Ukrainian Virtual Observatory: 
Joint Archive & Sci. Projects

http://ukr-vo.org.ua

Irina Vavilova (1)
Lyudmila Pakuliak (1), Yuri Protsyuk (2),
Vadim Savanevich (3), Vitaly Andruk (1)

(1) Main Astronomical Observatory, NAS of Ukraine, Kyiv, Ukraine, irivav@mao.kiev.ua
(2) Mykolaiv Astronomical Observatory, Nykolaiv, Ukraine, yuri@mao.nikolaev.ua
(3) Kharkiv National University of RadioElectronics, Kharkiv, Ukraine, domsv1@rambler.ru

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* Introduction
* UkrVO Joint Archive of Observations
* Scientific Projects:
  - UkrVO Joint Digitized Archive
  - New Stellar catalogues
  - Software for search of the new Solar System bodies
Astronomical Institutions: UkrVO Regional Nodes

- Main Astronomical Observatory (Kyiv 1944)
- Crimean Astrophysical Observatory (Simeiz 1908; Naukove 1945)
- Institute of Radio Astronomy (Kharkiv 1950-ies)
- Mykolaiv Astronomical Observatory (1821)
- Astronomical Observatory Kyiv Nat. University (1845)
- Astronomical Observatory L’viv Nat. University
- Astronomical Observatory Odesa Nat. University (1871)
  -- Institute of Astronomy Kharkiv Nat. University
  -- ICAMER (p. Terskol, North Caucasus, RF, 1970-ies)
- Space research Laboratory Uzhgorod Nat. Univ., 1957

Before 2009: 10 Local VO DBs including more 100 subLocal DBs in dependence on the past and current Res. Programs, Instruments, Software etc. (non-interoperability, wide heterogeneity)
## Joint Archive (2009-2011: monitoring, systematization etc.)

<table>
<thead>
<tr>
<th>Number Glass Plates (GP)</th>
<th>Years</th>
<th>Sci. Programs</th>
<th>Catalogued &amp; Hard&amp; Soft</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAO NAS of Ukraine</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>~85,000 GP</td>
<td>1949-1992</td>
<td>Galaxies, QSOs, FON, stars, open clusters, Sol.Sys. small bodies</td>
<td>C, H, S</td>
<td>~26,500 direct images; mpg= 11 - 16; 2,500 digitized &amp; 1500 PVI</td>
</tr>
<tr>
<td>~16,000 CCD</td>
<td>2001-2003</td>
<td>Stellar fields (ICRF) Active Sun</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~1440 GP spec</td>
<td>1976-1990</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mykolaiv AO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8,405 GP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23,300 CCD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Crimean AO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>~30,000 GP</td>
<td>1938-till now</td>
<td>Galaxies, stars, comets, asteroids, gaseous nebula</td>
<td>C, S</td>
<td>«dBASE III+» format mpg= 16 - 18; mv= 12-14;</td>
</tr>
<tr>
<td>~100,000 CCD Spec</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Kyiv AO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 GP</td>
<td>1895-1916; 1945-1996; N1916, Moon, stars Fundamental stars, open clusters, QSOs</td>
<td>4,500 systematized; Old collection (before 1916) digitized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 20,000 GP</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>L`viv AO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160 GP</td>
<td>1939-1976</td>
<td>Comets, Asteroids, Variable stars, N</td>
<td>C, S</td>
<td>~6,000 direct images, in WFPDB `4,000 digitized</td>
</tr>
<tr>
<td>~ 8, 000</td>
<td>(160 were taken in 1939-1945)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Odesa AO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 10,000</td>
<td>1909-1954</td>
<td>Variable stars, Comets, Asteroids, EASs. quasars</td>
<td>80% direct images (del: -15 +90 alfa: all) Photometr.homogen.</td>
<td></td>
</tr>
<tr>
<td>~ 10,000</td>
<td>Simeiz collection 1945-1956</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 84,000</td>
<td>1957-1998</td>
<td></td>
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</table>
Our goal – to originate and develop the National Virtual Observatory of Ukraine at the basis of the common unificated astroinformation resources of the astronomical institutions of Ukraine in the IVOA standards.

