

Workshop NAROO-GAIA

“A new reduction of old observations in the Gaia era”

June 20-22, 2012, Paris Observatory

Proposed communications and abstracts:

Arlot J.E. (IMCCE, Paris):

Title: Re-reducing old observations: a challenge for the next decade

Abstract: Since years, astronomers know the interest of old observations. The first use of old observations is to include them into a fit of parameters of a “time-dependant” model. For dynamical models of motion of solar system objects, it is necessary to include old data even the new data are of a high accuracy. The time factor is essential in order to describe long-term variations either periodic or secular. Unfortunately, old observations were reduced with the only tools available at that time. For example, star catalogues were very poor inducing a poor accuracy for the observations. Today, we are able to make corrections on these former reductions but with limits due to the measurements of positions and to the fact that our star catalogues are not able to describe the sky more than 30 years ago.

The arrival of new catalogues such as Gaia, the progresses in astrometric reductions and the possibility of scan of photographic plates open a new field of research. The selection of old data worth to be reduced with new tools will allow progresses in fundamental research, in the dynamics and the exploration of the solar system and in other fields of astronomy.

Beauvalet L. (IMCCE, Paris):

Title: Interest of old data for the determination of the heliocentric distance of Pluto

Abstract: Pluto has been discovered in 1930. As its revolution period is about 248 years, it still has not completed one revolution since its discovery. Pluto has not been explored in situ, a situation that will change with the New horizons spacecraft. For this mission to be successful, the determination of Pluto's heliocentric distance must be known with a 1000km precision since the probable accuracy of the ephemeris will be much larger at the time of New Horizons arrival. To improve the accuracy, the common way is to fit a dynamical model to the system's observations. We can then obtain the precision of the fitting process for the heliocentric distance. Yet, the uncertainty given is very tightly linked to the model. In this presentation, we will compare the different existing ephemerides of Pluto. We will show that, in spite of the number of observations we have, the distance between Pluto and the Sun is not known with a sufficient precision for the New horizons spacecraft. We will also discuss the possible contribution of a new reduction of the photographic plates to solve this situation.

Berthier J. (IMCCE, Paris):

Title: The IMCCE Virtual Observatory Solar System Portal: a tool for data mining and selection of plates to be analyzed

Abstract: The IMCCE Virtual Observatory solar system portal (<http://vo.imcce.fr/>) aims to provide to the astronomical community all the knowledge and the expertise of the IMCCE which concern the dynamics and the physics of the solar system bodies. The portal offers access to an information system dedicated to Sso, to ephemeris computation services, and tools dedicated to data mining. All of them are fully compliant with the interoperability concept of the Virtual Observatory.

Bertin E. (IAP, Paris):

Title: The DANCe project or how to recycle 15 years of archival wide-field data for kinematic studies.

Abstract: The DANCe project aims at deriving a comprehensive census of the stellar and substellar content of a number of nearby (<1 kpc) young (<500 Myr) associations. Members are identified based on their kinematics properties, ensuring little contamination from background and foreground sources. I will show how robust individual proper motions can be computed with a relative precision down to 1 mas/yr by combining thousands of wide-field images downloaded from public archives and covering more than a decade of observations.

Birlan M. (IMCCE, Paris):

Title: Near-Earth Asteroids Datamining on Astronomical Databases: Euronear experience.

Abstract: Several astronomical databases (CCD, photographic) from CFHT,INT, ESO-MPI2.2, and Bucarest-Romania have been investigated in the last four years inside Euronear network, for precovery and recovery of Near Earth Asteroids. A global presentation of these results, network experience and the on-line tools Precovery and Mega-Precovery are emphasized.

Cooper N. (Queen Mary University of London):

Title: Cassini ISS Astrometry by the Astronomy Unit at Queen Mary, University of London - An Overview

Abstract:"The Cassini group at Queen Mary, University of London has been using the Imaging Science Subsystem on the Cassini Spacecraft to obtain astrometric observations of the inner satellites and F ring of Saturn since 2004, in addition to observations of the small inner satellites of Jupiter during Cassini's flyby in 2000/2001. The talk will give an overview the available data and outline plans for future observations and archiving."

