MINISTRY FOR EDUCATION AND SCIENCE OF UKRAINE
UKRAINIAN ASTRONOMICAL ASSOCIATION
RESEARCH INSTITUTE NIKOLAEV ASTRONOMICAL OBSERVATORY

"RESEARCH OF ARTIFICIAL AND NATURAL NEOS AND OTHER SOLAR SYSTEM BODIES WITH CCD GROUND-BASED TELESCOPES"

International conference

PROCEEDINGS
OF THE CONFERENCE

May 17-20, 2004,
Nikolaev, Ukraine

Organizers:

Ministry For Education And Science Of Ukraine
Ukrainian Astronomical Association
Research Institute "Nikolaev Astronomical Observatory"

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The programme, abstracts of papers and other materials of the International Conference "Research of Artificial and Natural NEOs and Other Solar System Bodies with CCD Ground-based Telescopes" held in Nikolaev on May 17-20, 2004 are given in the Proceedings.

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11.50-12.10	**E. Hoeg** (Astronomical Observatory of Copenhagen University) The Depth of Heavens - Belief and Knowledge During 2500 Years
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11.00–11.20	**G. Pinigin** (RI NAO), Z. Aslan (TNO), I. Hamitov, R. Gumerov, A. Ibragimov, A. Nemtinov (KazSU), A. Ivantsov, L. Hudkova, A. Shulga (RI NAO) Astrometry at the RTT150 Telescope within the International Framework of KSU (Russia), TUG (Turkey) and NAO (Ukraine)
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16.00–16.15	**E.B. Vovchyk** (AO LNU), Ya. Blahodyr, O. Lohvynenko, A. Bilinsky, G. Kraynyuk , B. Klym, Ye. Pochapsky. About observations of artificial satellites in Lviv Astronomical observatory
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16.30–16.35	**V. Bortsov**, V. Lisachenko, A. Reznichenko, V. Yamnitsky (RTI TTR) Development of Robotic Telescopes for Observations of the Artificial Satellites
16.45–17.00	**V.V. Kleshchonok** (AO KNU) New astronomical television system "Spalah" – first results
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13.00–13.15	**V. S. Filonenko**, Velichko F.P., Krymsaljuk R.Yu., Velichko S.F. (IA KhNU) CCD observations of comets 2P/Encke and C/2001 A2 (LINEAR) at the Institute of Astronomy of Kharkov National University
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2. *M.Abele, A.Balklavs-Grnhofs, L.Osipova* (Institute of Astronomy, University of Latvia) Possibility of Minor Planets Distance Measurement with Laser Ranging Device

3. *L.S.Chubko , K.I.Churyumov, V.V.Kleshchonok, I.V. Luk'yanyk* (AO KNU). Study of Spectra Comets C/1999 S4 (Linear), C/2000 WM1 (Linear) and C/2002 C1 (Ikeya-Zhang)

4. *I.I. Motrunich, V.U. Klimik* (SRL Uz NU) Hazard of collisions of space objects on geosynchronous orbits

5. *N.M. Antonyuk, Yu.S. Efimov, N.N. Kiselev, S.V. Kolesnikov, V.K. Rosenbush, Shakhovskoy, D.N. Shakhovskoy, F.P. Velichko, S.F. Velichko* (IA KhNU). Polarimetry and Photometry of Comet C/2002 T7 (Linear)

6. *Burlak N., Dragomiretskiy V., Korniychuk L., Korobeynikova E., Koshkin N., Naumenko T., Paltsev N., Ryabov A., Strakhova S., Sukhov P.* (AO ONU) Astrometric and photometric observations of artificial satellites and cosmic debris in Odessa

7. *Karataev V., Koshkin N., Luk'yanenko N.* (AO ONU) Usage of results of a five-color photometry of small asteroids obtained by SDSS for revision of MBA-family members

8. *Paltsev N., Karpenko G., Koshkin N., Sukhov P.* (AO ONU) Transformation of satellite's position to reference-epoch. Determination of visible positions of stars

9. *Koshkin N., Paltsev N., Terpan S.* (AO ONU) Identification of background stars and compensation of jitter distortion at photometry artificial satellites

10. *A. Bilinsky* (AO LNU) Real-Time Linux control software of satellite laser ranger TPL-1M of Lviv AO

11. *W. Thuillot* (IMCCE, Paris Observatory) Astrometric Programs for the small objects of the Solar system: A Component to the GAIA mission.

12. *K. Alekseev (StPSUAI), G. Pinigin, N. Reshetnikova.* 3D Interactive Model of Observational Process of the Minor Planet Iris(7)

13. *F.Bushuev, Y.Obraztsov , A. Slivinsky, A.Shulga* (RI NAO) Research of the Ionosphere Data for Studying Solar Activity, Earth-Quake Forecasting and Correction Geodetic Information GPS Receivers

14. *D.P. Duma* (MAO NASU) Space Debris. Threat for the safety of the working spacecrafts

15. *A. Kovalchuk, A. Mazhaev, A. Shulga* (RI NAO) On New Possibilities for Research of the Artificial Satellites with CCD Camera in Drift Scan Mode

16. *N.M.Gaftonyuk, V.V. Prokof'eva* (CrAO) CCD observations of Near-Earth Asteroids in Simeiz Department of Crimean Astrophysical Obsevatory

17. *A. Kazantsev* (AO KNU) The system of three small telescopes for synchronized BVR photometric observations of NEAs

18. *Yu. N. Krugly* (IA KhNU) CCD Photometry Of Fast-Moving Asteroids: Observation And Reduction Techniques

19. *Ya. Blagodyr, S. Ternavska, A.Bilinsky, O.Lohvynenko* (AO LNU) Laser location of artificial satellites in Lviv

20. *O. Alexandrov, G. Kirpa, Eu. Kozyrev, V. Popova, Yu. Protsyuk, Eu. Sibiryakova, O. Shulga* (RI NAO). Usage of Scanner for Determination of Coordinates and Stellar Magnitudes of Objects on Astronomical Plates

21. *Bazey A.A.* (RI NAO) About Use of the Quickly Method for Calculation of the Element of Kepler Orbits of the High Satellite in the Nikolaev Observatory

22. *E. Hoeg* (Astronomical Observatory of Copenhagen University) Astrometry and photometry from space: Hipparcos, Tycho, Gaia

ABSTRACTS

POSSIBILITY OF MINOR PLANETS DISTANCE MEASUREMENT WITH LASER RANGING DEVICE

M. Abele[1]*, A. Balklavs-Grinhofs*[1]*, L. Osipova*[1,2]

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This paper presents calculations of laser pulse energy reflected from the surface of minor planets. The use of receiving telescopes of different size is evaluated. Implementation of such technical devices and measurement method could greatly improve orbital elements of Near Earth Objects (NEO).

3D INTERACTIVE MODEL OF OBSERVATIONAL PROCESS OF THE MINOR PLANET IRIS(7)

K. Alekseev[1]*, G. Pinigin*[2]*, K. Reshetnikova*[1]

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The presented paper is devoted to modelling of observational process of Iris7 movements to improve its orbit. Amateur astronomers have a great deal of interest to observations of the minor planets. Visualization of observational process allow us to implement a method of the orbit improvement. The observations of natural and artificial near-Earth objects are carried out with the Fast Robotic Telescope of the RI NAO.

The model presents the following modes of observations:

– stare and drift-scan modes with telescope is fixed in position;

– stare mode with daily telescope moving.

The model is interactive in 3D virtual space. 3D model of the telescope was implemented by using 3D Studio MAX software. Virtual reality modelling language (VRML) was used for development of interactive interface. One of the VRML browser such as Cortona VRML Client, Cosmo etc. is necessary for viewing of 3D scenes.

This research allow to refine possibilities of the Fast Robotic Telescope with automatic observations of the minor planets.

USAGE OF SCANNER FOR DETERMINATION OF COORDINATES AND STELLAR MAGNITUDES OF OBJECTS ON ASTRONOMICAL PLATES

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Photographic archives of observatories contain huge number of astronomical plates, which have been taken for the last 100 years. More than one hundred thousand of the astronomical plates are concentrated in the observatories of CIS only.

The interest in unique information contained in the photographic archives has increased for the last period of time because of the following reasons:

– proper motions of stars in Hipparcos catalogue need to be improved due to ageing of this catalogue;

– small asteroids need to be rediscovered at earlier epochs to improve their ephemerids in connection with GAIA space mission;

– modern computers, professional scanners (12800 dpi), and software for digital filtration allow us to make new, quick, and precise reduction of the astronomical plates.

The Scanning Measuring Machine (SMM) was created in the RI NAO for identification of objects, determination of their equatorial coordinates and stellar magnitudes.

Hardware of the SMM consists of:

– colour scanner: EPSON PERFECTION 3200 PHOTO, 3200dpi, 14.3 ms/row, (27200x37440) pix;

– control computer: Celeron 2.4 GHz, RAM-256 Mb, HDD-80 Gb.

Software of the SMM provides the whole range of data processing, namely: a scan, reduction to standard position, filtration, identification, determination of rectangular coordinates, determination of equatorial coordinates using Schonberg B-spline, determination of stellar magnitudes.

HIPPARCOS, TYCHO-2, USNO–A2, USNO–B1.0, UCAC2 are used as reference catalogues.

Trial measurements were carried out by using the plate with sizes of (210x210)mm containing the image of the Pleiades constellation made with the Zonal Astrograph of the RI NAO on 28.11.1962. The image size was 7000x7000 using space resolution of 1200 dpi. The file size was 40 Mb in bmp format.

