

Revised elements of seven known red variable stars from the article «59 New Red Variable Stars»: NSVS 16324859 and NSVS 16329544 are confirmed to be Mira variables

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Abstract: A careful review of the article «59 New Red Variable Stars» - published in PZP ("Peremennye Zvezdy", Prilozhenie, vol. 14, N 4 (2014)) - revealed that elements and variability types could be refined for several red variable stars. We were able to classify NSVS 16324859 and NSVS 16329544 as Mira variables; furthermore, the identification of NSVS 16329544, which was obviously misidentified in the original article, could be improved. Magnitude ranges are now given in V. Most stars' data required a deblending procedure to eliminate light contamination from neighboring stars and get an improved magnitude range.

Revised elements of seven known variable stars from the article «59 New Red Variable Stars» (Sergey et al, 2014) are presented in this article. For many objects in the mentioned paper, no periods or epochs have been published. This has motivated the authors to undertake a review of those stars and try to improve their elements using publicly available data from photometric surveys.

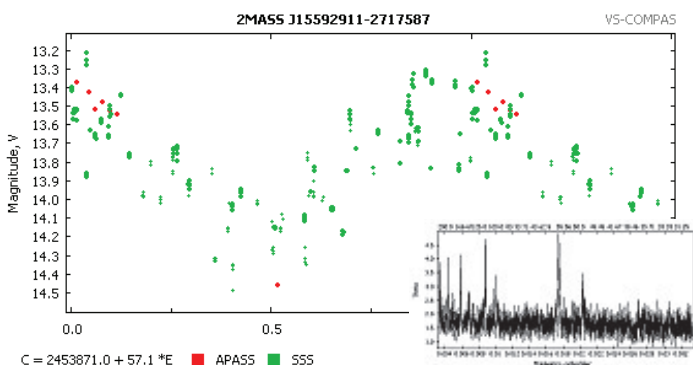
Period search and analysis was made by Siarhey Hadon using the "VSC Effect" custom software created by A. Prokopovich and I. Adamin, which finally led to a refined period value and, in some cases, an updated variability class.

In addition to using ASAS-3 photometry, a search for additional data in other sky surveys. such as the

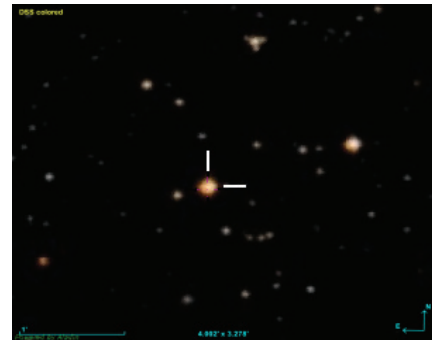
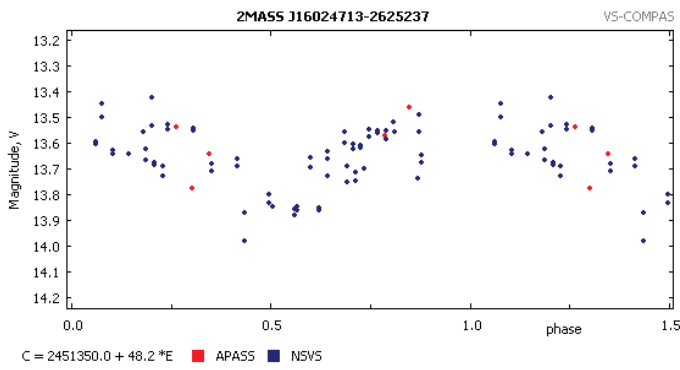
Northern Sky Variability Survey (Wozniak et al., 2004), the Catalina Realtime Transient Survey (Drake et al., 2012), the AAVSO Photometric All-Sky Survey (Henden et al., 2012), was performed for each object. Whenever possible, corresponding photometric data sets were included into the analyses to check if the resulting period matches the value determined by Sergey et al. (2014). This led to an improved quality and reliability of the results.

Below a table containing seven objects along with their individual 2MASS identifications, short research summary and remarks is presented. Updated elements and light curves along with the data published previously are summarized in the table for comparison.

