

THE ZVENIGOROD ASTRONOMICAL PLATE COLLECTION PRESENTED IN THE WIDE-FIELD PLATE DATABASE

SERGEI V. VERESHCHAGIN¹, NATALIA V. CHUPINA¹,
VALERY P. OSIPENKO¹, OLGA B. DLUZHNEVSKAYA¹
and MILCHO K. TSVETKOV²

¹*Institute of Astronomy of the Russian Academy of Sciences,
48 Pyatnitskaya Str., 119017, Moscow, Russia*

²*Institute of Astronomy, Bulgarian Academy of Sciences,
72 Tsargradsko Shosse Blvd. , 1784 Sofia, Bulgaria*

E:mail: svv@inasan.ru

Abstract. The results of the plate cataloging and digitization in the Zvenigorod Observatory are described. The observational material was obtained in the period 1972 - 2005 with the 40 cm Carl Zeiss astrograph (F=200 cm, field size 8x8 sq. deg., scale 100 arcsec/mm). The archive includes at present 3703 plates – observations in the northern hemisphere mainly for mapping the sky according to the FON program. In addition, other objects as asteroids, minor planets, Pluto, Mars, etc. were observed too. A part of the archive is scanned already, as well as original observational logbooks. These results are included in the Wide-Field Plate Database in Sofia (www.skyarchive.org) and described in the site of the Institute of Astronomy, RAN (<http://www.inasan.ru/rus/scan/>).

1. INTRODUCTION

The Zvenigorod Observatory of the Institute of Astronomy of the Russian Academy of Sciences has been built in the end of 50-th with the beginning of the era of the artificial satellites launched by the Soviet Cosmic Program. The primary goals of the observatory were monitoring of artificial objects and objects of solar system: minor planets, asteroids, comets. Stars for astrometry also were observed for the creation of astrometric catalogue (before the PPM era).

Now the Zvenigorod observatory manages an electronic library of astronomical negatives received with its own telescopes and instruments. Here we describe the Zvenigorod astrograph plate collection. It includes about 4 000 astronomical negatives. The digitization is carried out by means of two EPSON 1640 XL scanners.

2. CONTENT OF THE ZVENIGOROD ASTROGRAPH PLATE ARCHIVE

The Zeiss-400 astrograph is mounted in Zvenigorod in 1972. Its focus is 200 cm; the lens diameter is 40 cm. The plates have sizes 30 x 30 cm, covering the sky region 8 x 8 degrees. 3703 negatives have been received in the period 1972-2004. Distribution of plates with years is shown in Fig. 1. Fig. 2 shows the plate distribution according to observing programs.

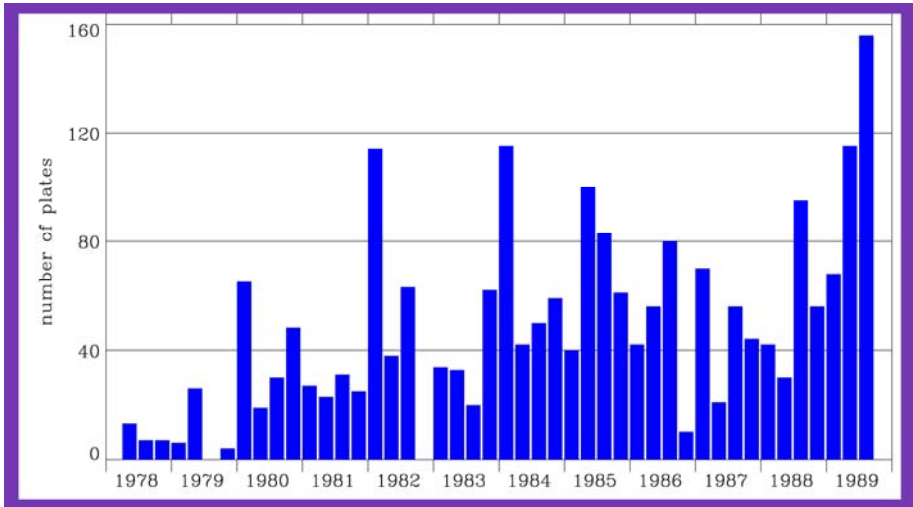


Figure 1. Distribution of the number of available Zvenigorod astrograph plates with years.

