

BALKAN COLLABORATION IN THE ARCHIVING OF WIDE-FIELD PHOTOGRAPHIC OBSERVATIONS

K. TSVETKOVA¹, M. TSVETKOV¹, K. Y. STAVREV¹, A. BORISOVA¹
M. STAVINSCHI², V. PROTIĆ-BENIŠEK³

¹*Institute of Astronomy, Bulgarian Academy of Sciences,
72 Tsarigradsko Shosse Blvd., 1784 Sofia, Bulgaria
E-mail katya@skyarchive.org*

²*Astronomical Institute, Romanian Academy,
5 Cutitul de Argint Str., 75212 Bucharest, Romania
E-mail magda@aira.astro.ro*

³*Belgrade Astronomical Observatory, Volgina 7, 11160 Belgrade 74, Serbia
E-mail vprotic@aob.bg.ac.yu*

Abstract. We consider the collaboration in the archiving of wide-field photographic observations in the astronomical observatories from the Balkan peninsula region. As a result of the collaboration the descriptive information for 49.2% of all existing wide-field observations in Bulgaria, Serbia and Romania (40 437 plates) is already included in the Wide-Field Plate Database (WFPDB). An on-line access to this information is organized in Strasbourg Data Center and in Sofia Sky Archive Data Center. A digitized plate archive is on the way to be created as a part of the WFPDB with the operating high-speed Epson Expression 1640XL flatbed scanner and high-precision PDS1010 microdensitometer in Sofia Sky Archive Data Center, as well as with UMAX Alfa Vista II flatbed scanner in Bucharest, which provide good opportunities for an effective processing of the archived observations. Another aspect of the collaboration is the exchange of experience in development and application of astronomical databases (WFPDB and BELDATA) and organization of mirror sites of the databases.

1. INTRODUCTION

The archiving of the wide-field photographic observations has some obligatory steps: to provide good storage with a suitable temperature and humidity free conditions, to give easy access to the plates, to make an inventory of the plate collection, to prepare computer-readable versions of the plate catalogues, to digitize plates and to assure access to the plate digitized information.

The biggest world plate vaults are in the Harvard College Observatory (USA) and in Sonneberg (Germany). Intention to establish Central Plate Store Unit for the European plate archives arose in Brussels with the project UDAPAC, which still is considered as an initiative. A similar initiative for the north American observatories vaults was raised in January 2004 in the Pisgah Astronomical Research Institute.

The effective use of the archived wide-field observations needs plate logs cataloguing in an uniform database format. Despite of the great difficulties with organizing and funding of the cataloguing an acceleration of this process is needed. Another obligatory condition is the existence of high-speed and high-precision microdensitometers, which provide astrometric and photometric accuracy while generating archival digital data. Last five years commercial flatbed scanners were widely spread in many observatories. In the Harvard College Observatory (USA) only some days ago (April 2004) a project for a flatbed scanner with a CCD camera capable to take 5 frames per second special fixturing to hold different size from plates of size up to 14×17 inch was approved.

Realizing the importance of archived wide-field observations astronomers from some Balkan countries initiated in the 90s of 20th century joint projects on the preservation, digitization and re-usage of plate archives. The work in this direction was greatly stimulated by the on-going project in Sofia for the creation of an wide-field plate database.

2. THE WIDE-FIELD PLATE DATABASE

The Wide-Field Plate Database (WFPDB, Tsvetkov 1992, Tsvetkov *et al.* 1998, <http://www.skyarchive.org>), created as a basic source of information for the archived wide-field photographic observations, consists of two parts: (1) Catalogue of Wide-Field Plate Archives (CWFPA) and (2) Catalogue of Wide-Field Plates (CWFP). In the CWFPA (version March 2004) an information for 375 archives with a total of 2 133 912 (2 069 824 direct and 64 088 spectral) plates from 124 observatories can be found. Especially in Europe 256 archives exist with 1 115 468 plates obtained in 74 observatories – more than half of all known wide-field plates world-wide obtained with professional astronomical instruments.

The CWFP up to March 2004 contains descriptive data for 378 187 wide-field photographic observations from 92 plate archives from all over the world.

3. BALKAN OBSERVATORIES, INSTRUMENTS AND PLATE ARCHIVES

In the geographically determined Balkan peninsula region there are astronomical observatories in Bulgaria, Greece, Romania, Serbia and Turkey, but archives of wide-field photographic observations exist only in Bulgaria (Institute of Astronomy, Bulgarian Academy of Sciences), Romania (Astronomical Institute of the Romanian Academy in Bucharest and Cluj) and Serbia (Belgrade Astronomical Observatory). Table 1 presents the astronomical observatories possessing archived wide-field photographic observations.

