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Three new EW stars in the field of the RR Lyrae star NSV2724 = GSC0125-0449

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Abstract: Three new EW stars (HMB01 = USNO A2 0900 02059141 = USNO B1.0 0950-0071306, HMB02 = USNO A2 0900 02064661 = USNO B1.0 0950-0071548 and HMB03 = USNO A2 0900 02064201 = USNO B1.0 0948-0071066) have been identified in the field of the RR Lyrae type variable NSV2724 (GSC0125-0449) in Orion. Full light curves for two of the stars are presented. The third stars light curve is not yet fully covered. For HMB01 a period P = 0.6032 +/- 0.0015 [d] with the epoch E_0 = JD 2454071.7676 and a variation of Δm = 0.7 mag. has been found. For HMB02 a period P = 0.27872 +/- 0.00025 [d] with the epoch E_0 = JD 2454071.8727 and a variation of Δm = 0.4 mag. has been found. And finally for HMB03 a period P = 0.33262 +/- 0.00058 [d] with the epoch E_0 = JD 2454080.7679 and a variation of approximately Δm = 0.4 mag. has been found.

Following the light curve variation of the RR Lyrae star NSV2724 = GSC0125-0449 in the constellation Orion has resulted in a rather large database of CCD observations of the field using a 50 cm f/8.2 Ritchey Chrétien telescope and the STL11000XM CCD camera with a clear filter. The field covered by this CCD is 30 x 20 arcmin^2. During inspection of the stars in the field with the program package C-Munipack **(Motl, 2006)** three other stars showing variability were detected. The first star HMB01 = USNO A2 0900 02059141 = USNO B1.0 0950-0071306 (R1 mag.: 15.79, R2 mag.: 15.67, I mag.: 15.03 according to the USNO-B1.0 catalog **(Monet et al., 2003)**) in the list is also the first one being discovered by myself and its position is at Right ascension: 05 h 54 m 27.65 s and Declination: +05 01' 58.6". The star has been observed during 8 nights in the period Dec. 1 to Dec. 26, 2006. This resulted in 1552 CCD observations. No filter was used during the investigation. The image exposure was 20 sec. As comparison star the star GSC0125-0341 = USNO B1.0 0948-0070852 was used. Its position and magnitude (based on data from GUIDE8 **(Gray, 2006)**) are:

05h54m29.565s +04 53' 59.24" 0.2" 13.31±0.40 star
05h54m29.572s +04 53' 59.17" 0.2" 13.80±0.41 star

From the USNO B1.0 catalogue **(Monet et al., 2003)** the following information for the comparison star is given: R1 mag.: 13.23, R2 mag.: 13.23, I mag.: 12.51.

