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On the incidence of chemically peculiar stars in the Large Magellanic cloud

E. Paunzen,[1] O.I. Pintado,[2⋆] H.M. Maitzen[1] and A. Claret[3]
[1] *Institut für Astronomie, Universität Wien, Türkenschanzstraße 17, A-1180 Wien, Austria (Ernst.Paunzen@univie.ac.at)*
[2] *Departamento de Física, Facultad de Ciencias Exactas y Tecnología, Universidad Nacional de Tucumán, Argentina*
Consejo Nacional de Investigaciones Científicas y Técnicas de la República Argentina
[3] *Instituto de Astrofísica de Andalucía CSIC, Apartado 3004, 18080 Granada, Spain*

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ABSTRACT
With the aim to corroborate the result of a search for chemically peculiar stars in the Large Magellanic Cloud (LMC) we present measurements obtained from CCD-imaging of two fields, one containing a young open cluster (NGC 1711). While for the latter field, including its surrounding we obtain a contribution of three percent of chemically peculiar stars detectable by Δa photometry (i.e. the magnetic objects of this group), the second field yields about half of this value in good accordance with the finding for NGC 1866 (Maitzen et al. 2001) the surrounding field of which has been found to exhibit a very low value of such stars - 0.3%. Thus we are faced with the fact, that our incipient impression about a substantially lower appearance of magnetic chemically peculiar stars in the LMC as compared to the Galaxy continues to be valid. Most of the photometrically identified peculiar stars (from their historical origin denominated Ap-stars) are located in the domain of the B-type stars. But this is a selection effect due to the limiting magnitude of our observing conditions impeding the observation of fainter main sequence stars. In addition to objects showing up as positive deviators in Δa photometry we also discuss nine stars which appear opposite the main line of normal stars, hence are negative deviators. For most of them the interpretation as emission stars of B-type seems to be appropriate. The statistically relevant number of observations obtained so far in the LMC supports the view that the formation of magnetic peculiar stars has occurred there at a significantly lower rate.

Key words: stars: chemically peculiar — stars: statistics — Magellanic clouds — techniques: photometric

1 INTRODUCTION

Since our pioneer work in which we have reported about the detection of the first extragalactical chemically peculiar (CP) stars (Maitzen, Paunzen & Pintado 2001), a huge effort was spent in order to make follow up observations in the Large Magellanic Cloud (LMC hereafter). Such measurements are rather time consuming when using a narrow band photometric system such as the three filter Δa CCD system, but much more efficient than spectroscopic observations.

We have focussed our efforts on the incidence of chemically peculiar stars in the LMC using the Δa photometric system (Maitzen 1976). It measures the characteristic broad band absorption feature located around 5200Å first described by Kodaira (1969). This flux depression is most certainly a consequence of the non-solar elemental abundance of CP and related objects in the presence of a strong stellar magnetic field (Kupka et al. 2004). The Δa photometric system measures the flux depression at 5200Å by sampling the depth of it, comparing the flux at the center (5205Å, g_2), with the adjacent regions (5030Å, g_1 and 5510Å, y) using bandwidths from 110Å to 220Å. The respective index a was introduced as

$$a = g_2 - (g_1 + y)/2$$

Since this quantity is slightly dependent on temperature (increasing towards lower temperatures), the intrinsic peculiarity index Δa had to be defined as the difference between the individual a-values and those of non-peculiar stars of the same colour. The locus of the a_0-values has been called normality line

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Table 1. Observing log

	Date	$\#_N$	$\#_{g1}$	$\#_{g2}$	$\#_y$
Field 1	23.11.1998	25	–	20	5
	21.08.2001	28	20	–	8
	22.08.2001	4	4	–	–
Field 2	05.01.2003	11	11	–	–
	06.01.2003	24	4	14	6
	07.01.2003	10	–	–	10

Table 2. Characteristics of the used filters.

