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Letter to the Editor

Linear polarimetric observations of SN 1987 A

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Summary

Multicolor UBVRI linear polarimetric observations of SN 1987a, obtained during the early hours of July 23, 1987, are reported. A foreground correction and a comparison with the intrinsic values of polarization on April, 1987, are performed. The linear polarization on July appears substantially different to that of April. A qualitative interpretation of the evolution of the intrinsic component is suggested.

Keywords: SN 1987a, polarization

1. Introduction

Optical linear polarimetry of SN 1987a, obtained about five months after its outburst is presented. The polarization measurements were carried out with the 2.15 m telescope of the Complejo Astronomico El Leoncito, located in San Juan, Argentina. The detector used was the Vatican Research Group Photopolarimeter (VATPOL), which is described by Magalhaes (1983). Standard filters U, B, V, R and I of Cousins (Cousins 1976) system were used. The instrumental polarization was determined by measuring non polarized nearby stars, selected from the Catalogue of Nearby Stars (Gliese 1969) and finally, the observations were reduced to the standard equatorial system by using highly polarized stars from the list of Serkowski et al. (1975). It was found unnecessary to correct for depolarization. The observational error was monitored in real time during the observation, and data gathering was interrupted when the desired error level (0.03% in the polarization) was attained. The integration times were: 200 seconds for U filter, 180 seconds for B, 100 seconds for V, R and I filters. The observational results are shown in Table 1.

2. Foreground Correction

The observed polarization is the result of the superposition of an intrinsic polarization (IP) of SN 1987a and the interstellar contribution due to the effect of the alligned dust grains. The latter contribution has to be removed if the IP is to be analysed. We have used the interstellar polarization proposed by Méndez et al. (1988), which follows Serkowski's (1975) law

$$P(\lambda) = Pmax \exp(-(\lambda/\lambda max)^2)$$

with characteristics parameters Pmax = 0.50, $\lambda max = 0.55\mu$, and K =1.15. The position angle in the equatorial system is 40 degrees. When this polarization is substracted from the observed one, the besults presented in Table 2 and Figure 1 are obtained. It should be noted that the adopted interstellar polarization contribution is different to that used by Barret (1987a) and Schwarz and Mundt (1987).

3. Discussion

Méndez et al. (1988) have extensively discussed the broadband linear polarimetric behaviour of SN 1987a, up to April 29, by using their own observations plus some others published elsewhere (Cropper and Bailey, 1987; Barret, 1987a, 1987b; Schwarz, 1987). They found useful to separate the IP in two temporal components. The first component, dominated the polarization of the supernova during the first 30 days approximately, showed wavelength independence and a decreasing trend with time. No rotation was observable between the plane of polarization at different colours. On the other hand, the second component, which appeared approximately 30 days after the explosion at a different position angle, was not wavelength independent and its trend was increasing with time. Additionally, its values were larger in the I and R filters than in the V filter, while it was almost inexistent in the B an U filters. There was a clear rotation of the plane of polarization between the V and B bands and a slight sistematic rotation between the U and I ones. The observations of April 1987, in Fig. 1, show this picture. The polarization in the filters U and B is representative of the first component, while that of the filters V, R, and I, is representative of the second one.

Those general characteristics have changed since then. On July 23, 1987, the polarization of SN 1987a is decreasing with the wavelength. The second component of the IP appears in the U and B filters, while it is

Table 1. Observed polarization

	Q(%)	U(%)	P(%)	P.A.
U	0.61 ± .11	−0.16 ± .11	0.63 ± .11	35.1
B	0.77 ± .04	−0.29 ± .04	0.82 ± .04	31.9
V	0.51 ± .04	0.09 ± .04	0.52 ± .04	47.2
R	0.32 ± .04	0.37 ± .04	0.48 ± .04	66.8
I	0.14 ± .04	0.49 ± .04	0.51 ± .04	79.2

Table 2. Intrinsic polarization

	Q(%)	U(%)	P(%)	P.A.
U	0.51 ± .11	−0.55 ± .11	0.75 ± .11	157
B	0.76 ± .04	−0.74 ± .04	1.06 ± .04	158
V	0.50 ± .04	−0.41 ± .04	0.65 ± .04	161
R	0.31 ± .04	−0.14 ± .04	0.34 ± .04	168
I	0.13 ± .04	0.04 ± .04	0.14 ± .04	189

relatively less important in the R and I ones. There is no rotation between the V and B bands, and the trend of the position angles with the wavelength is the opposite.

Combining the results of this letter and those of Méndez et al. (1988), it can be suggested that the IP of SN 1987a was produced in an aspherical scattering dominated atmosphere during the first ~ 30 days. After this time, the effect of the absorption, or perhaps some other polarizing mechanism, became to be important. Consequently, the wavelength dependence and the position angle of the IP were changed.

Due to the puzzling changes that the polarization of SN 1987a is still showing, its periodic monitoring is strongly recommended in order to increase the data base on polarimetric properties of supernovae.

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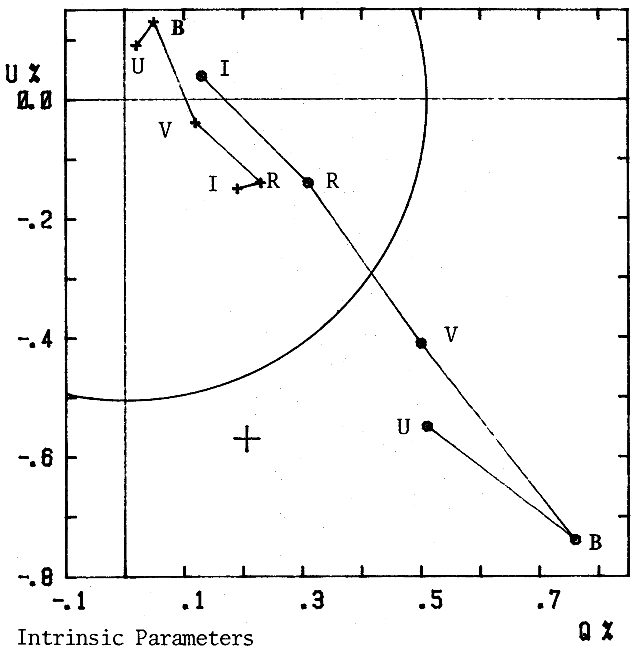

Fig. 1. Comparison between the intrinsic polarization of SN 1987a on April, 1987 (+), and July, 1987 (o). The April values are weighted means of 10 observations made between April 2 and April 11. The letters close to the symbols indicate the colour band of the observation. A representative error bar, and the p=0.5 % circle are shown.

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