

Action Item 38.2
Attitude motion characterization of LEO upper
stages using different observation techniques
ESA Contributions

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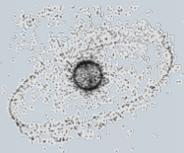
*41th IADC Annual Meeting,
June 12th - 15th 2023, Darmstadt,
Germany*

IADC AI 38.2 – ESA Report

● Observations

- ESA observations between April 2021 and March 2023
- Archive observations available

No.	Cospar ID	NORAD	Target name	Good LC obtained #	
2	87074G	18340	SL-14 R/B	29 12 Apr 2021 - 16 Mar 2023	<i>periodic</i> <i>period = 36 to 95 sec</i>
3	94023B	23088	SL-16 R/B	28 14 Dec 2014 – 15 Feb 2023	<i>periodic in 2014 and 2015!</i> <i>slow-tumbler or stable else</i>
4	94077B	23405	SL-16 R/B	10 06 Apr 2021 – 11 Jul 2022	<i>slow-tumbler or stable</i>
5	99008D	25637	DELTA 2 R/B	3 06 Apr 2021 – 11 Jul 2021	<i>slow-tumbler</i>
6	13033B	39198	Pegasus R/B	17 9 Jan 2021 – 20 Mar 2023	<i>slow-tumbler or stable</i>
7	15040B	40879	CZ-4C R/B	6 13 Apr 2021 – 6 Jul 2022	<i>slow-tumbler or stable</i>
8	16066G	41847	CZ-11 R/B	19 14 Apr 2021 – 19 Jul 2022	<i>slow-tumbler or stable</i>
9	16068B	41858	CZ-2D R/B	12 14 Apr 2021 – 5 Mar 2022	<i>slow-tumbler</i>
Total				124	



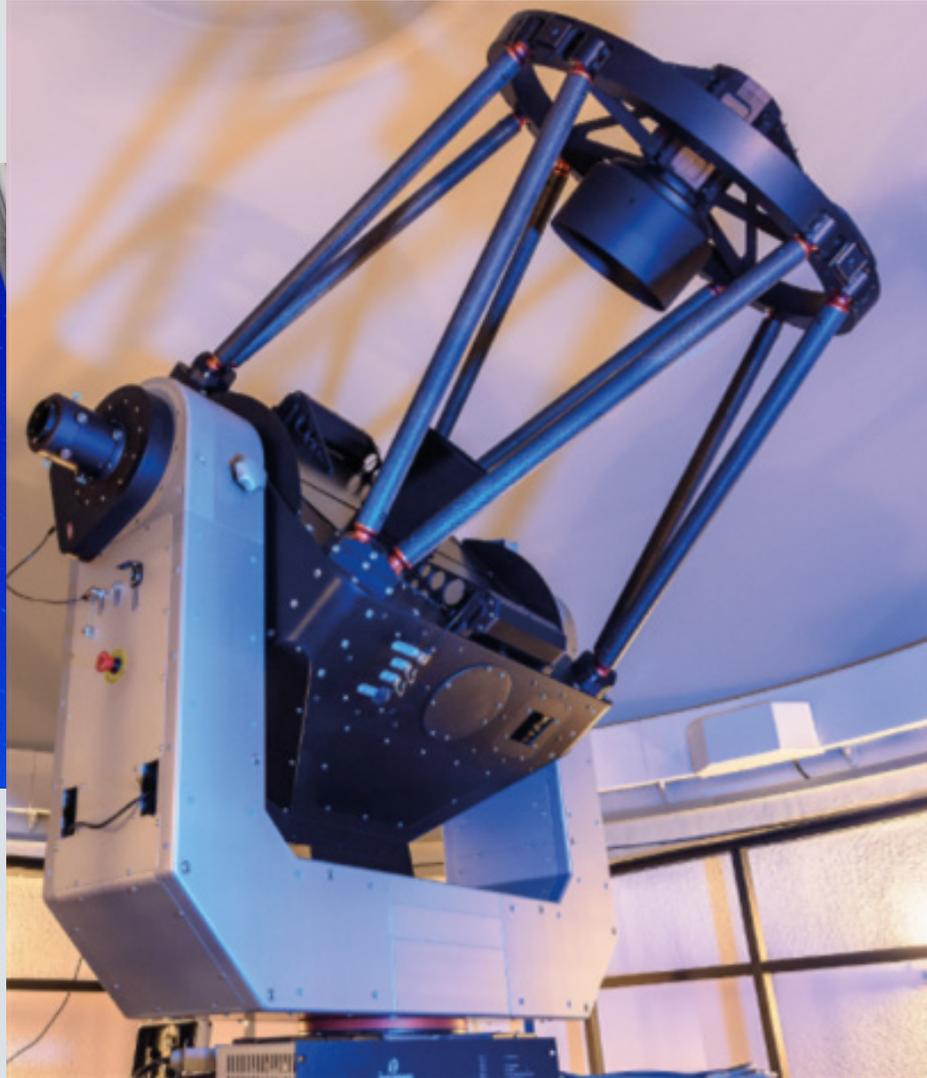
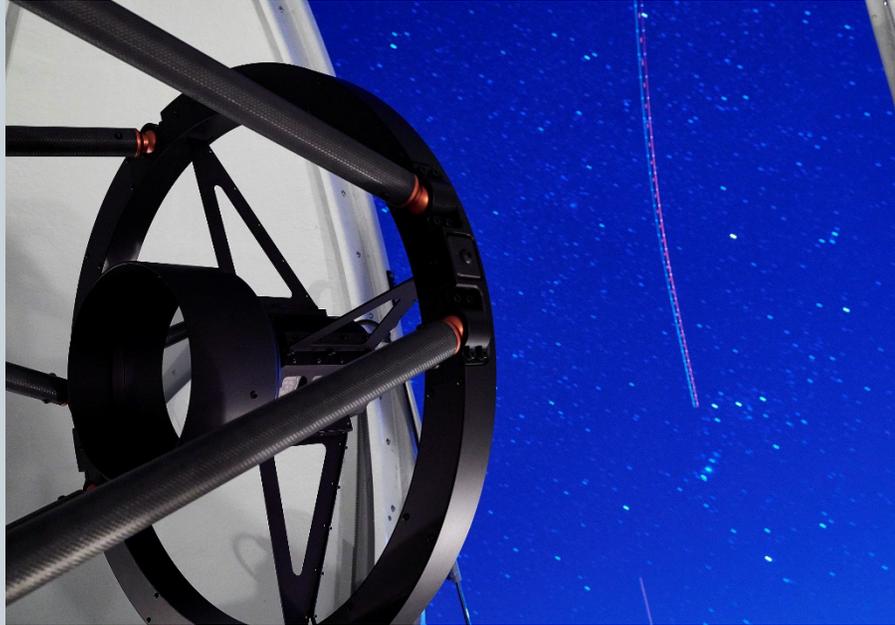
1-m ZIMLAT at SwissOGS



**1-m Zimmerwald
Laser and
Astrometry
Telescope ZIMLAT**

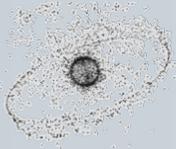
- **CCD light curves**
- **CMOS light curves**

