

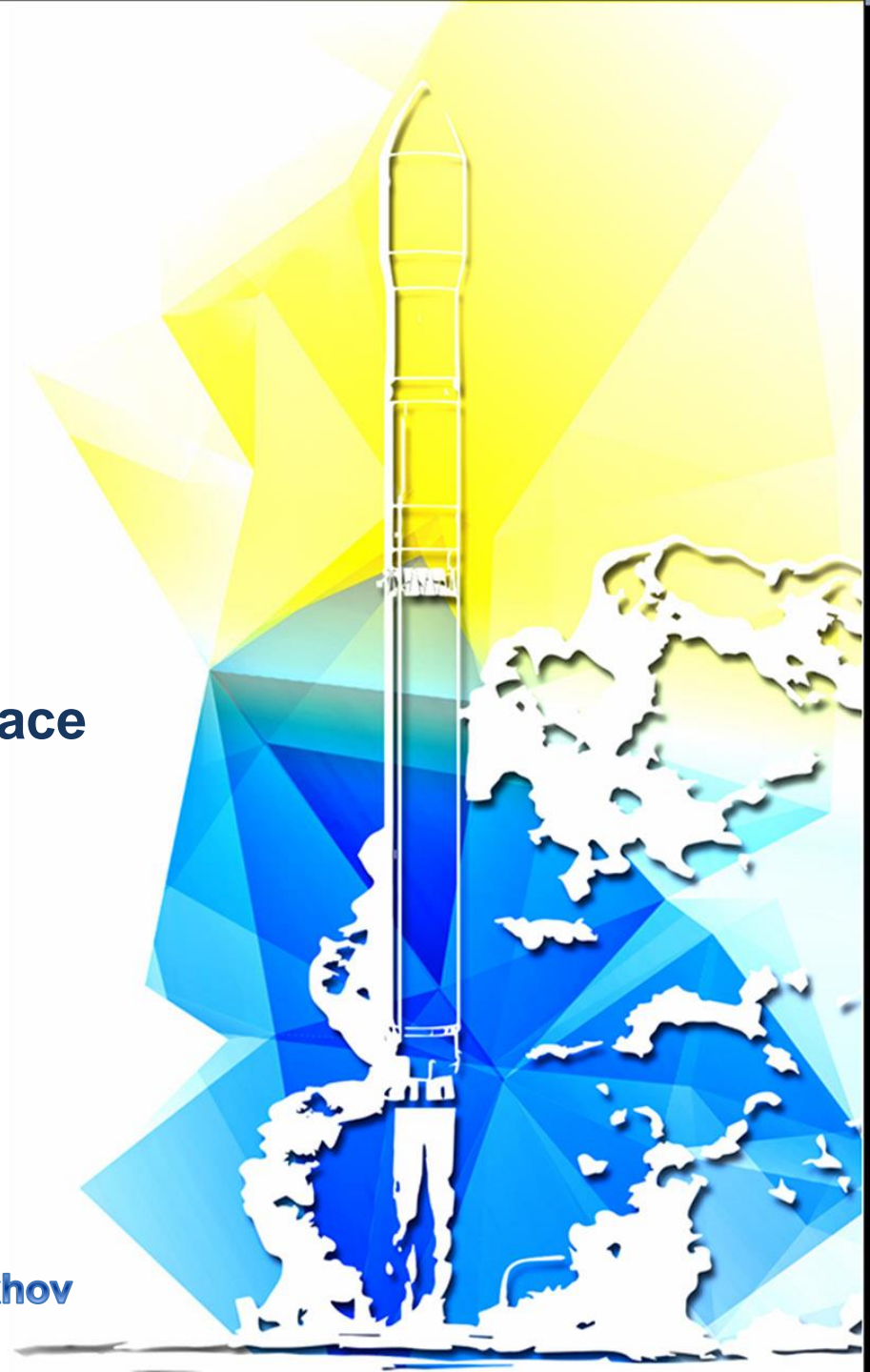


## **National Space Facilities Control and Test Center**

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# **Observation of the near-Earth space in Ukraine**