De Cuyper J.P. (ROB, Brussels):

Title: Digitizing and archiving photographic plates at ROB

Desmars J. (Shanghai Observatory)

Title: Estimation of Yarkovsky acceleration using datamining in the perspective of Gaia

Dourneau G. (Observatoire de Bordeaux, France)

Title : Presentation of the Bordeaux astrophotographic old plates archive (1893 - 1996)

Abstract: We present the Bordeaux Observatory astrophotographic old plates archive which has collected about 5000 plates taken from 1893 to 1996. They are located in an air conditioned room for a better conservation. The main series of archived plates are the "Carte du ciel" (2000 plates) made in the beginning of the 1900 , the solar system objects (more than 1500 plates) made since the 1950 and other series (nebulae, open clusters,...).

We also describe the 20 plates of solar system objects (Mars, Jupiter, Saturn, Uranus, Neptune and Pluto) and 2 plates of the "Carte du ciel", all taken at Bordeaux Observatory, that we have selected for a possible new measurement and reduction in the NAROO program.

Emelianov N. , Kuimov K.V. (Sternberg Astronomical Institute, Moscow, Russia), Samus N.N. (Institute of Astronomy, Russian Academy of Sciences, Moscow, Russia)

Title: The plate archive of the Sternberg Astronomical Institute

The photographic observations in the Sternberg Astronomical Institute started in 1895. Observations were made with sept telescopes in Moscou and Crimea. In total, until 2004, almost 60 000 photographic plates have been accumulated. Most of them have been made to study variable stars and galaxies.

Only the 9 000 from 60 000 photographic plates were made to determine the coordinates of Mars, Venus and selected asteroids. These photographic plates are processed. Some of obtained results are published. These 9 000 plates may be the subject of a new processing with the new star catalogs after they are scanned. This work can be undertaken if there is interest in new astrometric data with a modest accuracy for Mars, Venus, and selected asteroids.

This year, work has begun to search for objects of the solar system in other 51 000 photographic plates made to study variable stars and galaxies. The main interest was in finding the planets with natural satellites. For given moments of exposure and the coordinates of the field center using a relevant software, we determine the presence of planets on each plate.

A significant problem is that most of plates are identified only by the name of the galaxy or star. Our problem is also that only for 25 000 plates we have the moments and the coordinates recorded in the files. For the remaining 26 000 plates these data are still noted on paper. Of the 25 000 examined plates only on 340 of them the planets were found. We should also identify and write to file such data for 26,000 plates to search for planets with our software.

For half of the 51 000 plates expected astrometric accuracy is of about 0.2 arcseconds and for other plates the accuracy is not better than 1 arcsecond of arc.

About 1 700 photographic plates were scanned for photometric purposes. However astrometric accuracy of the scan does not match the possible accuracy of photographic plates.

Fienga A. (UTINAM, Besançon, France):

Title: The INPOP planetary ephemerides and Gaia: a mutual synergy

Abstract: we describe here how Gaia will help for the improvement of the planetary ephemerides INPOP and how these improvements are important for the post-analysis of the Gaia mission.

Grosheva E.A., I.S. Izmailov, E.V. Khrutskaya (Pulkovo Observatory, Russia):

Title: Mobile Device for Digitizing of photographic plates: the first results.

Abstract: The first results of astrometrical reduction for 24 plates with observations of Saturn's satellites and for 40 plates with images of selected asteroids are presented. Digitization of plates have been made using Mobile Digitizing Device (MDD) based on 21.1-megapixel full-frame CMOS digital single-lens reflex camera Canon EOS 5D Mark II. The speed of digitizing is 60-70 plates per hour. Random error of measurements for the same plate is 0.7-0.8 μm . The matters of calibration of MDD are discussed.

Ivantsov A., Hudkova L. (Nikolaev Observatory, Ukraine):

Title: Archive of photographic plates in Nikolaev Observatory and some results obtained from them

Abstract: Archive of orthographical observations of Nikolaev observatory consists of observations made at Zone astrograph (D=0.12 m, F=2.0, field of view $5^\circ \times 5^\circ$) in 1961-1998. The total number of plates is 8.5 thousands.