Filter	λ_C [Å]	Bandwidth [Å]	Transmission [%]
g_1	5027	222	66
g_2	5205	107	50
y	5509	120	54

Virtually all peculiar objects with magnetic fields (CP2 and CP4 stars) have positive Δa values up to +146 mmag (El'Kin, Kudryavtsev, & Romanyuk 2002). Only extreme cases of the CP1 and CP3 group exhibit marginally peculiar positive Δa values (+20 mmag) whereas Be/Ae/shell and metal-weak (e.g. λ Bootis group) stars exhibit significant negative ones (up to −35 mmag). The index $(g_1 - y)$ shows an excellent correlation with $(b - y)$ and can be used as indicator for the effective temperature (Kupka, Paunzen, & Maitzen 2003).

There are several important issues which can be answered from the observational side by establishing the incidence of chemically peculiar stars in the LMC. Most important is the question if there is an influence of metallicity on the (non-)presence of peculiarities since metallicity seems to distinctly influence the star formation scenario in the sense that the formation of larger clusters is only possible in low metallicity media. It seems worthwhile to investigate whether the formation of magnetic peculiar and (non-magnetic) λ Bootis stars occurs in the same proportion to "normal" stars for all degrees of metallicity. Furthermore, one should ask whether different general magnetic field strengths in the surrounding area of star formation will lead to the same frequency of magnetic stars. While one could try to find a relationship concerning metallicity also in our own Galactic disc, the Magellanic Clouds offer a scenario with distinctly lower metallicity and lower magnetic field strength. In order to explain CP stars stellar models are needed which take into account different metallicities, ages and magnetic field strengths.

In this paper we present Δa photometry for two representative fields in the LMC. One field samples the LMC field population in the bulge whereas the other one is centered on NGC 1711, a young globular cluster. In total, 1426 stars have been observed from which 22 show significant positive whereas 9 exhibit negative Δa values. We derive the percentage of apparent chemically peculiar stars and compare it with the numbers found for NGC 1866 and its surrounding as well as the Milky Way.

2 TARGET SELECTION, OBSERVATION AND REDUCTION PROCESS

The first field is located in the bulge of the LMC on its eastern edge (Cioni, Habing & Israel 2000) centered at $\alpha = 04{:}45{:}20$ and $\delta = -69{:}12{:}00$ (2000.0). There are no prominent clusters or HII regions within this field in order to ensure that only the field population of the LMC is observed. The second field is centered on NGC 1711, a well studied young globular cluster serving as a comparison to the published Δa photometry of NGC 1866 and its surrounding (Maitzen et al. 2001).

NGC 1711: The only recent detailed investigation, to our knowledge, of this cluster was done by Dirsch et al. (2000) who derived the following parameters within the Strömgren photometric system: $\log t = 7.70(5)$, $[Fe/H] = -0.57(17)$ dex. However, these data are not available for the community (Sect. 3). Therefore, we are not able to testify their results. Kubiak (1990) lists an age of $\log t = 7.3$ on the basis of solar abundant isochrones and Johnson BVI photometry. Mateo (1988), on the other hand, derived an age between $\log t = 7.3$ and 7.7, respectively.

Field population: it consists of a main sequence similar to that of NGC 1711 and an older population with a vertical extension of the red clump. Such a characteristics was observed in several areas of the LMC (Dolphin 2000). It seems that stellar evolution was rather uniform throughout the LMC until 200 Myr ago. Since then, a significant increase can be inferred from observational data. The different populations are also seen in Fig. 1 especially for the surrounding of NGC 1711.

The photometric observations within the Δa system were performed at the Complejo Astronómico el Leoncito (CASLEO) using the 2.15m telescope (observer: O.I. Pintado). The focal reducer yields a scaling of $0.813''$ pixel^{-1} and a field of view of about $9.5'$ using a TEK-1024 CCD.

The observations were performed in the years 1998, 2001 and 2003. The detailed log is listed in Table 1. We have checked the behaviour of the detector and the intrinsic transformations of all data and found no significant trends or deviations from one year to the other. The results for the open clusters in the Milky Way which were observed during the same runs, have already been published by Paunzen, Pintado & Maitzen (2002b, 2003). This includes NGC 3114, a well studied open cluster with published photoelectric Δa values which was used as a further test of our photometric system yielding high coincidence of both methods.