**Dr. O.Kozhukhov**

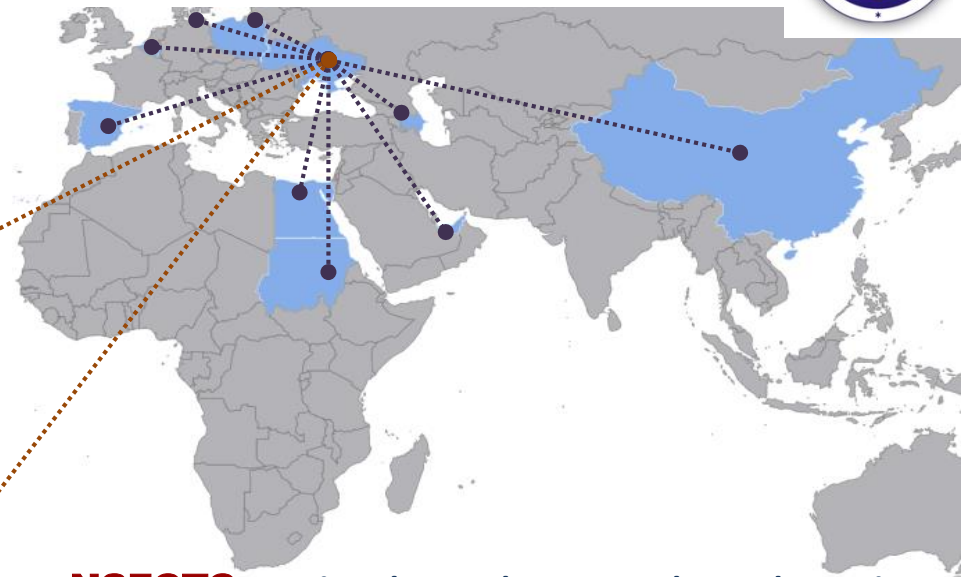
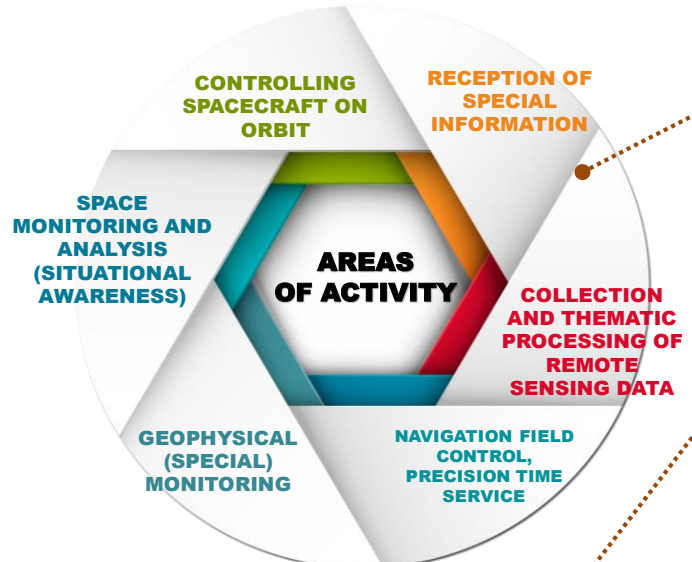




# National Space Facilities Control and Test Center



## Areas of Activity



**NSFCTC** – is the only research and testing organization in Ukraine, which ensures the implementation of the entire complex of operations on the operation of space, navigation and seismic systems, as well as remote sensing data processing.