The internal accuracy for the stellar magnitudes of 8 to 13 for two coordinates were ±0”.15 and ±0”.30, respectively. The uncertainty of single measurement for $(O-C)_{a,d}$ and stellar magnitude were ±0”.21 $(m-7)^{0.23}$ and $\pm 0^{m}.1$, respectively.

The research confirmed the expediency of usage of the professional scanner for determination of coordinates with uncertainty about ±0”.1 using measurements of the astronomical plates in four positions.

POLARIMETRY AND PHOTOMETRY OF COMET C/2002 T7 (LINEAR)

N.M. Antonyuk[4], Yu.S. Efimov[4], N.N. Kiselev[3], S.V. Kolesnikov[4], V.K. Rosenbush[2], D.N. Shakhovskoy[4], F.P. Velichko[3], S.F. Velichko[1]

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We present the results of polarimetric and photometric observations of comet C/2002 T7 (LINEAR), which were obtained from November 20, 2003 to February 26, 2004 with the 0.7-m telescope of Institute of Astronomy of Karazin Kharkiv National University and the 1.25-m and

2.6-m telescopes of Crimean Astrophysical Observatory. The 2.6-m and 0.7-m telescopes equip with the one-channel photopolarimeters, which work on the modulation principle with rapidly rotating polaroids. The observations were carried out with the HB narrow-band cometary filters: C_2 (5191/118 Å), GC (5260/56 Å), RC (7129/62 Å), and the wide-band filter WRC (7228/1142 Å). At the 1.25-m telescope the data were obtained with the five-channel UBVRI photopolarimeter.

Phase dependence of polarization for the comet in WRC filter was constructed in the range of phase angle 7°26°. We found the parameters of polarization phase angle dependence: the minimum of negative branch of polarization $P_{min} \approx -1.4$ %, the inversion angle α_{inv} = 21°.8, and the polarization slope h = 0.224 % per degree. These parameters are close to that for dust-rich comets. The fluxes of the emission band C_2 and continuum for the comet C/2002 T7 (LINEAR) are also given. Molecular column density and production rate of C_2 species in the framework of Haser model are presented.

ASTROMETRY AT THE RTT150 TELESCOPE WITHIN THE INTERNATIONAL FRAMEWORK OF KSU (RUSSIA), TUG (TURKEY) AND NAO (UKRAINE)

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Modern astrometric projects demand accurate measurements of position for objects down to 20–22 magnitudes. With ground-based observations, it is possible to do this with astrographs of 1 metre aperture or more with accurate tracking at long exposures and accurate timing. The multi-functional astronomical complex RTT150, implemented on the basis of AZT-22 telescope (LOMO, 1995), is suitable for such purposes (http://www.tug.tubitak.gov.tr/rtt150).

Special properties of the RTT150 computer control system, which ensure the necessary astrometric characteristics are presented in the paper. A possibility for accurate tracking is recognized for telescope motion along a given trajectory, which is successfully used for corrections of irregularities of the general gear and for compensation of the influence of differential refraction at great zenith distances. The computer control software has a user friendly interface which allows one to control the telescope both interactively and in automatic mode for a given list of objects. RTT150 is equipped with three CCD cameras, which give a possibility to conduct observations in tracking (stare) mode and drift scan one.

Description of the observation programs and methods is presented for new astrometric projects. In particular, problems concerning the research on small bodies of the Solar System down to 20 magnitudes are picked out, such as determination and improvement of the orbital elements of the near-Earth objects, determination of masses for the selected asteroids by the gravitation perturbations of the lesser asteroid orbits, participation in compiling an input catalogue of accurate positions of selected minor planets for ground-based provision of international program “GAIA Follow-Up”. Besides, photometric observations of brief occultations of stars by asteroids have been planned which will allow us to determine both accurate position of the asteroid and its diameter, presence of a companion and other characteristics.

It is planned to use the method and experience of CCD observations, which have been gained during the observing program of extragalactic radio sources (stare mode). It is possible for asteroid observations in drift scan mode to use the covered strips method [1] and combined CCD method [2].

Determination of accurate positions of small bodies of the Solar system with RTT150 can be realized with an accuracy of about 50 mas using of reference catalogues of high accuracy and density (TC2, UCAC, USNO-B1, etc).

1. R.I. Gumerov, A.N. Kovalchuk, G.I. Pinigin, Yu.I. Protsyuk, A.V. Shulga: 1999, Kinematics and Physics of Celestial Bodies. Supplement N1, Kiev, p. 79-83 (in russian).

2. V.Dedenok, Abrosimov, G. Pinigin, A. Shulga et al: 2001, In “Extention and Connection of Reference Frames using CCD Ground-based Technique”, Intern. conf. G.Pinigin (ed.), Atoll, Nikolaev, 2001, p.170-179.

ABOUT USE OF THE QUICKLY METHOD FOR CALCULATION OF THE ELEMENT OF KEPLER ORBITS OF THE HIGH SATELLITE IN THE NIKOLAEV OBSERVATORY

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Numerical model use in the framework of the two bodies for control of the quality corner ground observations. Programms security were create from observations corner coordinates calculations the Kepler elements of the satellite orbit by the Laplas method then it improvement by the method differential corrections. Receive elements of the orbit use for calculation of the satellite positions in the moment observations. Since deviations from Kepler movement of the high satellite are unimportant during observations then discrepancy between observation and calculation positions can be use for characteristic of the observations accuracy.

In most processing observation rows a discrepancy O-C have tendency to increase near by extreme moments of observations that show directly on the dependence of the observation accuracy from satellite apparent brilliance.

On the foundation calculation discrepancy of the satellite positions can be calculation rootmeansquare meanings and rootmeansquare deviations of the orbits elements.

A row of examples of the processing corner observation a geostationary satellite are lead. This observations are made in the Nikolaev observatory.

TELESCOPES FOR OBSERVATIONS OF ARTIFICIAL SATELLITES OF THE EARTH IN THE RESEARCH INSTITUTE NAO

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Artificial satellites of the Earth are cataloged in the RI NAO with the aim of monitoring the space debris dynamics on all near-Earth orbits, studing of the Earth geopotential and density variations in the upper atmosphere.

The observations are carried out with three telescopes, namely:

– the multi channel telescope (MCT) (160 mm, f/12.7);

– the axial meridian circle (AMC) (180 mm, f/13.8);

– the fast robotic telescope (FRT) (300 mm, f/5).

All telescopes are equipped with the CCD camera on the basis of ISD-017AP chip. Objectives of the MCT and FRT (100 mm, f/2.5) are used for observations of low orbit objects using high-sensitivity 1/2" TV CCD cameras. Main objectives of the MCT and FRT are used for observations of objects on low-Earth orbits (LEO) and geostationary orbits (GSO). The AMC is used for observations of objects on high-Earth orbits (HEO).

The telescopes allow us to observe on GSO in the range of 105°E to 32°W longitude; on LEO and HEO in the range of 25° in any direction. The observations are carried out with unmovable telescopes: on GSO by combined CCD mode, on HEO and LEO by quasi-strip mode.

Two groups of objects are included in the catalog. 90 geostationary satellites (GSS) of 18 telecommunication companies from 20 countries are included in the GEO group. 100 objects such as rocket carriers, used space apparatus, meteo satellites etc. are included in the LEO group.

Kepler orbit elements at a mean epoch of observations are calculated.

The catalog is available via the web site of the RI NAO. Physical features, equatorial coordinates at a mean epoch of 2000, orbit elements at a mean epoch of observations are given in the catalog.

The accuracy of single determination of (O-C) was estimated as the result of calculations of Kepler orbit elements. The accuracies for GEO and LEO observations were ±0.4"÷ ±1" and ±3"÷ ±10", respectively.

CCD OBSERVATIONS OF NEAR-EARTH ASTEROIDS: RESULTS, PROBLEMS AND PERSPECTIVES

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CCD observations of near-Earth asteroids (NEAs) started in Kharkiv Observatory in 1995. The observations with 70-cm home telescope are carried out on a regular basis and are directed to measure lightcurves and astrometric positions first of all of newly discovered NEAs. The obtained results including rotation periods, shapes, phase relations, and diameters are presented. CCD observation and reduction techniques are discussed. The significance of the cooperation between NEA observers is emphasized. The organization and perspectives of Space-Guard Center in Ukraine are discussed.

CURRENT STATE OF THE FAST ROBOTIC TELESCOPE

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The Fast Robotic Telescope (FRT) intended for observations of stars, globular clusters, solar system bodies, near-Earth objects was developed in the RI NAO. The FRT is able to observe in three different modes:

– stare mode;

– drift scan mode;

– satellite mode – observations of the near-Earth objects with orbit inclinations ± 90°.

A brief analysis of the problems, emerging in the course of high-accuracy optical observations of the artificial near-Earth objects, and possibilities of their resolution by using original methods and technical means are given. The possibility of angular measurements with the standard deviation about 1" at the moment of observation is discussed.

The general features of the FRT are given. The telescope is able to carry out observations of the artificial near-Earth objects, virtually, on all orbits and in a wide range of magnitudes.

A great deal of attention is given to the instrument hardware and software, which allow us to carry out observations in automatic mode.

The FRT has an equatorial mount with the following hardware:

– Maksutov telescope (300 mm, f/5.0), CCD camera (1040x1160, 16x16 mkm, FOV= 40'x40');

– the narrow field satellite camera, refractor (three lenses, 300 mm, f/1.6), TV CCD (1/2" , FOV= 30'x 30' , 25 frame/s);

– the wide field satellite camera, refractor (seven lenses, 100 mm, f/2.5), TV CCD (1/2" , FOV= 2°30'x2°30' , 1...25 frame/s);

– the positioning system with angular encoders (angular velosity up to 2.5 °/s , s = ± 0".1);

– the time recording system (s(t)= 0.1 s).

