

# Five New Variable Stars Discovered During a Campaign to Determine the Rotation Period of Asteroids

**Antonio Catapano**

**Luca D’Avino**

**Andrea Di Dato**

**Maurizio Mollica**

**Luigi Morrone**

*AstroCampania—Osservatorio Astronomico “Salvatore Di Giacomo” (L07), Agerola (Na), Italy*

**Alfonso Noschese**

*AstroCampania—Osservatorio Astronomico “Salvatore Di Giacomo” (L07), Agerola (Na), Italy, and Osservatorio Astronomico Elianto (K68), Pontecagnano (Sa), Italy*

**Nello Ruocco**

*AstroCampania—Osservatorio Astronomico “Salvatore Di Giacomo” (L07), Agerola (Na), Italy, and Osservatorio Astronomico “Nastro Verde” (C82), Sorrento (Na), Italy; nello\_ruocco@hotmail.com*

**Antonio Vecchione**

*AstroCampania—Osservatorio Astronomico “Salvatore Di Giacomo” (L07), Agerola (Na), Italy*

*Received August 2, 2021; revised August 11, 2021; accepted August 11, 2022*

**Abstract** This paper describes the discovery of five new variable stars, AC\_V1–AC\_V5—two binary systems and three pulsating stars—between 2017 and 2019. They have been included in the AAVSO Variable Star Index, but are being published now. We encourage all observers to further observe these stars so as to better characterize them. It might be interesting to make subsequent observations for constructing O–C diagrams as well as for modeling the binary systems.

## 1. Introduction

In this paper we describe the results of the discovery of five new variable stars, made between 2017 and 2019 during a scheduled northern sky survey to determine light curves of asteroids using the robotic telescope of the astronomical observatory “S. Di Giacomo” in Agerola, Italy. The stars have been named with the acronym AC (AstroCampania—the amateur astronomy club that manages Agerola’s Observatory) followed by the progressive discovery number.

## 2. Instruments and methods

All the observations have been made remotely using the 0.5-m f/8 Ritchey-Chretien telescope and a FLI PL4240 CCD in Agerola and, only for the High Amplitude Delta Scuti (HADS)

stars, the T25 iTelescope, a Planevawe CDK 431-mm with a FLI PL6303E CCD in New Mexico. The search for new variable stars was carried out with the MUNIWIN2 software (Hroch 2014) and the differential photometry was made with MAXIM DL1 (Diffraction Limited 2012). The light curve and the calculation of its main parameters was made with PERANSO3 (Vanmunster 2004–2021).

## 3. Results

Table 1 summarizes the main parameters for the five new variables. Each of them can be easily searched in the AAVSO VSX database (Watson *et al.* 2014) through their identifier as it appears in the first column. In the table, Epoch indicates the time of maximum brightness for pulsating stars and time of primary minimum for eclipsing binaries.

Table 1. Information and results for the new variables discovered.

<i>Star</i> (VSX identifier)	<i>R.A. (J2000)</i> h m s	<i>Dec. (J2000)</i> ° ' "	<i>Const.</i>	<i>V</i>	<i>Period</i> (days)	<i>Epoch</i> (HJD)	<i>Type</i>
AC_V1	17 30 53.42	−12 55 58.1	Ser	18.06–18.51	0.05797	2457921.4725	HADS
AC_V2	17 30 14.60	−12 56 26.0	Ser	15.7–16.11	0.134508	2457921.413	HADS
AC_V3	19 22 11.76	−17 03 10.0	Sgr	16.5–16.75	0.046238	2457929.4157	HADS
AC_V4	07 05 01.31	+20 27 26.7	Gem	15.79–16.30	0.376400	2458125.3333	EW
AC_V5	07 05 29.29	+20 22 54.7	Gem	17.93–18.37	0.262094	2458125.536	EW

### 3.1. AC\_V1

AC\_V1 is a HADS star with a period of 0.05797 d (83.48 m), an amplitude of about 0.45 magnitude, and a range between 18.06 and 18.51 V. In Figure 1, the light curve is phased with the main period of the pulsator. Figure 2 shows the field from the ALADIN interactive sky atlas (Bonnarel *et al.* 2000) with the new variable star in the center.

### 3.2. AC\_V2

AC\_V2 is a HADS star with a period of 0.134508 d (3.2282 h), an amplitude of about 0.41 magnitude, and a range between 15.7 and 16.11 V. In Figure 3, the light curve is phased with the main period of the pulsator. Figure 4 shows the field from the ALADIN interactive sky atlas (Bonnarel *et al.* 2000) with the new variable star in the center.

### 3.3. AC\_V3

AC\_V3 is a HADS star with a period of 0.046238 d (66.583 m), an amplitude of about 0.23 magnitude, and a range between 16.5 and 16.75 V. In Figure 5, the light curve is phased with the main period of the pulsator. Figure 6 shows the field from the ALADIN interactive sky atlas (Bonnarel *et al.* 2000) with the new variable star in the center.