# Main tasks of Space Monitoring and Analysis System



**Administering the main catalog of space objects (SO) and the catalog of tracked spacecraft.**

**Monitoring of the SO approaches in the outer space, determination of maneuvers of the spacecraft.**

**Predicting impact areas of the reentering space objects.**

**Information support of consumers of different levels (notifications).**

**Identification of space objects and identification of spacecraft designation.**

**Space Weather activities.**

**Observation of objects approaching the Earth.**



# SMAS Facilities



## Radar 5N86 "Dnepr", Mukachevo



## Perspective L-band Radar



## Perspective cm-band radar



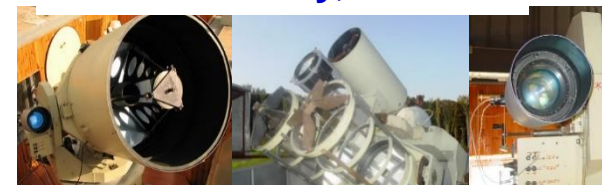
## QOS "Sazhen-S", Dunayivtsi



## Outer Space Monitoring Center



## Optical sensors of Lviv National University, Lviv



## Optical sensors RI"OAO" Odesa



## RD SCP, Novosilky, Kyiv region



## Optical sensors UzhNU, Uzhhorod



## Modernized UHF Radar (5N86)



- Detection of SO in the sector 120 degrees at a distance: from 250 to 5600 km

## Radar of the L-band using the technology of digital antenna arrays



- Detection of SO in all directions (support and rotary device) at a range: up to 3000 km
- Modular principle of the construction of receiving and transmitting equipment

## Perspective radar of centimeter band based on the 25-m Kasegren antenna



- Ultraprecise measurement of orbit parameters of SO
- Identification of the spacecraft designation





# Outer Space Monitoring Center



Main analytical unit of SMAS is the **Outer Space Monitoring Center (OSMC)**, located in the NSFCTC Branch of the Western Center of Radiotechnical Surveillance.

## Main tasks of the OSMC

- Collecting and storing information about the space situation from all possible sources (means of observation, Internet, etc.), data processing.
- Analysis of space situation data.
- Formation of tasks for monitoring facilities.
- Providing information to SMAS users.

Обработано наборов TLE: 999 по 204 КО. Обез...

Интервал обновления: 6 часов (мин)

Высота перепада ниже 500 км: 1 000

Высота перепада 500 - 5000 км: 3 000

Высота перепада выше 5000 км: 5 000

Опция: дата [UTC] 01.11.2015 11:13:30

Ближе TLE в серии, не ниже: 3

Масштаб файла с TLE: Добавить файл с TLE

Проверить интервалы обновления

Имя	№ [KO]	NORAD	TLE	Норма	Пар	Данность
DIRIDIUM 1	610 5	23657	5	4	3	967.9
DIRIDIUM 7	783 3	24783	5	4	3	967.9
DIRIDIUM 8	783 3	24783	5	4	3	967.9
DIRIDIUM 5	783 1	24794	5	4	3	967.9
DIRIDIUM 6	783 6	24795	5	4	3	968.0
DIRIDIUM 4	782 8	24796	5	4	3	967.9

Перезаписать анализ в таблицу в XLS Сохранить выборку TLE в файл

Программа формирования ТУ в формате "для данных ЦКДКО"

Выбор КО: Все сопроводительные | Выбрать на ПКДКО

Имя	№ [KO]	NORAD	TLE	Норма	Пар	Данность
19874	0795	2014 086A	Lobo			
1248	3046	2009 081A	КОСМОС 2405			
15880	3032	2008 045A	РАЙКОЕ 2			
18963	3032	2008 045B	РАЙКОЕ 3			
13869	3034	2008 046C	РАЙКОЕ 1			
18970	3035	2008 046D	РАЙКОЕ 3			
18971	3036	2008 046E	РАЙКОЕ 4			