Natural Satellites, Asteroids and Comets. Each plate contains 3-4 exposures depending on the brightness of the object. Great attention was put to the uniform distribution of the observations in the period of visibility of those objects. In 1961-1998 there were reduced 1314 positions of Galilean satellites of Jupiter using 360 plates. For reducing brightness of the bright satellites, the observations were made using either grating in front of the objective or filter. The weighted standard error of measurement of a single position for each of 17 oppositions was 0.08-0.14" in each coordinate. There were obtained 604 positions for 5 bright satellites (Tethys, Dione, Rhea, Iapetus, Titan) of Saturn using the same technique in 1973-1997. The standard error of a single position was 0.15" in each coordinate. For 19 selected asteroids, there were obtained 2450 positions in 1961-1998. The position here was calculated as the mean value of three consequent positions in one plate. The weighted standard error of a single position (not for mean one) was 0.15" in each coordinate. There were obtained more than 200 plates with bright comets.

Big planets. For big planets except Mercury there were obtained 2073 positions. Observational period was 1961-1998.

All observations of the Solar system except of comets, Jupiter and Saturn were reduced to the ICRS.

Stellar Catalogs. The North Pole zone (+70 to+90 declination) was observed twice. The first epoch (catalog of S. Belyavsky) was obtained in Pulkovo in 1928-1930. It contains about 200 plates (the positions were published). The second epoch was photographed in Nikolaev in 1973 for calculating proper motions. It contains 250 plates. Zodiacal zone within +/-10 degrees of the ecliptic was observed with twice overlapping. It contains 1196 plates. The mean epoch is 1979. Equatorial zone within +/-4 degrees of the celestial equator was observed with four-time overlapping. It contains 485 plates. The mean epoch is 1992. Stars of the list of A. Mikhailov were observed on 104 plates, the positions were published. The mean epoch is 1978.

ROAS observational program. There were observed 131 fields on 217 plates. The mean epoch is 1980. Additional information on the archive of plates is given on the site www.nikolaev.ua in the Virtual Observatory section.

Jacobson R.A. and M. Brozovic(JPL, USA):

Title: Spacecraft Based Astrometry - Description and Archival Status

Abstract: Optical navigation, imaging from a spacecraft to aid in the determination of the spacecraft trajectory, measures the direction from the spacecraft to the imaged bodies. The spacecraft's attitude determination system provides an estimate of the camera's inertial pointing direction. If star images are also present in the picture, the star positions from a star catalog can be used to improve knowledge of the spacecraft attitude. Once the spacecraft trajectory and attitude history have been reconstructed at the end of a mission, the imaging data effectively becomes spacecraft based astrometry for the imaged targets and may be used in the development of their ephemerides.

Optical navigation at JPL began with the Mariner and Viking missions to Mars where the spacecraft vidicon camera was used to image the planet and its satellites. Similarly, the Voyager missions to the outer planets relied heavily on vidicon imaging of the planetary satellites. For the Galileo mission to Jupiter, a CCD detector replaced the vidicon detector in the camera; optical navigation was employed for two enroute flybys of asteroids as well as for the satellite flybys in the satellite tour. The Cassini Saturn mission also used CCD based imaging of the satellites for its optical navigation. The small body missions, NEAR, Deep Space 1, Stardust, Deep Impact, Dawn, all imaged their target bodies for navigation. Although

optical navigation was not needed for the Mars Reconnaissance Orbiter approach to Mars, a specially designed navigation camera was tested during that approach.

The format of data used for optical navigation in mission operations is the Picture Sequence File (PSF), a text file containing information on the spacecraft camera, the time and camera inertial pointing direction for each picture, and the location of each object in the picture. To use the data, the position of an object at the time of the observation must be found from an ephemeris or star catalog and converted to an image location in the picture. The difference between the object's 'ephemeris' image location and its 'observed' location can be used to correct the ephemeris. With the exception of the position of the observer, i.e., the spacecraft, at the time of the observation, all of the information needed to convert the ephemeris position of the object to its image location is on the PSF. The spacecraft positions for JPL's missions may be obtained from files available through NASA's Navigation and Ancillary Information Facility (NAIF).

