Digital Wide-Field Plate Archives

K. Tsvetkova and M. Tsvetkov

Institute of Astronomy, Bulgarian Academy of Sciences, Bulgaria

Abstract

In this paper we present the digital wide-field plate archives done in the frames of the development of the Wide-Field Plate Database. This unique database aims to collect and store the world wide-field photographic astronomical plate collections as valuable scientific heritage. The database can quickly offer to the astronomical community an opportunity to see back in time and to use records of interesting astronomical phenomena. We began a digitization of some selected plates obtained in the frames of given astronomical programme: observations of the Pleiades stellar cluster, monitoring for flare stars – new and known ones, patrol of supernova stars, Carte du Ciel project, etc.

1. Introduction

Photography was applied as a method for astronomical observations since the first systematic observations of stellar clusters by B. Gould in 1872. The used astronomical photographic plates (or films) as detectors and information storage in these observations were the basis of many astronomical discoveries. Today the plates are the only information source for interesting astronomical objects requiring look and estimation of their positions and brightness back in time. Papers based on the archival plates appear frequently helping to solve the questions about object origin, way of evolution, trajectories. The plates used for more than 130 years can be considered not only as a present unique source of information for the past of the different astronomical objects, but also as scientific heritage representing the previous step of the present astronomical knowledge.

2. Observational Programmes Carried out with Wide-Field Plates

The main characteristics of the observing programmes in the frames of which the wide-field ($> 1^0$) plates or films were used, is their long duration, and as a result - the accumulation of large knowledge about the observed phenomena.

A compiled list of such programmes includes:

- Observations of the major planets and their satellites;

- Small solar system bodies observationsPhotographic sky surveys;
- Selection of reference stars;
- Artificial satellites observations;
- Observations of stellar occultations;
- Discovery and patrol of variable stars;
- Determination of parallaxes and proper motions of stars;
- Observations of binaries;
- Study of the Galaxy structure and kinematics;
- Search and monitoring of active galaxies, quasars, novae and supernovae.

Here we present a compiled list of astronomical tasks and results (Tsvetkova 2009a) achievable through the access to digitized archival plates from at least two plate archives stored in different astronomical observatories or institutions:

- Composed light curves of variable stars for as long as it is possible time period;
- Search for long-term brightness variations - in young solar-type stars, RS CVn, active red dwarf stars, the Pleiades red dwarf stars;
- Search for past eruptions of pre-main sequence stars;
- Observations of small solar system bodies;
- Search for optical analogues of Gamma Ray Bursts;
- Search for photometric variability of quasars;
- Supernovae search in digitized archives;
- *Usage of Carte du Ciel plates* - for proper motion determinations, for discoveries of quick brightness changes, for investigations of the differential rotation in the galactic plane up to 500 pc from the Sun.

3. Wide-Field Plate Archiving

The plates archiving as an essential first step to widely re-use of the plate archives stored in the astronomical observatories worldwide includes good storage with suitable temperature and humidity free conditions, an inventory of the plate collection, cataloguing, quick and easy access to the information for plates and plate archive locations and contents, and quick visualization of the needed astronomical plates and to good quality digital plate data. Such unique tool integrating the plate archives information from many different observatories, used telescopes for plate observations and scanning facilities for plate digitization is now the Wide-Field Plate Database (WFPDB, http://www.skyarchive.org). From all existed and stored 2 200 000 wide-field (>1°) plates in professional astronomical observatories and institutions all over the world, the database collects at the moment the online information for 546 000 plates, i.e. 25% of all. Based and developed since 1991 in the Institute of Astronomy, Bulgarian Academy of Sciences and with mirror site in Astrophysical Institute Potsdam since 2007, the WFPDB aims to store the valuable

scientific heritage and quickly to offer the opportunity to see back in time records of interesting astronomical phenomena.

The WFPDB consists of:

➲ **Catalogue of Wide-Field Plate Archives** (CWFPAs, Tsvetkova and Tsvetkov 2006a, 2008), whose actual version from March 2009 gives in table form the information for all known plate archives (with total number 442 up to the moment) and telescopes that have produced these archives* stored in the observatories mainly in Europe, North and South America and in South Africa.

Fig. 1 presents the archives distribution according to the initial year of telescope operation, with the oldest plate archive started in 1872 in Cordoba. The maximum in the appearance of new archives was after 1955 up to the beginning of 70s of the last century, when the first observations in more than 130 archives started. One can compare with the distribution, given in Fig. 2, of the establishment year for 364 astronomical observatories, which are operated and not more operated or only planned for near future: optical, ultraviolet, infrared, radio, solar space observatories (among about 580 operated observatories worldwide according to the Astro-