Выбор КО: 48

Формирование

Имя: 1989-077A

№ КО: 489

№ неждународный: 1989-077A

№ ЦКДКО: 0

№ ЦКДКО РФ: 0

Наименование ЦКДКО: FleetSatCom 8

Наименование NORAD: FleetSatCom 8

Имя: 1989-077A

№ КО: 489

№ неждународный: 1989-077A

№ ЦКДКО: 0

№ ЦКДКО РФ: 0

Наименование ЦКДКО: FleetSatCom 8

Наименование NORAD: FleetSatCom 8

Ведение каталога сопровождаемых КО

№ ЦКДКО	№ неждународный	№ ЦКДКО РФ	№ NORAD	Наименование КО в каталоге ЦКДКО	Наименование КО в каталоге NORAD	Газета	Признак сопровождения
489	1989-077A	0	20253	FleetSatCom 8	FleetSatCom 8	24.12.2014	Снят с сопровождения
4894	1990-002B	0	20410	LEASAT 5	LEASAT 5	24.12.2014	Находится на сопровождении
5015	1990-079A	0	20776	SKYNET 4C	SKYNET 4C	24.12.2014	Находится на сопровождении
5323	1993-056A	0	22787	LIFO F2	LIFO F2	24.12.2014	Находится на сопровождении
5973	1993-076A	0	22921	NATO 4B	NATO 4B	24.12.2014	Находится на сопровождении
6025	1994-034A	0	23124	INTELSAT 702	INTELSAT 702	24.12.2014	Находится на сопровождении
6052	1994-054A	0	23223	Mercury 1	Mercury 1	24.12.2014	Находится на сопровождении
6094	1994-065A	0	23313	SOLRADRAD 2	SOLRADRAD 2	24.12.2014	Находится на сопровождении
6185	1995-016A	0	23533	DMPSP BRD2-8	DMPSP BRD2-8	24.12.2014	Находится на сопровождении
6211	1995-033A	0	23665	Helios 1A	Helios 1A	24.12.2014	Находится на сопровождении
6216	1995-035B	0	23613	TDRS 7	TDRS 7	24.12.2014	Находится на сопровождении
6237	1995-046A	0	23657	SICH 1	SICH 1	13.02.2015	Находится на сопровождении
6242	1995-055A	0	23686	ASTRA 1E	ASTRA 1E	24.12.2014	Находится на сопровождении
6280	1996-003A	0	23768	ABS 1A (KOREASAT 2)	ABS 1A (KOREASAT 2)	24.12.2014	Находится на сопровождении
6304	1996-020A	0	23839	INMARSAT 3F1	INMARSAT 3F1	24.12.2014	Находится на сопровождении
6387	1996-021A	0	23842	ASTRA 1F	ASTRA 1F	24.12.2014	Находится на сопровождении

Имя: 1989-077A

№ КО: 489

№ неждународный: 1989-077A

№ ЦКДКО: 0

№ ЦКДКО РФ: 0

Наименование ЦКДКО: FleetSatCom 8

Наименование NORAD: FleetSatCom 8

Расчет невязок измерений КОС

Формат файла: Азимутальная (0 -> Север) | Создать файл для \*.xls

Азимутальная (0 -> Юг) | Эклиптическая

Файл \*.m?? 10

НИП № 84

Номер КА: 25030

НИП: Евпаторийский GPS

Данные по КА: Имя файла списка: URL: URL

Номер КА: 25030

Данные не введены!