The UkrVO' development allows us
- to save the unique astronomical observational heritage accumulated in observatories of Ukraine from the 1890-ies
- to open the wide on-line access to the joint database of digitized astronomic negatives and spectra for the national/foreign scientific community
- to create the technical and structural preconditions for joining the UkrVO to IVOA in 2011.

Main Tasks
- Joint Digitized Archive (both Photogr. & CCDs)
- Spectral Archives (by instruments, by objects, from decameter radio to gamma e.m.w. ranges)
- Catalogues of celestial bodies
- IT-resources and VO-instruments
- Science with VO
Sci. #1
UkrVO Joint Digitized Archive
(200,000 glass plates)
<table>
<thead>
<tr>
<th>Observatory</th>
<th>Number of observ. archives</th>
<th>Number of instruments</th>
<th>Years</th>
<th>Type of astroInformation</th>
<th>Number of images</th>
<th>Celestial bodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAO NASU</td>
<td>26</td>
<td>14</td>
<td>1949-2003</td>
<td>Direct images</td>
<td>2,500</td>
<td>Galaxies, stars, radiosources, Sol. Sys SB</td>
</tr>
<tr>
<td>Mykolaiv AO</td>
<td>2</td>
<td>2</td>
<td>1929-1931, 1961-1999</td>
<td>Direct images</td>
<td>4,000</td>
<td>Sol. Sys. SB, Near polar &amp; zodiacal zones</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>2003-2009</td>
<td>CCD</td>
<td>23,300</td>
<td>Equatorial zone</td>
</tr>
<tr>
<td>Crimea AO</td>
<td>7</td>
<td>7</td>
<td>2001-2010</td>
<td>CCD Spec</td>
<td>1,033,000</td>
<td>Galaxies, stars, GBs</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>4</td>
<td>1968-2010</td>
<td>Spec</td>
<td>96,000</td>
<td></td>
</tr>
<tr>
<td>L’viv AO</td>
<td>1</td>
<td>1</td>
<td>1939-1976</td>
<td>Direct images</td>
<td>1,700</td>
<td>Variable stars, Sol.Sys. SB</td>
</tr>
</tbody>
</table>
Database provides an opportunity to search plates and/or CCD frames by using equatorial coordinates, radius of search region, period of observations, names and types of objects, names of telescopes.

Access to the preview images is shown. Database includes about 34,000 plates and 23,000 CCD frames.
Databases of plates and CCD frames are available via Aladin interface. The same databases are used via browser and Aladin.

Visualisation process of search for plates is shown.
27 astrometric stellar catalogues with short descriptions in VOtable format are available for downloading from the web site. One can visualize and use any catalogue via Aladin or any other stand alone application.
JOINT DIGITAL ARCHIVE prototype

1 - Observational archives, currently included in JDA prototype
2 - Search Interface of Nikolayev AO for JDA data
3 - Search Interface of MAO NASU for JDA data

* joint results of search are highlighted
The initial processing of digitized images with calibrating software includes finding and eliminating of own flat field of the plate (B), finding and selection of objects, removing of «hot» pixels, restoration of overexposed images (C), removing of scanner mechanics errors (A).

(D) - photometric characteristics for two exposures
(E) - positional systematic differences over the field of plate
(F) - internal positional accuracy for 2 scanners

The virtual observatory of the **Mykolayiv Astronomical Observatory** is under the final stage of its development. *Database of observations with access via Aladin.* Database contains textual information about 7437 plates and 933 preview images. Plate scale: 100′/mm. Observational campaigns in: 1929-1931 and 1961-1999. Limiting magnitude: B=14m. Database contains textual information about 16660 CCD frames obtained with the AMC, the MCT and the FRT in 1996-2006. Database also gives links to 280 CCD frames obtained with the AMC in 2002-2003. Limiting magnitudes are R=16m, 14m, 18m for the AMC, the MCT and the FRT, correspondingly. *Astrometric catalogues of star in VOTable format* and other archives are available through Web-page: [http://www.mao.nikolaev.ua/ukr/vo2_u.html](http://www.mao.nikolaev.ua/ukr/vo2_u.html)

In the database of **Crimean Astrophysical Observatory** the digitized plate archive is stored in «dBASE III+» formats and comprises the data of photographic observations of stars down to 12m -14m in photo visual waveband and down to 16m-18m in photographic waveband. The time intervals of these observations cover 1938-1965, 1984 yrs. Crimean archives are included into global WFPDB.
The collection of glass plates in the archive of Main Astronomical Observatory NASU (Golosiiv plate archive – hereafter GPA) numbers near 85 thousands of negatives obtained in frames of various observational projects and starts in 1949. More than 26 thousands of them are the direct plates in the areas of the northern sky. The limiting magnitude of the most plates is 14m.0 – 16m.0.