The integration times were chosen between one to ten minutes in order to measure the whole magnitude range within the linear region of the CCD. In total, 102 frames in all filters for the two fields in the LMC were obtained. The used filters are listed in Table 2. They have been working horses during the last ten years.

The basic reductions (bias-subtraction, dark-correction, flat-fielding) were carried out within standard IRAF V2.12 routines. A point-spread-function-fitting procedure within the IRAF task DAOPHOT was performed, typically more than 30 individual, single stars were used to derive the PSF for each frame. Because of instrumentally induced offsets and different airmasses between the single frames, photometric reduction of each frame was performed separately and the measurements were then averaged and weighted by their individual photometric error. This is justified because the "standard" as well as program stars are on the same frame.

The table of all program stars with their photometric quantities and corresponding errors are only available at SIMBAD or from the first author upon request.

3 CALIBRATION

For both fields we have used the results of the extensive $UBVR$ CCD survey conducted by Massey (2002) to calibrate and check our data. He presented accurate measurements for approximately 250000 objects brighter than 18^{th} magnitude in the Small and Large Magellanic Cloud. Although there are several other sources of photometric data available (e.g. Holtzman et al. 1997), only data of Massey (2002) were included in our analysis in order to guarantee a sample free of bias on the basis of one widely accepted photometric standard system.

We have also tried to obtain the Strömgren $uvby\beta$ photometry from Dirsch et al. (2000) published for NGC 1711 (and five other clusters in the LMC). But it is neither available in electronic form nor upon request from the authors.

For the calibration of our y and $(g_1 - y)$ to standard Johnson V as well as $(B - V)$ values, we have chosen all stars in common with Massey (2002). This procedure gives a sample of 372 objects. A linear least square fit resulted in:

$$V = -2.67(9) + 0.88(2) \cdot y$$

$$(B - V) = 1.24(6) + 1.44(8) \cdot (g_1 - y)$$

In parenthesis are the errors in the final digits of the corresponding quantity.

Throughout this paper we use a distance modulus of 18.5 for the LMC taken from Alves (2004) who reviewed and summarized all relevant measurements as well as their methods.

For the estimation of the reddening towards the observed fields, the maps of Oestreicher, Gochermann & Schmidt-Kaler (1995) were taken. Both fields are located in areas with $0.05 < E(B-V) < 0.12$ mag. This is in line with the results for NGC 1711 by Dirsch et al. (2000) who derived $E(B-V) = 0.09(5)$ mag on the basis of Strömgren $uvby$ photometry. We have therefore adopted $E(B-V) = 0.1$ mag for both fields. Our fields are not covered by the extensive survey of Subramaniam (2005) who presented $E(V-I)$ values for 1123 locations in the LMC on the basis of the Optical Gravitational Lensing Experiment II.

We have checked the adopted reddening value and distance modulus by applying appropriate isochrones (Claret, Paunzen & Maitzen 2003, Claret 2005) to the photometric measurements. Our results for NGC 1711 are in good agreement with those from Kubiak (1990) and Dirsch et al. (2000).

For the normality lines, the $(g_1 - y)$ measurements were converted into $(B - V)$ values and dereddened. For Field 1 and 2 the following correlations were found, respectively:

$$a_0 = 0.716(1) + 0.162(1) \cdot (B - V)_0$$

$$a_0 = 0.733(1) + 0.181(1) \cdot (B - V)_0$$

Table 3. Statistics of observed stars in the spectral range up to F2 divided into Field 1 (centered at $\alpha = 04{:}45{:}20$ and $\delta = -69{:}12{:}0$; 2000.0), NGC 1711 and Field 2 (surrounding field population of NGC 1711). N_{all} is the total number of measured objects within the spectral range up to F2 or $(B-V)_0 = 0.3$ mag, N_+ and N_- are the numbers with significant positive as well as negative Δa values (Fig. 1, Table 4). The lower panel summarizes the results from Maitzen et al. (2001) who investigated the spectral range from B8 to F2.