Расчитать | Выход

Карты

Имя: 1989-077A

№ КО: 489

№ неждународный: 1989-077A

№ ЦКДКО: 0

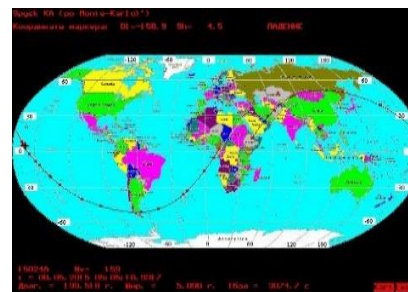
№ ЦКДКО РФ: 0

Наименование ЦКДКО: FleetSatCom 8

Наименование NORAD: FleetSatCom 8

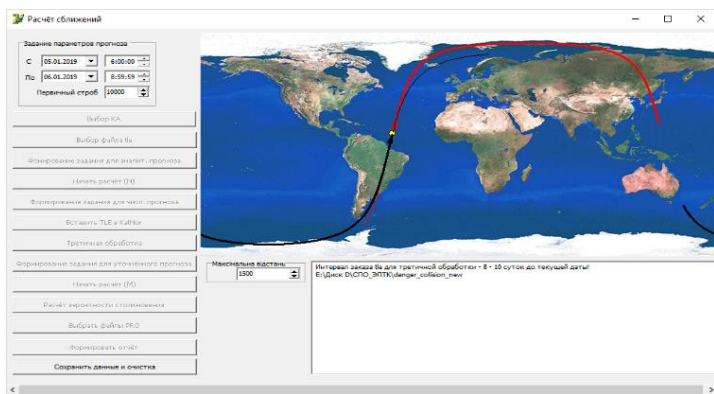
## Prediction of the existence time of SO and their possible impact areas

№ по кат. ЦККП	Международ. №	Наименние по кат. ЦККП	Тип	Страна/Владелец	Дата запуска	Дата НУ	Дата прекр. сущ.	Прогноз. инт-л прекр. сущ.	Комментарий
15432	2015-024A	Прогресс М-27М	Не определен	Россия	28.04.2015	06.05.2015	08.05.2015	07.05.2015 - 09.05.2015	



## Prediction of possible approaches of selected spacecraft with other SO available in the catalog

### Forecast of dangerous approaches of Space objects for the period 04.01.2019 - 05.01.2019

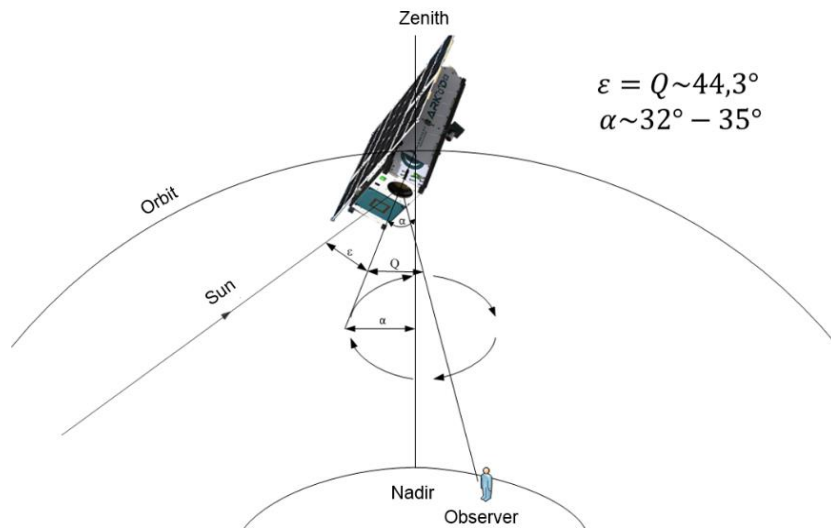
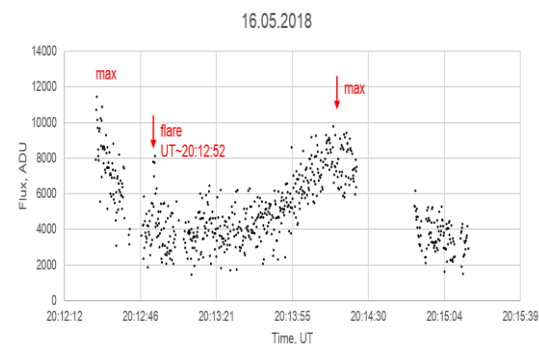
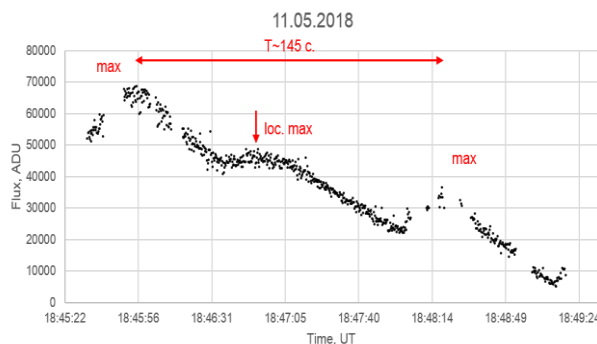
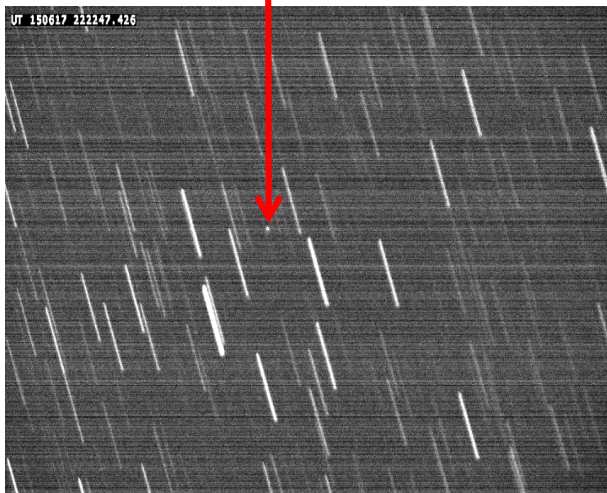
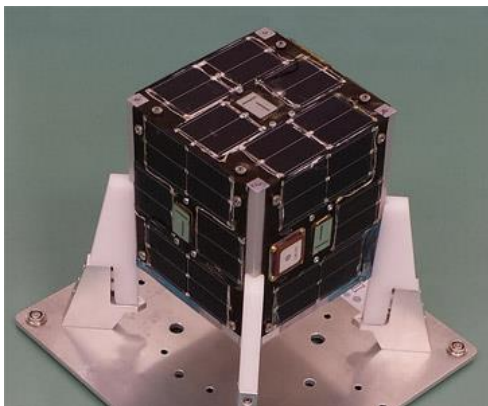