Trial observations gave the following results of the limiting magnitude:

– Maksutov telescope — up to 17m (τ=60 s);

– the narrow field satellite camera — 14m (τ=0.04 s);

– the wide field satellite camera — 10m (τ=0.1 s).

The FRT has begun the observations of NEO in semi-automatic mode.

REAL-TIME LINUX CONTROL SOFTWARE OF SATELLITE LASER RANGER TPL-1M OF LVIV AO

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Due to some special needs it was decided to modernize the control software of telescope TPL-1M of Laser Ranging Station "Lviv". We considered several operating systems to choose the most suitable for our purpose. The best choice was Real-Time Linux. The system has several essential advantages over others (MS-DOS, Windows, LynxOS, Linux). First of all RTLinux is free "hard" real time system which is used in the most advanced applied researches. Secondly, it runs standard Linux as least privileged task and this allows to use all advantages of Linux: local networking and Internet, free scientific astronomical software that can be used parallel to real time tasks, useful integrated development environments etc. All these preferences let us create inexpensive elegant program complex for automation astronomical observations.

LASER RANGING OF ARTIFICIAL SATELLITES IN LVIV

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In 2002 laser ranging station of Astronomical observatory of LNU was integrated in the international network ILRS (International Laser Ranging Service). Single shot errors are 3-6cm, normal point error are 0.6-12mm that satisfy ILRS requirments. The presence of such station integrated in the international network is very important for national geodesy, cartografy etc. Now the station has probation status and the staff works over performance improvement.

ROBOTIC TELESCOPES FOR OBSERVATIONS OF THE ARTIFICIAL NEAR-EARTH OBJECTS

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Use of astronomical telescopes for observations of the artificial near-Earth objects gains the increasing importance in connection with expansion of research dealing with the space debris problem and steady increase of requirements for initial measurement accuracy.

The observations of low orbit objects with optical means faces with a number of difficulties connected, on the one hand, with a narrow field of view of long focus telescopes and, on the other hand, with a fast angular movement of observable objects.

The optical telescope for observations of the near-Earth objects must have a wide range of tracking speeds and high accuracy of tracking, comparable with a half of the field of view.

In the case when the field of view equals to several angular minutes, the problem of tracking is difficult enough and application of special means is necessary.

The guiding system of the Automated Mirror Telescope (AMT-28) is considered.

The telescope guiding, based on the use of analytical forecast for motion of the near-Earth object in real time mode during the observation, is implemented into structure of the control system.

Input catalogues in TLE format are used for the telescope guiding.

Angular encoders, TV-tubes, and CCD cameras allow us to provide high tracking precision of objects with orbit altitude up to 400-500 km. The results of this work are given. The upgrade of the telescope was carried out within the financial framework of the national space program of Ukraine.

ASTROMETRIC AND PHOTOMETRIC OBSERVATIONS OF ARTIFICIAL SATELLITES AND COSMIC DEBRIS IN ODESSA

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On near-Earth orbits now there are some thousand artificial space objects, including about one thousand – on geostationary orbits. It requires the continuous monitoring of their orbits, study of interaction of these bodies with space environment and allows to use many from them for an estimation of parameters of this environment.

With this purpose on Astronomical observatory of ONU many years the astrometric and photometric observation artificial space objects (SO) are conducted. On a telescope KT-50 the observations of objects on low orbits will be carried out. For measurement of target coordinates are used precise goniometers established on two axes of a telescope. The CCD-camera intended for measurement of displacement of the satellite concerning optical axis of a telescope is established in the main focus of 50-sm mirror. Simultaneously, the information on change of shine of the cosmic object by means of electronic photometer on a basis of photomultiplier is registered. The processing of the photometric and astrometric data allows to determine the period of rotation of the SO and orientation of an axis of rotation or mode of its stabilization in space. For the decision of last task it is necessary to attract modeling of the optic-geometrical parameters of SO for comparison of model's shine with observations. On the basis of this monitoring the databank containing the information about the shine of LEO more than for 20 years of supervision is generated.

The astrometric measurements of a passive SO on low orbits are used for study of interaction of the cosmic body with Earth atmosphere and monitoring of change of atmosphere density at various heights during the increased solar and geomagnetic activity.

Geostationary and high-elliptic objects are observed on a 30-sm telescope with the television camera. The television field with the image of the satellite on a background of stars is quantized and is kept in the computer in a standard graphic format. For finding of coordinates of SO is used the original software. Calculated coordinates of the SO are used for their cataloguing.

RESEARCH OF THE IONOSPHERE DATA FOR STUDYING SOLAR ACTIVITY, EARTH-QUAKE FORECASTING AND CORRECTION GEODETIC INFORMATION GPS RECEIVERS

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Received in the Nikolaev Astronomical Observatory (Scientific Research Institute NAO) regular observations of a condition of the D-layer of an ionosphere, with use of a technique of inclined sounding by signals LW radio stations of accurate hour's services and frequencies (DCF-7 Germany), allow, by results of processing and the analysis of the accepted digital signal information which are carried out by a complex, developed in HAO, specialized programs to carry out detailed studying and the control of the current solar activity and its ground displays, to predict conditions of distribution of radiowaves, etc.[1]. Significant interest, in opinion of authors, represents an opportunity of use given ionosphere observations for search and detection ionosphere forecast of strong earthquakes in areas of the raised seismicity, with use of automatic algorithm, and also an opportunity of the ecological control of anthropogenous influences on an ionosphere.[2]. During the analysis of a file of the saved up data, have been found out as well steady correlations of significant distortions of the data permanent GPS stations NAO and x-ray solar flashes (up to 10 m on range) which adequate account allows to improve accuracy of the geodetic works which are carried out with use GPS of the equipment. Ionosphere data of NAO are registered with an interval in 1 second. Graphic results of the current data processing with 5 minute interval are removed on information site NAO http://www.mao.nikolaev.ua for an opportunity of operative use by consumers. Results of the lead spectral and comparative analysis of an annual file ionosphere data will well be coordinated tothe number,typical for dynamics of number of Volf, and other observable periodicity of solar activity, both on long, and on short intervals of time.[3] Periodicity of processes, annual duration, 112,52, 28, 7, 2 and 1,24 day, and also short-periodic variations with intervals 49.7; 30.3; 21.8; 17.1; 14.6; 11.8; 10.5; 8.8; 7.9 and 7.2 minutes. The assumption that such periods are caused constantly existing oscillations by processes in deep layers of the Sun has been stated. [4].

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THE LAST PULKOVO INVESTIGATIONS IN ASTROMETRY OF SMALL SOLAR SYSTEM BODIES, THEIR ORBIT DETERMINATIONS AND EPHEMERICE SERVICE

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A short rewiew on the last Pulkovo traditional researchs in estimation of an accuracy of positional asteroid observations made by professional and amateur observatories all over the World is given. For the years of 1999-2003 each position of the Number Minor Planet from MPC Database was tested with the help of EPOS Software created at Pulkovo Observatory by Dr.V.L'vov and his colleagues. The values of "Mean error of a single observation" were derived for more than 200 various CCD telescopes. These results will be demonstrated during this Conference. Also our EPOS Software allows to calculate (together with usual RA & DEC coordinates and other ephemeris data) the exact meaning of Pulkovo Parameters of Apparent Motion of any celestial body and take them into consideration as new inportant ephemeris values for an identification of moving object and its initial orbit determination with the use of Laplacean or Pulkovo AMP-method which was developed by Dr.A.Kiselev and his colleagues from 1973 - first of all for the Artificial Earth Satellites. Later AMP-method was applied for Double Stars, asteroids and comets. The EPOS Software, Laplacean and AMP methods were successfully used in a wast practice and must be taken account by our Systems of Space Control. Besides, Pulkovo Observatory (Dr. I.Izmailov) has great expierience in a exact processing of modern CCD frames with the images of stars and moving objects. He completely automatizied our 26" refractor – from observations to calculations of celestial object' positions. Drs. Khrutskaja and M.Khovrichev are known their works in the field of Star Catalogues compositions. The 0.32 m CCD reflector (Dr. A.Deviatkin) automatically and regularly observes Near Earth Asteroids. Double CCD Astrograph (Dr. I.Guseva) took part in several programs of Geostationary observations. It seems to author Pulkovo Observatory is possessing now the large potency and possibilities which must be used in developing of observational programsfor Near Space Control by Groud-based telescopes.

CURRENT STATE OF THE INTERNATIONAL SERVICE OF THE MINOR PLANET OBSERVATIONS

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The developing of the CCD technology of observation and sky surveying made a revolution in the minor planet service. The number of known asteroids and picture of distribution of them in the Solar System were changed dramatically in the course of the last decade.

In our days the total amount of numbered minor planets increases very fast, doubling every 1.5 – 2 years. It had exceeded 10000 in 1999, 20000 in 2001, 40000 in 2002 and is approaching now to 80000.

The contribution of the most prolific observatories to the minor planet discovery and the results of the most active observers are given in the report. Some details on the programs of main observatories are reported.

The prospects on the future works in the minor planet survey are discussed.