The main characteristics of the wide-field instruments of the astronomical observatories in Bulgaria, Romania and Serbia are given in Table 2.

As CWFPA (version March 2004) shows, there are 9 Balkan wide-field plate archives obtained with 9 instruments (Table 3). The total number of plates in them is 40 437.

The distribution of the number of wide-field plates obtained in Bulgaria, Romania

Table 1: Balkan astronomical observatories possessing archived wide-field photographic observations

Observatory	Marsden Number	Time Zone [h]	Coordinates		Altitude [m]
			λ	ϕ	
Belgrade	057	+1	20°31'0 E	+44°48'2	253
Bucharest	073	+2	26°05'8 E	+44°24'8	81
Cluj		+2	23°53'5 E	+46°46'5	412
Rozhen	071	+2	24°45'0 E	+41°43'0	1759

Table 2: Wide-Field Instruments: Main Characteristics

WFPDB Instrument Identifier	Telescope Original Name	Telescope Type	Aperture [m]	Focal Length [m]	Scale ["/mm]	Field Size [°]
BEL012	Ascania Rfr	Cam	0.12	1.00	206	7.0
BEL016A	Zeiss Ast	Ast	0.16	0.80	258	11.5
BEL016B	Zeiss Rfr	Cam	0.16	0.80	258	11.5
BUC016	16 cm Camera	Cam	0.16	0.80	258	7.4
BUC038	Prin-Merz Ast	Rfr	0.38	6.00	34	2.3
CLU020	Zeiss Rfr	Rfr	0.20	3.00	82.5	2.1
CLU050	Newton	Rfl	0.50	0.25	68.8	2.3
ROZ050	Schmidt	Sch	0.50/0.70	1.72	120	4.5
ROZ200	2 m RCC	RCr	2.00	16.00	12.9	1.0

Table 3: Balkan Wide-Field Plate Archives

WFPDB Instrument Identifier	Years of Operation	Number of Plates	Archive Data Form ¹	Astronomer in Duty
BEL012	1972-1996	4000	T	V.Protić-Benišek
BEL016A	1936-1985	10000	T	V.Protić-Benišek
BEL016B	1936-1941	500	T	D.Olević
BUC016	1930-1961	180	C	Gh.Bocsa
BUC038	1930-1995	10391	C	Gh.Bocsa
CLU020	1932-1976	1179	C	L.Mircea
CLU050	1952-1957	4821	C	L.Mircea
ROZ050	1979-1994	7359 ²	C	M.Tsvetkov
ROZ200	1979-1993	2007	C	K.Stavrev

¹ C – computer-readable form, T – not in computer-readable form

² 214 of them are objective prism spectral plates

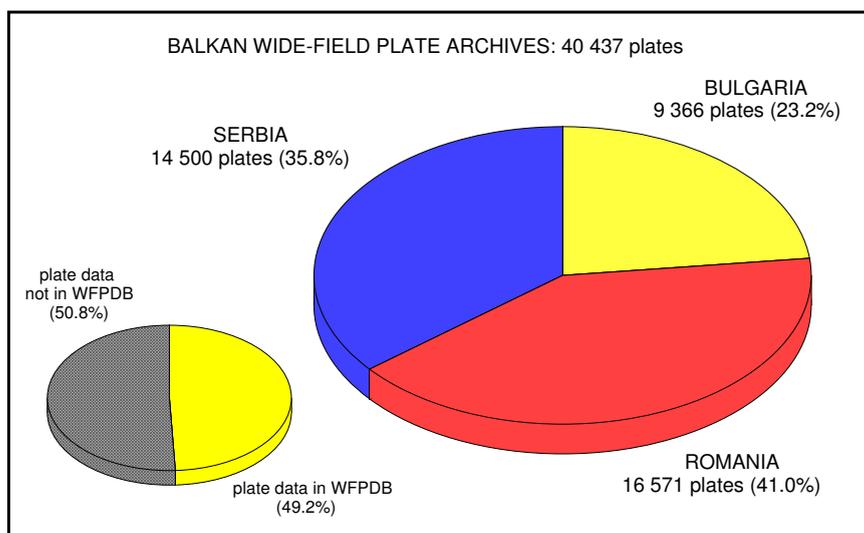


Figure 1: Distribution of the number of wide-field plates among the Balkan countries

and Serbia is shown in Fig. 1. Romania possesses 16 571 plates (41% of all Balkan plates), Serbia – 14 500 (35.8%), and Bulgaria – 9 366 (23.2%).