0.8-m ZimMAIN at SwissOGS



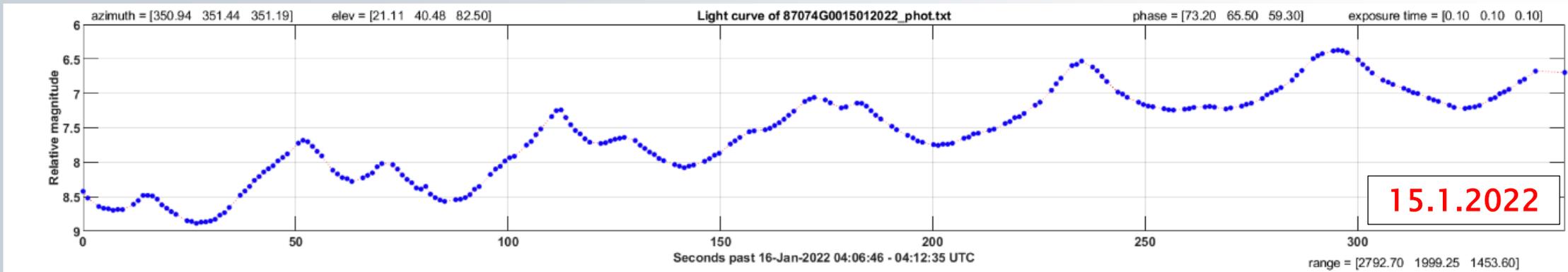
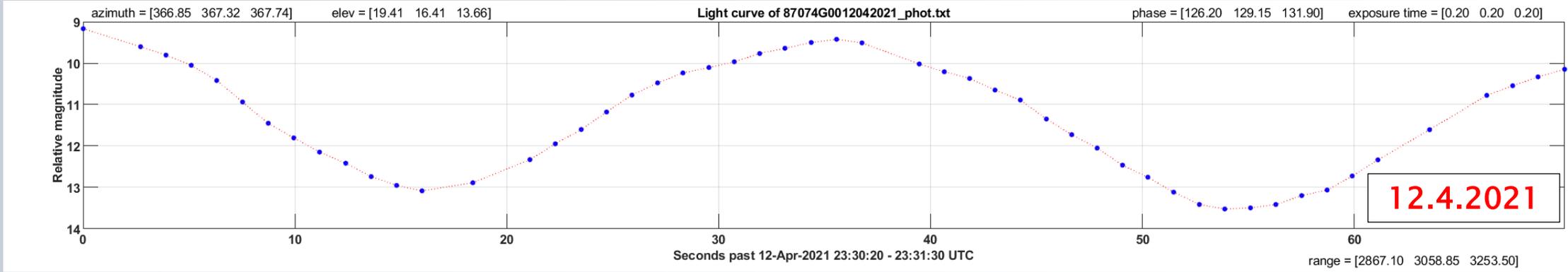
**0.8-m Zimmerwald
Multiple Application
Instrument ZimMAIN**

- **CMOS light curves**



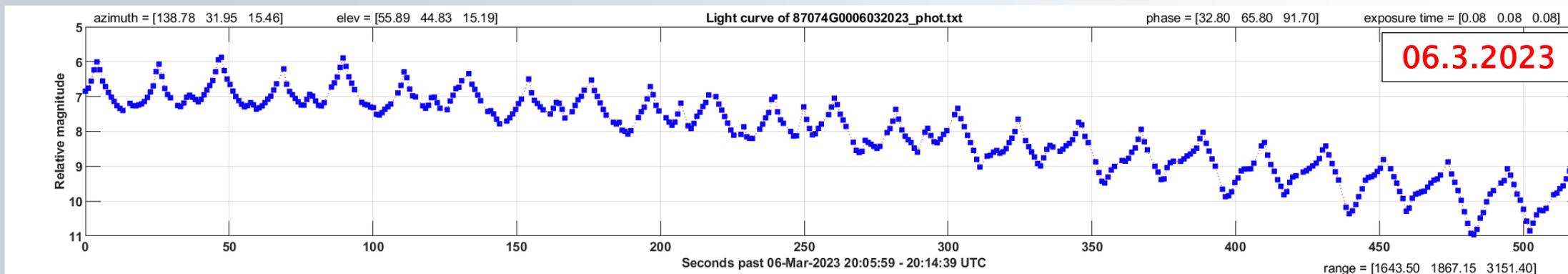
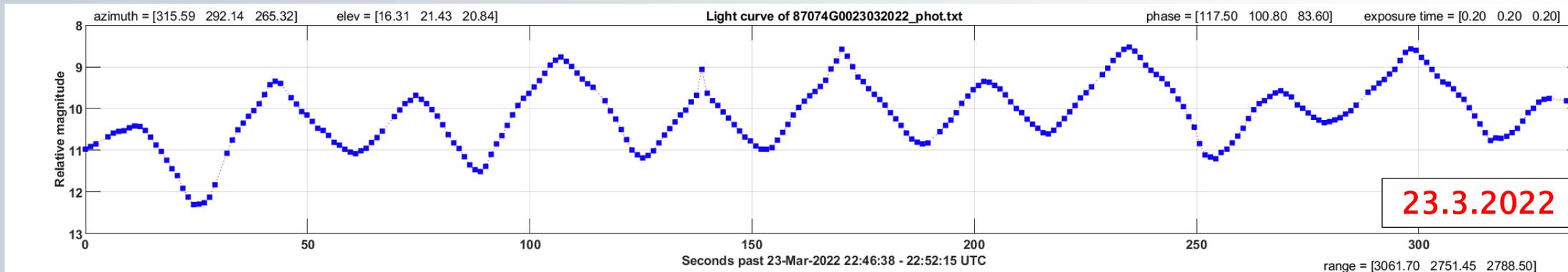
NORAD 18340 (87074G); SL-14

