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INVESTIGATIONS OF THE PERIODIC VARIABLES IN THE CATALINA AND LINEAR DATABASES

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In this study we continue spectral class determinations for large numbers of optically faint periodic variables taken from the Catalina Surveys Data Release 1 (CSDR1) and LINEAR data sets. Spectral classes and physical parameters are presented for 1184 periodic variables with periods $P \geq 10$ days, taken from modern large sky area spectroscopic and photometric databases, including LAMOST (Large Sky Area Multi-Object Fiber Spectroscopic Telescope), SDSS (Sloan Digital Sky Survey), the Hamburg Quasar Survey (HQS), the Hamburg/ESO Survey (HES), and Gaia Data Release 2 (DR2). In Gaia DR2 catalogue, luminosities are presented for 276 objects and radial velocities (RV) for 108 objects out of 1184. Spectral classes were confirmed for more than 650 objects. The majority of the variables are found to be F, G, K, M dwarfs and giants, a few dozen carbon (C) stars (N-type Asymptotic Giant Branch (AGB) stars), and a few S stars. Some periodic variables are blue objects, such as B and A stars. The periods are in the range $10 \leq P \leq 1504$ days and Catalina magnitudes in range $11.5 \leq V \leq 20.0$ mag. Finding new and faint evolved AGB stars in the halo of our Galaxy is the first priority. A catalogue containing multi-parameter data for 1184 periodic variables from modern astronomical databases has been generated.

Keywords: *Catalogs-periodic variables: surveys: late-type stars: M and C stars, general*

1. *Introduction.* The study of variable stars is one of the most popular and dynamic areas of modern astronomical research. Variability is a property of most stars, and as such it has a great deal to contribute to our understanding of them. It provides researchers with additional parameters (periods, amplitudes, etc.) which are not available for non-variable stars. These parameters can be used to deduce characteristics of the stars. The study of variability also allows us to directly observe changes in the stars: both the rapid and sometimes violent changes associated especially with stellar birth and death, and also the slow changes associated with normal stellar evolution. An overview of variable stars, including an introduction to variable stars in general, the techniques for discovering and studying variable stars, and description of the main types of variable stars are presented in more detail in the book by John Percy [1].

Determination of the correct classes of variables can be very important for studies of stellar populations. Some types of variable stars, such as RR Lyrae stars and Cepheids, are an excellent tool for studying our Galaxy. Being nearly standard candles (as distance indicators) and being intrinsically bright, they are a particularly suitable tracer of Galactic structure [2-4]. Long period variables (LPV, $\Delta V > 2.5$ mag, or Miras), which are Asymptotic Giant Branch (AGB) stars, are also very important distance indicators for old and intermediate age populations [5].

The variable optical sky was largely unexplored and poorly quantified until recently, especially at the faint end ($V > 15$ mag) in the Galactic plane and also at high Galactic latitudes in the halo of our Galaxy. Numerous questions remain unanswered for faint variables, in particular: what degree of different variable populations contribute to the overall variability, and how they are distributed in magnitude and color. To answer these questions, several contemporary projects were started which aimed at regular monitoring of the optical sky [6]. In paper [6], we reported eight new confirmed C stars in the Catalina Sky Survey (CSS Data Release 1, Drake et al. [7]).

In this paper we continue spectral class determinations for a large number of optically faint periodic variables (hereafter PV). These variables are taken from the CSS DR1 dataset and from the LINEAR database (Lincoln Near-Earth Asteroid Research, Palaversa et al. [8]). We study 1184 CSS and LINEAR PVs for which $P \geq 10$ days (an arbitrary choice), and present spectral classes for a large number of PV stars. We significantly increase the known sample of faint Catalina and LINEAR LPV evolved stars out of the Galactic plane. This paper is organized as follows: in Section 2, some useful details on the surveys that we use are given. In Section 3 we describe the modern large area low and moderate resolution spectroscopic databases which were used for spectral class determination; in Section 4 we present the list of 1184 PV stars with important data from the modern large sky area surveys, such as SDSS (Sloan Digital Sky Survey) [10]), second Gaia data release (DR2) [11] and LAMOST (Large Sky Area Multi-Object Fiber Spectroscopic Telescope) [12]; in Section 5 2MASS (Two Micron All-Sky Survey) [9] colour-colour plots for these variables are presented and some very interesting cases among the samples are considered; in Section 6 for a few of the newly confirmed M-class AGB stars and for M dwarfs some parameters are estimated; finally, we conclude in Section 7. We note that distant pulsating red giants, selected from the CSS are considered in [13].