STUDY OF SPECTRA COMETS C/1999 S4 (LINEAR), C/2000 WM1 (LINEAR) AND C/2002 C1 (IKEYA-ZHANG)

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In this paper we present some results of exploration of specta of three comets C/1999 S4 (Linear), C/2000 WM1 (Linear) and C/2002 C1 (Ikeya-Zhang). The spectra of comet C/1999 S4 (LINEAR) were obtained with the eshelle-spectrograph (and CCD) installed on the 2-m Zeiss reflector of the Shamakhy Astronomical Observatory of the Azerbajan Academy of Sciences (Mount Pirkuli) on July 21 and 23, 2000. Detailed identification of emission lines in the spectra of comet C/1999 S4 (LINEAR) was made. Changes in the lists of the identified spectral emission lines on July 21 and 23, 2000 during splitting of the cometary icy nucleus are discussed. The spectra of comet C/1999 S4 (LINEAR) were also obtained with the UAGS spectrograph (long slit and CCD) installed on the 1-m Zeiss reflector of the SAO of the RAS (Northern Caucasus, Nizhny Arkhyz) on July 23/24, 26/27 and 27/28, 2000. Detailed identification of emission lines in the spectra of comet C/1999 S4 (LINEAR) was made. Changes in the spectra on July 23/24, 26/27 and 27/28, 2000 are analyzed. The peculiarities of cometary luminescent continuum in the specta of cometC/1999 S4 (LINEAR) are discussed.

Analysis of middle-resolution optical spectra of comet C/2000 WM1 (LINEAR) obtained on November 22 and 24, 2001 and on Apr. 5, 2002 with the 2.12 – m reflector of the Guillermo Haro Astrophysical Observatory is given. Analysing distribution of brightness along the spectrograph slit in emission lines C_2, C_3, CN on Nov. 22, 2001 we determined some physical parameters of these neutral molecules - the velocity of expansion of molecules from the nucleus and their life time. Using Haser's model the rates of gasproductivity in emission lines of C_2, C_3, CN molecules for Apr. 5, 2002 were determined.

The results of study of middle-resolution optical spectra of comet C/2002 C1 (Ikeya-Zhang) obtained on May 5, 2002 with the help of the 2.12 – m reflector of the Guillermo Haro Astrophysical Observatory are discussed. Emission lines of the molecules C_2, C_3, CN, NH_2, CO (Asundi and triplet bands), and H_2O^+ were identified in these spectra. On the basis of the intensity distribution along the slit of the spectrograph in C_2, C_3, CN emission lines we determined the velocities expansion and life times of these molecules.

ROSETTA-SPACE MISSION TO COMET 67P/CHURYUMOV-GERASIMENKO

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Cometary nuclei are keys for solution of a problem of origin of the Solar system. Cometary nuclei retain the pristine matter of the primordial nebula from which the Sun, planets and other bodies of the Solar system were formed 5 billion years ago. Space missions to comets play important role for direct exploration of comet matter (Table). The International Comet Explorer (ICE) mission to comet 21P/Giacobini-Zinner in September

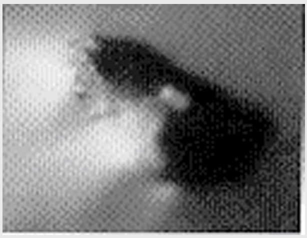
1985 gave the first direct data on the physical parameters of magnetic field and plasma of this comet. With the help of the VEGA-GIOTTO-SUISEI-SAKEGAKI-ICE missions to Comet Halley in March 1986 the first direct data on the nucleus, chemical composition and physical parameters of ion, neutral gas and dust particles and other data of this comet were received. Very interesting scientific results were obtained on the boards of ICE probe (comet 26P/Grigg-Skjelerupp), NEW MILLENIUM DS-1 probe (Comet 9P/Borrelly, Sep. 23, 2001 – fine images of the comet nucleus) and the STARDUST vehicle (comet 81P/Wild 2 , Jan. 2, 2004). The great significance of in situ investigations of comets was realised and now there are other space missions to periodic comets which are on the different stages of implementation. Some of them are carrying out while others are being planned. These are:

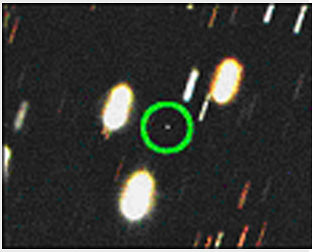
1) DEEP IMPACT mission to Comet 9P/Tempel 1 (the date of encounter is July 2005);

2) ROSETTA mission to Comet 67P/Churyumov-Gerasimenko (lunch in 2004). The Rosetta probe was sent to short period comet 67P/Churyumov-Gerasimenko on Mar. 2, 2004 with the help of the Ariane 5 G+ rocket. Rosetta with Lander-Phylae will get to comet 67P/Churyumov-Gerasimenko via a series of complex space manoeuvres, including Mars and two asteroids (Steins and Lutethia) flybys to catch the comet out near Jupiter and then follow the target comet in towards the Sun. The timescales involved are similar with the rendezvous planned for 2014.

Table

SPACE MISSIONS TO COMET NUCLEI

Mission	Target Comet (Encounter Date)
International Comet Explorer (ICE)	21P/Giacobini- Zinner (Sept. 1985)
VEGA-1, VEGA-2, JOTTO, SUISEI, SAKEGAKI, ICE	1P/Halley (March 1986) 

ICE	26P/Grigg-Skjele-rupp	
New MilleniumDS-1	9P/Borrelli (Sep. 23,2001)	
STARDUST	81P/Wild 2 (Jan. 2, 2004)	
Deep Impact	9P/Tempel 1 (July 2005)	
ROSETTA	67P/Churyumov-Gerasimenko (Aug 2014)	

LONGITUDE/LATITUDE MEASUREMENTS AND ASTROMETRY BY USING CCD TECHNIQUE

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We did a few CCD (Charge Coupled Device) experiments to make the observations for longitude/latitude measurements by using the instruments of astrometry and geodesy. The mobile zenith camera "G1" (near 4 kg), CCD MX916 (Starlight Xpress) with F=20 cm optic, was developed at the Technical University Vienna (TU Wien), and the accuracy of longitude/latitude results was near 0.5 arcsec with Hipparcos/Tycho Catalogue. The PC-guided measurements can be finished during 10 minutes. The accuracy of longitude/latitude of Belgrade Astronomical Observatory zenith-telescope BLZ (D=11 cm, F=128.7 cm), with CCD ST-8 of SBIG (Santa Barbara Instrument Group) and Tycho-2 Catalogue, can be about 0.1 arcsec. And the accuracy of the Punta Indio PZT (near La Plata, PIP instrument, D=20 cm, F=457.7 cm) with the same equipment can be a little better than the BLZ's one. The BLZ and PIP were in the list of BIH (Bureau International de l'Heure, Paris), and have a good possibilities for semi or full-automatic measurements.

THE KIEV PHOTOGRAPHIC CATALOGUE OF REFERENCE STARS 12-15 MAGNITUDE IN THE VICINITY OF EXTRAGALATIC RADIO SOURCES

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Positions of 2,785 stars in 115 fields of extragalactic reference sources (ERS) have been determined. New plate reduction has been done using the Tycho-2 Catalogue as reference one. A standard error of unit weight of 95 mas, 102 mas has been obtained for average plate solution in right ascension (x cosδ) and declination, respectively. Observations of plates were carried out with astrograph (D=200 mm, F=4126 mm) of Astronomical observatory of Kiev National Shevchenko University. A total number of 139 plates have been taken in during the period 1989-1993.

INITIAL DETERMINATION OF NEO ORBITAL ELEMENTS ON QUASI-CIRCULAR GEOCENTRIC ORBITS

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The important task during monitoring of geostationary orbits is the data processing of objects which orbits are absent in catalogues. Numerical methods can not be used for initial determination of the orbital elements of such objects. Application of classical methods (Laplacian and Gauss) for determination of the orbital elements can be inexpedient under a condition of short measuring interval, in connection with increase of a single measurement error.

The constructive approach to the initial determination of the orbital elements for the NEO on quasi-circular orbits is offered in the report. The orbit is supposed to be circular and the initial task breaks on subtasks of estimation of the orbital plane orientation in space and movement inside the plane, which are solved consistently. Thus, objective laws of orbital movement, determined by Kepler laws, and century influences, measured during long time intervals, are taken into account. Such approach allows us to decrease dimension of the estimation task up to single parameter, where a free parameter is the radius of circular orbit.

The estimations of potential accuracy of the orbit determination and the results of the data processing of optical observations are given.

ASTROMETRY OF THE SOLAR SYSTEM BODIES: PRESENT AND FUTURE

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Astrometry has experienced in repeated qualitative changes and refinements during the long-term its history as an experimental science about geometrical, kinematical and dynamical characteristics of separate celestial bodies, their ensembles, and the whole Universe. It was caused chiefly with introduction to the general practice of new means and methods of observations. By invention of optical tube in the XVII century the precision of position determination has been attained in only 2', but after introduction optical telescopes, thorough research and elimination of their errors in the observation practice it has lessed at almost 103 times and come to the 0.1" level and even better with separate means of astrometry observations. Further substantial improvement of the precision became problematical. That's why in the middle of the XX century a discussion has arised about the crisis in astrometry. Nevertheless in the second half of the XX century the fundamental changes have taken place in astrometry, which lead down to the introduction to the practice of new means and methods of astrometrical measurements for directions to galactic and extragalactic radiation sources and also direct measurements for the first time of the distances to the natural and artificial bodies of the Solar system. It has happened due to introduction to the practice of astrometry research by radar methods of planets and their satellites, light-radar methods of the Moon and artificial Earth satellites, radio interferometry of the natural and artificial radiation sources, radio-technical methods of observations, based on the Doppler principle, and astrometrical measurements outside the Earth atmosphere (space astrometry). At present astrometrical means of observations can register radiation of natural and artificial space bodies in the waveband from micrometres to dekametres with a precision of 2-3 orders better in comparison with classic astrometry. Another important positive sign of contemprorary astrometry is a high level of automation for astrometry observations, which gives a possibility to get results of the researches in a real-time mode. Astrometry has got dynamical development again. During the last three decades the problems of classic astrometry have been solved at the new quality level, and a possibility for the solving of new scientific problems has arisen.