№	Name of base object	International number of base object	Name of approaching object	International number of approaching object	Date of approach	Time of approach (UTC)	Approach distance, (m)
1	COSMOS 367	1970-079A	SL-16 DEB	1992-093DX	04.01.2019	11:08:49.4695	1396.25
2	TRIAD 1	1972-069A	METEOR 2-5 DEB	1979-095AX	04.01.2019	19:09:16.2664	716.28



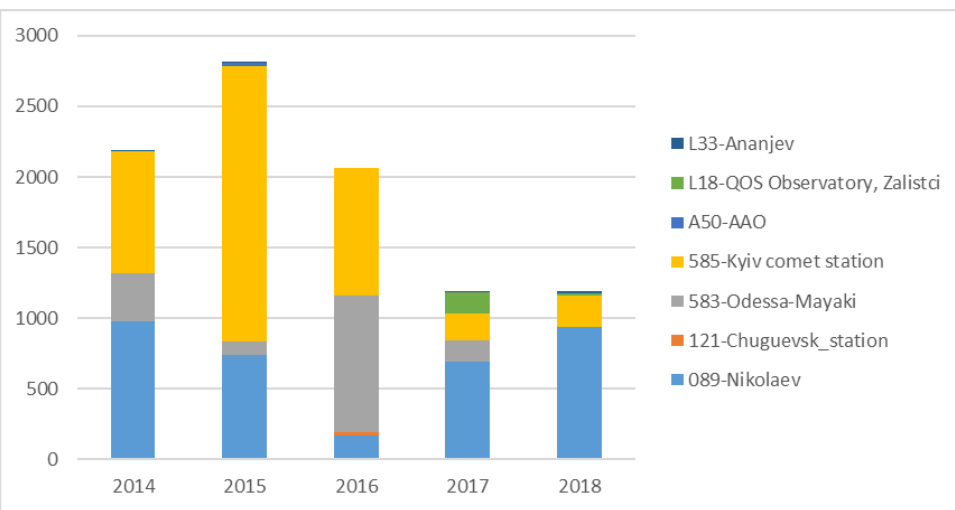
Determination of angular coordinates of SO with sizes from 10 cm at all altitudes (from 400 km to 40000-50000 km) with accuracy up to angular seconds.