### 3.3. AC\_V4

AC\_V4 is an EW star with a period of 0.376400 d (9.0336 h), an amplitude of about 0.51 magnitude, and a range between 15.79 and 16.30 V. In Figure 7, the light curve is phased with the main period of the binary. Red dots are our observations; black dots are ASAS-SN data. Figure 8 shows the field from the ALADIN interactive sky atlas (Bonnarel *et al.* 2000) with the new variable star in the center.

### 3.4. AC\_V5

AC\_V5 is an EW star with a period of 0.262094 d (6.2903 h), an amplitude of about 0.44 magnitude, and a range between 17.93 and 18.37 V. In Figure 9, the light curve is phased with the main period of the binary. Figure 10 shows the field from the ALADIN interactive sky atlas (Bonnarel *et al.* 2000) with the new variable star in the center.

## 4. Conclusion

Five new variable stars, AC\_V1–AC\_V5 (two binary systems and three pulsating stars), discovered between 2017 and 2019 have been included in the AAVSO Variable Star Index, and are now described here for the first time. We encourage all observers to further observe these stars so as to better characterize them. This work of discovery should only be the starting point from which to start in order to continue following these stars and their trend over time, perhaps by building periodic O–C diagrams and checking whether or not there are changes in the system.

## References

- Bonnarel, F., *et al.* 2000, *Astron. Astrophys., Suppl. Ser.*, **143**, 33 (<https://aladin.u-strasbg.fr>).
- Diffraction Limited. 2012, MAXIM DL image processing software (<http://www.cyanogen.com>).
- Hroch, F. 2014, MUNIPACK (<http://munipack.astronomy.cz/>), Astrophysics Source Code Library, record ascl: 1402.006 (2014ascl.soft02006H).
- Vanmunster, T. 2004–2021, PERANSO v.2.50 light curve and period analysis software (<https://www.cbabelgium.com/peranso>).
- Watson, C., Henden, A. A., and Price, C. A. 2014, AAVSO International Variable Star Index VSX (Watson+, 2006–2017; <http://www.aavso.org/vsx>).

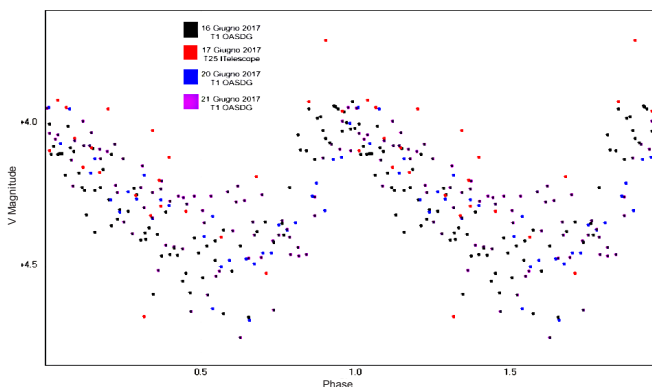


Figure 1. V light curve of AC\_V1.

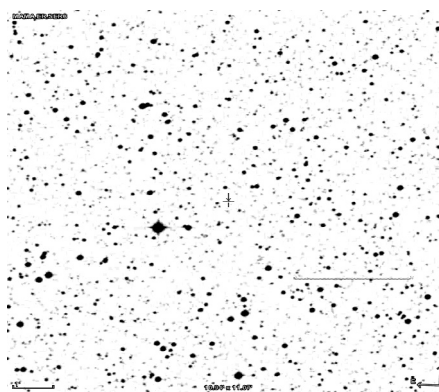


Figure 2. Field of AC\_V1 from ALADIN (Bonnarel *et al.* 2000).

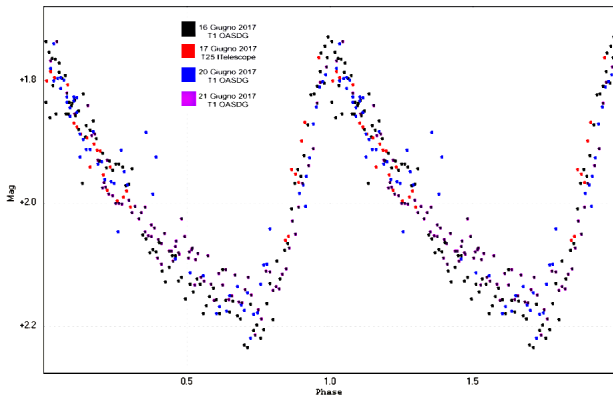


Figure 3. V light curve of AC\_V2.

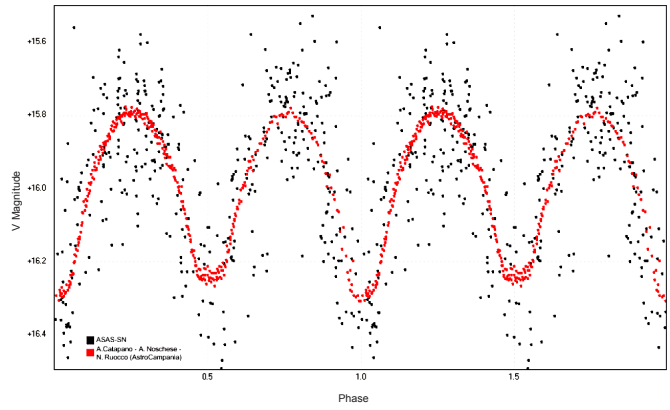


Figure 7. V light curve of AC\_V4.

