

# Inter-Agency Space Debris Coordination Committee



**State Space Agency of Ukraine**

---



## **PRELIMINARY RESULTS OF THE ANALYSIS OF PHOTOMETRIC OBSERVATIONS FOR TWO FAST ROTATING LEO OBJECTS: 18340 AND 13552**

IADC42

16-19/04/2024

**Dr. O. Kozhukhov, Dr. N. Koshkin**



## BACKGROUND

1. 18340 - IT 41.2 “Exploitation of data acquired in AI38.2”.
2. 13552 - proactive (started as part of IT 39.2 “Permanent IT on fragmentations” ).

**Inter–Agency Space Debris Coordination Committee**



IADC42

16-19/04/2024



18340

## Statistics and distribution



Observation interval: Aug-2020 – Apr-2024

JAXA: 8 LCs;

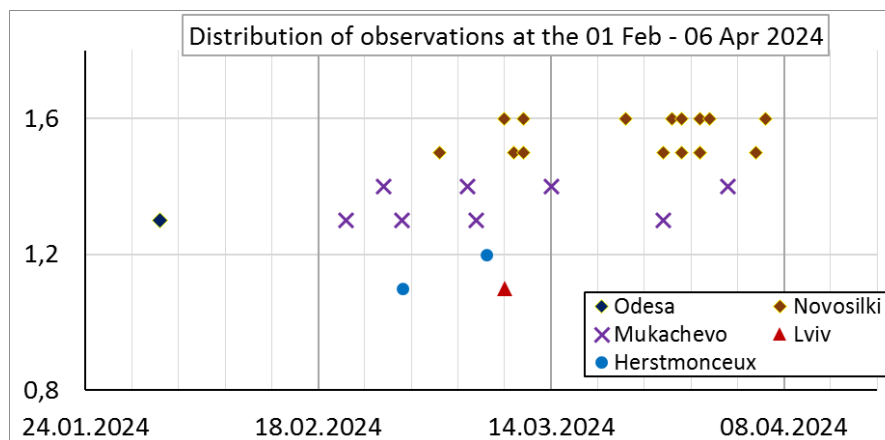
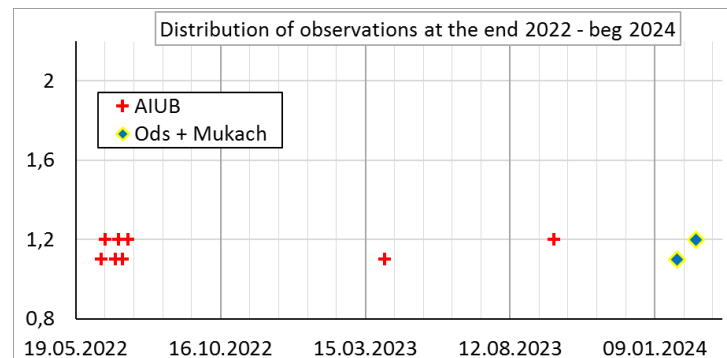
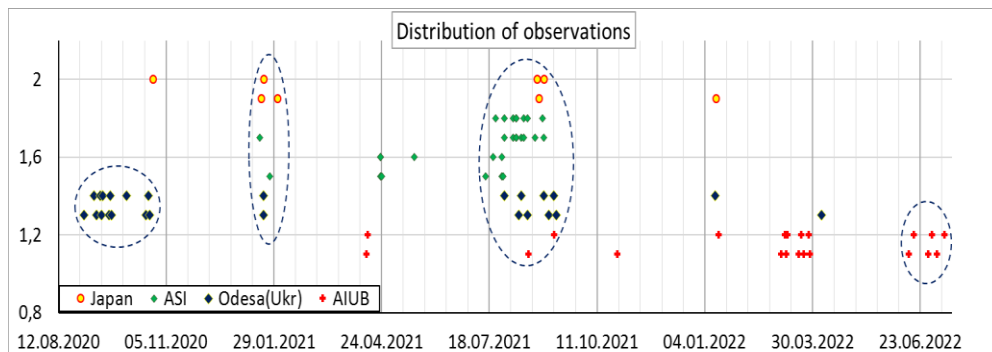
ESA (AIUB): 23 LCs;

SSAU (4 sites): 61 LCs;

UKSA (Herstmonceux): 2 LCs;

ASI (2 sites): 24 LCs;

Riga SLR Station: 2 LCs (not obtained).



