Science Research Institution “Astronomical Observatory”, AO.

Odesa I.I. Mechnikov National University

Ministry of Education and Science of Ukraine.

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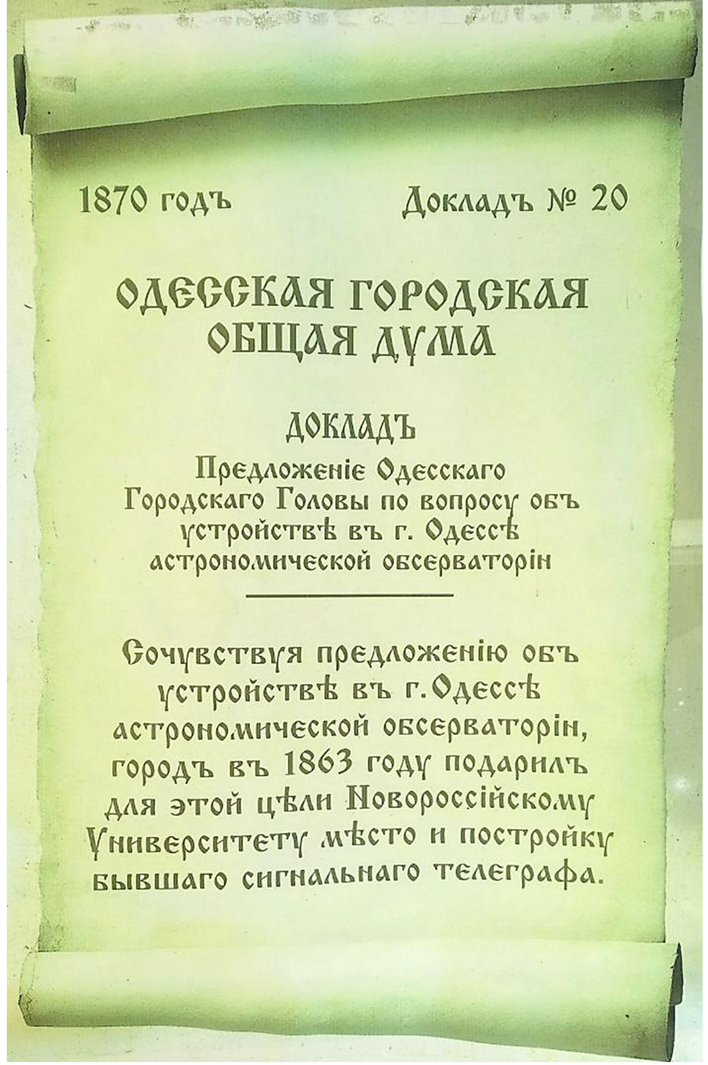


1870 годъ Докладъ № 20

ОДЕССКАЯ ГОРОДСКАЯ ОБЩАЯ ДУМА

ДОКЛАДЪ

Предложеніе Одесскаго Городскаго Головы по вопросу объ устройствѣ въ г. Одессѣ астрономической обсерваторіи