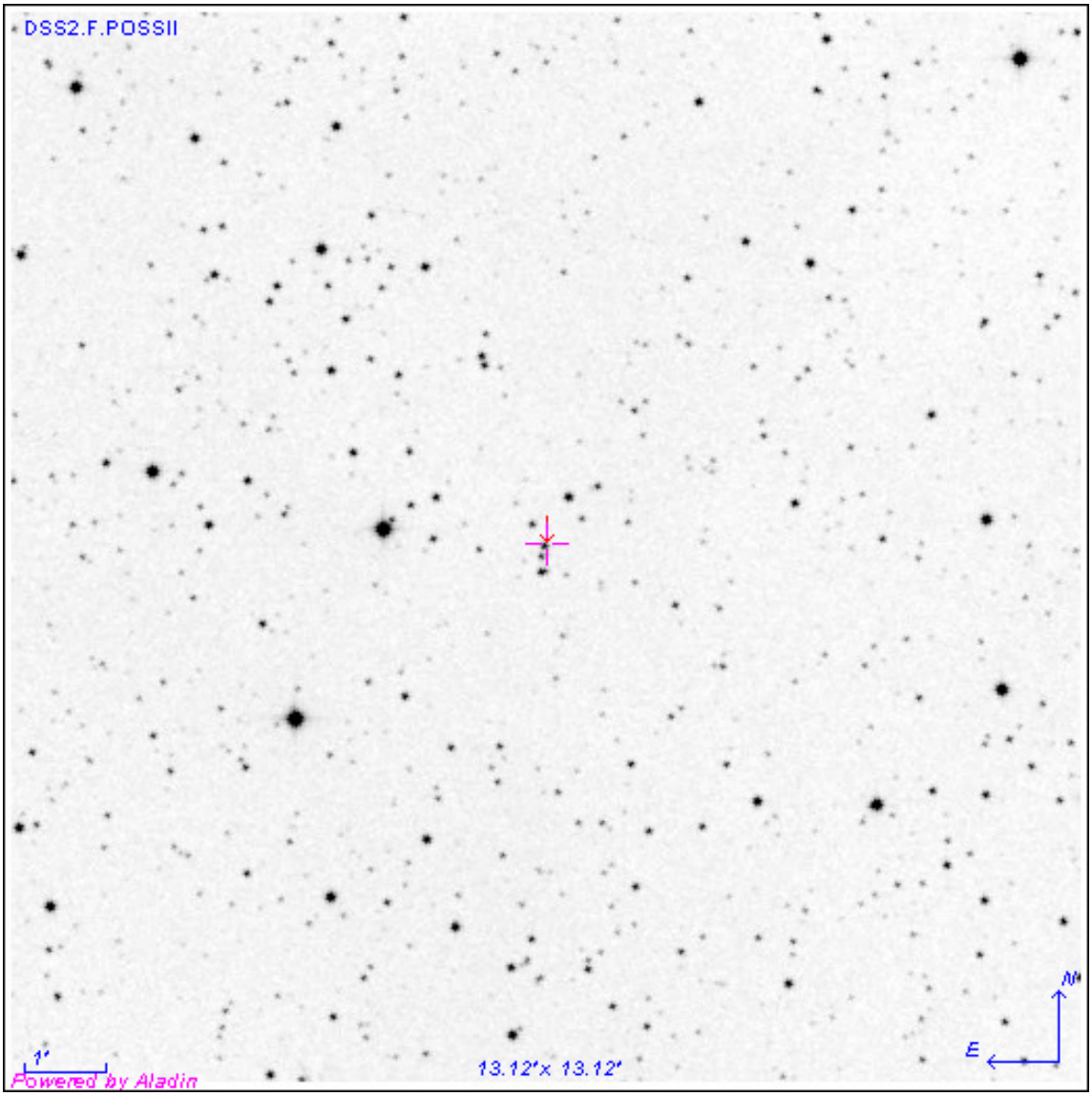

Fig. 1. Finding chart of the star HMB01 = USNO A2 900 02059141 = USNO B1.0 0950-0071306. The star is indicated by the red cross.

A finding chart of the star is given in Fig. 1. The resulting light curve of the star is given in Fig. 2. Relative magnitude differences are given. A very symmetric light curve is visible. The period was found with the period analysis software Peranso 2.11 **(Vanmunster, 2006)**. The derived elements for the minima of this star are the following:

P = 0.6032 +/- 0.0015 [d] with the epoch E_0 = JD 2454071.7627 and an amplitude of the light variation of Δm = 0.7 mag.

The following minima for this star could be deduced:

Delta Mag.	Type of Minimum	JD	Error
2.958	primary	2454071.7676	0.0019
2.928	secondary	2454076.8944	0.0039
2.957	primary	2454080.8136	0.0018
2.955	primary	2454085.9492	0.0028