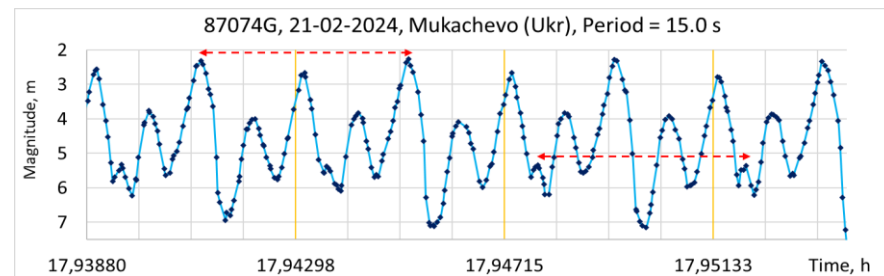
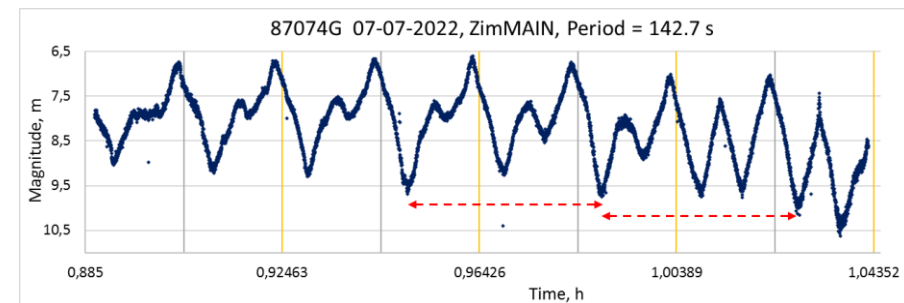
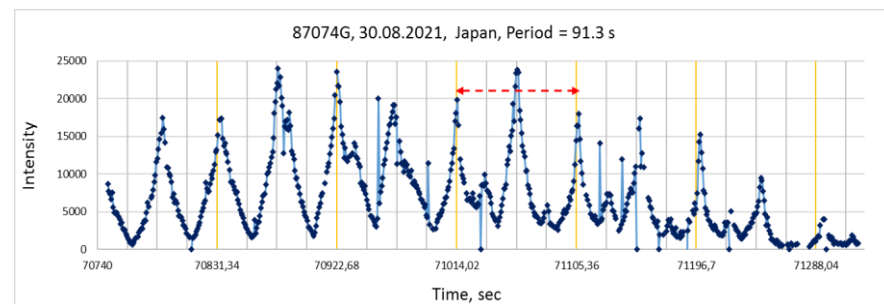
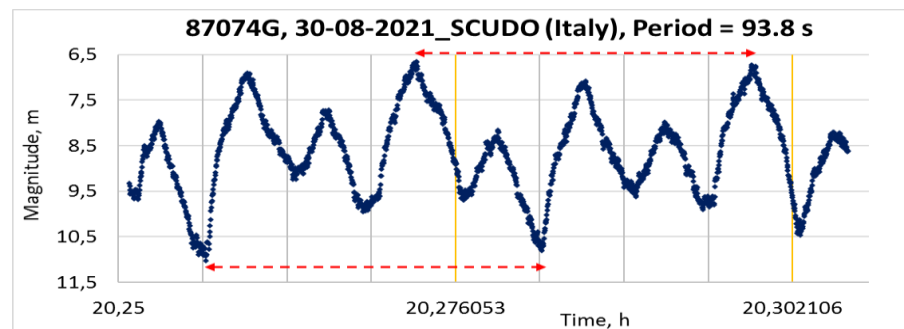
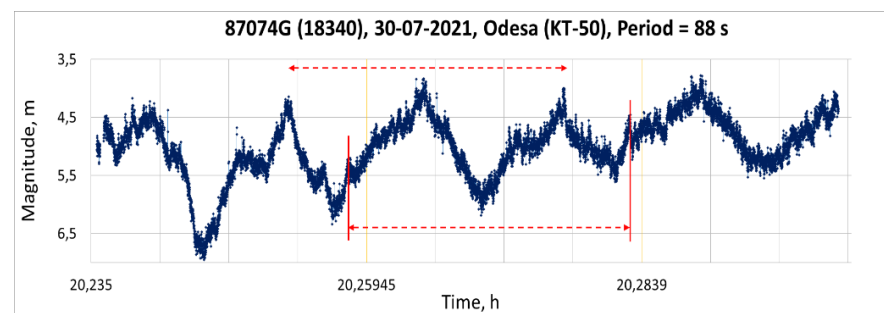
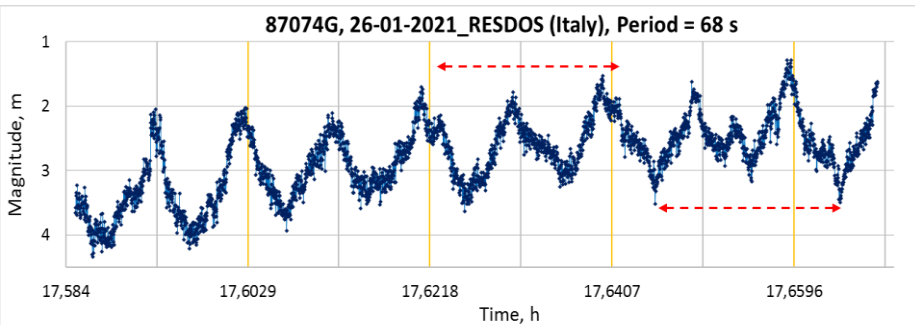
Inter-Agency Space Debris Coordination Committee