T. Schildknecht: IADC AI 38.2 LEO Light Curves – ESA Report
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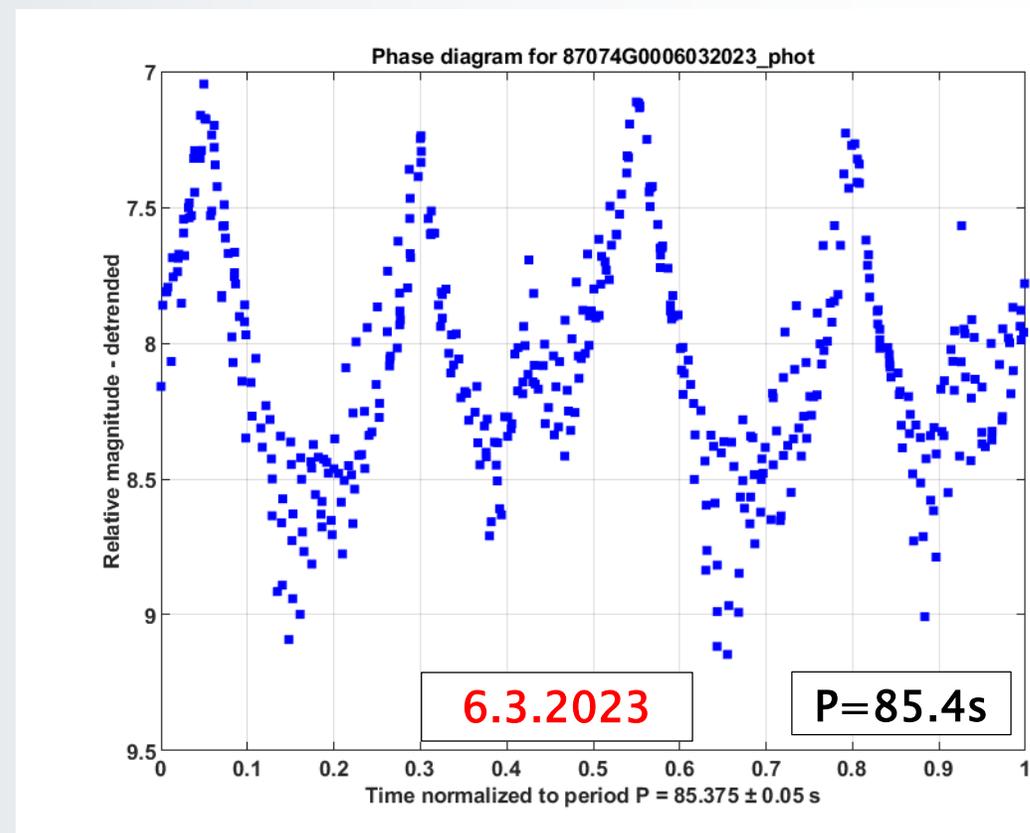
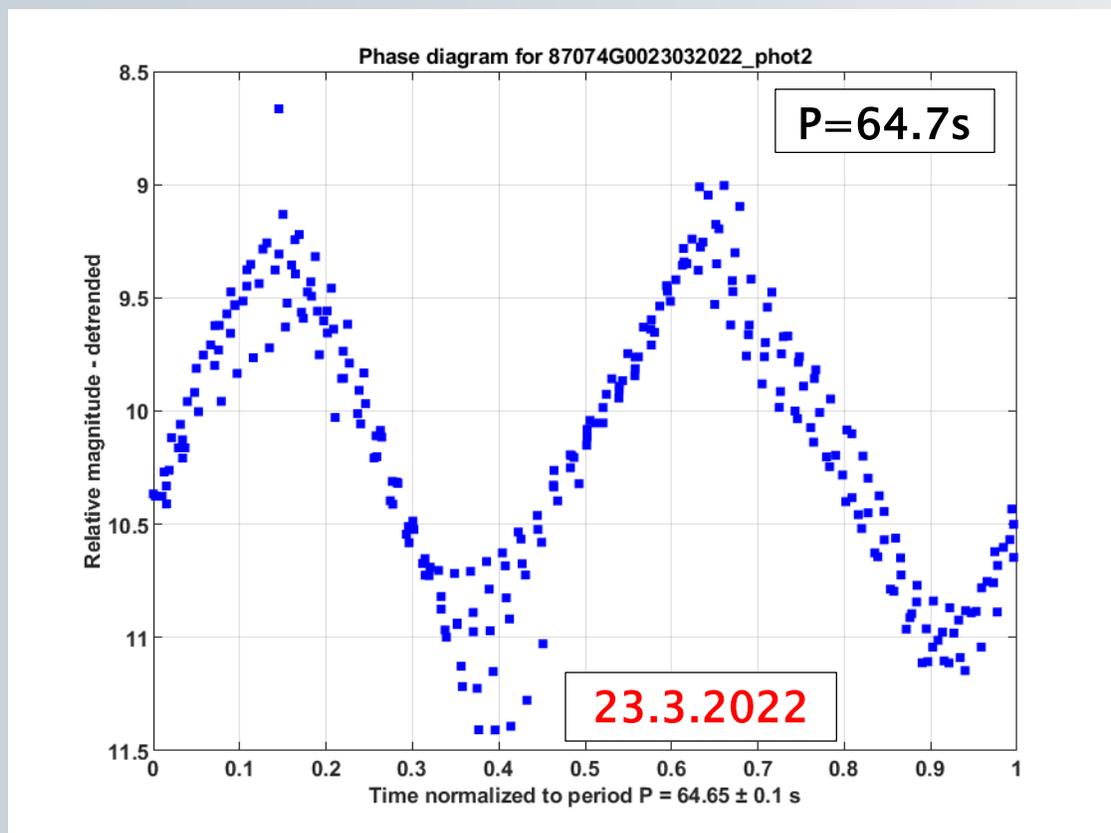


NORAD 18340 (87074G)