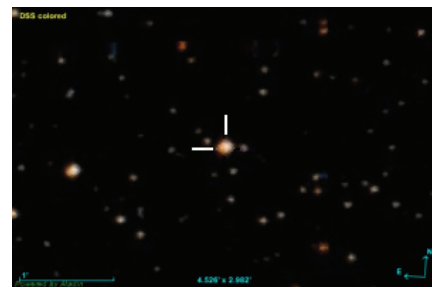
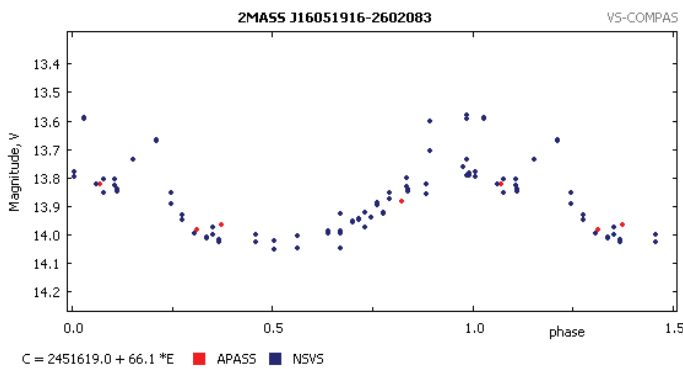
2MASS J15592911-2717587. Though the period from Sergey et al. (2014), based on the NSVS data, looks fine, checking the SSS data set combined with photometry from the APASS gives another period of 57.1 days, valid for HJD 2453600-2456500. The NSVS range has been corrected taking into account light contamination from neighboring stars of comparable brightness.



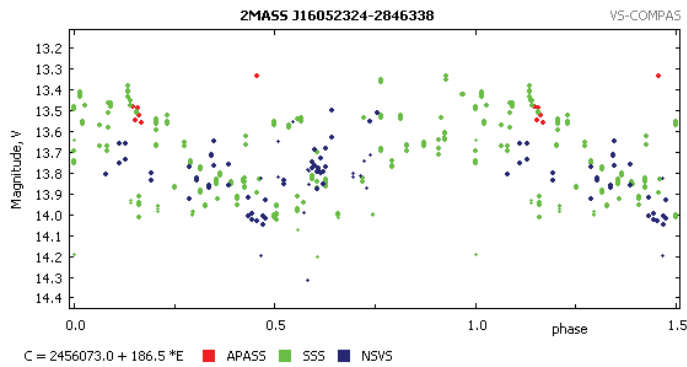
2MASS J16024713-2625237. For this star a period was not determined in the original paper. Combining APASS and NSVS data for the object results in a peak on the periodogram, corresponding to a period of 48.2 days.



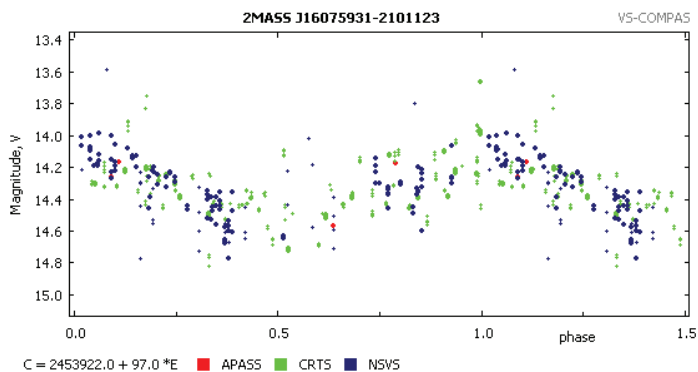
2MASS J16051916-2602083. Detailed analysis of the APASS and NSVS data revealed two periods for the star: 66.1 and 85.8 days. APASS points allowed to shift to the V scale. The period of 86 days presented in the original paper is not the primary one: the NSVS data contains a full cycle, which is clearly shorter than 86 days and corresponding to the period of 66.1 days.



