CP-STARS IN THE NEAR INFRARED : NORMAL !

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ABSTRACT. 17 CP-stars have been measured in the IR filter bands J,H,K,L and M. No significant differences between CP- and normal main sequence stars can be found. Flux exzesses at 4.8 microns are not confirmed.

1. Introduction

Besides their function as cornerstones of the method of integrated fluxes (BLACKWELL & SHALLIS, 1979) to evaluate simultaneously effective temperature and apparent angular diameter of stars, IR-fluxes from stellar objects are the most convincing indicators for the presence of circumstellar material.
In 1983 GROOTE & KAUFMANN (hereafter referenced as 'GK') summarized their IR-measurements, obtained during three observing runs at the ESO 1m photometric telescope. From a sample of 105 CP-stars 60% showed excessive radiation in the M-band at 4.8 microns, exceeding the exspected flux from a KURUCZ model, found by the integrated flux method, by more than 20%. They proposed a model in which CP-stars are surrounded by dust disks with temperature of 300 to 650 K (GROOTE & KAUFMANN 1984).
Surely this picture would throw new light on the CP puzzle, but soon the GK results were doubted. BONSACK & DYCK (1983, 'BD' hereafter) compared IR-fluxes from CP stars with those of normal main sequence stars and could neither find any significant differences between both groups, nor evidences for excess flux at 4.8 microns. This survey was done with a 2.2m telescope at Mauna Kea, hence from the northern hemisphere. Therefore only a few stars are in common in both works, but in these cases magnitude differences of more than half a magnitude occured.
In this situation it seemed worthwile to try a decissive answer to this controversary by new comparative measurements.

2. Observations and Reduction

During our observing run from Nov. 8.-16., 1984 at the ESO 1m telescope CATALANO observed 17 CP-stars with an InSb detector in the five IR-filter bands J,H,K,L and M. Central wavelengths and widths of the filters are tabulated in Tab. 1. 16 of the stars can be found also in the GK compilation, whereas 7 are in common

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with the BD survey.
The reduction was done in a straight forward manner, daily extinction values and zeropoints were obtained using

$$m_{inst} = m_{obs} - Ext. * Airm. + ZP$$

and a suitable set of standard stars. We selected 17 standards from the compilation of KOORNEEF (1983a, 1983b) that span approximately the same range in colors and magnitudes as our program stars.

Filter	λ	Δλ
J	1.24	0.32
H	1.63	0.28
K	2.19	0.39
L	3.79	0.68
M	4.64	0.63

Tab. 1 : Actual filter values; central wavelengths and widths as reported by ESO.

The transformation from instrumental to standard magnitudes may need a correction of the form

$$m_{st} = m_{inst} + corr(B-V, UT, m_{obs}, ...)$$

We checked such possible drift effects by plotting the differences between instrumental and standard star magnitudes versus J-L color, universal time and apparent brightness. Surprisingly we found a distinctive correlation with the brightness, which can be understood as a nonlinearity of the detector. The deviations could be satisfactorially fitted by a straight line that reversed its slope during most nights with increasing wavelengths, e.g. from J to M-Filter, as seen in Fig. 1. Because the corrections are in the order of tenths of a magnitude, hence fairly large, we recalculated extinction values (Ext'.) and zeropoints (ZP') with the corrections to the observed magnitudes of the form

$$m_{obs}' = m_{obs} + corr * m_{obs}$$

applied. After that no correlation of the deviation between standard and instrumental system could be found in respect to color, time or brightness that exceeded the errors of observations. Therefore the finally adopted equation for the transformation to the standard system is

$$m_{st} = m_{obs}' - Ext'. * Airm. + ZP'$$

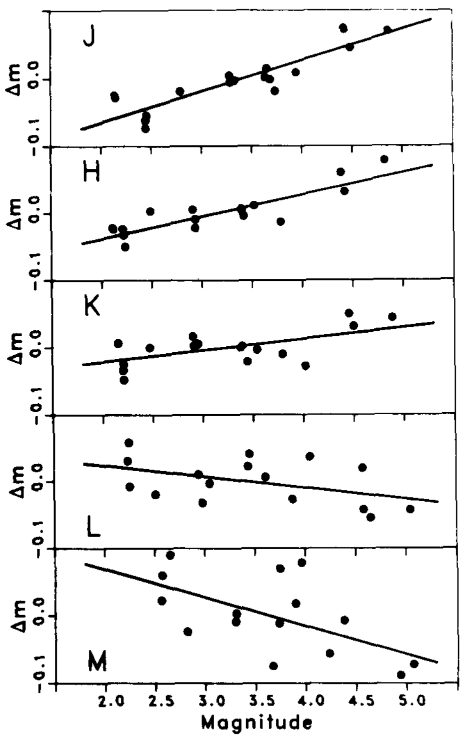

Fig. 1: Magnitude drift effect, difference of standard and instrumental magnitude versus apparent magnitude on Nov.8.,1984

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3. Results

Tab. 2 shows the M-magnitudes of the program stars with the differences to the work of GK and BD, respectively. Positive sign indicates that our measurements imply fainter magnitude.