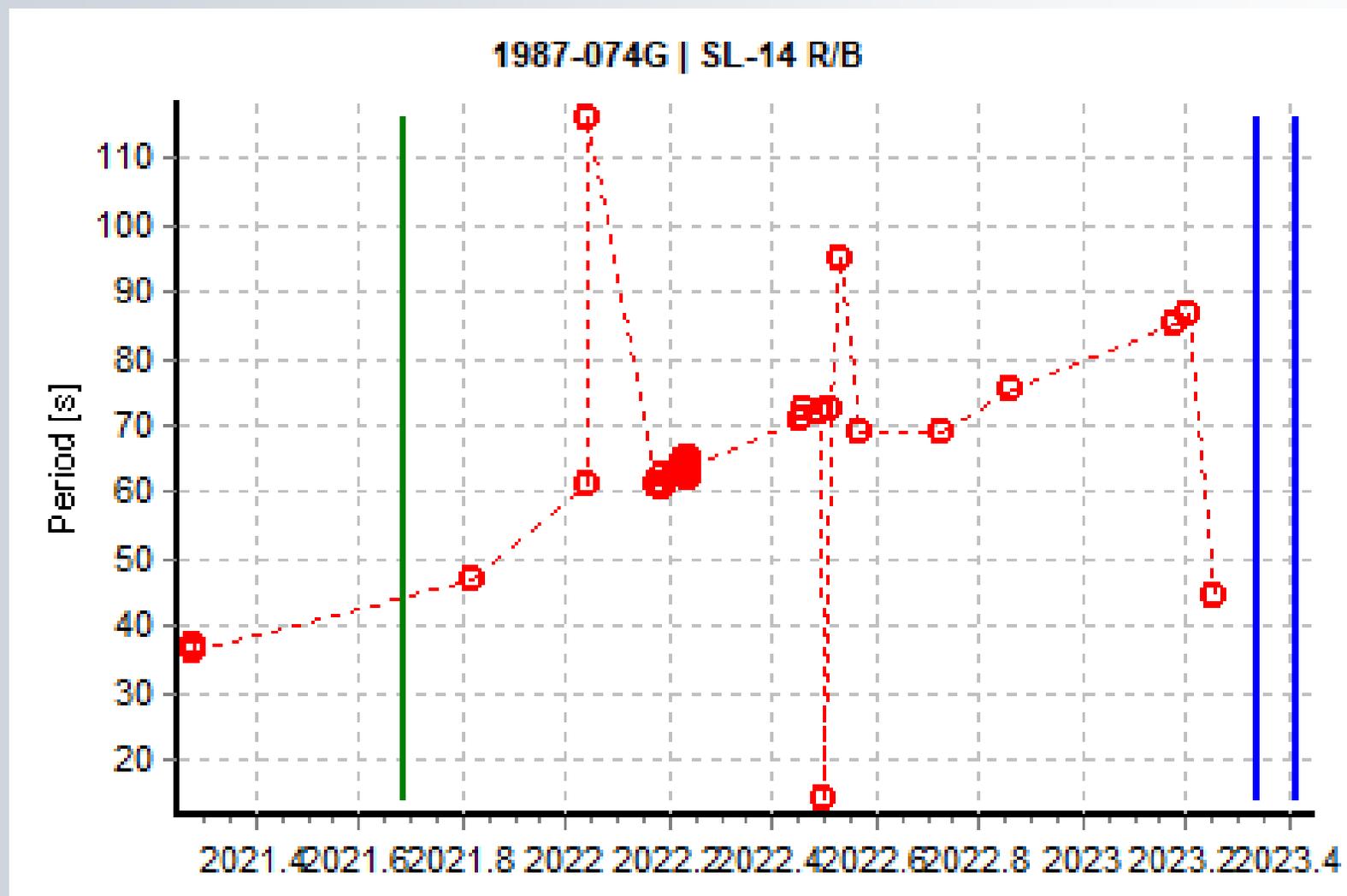


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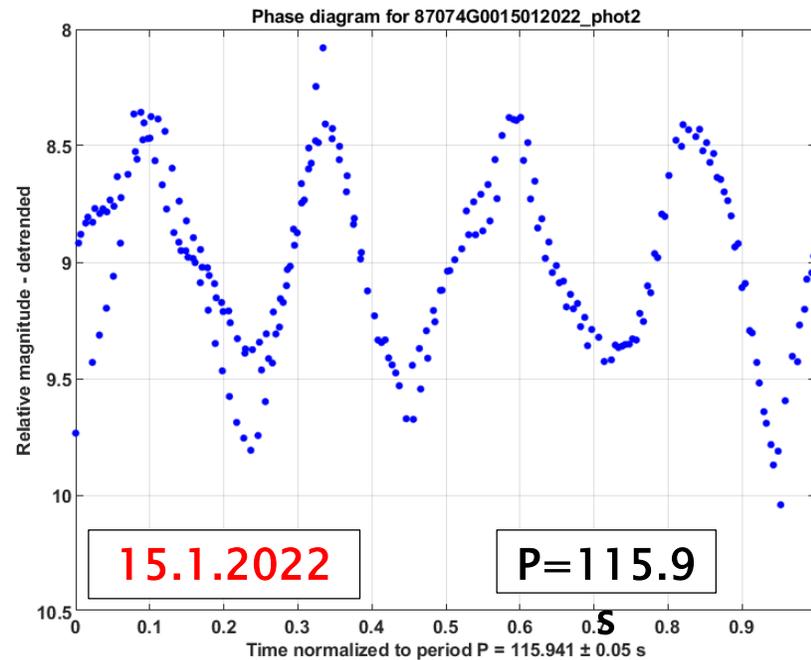
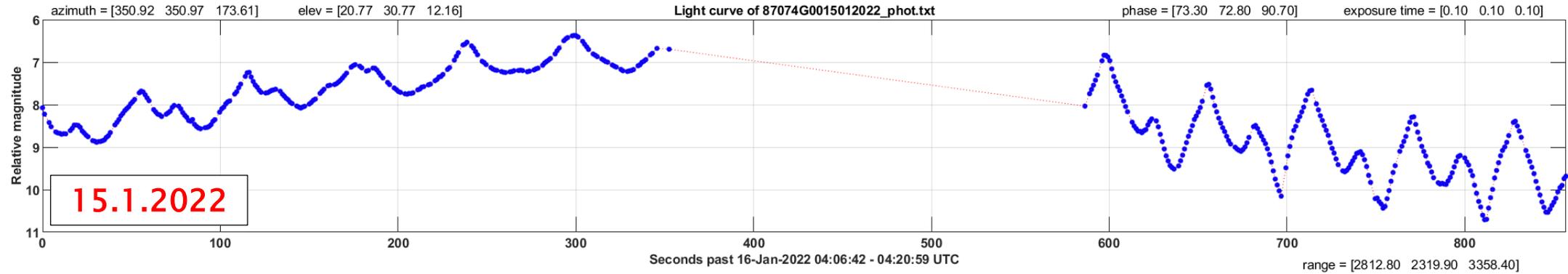




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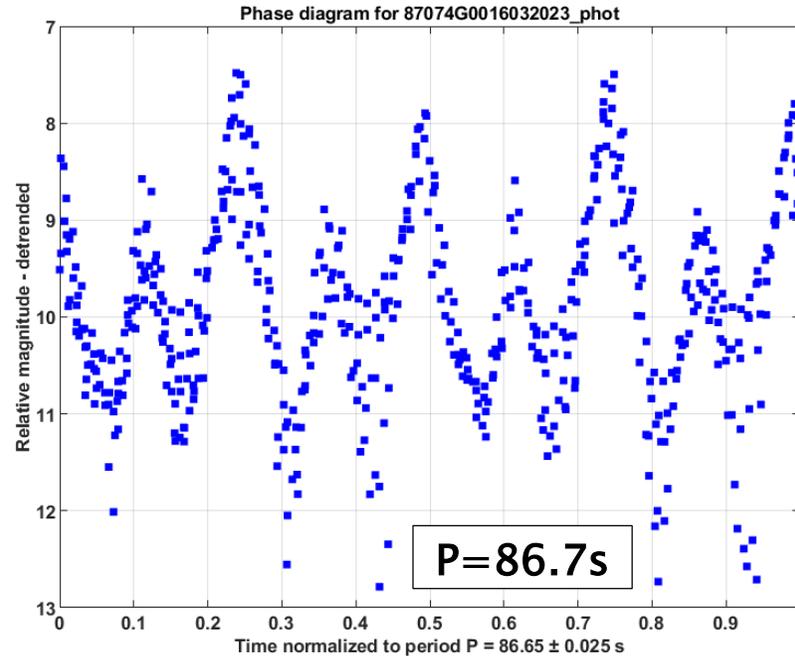
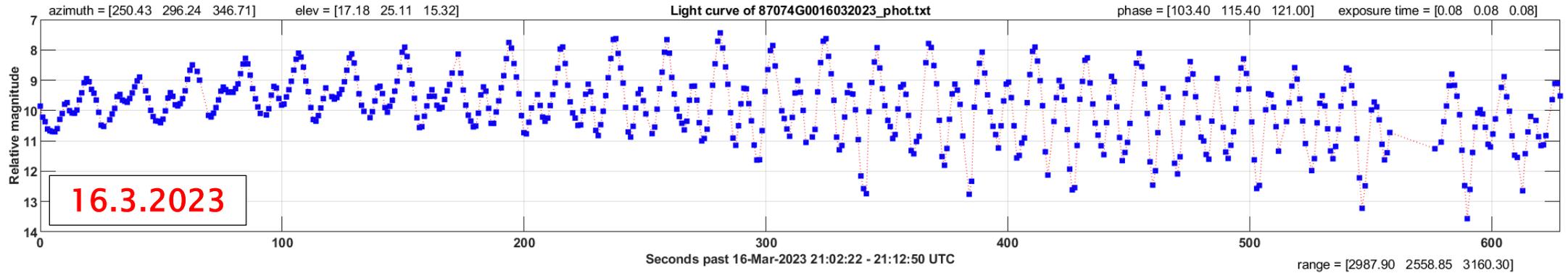


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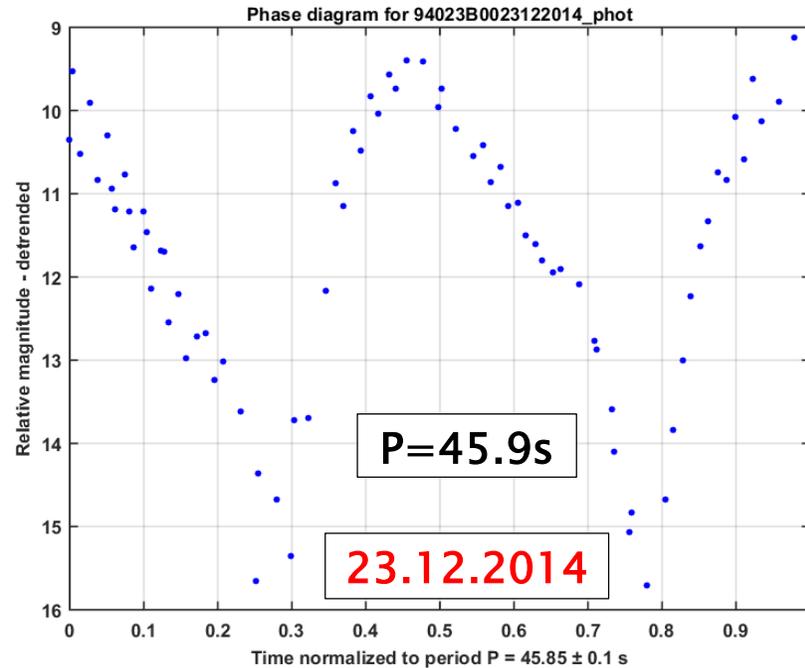
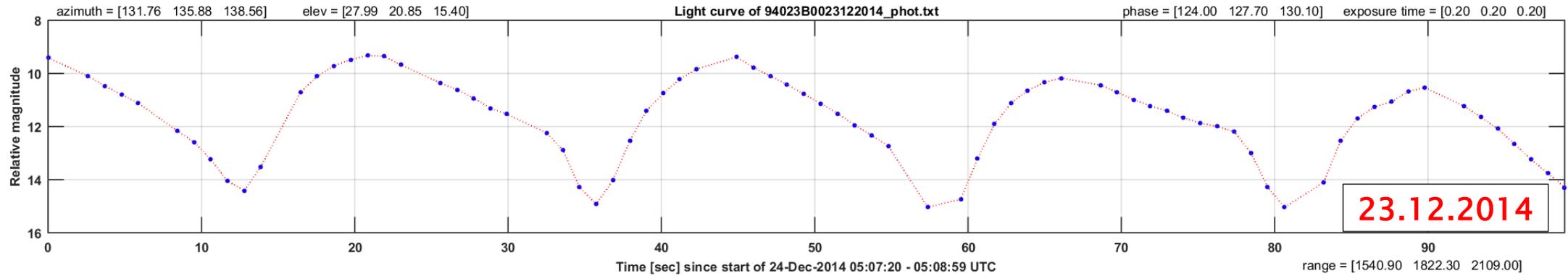


