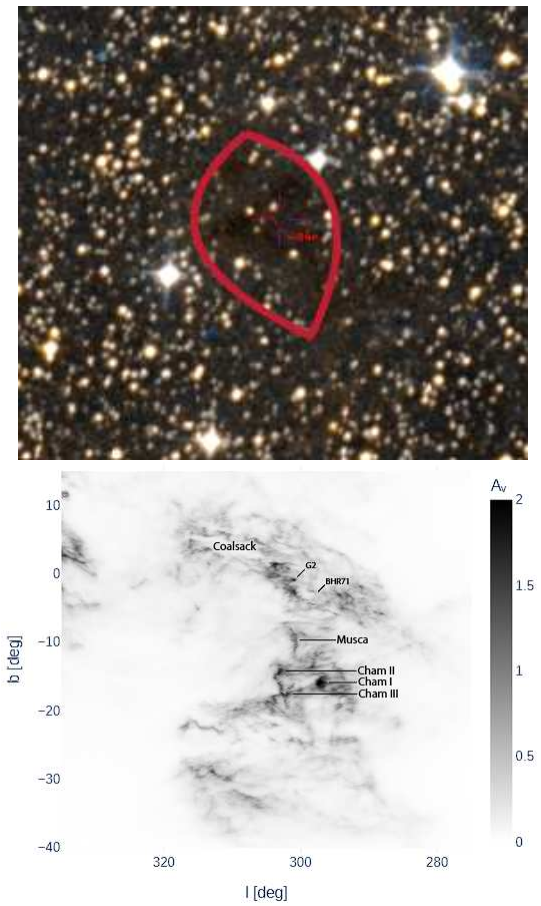

Figure 1. On the left, the image obtained from DSS2, centered on the region of the dark cloud; on the right, the "C", interaction of the clouds oalsack, Chamaleon and Musca.

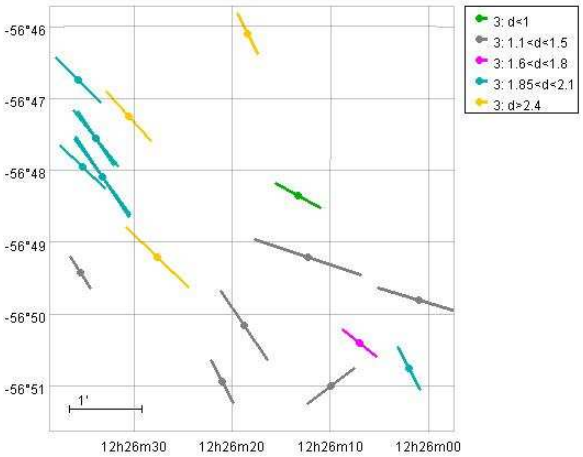

Figure 2. Sky plot of the observational data combined with the StarHorse2 catalog, overlaid on the region and color-coded by distance. Determination of the polarization of the Dark Cloud [DB2002b] G299.48+5.89.

(900 ± 60) pc. It can also be noted that the polarization measured outside the cloud's line of sight differs from that observed toward the cloud center. At a distance of (1.2 ± 0.1) kpc, all diagrams exhibit a transition in both polarization and extinction, a distance that is consistent with the Sagittarius–Carina spiral arm. From Fig. 3, it is possible to see that part of these stars lies along the cloud's line of sight. At (2.0 ± 0.1) kpc, a clear alignment

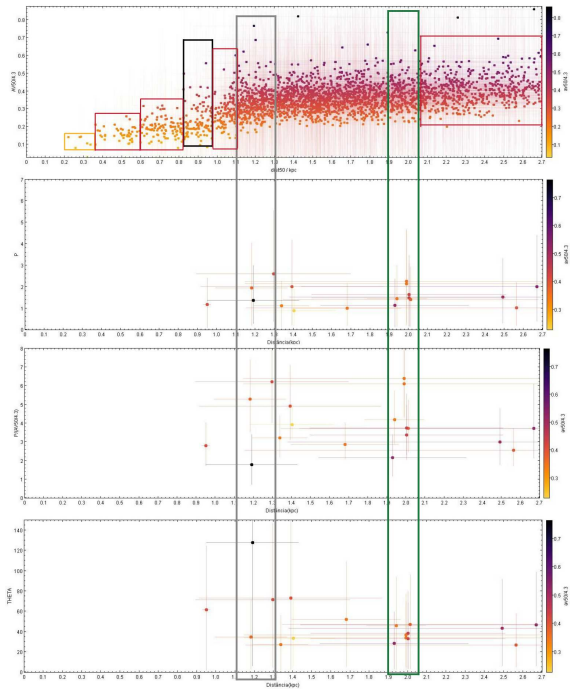

Figure 3. (1) Extinction as a function of distance; (2) polarization as a function of distance; (3) P/A_V as a function of distance; (4) polarization angle θ as a function of distance. Colored boxes indicate the main transitions, while secondary transitions are highlighted in red.

in both polarization and extinction become apparent, suggesting the presence of another structure associated with the Scutum–Centaurus spiral arm. The yellow box marks the distance limit of the "Great C" structure, located at distances shorter than 200 pc.

4. Conclusion

The results presented indicate that the cloud is located at a distance of (900 ± 60) pc. Two additional components were identified, which are most likely associated with spiral arms. The location and structural components of this cloud do not suggest a possible interaction with the "Great C" structure. Further observations will be required to achieve a more detailed characterization of the magnetic field and polarization properties of the dark cloud.

References

Anders, F. et al. 2022, A&A, 658, A91
Corradi, W. J. B. et al. 1997, A&A, 326, 1215
Corradi, W. J. B. et al. 2004, A&A, 347, 4
Crawford, D. L. & Mandewewala 1976, PASP, 88, 917
Dutra, C. & Bica, E. 2002, A&A, 383, 631
Edenhofer, G. et al. 2024, A&A, 687, 9
Egger, R. J. et al. 1995, A&A, 294, 25
Hartley, M. et al. 1986, A&AS, 63, 27
Nogueras-Lara, F. et al. 2021, A&A, 653, A33
O'Neill, T. J. et al. 2024, ApJ, 973, 136
Pelgrims, V. et al. 2020, A&A, 636, A17
Ramírez, E. A. et al. 2017, PASP, 129, 055001
Reis, W. & Corradi, W. J. B. 2008, A&A, 486, 471
Reis, W., Corradi, W. J. B., Avillez, M. A. & Santos, F. P. 2011, ApJ, 734, 8
Santos, F. P., Corradi, W. J. B. & Reis, W. 2011, ApJ, 728, 104
Saraiva et al. 2025, BSAB, 36, 54
Versteeg, M. J. F. et al. 2024, A&A, 167, 177