

**ABSTRACT**

The first NEO observations were conducted in 2017 using the new wide-field telescope of the "Sazhen-S" quantum-optical station of the National space Facilities Control and Test Center (NSFCTC) of the State Space Agency of Ukraine. Regular observations, including the follow-up of new objects discoveries, began in 2019. By the end of 2024, three telescopes of NSFCTC in different parts of Ukraine have already been participating in such observations. Despite the fact that NEO observations are not the main task of these optical sensors,

more than 15,000 observations of various NEOs were obtained in the period of time from 2017 to 2024, and participation was taken in follow-up of the discovery of more than 250 new NEOs, including more than 10 PHAs. The software tools for automatic planning of observations and analysis of the obtained results as well as the software for processing NEO observations were developed. In the future, it is planned to increase the limited magnitude of the telescope to expand the capabilities to follow-up the discovery of new NEOs.

**1. INTRODUCTION**

Optical observations of small bodies of the Solar System, including near-Earth objects (NEOs), began at the National Space Facilities Control and Test (NSFCTC) of the State Space Agency of Ukraine (SSAU) in 2010 as part of the participation of the NSFCTC's AZT-8 telescope in the GAIA Follow-Up Network – Solar System Objects (GAIA FUN-SSO) [1]. In particular, in 2013, a participation was taken in the campaign of optical observations of the asteroid Apophis in 2013 [2, 3]. Due to well-known political circumstances, these observations were halted in early 2014 and not resumed. The next observations of NEOs began in 2017 using the modernized wide-field telescope of the quantum optical station "Sazhen-S" (QOS-WFoV). The relatively successful observations of the 2014 JO25 [4] served as the basis for obtaining the International Astronomical Union Minor Planet Center (IAU MPC) observatory code L18 [5]. More or less regular observations began in 2019, so it was taken by the authors as the initial one. Following the commissioning of new NSFCTC telescopes in 2020–2022, they also joined these observations. In addition, two new IAU MPC codes were obtained: L99 for the Novosilky observatory [6] and M32 for the "Sunny Transcarpathian" observatory [7].

**2. INSTRUMENTS**

	QOS (Wide FoV only)	OEOS-1
Aperture, cm	30	50
Focal length, m	0.3	3.8
Camera (chip)	CMOS	Interline CCD
FoV	130'x80'	64.8' x 43'
Scale, "/pix	4.0	1.7 (with binning)
Mount	Equatorial	Equatorial fork
Slew rate, deg/s	Up to 2.5	Up to 5

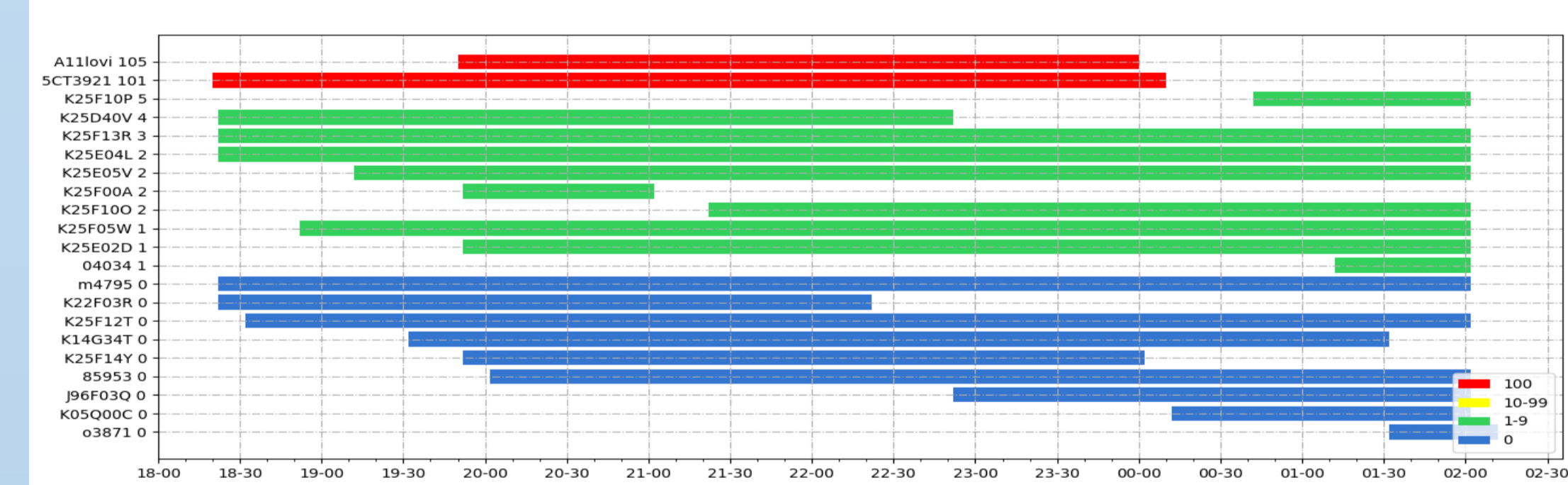


	L99	M32
Aperture, cm	30	35
Focal length, m	0.3	0.7
Camera (chip)	CMOS with GPS	CMOS with GPS
FoV (deg <sup>2</sup> )	130'x80'	55'x35'
Scale, "/pix	4.0	1.7
Mount	Equatorial with Direct Drive	Equatorial with Direct Drive
Slew rate, deg/s	Up to 10	Up to 20

**3. OBSERVATIONS PLANNING**

Software pipeline "Planner" from the NOAP package [8, 9]

План робіт для ОЕС L18 на 2025-03-30

**Observation plan in graphical form**

NAME	PR	START	END
SCT3921	101	2025-03-30 18:20:00	2025-03-31 00:10:00
A111ovi	105	2025-03-30 19:50:00	2025-03-31 00:00:00
K25D40V 4	4	2025-03-30 18:22:00	2025-03-30 22:52:00
K25F13P	5	2025-03-31 00:42:00	2025-03-31 02:02:00
K25F10R	3	2025-03-30 18:22:00	2025-03-31 02:02:00
K25E04L	2	2025-03-30 18:22:00	2025-03-31 02:02:00
K25F19Q	2	2025-03-30 21:22:00	2025-03-31 02:02:00
K25E05V	2	2025-03-30 19:12:00	2025-03-31 02:02:00
K25E06A	2	2025-03-30 19:52:00	2025-03-30 21:02:00
K25F05W	1	2025-03-30 18:52:00	2025-03-31 02:02:00
K25E02D	1	2025-03-30 19:52:00	2025-03-31 02:02:00
K25F14Y	0	2025-03-30 19:52:00	2025-03-31 00:02:00
K25F12T	0	2025-03-30 18:32:00	2025-03-31 02:02:00
K25F03R	0	2025-03-30 18:22:00	2025-03-30 22:22:00
K05Q00C	0	2025-03-31 00:12:00	2025-03-31 02:02:00
85953	0	2025-03-30 20:02:00	2025-03-31 02:02:00
04034	1	2025-03-31 01:12:00	2025-03-31 02:02:00
m4795	0	2025-03-30 18:22:00	2025-03-31 02:02:00
K14G34T	0	2025-03-30 19:32:00	2025-03-31 01:32:00
396F03Q	0	2025-03-30 22:52:00	2025-03-31 02:02:00
03871	0	2025-03-31 01:32:00	2025-03-31 02:12:00