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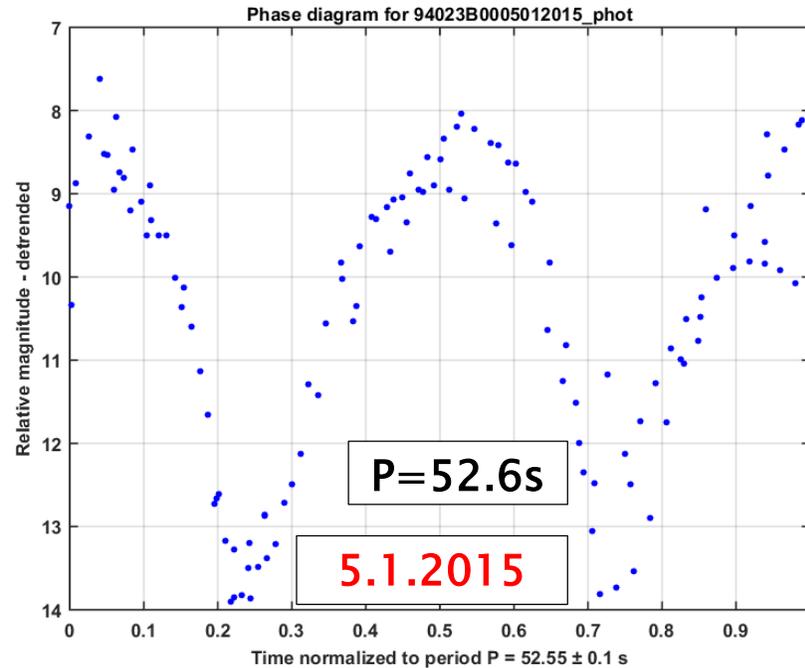
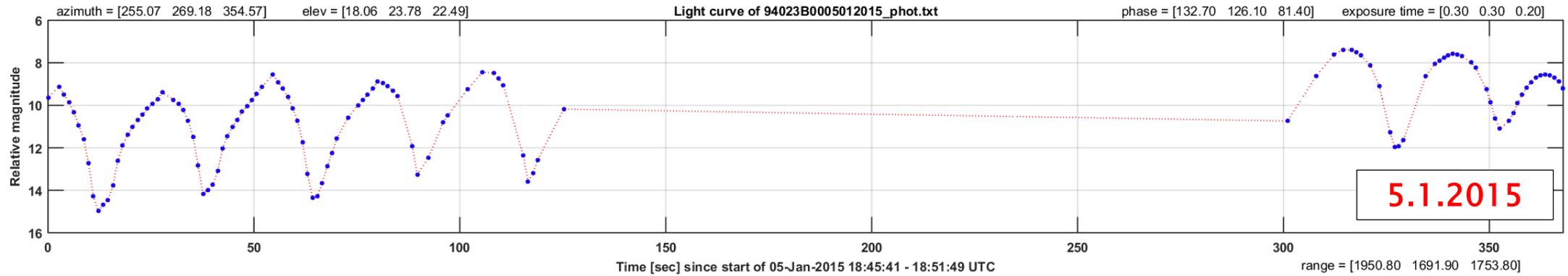


NORAD 23088 (94023B); SL-16



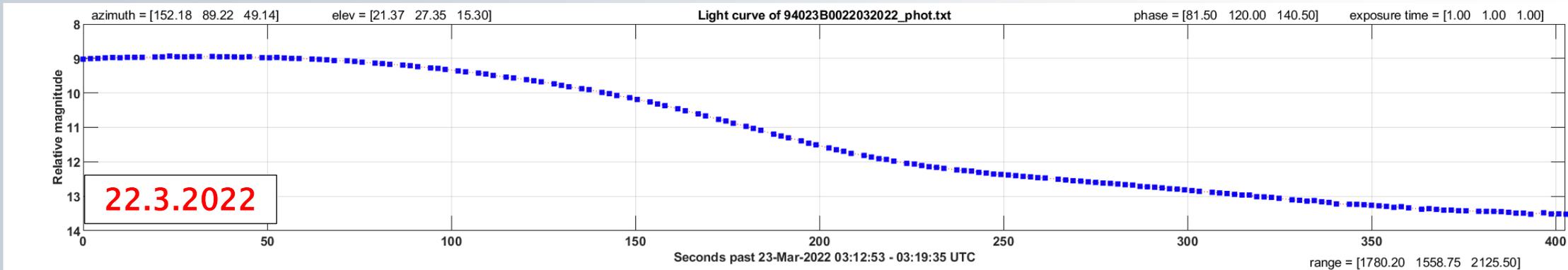
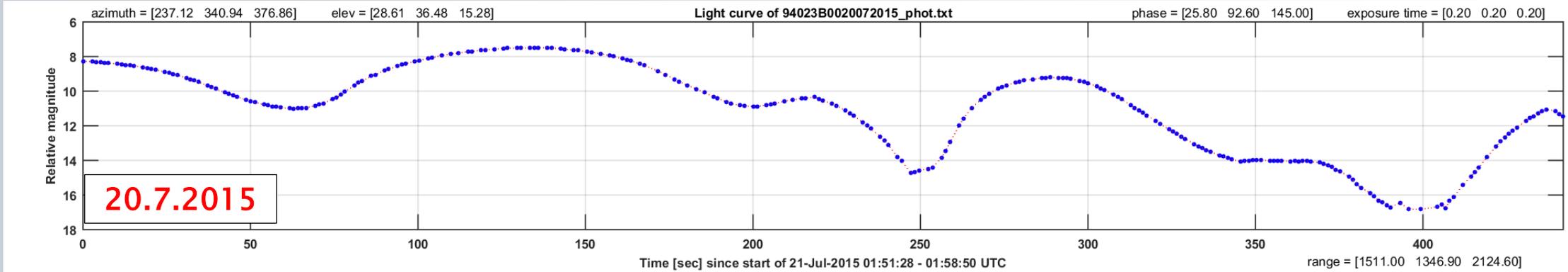


NORAD 23088 (94023B)