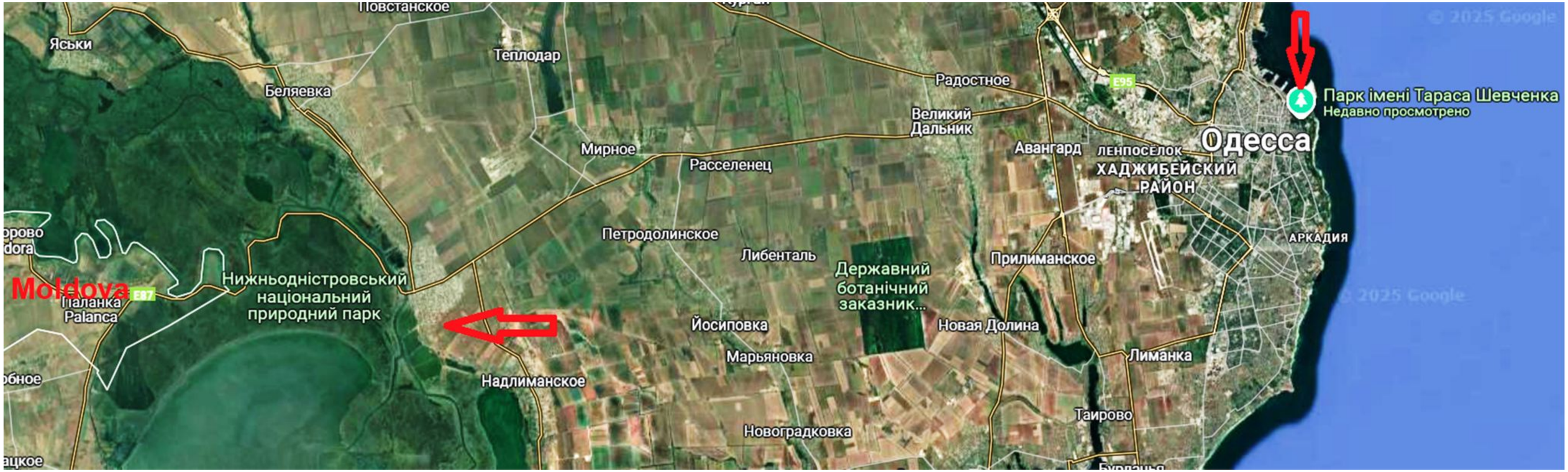
Сочувствуя предложенію объ устройствѣ въ г. Одессѣ астрономической обсерваторіи, городъ въ 1863 году подарилъ для этой цѣли Новороссійскому Университету мѣсто и постройку бывшаго сигнальнаго телеграфа.

- **1871.** A scientific department of Odesa University, which also serves as a base for the education of students majoring in astronomy (the long history needs a separate presentation).

The historical main building of AO in Shevchenko Park,

Locations:

- The AO Main Building, Shevchenko Park, Odesa.
- Mayaki Station, countryside.



Institute overview

- Core areas of astronomical research
  - Research into the physical characteristics, chemical composition, structure and evolution of stars and galaxies.
  - Cosmological models in four-dimensional and multidimensional space-time. Large-scale structure of the Universe.
  - Research into the motion, photometric characteristics and physical features of artificial celestial bodies.
  - Spatial distribution, physical characteristics and evolution of meteoric and cometary matter.
  - Development and creation of new telescope systems, methods and means of recording astronomical data
  - Polarimetry,

Pre-war capacity and international role

- **Major scientific outputs and achievements**

Theory of perturbations of Einstein's equations in cosmological models developed, and screening of gravitational interaction on cosmological scales predicted.

Analysis of chemical evolution of stars, sources of production and nucleosynthesis of chemical elements in the Galaxy has been made. Behavior of alpha-, iron peak, and neutron capture elements in galactic disk stars. Features of r-process element enrichment in disk and halo stars.

Barium excess in young open clusters, Lithium depletion in solar-analog stars, Mass dependence of high-mass planets (like Jupiter) on host star metallicity were studied.

A method for determining the effective temperature of stars has been developed, which is based on calibration relations between temperature and depth of spectral lines.

Discovery of metallicity gradients towards the center of the Galaxy and at its periphery.

Discovery of lithium in the atmospheres of Cepheids.

A catalogue of ~20 thousand light curves of Earth satellites was obtained; new methods for determining the parameters of their proper rotation have been developed, as well as a method for estimating the receiver coordinates based on optical astrometric observations of reference satellites.

Research into the physical characteristics, chemical composition, structure and evolution of stars and galaxies. Tamara Mishenina.

- **Major scientific outputs and achievements.**

Behavior of alpha-, iron peak, and neutron capture elements in galactic disk stars. Barium excess in young open clusters. Lithium depletion in solar-analog stars. Mass dependence of high-mass planets (like Jupiter) on host star metallicity. Analysis of chemical evolution, production sources, and nucleosynthesis of manganese, strontium, molybdenum, ruthenium, thorium, gadolinium, and dysprosium. Features of r-process element enrichment in disk and halo stars.

Research into the physical characteristics, chemical composition, structure and evolution of stars and galaxies.

- **Current work**

•Search for sources of molybdenum enrichment due to the inconsistency of interpretation with still existing models of galactic evolution and nucleosynthesis. Analysis of enrichment of elements of the first and second peaks of the s-process to detect different sources of their production.