Name	N_{all}	N_+	N_-	N_1	N_2	N_3
NGC 1711	109	3	5	–	2.8	4.6
Field 1	331	4	2	0.9	1.2	0.6
Field 2	622	15	2	0.6	2.4	0.3
NGC 1866	261	4	3	1.5	–	1.1
Field	1239	4	–	0.3	–	–

N_1: $100 \cdot \frac{N_+}{N_{all}}$ (B8 to F2), N_2: $100 \cdot \frac{N_+}{N_{all}}$
N_3: $100 \cdot \frac{N_-}{N_{all}}$

The results are shown graphically in Fig. 1. The 3σ limit for both fields is at ± 0.012 mag. The non-members in Field 1 are objects which are much too blue in respect to the main sequence. We can only speculate about their nature since no independent $(B-V)$ values are available in the literature. The most probable explanation is emission in the g_1 filter which would yield such a blue color index. Some of these object might also be very distant galaxies.

4 ANALYSIS

A summary of the results from the CCD Δa photometric measurements in the LMC is given in Table 3. In total, 2562 objects of which 30 exhibit significant positive whereas 12 have negative Δa values (Table 4). The latter are either Be/shell or metal-weak objects and have, in general, no strong magnetic fields.

The only paper about the number of apparent magnetic CP stars in the LMC was published by Maitzen et al. (2001) who found an overall percentage of CP stars for NGC 1866 ($\log t = 8.0$, [Fe/H] $= -0.43(18)$ dex; Hilker, Richtler & Gieren 1995) of 1.5% whereas the incidence within the LMC field was decisively less (0.3%). They have investigated a spectral range from B8 to F2 or $-0.1 < (B-V)_0 < 0.3$ mag using the same observational technique and instrument as in this work. We have included their results in Table 3.

It has to be emphasized that Kupka et al. (2003) showed on the basis of a synthetic Δa photometric system that only a shift of the normality line by about -3 mmag assuming an average metallicity of $[Fe/H] = -0.5$ dex relative to those in the solar neighborhood occurs. The absolute Δa values for CP stars are not affected.

Objects with significant negative Δa values: this group consists of either classical emission line or metal-weak objects (like λ Bootis stars). In total, nine of such objects were detected. Without any further photometric or spectroscopic data, no clear decision about the true nature can be drawn. However, it is not surprising to find a rather significant amount of these objects in NGC 1711 since it is a very young