Such problems have been solved in the classic astrometry, as

– construction of the spatial inertial reference frame, which is realized by the International Celectial Reference Frame, based on the determined by the VLBI method of positions for more than 600 extragalactic radiosources with the highest of 0.001" accuracy;

– construction of the high accuracy Earth reference frame, which is realized by the International Earth Reference Frame, based on the determined positions of the Earth reference places and velocities of their tectonic motion with the highest of 1 cm accuracy;

– detailed research of the Earth rotation (determination of the poles positions and their rotation velocities), which is characterised by discovery of many oscillations in rotation velocity with amplitudes from several tenth of millisecond to several hundreds of second and with periods from season (and lesser) to decades. Now the determination accuracy of pole position by observations during a season attains the level of (10^{-3})", and for rotation velocity of the Earth it is (10^{-4}) s;

– by radar and radio-technical observations there has been refined scale (astronomical) unit for Solar system for several orders, and there has been determined mutual disposition of the inner planets on average with an accuracy of several kilometres;

– realization of the optical reference system with the highest at two orders accuracy for the large number of faint brightness stars due to the realization of space experiment HIPPARCOS.

Tendencies of the development of astrometry researches are connected with increasing measurement accuracy to the level of $(10^{-4}—10^{-5})$" due to expansion of the network of the newest means of observations and realization of new space experiments with registration at different wavebands.

SPACE DEBRIS. THREAT FOR THE SAFETY OF THE WORKING SPACECRAFTS

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From October 4, 1957 until now there have been put out more than 4000 launches into near-Earth orbits and interplanetary space which have led to 20000 artificial celestial objects (INT) at the near-Earth ($H \leq 5000$ km), geostationary ($H \approx 42000$ км), and intermediate orbits. About 500 objects are still active now. About 150 INTs have been destroyed by explosions and collisions, moreover there have been found more than 500 fragments with sizes more than 10 cm after destructions of some artificial satellites (ISZ). Since 1980 passive ISZs, used stages of carrier rockets and their fragments, used devices and their parts, discharges of space rockets and space modules (KA), parts of paint which have stripped away, and so on are called space debris. The general weight of debris exceeds 3000 tonnes, moreover the large part of the weight falls on about 3000 big objects. Assessments for debris population by several specialists come to such numbers, as more than 10^5 units for sizes $d \geq 1$ cm and more than 3.5 million units for sizes $d \geq 1$ mm. Another evaluation for population of fragments of sizes from millimetre to several centimetres can reach 1011 units, and for objects of micron and less sizes, gas and dust factions it has $10^{13}-10^{14}$ units.

Space debris has uneven distribution in the near-Earth space ($10^{14}-10^{15}$ км^3). Forecast estimates give us a spontaneous increase of space debris has begun at heights about 900-1000 km, moreover in the next 50 years the number of collisions between fragments will increase in 10-20 times. At the stable places of geostationary orbits of longitudes 75° and 255° two “space dustbins” have been formed, that’s why these places are not used for placing ISZs. Natural small bodies and particles are great threat for space modules, forecast population for natural bodies, which sizes are about 1 mm, is evaluated in such numbers as to artificial particles.

The risk for collisions of debris fragments up to 1 cm with space modules is quite high. As far as there are several hundreds of active KAs, one destructive collision occurs on average every 1-2 years. For space station as МКС (−1500 $м^2$) one hit with particle with sizes d ≤1 cm can take place every 15 years that can lead to a hole in the plating up to 5 cm. Extensive experimental data about collisions with debris particles have been obtained during missions of Space Shuttles, space telescope Hubble and special satellites.

Since 1992 forecasts of dangerous closenesses have been made in Russia. According to the data 50 pairs of catalogued objects (d≥10 cm) have their closeness at the less 1 km distances, moreover one closeness take place at the less 100 m distance and it makes a situation of high risk collision. Number of uncatalogued objects in the low orbits is greater than catalogued ones by two orders, that's why the collisions with debris particles, which sizes are 1−2 cm, take place annually. Such methods for calculation of collision risks as statistical, semidetermined, and determined ones are used for estimates of dangerous closenesses. In Ukraine there are observational means, experience and scientific potential for the control of space with the aims to guarantee safe launches and flight of space modules.

USE OF OBSERVATIONS' EAS RESULTS IN THE TASKS OF APPLIED AND FUNDAMENTAL CHARACTER

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For years a space era the radical changes in relation to tasks and methods of the ground supervisions for EAS took place. From the separate supervisions of some satellites to service of control of space, decision of tasks of geodesy and geodynamics, cataloguing, methods of equation and authentication of space vehicles. Practice showed that with growth of number EAS on the orbits the information about high-fidelity positions of space objects is not enough. Decision all new problems is possible only at complex approach, with the use of position, photometric, colorimetric and polarization supervisions. For example, combination of high-fidelity co-ordinate information with photometric one enables to study the conduct (behavior) of the explored object on an orbit, with which absent communication, to determine his orientation, contours and form, optical descriptions of surface and their change in time.

The cycle of works executed in the laboratory of space researches of Uzhgorod National University confirmed that such approach to the supervisions of EAS was effective not only in the plan of their recognition but also estimations of nature and size of indignations, which operate on motion of space bodies. For the decision of this circle of tasks in the Laboratory of Space Investigations of Uzhgorod National University the untraditional solution of problem was offered. This method gives us an opportunity to control the changes in the EAS rotation under the indignations influence, which are based on high-fidelity determination of period of own rotation and orientation of uncontrolled satellites. Their fixing and proper calculations, allow to expose more thin nature of perturbations, as it takes place, after the changes of parameters of orbit, and, practically, in the moment of supervisions. For forecast of motion of unguided geostationary satellites for ten years completely enough data about the change of elements of their orbits.

Our assertions are based on the experimental results got on the satellite of series „Meteor" (№70047.01). On this object it was succeeded to define a size of indignations' moments on the given object from the side of the Sun, earth atmosphere, Earth's magnetic field and the solar radiation reflected from the Earths surface. Research of own rotation of satellites of series „Midas" showed clear correlation between it and sun activity. Last EAS, in our opinion, it is possible to use as indicators of overhead layers of atmosphere state effected with sun radiation change.

That touches possibilities of space objects identification new experimental findings on the satellites of series „Ferret" and „Spot", obtained in Laboratory of Space Investigations of Uzhgorod National University, confirm enough high efficiency of such complex EAS supervisions.

FIRST RESULTS OF PHOTOMETRY, POLARIMETRY AND ASTROMETRY OF GEOSTATIONARY OBJECTS AT 0.7-m TELESCOPE

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The problem of identification of artificial near-Earth objects is a far from perfection. It is particularly important for high Earth orbits and geosynchronous satellites (GEO), because the radar method does not working on well with the distant objects. The identification of GEO in optical wavelengths is the most promising method and in common with a high-accuracy reference star catalogue permit to solve a task of ephemeris assistance of photometrical, polarimetrical and positional observations, confidently.

We present a first result of the integrated observations of GEO, which are in the station-keeping point near East longitude of 10 deg. All bright GEO (including the operating satellite USA-149 Imeyuz) have been observed at the 0.7-m reflector of Institute of Astronomy of Kharkiv Karazin National University from December 2003 through April 2004. Photometry and polarimetry were made in the standard BVRI spectral bands under Cassegrain optical configuration of the telescope (F≈11m). Telescope was equipped with a photoelectric photometer-polarimeter and CCD-camera ST-6UV. Positional observations were made under Newton optical configuration of the telescope (F≈2.8m) with the CCD-camera. Coordinates of the satellites were determined by using the star catalogue UCAC and have accuracy about of ±0.3 arcsec in both right accession and declination.

CCD OBSERVATIONS OF COMETS 2P/ENCKE AND C/2001 A2 (LINEAR) AT THE ASTRONOMICAL INSTITUTE OF KHARKOV NATIONAL UNIVERSITY

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The CCD observations of two comets were carried out with use 70-cm reflector AZT-8 equipped by CCD camera ST-6UV at the Chuguev observational station of the AI KhNU. The 90 CCD images of comet 2P/Encke had been obtained at the Nov. 11, 2003 and the 75 CCD images of comet C/2001 A2 (LINEAR) had been obtained at the Aug. 1-5, 2001.

The 66 precision positions of comet 2P and the 75 positions of comet C/2001 A2 were determined in systems of USNO and UCAC2 references catalogues. The results of analyze of the accuracy of cometary positions in these systems are presented.

Also the photometry of the central areas of heads of these comets had been made. The correlation between temporal variations of values of (O-C)a,d and V, R magnitudes and color indexes of central area of comet C/2001 A2 and its integrated brightness had been found. This phenomenon, probably, is a result of the outburst activity of cometary nucleus and it is a new observational criterion for development of a mechanism of cometary outburst activity.

CCD OBSERVATIONS OF NEAR-EARTH ASTEROIDS IN SIMEIZ DEPARTMENT OF CRIMEAN ASTROPHYSICAL OBSEVATORY

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The CCD observations of near-Earth Asteroids (NEA) in Simeiz are began in 1996 in the framework of collaborations with Kharkov Astronomical Observatory and with support by it. The photometry observations are carried out at the 1-m telescope equipped CCD camera SBIG

ST-6 in the standard Johnson-Cousins photometric system. The primary aim of observations is to obtain important physical parameters of NEAs such as rotation rates, pole orientations, shapes and others. During 2000-2003 (60 nights) twenty two NEAs were observed. Most part of observations is made in R band. About half of observations are newly discovered NEAs. For these asteroids measurement of their astrometric positions are made too and are sent in Minor Planet Center. Some results of photometric observations are presented.