IADC42



16-19/04/2024

# 18340 LC examples



**Inter-Agency Space Debris Coordination Committee**

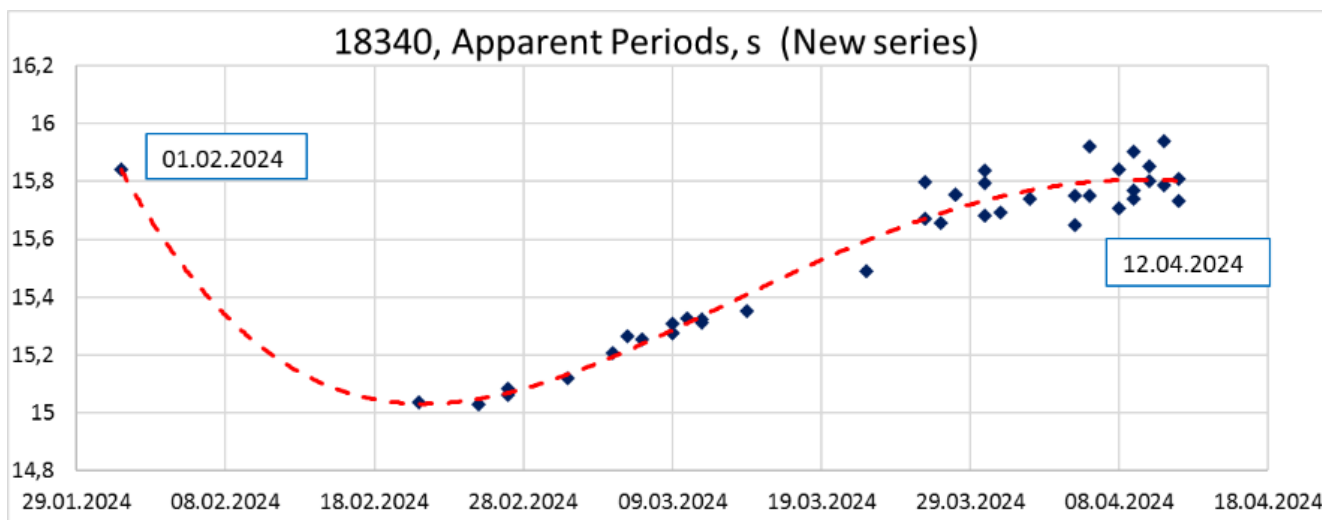
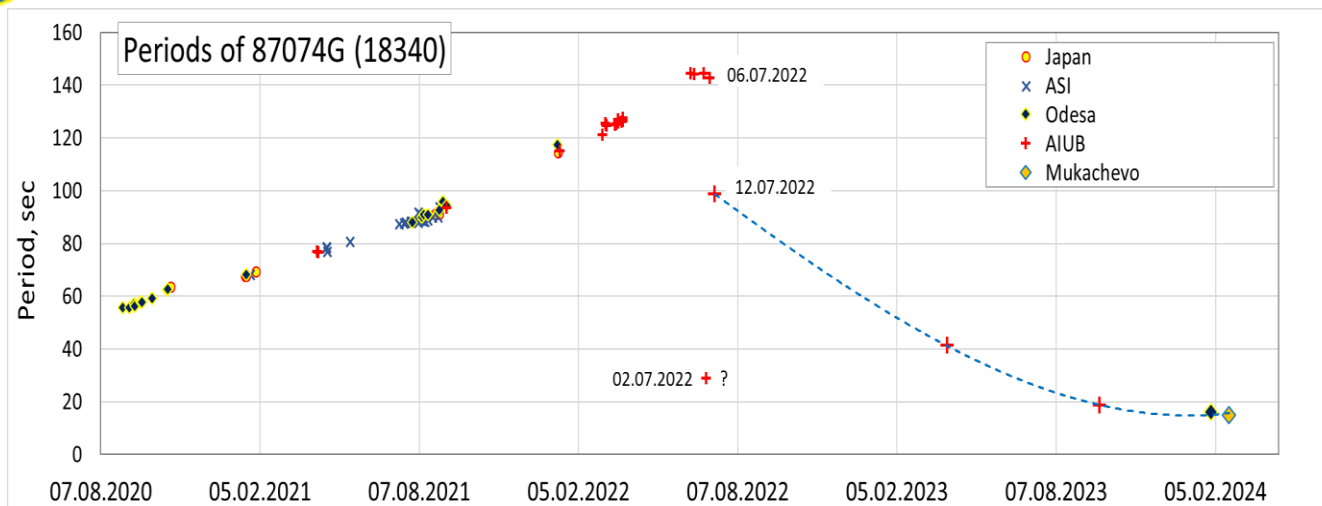
IADC42



16-19/04/2024



# 18340 APPARENT ROTATION PERIOD



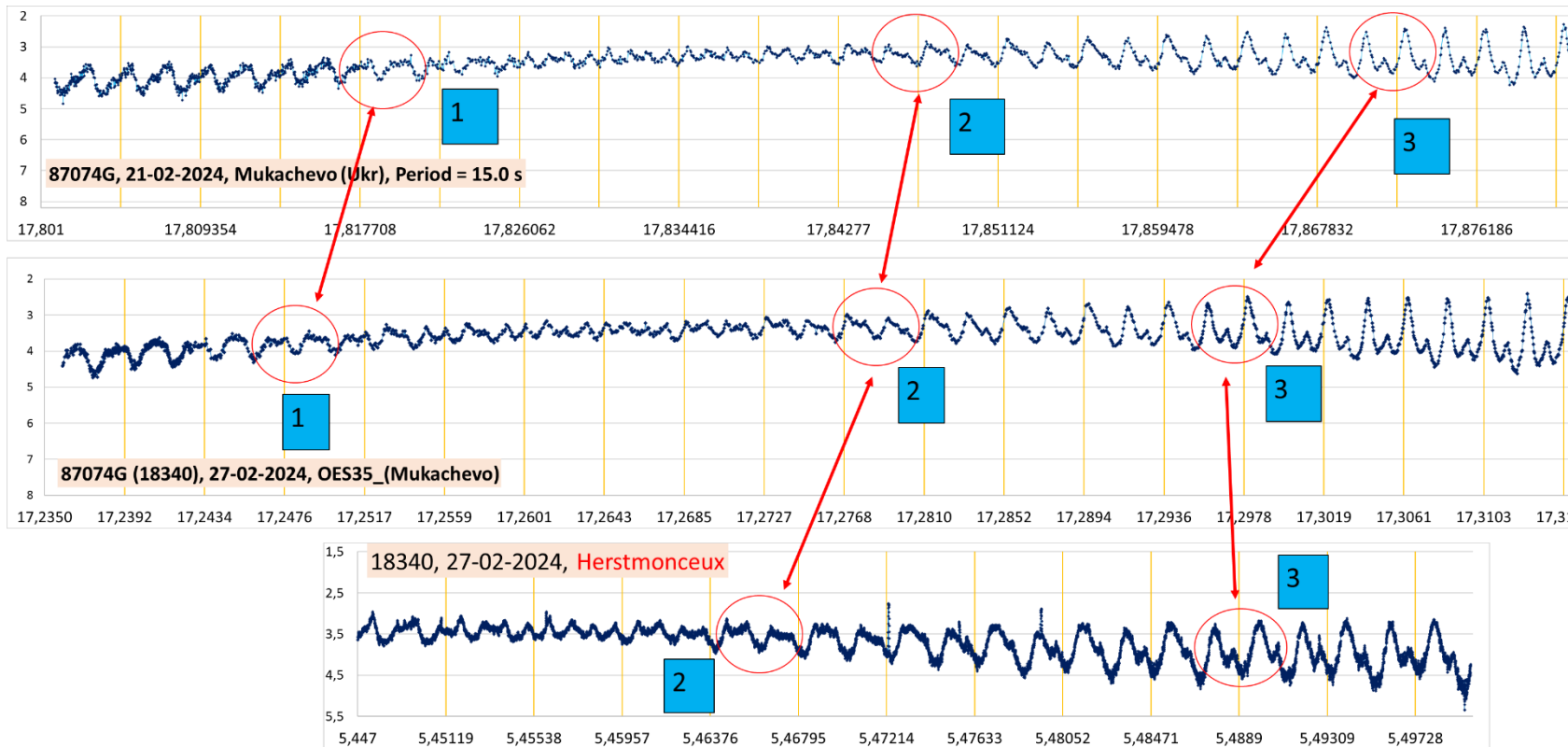
Inter-Agency Space Debris Coordination Committee

