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Preface

Dear Friends of Astronomy,

you have in your hands the proceedings from the first workshop about glass plate negatives. This proceedings put together selected lectures in the form of articles from the workshop.

The ASTROPLATE workshop held in Prague, Villa Lanna, in March 2014 represented major event in investigation, archiving, and digitization of astronomical photographic archives including all aspects. This volume represents collection of papers related to presentations and posters presented at the confrence.

The photographic emulsion was the only medium for creating and storing images in astronomy for more than 100 years, from the discovery of photography up to the beginning of the era of electronic imaging devices (mostly CCD) in early 1980. And the same was valid for all other areas working with photographs including other sciences, national musea and archives, etc. The astronomers need to save indeed a rich variety of of types of images ranging from direct images of stars and other celestial objects to wide field images covering large sky areas, to various types of spectral images, both wide-field with many spectral images, to just single recorded spectrum. I have got the opportunity to visit and work with more than 50 astronomical photographic archives. In last few years, I have found increasing number of damaged or even very damaged plates in these collections, the two main types of damage being the released emulsion layer and various types of yellow spots known as gold disease. We have established a consortium with specialists working in chemistry and photography restoration, in order to exploit the cause of these damages. It became obvious that if we want to save the large scientific cultural and historical heritage included in these archives, we need both national and international collaboration At the same time, scanning of photographic records started at numerous institutions, with different approaches, technologies, and methods. Again it became evident that wider collaboration is necessary to optimize the digitization procedures in all aspects including metadata treatment. This was the background of the idea to organize an international workshop in Prague, where specialists of all involved disciplines could meet and discuss their results. We were very impressed by the response of the community, and by the high level of the contributions presented at the ASTROPLATE conference. Unfortunately, many of our colleagues were unable to attend this time for various reasons. We plan to organize 2nd ASTROPLATE conference in spring 2016, again in the beautiful Villa Lanna in Prague.

René Hudec

Plate archive of Nikolaev Astronomical Observatory: digitization, databases, image processing and results of current research

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Abstract

Archive in Nikolaev contains more than 8300 photo plates obtained with the Zonal Astrograph (D=160 mm, F=2040 mm, FOV= 5° x 5°) in 1929-1999. Structure of the archive is given. We started digitization of plates in 2007. 99% images of plates from the archive are available for preview via web site of Ukrainian Virtual Observatory. Image processing of plates in selected areas is carried out using different software to obtain coordinates of stars. In 2012, catalogue of about 900 thousand stars $(8\text{-}16)^m$ at the mean epoch J1981.6 was compiled. Standard deviations of catalogue positions on both coordinates are ranged from 0.02-0.03" for the stars $(8\text{-}12)^m$ to 0.05-0.06" for the stars $(13\text{-}15)^m$. This catalogue was used as the first epoch together with modern CCD catalogues as the second epoch. In 2013, we compiled catalogue of positions and proper motions for 700 thousand of stars in selected fields with standard deviation about 0.03" on both coordinates.

Keywords: plate archive, digitization, image processing, database, virtual observatory.

Introduction

Archive in Nikolaev contains more than 8300 photo plates obtained with the Zonal Astrograph (D=160 mm, Iris = 120 mm, F=2040 mm, FOV= 5° x 5°) (Fig.1) in 1929-1999. Telescope was build by Carl Zeiss company (Germany) in 1926 by request of Pulkovo observatory for observation of AGK catalogue. At the beginning, sizes of used photo plates were 200x200 mm. Telescope was installed in Pulkovo in 1927. After renovation, the telescope was installed at Simeiz branch of Pulkovo observatory in 1937. The telescope was hardly damaged during the Second World War, and astronomers managed to save only objective, micrometer and plate box. After telescope renewal in 1960-1961 at LOMO factory, the telescope was moved to Nikolaev branch of Pulkovo observatory and operated as the Zonal Astrograph in 1961-1999. Sizes of used photo plates during this time period were from 90x120 mm to 240x240 mm. In the 21st century, telescope was equipped with one CCD and two TV cameras and renamed as the Multichannel Telescope [1].

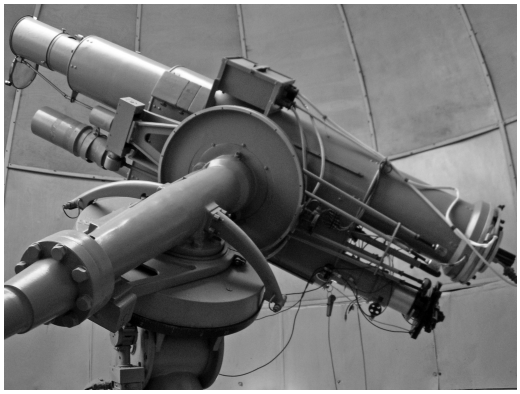

Fig.1 Multichannel telescope in 2005.

Data processing and digitization of plates

We converted observing log books from textual to electronic media in 2004-2006. The obtained data was used to compile electronic files in accordance with a format required by the Wide-Field Plate Database (WFPDB, Bulgaria) [2]. In 2007, the electronic files were included into the WFPDB [3].