**Observation plan in textual form**

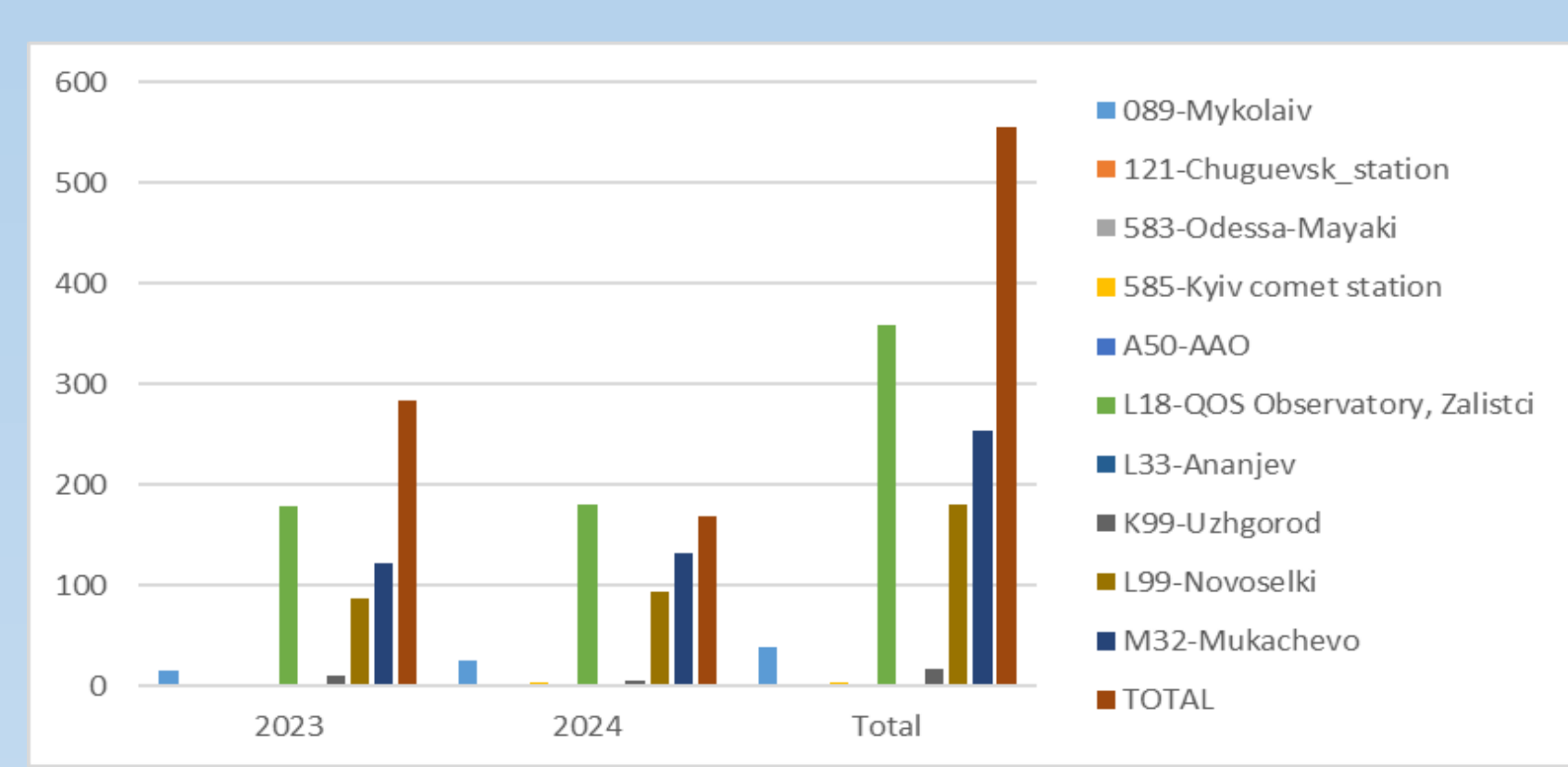
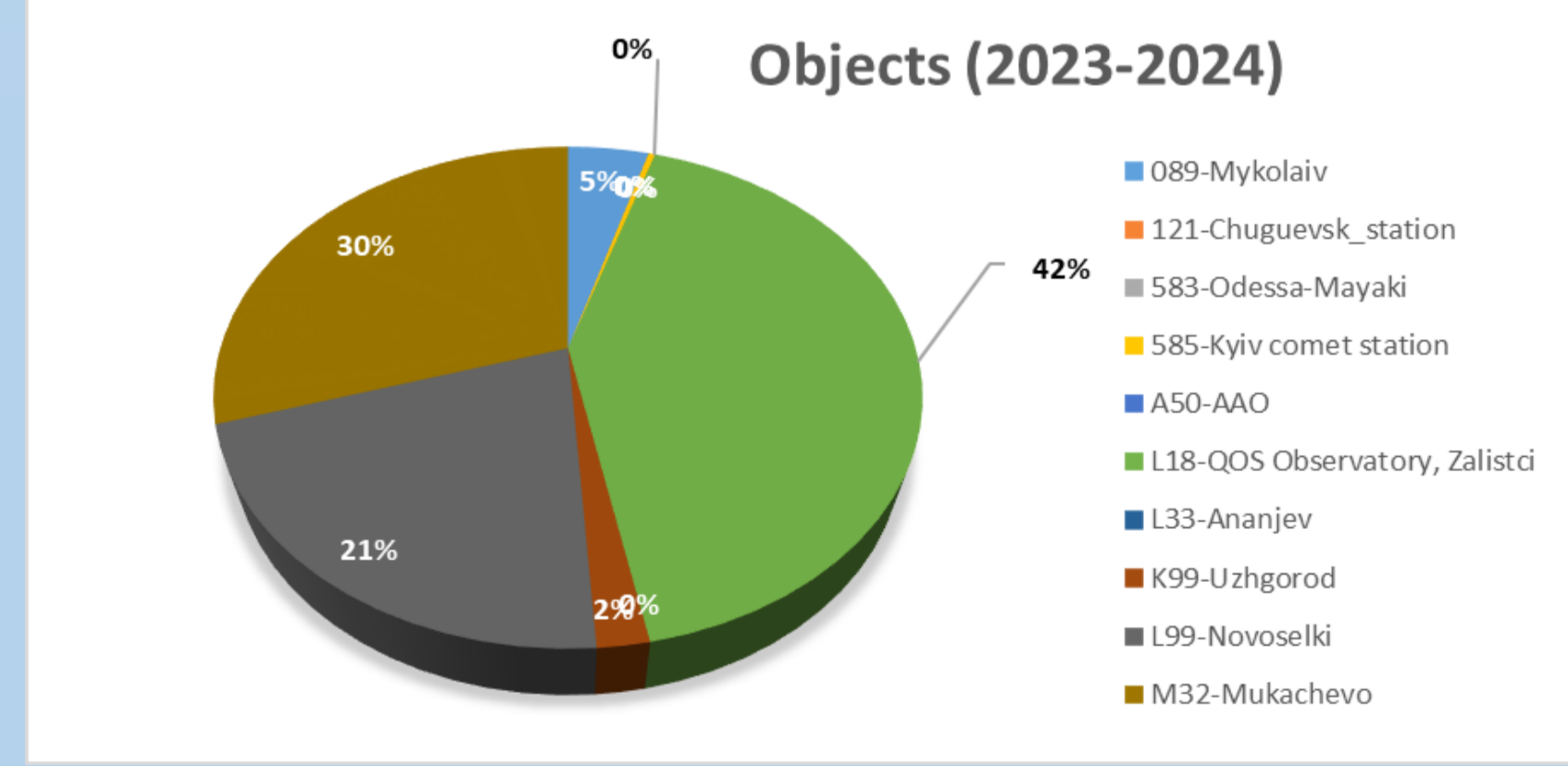