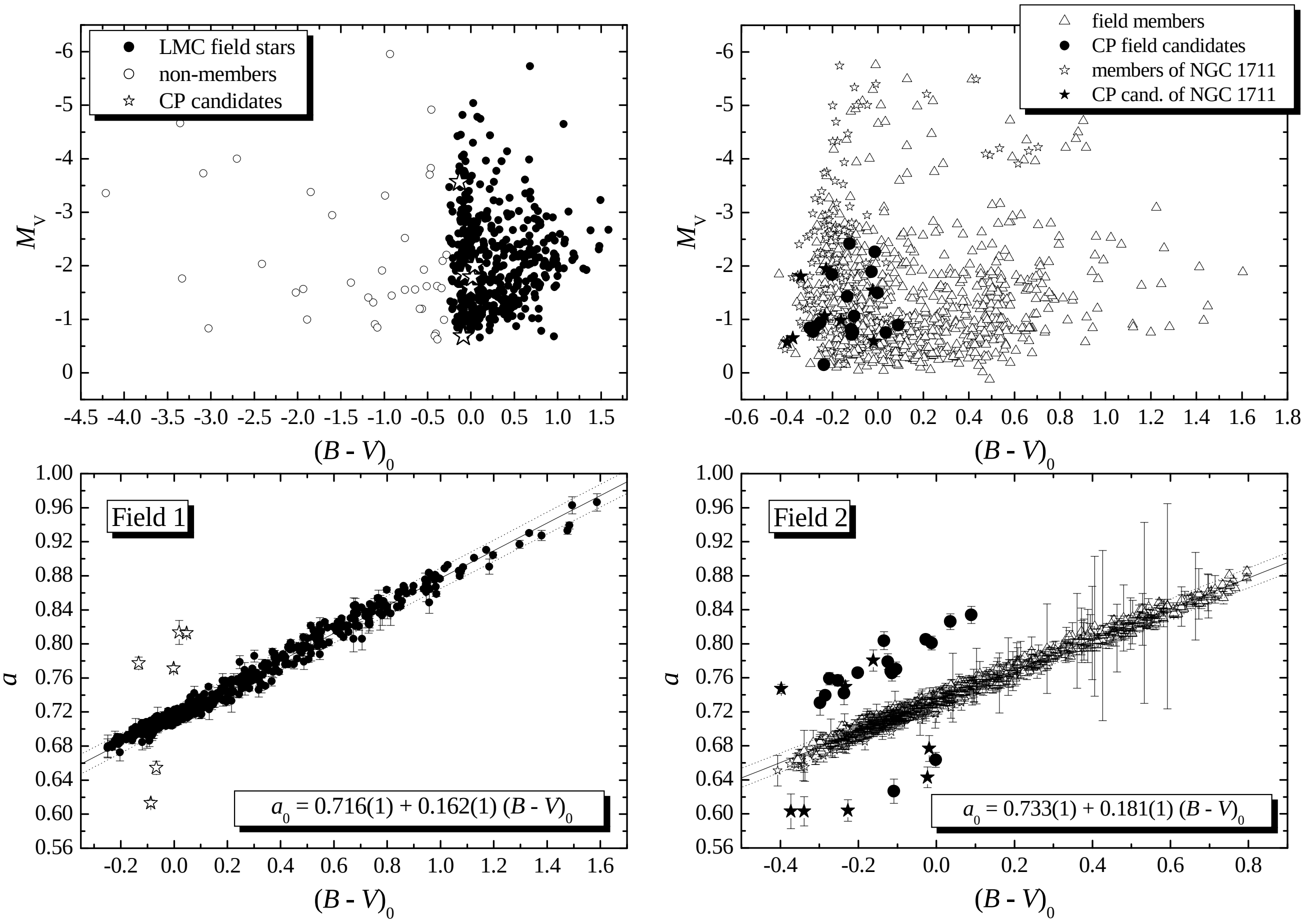

Figure 1. Observed diagrams for our two program fields in the LMC. The solid line is the normality line whereas the dotted lines are the confidence intervals corresponding to 99.9%. The error bars for each individual object are the mean errors. The measurement errors of M_V are much smaller than the symbols and have been omitted. The scales for the upper and lower diagrams are different because the relevant range for peculiar objects in the a versus $(B-V)_0$ diagrams seemed worthwhile to be shown. The M_V and $(B-V)_0$values were calculated using a distance modulus of 18.5 and a reddening $E(B-V) = 0.1$ mag.

cluster still connected with stellar activity and emission of all kinds. Metal-weak main sequence stars in the relevant spectral range (the so-called λ Bootis group) are very scarce (compared to metal-strong objects) in the field population of the solar neighborhood (only a maximum of 2% of all stars) and almost absent in open clusters older than $\log t = 7.30$ in our Milky Way (Gray & Corbally 2002). This might be caused by accretion from a diffuse interstellar cloud together with diffusion as most probable mechanism for the λ Bootis phenomenon (Kamp & Paunzen 2002). This scenario works at any stage of stellar evolution as soon as the star passes a diffuse interstellar cloud. Its dust grains are blown away by the stellar radiation pressure, while the depleted cloud gas is accreted onto the star. This would naturally generate an abundance pattern as found for the λ Bootis group, namely surface underabundances of most Fe-peak elements and solar abundances of lighter elements (Carbon, Nitrogen, Oxygen, and Sulphur). Since denser clouds within clusters dissipate on time scales of about 50 Myr, no λ Bootis stars are expected in older associations which make their appearance in clusters of the LMC rather unlikely.