We started digitization of plates in 2007 by using the HP 3300 scanner and saving images as BMP files at 600 DPI resolution. In 2008, we replaced the scanner with Epson Perfection V200 (3.2D), and saved images in FITS format (Tables 1, 3). In 2009, we started scanning with 1200 DPI resolution for scientific purposes to obtain coordinates of stars. In 2011, we replaced the scanner with Epson Perfection V750 Pro (4.0D), and scanned plates with 1200 DPI resolution to obtain high quality images for preview and science applications (Table 3). Since 2013, we have rescanned some plates, which were scanned in 2007-2008. Scanning of all plates will be finished in 2014. Quality of scanned plates is shown in Table 2.

Table 1. Number of plates by observing lists

Name	All plates	Scanned	Scanned in FITS
Comets	218	208	208
Equatorial catalog	489	471	471
Jupiter	457	456	456
Mars	425	425	425
Mikhailov's list	106	106	106
Minor planets	2487	2480	2368
Neptune	219	218	218
Polar zone 1st epoch	196	195	195
Polar zone 2nd epoch	276	275	275
Radio sources	211	209	209
Saturn	496	495	493
Satellites of Saturn	213	213	213
Satellites of Jupiter	334	333	241
Uranus	225	225	225
Venus	360	360	75
Zodiacal catalog - "A"	600	599	599
Zodiacal catalog - "B"	527	525	525
Pluto	10	10	10
Moon	269	267	267
Star fields	142	136	136
Pole	65	65	65

Table 2. Quality and sizes of plates

Plate quality	Number
Good	3660
Average	3925
White spots/scratches	134
Object signed on the emulsion	5
Badly scratched emulsion	6
Area of detaching emulsion	5
Golden spots	7
Bad tracking	1
Broken and patched	17
Missing piece	20
Size in mm	**Number**
90x120	252
160x200	86
180x130	7
180x240	27
200x200	4204
240x240	3749

Table 3. Number of obtained images

		FITS	
		600	1200
2007	847		

Total	8325	8271	7780

2008	1476	1147	
2009		1065	
2010		210	
2011		135	1043
2012			2551
2013			1638
2014			365

Databases and preview images

We have developed the FoxPro database management system (DBMS) for our plate archive since 2008. The DBMS provides us all available information about the plate archive contained in the observing log books as well as about all obtained images. The DBMS gives us a possibility to edit, analyze and view necessary information.

We have also developed a web-based database of photographic observations since 2007 [6,10]. The database operates on the basis of the MySQL DBMS at web site of Ukrainian Virtual Observatory (UkrVO) [4,7]. The database of photographic observations contains more than 34 thousand plates, which have been obtained and stored at two institutions: NAO and Main AO (Kyiv) [9,10]. The database provides the user an access to preview images in JPG format (300 and 600 DPI) for over 99% of plates stored at NAO. The user may get access to FITS images for 93% of plates stored at NAO on request (Table 1). The database contains mainly information about observations of the northern sky from -25° to +90°. The web interface allows the users to make flexible requests taking into account the following parameters: equatorial coordinates, search sizes, time period, object types, plate parameters, telescope names. The user may also get access to the database via the web interface of such stand alone application as Aladin by taking several simple steps described on the corresponding web page [5].

Image processing and scientific use of plates

In 2009, we carried out investigations of four different scanners to test their stability, image quality and accuracy of stellar coordinates. The results allowed us to use SOHO scanners in scientific work [8]. We have carried out image processing of plates in selected areas since 2009 using different software to obtain coordinates of stars. The first catalogue was compiled in 2009 for about 17000 stars $(7\text{-}14)^m$ in ecliptic zone. To obtain this catalogue, fifty plates were scanned five times each plate [8]. Standard deviations of catalogue positions are 62 mas on RA and 68 mas on DEC for stars $(8\text{-}12.5)^m$. In 2012, the second catalogue of about 900 thousand stars $(8\text{-}16)^m$ at the mean epoch J1981.6 was created. The catalogue contains stars in the galaxy plane obtained from image processing of 210 plates with exposure time of about 20 minutes. Each plate containing open cluster was scanned five times using Epson Perfection V750 Pro scanner. Initial processing was carried out by using the MIDAS software package [10], further processing and compilation of

catalogues were carried out using our software. Standard deviations of catalogue positions on both coordinates are ranged from 20-30 mas for the stars $(8\text{-}12)^m$ to 50-60 mas for the stars $(13\text{-}15)^m$. This catalogue was used as the first epoch together with the second epoch modern CCD catalogues obtained in Nikolaev in 2011-2012. In 2013, we compiled catalogue of positions and proper motions of about 700 thousand stars in selected fields with open clusters. Standard deviations were about 30 mas on both coordinates.

Conclusion

We are going to finish the digitization of plate archive at NAO in 2014. The database is available in the UkrVO web site [4,7]. Epson Perfection V750 Pro scanner provides sufficient accuracy of measurements to carry out scientific projects. Further work in this direction is being continuing. The authors wish to thank the Ukrainian Astronomical Association and Main Astronomical Observatory for providing us the Epson scanner.

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