2. *Surveys and PV catalogues used.* Variability data come primarily from DR1 of the CSS. The main focus of this survey is the discovery and tracking of Near-Earth Objects (NEOs) and potentially hazardous asteroids (PHAs), but their multi-epoch imaging of large areas of the sky provides excellent data for more general studies of the time-varying sky, including variable stars. In total the survey covers $\sim 33000\,\mathrm{deg}^2$ of the sky within the region $-75^{\circ} < \delta < +65^{\circ}$ and more than

10^o-15^o from the Galactic plane. The time baseline is greater than 7 yr. The whole survey has three components: the Catalina Sky Survey (CSS), the Southern Sky Survey (SSS), and the Mount Lemmon Survey (MLS), which cover the northern sky, southern sky and the ecliptic ($\pm 10^o$), respectively. In many cases, stars have data from more than one of these surveys (online access at http://nesssi.cacr.caltech.edu/DataRelease/).

The Catalina Survey data are provided by three telescopes: (1) the 0.7 m Catalina Schmidt telescope, which has a 8.1 deg^2 field of view, a pixel scale of 2.5 arcsec, and which reaches a limit of $V \sim 19$ - 20 mag (2); the 1.5 m Mount Lemmon reflector, with a 1.2 deg^2 field of view and a deeper limit, $V \sim 21.5$ mag; and (3) the 0.5 m Uppsala Schmidt at Siding Spring, Australia, with a 4.2 deg^2 field of view, a 1.8 arcsec $pixel^{-1}$ image scale and depth of $V \sim 19$ mag. All three telescopes operate with cooled, $4k \times 4k$ back-illuminated unfiltered CCD cameras. Drake et al. [7] presented a catalogue of periodic variables selected from the CSDR1 dataset, from a search of 5.4 million variable star candidates within the 20000 deg^2 area covered by the CSDR1. To select PVs, these authors use Lomb-Scargle periodogram analysis for all variability classes (pulsating, eclipsing, and eruptive). The catalogue contains data for 47055 variable objects - ("Catalina Survey Periodic Variable Stars", CDS VizieR Catalogue J/ApJS/213/9). All the Catalina data are analyzed for transient sources by the Catalina Real-Time Transient Survey (CRTS [14]). Papers [15,16] are devoted to the new RR Lyrae and Cataclysmic Variables (CV) found in the CRTS database.

We also use the LINEAR [8] database in addition to the Catalina Surveys. The LINEAR survey is similar to Catalina and the focus of the program is to discover and track NEAs larger than 1 km diameter. It operates from two 1 m telescopes located at the White Sands Missile Range in New Mexico. The camera is unfiltered and has a ~2 deg^2 field of view and 2.25 arcsec/pixel image scale. This survey (nearly 10000 deg^2 of the northern sky) is not as deep as Catalina, reaching down to $V < 18$ (see details at http://astroweb.lanl.gov/leneardb/). Palaversa et al. [8] presented a catalogue of the 7194 PVs ("LINEAR III. Catalog of Periodic Variables", CDS Vizier Catalog J/AJ/146/101, based on visual classification of light curves) acquired by the LINEAR asteroid survey. We selected 1142 PVs from CSS DR1 and 96 from the LINEAR datasets. 54 LINEAR PVs are included also in the CSS DR1 database. From both catalogues 1184 objects were selected with $P \geq 10$ days.

3. *Spectroscopic databases used*. Very useful quantities for our work are the covered area and the limiting magnitude. In order to determine spectral classes for PVs we use the following main sources of information. They are: Hamburg Quasar Survey (HQS) and Hamburg/ESO (HES) surveys (online access to HQS

and HES surveys at https://www.hs.uni-hamburg.de/DE/For/Exg/Sur/hqs/online/index.html/). For HQS, the area covered is 13600 deg^2 and $B(\mathrm{lim}) = 19^m.0$; for HES, 6400 deg^2 and $B(\mathrm{lim}) = 18^m.0$. HQS offers a low resolution (1300 Å /mm at $H\gamma$) from 3400 to 5400 Å , while it is 3200 Å to 5300 Å (450 Å /mm near $H\gamma$) for HES. Supplementary spectral information is also given by the Sloan Digital Sky Survey Data Release 15 and the LAMOST spectra (coverage 3700 to 9000 Å , Data Release 5. Finally, for each of 1184 PVs we check for any spectral information in the SIMBAD database.