The data for almost half of all Balkan wide-field plates (19 914) are included in the WFPDB and can be accessed on-line. This concerns the archives of BUC016, BUC038, ROZ050 and ROZ200. The plate data for BEL012, BEL016A, BEL016B, CLU020 and CLU050 is not yet included in the WFPDB.

More information about the archives in Table 3 is given in Stavrev and Barzova (1994); Mutafov *et al.* (1994); Vass (1994); Vass *et al.* (1994); Tsvetkov *et al.* (2000a; 2000b); Chis *et al.* (2000); Blaga *et al.* (2003).

4. SCANNERS

The Sofia Sky Archive Data Center (SSADC) has at its disposal a PDS 1010plus microdensitometer (the formal ESO one) for precise plate digitization. Since August 2003 SSADC possesses also a flatbed scanner Epson Expression 1640XL with a scanning platform 310×437 mm and resolution 1600×3200 dpi. The duration of the scanning for plate size 16×16 cm is 5 min with a volume of the digitized information 120 Mb. A flatbed scanner UMAX Alpha Vista II with a resolution 1200×2400 dpi is at disposal in the Astronomical Institute of the Romanian Academy (Bucharest). Its scanning platform is 203×254 mm. The duration of the scanning for 9×5 cm plate is 6 min (2 min for prescan and 4 min for real scan) with a volume of the digitized information about 30 Mb for this plate size.

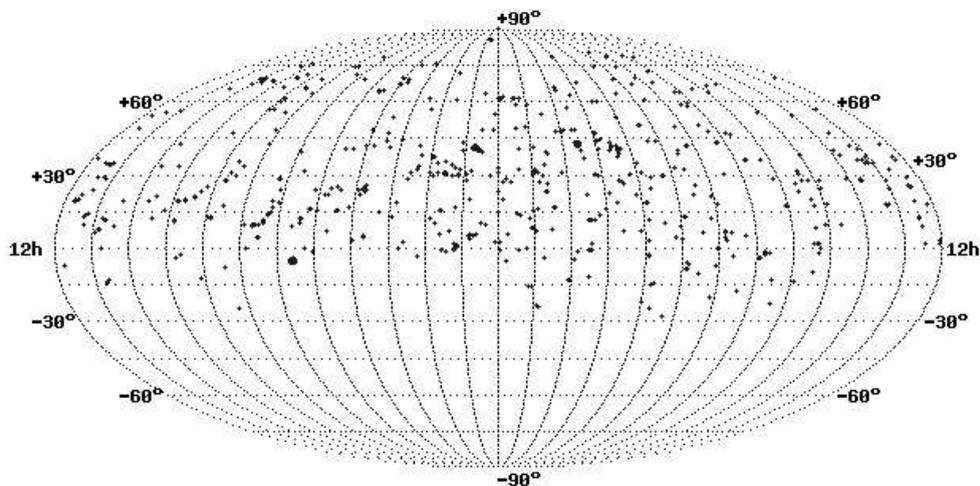


Figure 2: All-sky distribution for the Rozhen 2 m RCC (ROZ200) plates.

5. PROJECTS AND TOPICS

There are two bilateral projects:

- between the Space Research Institute of the Bulgarian Academy of Sciences and the Astronomical Observatory Belgrade, titled "Development and Application of Astronomical Databases", and
- between the Institute of Astronomy of the Bulgarian Academy of Sciences and the Astronomical Institute of the Romanian Academy, titled "The Wide-Field Plate Database: Application of the Romanian Photographic Plates".

The number of participants in these projects is : 6 from Bulgaria, 6 from Romania and 11 from Serbia.

The main topics of collaboration can be summarized as follows:

- Cataloguing of wide-field photographic observations,
- Digitization of selected plates,
- Plate processing,
- Application of archived observations,
- Exchange of experience and astronomical data (WFPDB and BELDATA).