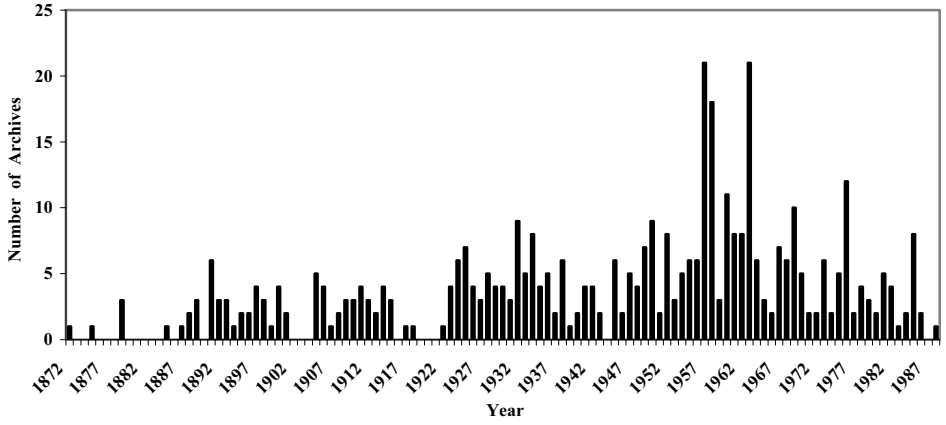

Figure 1. *Distribution of wide-field plate archives according to the initial year of telescope operation*

* As "plate archive" we denote a collection of plates produced with a definite telescope at a definite observational site and stored at a definite place. This means that one telescope may have more than one archive, if the telescope was moved or if its plates are stored at different observatories or institutions. The most of the wide-field plate archives are produced with small apertures telescopes up to 50-60 cm, mostly refractors, astrographs and cameras. The number of plates in the individual archives ranges between several tenths to more than 100000. Only a small number of archives have more than 10000 plates.

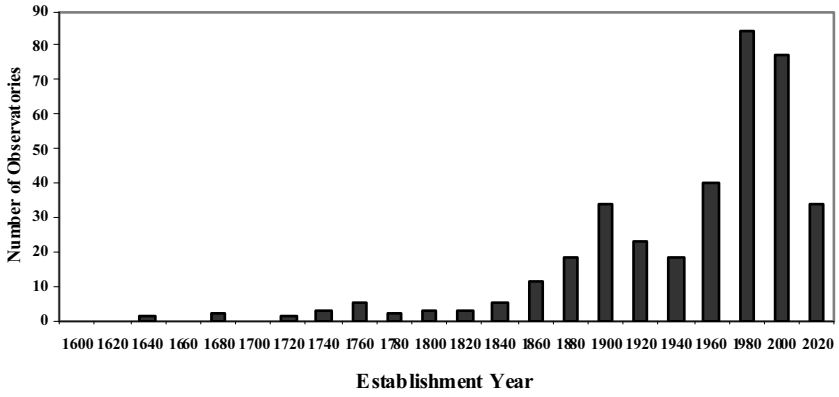

Figure 2. *Distribution of the establishment year of 364 astronomical observatories*

nomical Almanac 2009) in order to illustrate the developmentof astronomy generally. Since 1600 (i.e. after the Galileo usage of the telescope for astronomical observations) there is increasing number of established observatories. In the distribution can be noticed a depression because the two world wars, a peak around 1900 when the photographic observations in astronomy began to be widely used and quickly increased number since 1960, when was the "Golden Age" of wide-field photography. The reason for the decreasing number of observatories after 2000 is that too much money is needed to build an observatory now and only big corporations can afford it. Such example is the Large Synoptic Survey Telescope (LSST) - a future wide-field, ground-based (in Chile) telescope with 3-mirror system with an annular 8.4-m primary; the effective collecting area - equivalent to a 6.7-m diameter unobstructed primary, designed to obtain sequential images of the entire visible sky every few nights. **Catalogue of Wide-Field Plate Indexes** (CWFPIs), with two versions: Static version installed since 1997 at Strasbourg (http://vizier.u-strasbg.fr/cats/ VI.htx) with online search via VizieR (see Search in the WFPDB - catalogue number VI/90) for information on 323 000 plates, and Enlarged regularly updated and developed version installed since 2001 at Sofia Sky Archive Data Center (http://skyarchive.org), containing up to June 2009 the parameters of 545 876 plates from 123 archives with provided new possibilities for data search, quick plate preview with low resolution in JPEG files of some of the plates and complete plate image with high resolution in FITS files upon request.

The all-sky distribution of the plate centers in equatorial coordinates is present in Fig. 3 with larger density of observations in the regions near the ecliptic and the galactic equator due to the large number of observations of solar system bodies and of objects in the Galaxy and smaller regions of high concentration of plates like the regions of M 31, the Pleiades, the Magellanic Clouds).

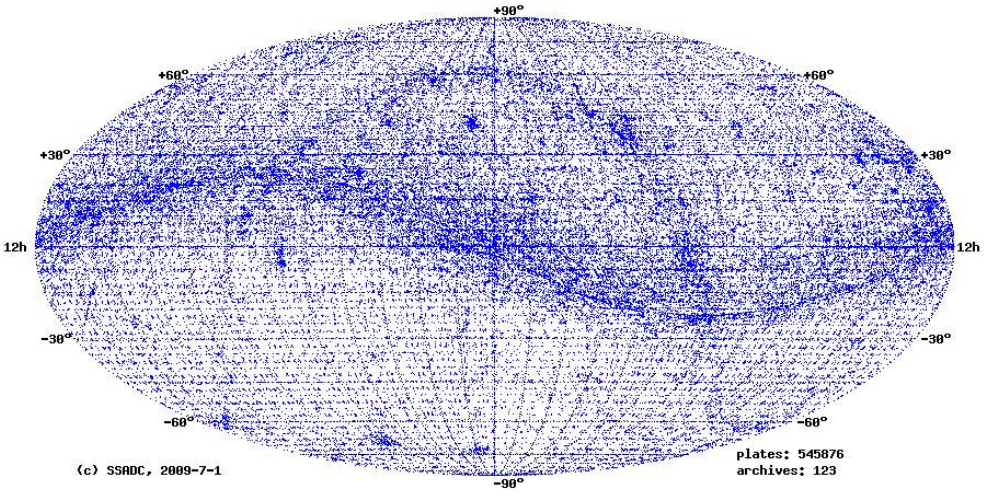

Figure 3. *All-sky distribution in equatorial coordinates of the centers of plates included in CWFPIs.*

