

## Variable Stars in Cygnus Discovered with Kourovka Planet Search. Part III: Pulsating variables of Delta Scuti type

[A. A. Popov](#)<sup>#1</sup>, [A. M. Zubareva](#)<sup>#2,3</sup>, [A. Y. Burdanov](#)<sup>#4</sup>, [V. V. Krushinsky](#)<sup>#1</sup>, [E. A. Avvakumova](#)<sup>#1</sup>, [K. Ivanov](#)<sup>#5</sup>

#1. Kourovka Astronomical Observatory of Ural Federal University, Ekaterinburg, Russia;

#2. Institute of Astronomy, Russian Academy of Sciences, Moscow, Russia;

#3. Sternberg Astronomical Institute, Lomonosov Moscow State University, Moscow, Russia;

#4. Space sciences, Technologies and Astrophysics Research (STAR) Institute, Université de Liège, Liège, Belgium;

#5. Irkutsk State University, Irkutsk, Russia.

Received: 11.12.2017; accepted: 25.12.2017

(E-mail for contact: [apopov66@gmail.com](mailto:apopov66@gmail.com))

#	Name	Other	Coord (J2000)	Type	Max	Min	System	Period	Epoch (JD)	type	Sp	Comment	L.Curve	Find.Chart	Data
1		2MASS 20250468+5026580	20 25 04.68 +50 26 58.0	DSCT	14.008	14.037	R	0.06543	2456131.40	max			<a href="#">TF1-01345_lc.png</a>	<a href="#">TF1-01345_fc.png</a>	<a href="#">TF1-01345.txt</a>
2		2MASS 20262340+5005365	20 26 23.40 +50 05 36.5	DSCT	12.749	12.769	R	0.13274	2456140.32	max		<a href="#">Comm. 2</a>	<a href="#">TF1-03831_lc.png</a>	<a href="#">TF1-03831_fc.png</a>	<a href="#">TF1-03831.txt</a>
3		2MASS 20274366+4944360	20 27 43.66 +49 44 36.0	DSCT	11.346	11.362	R	0.04184	2456154.24	max			<a href="#">TF1-06321_lc.png</a>	<a href="#">TF1-06321_fc.png</a>	<a href="#">TF1-06321.txt</a>
4		2MASS 20274367+5021300	20 27 43.67 +50 21 30.0	DSCT	12.390	12.403	R	0.04758	2456131.33	max			<a href="#">TF1-06322_lc.png</a>	<a href="#">TF1-06322_fc.png</a>	<a href="#">TF1-06322.txt</a>
5		2MASS 20274485+5025395	20 27 44.85 +50 25 39.5	DSCT	10.795	10.800	R	0.05167	2456063.30	max			<a href="#">TF1-06358_lc.png</a>	<a href="#">TF1-06358_fc.png</a>	<a href="#">TF1-06358.txt</a>
6		2MASS 20274663+5121461	20 27 46.63 +51 21 46.1	DSCT	12.822	12.836	R	0.07053	2456160.27	max			<a href="#">TF1-06411_lc.png</a>	<a href="#">TF1-06411_fc.png</a>	<a href="#">TF1-06411.txt</a>
7		2MASS 20274915+4935599	20 27 49.15 +49 35 59.9	DSCT	12.058	12.080	R	0.08019	2456135.34	max			<a href="#">TF1-06492_lc.png</a>	<a href="#">TF1-06492_fc.png</a>	<a href="#">TF1-06492.txt</a>
8		2MASS 20284384+5031252	20 28 43.84 +50 31 25.2	DSCT	12.761	12.779	R	0.21939	2456160.44	max			<a href="#">TF1-08235_lc.png</a>	<a href="#">TF1-08235_fc.png</a>	<a href="#">TF1-08235.txt</a>