IADC42



16-19/04/2024

# 18340 Orientation



New method for determining  
the orientation of the rotation  
axis - “method of  
photometric patterns”

Inter–Agency Space Debris Coordination Committee

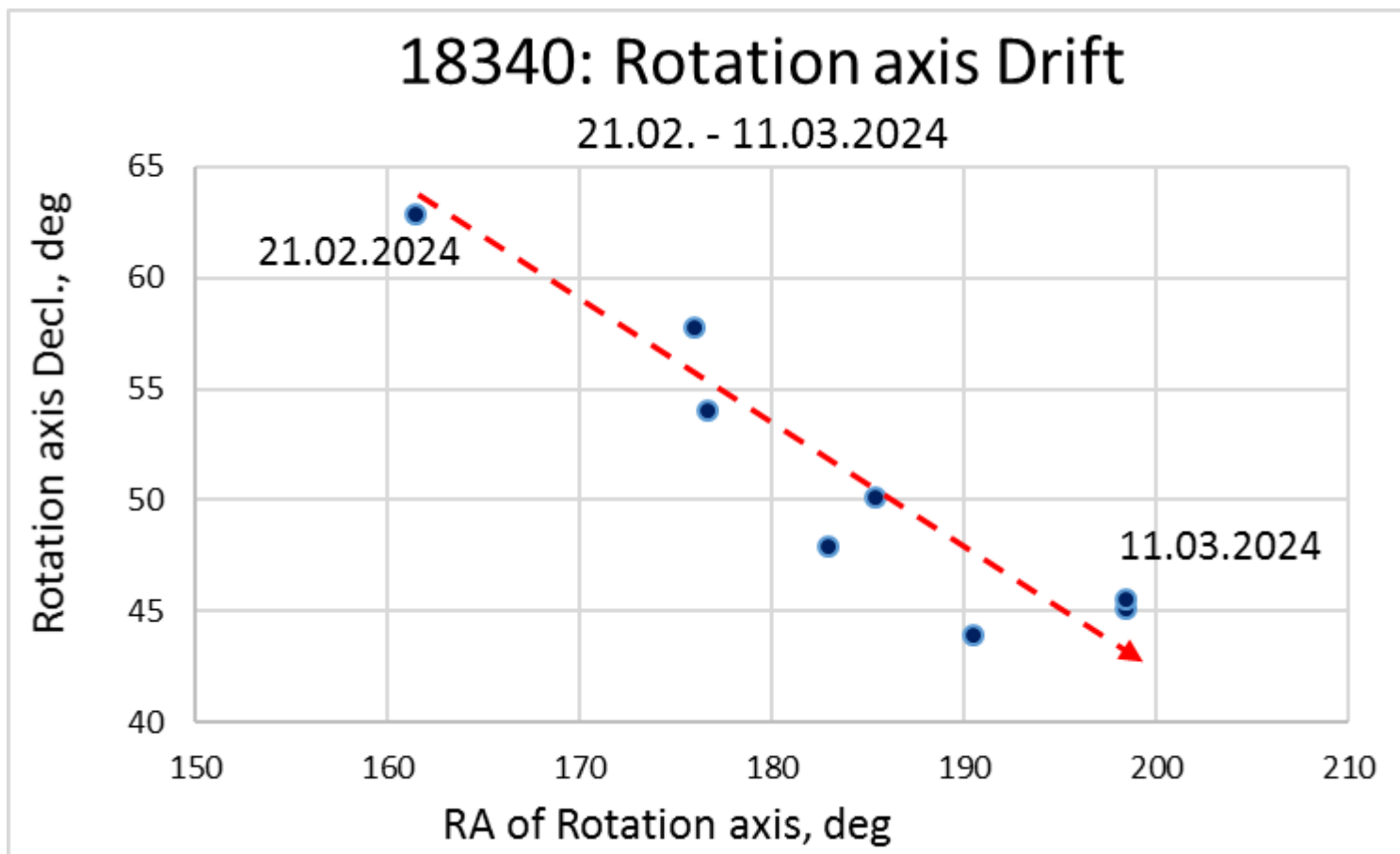
IADC42



16-19/04/2024



## 18340 Orientation



**Inter-Agency Space Debris Coordination Committee**



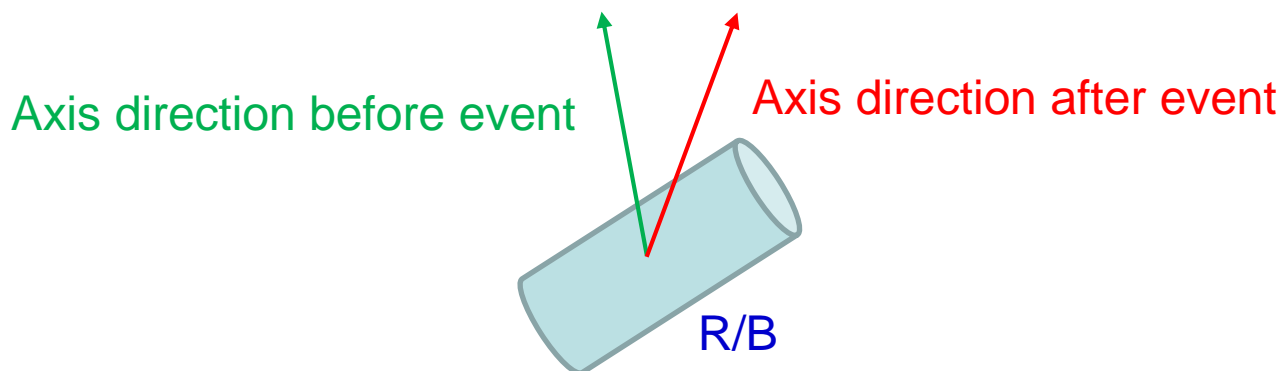
IADC42

16-19/04/2024

18340

## Possible reason for acceleration of rotation

Depressurization of a container with gas. Possible sign: change in the direction of the rotation axis relative to the body (The picture below is just an illustration - the actual difference between the axes will most likely be much smaller).