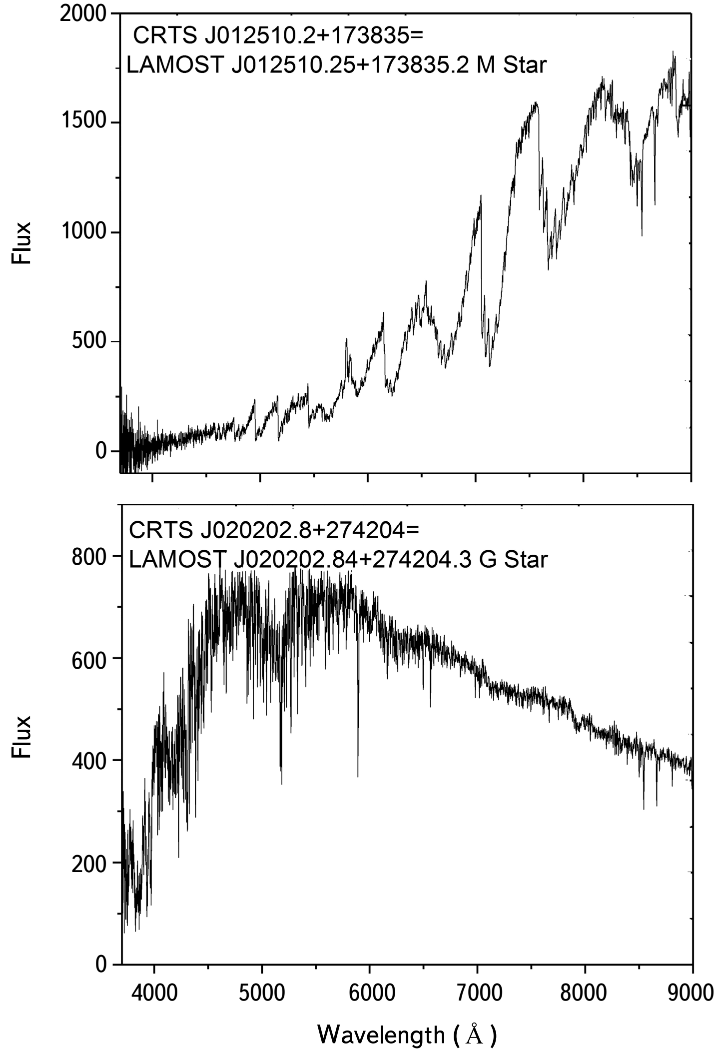

Fig.1. The LAMOST telescope spectra in the range λ 3700 - 9000Å for the two PVs CRTS J012510.2+173825 (classified as a LPV M star) and CRTS J020202.8+274204 (classified as G star, RS CVn type variable).

Fig.1 shows an example of LAMOST DR5 spectra for two CRTS periodic variables, which are classified as M and G-stars. They are CRTS J012510.2+173835 (classified as LPV by Drake et al. [7]) and CRTS J020202.8+274204 (classified as a RS CVn type variable). Fig.2a, b illustrates corresponding HQS and HES objective prism low resolution (lr) spectra for CRTS J170621.4+142735 and CRTS J151432.4-093932, which we classify as M stars based on the presence of TiO absorption bands in the lr spectra. An important note is that for a certain classification, we present HQS and HES class in our list only for M and C stars, showing absorption bands of TiO and C_2 molecules respectively in lr spectra (at a given resolution there are no spectroscopic criteria to discriminate F, G, and K stars on HQS and HES digitized plates).

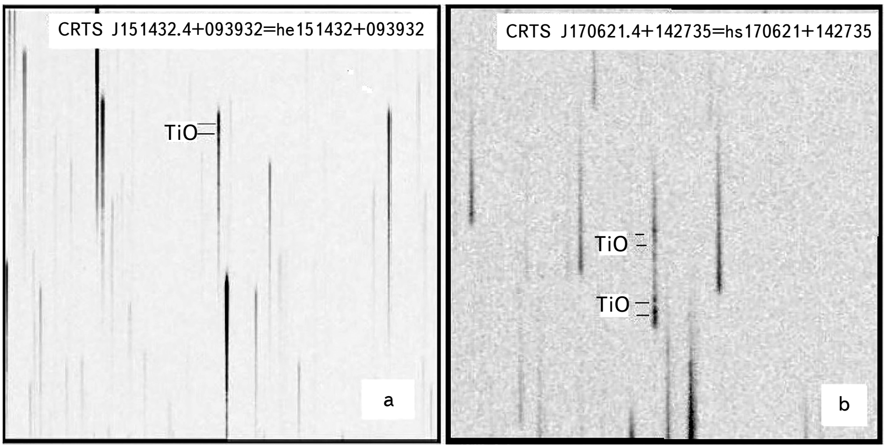

Fig.2. HE lr spectra in the range $\lambda 3200 - 5400$Å for the newly confirmed M-type star CRTS J151432.4-093932. TiO molecule absorption bands are indicated. Field is $15' \times 15'$ (a), and (b) HS lr spectra in the range $\lambda 3400 - 5400$Å for the newly confirmed M-star CRTS J170621.4+142735. TiO molecule absorption bands are indicated. Field is $5' \times 5'$.

In the SDSS DR15 database, spectra in the range 3600-10000 Å are available for 32 PVs. Only 3 objects have APOGEE (Apache Point Observatory Galactic Evolution Experiment) infrared spectra (in the range 1.5 to 1.7 μm , for more detail see the site http://www.sdss.org/instruments/apogee_spectrograph/). They are CRTS J114143.6+262359, APOGEE id. is 2M11414364+2623592, which is an M4.5 III Mira variable, CRTS J140556.0+014031, APOGEE id. 2M14055603+0140310, an M2 subclass star, and CRTS J224228.1+060856, APOGEE id. 2M22422816+0608567. According to LAMOST DR5, the last object is of K1 subtype.