The vast amount of information, contained in this archive, its partial regulation and absence of the unified systematization didn’t allow to use the archive either in total efficiently or to find separate plates quickly. At the moment when photographic observations had been totally stopped, a sheer necessity arose to order and classifies all the information collected in MAO NASU during more than 60 years of observations. The process started in 2000 with mere ordering of boxes with plates, analyzing characteristics of plates from the point of view which instruments were applied, which goals were pursued and formats were developed for the observational log data digitizing.

GPA collection was obtained generally with the telescopes, installed in MAO NASU. 85% of the northern sky observations are conducted with five instruments: Double Long Focus Astrograph – 10.5 thousands of plates, Double Wide Angle Astrograph – 9.7 thousands of plates, Double Short Focus Astrograph – 4.2 thousands of plates, Three Camera Astrograph – 1 thousand, stellar telescope AZT-2 – 1.1 thousands. The residue of plates was obtained on four foreign instruments in Ecuador, Uzbekistan and Russia.

See DBGPA V2.0  http://gua.db.ukr-vo.org
In 1966 the Simeiz (Crimean) collection of about 10,000 glass plates exposed in 1909-1953 was conveyed to Odesa AO.

Record at the envelope with a glass plate is dated by March 3, 1911
Scheme of covering the sky by the fields of 3, 4, 5, and 6 cameras, III series (blue) and of 1, 2, and 7 cameras, III series (red), 7-camera astrograph
Sci. 2. Software for the search of the new Solar System small bodies

Formation of CCDframe with the asteroid image
Sci. 2. Software for the search of the new Solar System small bodies
CoLiTec (Savanevich et al.)

Estimation of SB’ coordinates at the discrete image

Estimation of SB’ signal light by amplitude of its mark on the CCD frame

Removal of fixed object
Two-steps
Sci. 2. Software for the search of the new Solar System small bodies

- Frame's loading and accounting of residual noise at image
- Hand-make filtration of observational results
- Identification of stars with the use of stellar catalogues
- Online comparison of obtained measurements with IPC database, identification of known objects. Decision making about discovery of new objects
Sci. 2. Software for the search of the new Solar System small bodies

SoLiTec software Users

Observatory ISON-NM
Discovery C/2010 X1 (Elenin) comet

December 10, 2010, Comet c/2010 X1 was discovered by Elenin with the use of SoLiTec software

Andrushivska Observatory (Ukraine)
Zeiss-600, FLI PL09000 CCD camera

Russian observatory ISON-NM located in New-Astrograph Astroworks Centurion-18, D-45 cm

On the use of SoLiTec software, after its input into trial operation there were discovered about 200 new asteroids (for Andrushivska observatory) and about 1185 of 2010 X1 at observatory (centurion-18, D-45 cm). This software is successfully used in frame of the Space debris program at the National Space Centre (Evpatoria, Ukraine)
Conclusion—UkrVO Sci. Projects

- Creation of the UkrVO Joint Digital Archive
- Software for JDA and for the local data archive of observatories
- Science with UkrVO JDA
  -- new stellar catalogue (for fainter objects)
  -- search for new Solar System small bodies (small planets, transneptunian objects, comets, space debris)
  -- search and study for variable stars
  -- search for GRB’s counterparts
  -- multi-wavelength extragalaxy research (cross-correlation of ground-based long-term monitoring data in optical with the data from space mission in X-ray, gamma for estimation, for example, the black hole mass in AGNs)
  -- study of solar active formations and their evolution during the solar activity cycle
UkrVO site [http://ukr-vo.org.ua](http://ukr-vo.org.ua)

will be opened in July, 2011.

We are planning to apply the UkrVO for

the IVOA membership in 2011.

Thank you for your attention!