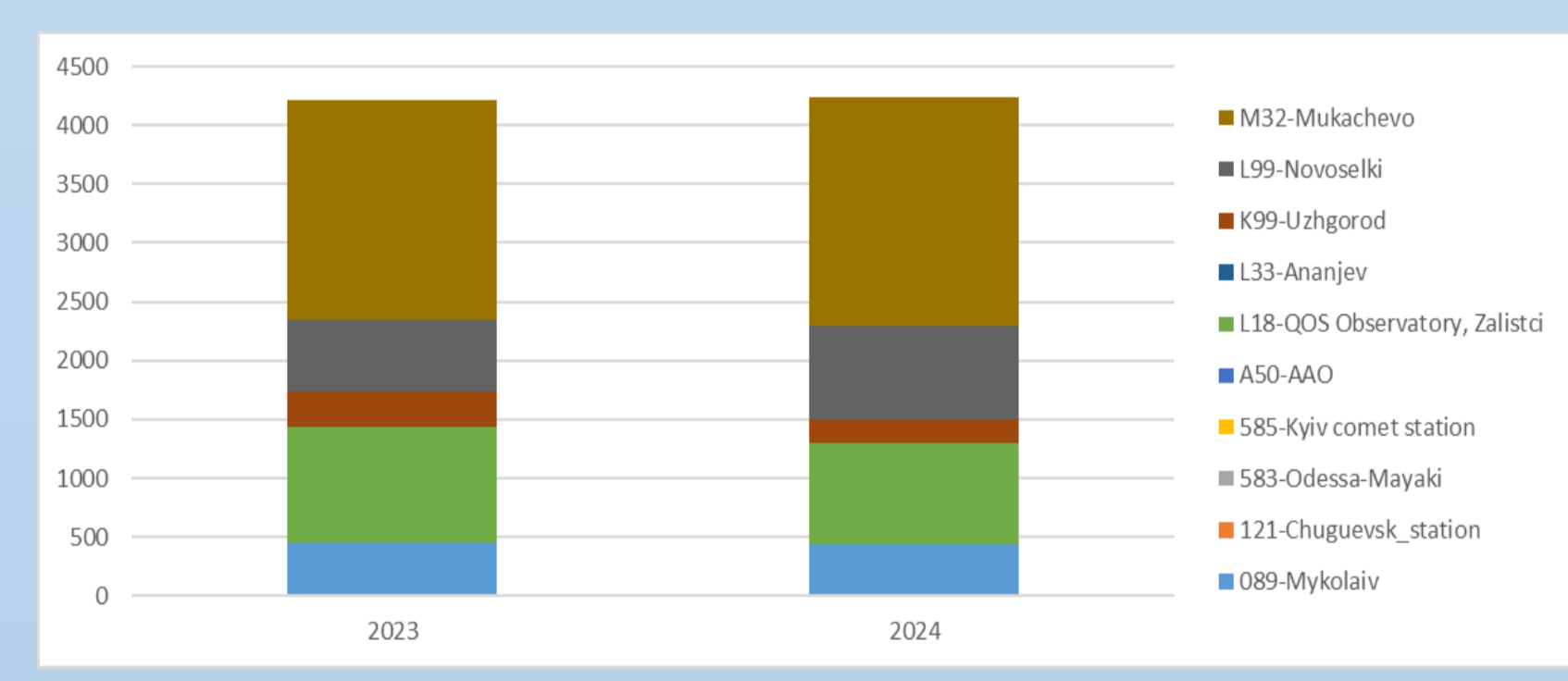
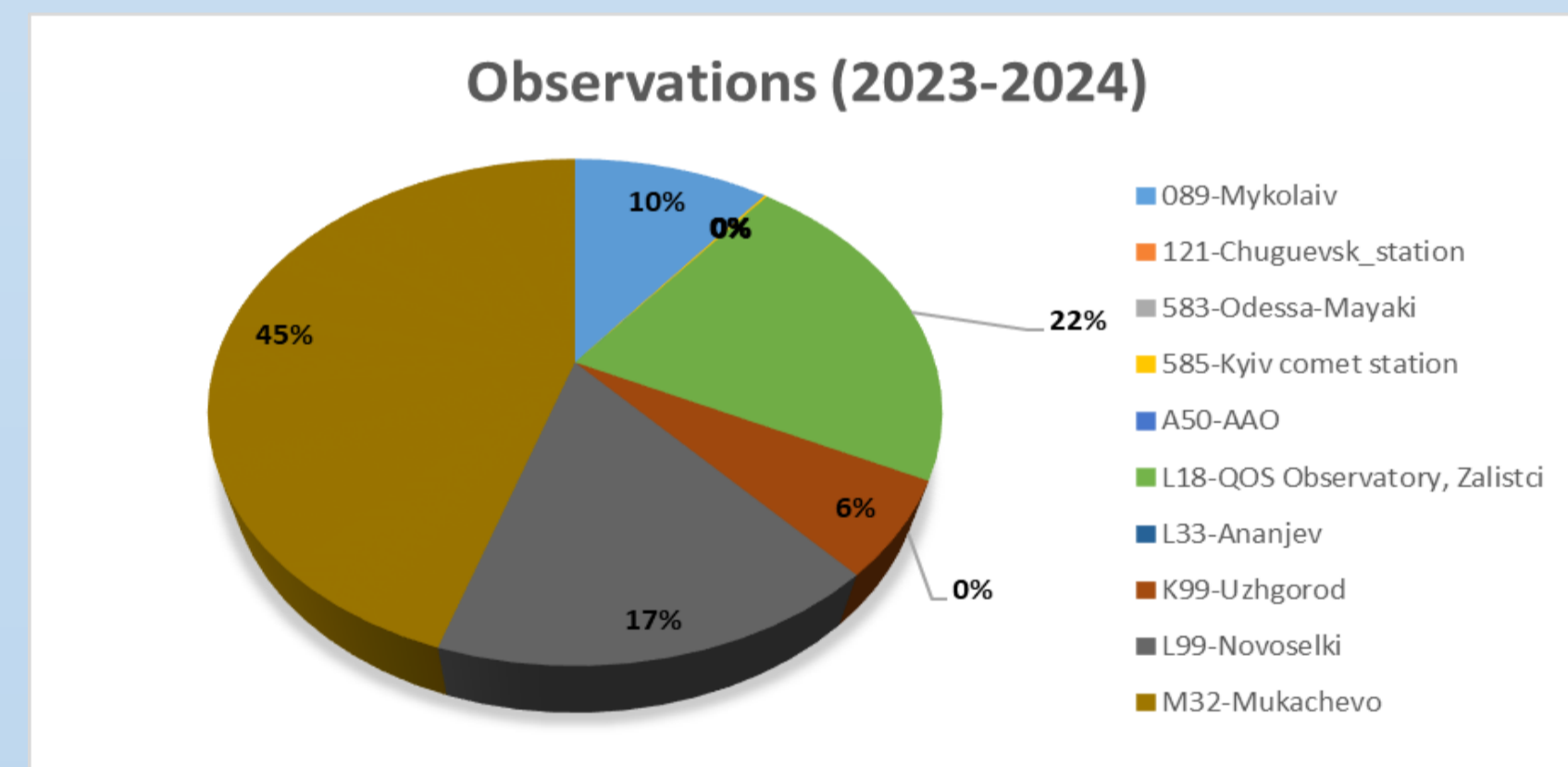
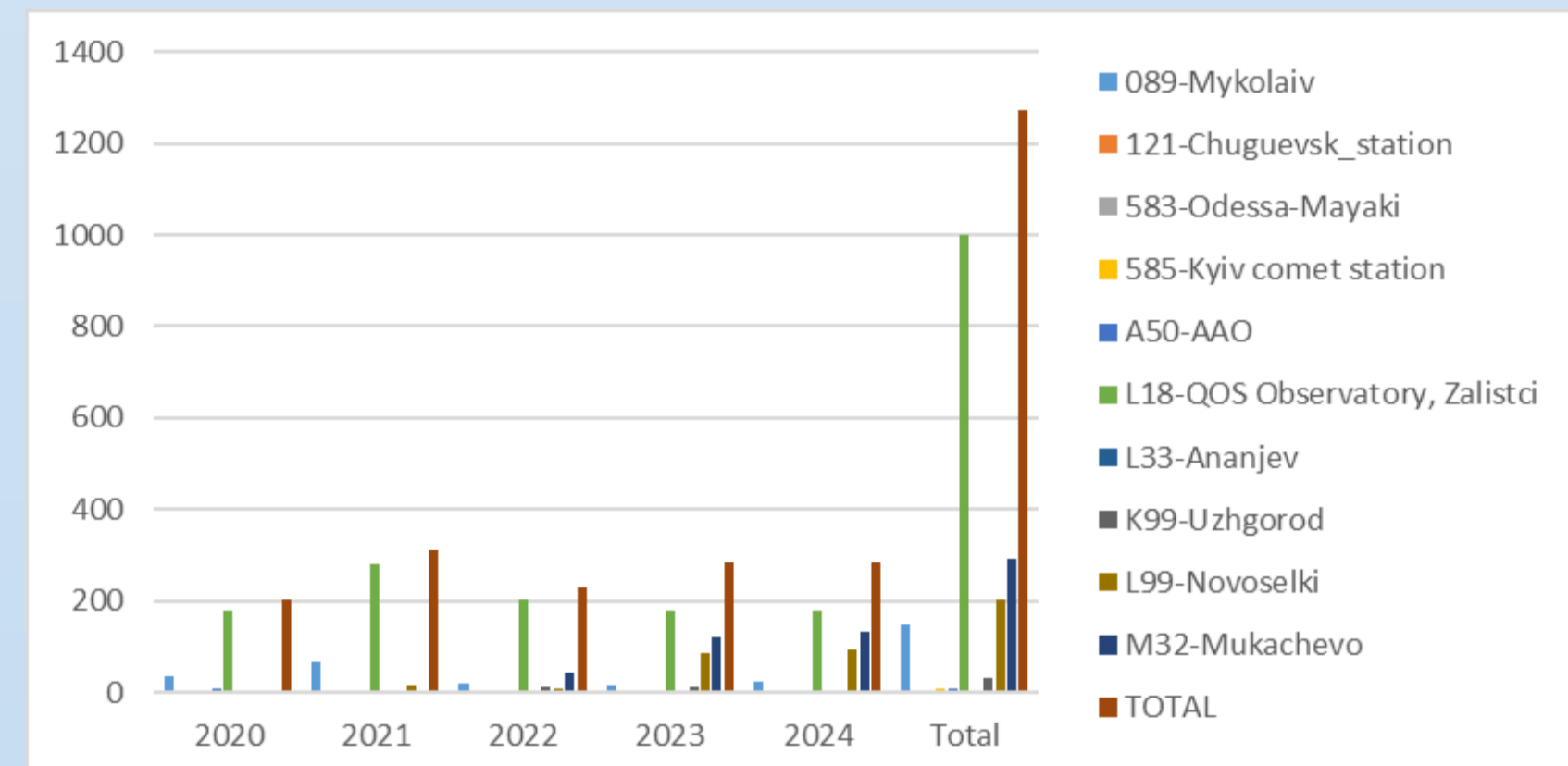