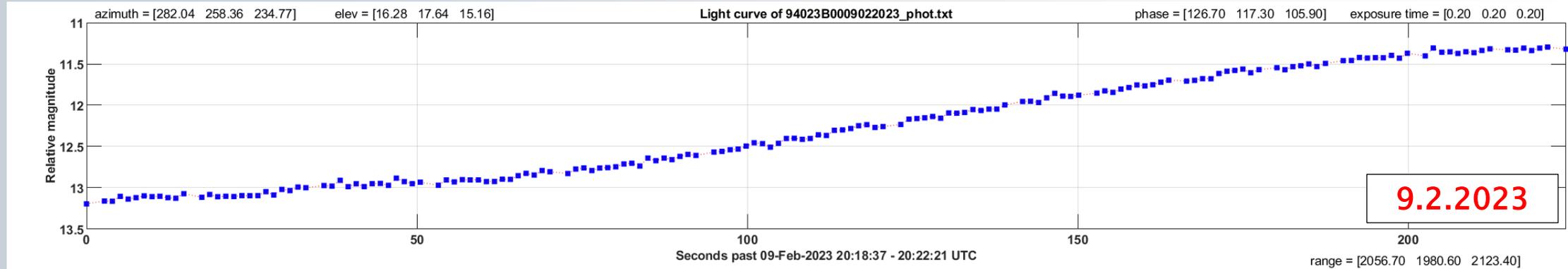
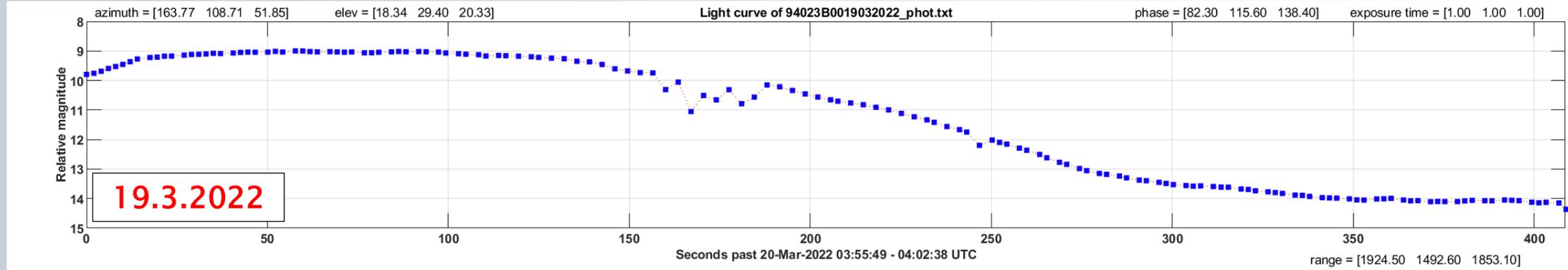


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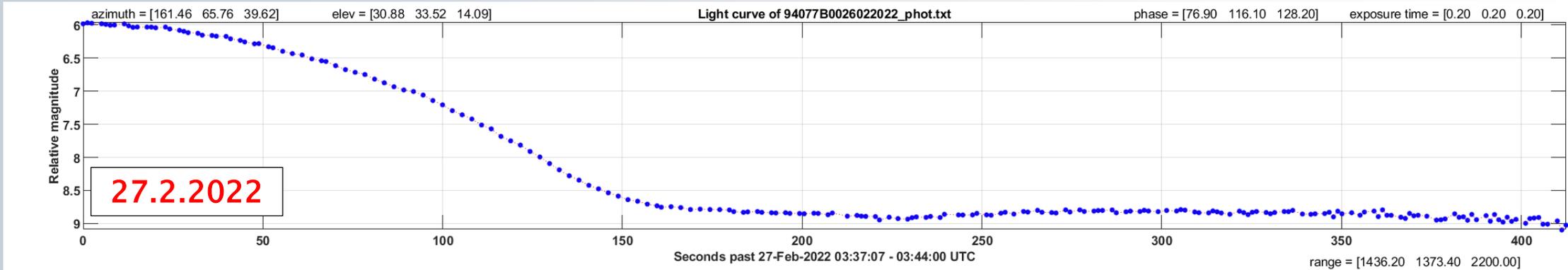
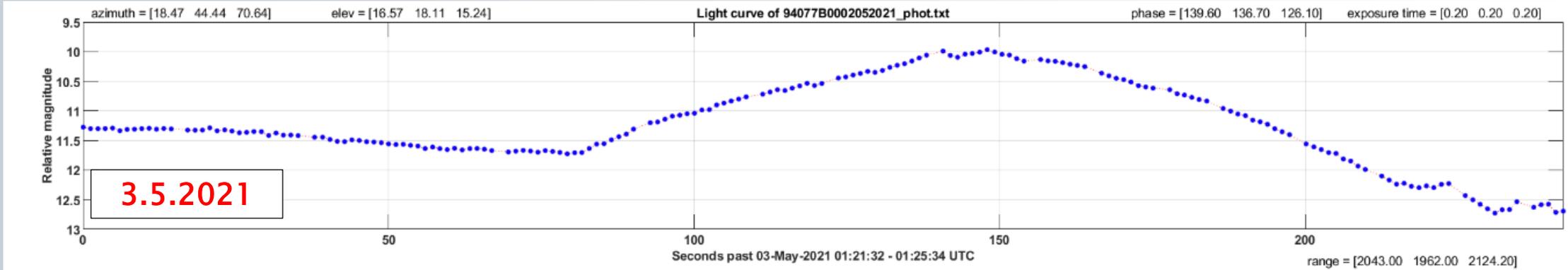


NORAD 23088 (94023B)





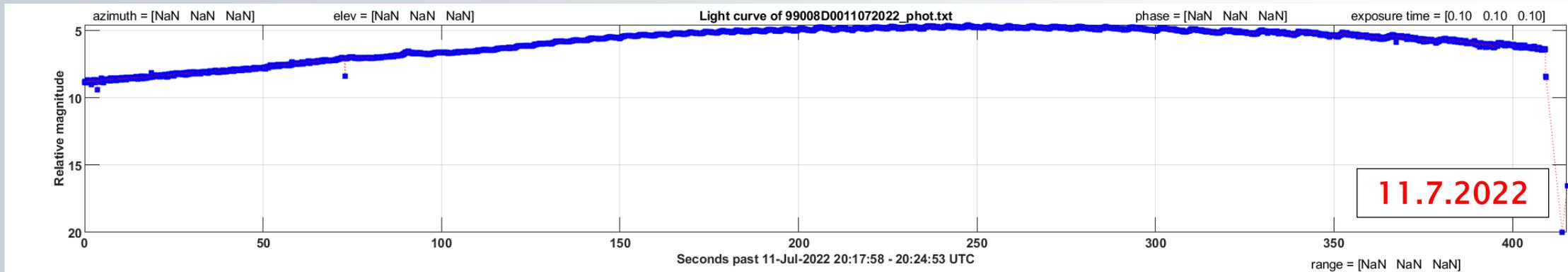
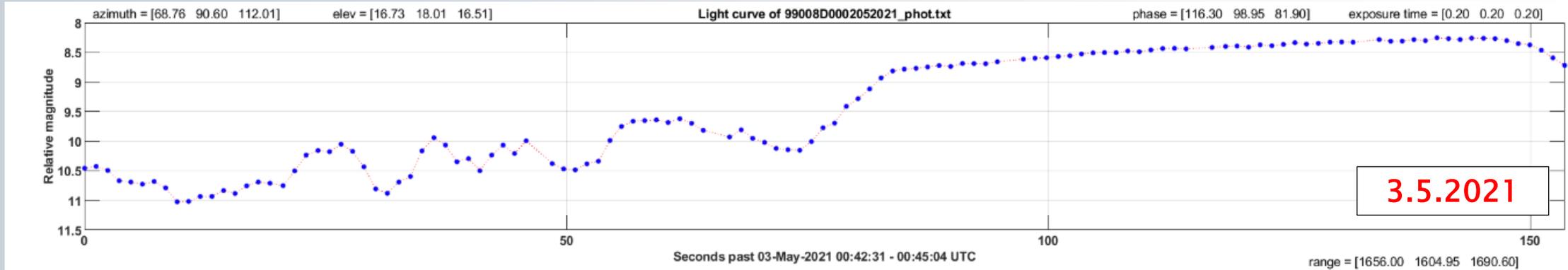
NORAD 23405 (94077B); SL-16