•Analysis of enrichment of various elements (including radioactive thorium) of stars with planets and the connection with the formation of Earth-like and Jupiter-like planets. Analysis of production sources and interpretation of the spread of r-process abundances in metal-deficient stars.

Cosmological models in four-dimensional and multidimensional space-time. Large-scale structure of the Universe. Oleksandr Zhuk

- **Major scientific outputs and achievements.**

•Multidimensional classical and quantum cosmological models building, definition of the extra dimension stability and conditions for viable Kaluza-Klein models. The study of the large-scale structure of the Universe in 4-dimensional space-time. We have developed a fully relativistic approach to describe the dynamics of perturbations of the metric and density of matter in the Universe which was dabbed as the cosmic screening approach. Addressing the cosmological tension problem both analytically and with N-body simulations.

- **Current work**

Addressing the cosmological tension problem both analytically and with N-body simulations**.**

Possible collaboration: Collaboration on the topic of cosmological tensions is possible with Alexey Boyarsky from Lorentz Institute for Theoretical Physics, Leiden University.

Polarimetry: Revision of existing qualitative models as a result of obtaining a long series of complete Stokes parameters. Development of polarimetric instruments. Sergey Kolesnikov.

- **Major scientific outputs and achievements.**

Qualitative models have been proposed and confirmed by observations: a swinging dipole for classical polars AM Her and QQ Vul; two nearly equatorial columns for the intermediate polar V405 Aur.

Qualitative models have been confirmed by observations: an asynchronous polar for BY Cam (based on the results of two international programs);

magnetic nature of the variability of a single white dwarf WD1748+708

The results of observations have significantly limited the parameters of models for a number of non-magnetic close binary systems: TT Ari, MV Lyr, HQ And, HV And, BZ Cam, etc. Also - a number of small bodies of the Solar System.

- **Interested in cooperation: to create numerical models based on available observations; the creation of new polarimetric devices.**
- **Priority needs: Stable funding**

International collaborations

- **Projects:** Ukraine-France "Dnipro", 2004-2005, Ukraine - Lithuania, 2009-2010, Ukraine - Switzerland SCOPES "Stars, Stellar Explosions and the Origin of Elements" (2014-2017), as well as the COST project (European collaboration in the field of science and technology) ChETEC - Chemical Elements as Tracers of the Evolution of the Cosmos, 2018 – 2021 and ChETEC – INFRA, 2021-2024 – as an Associated Member of Ukraine; Ukraine-Span, INCINSTITUTO DE ESTRUCTURA DE LA MATERIA, “Stellar nucleosynthesis in advanced burning phases and explosive scenarios” 2024-2026.

Collaboration: Goddard Space Flight Center, Korea Aerospace Research Institute, Chongqing University, The Astronomical Institute of Slovak Academy of Sciences, Jagiellonian University (Poland)...
Areas of international cooperation – astrophysics, cosmology, Solar system and near-Earth space.

Impact of the war

- The observatory's facilities were not physically damaged, although all of its territories are in the zone of constant UAV and rocket attacks.
  At the same time, windows were knocked out in the university's administrative building and the student dormitory.

- Starting in 2022, observations on telescopes of Mayaki station have been suspended, and regular practical trainings of students and postgraduates on the observatory's telescopes and equipment have been disrupted.

The observatory is functioning, observations are continuing on some telescopes, and scientific plans are being implemented.

Current status and priority needs

- The main problem is the lack of basic funding for scientific institutes. This has led to a lack of necessary technical personnel.
- Also, since 2022, the observatory's scientific staff has been significantly reduced (some were called up for military service, some left the country).

Strategic vision and collaboration opportunities

- The astronomical observatory is located in the south of Ukraine, has a good astronomical climate and atmospheric transparency.
  There is a plan to build a Southern Ukrainian observatory based on our out-of-town station in the village of **Mayaki**. For this purpose, before the start of the war, in 2021, we developed a project that includes the acquisition of a new 1.5m telescope.

- In the ruined Ukraine it will be difficult to revive the Astronomical Observatory in Odessa as it was before. However, the Department of Astronomy together with the scientific staff of the observatory have trained numerous scientific personnel (including young ones), who have now left for all over the world.
  We hope that the post-war restoration of Ukraine and decent funding of science will allow many of them to return to Odessa and “revive” our observatory.