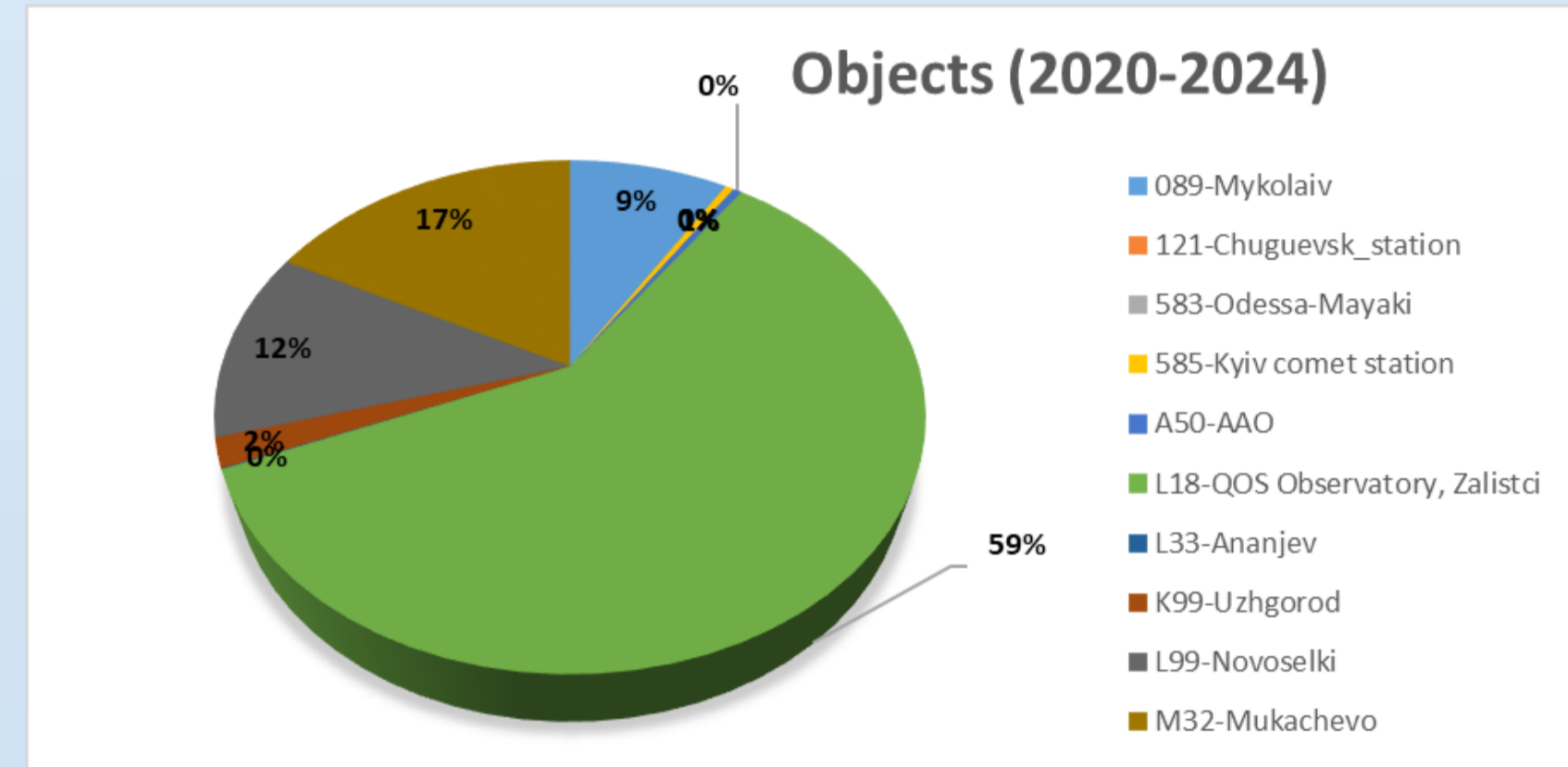
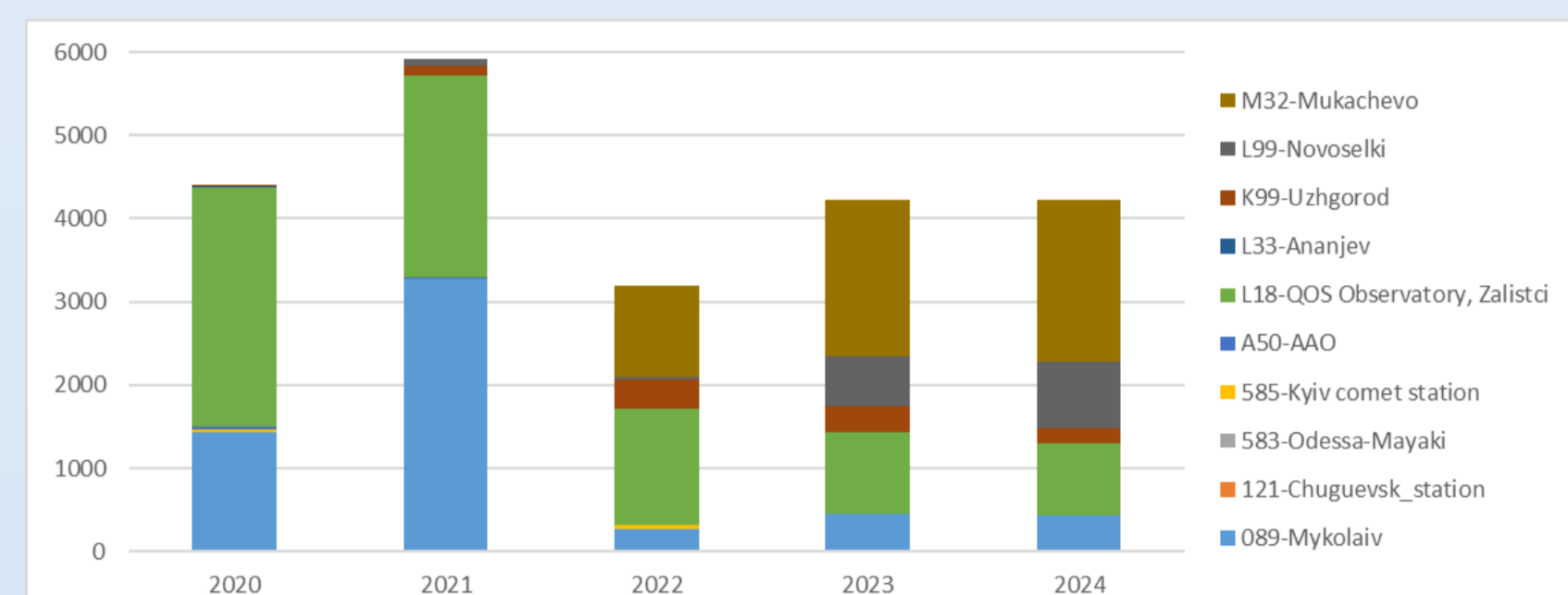