Our plan is to collect the PSF's from JPL's missions and make them available to the general astronomical community. We have already begun this task by putting the data from the Voyager Uranus and Neptune encounters and the Mars Reconnaissance Orbiter approach on the IAU Commission 4 website which distributes the astrometry used for planetary ephemeris development (<http://iau-comm4.jpl.nasa.gov>). As time and resources permit, we will place additional PSF's on that website.

Khrutskaya E., A. Berezhnoy, S. Kalinin.

Title: An old photographic plates in the Gaia era: archive plates Pulkovo observatory, digitization, results of astrometric reduction, error analysis.

Abstract: The tasks of astronomy, for which digitization of the old photographic plates and their new reduction can be useful are discussed. Information on the photographic plates of "glass archive" of Pulkovo Observatory (50200 plates) and a description of a database of photographic plates ([www.puldb.ru /db/plates](http://www.puldb.ru/db/plates)) is given. The results of astrometric reductions for 1800 plates with asteroids, digitized by a flatbed scanner, and the results for the 223 plates with asteroids and Pluto, digitized by Damian digitizer in the ROB, are shown. The error of the measured coordinates (X,Y) is 0.9-1 μm for a flatbed scanner and 0.2-0.3 μm for Damian digitizer. The accuracy of astrometric reduction (the error of unit weight) for a flatbed scanner is within 110-130 mas, for Damian digitizer - 85-105 mas. UCAC3 catalog was used as a reference. Errors associated with measuring device, with the quality of photographic plates and astrometric reduction are analyzed.

Kisilev A.A., Kiyeva O.V., Izmailov I.S., Romanenko L.G., Shakht N.A., Kalinichenko O.A., Vasilkova O.O., Vasileva T.A., Poliakov E.V. (Pulkovo Observatory, Russia):

Title: Results of reduction of photographic plates taken with 26-inch refractor in Pulkovo observatory (given by Vasilkova)

Abstract: We present the results of narrow-field reduction for about 8000 photographic glass plates taken with the Pulkovo 26-inch refractor in the period from 1958 to 2007 years. They contain the images of double stars, included in the current version of Pulkovo Double Stars Catalogue. Three machines participated in digitizing: Ascorecord (till 1996 year), Fantasy and Flat scanner (up to date).

The mean errors at measuring the relative distances and positional angles of double star components are presented for all machines. Additionally, for the best comparison, the same plates are chosen, where it is possible, to find the systematic differences between the

measurements with these machines (including more than 300 plates for Fantasy and Flat scanner).

Kulyk I. (MAO, Kyiv, Ukraine)

Title: Overview of the database of photographic observations of natural satellites obtained at the Main Astronomical Observatory of National Academy of Sciences of Ukraine during 1961-1990

Abstract: About 1000 astrometric positions of the Saturnian satellites, 400 positions of the satellites of Mars, and 30 positions of the external satellites of Jupiter were obtained from the numerous photographic observations of the natural satellites made at the Main Astronomical Observatory of National Academy of Science of Ukraine during 1961-1990. The astronomical observations were carried out with 400/5500 double long-focus astrograph, 400/2000 double wide-angle astrograph (Golosiiv, Ukraine), 400/3000 double wide-angle astrograph (Kitab, Republic of Uzbekistan), 600/7500 Zeiss reflector (Majdanak, Republic of Uzbekistan). All astrometric positions were derived or re-reduced later with Tycho-2 and ACT catalogues. The quantitative and qualitative analysis of the available photographic plates as well as the derived positions will be given in the presentation. It will be shown that the positions have different inner accuracy being at 0.2 arcsec at average. Moreover, some of them may be biased with the different systematic effects such as closeness of the bright primary planet. Nevertheless, the database likely contain useful material to be re-analyzed and re-reduced with a modern reference catalogue, for example, uniform set of the observations for Iapetus, Titan, Rhea, and Dione as well as Phobos and Deimos, which cover every opposition between 1961 and 1988.

Lainey V. (IMCCE, Paris)

Title: The need of long time series of observations for the natural planetary satellites

Li Shan-Na (IMCCE, Paris and Shanghai Obs.)