9		2MASS 20291369+5043247	20 29 13.69 +50 43 24.7	DSCT	12.588	12.614	R	0.12895	2456161.43	max		<a href="#">Comm. 9</a>	<a href="#">TF1-09161_lc.png</a>	<a href="#">TF1-09161_fc.png</a>	<a href="#">TF1-09161.txt</a>
10		2MASS 20291725+4943570	20 29 17.25 +49 43 57.0	DSCT	12.739	12.772	R	0.13093	2456160.46	max		<a href="#">Comm. 10</a>	<a href="#">TF1-09262_lc.png</a>	<a href="#">TF1-09262_fc.png</a>	<a href="#">TF1-09262.txt</a>
11		2MASS 20292279+5018015	20 29 22.79 +50 18 01.5	DSCT	13.878	13.912	R	0.17006	2456155.33	max		<a href="#">Comm. 11</a>	<a href="#">TF1-09453_lc.png</a>	<a href="#">TF1-09453_fc.png</a>	<a href="#">TF1-09453.txt</a>
12		2MASS 20294536+5032540	20 29 45.36 +50 32 54.0	DSCT	10.732	10.742	R	0.09654	2456141.39	max			<a href="#">TF1-10158_lc.png</a>	<a href="#">TF1-10158_fc.png</a>	<a href="#">TF1-10158.txt</a>
13		2MASS 20294695+4930547	20 29 46.95 +49 30 54.7	DSCT	11.347	11.352	R	0.06289	2456169.42	max			<a href="#">TF1-10201_lc.png</a>	<a href="#">TF1-10201_fc.png</a>	<a href="#">TF1-10201.txt</a>
14		2MASS 20295420+5032315	20 29 54.20 +50 32 31.5	DSCT	12.385	12.407	R	0.19545	2456168.23	max			<a href="#">TF1-10484_lc.png</a>	<a href="#">TF1-10484_fc.png</a>	<a href="#">TF1-10484.txt</a>
15		2MASS 20302031+4943117	20 30 20.31 +49 43 11.7	DSCT	11.970	11.976	R	0.05801	2456131.38	max		<a href="#">Comm. 15</a>	<a href="#">TF1-11402_lc.png</a>	<a href="#">TF1-11402_fc.png</a>	<a href="#">TF1-11402.txt</a>
16		2MASS 20304189+4957269	20 30 41.89 +49 57 26.9	DSCT	11.649	11.656	R	0.07787	2456168.30	max			<a href="#">TF1-12151_lc.png</a>	<a href="#">TF1-12151_fc.png</a>	<a href="#">TF1-12151.txt</a>
17		2MASS 20304930+5104595	20 30 49.30 +51 04 59.5	DSCT	11.128	11.138	R	0.05266	2456124.29	max			<a href="#">TF1-12383_lc.png</a>	<a href="#">TF1-12383_fc.png</a>	<a href="#">TF1-12383.txt</a>
18		2MASS 20310164+5014147	20 31 01.64 +50 14 14.7	DSCT	11.736	11.744	R	0.07832	2456161.36	max			<a href="#">TF1-12817_lc.png</a>	<a href="#">TF1-12817_fc.png</a>	<a href="#">TF1-12817.txt</a>
19		2MASS 20311156+5111105	20 31 11.56 +51 11 10.5	DSCT	11.251	11.292	R	0.06023	2456160.44	max			<a href="#">TF1-13160_lc.png</a>	<a href="#">TF1-13160_fc.png</a>	<a href="#">TF1-13160.txt</a>
20		2MASS 20311900+4946378	20 31 19.00 +49 46 37.8	DSCT	11.493	11.522	R	0.06808	2456148.34	max			<a href="#">TF1-13402_lc.png</a>	<a href="#">TF1-13402_fc.png</a>	<a href="#">TF1-13402.txt</a>
21		2MASS 20320758+5044470	20 32 07.58 +50 44 47.0	DSCT	11.711	11.721	R	0.08317	2456141.39	max			<a href="#">TF1-14972_lc.png</a>	<a href="#">TF1-14972_fc.png</a>	<a href="#">TF1-14972.txt</a>