# 13552



The only fragment of COSMOS 1408 with a “LARGE” RCS in the Space-Track catalogue as of mid-June 2023. Perhaps this is the same object with the maximum RCS from TIRA observations in November 2021.

## Observations

1<sup>st</sup> Campaign: June – July 2023, 21 LCs from 3 Ukrainian sites, preliminary analysis was done.

2<sup>nd</sup> Campaign: October – November 2023 : 9 LCs from 3 Ukrainian sites, 1 LC (obt. by SLR photon counter) from UKSA, BIRALES data (5 passes for Sept-Nov).

3<sup>rd</sup> Campaign: January – February 2024: 3 LCs from UKSA, 4 LCs from 2 Ukr. sites, 2 LCs from Riga SLR station.

4<sup>th</sup> Campaign: March – April 2024: 8 LCs from 2 Ukr. sites, observations continue.

**Inter-Agency Space Debris Coordination Committee**



IADC42

16-19/04/2024

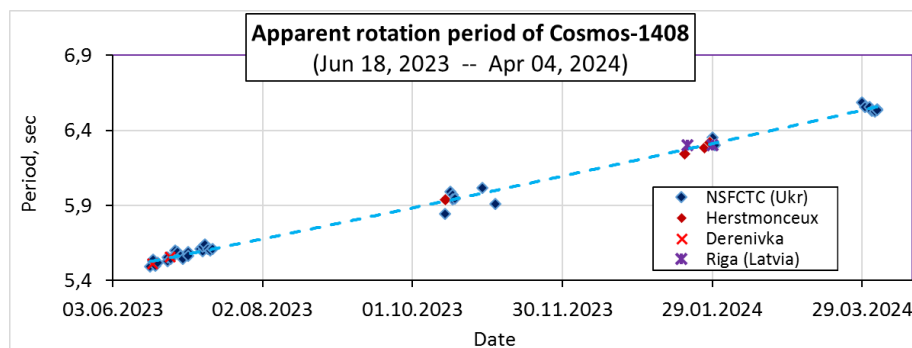
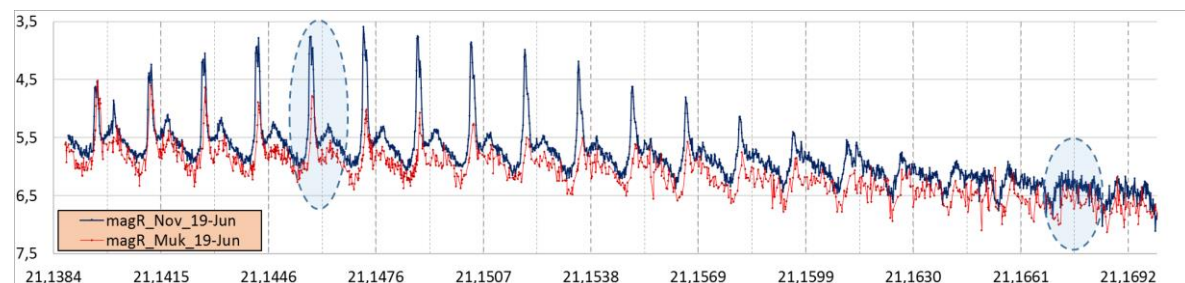
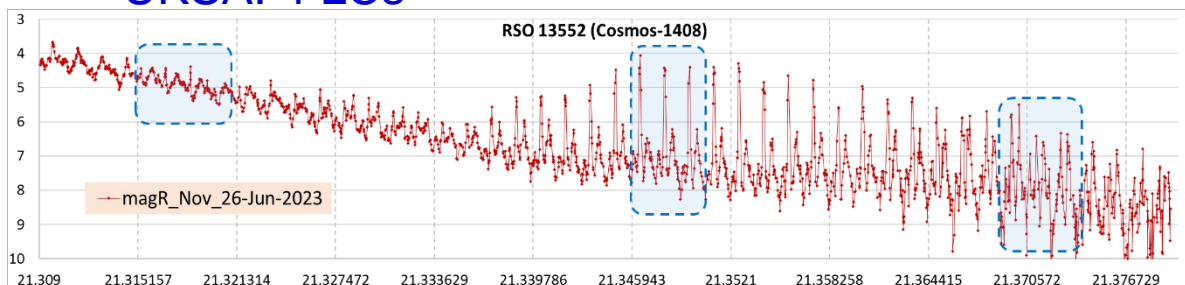