Specific needs and proposals for partnership (e.g. joint research, equipment, staff exchanges)

- The scientific staff of the Observatory and the Department of Astronomy have extensive contacts with colleagues all over the world.

  However, we are in great need of financial support (including individual support), without which there is no point in formulating scientific plans. We often cannot dream of funding from our university for participation in scientific conferences far from Ukraine.
  It would be very appropriate to create a Fund to support the participation of Ukrainian astronomers in the congresses of the IAU, EAU, COSPAR, etc.

SRI “Astronomical Observatory”. Mayaki Station

Mayaki is the main observational base AO in Ukraine. It is mothballed due to martial law.

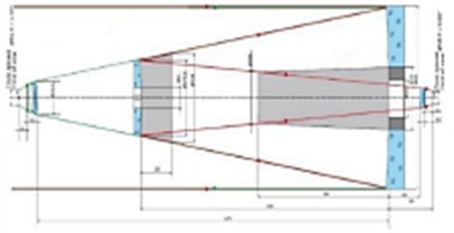
Mayaki is the location for the project **South Ukrainian Astronomical Observatory (UASO)**

Yaroslav Yatskiv and Iryna Vavilova

OMT-800 (Odessa Multifunctional Telescope)

Location: Mayaki

Main mirror diameter: 800 mm
Telescope effective focal length: 2138 mm
Focal ratio: F/2.67
CCD camera: FLI ML09000
Field-of-view: 59' x 59'
Limiting magnitude: ~ 19.5^{m}



The optical layout: catadioptric plananastigmat (modif. of N. Fashchevsky)

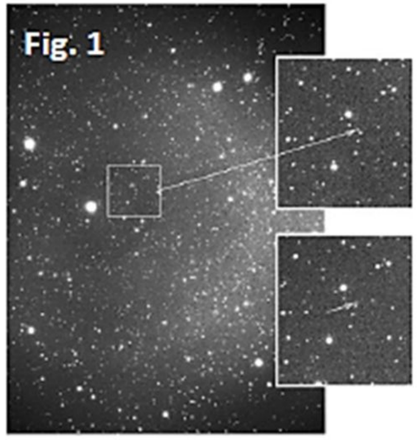


Fig.1. The shot is made with OMT-800 March 3, 2013, 0:00UT (exp. 10 sec). The arrow shows the image of comet C/2012 S1 ISON. The next fragment of the shot was made 25 minutes later (is shown at the bottom right).

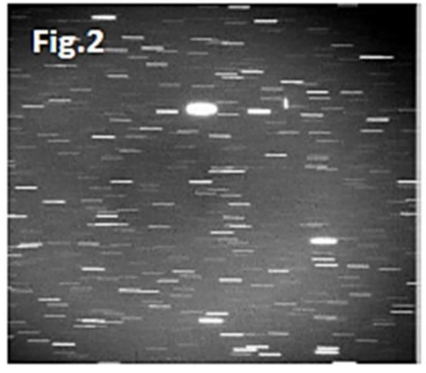


Fig.2. The figure shows a typical image of the sky with the object being tracked

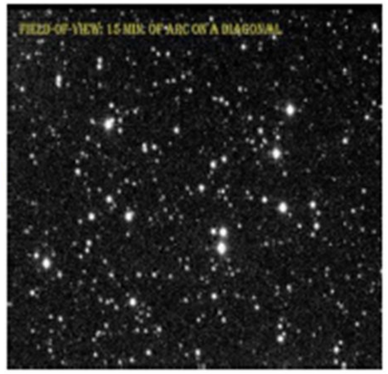
Observation program:
Positional observations of artificial satellites in the geostationary orbits.
Observations of the near-Earth approaching objects.
Observations of the Solar system small bodies (Fig.1, as an example).
In addition, this telescope can be used for the high precision photometric observations of faint objects up to 19 mag.