OBSERVATIONS OF NEO IN ANDRUSHIVKA OBSERVATORY IN 2003 - 2004

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We outline the results of positional and photometric observations of NEO carried out in Andrushivka Observatory (MPC code A50) [1] from March 2003 till April 2004 with the Zeiss-600 astrograph and the Electron-Optronic S1C CCD-camera [2]. The telescope operational time is divided among the 3 principal programs.

1. NEO follow-up. We contributed to 75 Minor Planet Center Electronic Circulars (MPEC) [3]. The A50 NEO observations are best presented at the NEODYs web-page [4]. As of 24 April 2004, 751 positions of 109 NEO obtained at the Andrushivka Observatory are presented in the MPC database. Statistical performance shows the averaged rms errors of positions to be of ±0.5”.

2. Lightcurve parameters. Some Near-Earth Asteroids are targets of Arecibo or Coldstone radar observations [5,6]. The rotation parameters of 2 such objects – 2001 US16 and 2003 YT1 – were studied in April 2004. Our results proved to be close to that of Dr. Peter Pravec [7,8].

3. NEO search. From time to time small surveys in the areas with higher probability of new NEO discovery, bright recovery opportunities, and the Spaceguard Central Node Priority List sky regions [9] are carried out. As of now, no new NEO was detected because of somewhat small

field of view (20x20'). As a by-product, 16 Main Belt Object discoveries were reported to the MPC. To enhance the efficiency of the surveys, an optical corrector has been constructed that will enable increasing the field-of-view size to 40x40'. Test observations in the focus reduced to the focal length of F=1.2 m are to start in early June 2004.

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5. http://www.naic.edu/~pradar/sched.shtml

6. http://echo.jpl.nasa.gov/asteroids/goldstone_asteroid_schedule.html

7. http://echo.jpl.nasa.gov/asteroids/2001US16/html/2001US16_planning.html

8. http://echo.jpl.nasa.gov/asteroids/2003YT1/html/2003YT1_planning.html

9. http://spaceguard.esa.int/servlet/PriorityListServlet

PRELIMINARY RESULTS OF TELEVISION TELESCOPIC OBSERVATIONS OF METEORS IN ODESSA

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Results of the regular TV telescopic meteor observations which are carried out at the Kryzhanovka station since 2003 are presented. The meteor patrol based on Schmidt telescope and TV CCD detector enabling one to record meteors of 12 mag is described. The description of a program code elaborated for the photometric image reduction is also given. The classification of the detected meteors is explained. The results confirming fragmentation of the dust grains are presented. The meteor afterglow phenomenon was discovered. The characteristic time of such an event was estimated. The analysis of the results obtained through the TV meteor image reduction is being carried out.

TV METEOR PATROL IN ODESSA

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Historical review of the Odessa photographic meteor patrol is presented.

A new TV meteor patrol which uses the two methods' combination - TV and telescopic ones, is described. The description includes meteor patrol at the Kryzhanovka station based on Schmidt telecope (17/30 cm) and TV CCD detector, as well as results of the equipment testing. Merits and demerits of this observational complex are discussed.

The first results of the meteor event observations during 2003-2004 are presented.

The further tasks of the meteor astronomy that could be based on the meteor patrol data are considered.

CCD OBSERVATIONS OF MINOR PLANETS IN NIKOLAEV IN 2002-2003

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Regular observations of selected minor planets have been hold with Zone Astrograph (D=0.12 m, F=2.04 m) of Nikolaev Astronomical Observatory, equipped with CCD camera (ISD017A, 1094x1160, 16x16 mkm^2), since 2000.

Results of processing of CCD images obtained with accurate timing better than 1 ms from August 2002 till the end of 2003, by observation programme of selected minor planets for asteroid mass determination in dynamical way are presented in the paper.

CCD processing was made with Astrometrica 4.3.2.346 Software (http://www.astrometrica.at) and reference stars taken from UCAC2.

Evaluation of accuracy of these observations was made from comparison of observed and calculated positions.

THE DEPTH OF HEAVENS - BELIEF AND KNOWLEDGE DURING 2500 YEARS

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For Dante Alighieri (1265-1321) the spiritual cosmos contained the Heavens, Earth, and Hell, and it was compatible with the physical cosmos known from Aristoteles (384-322 B.C.). Dante's many references in his Divina Commedia to physical and astronomical subjects show that he wanted to treat these issues absolutely correct. Tycho Brahe proves three hundred years later by his observations of the Stella Nova in 1572 and of comets that the spheres of heavens do not really exist. It has ever since become more and more difficult to reconcile the ancient ideas of a unified cosmos with the increasing knowledge about the physical universe. -- Ptolemaios derived a radius of 20 000 Earth radii for the sphere of fixed stars. This radius of the visible cosmos at that time happens to be nearly equal to the true distance of the Sun, or 14 micro-light-years. Today the radius of the visible universe is a million billion (10 to the power 15) times larger than Tycho Brahe believed.

The lecture gives an overview of astronomical distances and their dramatic change during two and a half millennia in the developing cultural environment from ancient Greece to modern Europe.

ASTROMETRY AND PHOTOMETRY FROM SPACE: HIPPARCOS, TYCHO, GAIA

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The Hipparcos satellite of the European Space Agency is the first satellite specifically designed for astrometry. It obtained high-precision astrometry for 120 000 stars in 3 years of observations (1989-1993), published 1997 in the Hipparcos Catalogue. The median precision for positions is 0.7 milliarcsec. For 21000 stars the precision of distances is better than 10 per cent. Also photometry in a broad spectral band was obtained, with a median precision of 0.0015 mag. The Tycho experiment onboard the satellite obtained astrometry and two-colour photometry for 2.5 million stars,published in the Tycho-2 Catalogue. The powerful successor to Hipparcos is the Gaia satellite, approved by ESA in 2000.

THE GAIA SURVEY OF OUR GALAXY AND SOLAR SYSTEM

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The GAIA satellite project has been approved by the European Space Agency in 2000 and may be launched in 2010. It will obtain high-precision astrometry and multi-colour photometry for all the one billion stars and quasars brighter than V=20 mag. Astrometric precision for V<15 mag: 10 microarcsec. GAIA data will have the precision necessary to quantify the early star formation, and subsequent dynamical, chemical and star formation evolution of the Milky Way Galaxy.

Since all point sources brighter than V=20 mag will be detected and measured astrometrically and photometrically, GAIA will deliver a deep survey of about one million small objects in our Solar System.

INFLUENCE OF THE ATMOSPHERE ON ASTROGEODETIC MEASUREMENTS

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During last three decades geodesy, geodynamics, navigation and many other sciences have gone through real revolution due to the application of artificial satellites of the Earth (ASE). The majority of these sciences studies the processes of passing of electromagnetic impulses through the Earth's atmosphere.

Electrically charged area of the atmosphere - ionosphere, as well as neutral area which consist of the troposphere and stratosphere, influence the speed and the direction of propagation of electromagnetic waves. As the ionosphere is the dispersion environment for radio waves we can almost avoid the effect of ionospheres using the technique of two frequencies.

The elimination of the influence of neutral atmosphere, which is non-dispersion space for definite radio frequencies, being the main problem, it is impossible to apply bifrequency methods for it. The neutral atmosphere is the reason of two effects - delay of propagation of a signal and the bending of a ray (refraction).

The development of day-time laser observations ASE, the increase of instrumental accuracy of laser measurements of distances to ASE up to 1-5 mm, the development of radio engineering observations (GPS - observation), and the fulfilment of international state programs and projects have coused the necessity of making the researches on increasing of the accuracy of models of reduction for influence of atmosphere both registration of regional and local features of a field of a refraction. Thus, one of the actual tasks is the estimation and refinement of models of atmospheric reductions at the analysis of interpretation of astronomical - geodesic observations with the purpose to increase the accuracy of registration of influence of the atmosphere on outcomes of ranging observations of ASE.

This paper is devoted to the problem of accuracy increasing in allowing for Earth's atmosphere influences on results of daily ranging observation of the Earth artificial satellites.

For an optical range the correction ΔρL was calculated in two ways: by the method of numerical integration under the data of aerological sounding(probing) of the atmosphere and under the Mariny Murray formulas. For a radio-frequency range the correction ΔρR is obtained also by method of numerical integration, and also under the Saastamoinen and Hopfeld formula.

The divergences between the values of the corrections ΔρR, calculated under the Saastamoinen formula, and the corrections obtained by a method of numerical integration, in a radio-frequency range are much more larger, than in optical range. A reason of such a divergence is that in a radio-frequency range the considerable influence has partial pressure of water vapours. In papers the estimation of the precipitable water vapour for GPS observations in Ukraine.

USAGE OF RESULTS OF A FIVE-COLOR PHOTOMETRY OF SMALL ASTEROIDS OBTAINED BY SDSS FOR REVISION OF MBA-FAMILY MEMBERS

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The numerous discovery of new asteroids have allowed essentially to expand the inventory of the members of families. The statistical techniques, such as a hierarchical clustering method, allow to identify groupings (clusters) in phase space of proper orbital elements designating them as families. However, significant part of the members of these groupings are not the "true" members, as belong to asteroids of a background.

Besides as a result of secondary processes of disruption of the family's members can be formed so-called "clans", that is groups consisting from several subfamilies, which are difficult for separating based only on the orbital data, but which, probably, have various mineralogic structure.

Being based on results five-colour photometry of Sloan digital sky survey, which has covered a range of magnitudes from 14 up to 21 and includes asteroids of the kilometer sizes, the analysis of the colour characteristics of the members of the large families in the main belt is carried out. Considering colour of asteroids it is possible to reject the casual interlopers of families and to reveal of colour heterogeneity in structure of some families.