Obtaining non-coordinate information for assessing the state of the SO and determining its designation.



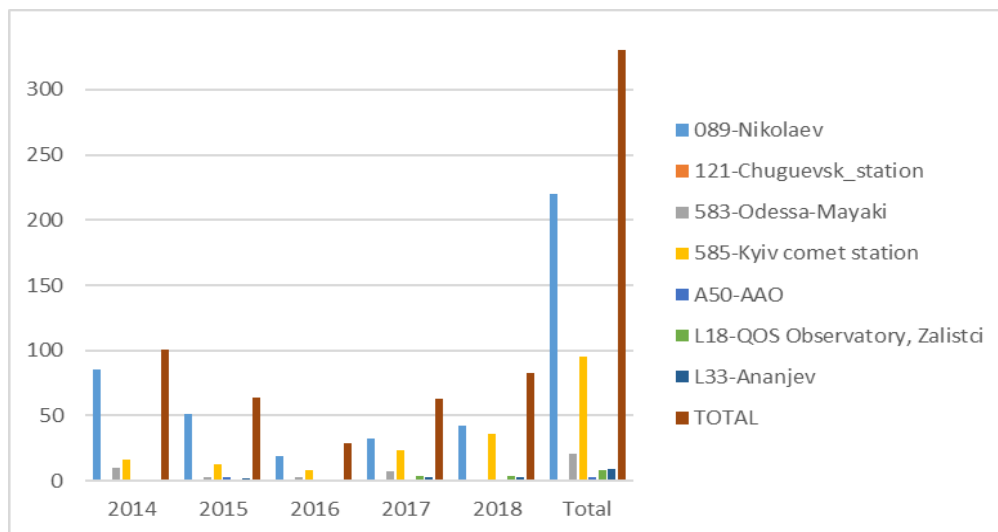
## Observation of NEOs by Ukrainian observatories in 2014-2018

Observations



Total: 9450 observations,  
330 NEOs  
(<https://newton.spacedys.com/neodys/>)

Objects



## Ukrainian Software for Surveillance of NEOs - CoLiTec

### Main features of CoLiTec

1. Automatic detection of weakly moving objects (WMO>2.5)
2. Work with super-large fields of view (more than 10 sq. degrees)
3. Automatic calibration and image correction
4. Automatic robust algorithm for astrodetection
5. Automatic filtering of poor measurements.
6. Viewer of results (LookSky) with GUI NEOs
7. Multithreading support in multi-core systems and in a local network
8. Processing in a time scale close to real time managed by OLDAS (OnLine Data Analysis System)

### Results (2010 – 2018)

**Observations: 600 000+.**

**Discovered: 1566** asteroids and 4 comets.

#### Comets

C/2011 X1 (Elenin) – December 10, 2010 (ISON-NM).

The first comet discovered by the Russian astronomer for the last 20 years.

P/2011 NO1 – July 7, 2011 (ISON-NM)

C/2012 S1 – September 21, 2012 (ISON-Kislovodsk)

P/2013 V3 (Nevski) – November 6, 2013 (ISON)

#### Tropical of Jupiter

2010 XR32, 2010 XG21, 2010 VO138, 2010 VT36, 2011 QJ9, 2011 QQ47, 2011 QZ75, 2011 YD47, 2011 YA3, 2011 QB76, 2012 SC50, 2012 AF1, 2012 CF52, 2012 BB27, 2012 RZ4, 2012 RM6, 2012 SD3, 2012 SN9, 2013 BP2, 2013 UF9, 2013 VD