2022, January

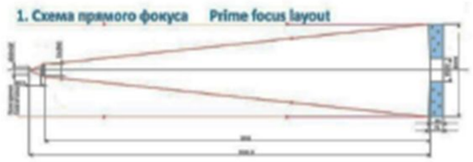
AZT-3

Location: Mayaki

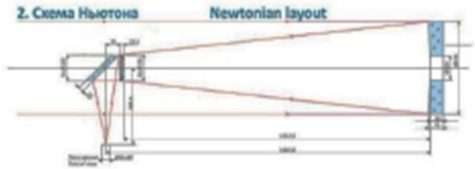
Main mirror diameter: 480 mm
Telescope effective focal length: 2024 mm
Focal ratio: F/4.5
Camera: UAI CCD ICX429ALL
Field-of-view: 12.0’ x 8.5'
Limiting magnitude: 17^m



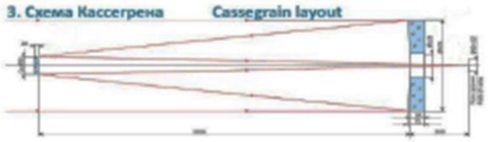
CCD image of variable stars

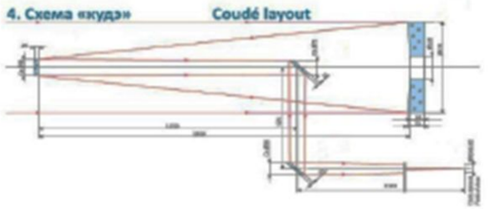


The optical layout: Prime focus, Newtonian (used now), Cassegrain and Coudé



Observation program:
Photometric studies of short-period variable stars of various types are conducted:
RR Lyr, δ Sct, SX Phe, β Cep etc.





Archive of astronomical negatives obtained with AZT-3
Number of plates (1969-1992): about 1,000
Plate size: 40 x 40 mm
Field-of-view: 60’ x 60'
Emulsions: Agfa Astro, ORWO (ZU1, ZU-2, ZU21, ZP-1, ZP-3)
Studied objects: variable stars, comets, asteroids and satellites

Odessa Collection of Astronomical Negatives. The earliest plate is dated 1909, and the total number of plates exceeds 110 thousand.
Variable stars, Comets, Asteroids, EASs, quasars. Simeiz collection, ~ 10,000 (1909-1954), and
Odesa, ~ 10,000 (1945-1956), Mayaki, ~ 84,000 (1957-1998).
Instrumental system B, V.
Epson Perfection V700 Photo scanner.
About 1500 astronegatives were digitized. The program is suspended due to martial law.

The Odessa archive of astronegatives

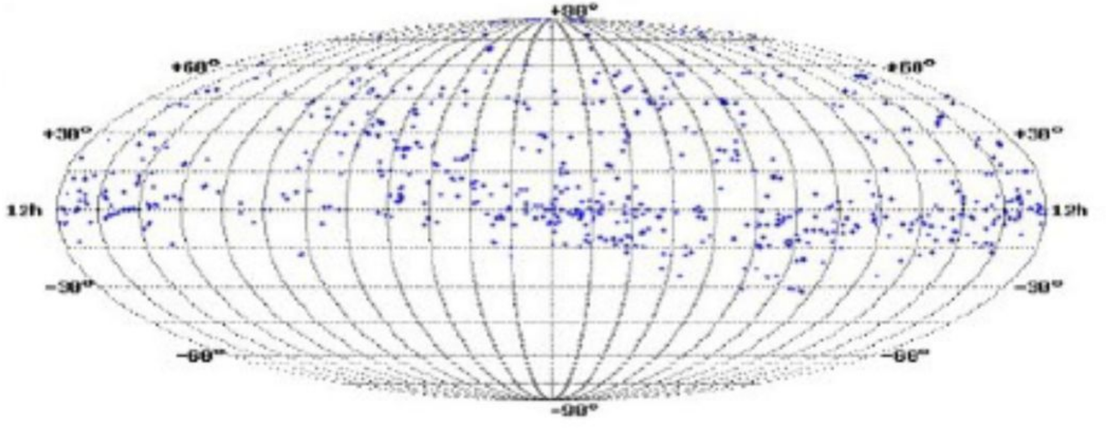
Double astrograph with 120 mm Unar lenses

Brooks comet, 16.09.1911

SIMEIZ COLLECTION (1909 – 1953)

Location of Double astrographs: Simeiz (1909-1942, 1944-1953), Kitab (1942-1944)
Plate size: 130 x 180 mm
Emulsion: more than 10 varieties
Field-of-view: 11.9 x 16.2 deg