➲ **Data Bank of digitized plate images** (with volume about 2TB) – either plate previews for quick plate visualization and easy on-line access, or working scans for photometric and astrometric investigations with implementation of Wavelet transformation methods for compression;**Links to online services and cross-correlation with existing catalogues or journals** (e.g. plate images in the WFPDB and published papers in IBVS as scientific output of the usage of plates, Holl et al. 2006).

Combining the information from all parts of WFPDB one can obtain the complete available data for any observation in the database. Search and sampling from the WFPDB is possible by equatorial coordinates and observation time (UT), as well as by the following instrument and observation parameters: instrument type and aperture, plate scale and size, object/field designation, method of observation, emulsion, filter type, exposure time. With the exception of coordinates and time, searches by any of the other observation parameters may be seriously affected by missing data in the original plate catalogues, constituting the WFPDB. For instance the distribution of the wide-field plates versus object type, given in the WFPDB, does not present the real situation because not always the object type was assigned in the database: only coordinates or very specific designations are given and assigned type of object Field, Galaxy or Variable Star is very broad. Data retrieval for the plate quality and availability, notes, observer and plate digitalization is possible.

4. Preparation of the Plate Catalogues

The preparation of a plate catalogue, i.e. preparation of a computer-readable version of the plate archive, as well as its inclusion into the WFPDB in the standard format with online access, aims its plates to be used again for different astronomical tasks by the whole astronomical community.

During the reduction of the original plate catalogues to the accepted WFPDB format some problems can arise out of the existence of different log-books for the different observing programmes, where very often the same original plate number could be met even several times. According to the WFPDB rule a suffix (A, B, C, and so on) was assigned to the original plate number. In an occasion of existence of more plates with the same original number a suffix was assigned to the original plate number in an order: "A" for one used observing programme, "B" for another one, and so on. Such example is the plate archives done with the Double Wide-angle Astrograph (DWA, D=0.40 m; F=2 m; Scale=103.16 arcsec/mm) of the Main Astronomical Observatory of the National Academy of Sciences of Ukraine in Golosiiv (Kyiv), where about 5500 plates with limit stellar magnitude up to 16.2 (pg) were obtained in the period 1976 – 1998 according to different observational programmes:

(1) DWA: Selection of the kinematically homogeneous group of reference stars and proper motion investigations, and calibration of stellar magnitudes for compilation of a general catalogue, as well as Observations of planets and asteroids;

(2) FON: Creation of Photographic Survey of the Northern Sky with declination from $+90^0$ up to -2^0 with the collaboration of observatories from the former Soviet Union and determination of positions, proper motions and photometric data for stars of Astrographic Catalogue (AC), which is a part of the Carte du Ciel project;

(3) MEGA: Investigation of the kinematics and the structure in the main meridian section of the Galaxy, construction of catalogues of proper motions of stars with respect to more than 200 galaxies in selected fields, their positions, stellar magnitudes in UBVR and Vilnyus systems, parameters of stellar classification: absolute stellar magnitudes, effective temperatures, metallicities of all stars to 12^m in 47 areas of the sky;

(4) SIZ: a programme for comet investigations, initiated by Yu.V. Sizonenko. The plate catalogues prepared for the both archives of the both tubes of the double astrograph consist of plates with the WFPDB identifiers GUA040 with suffixes C (for one tube) or D (respectively for another one) plus the original plate number with a suffix assigned in an order: "A" for the FON plates, "B" for the DWA plates, "C" for the SIZ plates, "D" for the MEGA plates.

The work of incorporation of the plate catalogues in the WFPDB revealed mistakes (in coordinates and dates, misprints of different origin as in object names, observer's names, emulsions or filters, notes, etc.) either of the observers or made during the preparing of the computer-readable catalogue. These mistakes have been corrected in the present WFPDB plate catalogues versions, which make them different from the original ones stored in the observatories, possessing the archives.

The following-up analysis of the plate catalogues based on the data retrieval from the WFPDB provide the key to the plate repeated usage.

4. Plate Digitization

The following step after having the plate catalogue at disposal is plate digitization with estimation of the quality of the digitization data, linkage of the scanned plate images (plate previews – with minimal resolution for quick plate visualisation and quick online access, and working scans – photometric or astrometric scans with optimal big resolution) to WFPDB and online access. Plate digitization aims to provide quick access, online previews, and working scans, which will facilitate sharing and re-use of data.