TRANSFORMATION OF SATELLITE'S POSITION TO REFERENCE-EPOCH. DETERMINATION OF VISIBLE POSITIONS OF STARS

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Visible (seen) positions of the stars or satellite - those positions, which we in the certain time can see in the sky by a unaided eye and to observe by means of any of the device or tool. The visible positions of the stars are considered at the decision of tasks of satellite astronomy:

– determination of positions of objects noticed on a background of stars (Tarner's method);

– determination of scales' origin (zero-point) of measuring devices of observant tools.

For the decision of these tasks is used usually a procedure of translation of coordinates of stars from standard epoch on seen places of observation's epoch. The initial data for calculations are the coordinates of stars a_0, d_0 and their own movements m_{a_0}, m_{d_0} resulted in the catalogues and referred to epoch and equinox of the used catalogue.

All necessary transformations of coordinates will be carried out by means of the known formulas, allowing to take into account also influence precession, nutation and stellar (year's) aberration, i.e. amendment not connected with a place of the observer. Just such places of stars are usually resulted in Astronomical Year-books as 'seen'.

For a final transformation of stars to seen places it is necessary to take into account also influence daily aberration and astronomical refraction (for stars) or refracting parallaxe (for satellite). These amendments are already connected with a place of the observer and with weather conditions in a place of observation.

The transformation of visible positions of stars and satellite on standard epoch represents return procedure and consists of the following steps:

– account of tool mistakes, atmospheric refraction and daily aberration;

– account of stellar aberration, account of nutation and precession.

The specified procedures of transformation of stars and satellite's positions are carried out by use FORTRAN and C++ programs. They use the stars' catalogues FK5 and PPM, referred to standard epoch and equinox J2000.0. The account of nutation, precession, both stellar and daily aberration is made with use of the IAU nutation theory (1980), fundamental arguments and constant, resulted in [1, 2]. The account of refraction is made separately for stars and satellite.

The calculated visible positions of stars are used by us for definition of positions of GSS on television images, for determination of zero-point of measuring devices of theodolite KT-50, and also for clearing a shine' curve of satellite from distortions caused by hit of stars in a field of sight of photometer. Calculated average coordinate of satellites, referred to average equinox of standard epoch J2000.0, are used for cataloguing observed satellites.

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THE SYSTEM OF THREE SMALL TELESCOPES FOR SYNCHRONIZED BVR PHOTOMETRIC OBSERVATIONS OF NEAS

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It is proposed to combine three telescopes – reflectors (AZT – 14, D = 48 cm, AZT – 8 D = 70 cm, Ceiss-600, D = 60 cm) of astronomical observatory of Kyiv Taras Shevchenko National University (AO KNU) and Andruchivka astronomical observatory in Jytomyr region (AAO) for the purpose of synchronous observations of NEAs. Carrying out of strictly synchronous observations of NEAs in three different filters will give a possibility to obtain rapidly its taxonomic types and, consequently, sizes.

NEW ASTRONOMICAL TELEVISION SYSTEM "SPALAH" – FIRST RESULTS

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The new astronomical television system "Spalah" was created for star occultation observations. The system is consists of sensitive TV camera, computer with VIVO video card and GPS-receiver. The system time accuracy is 10-15 ms per frame as the results of laboratory tests show. Effectiveness of the system was confirmed by some observations: double star occultation, occultation by bright side of the Moon, occultation of the limit faint star.

HAZARD OF COLLISIONS OF SPACE OBJECTS ON GEOSYNCHRONOUS ORBITS

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For research of hazard of collision of objects on geosynchronous orbits is used with some simplifications of direct approach [1]. There is an archive of dangerous rendezvouses with the particular information on each rendezvous. By these outcomes the probabilities of collision of geosynchronous objects (GO) are calculated. As dangerous rendezvouses the distances between GO, not exceeding 100 km are considered. These rendezvouses have only probabilities sense, as the error of forecasting of a situation GO on orbit can make 0.1°, that corresponds to distance of 74 km along orbit. The frequency function of distribution of distances between two satellites in dangerous rendezvouses can be presented by a parabola few distinguished from a straight line. From this function it is possible to receive probability of collision at dangerous rendezvouses, that is probability of rendezvous on distance $r_1 + r_2$, where r — mean radius GO. Average value r is equal 4 m.

The calculated value of probability of collision unguided GO during one year P = 0.00002, that in 1500 times is less, than probability of collision of objects on low-altitude orbits. Actually this difference is much less, as at calculation of probability of collision GO the catalogue satellites, that is GO by the sizes more than 1 m were taken into account only. It is necessary also to take into account, that the zone of GO takes a smaller volume of space, than area of orbits of objects with low-altitude orbits. And still geostationary orbit is safer than low-altitude orbits. The probability of collision of controlled GO with unguided makes 3% from value of probability of collision between unguided GO. The hazard of collision unguided GO depends on a type GO a little.

At dangerous rendezvouses of two unguided GO the angle α between straight lines conterminous to directions of their speeds, is very small and does not exceed 20°. The frequency function of distribution $P(\alpha)$ fast decreases with increase of this angle. The values of relative speeds unguided GO in most cases are in an interval from 0 up to 100 m/s.

Frequency function of a spatial distribution unguided GO $P(\phi, r)$, where ϕ - geographical latitude, r - geocentric distance up to a satellite, is represented by an equation of an ellipse in coordinate system ϕ, r. The large and small semi-axis of an ellipse contains a function $P(\phi, r)$. The semimajor axis on 2 orders is more than a semiminor axis.

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IDENTIFICATION OF BACKGROUND STARS AND COMPENSATION OF JITTER DISTORTION AT PHOTOMETRY ARTIFICIAL SATELLITES

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At observation of artificial satellites through a photometer field, which is limited by objective aperture (diaphragm), frequently there pass stars, which shine is comparable with shine of measured satellite. It results that some readout of photometer appear deformed (erroneous), and the curve of shine becomes unsuitable for the further research. In this connection there is an important problem of clearing of the satellite's shine from distortions caused by hit of stars in a field of sight. Usually this problem is decided with the help of the following procedures.

Visible angular coordinates of the satellite - azimuth Ai and altitude Hi, referred to the moments of time Ti (i = 1, ..., n), are corrected for tool mistakes and under the formulas of spherical astronomy the right ascensions and declinations of the satellite are calculated.

Then the catalogue's positions of stars which are taking place in the nearest vicinity of the point placed by satellite are translated on seen places appropriate to the moments of supervision , the angular distances on the sky from satellite up to the stars, nearest to it, are determined and compare with the aperture size of photometer rd . This variant is complicated because of translation of a plenty of star's places from epoch of the catalogue on seen places of current epoch.

In the program the alternative variant is realized, when instead of the specified translation of catalogue's positions of stars on a seen places, the translation of seen positions of the satellite on epoch of the catalogue is carried out. The number of such transformations is limited, that appreciably simplifies a task.

At "fast" displacement of the satellite and, hence, center of aperture during accumulation of a signal , the form of area in the sky with background stars essentially differs from a circle. The integration by time of stay of a star in range of vision of photometer allows to construct time function of shine of an "average background", which is compared to a common curve of shine. The good synchronization makes possible to subtract of shine of a background from common shine.

ON NEW POSSIBILITIES FOR RESEARCH OF THE ARTIFICIAL SATELLITES WITH CCD CAMERA IN DRIFT SCAN MODE

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At present, the Axial Meridian Circlle (AMC) is equipped with modern devices and necessary means for robotic observations to realise all possibilities of high-accuracy observations of different space objects.

A substantial part of the report is devoted to presentation of the features of separate automated systems and the entire instrument as well, for example, principal layouts of electronic hardware and necessary software are given.

The features of opto-mechanical and electronic devices are given, namely:

– the telescope CCD camera;
– the telescope positioning system;
– the circle reading system with four CCD microscopes;
– the CCD autocollimator;
– two CCD meridian collimators;
– the time recording system.

CCD PHOTOMETRY OF FAST-MOVING ASTEROIDS: OBSERVATION AND REDUCTION TECHNIQUES

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Photometric observations remain to date the principal source of information on the physical properties of asteroids. Observations of near-Earth asteroids (NEAs) are usually performed during the periods of their closest approach to the Earth. At this time NEAs move at fast angular rates that are usually greater than 1 deg per day. The problems associated with the photometry of fast-moving objects are discussed.

The effect of noise in CCD observations on the photometric accuracy is analyzed. A photometric accuracy limitation is shown to exist for observations of a fast-moving object. The effective exposure time for observing a moving object is determined.

Since an NEA often moves rather fast across the sky and, that during a one-night observations it may run an arc several times longer than the size of the field of view of the CCD camera. The method of overlapping areas is analyzed, which is used for obtaining the lightcurves of fast-moving asteroids. This method includes the determination of the mutual magnitude differences for the entire ensemble of comparison stars, the reduction of the magnitudes of all these stars to the magnitude of one of them adopted as the primary comparison star, the determination of the magnitude of the "average star" on each frame of the entire series of CCD observations, and the computation of the lightcurve as the difference between the magnitude of the asteroid and that of the average star.

The estimates of observation accuracy with CCD-camera ST-6UV and 70-cm reflector are made.

ON POSSIBILITIES OF THE AMT-28 FOR OBSERVATIONS OF THE NEAR-EARTH OBJECTS

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The Automatic Mirror Telescope (AMT-28) was created in 1986 in Evpatoria. The main objective of the AMT-28 is the coordinate measurements of the near-Earth objects (NEO) and laser location of the artificial satellites. In 1993-1994, the telescope carried out the trajectory measurements of space vehicles (SV) equipped with angular reflectors in accordance with the international program and was awarded on behalf of the European Space Agency. In 1995-2002, the telescope did not work because of some reasons. The trial measurements have begun since the end of 2002. At present, the telescope consists of:

– two parallel channels using quick-response television technique on the base of superizokons, which allow us to realize an algorithm of automatic tracking of the NEO even under condition of inexact initial ephemerid;

– two CCD cameras, which provide high-precision coordinates of the objects;

– the laser distance measuring channel;

– the photometric channel;

– control computers.