6. RESULTS

For the period of the collaboration the descriptive information for the Bucharest wide-field photographic observations was included in the WFPDB. An on-line access to this information for the astronomical community was provided through the VizieR facility in Strasbourg (since 1996, <http://vizier.u-strasbg.fr/cats/VI.htx>), and the WFPDB updated version in SSADC (since November 2001, <http://www.skyarchive.org>). The results from the analysis of the Bucharest plate archives are

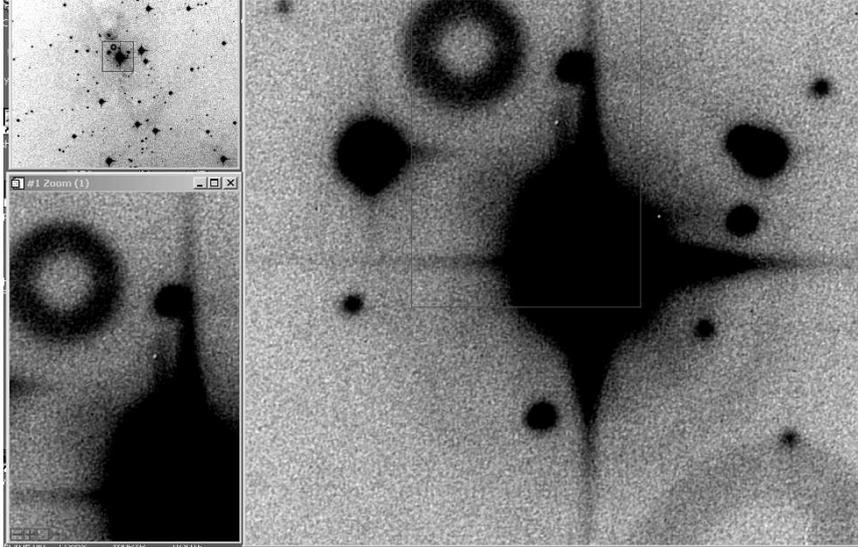


Figure 3: Images of the ROZ200 001655 plate with the variable star KH 15D in the stellar cluster NGC 2264.

presented in Vass (1994), Vass et al. (1994), Tsvetkov et al. (2000a, 2000b). All-sky distribution of the plate centers of the Bucharest plate archives (and of all other archives included in the WFPDB) can be found at <http://draco.skyarchive.org/archives/archives.html>. In Fig. 2 all-sky distribution taken from the same URL address for the Rozhen 2 m RCC (ROZ200) plates is presented.

The information for the Cluj archives (Chis et al., 2000; Blaga et al., 2003) has been added to the CWFPA (version March 2004).

The creation of an archive of digitized preview images of plates as an unseparated part of the WFPDB has started, as well as of an archive of selected digitized plate images to be available on-line. The beginning of this work was the digitization of selected interesting Bucharest plates containing images of more than 4 minor planets. The plates have been scanned with the PDS 1010plus microdensitometer (see Tsvetkov et al., 2000a; 2000b). Fig. 3 shows a part of digitized with the PDS1010 plus microdensitometer ROZ200 001655 plate with the variable star KH 15D in the stellar cluster NGC 2264 (K7 pre-main sequence cluster member with 48 day periodicity and extremely deep $\sim 3.5^m$ minima, caused by eclipse from a circumstellar disk).

Archive of the scanned Pleiades plates obtained in Bucharest, Cluj, Belgrade and Rozhen has been prepared using besides the scanners mentioned above also the flatbed scanner UMAX PowerLook 3000 of Konkoly Observatory with resolution 3048 dpi ($8 \mu\text{m}$). In Fig. 4 a part of the digitized with the Epson Expression 1640XL flatbed scanner Pleiades ROZ050 000057 plate obtained by multiexposure method (6 exposures of 10 min each) is given.