The plate images which are either previews - scans with low resolution (usually 600 dpi) and snapshots of the plates made with digital cameras - or scans with higher resolution (usually > 1200 dpi) constitute the bank of digitized plate images as a part of WFPDB. The previews offer to the WFPDB user the possibility to examine visually the plate appearance and to make a preliminary judgment for the usefulness of a certain archived observation for his purposes. Why is important to make plate preview before real scanning. Making the preview images with minimal resolution (even with digital camera and light table) stores the important marks of the observer and provides quick plate visualisation and quick online access. The preview images are made in JPG format with file size about 1-2MB. The plate scans with higher resolution (2400 dpi in FITS format of the output file) are intended for photometric or astrometric processing. They are not yet accessible online.

The preparation of digitized archives of selected plates (e.g. containing images of the Pleiades stellar cluster, of minor planets and comets, etc.) as well as the systematic plate scanning will give a huge volume of scan data as a rough estimation.

5. Some Examples of Digital Plate Archives

The digital plate archives aim to assemble and explore massive data sets in order to reveal a new knowledge existing in the data, but it cannot be recognized in

any individual data set. The WFPDB gives such possibility to select plates among the different plate catalogues. In the WFPDB search page every plate catalogue can be found with the WFPDB observatory identifier, instrument aperture, instrument aperture suffix plus the original plate number. For every catalogue under the appropriate WFPDB identifier can be found more details for the location of the archives, for the observatory, for 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, some notes with specific contains, the name of the observer, the place of plate storage (availability) and the status of plate digitization, as well as the name of astronomer in charge for the archive.

The search can be done either by object or field coordinates or by constraints on the observation parameters. From the result page the user can display an additional page with details for the archive to which a selected plate belongs with a map of the all-sky distribution of the observations from this archive, as well as an additional page with details for the selected observation, including, if available, notes, observer name, and information for the plate availability and plate digitization. This page may contain also the plate preview, if available. The plate image can be examined in detail by zooming the preview.

The observing programmes as usual make a specified identification of every archive – method used, exposure multiplicity, emulsions, plate quality, etc. with a view to repeated use of the plates. That is why the shortly description of the main executed observing programmes is given in separated publication for every archive (e.g. for Bamberg Northern Sky Survey: Tsvetkova et al. 2006b, for Uccle CdC plate catalogue: Tsvetkova et al. 2007) –Time distribution of the plates in a certain catalogue, Plate number versus observing programme, Plate number versus object type, Plate number versus method used, Plate number versus exposure multiplicity, Plate number versus exposure duration, other information which could be essential for some tasks – as plate quality, availability, name of the observer, existence of observer note (where as an example the beginning of the following exposures is usually given).

For every included catalogue we made analysis with stress on the future re-use of the plates inside (distribution of the number of plates according to the listed observing programmes, the exposure duration which influence the plate limit and observed objects requiring longer exposures as minor planets, comets and fields, as well as the exposure multiplicity as a method of observation required by different programmes (for minor planets, search for flare stars, etc.), type of the observed objects (planets, minor planets, comets, artificial satellites, fields, galaxies, stars, star clusters, reference stars), as well as the used emulsions, their size when it concerns the plate digitization.

Asteroids:

Archives of Bucharest selected digitized plates (e.g. with images of more than 3 minor planets) are under preparation (see the plates distribution of the most observed minor planets with Bucharest 38 cm telescope in Fig. 4). For quick plate visualization and for storage of observer's markers we are preparing plates previews with digital camera in TIFF format with 4MB plate storage, with the flatbed scanner UMAX Alpha Vista II in TIFF format with 600dpi (45MB) for the Bucharest plates and with 100dpi (220KB in TIFF or GIF format) with HP SCANJET 8200 scanner for the Cluj plates. The working scans are with resolution 1200 dpi (or about 180MB plate storage) in TIFF format. Some of the Bucharest plates have been scanned with the EPSON Expression 1640XL of Sofia Sky Archive Data Center with resolution 1600 dpi in FITS format (about 460 MB).

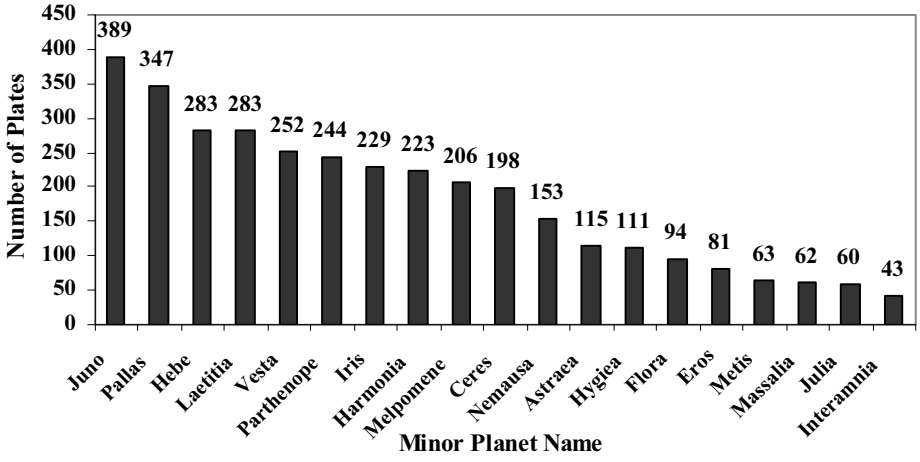

Figure 4. Most observed minor planets in BUC038 plate catalogue

The Pleiades Plate Database:

The Pleiades stellar cluster is a good and accessible sample for studying of long-term brightness variations in the red dwarf stars (the most of the red dwarf stars are flare stars). The total number of the known Pleiades flare stars according to the Flare Stars Database (Tsvetkova et al. 1995) is 547, having in view that for some stars published as flare stars better observations are needed to confirm their membership to the flare stars class variables according to Tsvetkova and Tsvetkov 4(1989).