# 13552 Statistics

Observation interval: Jul-2023 – Apr-2024

SSAU: 42 LCs (4 sites); Riga SLR Station: 2 LCs;

UKSA: 4 LCs



Inter-Agency Space Debris Coordination Committee

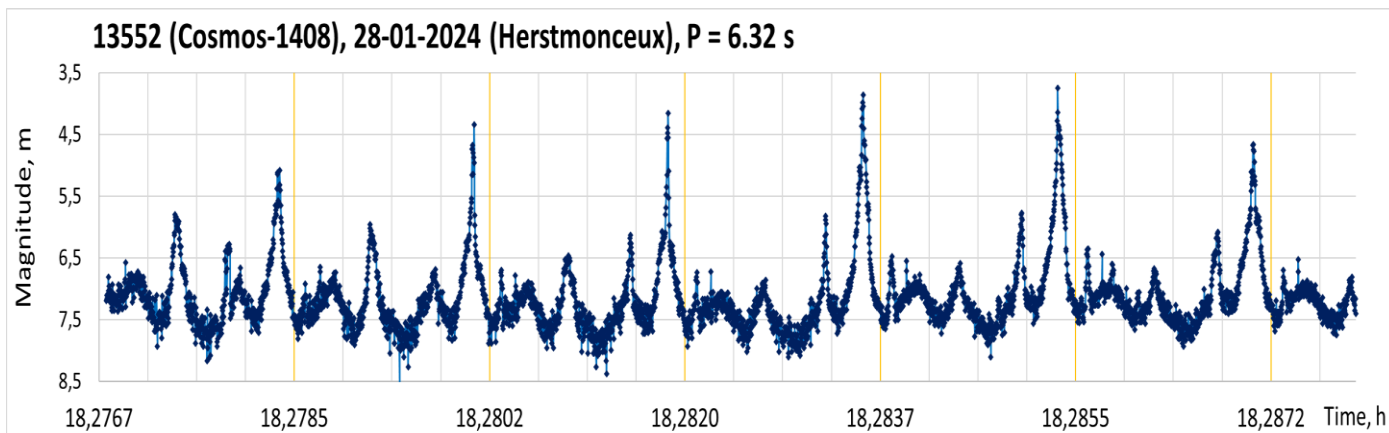
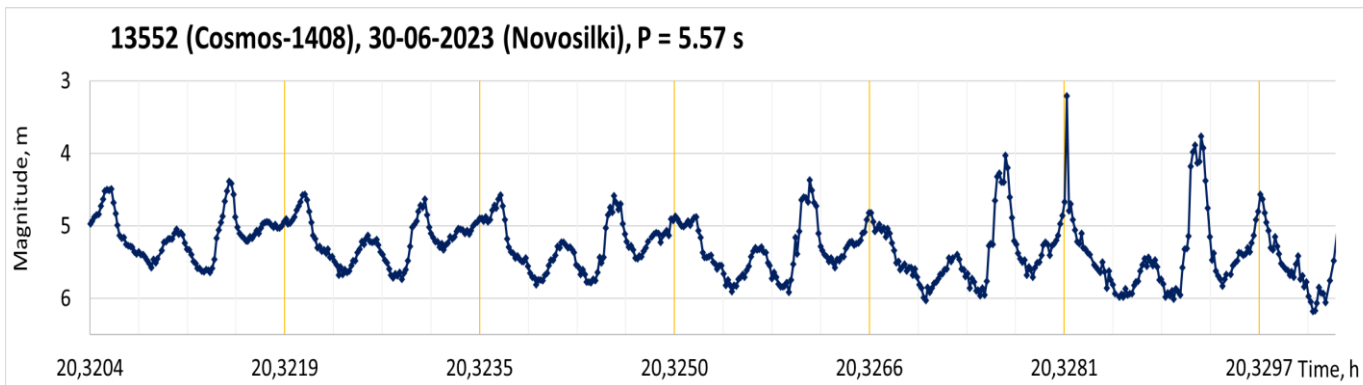
IADC42