All subsystems are installed on one mount and work in parallel although they can be used independently from each other.

More than 200 observations of the NEO with an orbit less than 40000 km, about 450 measurements of the geostationary satellites, and a few tens of high elliptical orbit satellites has been carried out since 2002. Moreover, 364 measurements of the geostationary objects were obtained during seven nights in March 2004. 286 among them were found in a free search mode. The observations of the high elliptical orbit satellites are carried out to estimate the possibilities of taking part in the VLBI international program. About ten measurements of distance for space vehicles from the ILRS list were carried out. Observation of stellar eclipse (TYC 1343-00785-1) with asteroid 2001 XR254 from Koyper belt was carried out on February 14 – 15, 2004 within the framework of Asteroid Danger program. The algorithm of GSS detection with a significant inclination of orbits was developed.

Programs of joint observations with Nikolaev and Odessa astronomical observatories are being developed. In particular, work on estimation of capability for distance measurements by synchronous observations and basic calculation method will be carried out in the near future. Contract on scientific cooperation with Nikolaev astronomical observatory was signed.

PHYSICAL PROPERTIES OF NEAR-EARTH ASTEROIDS AS PRINCIPAL IMPACTORS OF THE EARTH

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About 3000 NEAs are discovered to-date. They are the objects of a special interest from the point of view not only of the fundamental science but of the applied science as well (the problem of asteroid hazard, NEAs as the potential sources of raw materials in the nearest to the Earth space, etc.). The NEAs are the principal bodies which strike our planet occasionally and therefore they are a real threat to the Earth's civilization.

NEAs are much smaller in sizes in comparison with main-belt asteroids (MBAs). The largest object is 1036 Ganymed (D=38.5 km) and the smallest known NEAs are about 10 m across. The data of ground-based observations and space missions (Galileo, NEAR) show that NEAs have irregular and elongated shapes and are covered with a large number of craters of different sizes. Most of NEAs are covered with a regolith of low thermal inertia and different thickness. But the regolith of NEAs tends to be more coarse-grained than that of MBAs and still more coarse-grained than the lunar one.

The distribution of the rotation rates of NEAs shows that on the average they rotate practically in the same manner as the small MBAs and considerably faster than large MBAs. The main peculiarity of NEA rotation is that among this population there exist objects with very complex and non-principal axis rotation (so-called “tumbling” asteroids). The new data on photometric and radar discovery of binary systems are evidence that about 15-20% of NEAs could be double systems.

Most of the NEAs for which mineralogical information exists, represent differentiated assemblages. Among them there are objects with monomineral silicate composition and purely metallic ones (for example, the amor-asteroid 6178 1986 DA has radar albedo clearly indicating the real metallic composition of it). The variety of taxonomic classes among NEAs reflects the diversity of their surface mineralogy and an overall analogy with the main-belt asteroids.

Available data on the sizes, shapes and rotation of NEAs, variety of their taxonomic classes and mineralogy, optical properties and surface structure as compared to those of MBAs – all these clearly indicate that the main asteroid belt is the principal source of NEA origin. On the other hand, the identification of a few asteroids with extinct or dormant comets does not exclude the cometary origin of some of them. Hence, the main problem of NEAs’ origin is the estimation of the contributions of both sources.

The discovery rate of NEAs increases greatly over the last years, and the initiation of new programs for their discovery and study in the USA and Europe gives hope that an active ground-based and space-mission investigations will give us all the information necessary for the solution of fundamental and applied problems connected with NEAs.

INCREASING OF ASTRONOMICAL TELEVISION OPTIC-ELECTRONIC SYSTEMS PENETRATING ABILITY BY MEANS OF POST-DETECTOR SPACE-TIME FILTRATION OF VIDEOIMAGES

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Use of optic-electronic systems (OES) of television type, was included in practice of astronomical supervision of space bodies of natural and artificial origin. Modern television receivers on basis of CCD matrixes have a number advantages to which it is possible to relate high sensitivity, resolution, mass-dimension characteristics. The output television signal can be relatively easy transformed to the digital form that allows to realize highly effective methods of signals processing in real time with application of modern computers, to automate process of information collection and processing, to increase information capacities of astronomical supervisions and to improve characteristics of OES as a whole.

OES penetrating ability is defined by many factors, to which it is possible to attribute characteristics of optic details (for example, a relative aperture, the sizes of the entrance aperture), level of internal noise of the television receiver, level of background radiation, etc. Methods of the account and decrease of influence of these factors are widely covered in the scientific and technical literature.

In opinion of authors, it is necessary to pay special attention to methods post-detector processing of the information as their realization does not demand changes of OES design and allows to use effectively modern computing means and information processing methods.

Algorithms of post-detector space-time filtration of a television signal which realisation allows to increase penetrating ability of television OES are developed by authors.

The mathematical model of a signal in the output plane of OES served as theoretical basis for synthesis of algorithm. The model was developed with use of both wave theory and corpuscular theory of light, and with taking into account statistical properties of accidental discrete photons streams.

The experimental researches of proposed algorithms that have been carried out, allows to draw a conclusion on possibilities of their technical realization. The profit in penetrating ability depends on parameters of the initial television image and can reach five star magnitudes.

ASTRONOMICAL DATABASE OF THE NIKOLAEV OBSERVATORY

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Results on creation of the digital database of the Nikolaev Astronomical Observatory (NAO) are shown. The total amount of the own information makes about 90GB, obtained from other sources - about 15GB. The mean diurnal level of receipt of the new astronomical information from the NAO CCD instruments makes, depending on the purposes and conditions of observations from 300MB up to 2GB. The overwhelming majority of observational data is stored in FITS format. Possibility of using of VO-table format for displaying our data in the Internet is studied. Activities on development and the further refinement of storage, exchange and data processing standards are conducted.

Also activities on implantation of new methods of operating automatic processing of the CCD observations on NAO's robotic telescopes for decreasing of period from observations to obtaining final results are shown. At present the NAO local network includes three astronomical complexes where observations are carried out. All obtained astronomical data and results of their processing are included in the general database of the NAO.

TEST OBSERVATIONS OF FAINT OBJECTS PERFORMED WITH BUCHAREST PRIN ASTROGRAPH

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The modernization of Bucharest Prin Astrograph is included in the topic.

Development and applying of optoelectronic techniques of acquisition and image processing in order to improve the accuracy and efficiency of ground-base astronomical observations. The improvement of the efficiency of astronomical observations by using the automatic control of the positioning and data processing with an appropriate software was performed studying and applying techniques of observation by utilizing an acquisition system with CCD camera; development and use of intelligent systems with stepper motors, planetary gear box and electronic drivers for the command; development and obtaining of a control system with high resolution absolute encoder for the angular position; interface for acquisition and data processing. The paper contains the first observational results of asteroids, the image quality and the accuracy of astrometric positions is satisfactory.

UKRAINIAN PROGRAM OF COMPLEX INVESTIGSTION OF THE SOLAR SYSTEM SMALL BODIES

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A version of the program is presented to cover both observations and theoretical research such as

– spectroscopy, photometry, imaging and polarimetry of cometary atmospheres;

– theoretical modelling of cometary activity and the physical processes at surfaces of cometary nuclei as well as in the cometary atmospheres;

– study of dynamical and physical properties of asteroids, especially with respect to problem of NEO.

The instrumental problems of these investigations are under discussion especially the comparative possibilities of different type matrix sensors for the astronomical observations of this kind.

ASTROMETRIC PROGRAMS FOR THE SMALL OBJECTS OF THE SOLAR SYSTEM: A COMPLEMENT TO THE GAIA MISSION

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The GAIA astrometric space mission will be launched before 2012. During this 5 years mission, a huge amount of data will be acquired and analyzed. A large part of it will concern the Solar system objects. Almost all the small objects of the Solar system brighter than magnitude 21 will probably be then detected and their positions measured. Several morphological and physical parameters will also be determined. Therefore, if several interesting astrometric programs can be carried out with small telescopes nowadays, only a few among them will probably still remain relevant to study the Solar system objects after the GAIA mission. In this paper, I report on several astrometric programs for CCD ground based observations of asteroids and natural satellites and I discuss their interest either as a complement to the GAIA mission or as autonomous and separate programs.

ABOUT OBSERVATIONS OF ARTIFICIAL SATELLITES IN LVIV ASTRONOMICAL OBSERVATORY

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History about photometric observations of artificial satellites in Lviv would be related in this paper. How this work began and what results were achieved. Some words about interpretations of the light curves and explanation what for the polarimetric characteristics are needed will be given. As the summary a new model of a combined photopolarimeter on photomultipliers and CCD would be presented.

UKRAINIAN-POLISH SCIENTIFIC RESEARCHES USING OF GPS-TECHNOLOGY AND THEIR PERSPEKTIVES

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During last ten years it became possible to use the potential of Global Position System (GPS) to solve the problems which are connected with discovering of the Earth. These problems are solved by Ukrainian and Polish scientists. Scientists of the Space Research Center (Warsaw) take part in the international programs, where observations with help of GPS technologies are used. During last few years the network of GPS-stations is made in Ukraine where lots of different researches were done. After signing a contract between Space Research Center (Warsaw) and National University;Lvivska Politechnika; the group of Ukrainian and Polish scientists joined their efforts to discover and develope GPS-technologies. They also investigate how the sun activity influences on results of GPS- observations.

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