The statistical evaluation of the total number of all flare stars in the Pleiades (registered and not registered up to now) is about 1000. Precise coordinates of the

known Pleiades flare stars were determined as a necessary step to the further work of automated search for long-term brightness variations. Searching the WFPDB for the Pleiades plates more than 3100 plates obtained in the period 1885 – 1998 were found in the observatories in Asiago (Italy), Sonneberg (Germany), Harvard (USA), Kyiv (Ukraine), Moscow (Russia), Rozhen (Bulgaria), Konkoly (Hungary), Byurakan (Armenia), Potsdam (Germany), Edinburgh (UK), Bamberg (Germany). The archive of the digitised plates in the Pleiades stellar cluster contained already about 1500 plates. The plate images are included into the developed Pleiades Plate Data Base (PPDB, Borisova et al. 2003; Tsvetkov et al. 2005). It gives the opportunity to obtain almost continuous photometric data set for the red dwarf stars in the cluster.

Patrol Flare Stars Digital Archives:

The plate digitization makes possible automatic search for brightness increase, which yielded in discovery of 50% more flare stars in comparison with the usual plate checking. The flare star patrol plates are part of the running process of preparation of digital archives of representative plates obtained with the Schmidt telescopes of Konkoly and Rozhen observatories during the observation campaign for search and investigations of the flare stars in stellar aggregates (open stellar clusters and associations) in 1970-1990[*]. The plates are scanned with resolution 1200 dpi for plate visualization and to preserve the observer marks. The image is saved as tiff (7322x7322 pixels) with size 51.12MB and as jpeg file (compressed to 2000x2000 pixels) with size 1.65MB. After the cleaning the observer marks the plate is scanned with high resolution (2400 dpi) and saved as fits file with size 409 MB.

Supernova Digital Archives:

An example of digital archive of representative plates obtained according to the supernova search programme, is Konkoly Supernova Digital Plate Archive (Tsvetkova et al. 2008). One of the important observing programmes carried out with the 60/ 90/180 cm Schmidt telescope was the supernova search, started at the

[*] In the same time another observation campaign for search and investigations of flare stars in the solar vicinity with photoelectric observations took place, where G. Asteriadis contributed a lot in the period 1972 - 1984 with the patrol observations of AD Leo, UV Cet, EV Lac, BY Dra, YZ CMi, Gliese's dM4e star 487, BD +16 2708 and BD +13 2618 using a Johnson dual channel photoelectric photometer attached to the 30-inch Cassegrain reflector of the Stephanion Astronomical Station of the Department of Geodetic Astronomy, University of Thessaloniki. In the frames of the bilateral cooperation at the Rozhen National Astronomical Observatory, Bulgarian Academy of Sciences began the patrol photoelectric observations with the 60 cm Cassegrain telescope and the UBV one-channel photometer.

end of 1963, with which Konkoly Observatory for about more than a 30-year period took part in the international campaign initiated by F. Zwicky. With the intention of future scientific investigations and educational use we undertook the procreation of the Konkoly Supernovae Search Digital Plate Archive. Total 12707 plates were obtained in the period 1962 - 1996 with size 16x16 cm and limiting magnitude 19 mag (B). The distribution of the plates according to the constellation name, which is more informative for the SN observations, is present in Fig. 5. In the original plate catalogue only for less than 51% of all plates the constellation name was given. We assigned the respective constellation name if only the coordinates of the observed object were given, or only NGC number or Messier number exists in the original plate catalogue giving completeness and enlargement of the plate data.

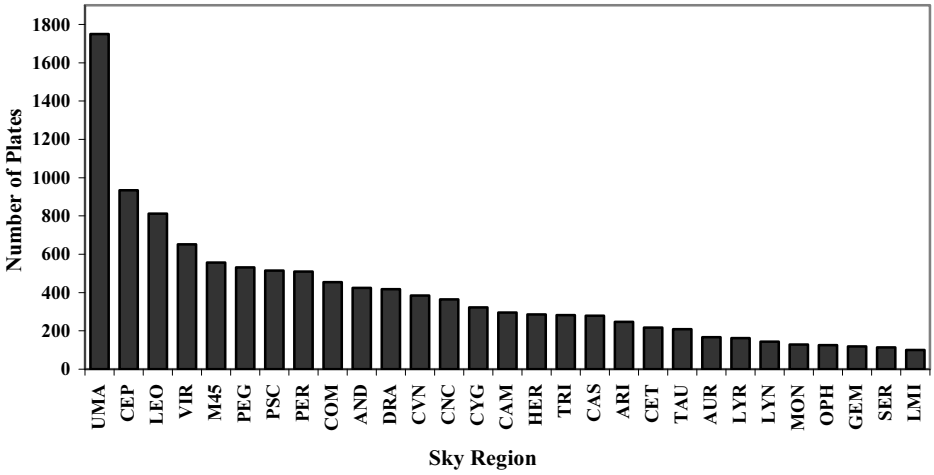

Figure 5. *Distribution of the observed regions in Konkoly Observatory with its Schmidt telescope according to the constellation name*