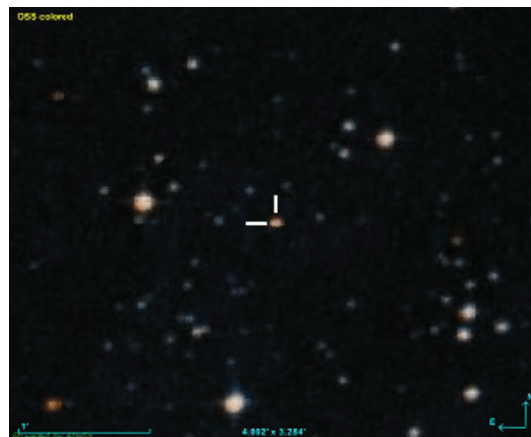
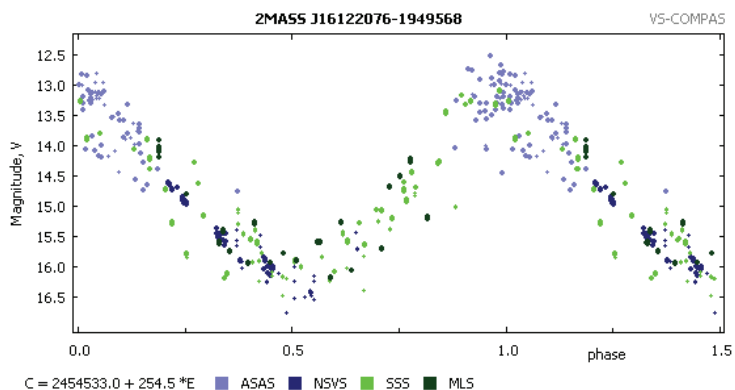
2MASS J16052324-2846338. For this star a period was not determined in the original paper. Combining NSVS, APASS and SSS data for the object results in a peak corresponding to a period of 186.5 days.



2MASS J16075931-2101123. The period of 76 days presented in the original paper does not seem to fit the NSVS data it is based on. Combining the NSVS data with CRTS photometry for this star results in a strong peak around 97 days instead of 76. This matches the two NSVS datasets well, providing two minimums separated by exactly three cycles of 97 days.



2MASS J16122076-1949568. This star is particularly interesting, as all major surveys boast photometric data, which allows to build a solid light curve with a magnitude range of roughly 3.3 mag! Again, the original paper does not provide data on the period, so this one instantly became a new Mira variable with a pulsation period of 254.5 days.



2MASS J16164645-2011547. This designation is not present in the original paper, but there are reasons to believe that the object 2MASS J16164871-2011275 presented as a variable in Sergey et al. (2014) is a mis-identification. The NSVS 16329544 data set belongs to 2MASS J16164645-2011547, a near-infrared-bright star with a J-K index of 1.54, which is typical of a red variable.

See the SDSS field image below, displaying the NSVS position and three nearest stars to it. Combining a data from the NSVS 16329544 and SSS_J161646.5-201154 produces a solid light curve with a period of 324 days and a magnitude range of 3.0. Thus, 2MASS J16164645-2011547 is considered a Mira pulsating variable star. The minimum occurs at phase 0.65.

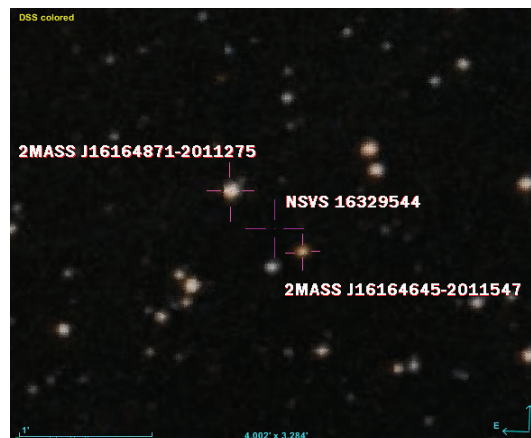
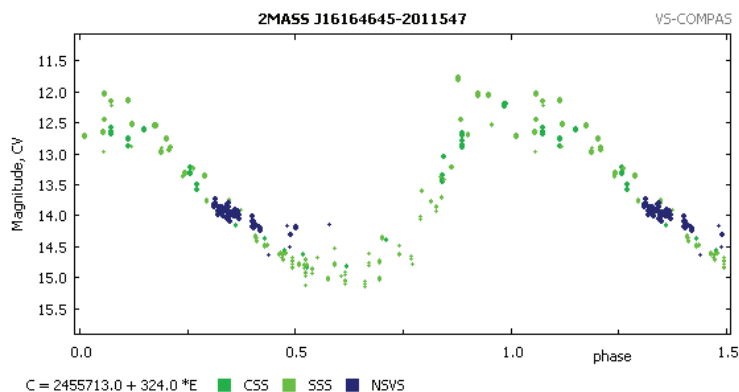


Table 1. – Updated elements (typed in bold) of seven red variables published by Sergey et al (2014).