4. *The list of 1184 PVs with* $P \geq 10$ *days*. All 1184 periodic variables are cross-correlated with available modern astronomical catalogues and databases,

namely 2MASS, SDSS DR15, Gaia DR2, and LAMOST DR5. The contents of the list are as follows:

1) CRTS - Catalina Sky Survey identifier (JHHMMSS.s+DDMMSS) or LINEAR Number,

2) RA, Dec (J2000), <*V*> mag, *P* (days), and amplitude (mag) and variability type according to the CRTS DR1 catalogue (J/ApJS/213/9 [7]),

3) 2MASS *J*, *H*, and *Ks* magnitudes and errors, $J-H$ and $H-Ks$ colors,

4) Gaia DR2 Name, Gmag, T_{eff}(K), BP-RP color index, radius and luminosity in solar units with errors when available (CDS VizieR Catalogue I/345/gaia2),

5) HQS and HES associations (hs or he number, spectral classes only for M and C stars, see section 4 for details),

6) LAMOST DR5 catalogue associations and spectral classes (if available),

7) SDSS DR15 associations and spectral classes (if available),

8) Alternative names of objects from SIMBAD and spectral class, references or elsewhere.

A representative sample table with key columns and key rows is given as Table 1. The columns are follows: (1) CRTS Name, (2) CRTS <*V*> median magnitude, (3) Period (in days), (4-6) Gaia DR2 *G* mag., BP-RP color, and T_{eff} consequently, (7) hs or he associations, (8) Gaia DR2 luminosities (in solar units), (9) spectral class of the object.

5. *2MASS colors*. In Fig.3 the 2MASS $J-H$ vs. $H-Ks$ (two-color) diagram is illustrated for all PVs except the 22 objects out of 1184 that have no 2MASS *J*, *H*, and *K* photometric data. The 2MASS two-color diagram is considered in

Table 1

A SAMPLE LIST OF THE CRTS PV STARS[1,2]

CRTS and LINEAR number	<*V*> mag	*P* days	*G* mag	BP-RP Color	T_{eff} K	hs Association	Lumin. $L_{\odot}$	Sp. class
J010453.2+450136	12.61	248.01	12.49	4.35	3380	010453+450136		M
J010354.4+203955	13.89	24.55	13.84	1.25	5130	010354+203955	48.87	G
J020424.0+325248	14.14	15.71	14.32	1.39	4620	020424+325248	2.36	Unknown
J032905.5+305924	15.05	17.24	15.27	2.80	3820		0.10	Unknown
J034525.1+294352	14.36	13.88	14.75	2.63	3470	034525+294353	0.32	M
J163525.0+383247	14.15	146.52	14.07	2.29	3800	163524+383246		M
J220910.4+022323	15.57	330.86	15.58	0.96	5360	220910+022323	2.25	F
LINEAR 3577682	15.17	179.42	15.06	1.93	4060	122041+491844		N
LINEAR 13990545	16.80	1503.71	17.05	0.14	9460	151916+064529		B

[1] Table 1 does not present all parameters which are included in the electronic format of the list, see Discussion and Conclusion.

[2] Notes for some interesting objects and their other associations in SIMBAD data base.

CRTS J010506.6+021333, $<V> = 19.06$, $P = 533.62$ days, Amp. = 1.87 mag. This object is noted by Menzies et al. [17], as a LPV AGB in a local dwarf irregular galaxy IC 1613 (Gaia DR2 $G = 19.69$, BP - RP = 2.53 mag).

CRTS J034345.1 + 320358 = IC 348 LRL 245, Young Stellar Object (YSO). Object shows periodic variability with amplitude $\Delta m \approx 2.0$ mag.

CRTS J034855.8 + 350332 = LAMOST J034855.83 + 350332.6 is an eclipsing binary with A1 subclass and $L = 0.27\,L_{\odot}$ luminosity, the distance of the object is 411 pc from the Sun (CDS Vizier Catalogue I/347/gaia2dis) [18].

CRTS J052909.7 + 035128, $<V> = 15.94$, $P = 14.4$ days, $J - H = 0.66$, $H - K = 0.25$, this object is the source with the lowest Gaia DR2 luminosity value among the sample ($L = 0.05\,L_{\odot}$) and is an eclipsing binary at a distance 339 pc from the Sun [18].

CRTS J053347.7 - 045208 = LAMOST J053347.70 - 045208.4 = V731 Ori, which is a RS CVn type variable and is an M dwarf star (M3 subclass). Gaia DR2 data are: $L = 0.13\,L_{\odot}$, $G = 15.34$, $T_{eff} = 3690$ K, the distance $r = 338$ pc [18].