The selection of the plates was done on the basis of the compiled list of all 50 supernovae discovered at Konkoly Observatory (one example is given in Fig. 6) and using the search procedure provided by the WFPDB taking into account that in the supernova search programme two successive plates were obtained for every controlled field with exposure duration of 15 min. The selected 106 available plates with the best temporal and positional coincidence with the discovered supernovae were scanned with the UMAX PowerLook 3000 FB scanner with resolution 300 dpi (85 μu) for quick plate visualization (with data volume 6 MB), with 1600 dpi (16 μu) allowing maximal area for photometric tasks (in average 170 MB) and with

maximal resolution 3048 dpi (8 μu) only the region around the supernova (30 MB). The volume of data stored in TIFF format files is 19 GB. The plate visualization scans (so called preview scans) can be accessed on-line in the WFPDB. The scans, intended to be used for astronomical tasks (so called real scans) are presently stored in Sofia Sky Archive Data Center and can be obtained upon request.

The time distribution of all obtained plates compared with the time distribution of the supernovae discovered at Konkoly Observatory revealed a coincidence between the maximums of the observational activity and the time of the supernova discoveries according to Tsvetkova et al. (2008b): at the maximum in 1967-1968 6 SN, in 1973-1973 2 SN, in 1976 - 6 SN and in 1982 - 5 SN were discovered. The final database (in preparation now) contains the following information: supernova data and discovery information, publication bibliographic data, plate metadata, plate quick visualization scan, plate large resolution scans (full plate and partial plate around the location of the supernova), image metadata characteristics, other plates in the same field, POSS image link.

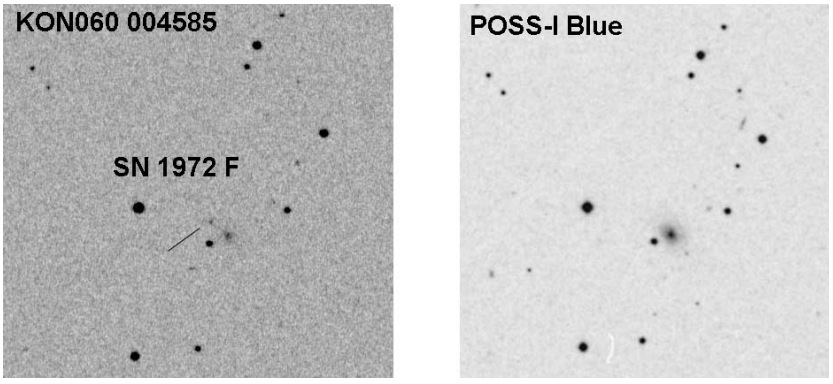

Figure 6. *Part of KON060 004585 plate with the discovered SN 1972F and the same region from POSS-I Blue (according to Tsvetkova et al. 2008b)*

Variable Stars Digital Archives:

Almost half of all investigated stars are variable stars. According to the Combined General Catalogue of Variable Stars (Samus et al. 2004) their number is more than 76 000 (among them 38 600 have designation) with rate of increasing of 1500 more every year (Samus 2008). The light curves with larger statistical basis with involving archival plates can better classify the type of variability. That is why we choose some interesting variable stars and scanned the selected plates in order to composed their light curves. In Fig. 7 a part of the digitized image of the plate SKA030 003604 taken at Skalnate Pleso Observatory on Dec 3, 1986 with 15 min exposure as a part of the digital archive of plates containing the image of the variable star Par 1724 Ori is shown.

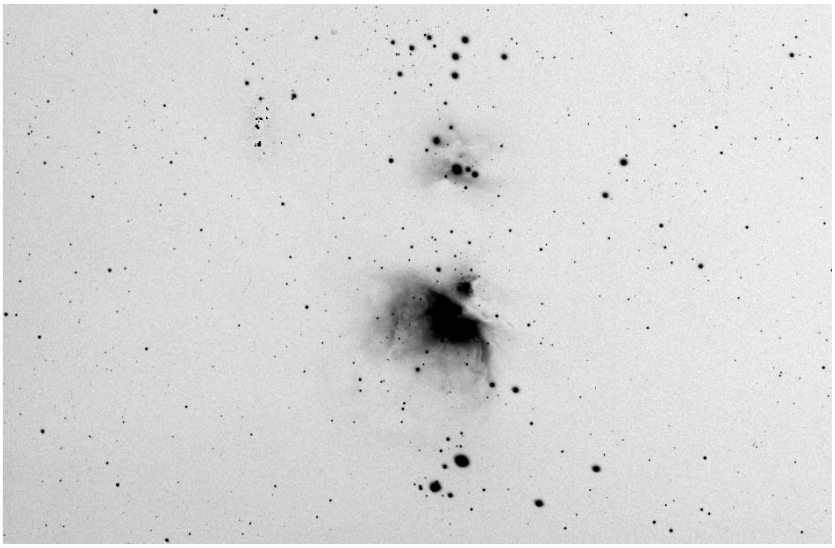

Figure 7. *A part of the digitized Skalnate Pleso Observatory plate (SKA030 003604)*

Carte du Ciel Digital Archives:

Carte du Ciel (CdC) was the name of the first photographic all-sky survey with maps (CdC charts) to 14th magnitude and measured positions for stars to 11th magnitude (Astrographic Catalogue, AC), observed by telescopes of the same type, aperture and focal length giving a scale of 60 ″/mm for homogeneity of the results.