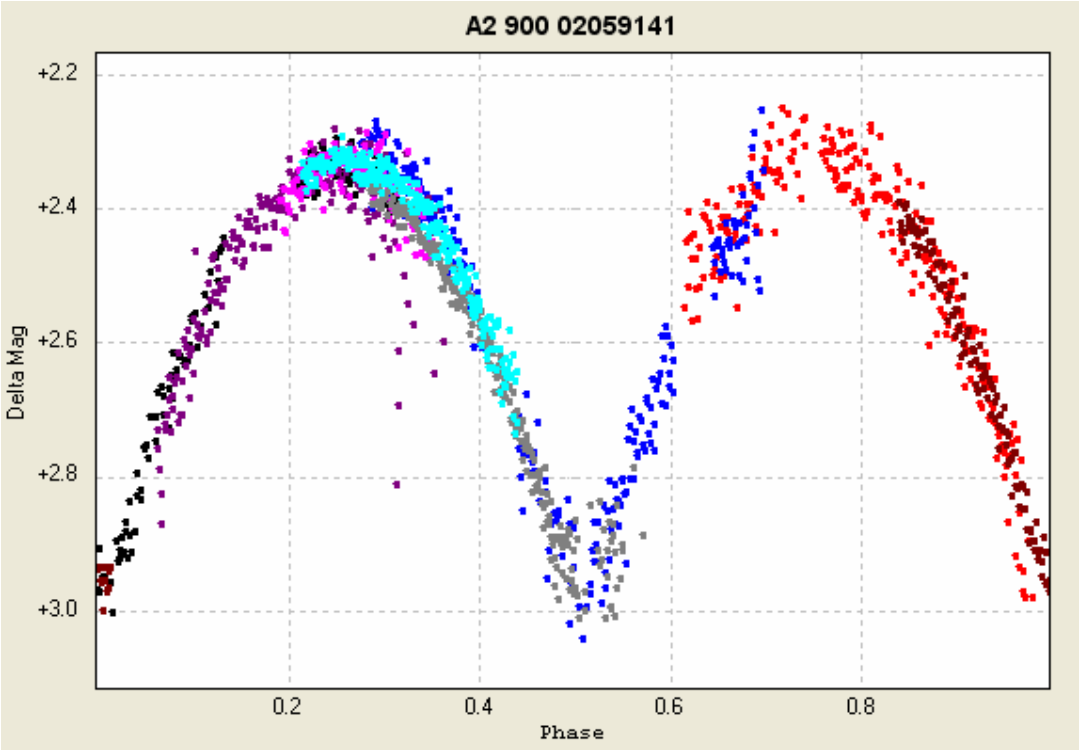

Fig. 2. Phase diagram of the star HMB01 = USNO A2 900 02059141 = USNO B1.0 0950-0071306. The different colours are the different observing campaigns covering a period of more than 20 days.

The second star HMB02 = USNO A2 0900 02064661 = USNO B1.0 0950-0071548 (R1 mag.: 15.50, R2 mag.: 15.86, I mag.: 14.98 according to the USNO-B1.0 catalog (**Monet et al., 2003**)) in the list is at position Right ascension: 05 h 54 m 59.14 s and Declination: +05 04' 19.7". The star has been observed during 6 nights in the period Dec. 1 to Dec. 26, 2006. This resulted in 933 CCD observations. No filter was used during the investigation. A finding chart of the star is given ion Fig. 3. The resulting light curve of the star is given in Fig. 4. The period was found with the period analysis software Peranso 2.11 **(Vanmunster, 2006)**. The derived elements for the minima of this star are the following:

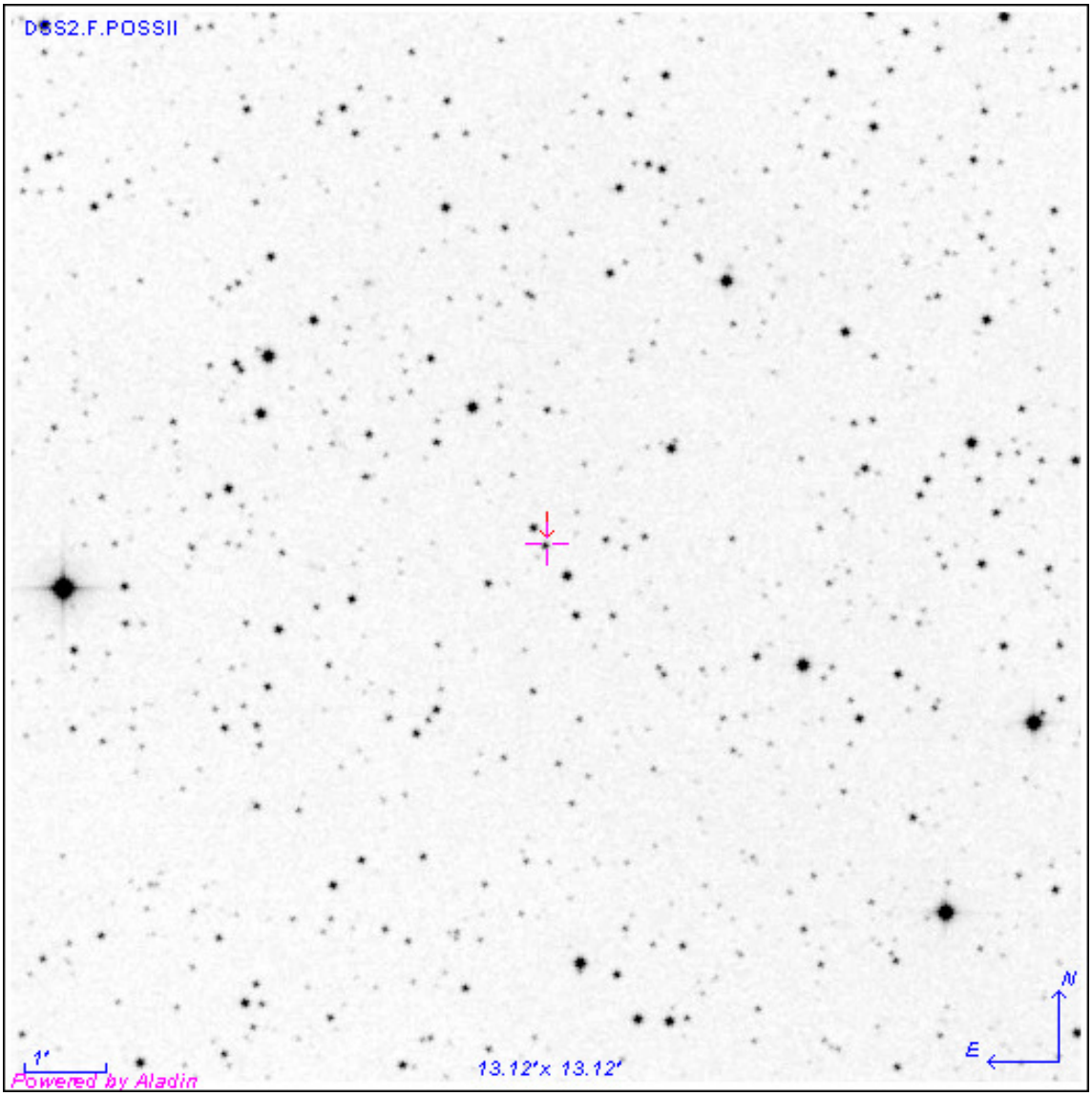

Fig. 3. Finding chart of the star HMB02 = = USNO A2 0900 02064661 = USNO B1.0 0950-0071548. The star is indicated by the red cross.

P = 0.27872 +/- 0.00025 [d] with the epoch E_0 = JD 2454071.8727 and an amplitude of the light variation of approximately Δm = 0.4 mag.

