Asteroid observations from QNO

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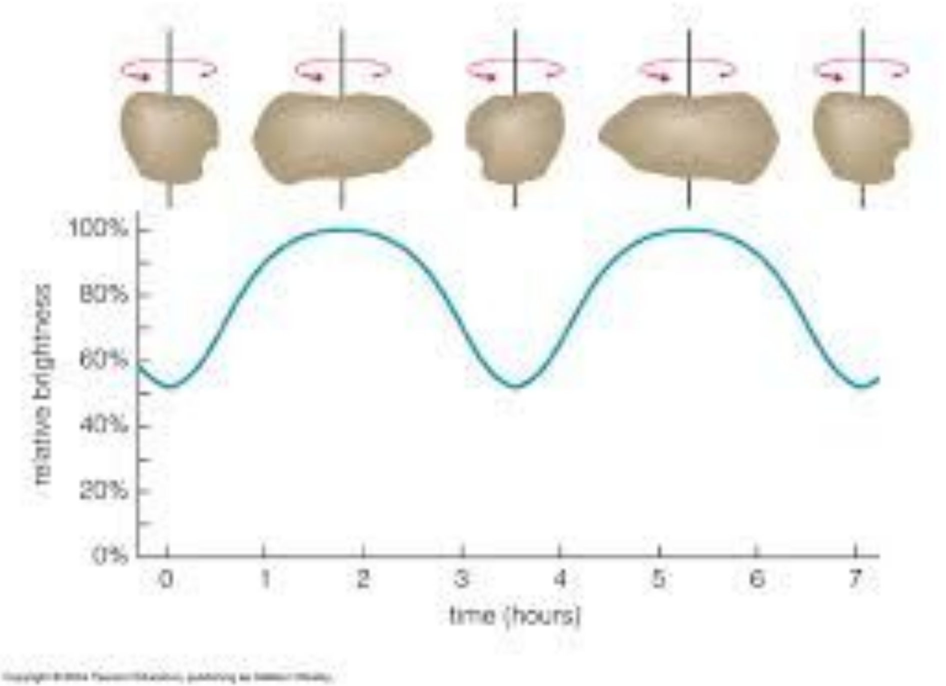
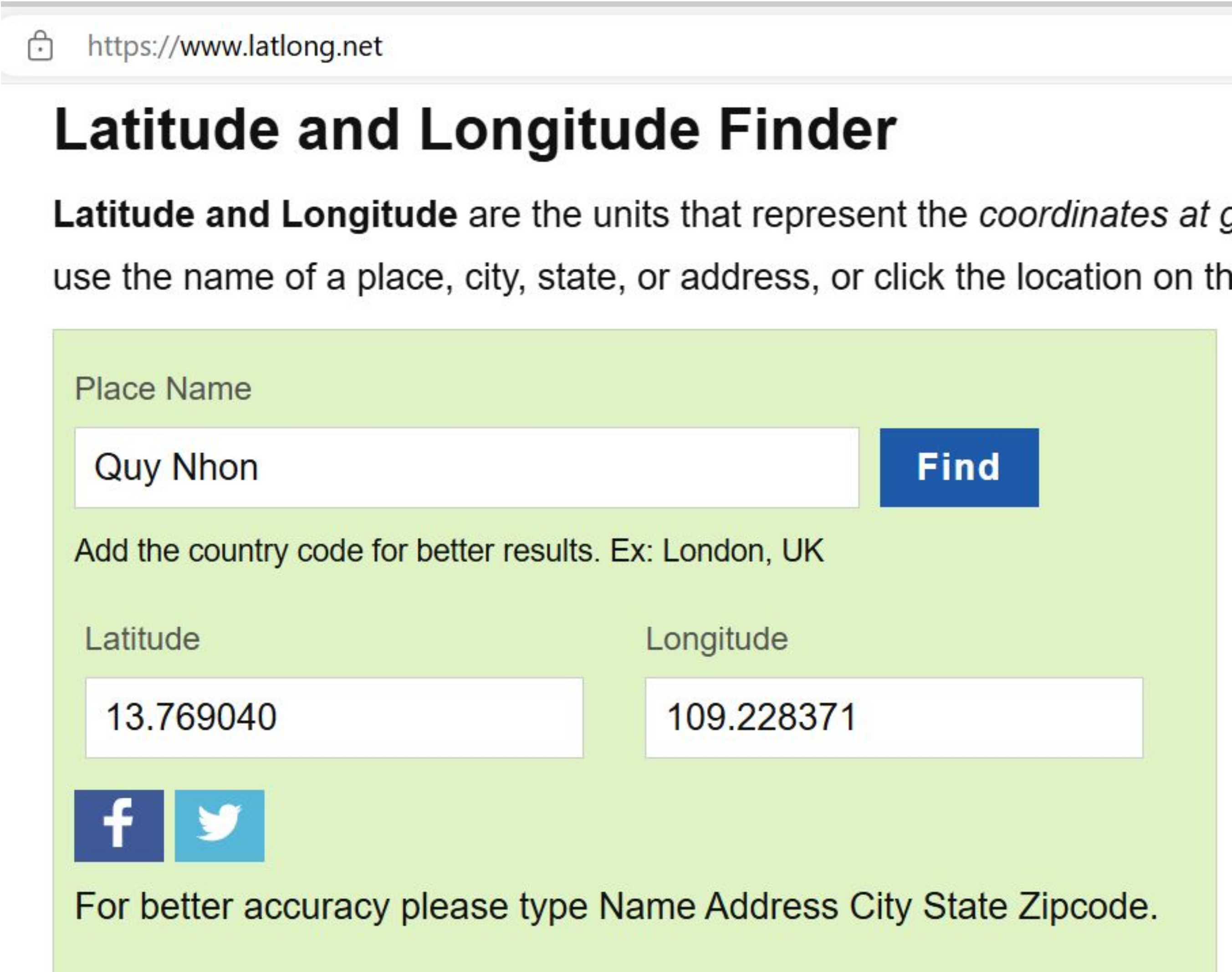
Our goal