Limiting magnitude: $m_{pg} \sim 15$
Exposure time: up to 2 hours
Studied objects: small bodies of the Solar System
Number of plates: about 8,000
Digitized: 5,500



Distribution 887 plates SIM012A in the sky, the projection of the Molveide
(http://www.wfpdb.org/ftp/WFPDB/archives/SIMEIZ/)

THE “OLD COLLECTION” (1951-1957)

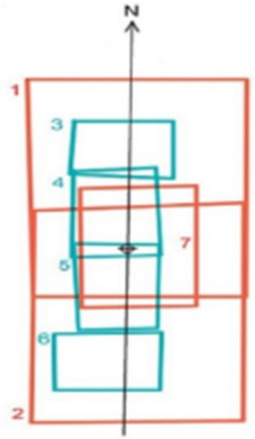
Obtained on three instruments: "Large" Astrograph ("Cook"), "Small 2-camera" Astrograph and 3-camera Astrograph "Hedgehog"

Location: Odessa
Plate size: 130×180, 180× 180 and 180×240 mm
Emulsions: Ilford, Agfa Astro, "Isoorto" with yellow, red filters and without filters
Field-of-view: 24 x 33 deg

Guide stars: 64 (+35 single stars)
Limiting magnitude: m_{pg} ~ 13.5
Exposure time: from 0.5 to 3 hours
Studied objects: variable stars, comets, asteroids
Number of plates: about 10,000

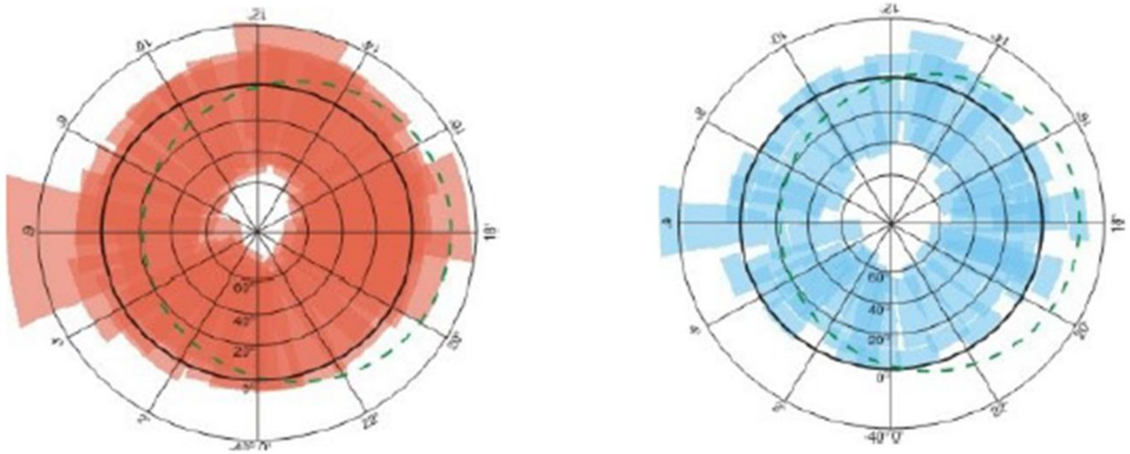
COLLECTION OF "THE 7-CAMERA ASTROGRAPH" (1957-1998)

The 7-camera astrograph



Location: Mayaki
Plate size: 130×180,180×240 mm
Field-of-view: 30 x 80 deg
Emulsion: Agfa Astro, ORWO, with yellow filters and without filters
Guide stars: 39
(+75 single stars)

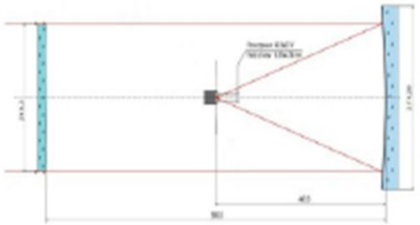
Limiting magnitude: m_{pg} ~ 14.5, m_{pv} ~ 12
Exposure time: 30 min
Studied objects: variable stars («Sky service»)
Number of plates: about 84,000
Digitized: about 400



Scheme of covering the celestial sphere with and without filters (7-camera astrograph)

The total number of plates in the Odessa collections contains more than 100,000 wide-angle images of the sky (1909 – 1998)