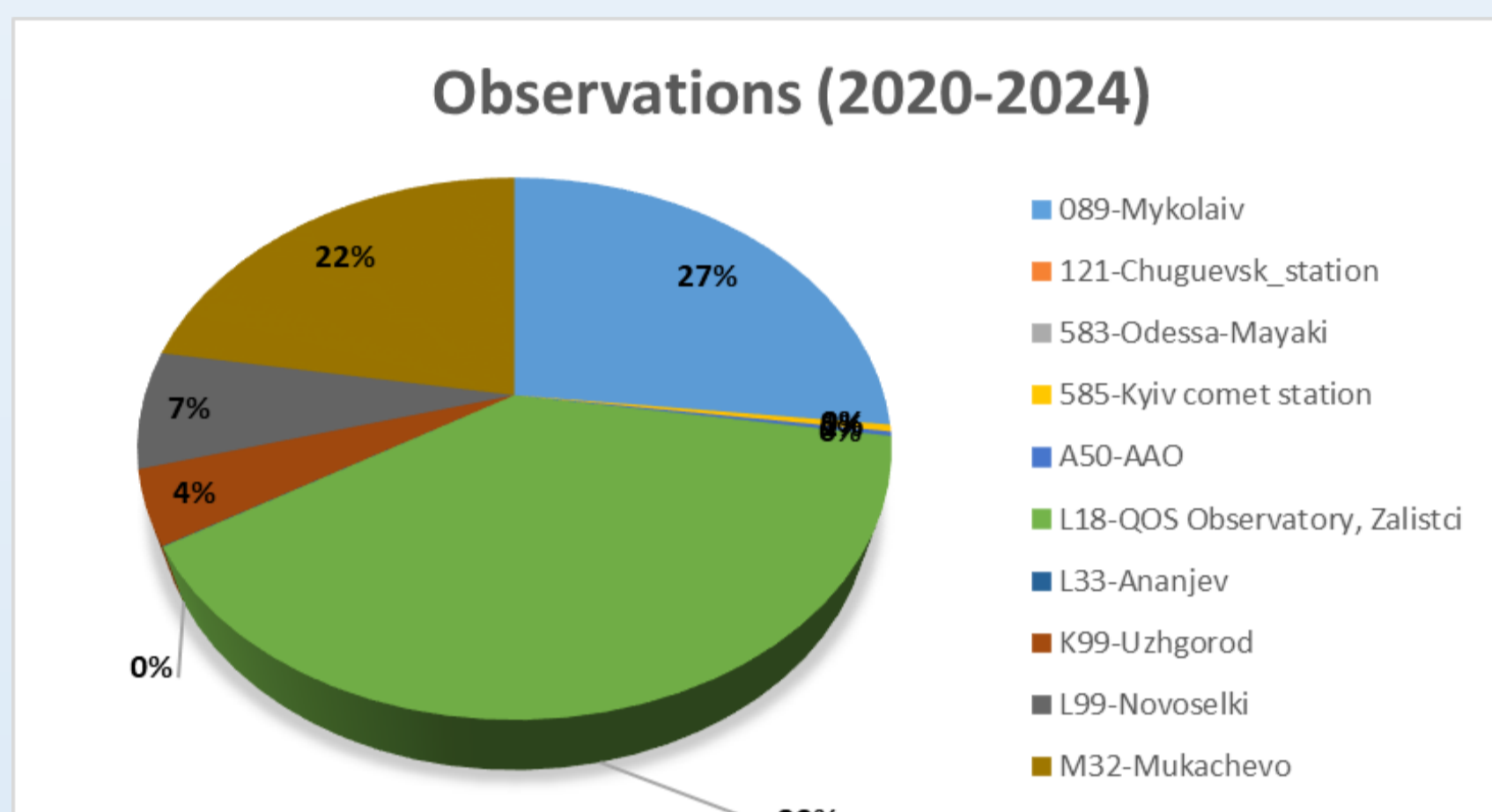
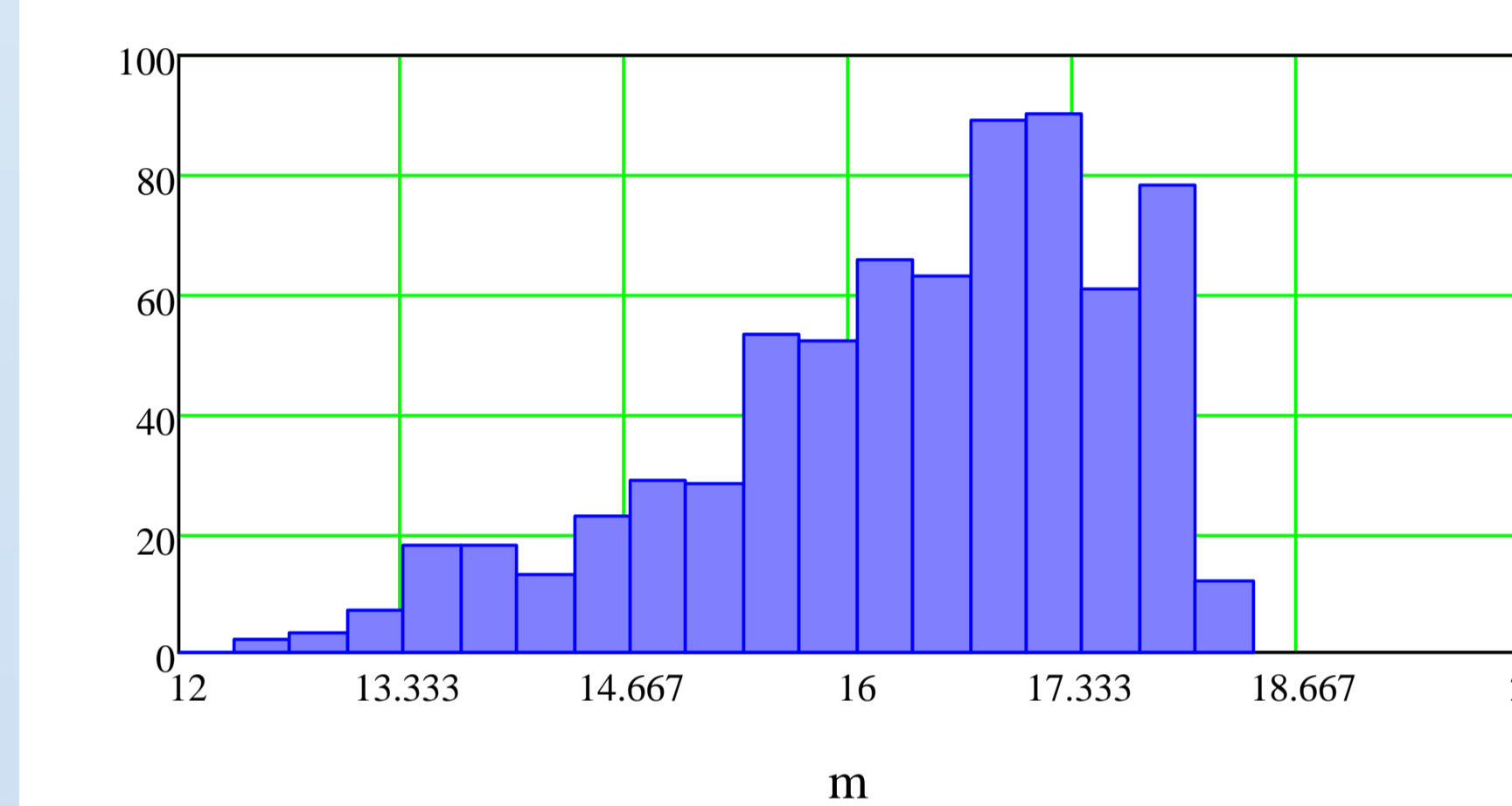
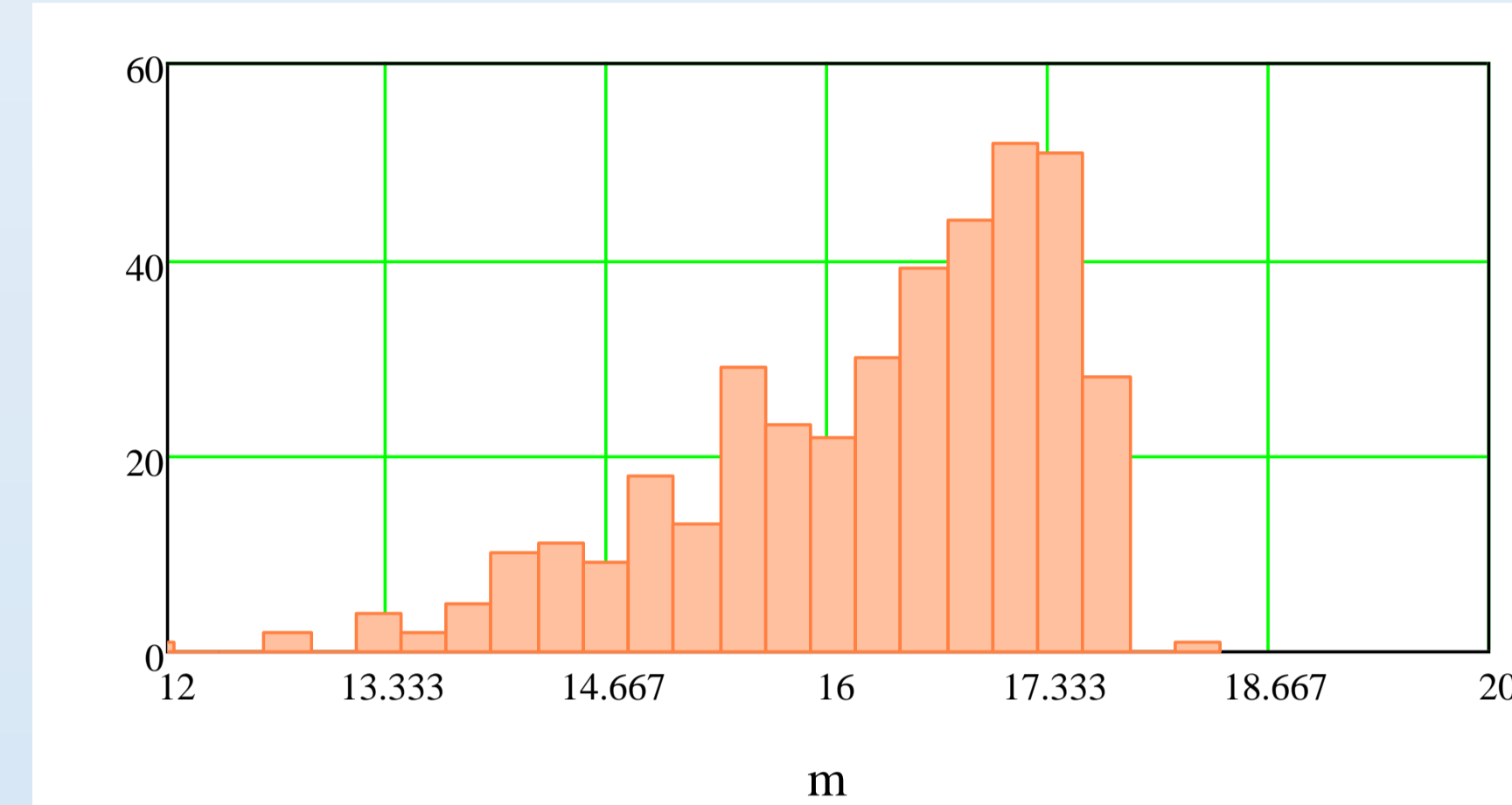