The incidence of Be/Ae/shell as well as metal-weak stars in the LMC: these are the only groups which exhibit significant negative Δa values. The Be/shell population in the LMC is well studied (Keller, Wood & Bessell 1999). They found a fraction of main sequence stars that are Be objects between 0.1 and 0.34 (mean value of the Milky Way is about 0.17) varying for six very young clusters and their field population in the LMC. No correlation of the incidence with the age or metallicity was detected. Gray & Corbally (2002) concluded that the frequency of λ Bootis stars in the Galactic field among main sequence A to F objects is about 2% (no investigation for the LMC is available up to now). The age distribution of both groups are rather different. Whereas Be/Ae/shell stars are preferably found at young ages with $\log t < 7.5$, the members of the λ Bootis group in the Milky Way are evolved with a peak at $\log t = 9.0$ (Paunzen et al. 2002a). The detection capability of the Δa photometric system for a 3σ limit of 0.012 mag is at 50% as well as 10% for the λ Bootis and Be/shell group, respectively (Paunzen, Stütz & Maitzen 2005). This means that 10% of the complete Be/Ae/shell as well as 50% of the λ Bootis population can still be detected with a high statistical significance at a limit of 0.012 mag. If we take the maximum percentage of the relevant group members from Keller et al. (1999) and Gray & Corbally (2002), an upper frequency of 4.4% of objects with negative Δa values (3.4% Be/Ae/shell as well as 1% λ Bootis) among all main sequence B to F type stars should occur in the LMC for the derived detection limit of 0.012 mag. The number of such objects in NGC 1711 is 4.6% and significantly less in the other fields. The presence of these stars is, in general, depending on denser interstellar clouds (λ Bootis group) as well as stellar activity which is closely correlated with the age. However, it showes that Δa photometry, taking into account a certain detection limit, is able to find essentially the same frequency of Be/Ae/shell and metal-weak stars as other photometric as well as spectroscopic surveys.

Objects with significant positive Δa values: the detected 22 objects are most certainly magnetic CP (CP2 and/or CP4) stars. The main characteristics of the classical CP2 stars are: peculiar and often variable line strengths, quadrature of line variability with radial velocity changes, photometric variability with the same periodicity and coincidence of extrema in the presence of slow rotation. Overabundances of several orders of magnitude compared to the Sun were derived for heavy elements such as Silicon, Chromium, Strontium and Europium (Bagnulo et al. 2002). CP2 stars are found over the spectral range from early B to early F. The CP4 stars comprise helium weak B type objects. As the CP2 group, they have strong magnetic fields, elemental surface inhomogeneities together with photometric variations. Several objects also show emission in the optical spectral range and signs of mass loss (Wahlgren & Hubrig 2004). The peculiar objects found here should be a mixture of both groups. Only for the two objects cooler than A0, $(B-V)_0 = 0$ mag, i.e. we can assume a membership to the CP2 group.

The incidence of magnetic CP stars in the Milky Way: two aspects have to be taken into account when comparing the number of CP stars in the Milky Way and the LMC. First of all, the metallicities in the solar neighborhood and the galactic open clusters are significantly higher than in the young associations in the LMC which hardly reach −0.5 dex. The second issue is about the evolutionary effect on the incidence of magnetic CP stars. The Hipparcos data suggest that the CP group behave just like apparently normal stars in the same range of spectral types occupying the whole width of the main sequence with kinematic characteristics typical of thin disk stars younger than about 1 Gyr (Gómez et al. 1998). This finding was supported by Pöhnl, Maitzen & Paunzen (2003) who investigated four young open clusters (ages between 10 an 140 Myr) with known CP2 members establishing the occurrence of such objects at very early stages of the stellar evolution. However, Hubrig, North & Mathys (2000) challenged these results and claim that the distribution of the magnetic CP stars of masses below 3 $M_\odot$ in the Hertzsprung-Russell-diagram differs from that of the normal stars in the same temperature range at a high level of significance, magnetic stars being concentrated toward the center of the main sequence band. In particular, they argue that magnetic fields are detected only in stars which have already completed at least approximately 30% of their main sequence life time. This somewhat discrepant result might be understood by the detectability of resolved Zeeman patterns which requires a specifically slow rotation. This gives preference to finding such objects in advanced phases on the main sequence band where rotational velocities have been decreased by the growth of stellar radii.