Title: Improvement of the old reductions of irregular satellites using the first publications of the data

Mignard F. (OCA, Nice, France):

Title: How good would Gaia positions be in the early 1900s. ?

Abstract: Gaia is due for launch in the third quarter of 2013 and will open a new page in fundamental astronomy. The astrometric accuracy achievable of about 20 μ as/yr at $G=15$ to below 10 μ as/yr at the bright end will permit to know the positions of millions stars with μ as accuracy almost 100 years back in time. I will present the current expectations regarding the accuracy of Gaia astrometry at the end of the mission and explain how to propagate the stellar positions and their covariance matrix several decades away from the Gaia epoch without introducing modeling error. I will show also diagrams illustrating the positional accuracy down to 1900 as a function of magnitude and sky position.

Murray C. (QMUL, London):

Title: The Status of the RGO Archive

Abstract: Following the closure of the Royal Greenwich Observatory in 1998, its archive of some 165,000 plates was placed in storage in London. Records of the contents of each crate are available and these can be used to identify which plate is in which crate. We are particularly interested in photographic plates of the outer planets taken from the 26-inch refractor and 30-inch reflector. However, the records do not have the time of each observation and so we are in the process of examining the RGO archive for suitable records, as well as making use of published material. The plate archive is held by the UK's Science and Technology Facilities Council and there are plans for it to be transferred to a curated facility maintained at a branch of Oxford's Bodleian Library in 2012.

Nedelcu D.A., P. Popescu, O. Badescu (Astronomical Institute, Bucharest):

Title: Preliminary reduction and analysis of the Bucharest Observatory photographic plates: Astrometry of asteroids

Abstract: The Romanian Astronomical Plate Archive consists of 10550 plates from which 8169 are of asteroids observations. A total of 850 asteroids and 78 comets were observed in the 1930-2005 period. After a careful investigation of the whole plate archive we discovered that a series of observations were not capitalized, such as a set of minor planets which were observed during 1930-1955. The lack of accurate star catalogues containing positions and proper motions was one of the reasons why the finalization of the reductions was neglected in that period. Here we report 300 astrometric positions for 150 asteroids found on the oldest plates of the archive (1931-1933).

Pascu D. (USNO, Washington DC):

Title: USNO Satellite Astrometric Observations: 1967-2003

Abstract: Photographic astrometric observations of the satellites of Mars, the Galilean satellites of Jupiter and Saturn satellites I to VIII, were made at the U.S. Naval Observatory (USNO) from 1967 to 1999. The earliest motivation was the improvement of the published ephemerides of the astronomical almanacs of the United States, Great Britain and France. In 1973, support for NASA/JPL planetary reconnaissance programs provided impetus to continue the photographic observations until 1999 when Kodak discontinued manufacturing astronomical plates. CCD observations were begun in 1980 in support of HST/WFPC investigation development and ended with the favorable opposition of Mars in 2003. The primary target of these observations was the faint inner satellites. The resulting archive constitutes the largest of its kind. It is intensive as well as extensive, and homogenous in observational technique. The techniques of observation and reduction are described as well as the precision and disposition of the observations. Presently, the IMCCE and ROB has committed to the remeasurement, reduction and astrometric analysis of this archive, leading to improved orbits for the satellites, and for the planets as well.

Popescu P., L. Serbanescu, D.A. Nedelcu (Astronomical Institute, Bucharest):

Title: A database for the Bucharest Observatory photographic plates archive

Robert, V. et al. (IMCCE, Paris):

Title: First study of digitized USNO photographic plates of the Galilean satellites

Abstract: About 500 plates of the Galilean satellites made with the 26-inch refractor of USNO in Washington DC from 1967 to 1998 were digitized and reduced using the UCAC2

catalogue. Results on the ephemerides of the Galilean satellites and on the determination of the mass of Amalthea will be presented. An evaluation of the accuracy of several ephemerides of Jupiter on the period 1967-1998 will also be provided.