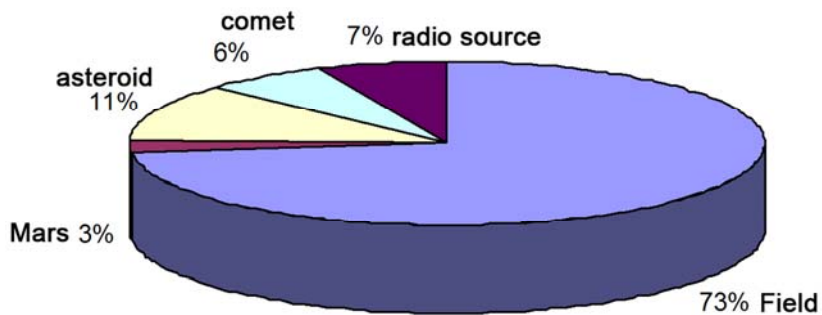


Figure 2. Plate Collection contents according to programs of observations.

2.1. The Fon Program

The Photographic Survey of the Sky (FON) was carried out in the period 1980 - 1992 for astrometric catalogue creation. The FON program comprises about 50% of the whole collection. Its completeness is up to 16.5 magnitudes. It covers the sky between -6 to +90 degrees. The neighboring plates overlap each other 50%. There were exceptions in winter zones: R.A. from 4 till 9 h and DEC from -2 up to +25 degrees and a few ones from 16 till 18h at low delta. Each plate has two exposures with small shift of the telescope between them: long one is usual near 30 minutes and short one – 1-2 minutes. The exposures were set in the way that the plate images of stars up to 16.5 magnitudes to be well visible. Actually the limited magnitude is just beyond 14 - 15 magnitudes. V. P. Osipenko and V. A. Jurevich conducted the observations.

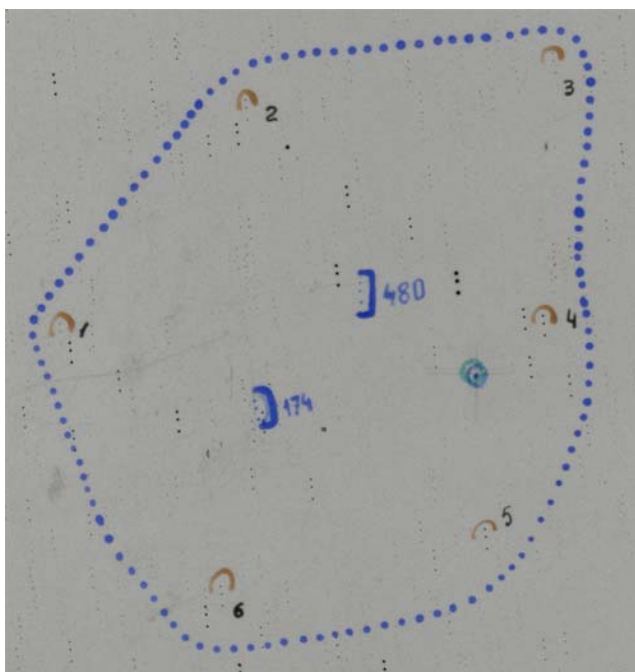


Figure 3. The astrograph plate fragments include the asteroid and stars images in the form of a chain with three exposures.

2.2. The Asteroids Program

The program of asteroids observations from 1978 up to 1992 was executed by ITA supervision and includes 20 selected asteroids. The second program was carried out under IAU from 1980 to 90-th years and it is a subprogram of the photographic observation of 15 selected asteroids. The program goal is the position specification at a point of a spring equinox. Three exposures with camera

shifted in declination between exposures (which took usually a few minutes) were carried out. Thus the sequence of images of the observed minor planet is inclined in relation to a star image sequence and thus it is easy for finding the objects on a plate (see Fig. 3). The coordinates of the main object (a minor planet from the list of ITA RAN), as well as of other asteroids that have casually appeared on the same negative, were measured. The asteroids program comprises about 30% of photographic collection. V. P. Osipenko received more than 60% of the plates.

2.3. The Comets Program

The comets observations were additional for the observers - the observatory had not an official program for a long period. Later the Zvenigorod Observatory took a part in the respective international program with the observations of the comets of Giacobini-Zinner, Halley and Hale-Bopp. For the exact coordinates definition a star-shaped comet image was used. The astrograph allows receiving the coordinates of a comet with accuracy 3-5 arcsec. For this purpose a chain of exposures of 5 sec + 15 sec + 45 sec + 135 sec + 2 minutes + 6 minutes was used. Besides, observations for studying comet tails and different formations inside it (separations, condensations, turbulences) with exposure one or more hours were carried out. The guiding star was close to the comet head and displaced from the plate center. So it was possible to receive the tail image with length up to 7° (25 cm). The comets program comprises about 8% of the whole plate collection.