Table 4. Peculiar objects found during our survey in the LMC. The zero point for Field 1 is star No. 22207 (Massey 2002; $\alpha = 04{:}54{:}49.84$, $\delta = -69{:}11{:}26.4$, 2000.0) as well as No. 7391 ($\alpha = 04{:}50{:}17.20$, $\delta = -69{:}57{:}57.3$, 2000.0) for Field 2 (including NGC 1711), respectively.

No.	X [Pixel]	Y [Pixel]	$(B-V)_0$ [mag]	Δa [mag]	V [mag]
Field 1					
35	−52.2	−54.0	+0.019(9)	+0.094	17.024(1)
40	−47.8	+107.9	−0.087(4)	−0.089	18.125(5)
118	+20.8	+220.3	−0.067(7)	−0.050	16.973(9)
250	+148.6	+359.1	−0.133(8)	+0.083	15.241(9)
278	+175.5	−6.5	−0.001(3)	+0.055	17.227(3)
483	+327.9	−78.5	+0.047(3)	+0.089	16.807(3)
Field 2					
105	−307.4	+206.3	−0.284(3)	+0.058	18.041(2)
107	−305.0	−96.5	−0.109(8)	−0.086	18.052(8)
117	−300.7	+212.6	−0.125(5)	+0.069	16.397(5)
186	−269.2	+264.8	−0.298(8)	+0.052	17.970(3)
196	−265.8	+189.3	−0.012(4)	+0.071	16.551(5)
199	−265.2	+199.7	−0.274(4)	+0.076	17.947(4)
202	−263.8	+257.8	−0.201(2)	+0.070	16.972(2)
232	−249.8	+262.7	−0.252(3)	+0.070	17.875(3)
668	−102.5	+229.6	+0.036(5)	+0.087	18.060(5)
708	−89.8	+139.8	−0.103(4)	+0.056	17.750(4)
789	−56.2	+330.5	−0.237(7)	+0.052	18.661(3)
825	−43.5	+289.3	−0.114(5)	+0.054	18.096(5)
911	+10.1	+230.0	−0.117(3)	+0.056	17.995(3)
936	+31.4	+95.9	−0.027(3)	+0.078	16.919(3)
951	+40.2	+243.5	+0.090(5)	+0.085	17.918(6)
982	+73.5	+264.4	−0.134(6)	+0.095	17.385(3)
998	+98.6	−12.5	−0.001(2)	−0.069	17.314(1)
NGC 1711					
390	−186.9	+100.0	−0.398(2)	+0.087	18.238(2)
481	−158.0	+83.6	−0.227(6)	−0.087	16.871(7)
499	−151.3	+75.9	−0.162(3)	+0.077	17.834(3)
554	−137.8	+104.5	−0.339(9)	−0.068	17.009(9)
572	−132.6	+47.8	−0.022(7)	−0.085	17.271(6)
586	−129.8	+126.6	−0.233(2)	+0.059	17.751(1)
652	−106.3	+55.4	−0.373(9)	−0.062	18.159(9)
719	−86.4	+66.7	−0.018(8)	−0.052	18.222(6)