Robert, V. (IMCCE, Paris):

Title: The level of accuracy for digitizers dedicated to astrometry

We discuss different parts of the digitization process and their influence on the final measurement for astrometry. The goal is to define what could be the adapted digitizer components providing the required astrometric accuracy. We base our discussion on the use of the DAMIAN scanner with USNO photographic plates. Thus we evaluate instrumental parameters and their influence such as the stability and the position repeatability, with optical parameters such as the camera optical distortion and repeatability.

Shakht N.A., A.A.Afanas'eva, D.L. Gorshanov, E. V.Poliakow (Pulkovo Observatory, Russia):

Title: Long-term photographic observations for selected objects of Pulkovo program: measurements and results.

Abstract: The selected objects, observed at Pulkovo observatory during long time period have been of intense interest among astronomers, and now they are the most important aims for space investigations. These are the stars which have pointing out a presence of dust disks or invisible satellites of small masses, and also possible existence of planet-like companions, including the Earth-type planets.

The nearest stars such as 61 Cygni, Lalande 21185, STF1321, etc are considered as the most interesting objects. Some of them were selected as prime target stars for NASA's optical Space Interferometry Mission (SIM) and for ESA's infrared DARWIN mission. Data about these objects are in NASA STAR and Exoplanet Database.

Now we believe, that they also are interesting for observation during space mission Gaia. We have processed a materia which has been based on long-term observations within several decades and contains more than 2 000 plates. Plates were remeasured by means of automatic machine "Fantasy " and positions of objects have been reduced to the uniform system.

The estimations of accuracy have been made in accordance with classical scheme. We represent results of comparison of the measurements made on different devices, and also the detected systematic differences and some methodical researches.

Results of comparison are represented from the examination of errors of images up to estimation of accuracy of dynamic and kinematic parameters, orbits and masses determinations.

Souchay J. (SYRTE, Observatoire de Paris):

Title: The MEGACLIP project

Tang Zheng Hong (Shanghai Observatory):

Title: Work plan of digitizing Chinese photographic plates

Abstract: Supported by Ministry of Science and Technology of China, the project of digitizing Chinese photographic plates starts from April of 2012 and will last 5 years. Over 30000 plates covering different kinds of objects, such as binaries, variable stars, radio stars, asteroids, comets, extragalactic galaxies, and so on, will be scanned by a special scanner with

high precision astrometry and photometry. The initial work plan of this project is introduced. Collaboration with colleagues with good experience on this field is necessary.

Thuillot W. Bancelin D., Desmars J., Hestroffer D. (IMCCE, Paris)

Title: Asteroid datamining and precoveries in the Gaia era

The fast computation of orbit of a newly detected Near Earth Object, as well as the improvement of the orbit of a known Potentially Hazardous Asteroid, require to perform the best stellar astrometry possible in order to reach the best accuracy for an exact assessment of impact risks. The high accuracy of the Gaia measurements will therefore have a strong impact not only on the orbit modeling of the objects which will be observed during the mission, but also and in general on those of all the NEAs and PHAs through the stellar catalogue.

Furthermore, stellar astrometry with this catalogue will reinforce the impact of the data mining which can give us the opportunity to make precoveries (pre-discovery recoveries) of NEAs. We will illustrate the role of data mining and precoveries of NEAs and the importance of the Gaia observations for the orbit determination and orbit propagation of these objects.

Tsvetkova K. (Institute of Astronomy, Sofia, Bulgaria):

Title: Catalogue of Wide-Field Plate Archives

Abstract: The last version of the Catalogue of Wide-Field Plate Archives (CWFPAs) from January 2012 is presented. As "plate archive" we denote a collection of plates obtained with a certain telescope at a certain observational site and stored at a certain place, i.e. one telescope may have more than one plate archive, if the telescope was moved or if its plates are stored at different observatories or institutions. The CWFPAs gives in table form the descriptive information for all included plate archives (with total number 476) with 2 475 600 plates stored worldwide, using the archive identifier composed by the name of the observatory, respective instrument aperture, and instrument aperture suffix (in the case of existing instruments with the same aperture).

One can find more details for the observatories, where the plates were received, for the parameters of the used telescopes and the period of its operation since the first plate observations up to the last ones, as well as the present location of the archives, and the name of astronomer in charge for contact. The number of the known archives grew from 68 (according to the first lists prepared by B. Hauck and C. Jaschek in 1989) up to 476, respectively the number of included direct and objective prism plates - from 1 500 000 (1989) up to more than 2 475 600 (2012).

