



Wave-length Dependence *in Position Angle* of Interstellar Polarization

--- Application of Two-component
Model to HBS Observations ---

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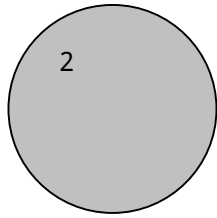
2002.09.25 OAOUM



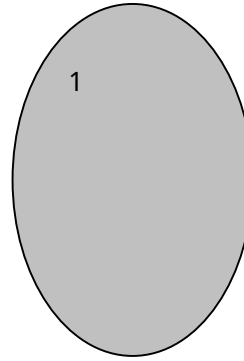
Definitions



觀測者



$$(p_{\max,2}, \lambda_{\max,2}, \theta_2)$$



$$(p_{\max,1}, \lambda_{\max,1}, \theta_1)$$





Stokes Parameters & Derived Relations

$$q_{obs} = q_1 + q_2 \qquad u_{obs} = u_1 + u_2$$

$$\tan 2(\theta_{obs} - \theta_1) = r \sin 2\phi / (1 + r \cos 2\phi)$$


$$v_{obs} = (e_2 / P_2) P_{obs}^2 G$$

where

$$r = P_2 / P_1$$

$$\phi = \theta_2 - \theta_1$$

e_i = phase shift in component # i



$$G = -r \sin 2\phi / (1 + r^2 + 2r \cos 2\phi)$$

Geometry dependent factor

$$d\theta / d\lambda = -0.5 G d \ln r / d\lambda$$

$$\lambda_{\max,2} / \lambda_{\max,1} = \exp[-(d\theta / d \ln \lambda) / K G]$$

$$P(\lambda) = P_{\max} \exp[-K \ln^2 (\lambda_{\max} / \lambda)]$$



H B S Observations @OAO/DAO

**Three among seven stars observed
are chosen for further analysis:**

HD	SP	E(B-V)	d(kpc)	l	b	V_{mag}
22253	B0.5	0.61	0.74	144	+1	6.79
24431	O9 -	0.68	0.77	149	-1	6.73
2 OriA	O9.5	0.19	0.54	186	-6	5.17

**(Sakurai, Akitaya, Hirakata, Kawabata, Nakayama,
Matsumura, Hamasaka, Hirata, & Seki 2001)**

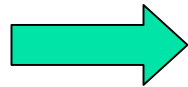


Results

HD22253

	P max(%)	max(μ)	($^{\circ}$)
obs	1.80 ± 0.10	0.50 ± 0.03	120 ± 2
■ comp# 1	2.68 ± 0.15	0.65 ± 0.01	117
■ comp# 2	1.15 ± 0.16	0.90 ± 0.01	201.9 ± 0.8

sq= 1.080



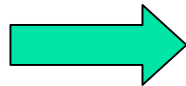
- $=84.9 (^{\circ})$ $d / d = 6.0 (\text{deg} / \mu)$
- $\text{max},2 / \text{max},1 = 1.38$



HD24431

	P max(%)	max(μ)	($^{\circ}$)
obs	2.15 ± 0.10	0.50 ± 0.03	116 ± 1
■ comp# 1	3.23 ± 0.33	0.63 ± 0.02	113
■ comp# 2	1.30 ± 0.34	0.82 ± 0.02	198.3 ± 1.3

sq= 1.077

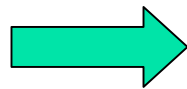


- =85.3 ($^{\circ}$) d /d =4.8 (deg/ μ)
- max,2/ max,1 = 1.30

Theta 2 Ori A

	P max(%)	max(μ)	($^{\circ}$)
obs	1.03 ± 0.05	0.76 ± 0.02	100 ± 4
■ comp# 1	0.36 ± 0.02	0.42 ± 0.01	57.6 ± 5.1
■ comp# 2	1.07 ± 0.05	0.77 ± 0.02	110

sq= 0.925



- =52.4 ($^{\circ}$) d /d =25 (deg/ μ)
- max,2/ max,1 = 1.83




Geometry Factor G

- G , a measure of the amount of change in the IS Magnetic Field direction, can be estimated with $\frac{d \ln B}{d \ln r}$ and $\frac{d \ln B}{d \ln l}$:

$$\text{HD22253: } G = -0.159$$

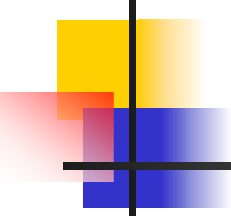
$$\text{HD24431: } G = -0.156$$

$$\text{Theta 2 Ori A: } G = -0.358$$

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- Martin and Campbell(76) determined G values for 62 stars from observations of **circular** polarization.

(Stokes parameter $v=V/I$ in Slide#3),
and derived for

- HD22253 $G = -0.73 \pm 0.18$
HD24431 $+0.45 \pm 0.18 @ 0.37 \mu$.

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- The difference in G from ours might be due to the strong dependence on wavelength.
 - They also found a statistical tendency that

$$G \sim -0.5$$

for stars within a few hundred parsecs.

For [theta 2 Ori A](#), the G factor derived from our model is well [consistent](#) with Martin's.




Depolarization Factor, D

- The ratio r ($=P_2/P_1$) is calculated by using derived values for G and β as follows:

$$r = 0.37 \quad (\text{HD22253})$$

$$0.36 \quad (\text{HD24431})$$

$$2.86 \quad (\text{Theta2 Ori A})$$

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- $D = P(\phi) / P(0)$ is calculated with known values for r and ϕ by the formula

$$D = \sqrt{(1 + r^2 + 2r \cos 2\phi)} / (1 + r)$$



Future Works

- The effect due to the intrinsic polarization:
Monitoring of temporal variation
- More samples.
- Calculation of V/I () with P_i () and P_c () and derivation of G with it:
Critical for examination of the difference in G_s found in the present study and for investigation of **IS/CS circular** polarization.