CRTS J075525.0 + 2359522 = LAMOST J075525.0 + 235952.2 ($<V> = 17.01$, $P = 323.71$ days, $J - H = 0.82$, $H - K = 0.12$), is known also as ULAS J075525.09 + 235952.2. In paper [19] this object is presented as an M giant at a distance 50 kpc from the Sun.

CRTS J094757.4 + 131643 = IRC + 10216 (CW Leo), an N-type carbon star [20] and well known protoplanetary nebula (PPN), the reddest object among the sample (see Fig.3, $J - H = 4.09$, $H - K = 2.46$, $P = 652$ days).

CRTS J111320.6 + 221116, $<V> = 18.28$, $P = 183.35$ days, this object is an N-type C star in the dwarf spheroidal galaxy Leo II [21].

CRTS J181216.8 + 311455 = PZ Her, a LPV, $L = 480\,L_{\odot}$ (having the maximum luminosity among the sample) is an M type giant, Gaia DR2 BP - RP = 2.84 mag.

LINEAR 2825992 = LP 376-6 is a high proper motion star (Plx = 30.5 mas) at a distance 33 pc from the Sun.

CRTS J122846.8 + 052726 = EL Vir = LAMOST J122846.80 + 052726.4, an eclipsing binary, subclass is K3, $L = 5.57\,L_{\odot}$, distance is 1860 pc according to [18].

CRTS J123014.1 + 251806 = LINEAR 3766947 ($<V> = 15.6$ mag, $P = 897.65$ days, Amp. = 2.24 mag) = ICRF J123014.0 + 251807 (BL Lac object) [22].

CRTS J124219.4 + 093820 = LINEAR 7682813 = LEDA 1367921 (galaxy) [23].

CRTS J151915.9 + 064529 = LINEAR 13990545 = LAMOST J151915.86 + 064529.1, $P = 1503.71$ days, $<V> = 16.8$, Amp. = 0.63 mag, object with largest P among the 1184 sample considered [24].

CRTS J170810.3 - 022022 ($<V> = 12.97$, $P = 385.21$ day, $J - H = 1.37$, $H - K = 1.11$) is presented by Drake et al. [7] as a LPV. This object is observed in the H_2O maser line by Yung et al. [25]. In our list we noted spectral class as "Unknown".

CRTS J211429.5 + 074833 = IRAS 21120 + 0736, $J - H = 1.16$, $H - K = 0.96$, is a Mira variable Galactic OH/IR star [26] with large Gaia DR2 color index (BP - RP = 7.68 mag).

CRTS J224003.3 + 251532 = 2MASS J22400335 + 2515346 = LAMOST J224003.34 + 251534.6 with Gaia DR2 radial velocity data RV = -403 km/s is an M4 subclass AGB star at a distance 6610 pc from the Sun [18].

numerous papers as a dwarf/giant discriminator. It can select the area on the diagram ($0.0 \le H - K \le 0.7$, and $0.2 \le J - H \le 1.0$) where the maximum concentration of objects is evident. Primarily F, G, and K type stars are in this region. Objects with $J - H \ge 1.0$ are M and N-type AGB stars only. A few unknown objects lie in the zone where $J - H < 0.8$ and $H - K > 0.2$. Further spectroscopic observations are necessary to clarify the nature of these objects. Usually in this region of the diagram M dwarfs, carbon dwarfs (dC) and brown dwarfs are located.

6. *Parameters for some M stars.* Faint LPV stars offer the best opportunity to probe and study the outer halo of the Milky Way and are ideal

for tracing the Sagittarius dwarf galaxy (Sgr) tidal streams, and also to map the all sky view of the Galaxy. Table 2 presents some important data for newly confirmed M stars having $J - K > 1.2$. They are presented by Drake et al. [7] as LPV stars.

The distance estimation (Table 2) is based on applying the Period-Luminosity ($P - L$) relation from Whitelock et al. [27]. The $P - L$ relation used here is:

$$M(K) = -3.69(\log P - 2.38) - 7.33. \quad (1)$$

The last two objects in Table 2 deserve more attention. They are fainter than 11 mag in the 2MASS Ks band and belong to the leading arm of the Sgr dwarf