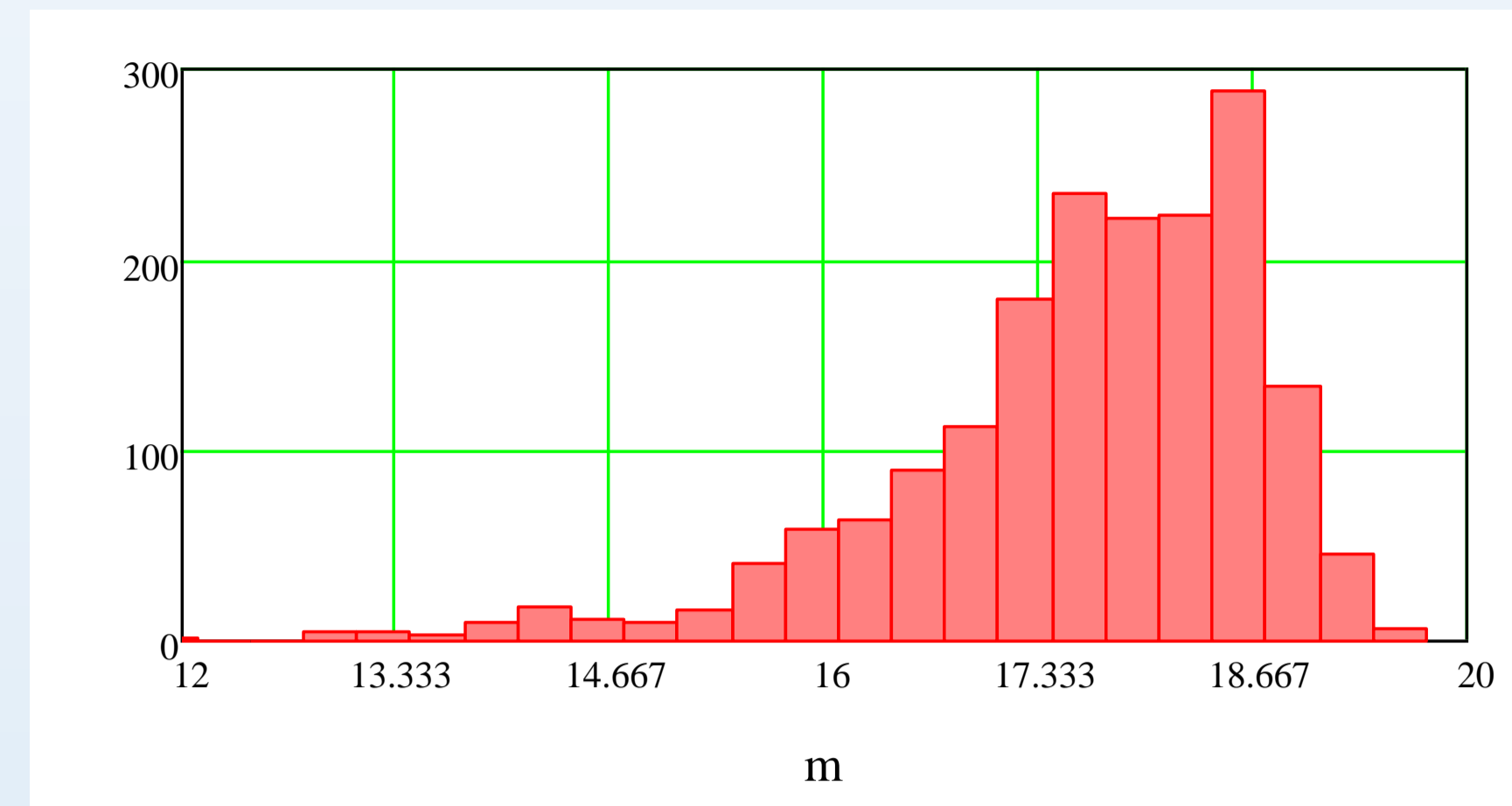
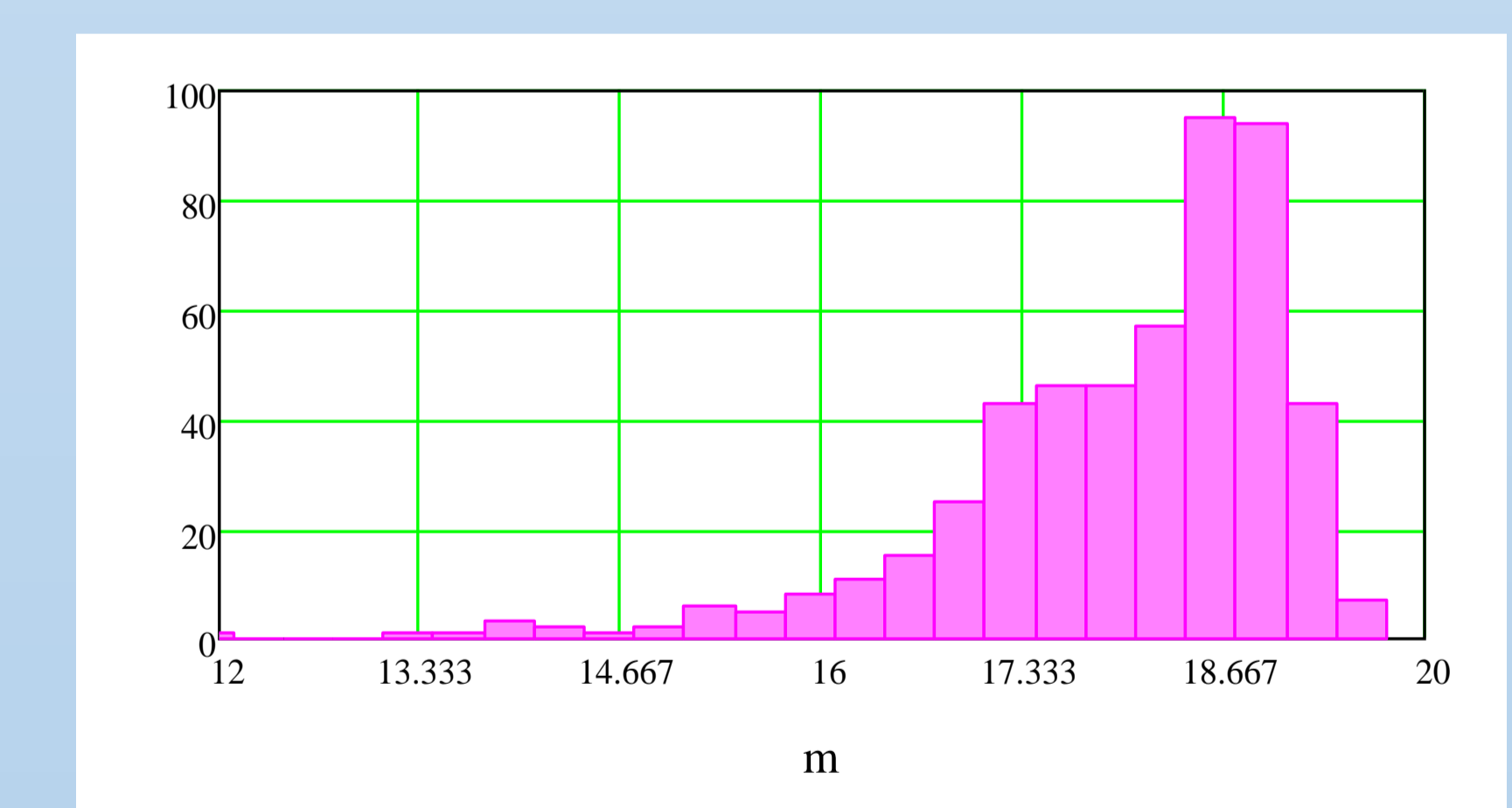
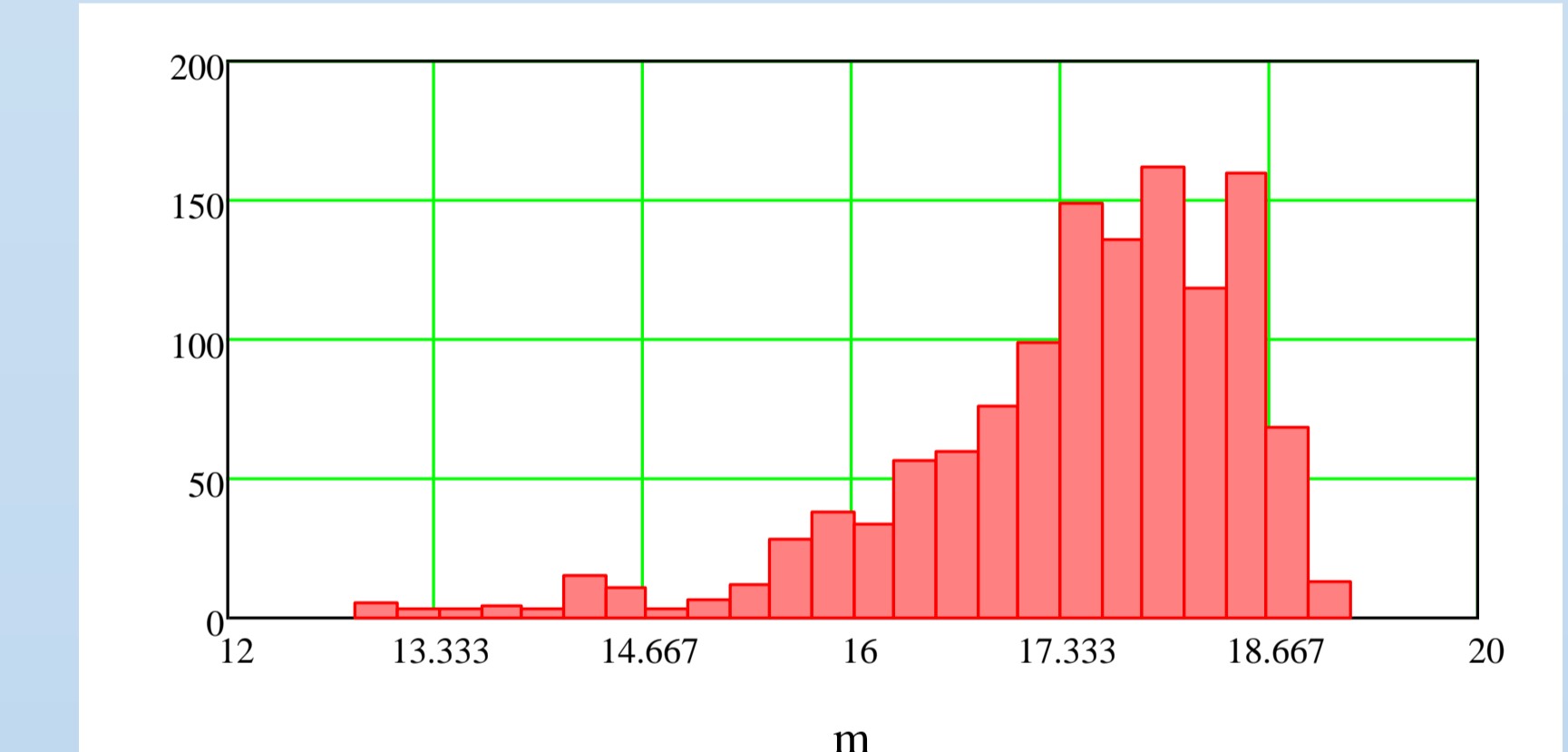
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03871	0	2025-03-31 01:32:00	2025-03-31 02:12:00