The information stored in the CdC plates and having good potential to see the astronomical objects of interest back in time, as well as considered to be reasonable first epoch material, was the reason for the undertaken digitization of such plate collections in the observatories in Sydney, Toulouse, Cordoba, Bordeaux , Uccle and San Fernando.

The first CdC catalogue with a complete inventory accessible through the WFPDB is this one of the Royal Observatory of Belgium (Uccle Observatory). The plates cover the zone +33 +39 and were obtained in the period 1908 –1939. 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 WFPDB observatory identifier (ROB) followed by the instrument aperture (033), plus the original plate number. The Uccle CdC plate collection comprises 682 plates of good to very good quality (Tsvetkova et al. 2007). The digital archive consists up to the moment from the plate previews made with the flatbed scanner AGFA DUOSCAN HiD with a resolution of 250 dpi and stored in TIFF format (of size 2.5 MB).

The second CdC catalogue accessible online consists of the Potsdam CdC plates stored now in the Astrophysical Institute Potsdam (AIP). The Potsdam Astrophysical Observatory (AOP) had been involved in the Carte du Ciel (CdC) project - -

since the establishment of the project in 1887 at the meeting of the International Astronomical Congress in Paris together with another eighteen well-qualified observatories, distributed throughout the northern and southern hemispheres. The zone assigned to the AOP covered the sky region between +32◦ and +39◦ divided into 1232 areas, whose observations began in 1893 by A. Schwassmann, H. Clemens, G. Eberhard, H. Ludendorff, J. Scheiner and other. The second epoch plates were obtained in the period from 1913 August to 1924 February by W. Muench, K.Jantzen, O. Birck, and E. Hertzsprung. Now from the 2200 CdC plates less than 45% are stored in the AIP now, namely – 977 plates (Tsvetkova et al. 2009b). The time distribution for Uccle and Potsdam CdC plates is given in Fig. 8. For the both distributions the gap caused by WWI (1914 - 1919) is well visible. The stored Potsdam CdC plates are scanned with EPSON EXPRESSION 10000 XL flatbed scanner with 1200 dpi resolution for the preview scans and with 2400 dpi for the working scans stored in JPEG and FITS format files. They are installed on the German Astrophysical Virtual Observatory (GAVO, see http://vo.aip.de/plates) Potsdam server.

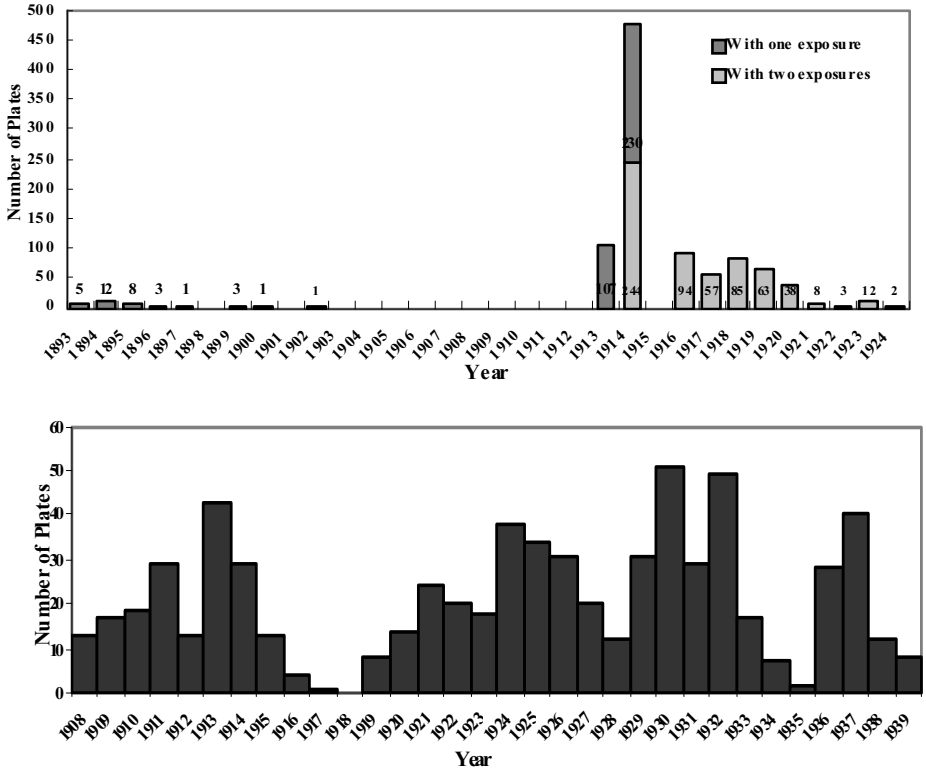

Figure 8. *Time distribution of the plate number for POT032 (upper panel) and ROB033 (bottom panel) CdC plates*