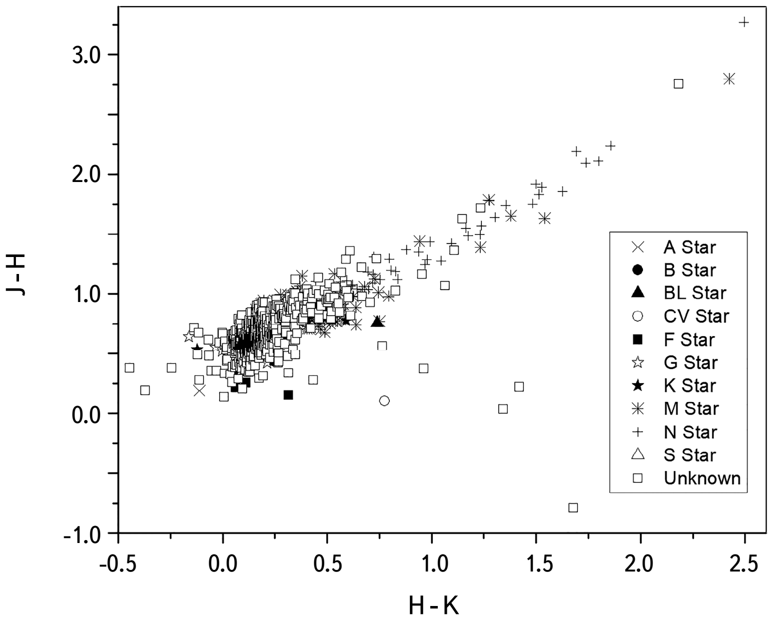

Fig.3. 2MASS color-color diagram for CSS and LINEAR PVs.

Table 2

SOME IMPORTANT GAIA DR2 DATA FOR 6 PV STARS

CRTS and LINEAR Number	$<V>$	Period days	G	BP-RP color	hs or he associations	D (kpc)
J012510.2+173835	12.73	425.35	12.54	3.08	hs 012510+173835	18.0
J012842.1+433218	13.05	119.00	13.26	3.34	hs 012842+433218	10.0
J063516.1+524425	12.08	259.59	12.12	4.83	hs 063516+524424	3.98
J133725.3-014948	12.91	147.53	12.65	2.43	he 133725-014948	10.5
J152042.9-093148	15.75	233.37	16.03	3.33	he 152042-093148	50.0
LINEAR 9809348	15.47	76.87	15.46	1.71	he 133646+075230	33.0

galaxy (see more detail in Fig.22 of Huxor and Grebel [28]). Drake at al. [7] discussed and presented the distribution of LPVs (see their Fig.37, compared to the Law & Majewski [29]) in a model of the Sagittarius streams for objects with $14.9 < V_{CSS} < 15.9$ but without information about spectral classes and adopted for all LPVs $M_V = -3.0$. However, LPV stars have a very broad range of absolute magnitudes [30]. Note that only for object CRTS J063516.1+524425 (M8 subclass star) are the distance estimation based on P - L relation and presented in catalogue I/347/gaia2dis [18] based on parallaxes in good agreement. These two values of the distances are inconsistent for the remaining objects of the Table 2.

Table 3 presents CRTS and LINEAR PVs with available Gaia DR2 luminosity and LAMOST DR5 spectral class information.

Table 3

LAMOST DR5 SPECTRAL CLASSES FOR 9 PV STARS

CRTS or LINEAR	Period (days)	Gaia DR2 T_{eff} (K)	Luminosity $L_\odot$	LAMOST DR5	Sp. Class
J034525.1+294352	13.88	3470	0.33	J034525.07+294352.8	M3
J035614.7-022826	240.9	5070	2.15	J035615.47-022810.6	F9
J040513.0+220743	10.00	3570	0.06	J040513.07+220743.8	M2
J045535.3+213800	60.46	4080	21.82	J045535.29+213800.4	G5
J144715.4-021415	13.57	4440	2.60	J144715.50-021415.2	K3
J170211.1+175334	10.24	4970	26.73	J170211.11+175334.2	G9
J173134.5+573738	14.98	4970	69.17	J173134.56+573738.0	G5
LINEAR 3513885	16.18	4980	6.5	J121628.86+313743.5	K1
LINEAR 13990545	1503.71	9470		J151915.86+064529.1	B0 IV

In Fig.4 LAMOST telescope spectra in the range $\lambda 3700-9000$ Å for objects CRTS J034525.1+204352 and CRTS J144715.4-021415 of Table 3 are presented. Fig.5 presents Gaia DR2 color-temperature relation for 1184 PVs. We selected 76 PVs out of 1184 having large Gaia DR2 BP - RP colors (>5.0 mag). All of them are Miras (M stars later than M7 subclasses). In our list we could not classify 23 objects with very red colors. They are all unknown and associated with IRAS Point Sources (CDS VizieR catalog II/125/main) and are out of the HQS and HES fields. Their V_{CSS} is brighter than 13 mag. In the blue part of the diagram ($T_{eff} > 9000$ K), there are 3 objects. They are LINEAR 13990545 = SDSS J151915.86 + 064529.1 (B0 IV star, $V = +76$ km/s) is a CV star, LINEAR 152733636 = CT Ser = SDSS J154539.08 + 142231.6 (B0 IVe star, $V = -28$ km/s [31], and CRTS J204053.8 - 115426 (eclipsing binary, spectral class unknown).