Abt (1979) investigated the dependence of the percentage of CP members in open clusters on their age. His sample, divided into magnetic Ap (Si) and Ap (Sr,Cr) stars, includes data for 14 galactic open clusters as well as associations, a rather small number if one takes into account that at least 1500 open clusters are known in our Milky Way (Dias et al. 2002). The frequency of Ap (Si) objects with $-1.3 < M_V < 1.4$ mag increases from 4% to 8% during $\log t = 7.0$ and 8.0, respectively, whereas the youngest Ap (Sr,Cr) stars are found at $\log t = 7.5$ (3% at $\log t = 8.0$). For, at that time, known peculiar stars (Osawa 1965) of the Bright Star Catalogue, Abt (1979) gives a number of 6.5% for the same magnitude and declination range as the investigated members of open clusters. No value for the CP4 group is listed in Abt (1979). Another source for a statistically analysis of galactic CP field stars is the conference paper by Schneider (1993) who considered also the Supplement to the Bright Star Catalogue and the CP stars listed in Renson (1991). He lists for the magnitude range $V < 7.1$ mag a lower limit of 16% (CP2 and CP4) and 5% (CP2 only) for stars hotter and cooler than A0, respectively. These numbers should be taken with care since Schneider (1993) quotes that "the single values should not be taken too serious because the MK classification influences the single values strongly". From the mentioned sources we conclude that one would expect an incidence for magnetic CP stars of at least 6% over the relevant spectral range up to F2 main sequence objects. This number has to be treated as statistically lower limit for the percentage of magnetic CP stars for any test sample of main sequence objects in the Milky Way. The only limitation might be very young open clusters and associations ($\log t < 7.0$) where the incidence seems slightly less than 6% (Borra, Joncas & Wizinowich 1982).

The incidence of magnetic CP stars in the LMC: first of all, one has to correct the observed ratio of CP stars for loss of objects because of the detection limit. Paunzen et al. (2005) estimated a detection rate of 90% for CP2 and CP4 objects for a limit of 0.012 mag. Incorporating this fact for the values listed in Table 3, a maximum value of about 2.5% (the percentage for NGC 1866 might be up to 3% if we extrapolate the result) for the incidence of magnetic CP stars in the whole spectral range up to F2 is inferred. This number is based on the measurements of 2562 individual objects. The occurrence of magnetic CP stars in the LMC is therefore only about half the value as in the Milky Way.

5 CONCLUSIONS AND OUTLOOK

We have continued our search for CP stars of the upper main sequence in the LMC applying the tool of Δa photometry which measures the characteristic broad band absorption feature located around 5200Å. This flux depression is most certainly a consequence of the non-solar elemental abundance of CP and related objects in the presence of a strong stellar magnetic field. Our final goal is to establish the incidence of those objects and to compare it with the values found for the Milky Way. Such an investigation is very important for stellar evolution theory since the overall metallicity of the LMC is reduced by up to 0.5 dex compared to the Sun. Furthermore, its global magnetic field consists of a coherent axisymmetric spiral of field strength which is weaker than that of the Milky Way. Both parameters play a key role in the context magnetic CP stars because the origin of their magnetic fields is still a matter of debate: those who favor the survival of frozen-in fossil fields originating from the medium out of which the stars were formed are in opposition to those following the idea that a dynamo mechanism is acting in the stellar interior.

In total, 2562 objects in two young globular clusters and three different field populations in the relevant spectral range from early B to early F have been photometrically investigated. From this sample, 30 objects (most certainly magnetic CP stars) exhibit significant positive whereas 12 have negative (metal-weak or Be/Ae/shell stars) Δa values.

From a comparison of the published statistics of magnetic CP stars in the galactic field and open clusters in the Milky Way, we concluded that the incidence in the LMC is only about half the value from the Milky Way. This is already a very strict observational constraint for the standard evolutionary model. Our derived number of metal-weak and Be/Ae/shell stars in the observed fields match excellent the numbers derived from spectroscopic investigations in other fields of the LMC.

As next ambitious step, we will try to establish the incidence of CP stars in the Small Magellanic Cloud. A galaxy with an ever lower metallicity than the LMC. Furthermore, high resolution spectroscopy of the detected CP stars is needed to compare their detailed elemental abundances with those of galactic counterparts.

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