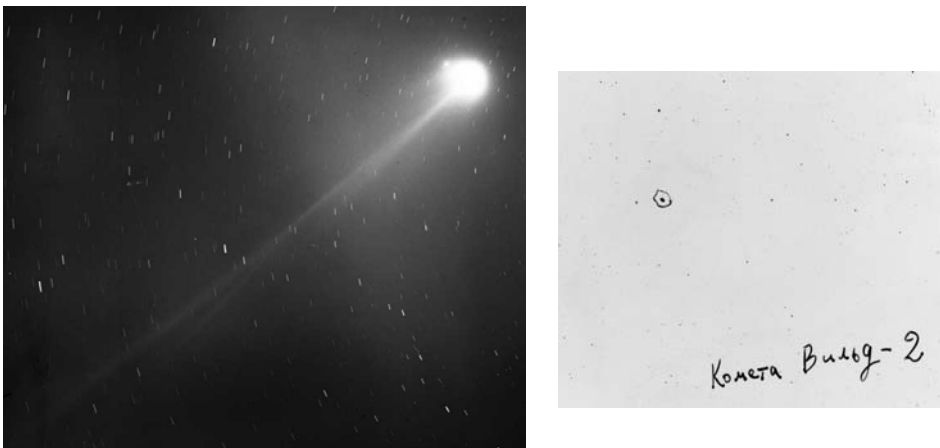


Figure 4. The star-shaped image of the comet of Hyakutake B2 passed on the shortest distance from the Pole (4 degrees).

2.4. The Radio Sources

The first joint program of the Soviet observatories where the astrograph has been involved was the observation of the nine bright quasars (up to 18th magnitude) with a point type images. The program goal was the construction of inertial coordinates system for which reference stars from the catalogue of star positions were used. In this case the long exposures were required. Our plates have been sent to Pulkovo Observatory where they were processed. Further the observatory participated in the program of drawing up of the catalogue of reference stars around 190 radio sources. The program coordinator was Dr. N.G. Rizvanov from Kazan Observatory. This program comprises about 8% of all negatives.

2.5. Pluto And Mars Observations

These plates comprise about 3% of the whole collection. The Pluto observations were carried out in 1998 - 2005 for specification of its orbit. The plates with size 9 x 12 cm were used for this purpose. The observation conditions were adverse: the planet moves at low distance above the horizon. The time of observations was limited: one week at the evening visibility at the end of Spring and one week of morning visibility at the end of Summer. Nevertheless V.P. Osipenko has received nearly 180 plates. The observations of Mars were used for maintenance of the flights of two Fobos satellites in 1988.

3. ACCESS TO ARCHIVE

The observatory working team put the specific target: creation of a database of a plate images at the Zvenigorod observatory, installation of the software and of the digital plate archives of the collection on the servers of the Institute of Astronomy and online access and support to them.

We scan the plates with the EPSON 1640 XL scanner. Two types of image data were obtained as a result of the scanning:

1) The full-colour preview JPG in low-resolution scans (3MB). They are useful for the users to get information about the plate quality, and see the observer remarks on the plate surface. Also we obtained the TIFF-preview images with resolution 1200 dpi (600MB) in the print case.

2) The main data are the plate scans with resolution 1600 dpi in FITS-format (700MB).

This archive is stored in the Zvenigorod Observatory.

СКАНИРОВАНИЕ АСТРОНОМИЧЕСКИХ ФОТОПЛАСТИНОК НА ЗВЕНИГОРОДСКОЙ ОБСЕРВАТОРИИ ИНСТИТУТА АСТРОНОМИИ РАН

Общая информация

Фотграфическая астрономия существует уже около 140 лет. За это время на обсерваториях было накоплено огромное количество фотопластинок - их число оценивается в три миллиона.

На пластинках зафиксирована уникальная информация о Вселенной. Эта информация неповторима и может быть востребована для решения научных и иных задач. С помощью астрофотографов могут осуществляться открытия новых объектов и явлений. Данные обработки пластинок могут использоваться для расчетов орбит движущихся объектов (астероидов, планет, ИСЗ). Неценима такая информация и для изучения объектов с переменным блеском, например новых и сверхновых.

Таким образом, получается, что электронные архивы - средство не только хранения информации, но и обеспечения моментального доступа к большим массивам информации широкому кругу пользователей.

Полезные ссылки

Сканирование в астрономии

WIDE-FIELD PLATE DATABASE

The Aladin Interactive Sky Atlas

MAST Multimission Archive at Space Telescope

Выбор пластинок:

Укажите область на небе или/или дату получения негатива. Область задается своим центром и радиусом. Определите дату.