7. *Discussion and conclusion*. PV stars include different classes of objects with different absolute magnitudes. In this paper we continue the spectral class

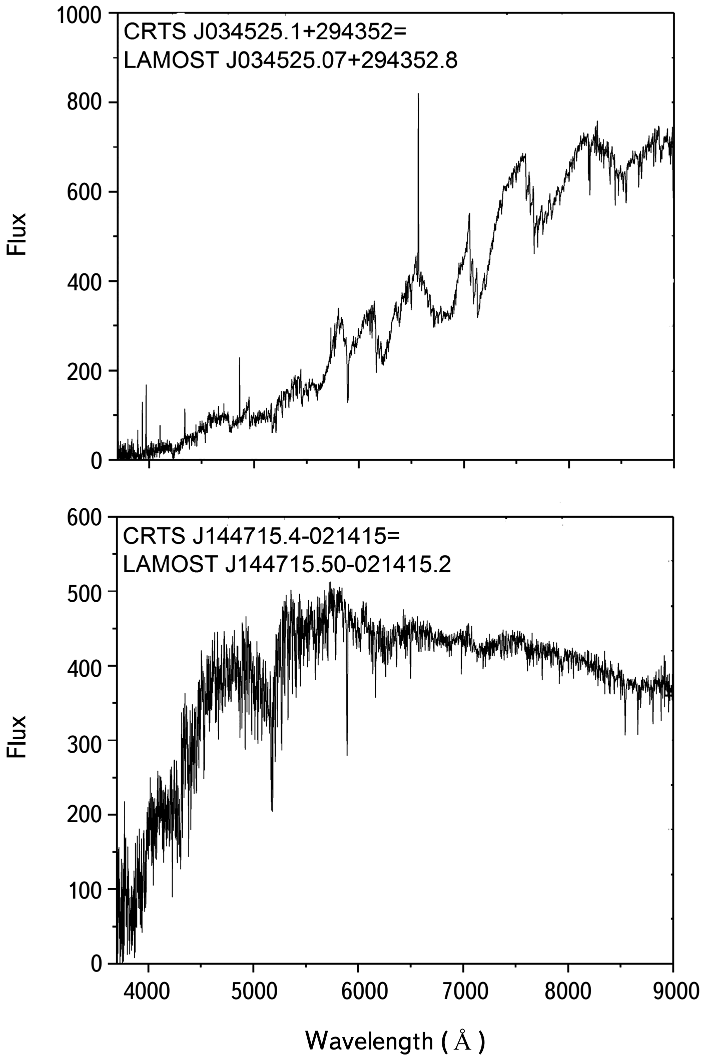

Fig.4. LAMOST telescope spectra for CRTS J034525.1+294352 (classified as eclipsing binary) and CRTS J144715.4-021415 (RS CVn type variable) in the range $\lambda 3700 - 9000$Å .

determinations for faint PVs at high Galactic latitudes selected from the CSS and LINEAR databases. We listed 1184 CRTS and LINEAR objects for which $P \geq 10$ days. A large amount of objects among the sample are newly confirmed faint pulsating LPV, M and N-class evolved giants and AGB stars at high latitudes. Spectral classes are confirmed for more than 650 PV stars. The most important results in this paper can be summarized as follows: (a) using modern large sky area spectroscopic databases, we classify more than 650 CRTS and LINEAR PVs, (b) many PVs are associated with the F, G, K, and M giants and dwarfs, also the faint N-type AGB C stars at high Galactic latitudes, (c) a significant number of the faint Mira variables are classified as M stars of very early subclasses, (d) for a large number of the PVs, we confirm spectral classes for objects presented in the "General Catalogue of Variable Stars: Version GCVS 5.1" [32] but without spectral class information. Our list should be very useful for future versions of the GCVS.

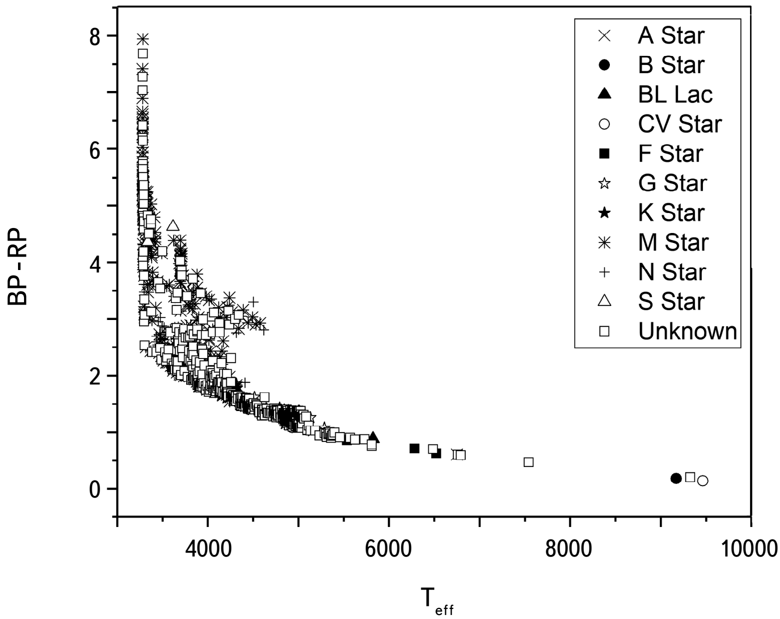

Fig.5. Gaia DR2 color-temperature relations for CRTS and LINEAR PVs. The symbols are the same as in Fig.3.