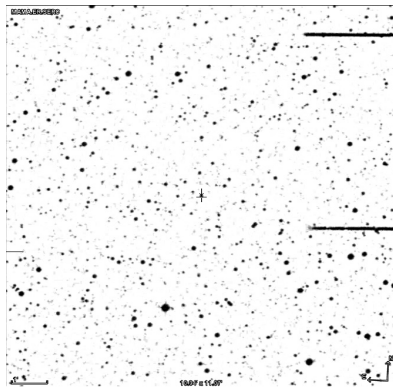


Figure 4. Field of AC\_V2 from ALADIN (Bonnarel et al. 2000).

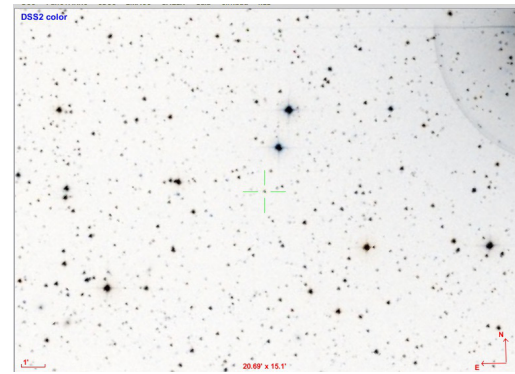


Figure 8. Field of AC\_V4 from ALADIN (Bonnarel et al. 2000).

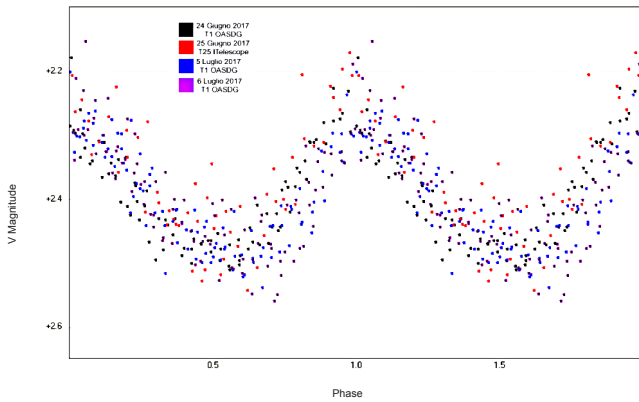


Figure 5. V light curve of AC\_V3.

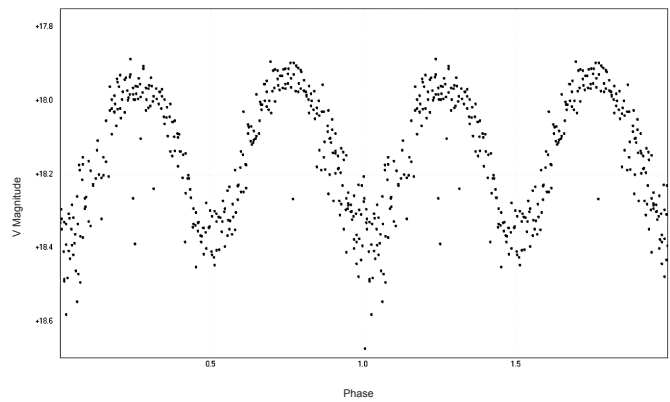


Figure 9. V light curve of AC\_V5.

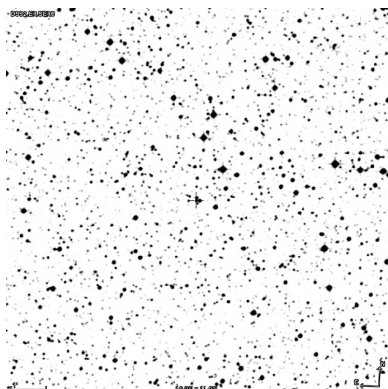


Figure 6. Field of AC\_V3 from ALADIN (Bonnarel et al. 2000).

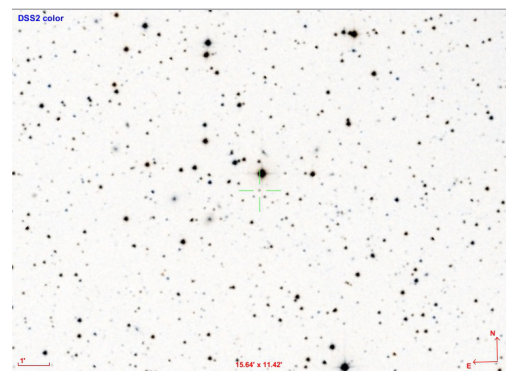


Figure 10. Field of AC\_V5 from ALADIN (Bonnarel et al. 2000).