Центр области (J2000):
 Прямое восхождение (hh mm ss) Склонение (dd mm)

Радиус в градусах (xx.xxx)

год месяц день

Selected plates:

date: 1980-05

Plate number	Optical center	exp	Exposure date	Begin exposure	Exp length	Project	Object name	Object type	Observation method	magn. limit	f.c.	Pressure	Observer	Digital
1	0154 12 54 31 +11 32	1	1980-05-11	20:03.00	03 00	ROAS	1252+119	star around a radio source	direct photogr., multisp.	16.6			Yurevich	no
		2	1980-05-11	20:07.00	03 00									
2	0155 13 30 49 +30 30	1	1980-05-11	20:17.00	03 00	ROAS	1328+307	star around a radio source	direct photogr., multisp.	17.0	2		Yurevich	no
		2	1980-05-11	20:21.00	03 00									
3	0156 14 07 15 +28 28	1	1980-05-11	20:30.00	03 00	ROAS	1404+286	star around a radio source	direct photogr., multisp.	14.0			Yurevich	no
		2	1980-05-11	20:34.00	03 00									
4	0157 14 07 15 +28 28	1	1980-05-11	20:50.00	40 00	ROAS	1404+286	star around a radio source	direct photogr.	14.0	1		Yurevich	no
5	0158 16 41 41 +39 42	1	1980-05-11	21:37.00	64 00	ROAS	1641+399	star around a radio source	direct photogr.	17.0			Yurevich	yes


Total number of plates: 5

Figure 5. The description of the plate archives in the site of the Institute of Astronomy, RAS (<http://www.inasan.ru/rus/scan>).


We created the computer-readable catalogue of the astrograph plates (ASCII). Access to it is available both in INASAN server¹ and in the WFPDB (Tsvetkov, 2005; Tsvetkov and Tsvetkova, 2008).

In the INASAN site there is a detailed description of the instruments, archive and observational programs. Also there the plate information can be found and a search with various parameters is organized (see Fig. 5).

¹Chupina N., Vereshchagin V., The INASAN plate archive (<http://www.inasan.ru/rus/scan>).



Wide-Field Plate Database - Sofia



[WFPDB](#)
WFPDB@VizieR
[Aladin](#)
[Other Plate Catalogues](#)
[Access Log](#)
[Help](#)

Details for archive: ZVN040A

<i>Location of the Archive:</i>	<i>Clear aperture: 0.40 m</i>
Site: Zvenigorod	<i>Mirror diameter:</i>
Country: Russia	<i>Focal length: 2.00 m</i>
<i>Observatory:</i>	<i>Scale: 103 "/mm</i>
Name: Zvenigorod	<i>Type: Ast</i>
Site: Zvenigorod	<i>Field size: 8.6°</i>
Country: Russia	<i>Years of operation:</i>
<i>Time zone: +3 h</i>	From: 1972
<i>East longitude: 36° 45.5'</i>	To: 1992
<i>Latitude: 55° 41.9'</i>	<i>P/F:</i>
<i>Altitude: 198 m</i>	

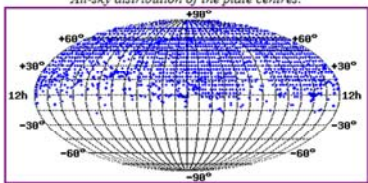
<i>Number of direct plates: 4500</i>	<p style="font-size: x-small;"><i>All-sky distribution of the plate centres:</i></p> 
<i>Archive type: C</i>	
<i>Number of spectral plates:</i>	
<i>Archive type:</i>	
<i>Number of plates in WFPDB: 2188</i>	
<i>Quality: A</i>	
<i>Astronomer in charge: S.Vereshchagin</i>	

Figure 6. An example of WFPDB search: ZVN040 details with the all-sky distribution of the astrograph plate centers in the equatorial coordinates (J2000).

In the Wide-Field Plate Database - Sofia Search Page (<http://www.skyarchive.org>), the information on every plate from the catalogue can be retrieved using the observatory identifier (ZVN) followed by the instrument aperture (040), plus the original plate number. At WFPDB you can find more details for the location of the archives, the observatory specifications, the parameters of the telescope, and the period of its operation, the coordinates of the plate center in epoch 2000.0, the date and beginning of the observation in UT, object name and type, method of observation, number of exposures and their duration, type of emulsion, filter and spectral band, the size of the plate, the quality of the plate, the name of the observer, the status of plate digitization, the name of astronomer in charge (see Fig. 6 and Fig. 8).

The logbooks were digitized too. They can be seen in a database (see Fig.7). Each plate has the reference to corresponding record in digitized logbook.