#### NEOs

**2011 QY37**

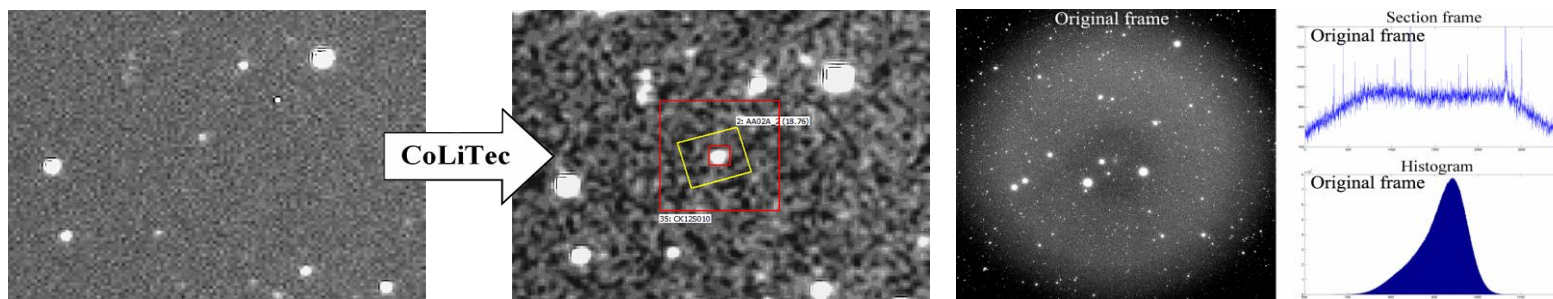
**2012 RQ16**

**2013 TB80**

**2014 KH2**

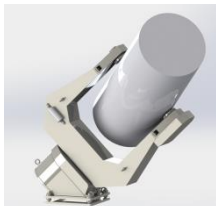
#### Unusual

2013 UL10, 2018 SQ13 (confirmation only)



## Optical facilities

### Development of optical observation facilities of NSFCTC in 2019



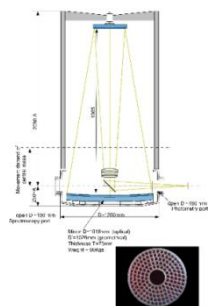
**0.5 m f/3.8 telescope** with CCD and CMS cameras (CSIRP and NFC)



**0.3 m f/1 telescope** with CCD or CMS cameras (NSFCTC)

### Capabilities of Ukrainian organizations to create new telescopes

#### Optical systems



Name	D/F	Optical scheme	Focal ratio
WSZ	300/300	Zonnefeld	f/1
WSH	350/700	Gamilton	f/2
WSNP	500/2000	Parabolic Newton with field correction	f/4
WSNH	500/1500	Hyperbolic Newton with field correction	f/3
WSMDC	500/3400	Modified Dall-Kirkham	f/6.8
WSNP	800/3200	Parabolic Newton with field correction	f/4
WSNH	800/2400	Hyperbolic Newton with field correction	f/3
WSNH	1000/3000	Hyperbolic Newton with field correction	f/3
WSMDC	1000/6800	Modified Dall-Kirkham	f/6.8

#### Mounting



<b>WS- 300 DD</b>	German, with a direct drive. For 0.4 m telescopes
<b>WS-240 WD</b>	German, with a worm drive. For 0.4 m telescopes
<b>WSF-500 WD</b>	Forklift, with a worm drive. For 0.5 - 0.8 m telescopes
<b>WSF-500 DD</b>	Forklift, with a direct drive. For 0.5 - 0.8 m telescopes
<b>WSF-1000 WD</b>	Forklift, with a worm drive. For 0.8 - 1.2 m telescopes
<b>WSF-1000 DD</b>	Forklift, with a direct drive. For 0.8 - 1.2 m telescopes



# Conclusions



- 1. Ukraine's software and hardware facilities allow us to carry out a full range of tasks for monitoring near-Earth space throughout the whole range of altitudes, including space debris and NEO.**
  
- 2. The National Space Facilities Control and Test Center is ready for mutually beneficial cooperation on issues related to the monitoring of near-Earth space.**



**THANK YOU  
FOR YOUR  
ATTENTION!**

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