6. Conclusions

The work on making digital plate archives is a part of the long-time programme for search, preservation and re-usage of the world wide-field photographic astronomical plate collections. The information for the distributed plate archives, the contents of their prepared plate catalogues and tool for searching observational data for certain object, spatial plate distribution on the sky region, temporal coverage, used observing method and special techniques, purpose of the plates (it is a part of sky survey or sky patrol), magnitude limit of the plates, plate quality, etc., is the first step. The second step is the bank of digitized images of the needed plates for quick plate visualization with low resolution, as well as with photometric and astrometric accuracy making them practically identical with the originals. For some of the plate archives the catalogues are at disposal, but the scanning is fulfilled only for preview images of representative plates containing images of the observed objects according to the main observing programmes. The organization of the plate scans in an image database is the last step before systematic astronomical research. The current tasks are the development of a software system for object plate identifications, for searching in an image database with many data storage variants, as well as plate processing and data analysis for astronomical tasks.

Acknowledgements

The work is partly supported by the BG NSF DO-02-273 grand.

References

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, "Usage of the Photographic Plate Archives for Studying the Pleiades Flare Stars Long-Term Behavior", Astronomical and Astrophysical Transactions, 22, p. 487, 2003.

Holl, A., Kalaglarsky, D., Tsvetkov, M., Tsvetkova, K., Stavrev, K.: Interlinking between IBVS and WFPDB, in Virtual Observatory, Plate Content Digitization, Archive Mining, Image Sequence Processing, Eds. M. Tsvetkov, V. Golev, F. Murtagh, R. Molina, Heron Press Science Series, Sofia, ISBN-10: 954-580-190-5, p. 374-378, 2006.

Samus, N.N., Durlevich O.V., et al.: Combined General Catalogue of Variable Stars http://cdsarc.u-strasbg.fr/viz-bin/Cat?II/250.), 2004.

Samus, N.N.: private communication, 2008.

Tsvetkov, M., Tsvetkova, K., Borisova, A., Kalaglarsky, D., Barbieri, C., Rampazzi, F., Kroll, P., Sergeeva, T., Sergeev, A., Mink, D., Doane, A., Samus, N.: The Pleiades Plate Database: a New Update, in *Kinematika i Fizika Nebesnykh Tel,* Suppl, **5**, 567-569, 2005.

Tsvetkova, K.P. and Tsvetkov, M.K.: Note on Cross-Identification of Flare Stars in the Pleiades, *IBVS,* No. 3366, 1989.

Tsvetkova K.P., Tsvetkov M.K., and Stavrev K.Y.: Flare Stars Database - Present Status, in *Lecture Notes in Physic,* 454, 121, Eds. J. Greiner, H.W. Duerbeck and R.E. Gershberg, Springer Verlag, 1995.

Tsvetkova, K., Tsvetkov, M.: Catalogue of Wide-Field Plate Archives: Version 5.0, in Virtual Observatory, Plate Content Digitization, Archive Mining, Image Sequence Processing, Eds. M. Tsvetkov, V. Golev, F. Murtagh, R. Molina, Heron Press Science Series, Sofia, ISBN-10: 954-580-190-5, p. 45-53, 2006a.

Tsvetkova, K., Tsvetkov, M., Heber, U., Kalaglarsky, D., Bogdanovski, R.: Bamberg Northern Sky Survey: Catalogue and Incorporation in the WFPDB, in Virtual Observatory, Plate Content Digitization, Archive Mining, Image Sequence Processing, Eds. M. Tsvetkov, V. Golev, F. Murtagh, R. Molina, Heron Press Science Series, Sofia, ISBN-10: 954-580-190-5, p. 109-114, 2006b.

Tsvetkova, K. P., Tsvetkov, M.K., Kalaglarsky, D.G., Lampens, P., Duval, D. : Analysis of the Uccle Carte Du Ciel Catalogue (ROB033) Present in the WFPDB, Proceedings of the 5th Bulgarian - Serbian Conference: "Astronomy and Space Science", *Eds.* M.Tsvetkov, L.Filipov, M.Dimitrijevic, L.Popovic, Heron Press Science Series, Bulgarian Journal of Physics, vol. 34 (2), ISBN 978-954-580-233-1, p. 177-186, 2007.

Tsvetkova, K. and Tsvetkov, M.: Catalogue of the Wide-Field Plate Archive, VizieR Online Data Catalog: VI/126, 10/2008a.

Tsvetkova, K., Holl, A., Balazs, L.G.: Digital Plate Archive for Supernova Search at Konkoly Observatory, Baltic Astronomy, vol. 17, p. 405-414, ISSN 1392-0049, 2008b.

Tsvetkova, K.: Wide-Field Plate Database and Present Exploitation of the Archival Plates, Proceedings of the VI Serbian-Bulgarian Astronomical Conference, 07 – 11 May 2008, Belgrade, Serbia, p. 251-260?, ISBN 0506-4295, 2009a.

Tsvetkova, K., Tsvetkov, M., Boehm, P., Steinmetz, M., Dick, W.: Potsdam Carte Du Ciel Plates: Present I Inventory and Plate Catalogue, in preparation, 2009b.