Schmidt-type telescope



Location: Kryzhanovka

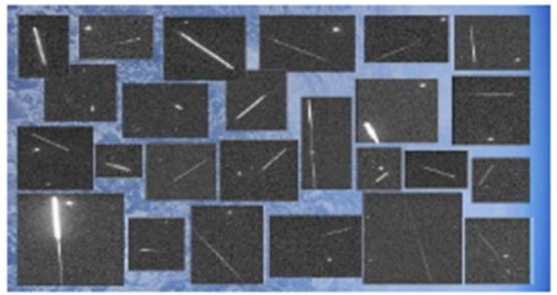
Main mirror diameter: 271.25 mm
Diameter of the correction plate: 219.2 mm

Telescope effective focal length: 0.44 m

Focal ratio: F/2
Field-of-view: 49.5' x 37.4'
Limiting magnitude: ~ 19.2^{m}

CCD camera: Videoscan-415-2001

C/2018 Y1 Iwamoto 13/14.02.2019

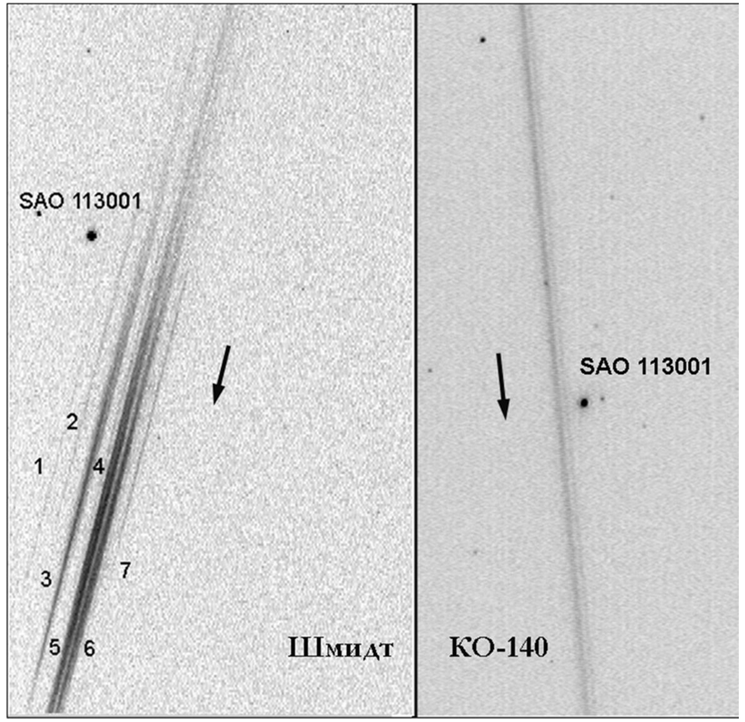


Images that were made with meteor patrol

Observation program:

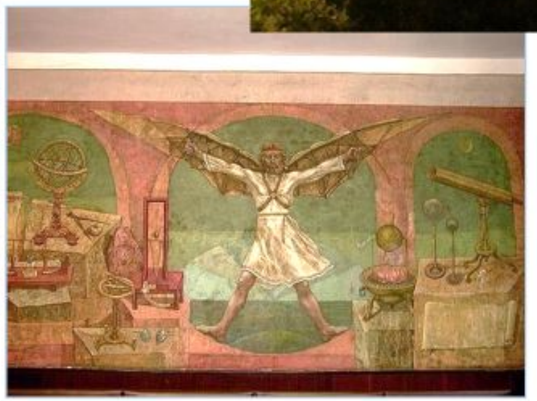
From 2003 to 2015 Schmidt telescope was equipped with TV camera WATEC LCL-902K and it was used for the regular patrol observations of the meteor events. During that period 2345 meteor phenomena were observed. The time resolution of obtained data is 0.02 s and angular resolution is up to 1 arcsec.

In 2015 this telescope was modernized and equipped with the Videoscan-415-2001 camera (exposure time is 0.0029 - 40 s). Since that time the telescope is also used for the cometary tails observations.



Gorbanev Yu.
and his Meteor group,
located in
Kryzganovka. Bazis
observations of the
meteors.
The program was

I hope that soon my sweet Odessa will be safe and open to guests from all over the world.
Odessa is not just a city, it is the smile of God



Thank you