**Example of ephemeris for NEO in MPC format with a defined priority and observation mode (exposure and number of frames)**

NAME	PR	START	END
SCT3921	101	2025-03-30 18:20:00	2025-03-31 00:10:00
A111ovi	105	2025-03-30 19:50:00	2025-03-31 00:00:00
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**4. RESULTS****General statistics**

According to the NEODyS-2 website [10], as of March 17, 2025, for the years 2019–2024 (i.e. since the start of regular observations of NEOs), the L18, L99, and M32 observatories received 15,395 observations of more than 1,200 NEOs. During this time, these observatories participated in the confirmation of the discovery of 266 NEOs (including 11 potentially hazardous asteroids, PHA) and 2 long-period comets. Of these, 246 NEOs (11 PHA) and 2 long-period comets were confirmed by the L18 observatory.

**Distribution of observed NEOs by magnitude (2019 – 2024)****Results of improving the algorithm for selecting NEOs for observation by L18****5. CONCLUSIONS AND PLANS FOR THE FUTURE**

Between 2019 and 2024, the SSAU significantly increased its activity in the field of positional observations of NEOs, primarily through the increase in the number of observing telescopes. It participated in the confirmation of the discovery of more than 250 new NEOs, including 11 PHAs.

The introduction of a software pipeline has significantly simplified the process of planning NEO observations for several observatories due to its full automation.

Looking ahead, further improvements to the observation planning software are anticipated. In addition, the most effective instrument - OEOS-1 is planned to be upgraded by replacing its camera with a CMOS camera with higher quantum efficiency. We hope that this will allow this telescope to observe NEOs with an apparent brightness of up to 20<sup>m</sup>.

[1] A.M. Kozhukhov, Maigurova N.V. Asteroid observations with NCSFCT's AZT-8 telescope, Science and innovations 13(1) (2017) 85–88, <https://doi.org/10.15407/sci13.01.093>.  
[2] W. Thuillot, et al., The astrometric Gaia-FUN-SSO observation campaign of 99 942 Apophis, Astronomy & Astrophysics 583 (2015) id.A59 [Online]. Available, <http://www.aanda.org/articles/aa/pdf/forth/aa26003-14.pdf> (Accessed 17 March 2025).  
[3] A.M. Kozhukhov, N.V. Maigurova, A.V. Pomazan, V.F. Kryuchkovskiy, Observations of Apophis in NSFCTC (Yevpatoria) and RI NAO (Mykolaiv), Odessa Astronomical Publications 26/1 (2013) 70–72, <https://doi.org/10.18524/1810-4215.2013.26.81847>.  
[4] N. Maigurova, A. Pomazan, O. Kozhuhov, Results from optical CCD observations of asteroid 2014 JO25 during its close approach to the Earth on April 19, 2017 (in Ukr), Bulletin of Taras Shevchenko National University of Kyiv. Astronomy 56(2) (2017) 22–25, <https://doi.org/10.17721/bisnuia.2017.56.22-25>.  
[5] L18. [Online]. Available, <https://newton.spacedys.com/index.php?pc=2.1.0&cl=L18> (Accessed 17 March 2025).  
[6] L99. [Online]. Available, <https://newton.spacedys.com/index.php?pc=2.1.0&cl=L99> (Accessed 17 March 2025).  
[7] M32. [Online]. Available, <https://newton.spacedys.com/index.php?pc=2.1.0&cl=M32> (Accessed 17 March 2025).  
[8] O.M. Kozhukhov, M.S. Medina, NOAP — script package for planning and analysis of NEO observations, Space Science and Technology, 29(6)/145 (2023) 80–92, <https://doi.org/10.15407/kni2023.06.080>.  
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[10] Near Earth Objects Dynamic Site. [Online]. Available, <https://newton.spacedys.com/index.php?pc=0> (Accessed 17 March 2025).