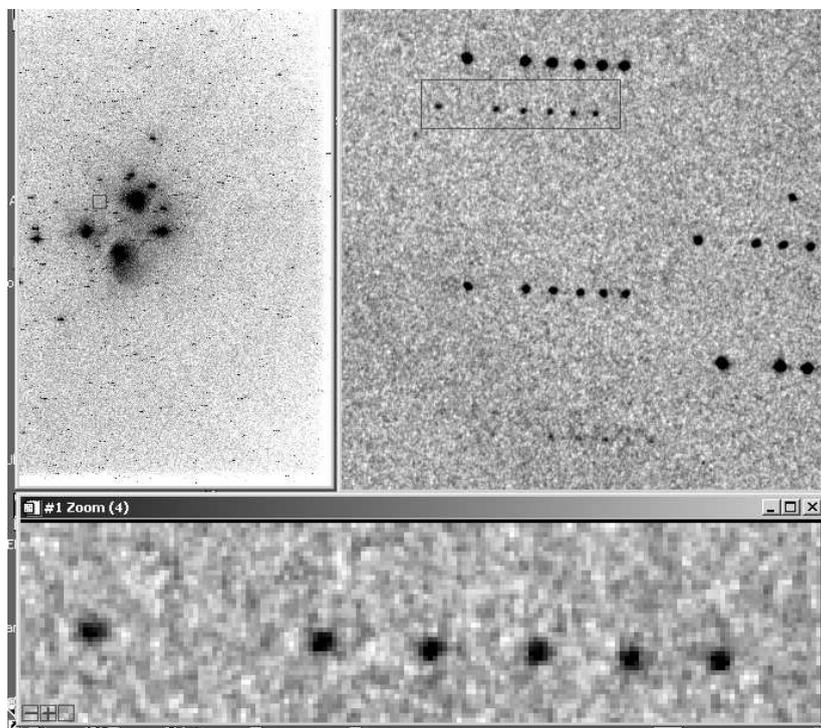


Figure 4: Images of the Pleiades ROZ050 000057 plate obtained by multiexposure method.

Some test scans of the Cluj plates in the Pleiades have been made with the UMAX Alpha Vista II scanner in Bucharest for the joint investigations of the Pleiades red dwarf stars.

7. FUTURE PLANS

The Cluj archive and the last 180 plates, obtained in Bucharest in the period 1993 – 2001 in the frames of the programme for the connection of optical (FK5) and radio (VLBI) observations of reference stars (so called CONFOR project), will be added to the WFPDB. The preparation of a plate catalogue in the WFPDB format for the wide-field photographic observations at the Astronomical Observatory Belgrade will be the final stage for the Balkan archiving. The plate catalogue will be included in the WFPDB and in BELDATA. For both databases mirror sites will be organized.

The creation of an archive of digitized plates with an on-line access will have a main priority in the working programmes of the bilateral projects. Digitized archival wide-field observations will be used for investigations of the Pleiades red dwarf stars, aimed at revealing their long-term behaviour (Borisova et al., 2002; 2003).

References

- Blaga, C., Chis, G.-D., Mircea, L.: 2003, *Rom. Astron. J.*, **13**, 83.
- Borisova, A.P., Tsvetkov, M.K., Tsvetkova, K.P., Hambly, N., Kalaglarsky, D.G.: 2002, *Publ. Astron. Obs. Belgrade*, **73**, 81.
- Borisova, A.P., Tsvetkov, M.K., Tsvetkova, K.P., Hambly, N., Kalaglarsky, D.G., Richter, G.M., Boehm, P., Kelemen, J., Fresneau, A., Argyle, R.W.: 2003, *Astronomical and Astrophysical Transactions*, **22**, 487.
- Chis, G.-D., Blaga, C., Mircea, L.: 2000, *Rom. Astron. J.*, **10**, 191.
- Mutafov, A., Ilcheva, P., Kusheva, M., Michailov, M., Borisov, Z., Lazarov, N.: 1994, in Proc. IAU Symp. 161 "Astronomy from Wide-Field Imaging", 23-27 August 1993, Potsdam, Germany, Eds. H.T. MacGillivray et al., Kluwer, Dordrecht, p. 377.
- Stavrev, K.Y., Barzova, I.S.: 1994, in Proc. IAU Symp. 161 "Astronomy from Wide-Field Imaging", 23-27 August 1993, Potsdam, Germany, Eds. H.T. MacGillivray et al., Kluwer, Dordrecht, p. 371.
- Tsvetkov, M.: 1992, *IAU WGWFI Newsletter* 2, 51.
- Tsvetkov, M.K., Stavrev, K.Y., Tsvetkova, K.P., Semkov, E.H., Mutafov, A.S., Michailov, M.-E.: 1998, in Proc. IAU Symp. 179 "New Horizons from Multi-Wavelength Sky Surveys", Eds. McLean, B. et al., Kluwer, Dordrecht, p. 462.
- Tsvetkov, M.K., Stavinschi, M., Tsvetkova, K.P., Stavrev, K.Y., Bocsa, G., Popov, V.N., Cristescu, C.: 2000a, *Baltic Astron.*, **9**, 573.
- Tsvetkov, M., Stavinschi, M., Tsvetkova, K., Stavrev, K., Bocsa, G., Popov, V., Cristescu, C.: 2000b, *Rom. Astron. J.*, **10**, 177.
- Vass, G.: 1994, *Rom. Astron. J.*, **4**, 183.
- Vass, G., Bocsa, G., Ionescu, V., Alexiu, A., Birlan, M.: 1994, *Rom. Astron. J.*, **4**, 179.