16-19/04/2024



# 13552 LC examples



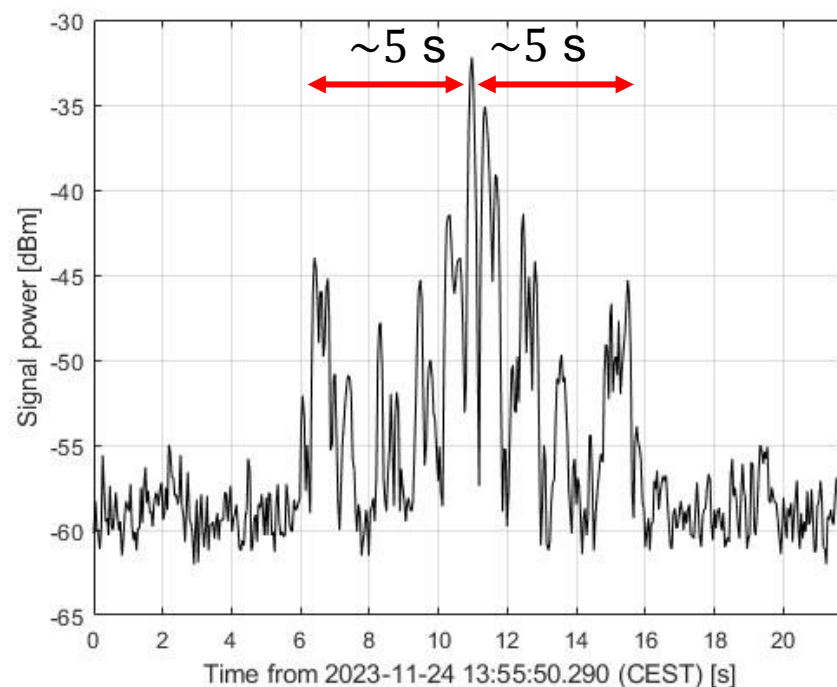
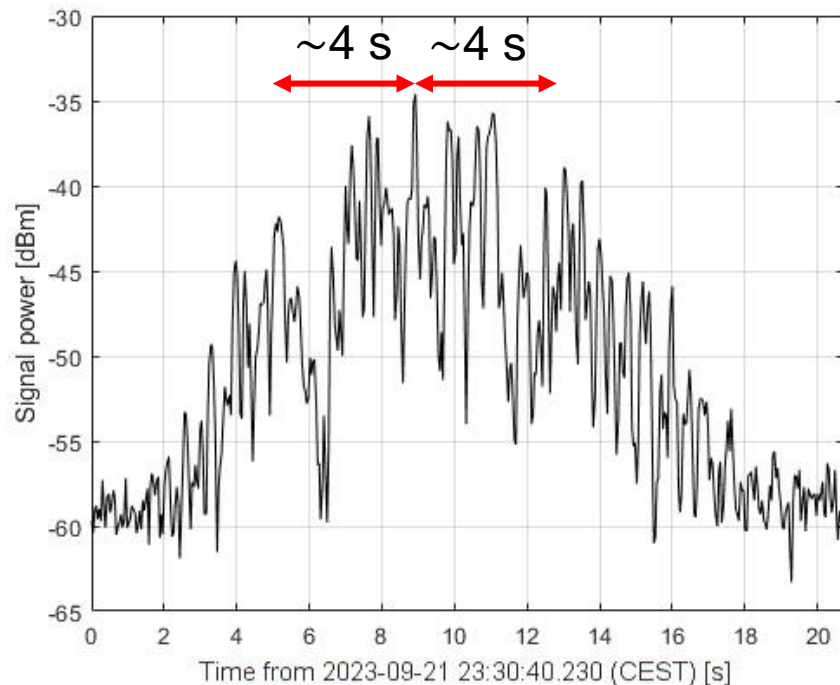
Inter-Agency Space Debris Coordination Committee



IADC42

16-19/04/2024

# 13552 BIRALES data



Does not match optical data. Maybe you need to try a different metric?  
What about data from other radars?

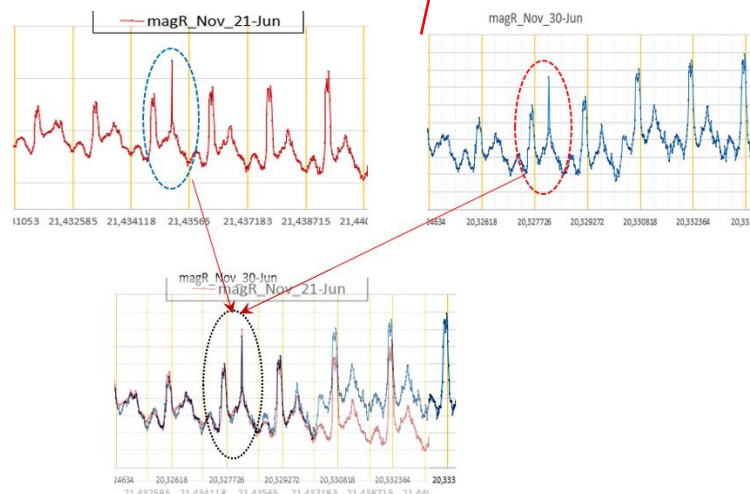
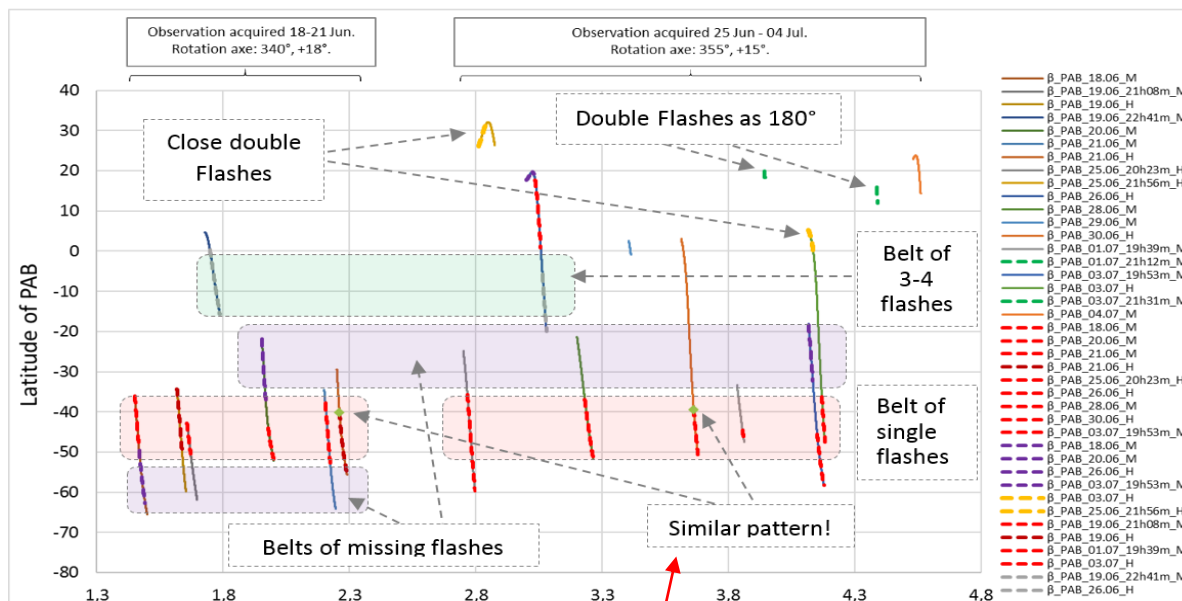
**Inter-Agency Space Debris Coordination Committee**