The apparent flat minimum at phase 0.0 is probably caused by the fact that this binary shows total eclipses.
The following minima for this star could be deduced:

Delta Mag.	Type of Minimum	JD	Error
2.764	primary	2454071.8727	0.0021
2.665	primary	2454075.9115	0.0028
2.680	secondary	2454076.8976	0.0042
2.672	primary	2454077.8666	0.0034
2.702	secondary	2454080.7924	0.0035

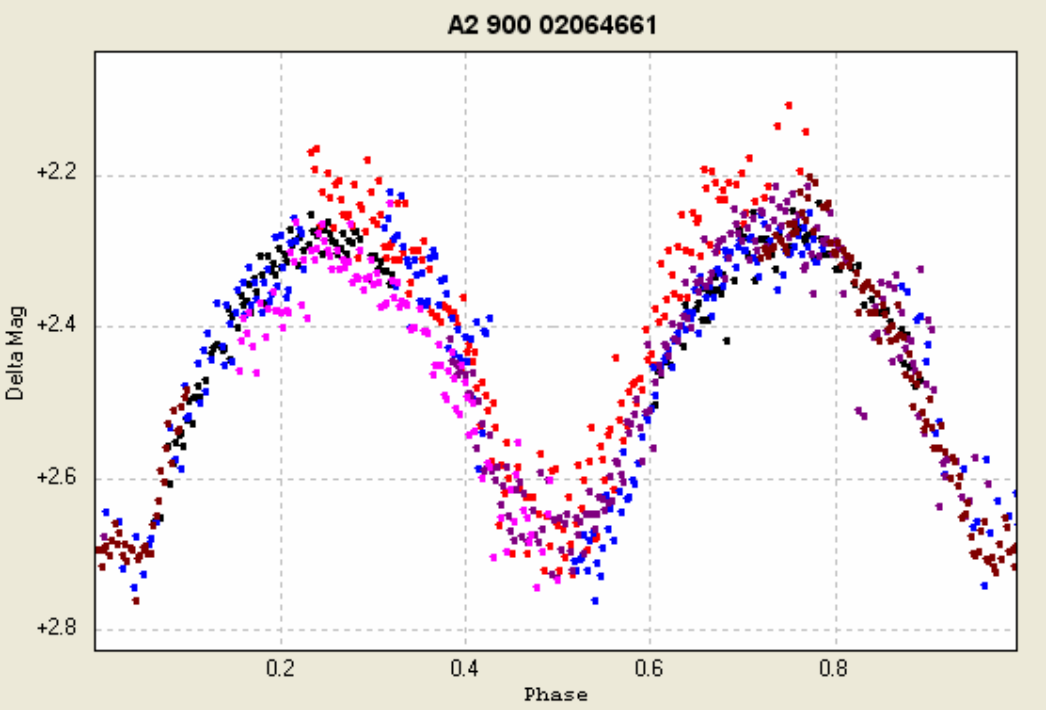

Fig. 4. Phase diagram of the star HMB02 = USNO A2 900 02064661 = USNO B1.0 0950-0071548. The different colours are the different observing campaigns covering a period of more than 9 days.

The third star HMB03 = USNO A2 0900 02064201 = USNO B1.0 0948-0071066 (R1 mag.: 17.20, R2 mag.: 17.73, I mag.: 16.22 according to the USNO-B1.0 catalog (**Monet et al., 2003**)) in the list is at position Right ascension: 05 h 54 m 56.58 s and Declination: +04 53' 54.4". The star has been observed during 4 nights in the period Dec. 1 to Dec. 26, 2006. This resulted in 715 CCD observations. No filter was used during the investigation. A finding chart of the star is given ion Fig. 5. The resulting light curve of the star is given in Fig. 6. The period was found with the period analysis software Peranso 2.11 **(Vanmunster, 2006)**. The derived elements for the minima of this star are the following:

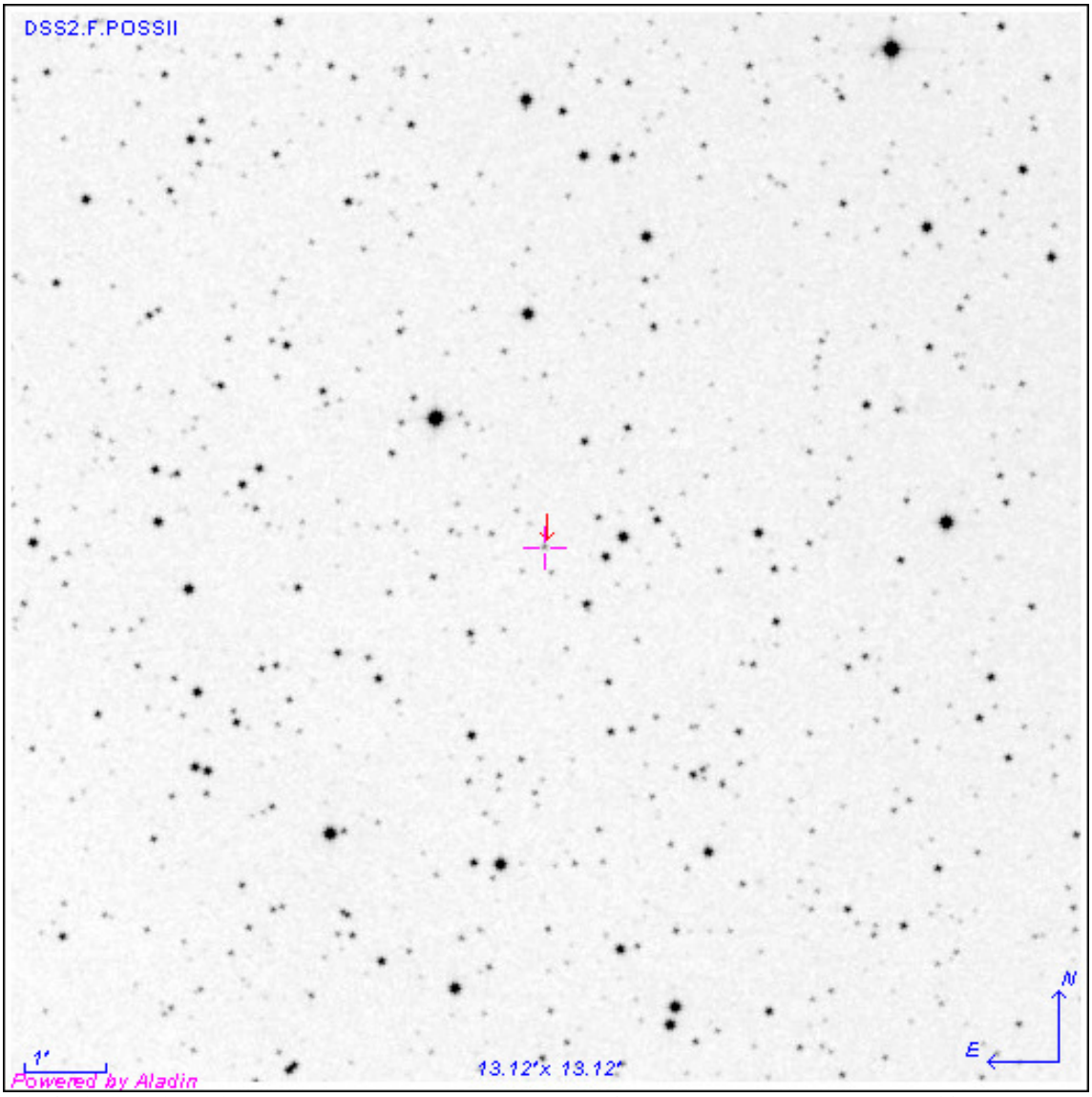

Fig. 5. Finding chart of the star HMB03 = USNO A2 0900 02064201 = USNO B1.0 0948-0071066. The star is indicated by the red cross.

P = 0.33262 +/- 0.00058 [d] with the epoch E_0 = JD 2454080.7679 and an amplitude of the light variation of approximately Δm = 0.4 mag.