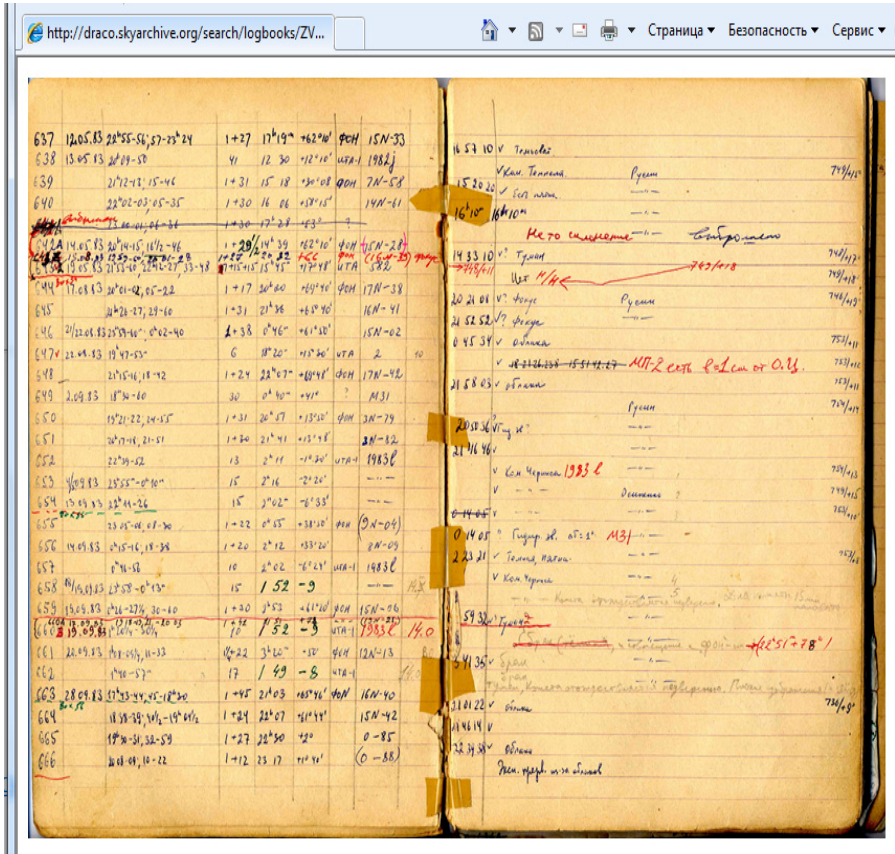


Figure 7. An example of WFPDB search: the logbook page for plates with numbers from 637 to 666.



Wide-Field Plate Database - Sofia



[WFPDB](#)

[WFPDB@VizieR](#)

[Aladin](#)

[Other Plate Catalogues](#)

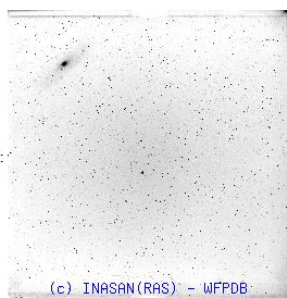
[Access Log](#)

[Help](#)

Details for: ZVN040A000655

IDobs: ZVN	OBJNAM:
IDins: 40	OBJTYP: F
IDSuf1: A	METHOD: 2
IDno: 000655	MULTEX: 2
IDSuf2:	EXP: 1.0
RAJ2000: 00 57 46	EMULS: ZU21
DEC2000: 39 06 13	FILT:
CCOD:	SPEC:
DATE: 1983 09 13	DIMx: 30
UT: 23 05 00	DIMy: 30
TCOD:	
QUALITY:	
NOTES: EXP(1) BEGIN=23 05 00 END=23 06 00	
EXP(2) BEGIN=23 08 00 END=23 30 00	
OBSERVER: Osipenko	
AVAILABILITY:	
DIGITIZATION:	
Original Log-book scan: logbooks/ZVN040A000637-666.jpg	

PREVIEW:



SCAN: N/A

Figure 8. An example of WFPDB search: the details for plate with number 655.

Acknowledgements

This work is supported by the Bulgarian National Science Fund project 00-02-275 and the bilateral project Astrobases between BAS and RAS.

References

- Tsvetkov, M.: 2005, Wide-Field Plate Database: a Decade of Development, Virtual Observatory: Plate Content Digitization, Archive Mining and Image Sequence Processing, iAstro workshop, Sofia, Bulgaria, 2005, pp. 10-41 (2006, <http://www.skyarchive.org>).
- Tsvetkova, K., Tsvetkov, M.: 2008, Catalogue of the Wide-Field Plate Archives, VizieR On-line Data Catalog: VI/126, 10/2008.