	2MASS	Cross-identifications	Var. Type	Epoch (HJD)	Period (d)	Mag. Range	Src *
1	2MASS J15592911-2717587	UCAC4 314-082829 USNO-B1.0 0627-0473223 NSVS 19106759	SR SR:	2453871 2451632	57.1 59.6:	13.3-14.4 V 12.65-13.20 R1	VSC PZP
2	2MASS J16024713-2625237	UCAC4 318-085039 USNO-B1.0 0635-0372143 NSVS 19110215 IRAS Z15597-2617 AKARI-IRC-V1 J1602471-262523	SR LB	2451350 -	48.2 -	13.45-13.85 V 11.30-11.70 R1	VSC PZP
3	2MASS J16051916-2602083	UCAC4 320-084536 USNO-B1.0 0639-0365713 NSVS 19113044 IRAS Z16022-2553 AKARI-IRC-V1 J1605191-260209	SRB SR:	2451619 2451617	66.1 86:	13.7-14.0 V 11.30-11.75 R1	VSC PZP
4	2MASS J16052324-	UCAC4 307-084234 USNO-B1.0 0612-0364147	SR LB	2456073 -	186.5 -	13.4-14.0 V 12.5-13.05 R1	VSC PZP

	2MASS	Cross-identifications	Var. Type	Epoch (HJD)	Period (d)	Mag. Range	Src *
	2846338	NSVS 19113545 NSVS 19148819					
5	2MASS J16075931- 2101123	UCAC4 345-079812 USNO-B1.0 0689-0344635 NSVS 19115455 NSVS 16320364	SR SR:	2453922 2451303	97 76	14.0-14.7 V 13.2-13.7 R1	VSC PZP
6	2MASS J16122076- 1949568	UCAC4 351-079376 USNO-B1.0 0701-0332188 NSVS 16324859 IRAS Z16094-1942 AKARI-IRC-V1 J1612207-194957	M LB:	2454533 -	254.5 -	12.7-<16.0 V 12.50-14.50 R1	VSC PZP
7	2MASS J16164645- 2011547	USNO-B1.0 0698-0343637 NSVS 16329544 SSS_J161646.5-201154 IRAS 16138-2004 AKARI-IRC-V1 J1616464-201155	M LB:	2455713 -	324 -	12.0-15.0 CV 13.50-14.10R	VSC PZP

* **VSC** = The VS-COMPAS Project; **PZP** = "Peremennye Zvezdy", Prilozhenie.

Remarks on objects:

1. J-K = 1.17. NSVS magnitudes are contaminated by 2MASS J15593087-2717312 (J-K = 0.44, V = 15.4, sep. 36"), 2MASS J15593254-2717586 (J-K = 0.42, V = 15.8, sep. 45"), 2MASS J15593254-2717586 (J-K = 0.42, V = 15.8, sep. 45"), 2MASS J15593244-2717248 (J-K = 0.54, V = 16.4, sep. 55"), 2MASS J15593258-2718322 (J-K = 0.55, V = 16.8, sep. 57"). Range has been corrected. The table gives elements for HJD 2453500-2456500.
2. J-K = 1.37. NSVS magnitudes are contaminated by 2MASS J16024843-2625284 (J-K = 0.61, V = 16.4, sep. 18"), 2MASS J16024639-2625492 (J-K = 0.54, V = 16.7, sep. 27"), 2MASS J16024511-2624594 (J-K = 0.61, V = 17.4, sep. 36"). Range has been corrected. Sp. Type – M7.
3. J-K = 1.31. Other period: Max= 2451363+ 85.8* E.
4. J-K = 1.22. NSVS magnitudes are contaminated by 2MASS J16052547-2846214 (J-K = 0.62, V = 16.3, sep. 31"), 2MASS J16052667-2846554 (J-K = 0.63, V = 16.7, sep. 50"). Range has been corrected.
5. J-K = 1.26. NSVS magnitudes are contaminated by 2MASS J16080212-2101079 (J-K = 0.47, V = 15.1, sep 39"). Range has been corrected.
6. J-K = 1.41.
7. J-K = 1.54. Wrong position/identification in Sergey et al. (2014). The variable star is 2MASS J16164645-2011547, not 2MASS J16164871-2011275.

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