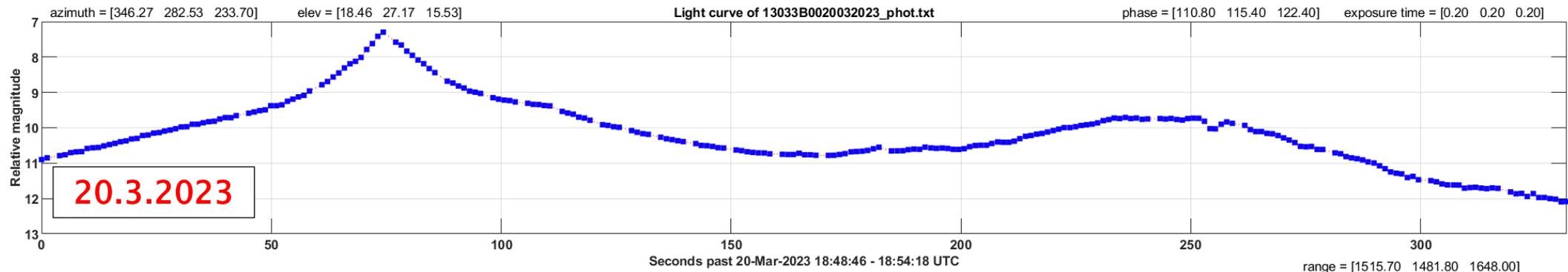
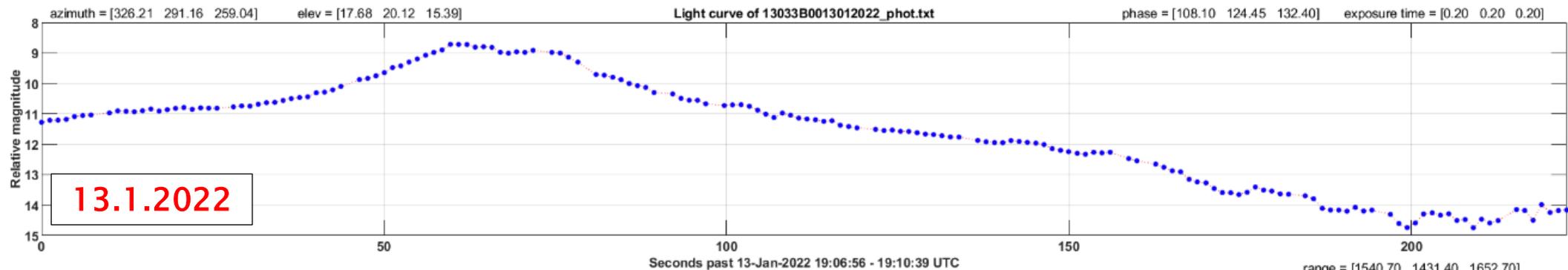
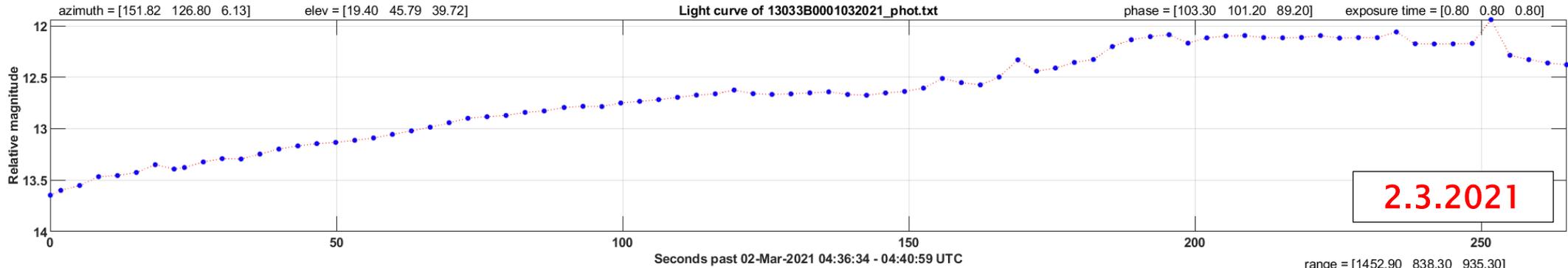
NORAD 25637 (99008D); Delta-2

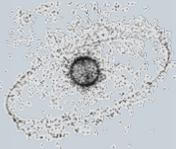
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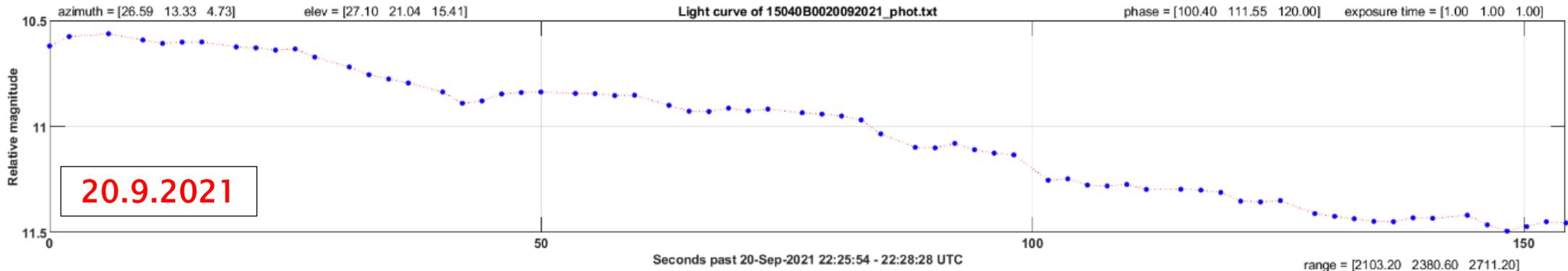
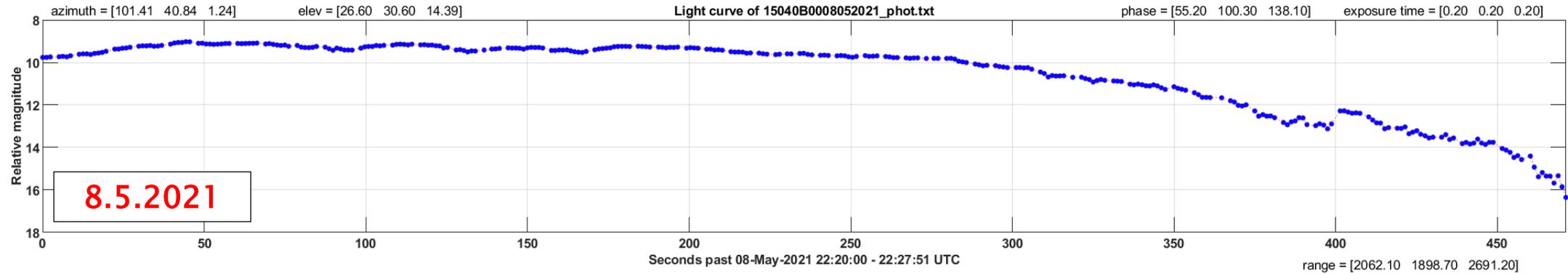