22	2MASS 20324010+5036368	20 32 40.10 +50 36 36.8	DSCT	11.529	11.537	R	0.16785	2456163.45	max			<a href="#">TF1-16032_lc.png</a>	<a href="#">TF1-16032_fc.png</a>	<a href="#">TF1-16032.txt</a>
23	2MASS 20325225+5054269	20 32 52.25 +50 54 26.9	DSCT	12.625	12.635	R	0.06599	2456148.30	max			<a href="#">TF1-16430_lc.png</a>	<a href="#">TF1-16430_fc.png</a>	<a href="#">TF1-16430.txt</a>
24	2MASS 20341630+5043362	20 34 16.30 +50 43 36.2	DSCT	11.357	11.362	R	0.04867	2456131.35	max			<a href="#">TF1-19254_lc.png</a>	<a href="#">TF1-19254_fc.png</a>	<a href="#">TF1-19254.txt</a>
25	2MASS 20341779+5041368	20 34 17.79 +50 41 36.8	DSCT	10.965	10.976	R	0.10445	2456124.33	max			<a href="#">TF1-19306_lc.png</a>	<a href="#">TF1-19306_fc.png</a>	<a href="#">TF1-19306.txt</a>
26	2MASS 20343224+4945589	20 34 32.24 +49 45 58.9	DSCT	9.917	9.934	R	0.13487	2456152.25	max		<a href="#">Comm. 26</a>	<a href="#">TF1-19788_lc.png</a>	<a href="#">TF1-19788_fc.png</a>	<a href="#">TF1-19788.txt</a>
27	2MASS 20344974+4953155	20 34 49.74 +49 53 15.5	DSCT	12.138	12.159	R	0.08397	2456167.38	max			<a href="#">TF1-20383_lc.png</a>	<a href="#">TF1-20383_fc.png</a>	<a href="#">TF1-20383.txt</a>

### Comments:

2. There is a second periodicity  $P = 0^d.11972$ .

9. There is a second periodicity  $P = 0^d.12126$ .

10. There is a second periodicity  $P = 0^d.13658$ .

11. There are long-period changes of brightness.

15. There is a second periodicity  $P = 0^d.05356$ .

26. There is a second periodicity  $P = 0^d.15328$ .

### Remarks:

In the current paper, we continue to announce new variable stars discovered in the frame of the KPS (Kourovka Planet Search). Detailed information about the project and about Algol-type eclipsing binaries we detected is provided in the first paper ([Popov et al. 2015](#)), and eclipsing binaries of  $\beta$  Lyrae and W Ursae Majoris- types are presented in the second paper ([Popov et al. 2016](#)).

This paper is dedicated to pulsating variables of the  $\delta$  Scuti type. We discovered 27 such stars.

Each figure consist of three panels. In the upper part, we provide the power spectrum obtained using the [on-line light curve analysis tool](#) by Kirill Sokolovsky. The lower part of each figure has two panels. The star's instrumental magnitude as a function of Julian Date is given in the left panel, and the phase-folded light curve is given in the right panel. We used red colour for R band, green colour for V band, and blue colour for B band data.

### Acknowledgements:

This work has been supported by Russian Foundation for Basic Research grants 14-02-31338 and, partially, 14-02-31056.

The authors wish to thank Dr. Kirill Sokolovsky for providing the on-line lightcurve analysis tool.

This research made use of Aladin (Bonnarel et al., 2000), SIMBAD database (operated at the Centre de Données astronomiques de Strasbourg), the International Variable Star Index (VSX) database (operated at AAVSO, Massachusetts, USA), PyRAF (product of the Space Telescope Science Institute, operated by AURA for NASA), and the NASA/IPAC Extragalactic Database (NED) (operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration).

### References:

- Bonnarel, F., Fernique, P., Bienaimé, O., et al. 2000, *Astron. and Astrophys. Suppl.*, 143, 33  
 Popov, A. A., Burdanov, A. Y., Zubareva, A. M., Krushinsky, V. V., Avvakumova, E. A., Ivanov, K. I., 2015, *Perem. Zvezdy Prilozh.*, 15, No. 7  
 Popov, A. A., Burdanov, A. Y., Zubareva, A. M., Krushinsky, V. V., Avvakumova, E. A., Ivanov, K. I., 2016, *Perem. Zvezdy Prilozh.*, 16, No. 5