Five objects in our list deserve more attention. For all of them Gaia DR2 RV > 300 km/s. They are CRTS J102416.0+240215, RV = +317.9 km/s, $<V> = 13.12$, $P = 324.44$ day, $T_{eff} = 4069$ K, $r = 6442$ pc [18], RS Cvn type variable, spectral class "Unknown", CRTS J133855.8 + 184241 = AL Boo, variable star of Mira Cet type, RV = +307.01 km/s, $<V> = 12.66$, $P = 165.45$ days, $T_{eff} = 3641$ K, $r = 8349$ pc [18], CRTS J163945.4 + 091635 = hs163945 + 091636 = V1118 Her, Mira variable, RV = -368.15 km/s, $<V> = 11.67$, $P = 126.63$ day, $T_{eff} = 3800$ K, $r = 3220$ pc [18], CRTS J171457.0 + 182559 = hs174757 + 182559, RV = -412.6 km/s, $<V> = 12.77$, $P = 327.4$ day, Amp. = 0.27 mag, $r = 8517$ pc [18], RS CVn type variable, CRTS J224003.3 + 251533 = LAMOST J224003.34 + 251534.6, RV = -403.46 km/s, $<V> = 13.33$, $P = 127.72$ day, $r = 6610$ pc [18]. We confirm spectral classes for last four objects. They are M stars.

We note also that a few southern objects ($\delta < -10^{\circ}$, and brighter than 13 mag. in visual) was cross-matched with the ASAS [33] (see the CDS VizieR Catalogue

II/264/asas3). We confirm the spectral classes for some of PVs in ASA data base. Meanwhile, it is worthy to note also the ASAS-SN (onlain at https://www.astronomy.ohio-state.edu/asassn/index.shtml/) variability data base, which covers all sky. Both variability surveys are not deeper (<16 mag) than Catalina and LINEAR.

Nearly 100 LPV stars and 25 objects with very large Gaia DR2 BP - RP colors still need to be confirmed spectroscopically, and they will be included in our future observations. For a large fraction of the LPVs, the CRTS $<V>$ median magnitudes is fainter than 15.0 - 16.0. Our list very significantly extend the census of M giants, faint N-type AGB carbon stars, and M dwarfs in the Solar vicinity up to 17.0 mag in the visual.

The full catalogue is available on request by mailing to kgigoyan@bao.sci.am.

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ИССЛЕДОВАНИЕ ПЕРИОДИЧЕСКИХ ПЕРЕМЕННЫХ ИЗ БАЗ ДАННЫХ CATALINA И LINEAR

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В настоящей работе мы продолжаем определение спектральных классов для большого количества оптически слабых периодических переменных. Эти переменные взяты из данных Catalina Surveys 1 (CSDR1) и LINEAR. Спектральные классы и некоторые другие очень важные параметры представлены для 1184 периодических переменных, для которых $P \geq 10$ дней, используя современные спектроскопические и фотометрические базы данных на большой области неба, таких как LAMOST (Large Sky Area Multi - Object Fiber Spectroscopic Telescope), SDSS (Sloan Digital Sky Survey), Hamburg Quasar Survey (HQS), Hamburg/ESO Survey (HES) и Gaia Data Release 2 (DR2). В Gaia DR2 каталоге светимости представлены для 276 объектов, а лучевые скорости - для 108 объектов из 1184. Спектральные классы были подтверждены для более чем 650 обьектов. Установлено, что большинство переменных - это карлики и гиганты F, G, K, M спектральных классов, несколько десятков - углеродные звезды (C) (звезды AGB (Asymptotic Giant Branch) класса N), а также несколько звезд спектрального класса S. Некоторые периодические переменные - это голубые обьекты, такие как звезды спектральных классов B и A. Периоды для всех звезд находятся в диапазоне $10 \leq P \leq 1504$ дней, а CSDR 1 величины в диапазоне $11^m.5 \leq V \leq 20^m.0$. Обнаружение эволюционированных новых и слабых AGB звезд в Гало нашей Галактики является первоочередной задачей. Создан список, содержащий многопараметрические данные для 1184 периодических переменных из современных астрономических баз данных.

Ключевые слова: *Каталоги: периодические переменные: обзоры: звезды поздних М и С классов*

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