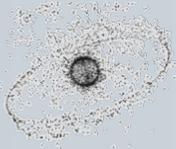
NORAD 39198 (13033B); Pegasus r/b



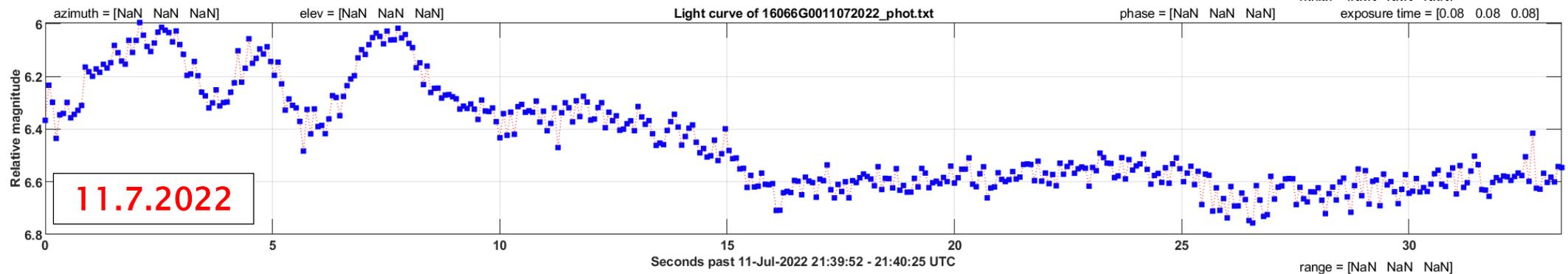
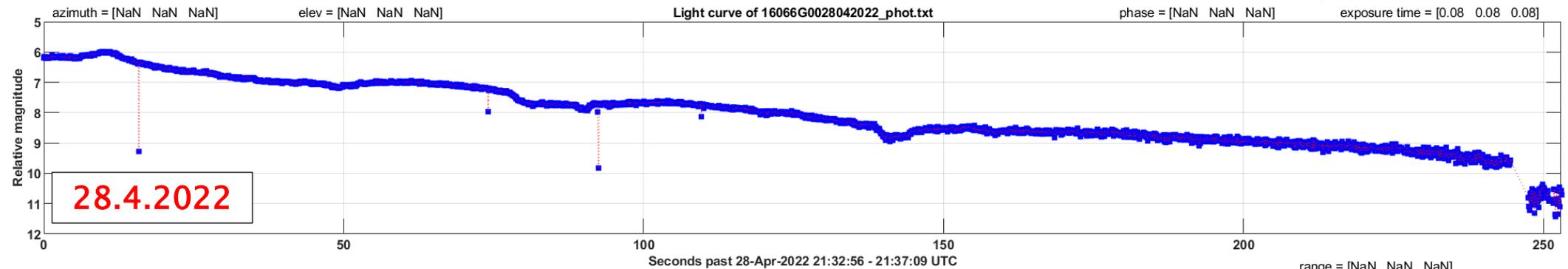
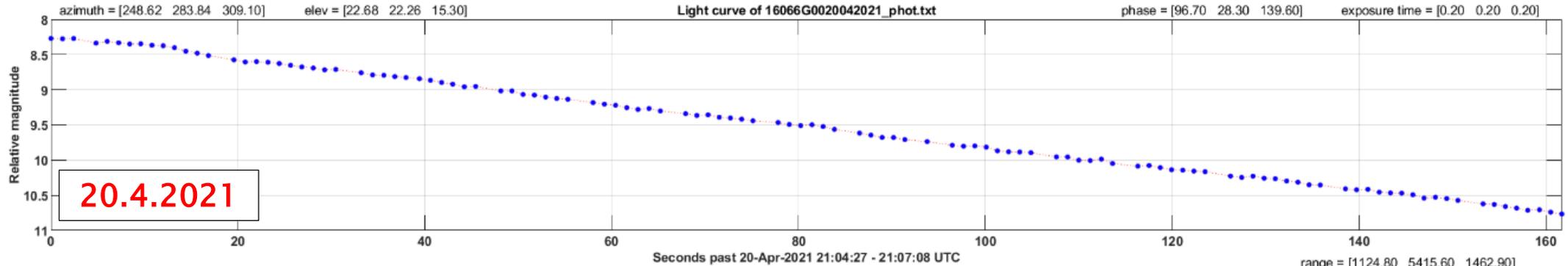


NORAD 40879 (15040B); CZ-4C



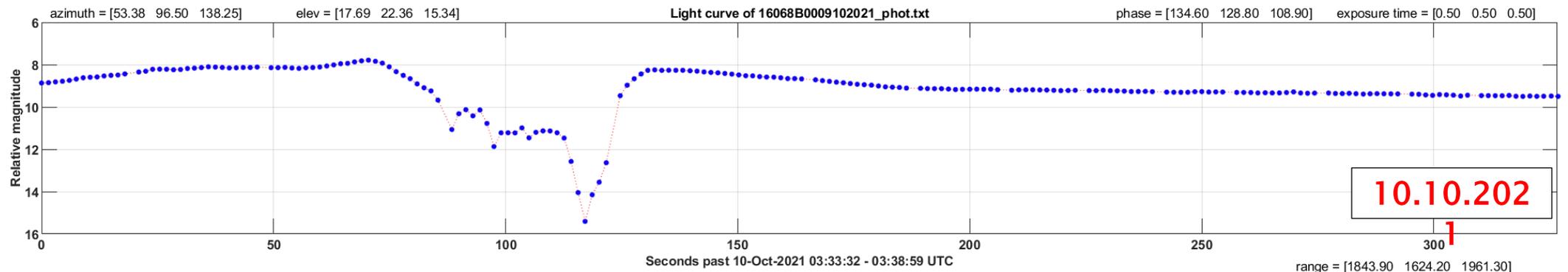
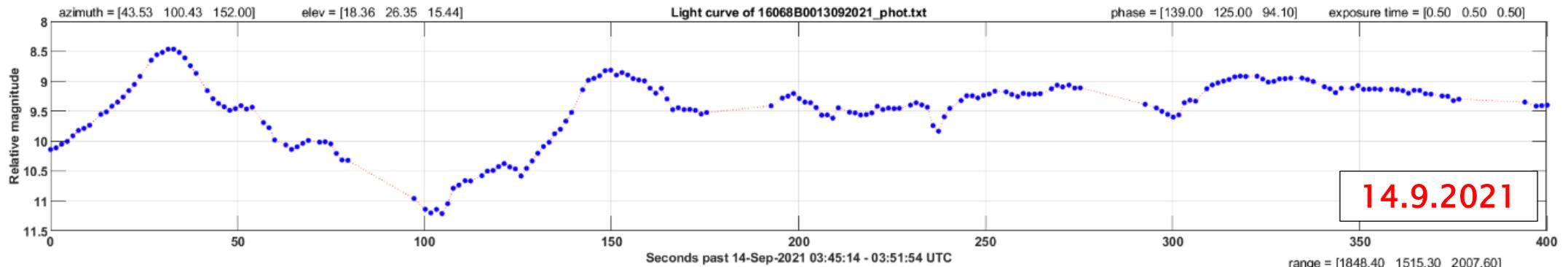
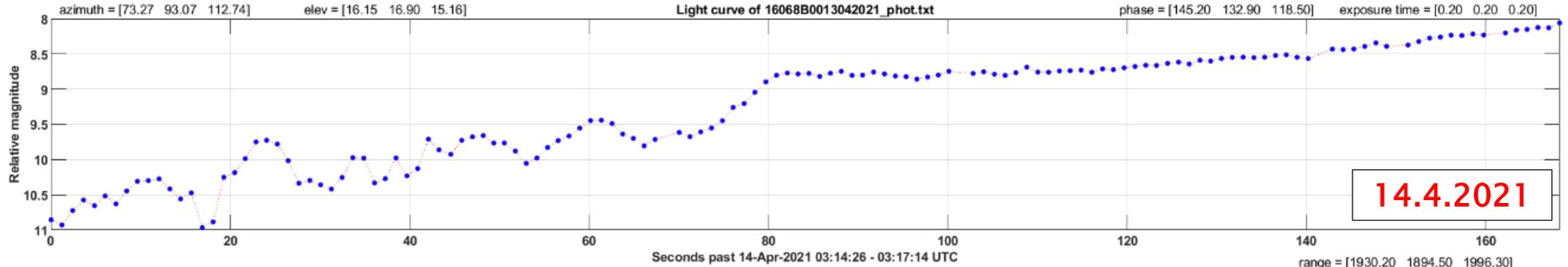


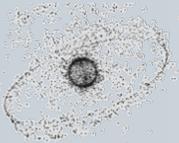
NORAD 41 847 (16066G); CZ-11





NORAD 41 858 (16068B); CZ-2D





Summary – Lessons Learned

- 124 light curves of 8 LEO r/b acquired from April 2021 to March 2023 complemented with some archive observations
- NORAD 18340 (87074G), SL-14 shows periodic signal with period increasing from 36s to 87s over 2 years
- NORAD 23088 (94023B); SL-16 was periodic with
14.12.2014 P=46s
05.01.2015 P=53s
20.07.2015 P > 220s
after March 2022 NO periodic signal
- light curve of slow tumblers may change considerably over time (observation geometry?)
→ no signal in a single light curve does not mean that the object is stable