The analysis of the catalogue information showed that the most of the wide-field plate archives were established with small apertures telescopes up to 50-60 cm, mostly refractors, astrographs and cameras. The plate number in a separate archive ranges between several tenths to more than 100 000. Only a small number of archives have more than 10 000 plates. The time distribution of the number of worldwide plate archives reveals a peak around 1892 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, as well as the both depressions because the two world wars. The maximum in the appearance of new archives is after 1955 up to the beginning of 1970, when the plate observations comprised in more than 130 archives started.

Analysing the content of the plate archives, namely the number of plates and its time distribution, the observing programmes in the frames of which the plates were obtained, observed object type, used method of observation, exposure multiplicity and duration, emulsions and filters for realization of given photometric system, one can have also a look to

history and development of astronomy in the respective country. Very often the time distribution of the plates reveals a coincidence between the maximums of the observational activity and the periods of some observational campaigns executed in the respective observatory: observations of asteroids, sky surveys, supernova search, investigations of the type of stellar variability, etc. A special emphasis is made on the WFPDB astrometric plate archives selected on the base of the used telescope and observing programme.

Tsvetkov M. (Institute of Astronomy, Sofia, Bulgaria):

Title: Wide-Field Plate Database

Abstract: The Wide-Field Plate Database (WFPDB) as a basic source of data for the wide-field astronomical photographic plates obtained with professional telescopes worldwide, is presented. Now the WFPDB consists of four parts: Catalogue of Wide-Field Plate Archives (CWFPAs); Catalogue of Wide-Field Plate Indexes (CWFPIs), Data Bank of Digitized Plate Images, Links to online services and cross-correlation with other needed catalogues and journals.

The CWFPIs has a static version for about 323 000 plates installed in Strasbourg (<http://vizier.u-strasbg.fr/cats/VI.htx>) with online search via Vizier (see Search in the WFPDB - catalogue number VI/90), and an enlarged and regularly updated version installed in Sofia (<http://wfpdb.org/search>), and mirrored in Potsdam since 2007 (<http://vodata.aip.de/WFPDBsearch/>). This last version contains up to March 2012 the parameters of 563 612 plates (<http://wfpdb.org/allsky.html>) from 131 archives with provided 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.

More than 280 000 plates in different observatories in Europe were digitized with commercial high-quality flatbed scanners last decade. The developed technology in Sofia for plate digitization with such scanners is presented too. The digitized plate images are with low resolution for quick plate visualization and easy online access, and with high resolution aiming photometric and astrometric investigations and with implementation of contemporary methods for compression. There is no universal procedure for scanning the plates, but an optimal one for a given telescope could be chosen.

A special attention on the plate archiving is paid to some plate collections in Germany, Bulgaria, Hungary, Belgium, Romania, etc., where with the help of our working team and the efforts of astronomers, networking and information technology specialists, and librarians, the process of plate archiving is running actively.

Vienne A. (IMCCE, Lille, Paris):

Title: New solution for the geometric distortion in astronomical images.

A new approach for the correction of the geometric distortion is proposed. This approach is applied to observations of three open clusters taken at the Yunnan Observatory. It is shown that the correction depends on the filter used. The technique is then used to correct the positions of Phoebe (ninth satellite of Saturn). The precision on the positions is significantly improved.

Xi Xiaojin (National Time Service Center, Shaanxi, China)

Title: The introduction of the natural satellites observation and orbit update by NTSC

Abstract: This communication is to introduce the work of NTSC in nearly 30 years on the planetary observation and orbit update.

Zacharias N. (USNO, Washington DC):

Title: Star catalogs, photographic plates and errors for solar system astrometry improvements

Abstract: The current and near future status of astrometric reference stars is reviewed in the context of measuring and reducing photographic plates of solar system objects. Random and systematic errors of the entire process are discussed based on experience with the StarScan and DAMIAN measure machines to illustrate potential improvements and limitations of solar system astrometry from utilizing photographic data spanning several decades.