HD	M	GK	BD	n
3980	5.75	+.53		3
12447	3.80	+.03		4
22470	5.69	+.38	+.08	28
24712	5.37	+.29		6
25267	5.09	+.22	-.11	3
28843	6.30	+.56	-.05	12
37017	7.28	+.89	+.18	3
49333	6.70	+.52		3
54118	5.33			3
72968	5.75	+.34	-.28	9
74196	6.23	+.60		3
203006	4.72	.00	-.31	2
206088	3.08	+.04		2
220825	5.01	+.46		6
221006	6.15	+.58		6
221760	4.50	+.12		2
223640	5.68	+.24	+.01	4

Tab. 2 : M-Magnitude and differences to GK and BD surveys. Positive sign means our value is fainter. Last column gives number of measurements

	GK	BD
J	-.04	-.06
H	+.01	-.05
K	-.01	-.06
L	.00	(-.14)
M	+.36	-.07

Tab. 3 : Mean magnitude differences between this work and GK and BD surveys, respectively.

Tab. 3 shows the mean differences in all filters between this work and the two other author pairs. The agreement with GK is excellent in the J,H,K and L filters, whereas in the M-band a large discrepancy occurs. If we plot the M-band differences versus the apparent magnitude (in J-band), as done in Fig. 2, a strong correlation is seen in the sense that the differences get larger with decreasing brightness. We conclude that the GK work is affected by systematic errors. A reasonable explanation would be that they have been trapped by magnitude drift effects as discussed above, since they used primarily bright standard stars.

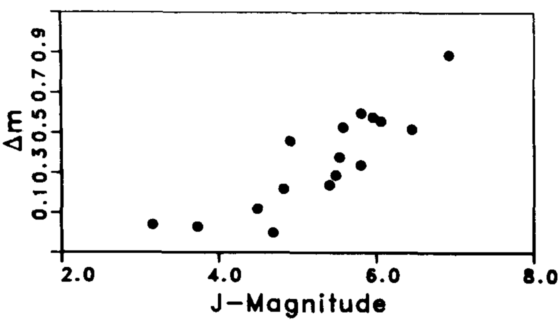

Fig. 2 : M-Magnitude differences between this work and GK versus apparent magnitude in J-band

Between our and the BD measurements there seems to exist a small zeropoint difference, since in all filters we measure notoriously about .06 magnitudes brighter than they do. The larger difference in the L-band is due to the fact that BD calibrated their filter in the L' standard system, shifted 0.2 microns redwards to the standard L-filter.

To answer the question if

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there is still some of the claimed flux excess left, we apply the same procedure as done in the 1984 paper of GK. A double logarithmic plot of flux versus wavelength produces a straight line in the Rayleigh-Jeans approximation. For the flux calibration we used the values of KOORNEEF (1983b). Fig. 3 shows for each star straight lines computed with the first four filter values. All M-fluxes lay slightly below this line, thus the question now emerges as: are the CP-stars flux deficient in this range ? They are not. If we apply the same procedure to the standard stars, we also find flux deficiencies in the M-band of about 10% for stars of J-L color around zero. The reason for that behaviour are deviations from the Rayleigh Jeans approximation.

Now no more significant differences remain between CP- and normal stars.

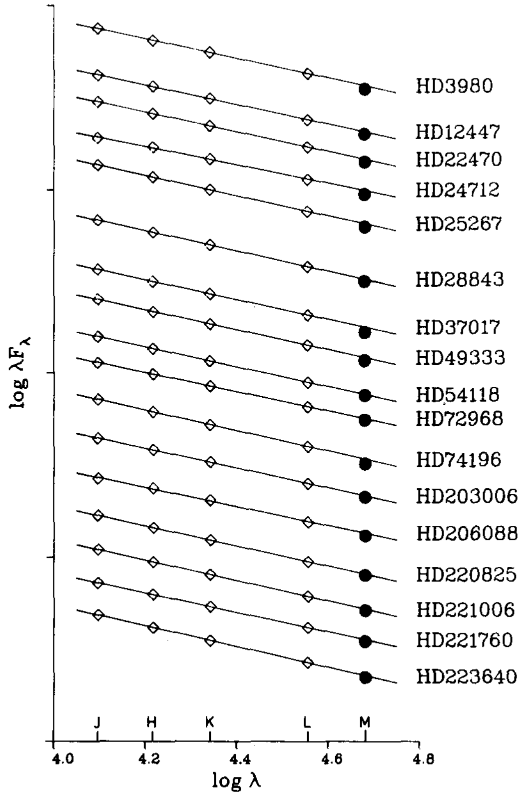

Fig. 3 : Exzess diagnostic diagram. M-values above line would indicate flux excess. For further explanation see text.

4. Conclusions

We have shown that IR fluxes from CP-stars in the range of one to five microns are not significantly different from those of normal stars. Therefore from such measurements we have no evidence for circumstellar matter around CPs, shining up at such wavelengths. HAVNES & GOERTZ (1984) have shown that a stellar magnetosphere, filled by mass loss from the central star could not account for the amount of IR-radiation needed to explain the GK results. We agree with their conclusion, that in order to detect circumstellar matter around CP-stars by the means of IR astronomy, observations at wavelengths longer than 5 microns are needed.

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