IADC42

16-19/04/2024

13552



“method of photometric patterns”

Inter-Agency Space Debris Coordination Committee

IADC42



16-19/04/2024

13



# CONCLUSIONS

## PRELIMINARY RESULTS

Almost all optical data sets showed good compatibility with each other in terms of timing of the obtained data

Data were obtained on the evolution of the rotation period of 18340 over almost 4 years.

It was discovered that after a long period of slowing rotation, in July 2022 RSO began to accelerate and has continued to do so ever since (the period has decreased by almost 10 times!). Since February 18, 2024, a new cycle of rotation slowdown has begun.

Four phases of observations showed a steady slowdown in rotation for 13552.

For both objects, it was possible to establish the orientation of the rotation axis using the “photometric pattern” method.

**Inter-Agency Space Debris Coordination Committee**



IADC42

16-19/04/2024





## CONCLUSIONS PROBLEMS

The “photometric pattern” method requires series of observations obtained in different conditions to be used successfully.

The wide variety of possible patterns (both in form and duration) seriously complicates the automation of their search. It, in turn, leads to a low speed of analysis of the obtained large volumes of observations.

It is advisable to try to understand the reasons for the differences in the data on the rotation period 13552 obtained by optical sensors and the BIRALES radar.

## LESSONS LEARNED

To obtain an adequate assessment of the orientation of the object selected for the ADR mission, it is necessary to organize an observation campaign not long before the planned time of the mission. In this case, it is necessary to use the maximum possible number of sensors.

**Inter-Agency Space Debris Coordination Committee**



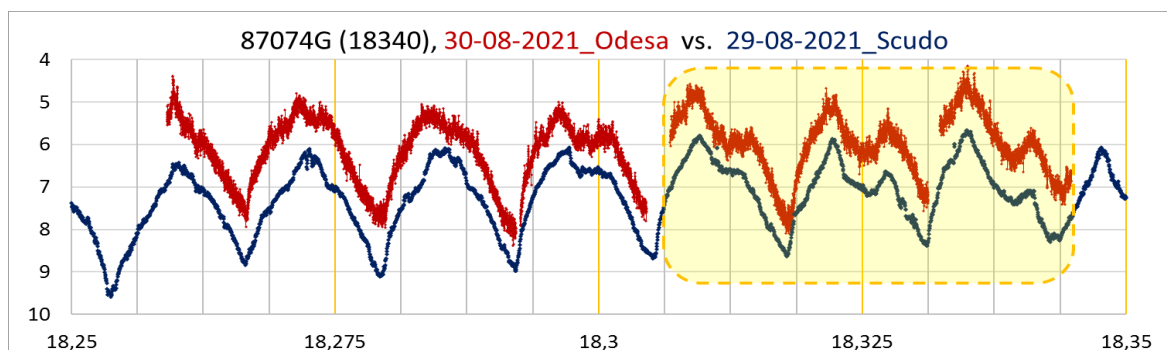
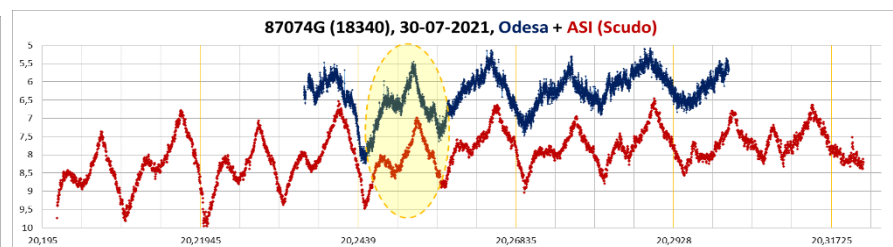
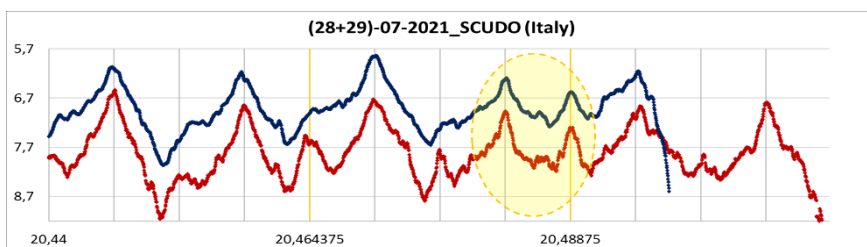
IADC42

16-19/04/2024

# CONCLUSIONS

## FUTURE WORK

Evaluation of the orientation of the axis of rotation 18340 for the «old» observations at least for intervals with a high density of them



Analysis of the entire data set for each object.

**Inter-Agency Space Debris Coordination Committee**

IADC42



16-19/04/2024



# THANK YOU FOR YOUR ATTENTION!

**Inter-Agency Space Debris Coordination Committee**



IADC42

16-19/04/2024