The following minima for this star could be deduced:

Delta Mag.	Type of Minimum	JD	Error
4.511	primary	2454080.7679	0.0053
4.509	primary	2454096.7362	0.0035

Discussion:
The classification of all the three stars as EW stars is based on the fact that the light curve shows a smooth top and a very sharp (for stars HMB01 and HMB03) or constant minimum (star HMB02). RR Lyrae star of similar period show a different light curve pattern. Delta Scuti of delta Cephei stars also have a different form of their light curves. Star HMB03 shows a broader primary minimum, which points to the fact that a total eclipse of this binary star system takes place. The secondary minimum does not seem to show a similar pattern. However, the scatter in the data is larger and the minimum is not as sharp as in case of star HMB01 or HMB03. Hence, one could interpret also this minimum as broad and indicating a constant minimum light as expected.

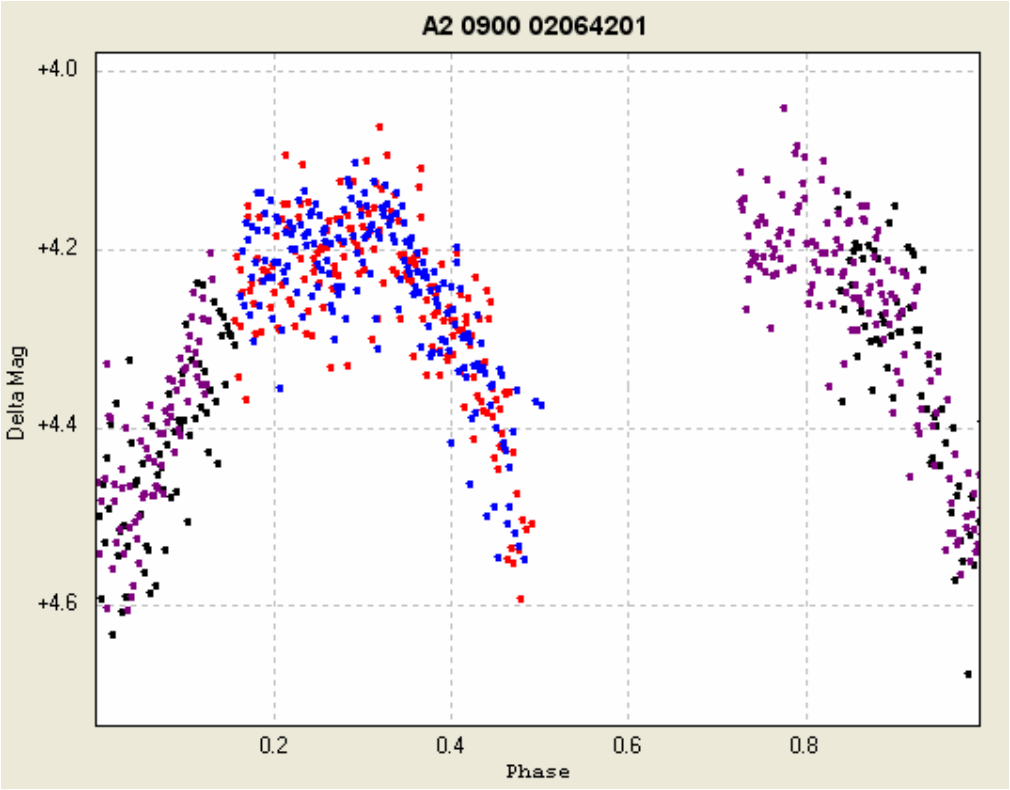

Fig. 6. Phase diagram of the star HMB03 = USNO A2 900 02064201 = USNO B1.0 0948-0071066. The different colours are the different observing campaigns covering a period of more than 16 days.

In addition the International Variable Star Index Database (VSX) of the AAVSO **(AAVSO, 2006)** has been consulted and checked whether the three mentioned new variable stars are already known. This was not the case. The following table gives a summary about the information on the newly detected variables:

Name	I-Magnitude	Delta-Mag.	Epoche (JD)	Period [d]
HMB01	15.03	0.7	2454071.7676	0.6032 +/- 0.0015
HMB02	14.98	0.4	2454071.8727	0.27872 +/- 0.00025
HMB03	16.22	0.4	2454080.7679	0.33262 +/- 0.00058

Acknowledgements:
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