We want to obtain light curve of a sample of asteroids in order to model its spin period and also its shape and orbital parameter calculation



Find latitude and longitude Quy Nhon.

You can use any coordinate tool, here we use latlong.net



minorplanet.info/php/callopplcdbquery.php

both date and phase angle should be confirmed by using the JPL Horizons web site.

Using the Results Table

Check one or more asteroids to generate a 40-day ephemeris started with the specified date

Enter Longitude and Latitude to the nearest whole degree.
Use negative numbers for the Western and Southern Hemispheres (i.e., use negatve longitudes for the Americas and negative latitudes for Ausralia and most of South America, and much of Africa)

Enter the Elevation in meters (1 foot = 0.3048 m)

Enter UT as the nearest whole hour, 24-hour format.

The Ephemeris Start Date and UT are not validated.
Make sure to use YYYY-MM-DD format (e.g., 2021-12-31 for Dec 31, 2021)

Ephemeris Information

Positions: Geocentric

Longitude: 109.2283 Latitude: 13.769 Elevation: 9

Start Date (yyyy-mm-dd): 2024-07-31 UT: 7

See the LCDB Readme (section 3) for a listing of family numbers and names.

LCDB Ephemeris Reset

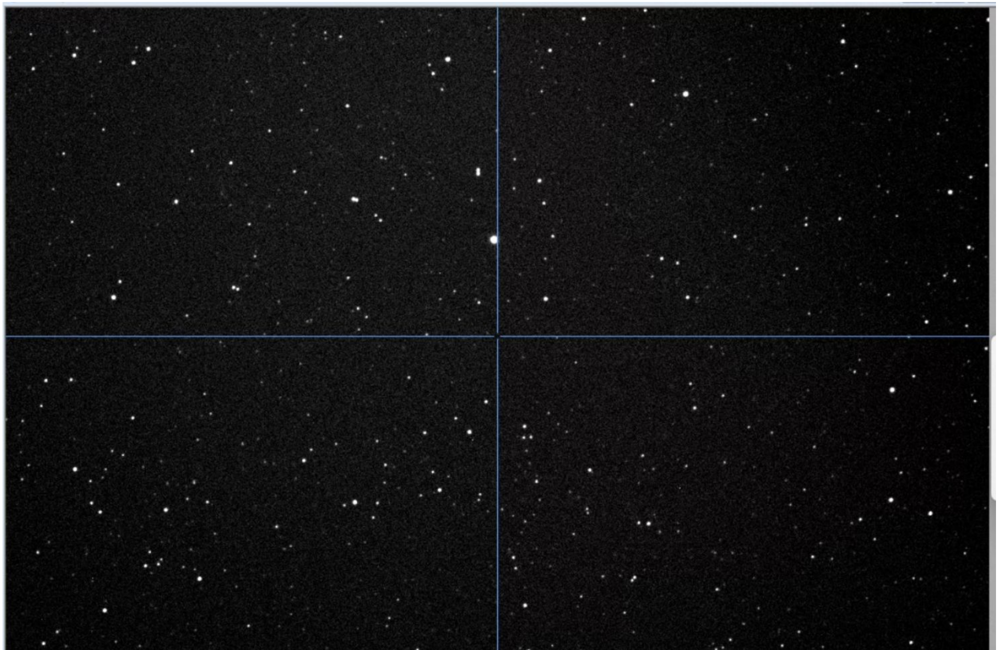
LCDB	Eph	CN	CS	Fav	Num	Name	Fam	ODate	OMag	MDate	MDist	BDate	BMag	BDec	PDate	PMin	PDec	PF	Period	AMin	AMax	U	
◉	☐	N	N	N	4678	Ninian	9104	07 31.0	15.4	08 07.8	0.865	08 01.0	15.4	-26	07 30.881	4.3	-26		56.72		1.04	3-	1
○	☐	N	N	N	58110	1980 UF1	9104	07 29.9	17.7	08 05.5	0.971	08 01.0	17.7	-33	07 30.161	7.5	-33						1
○	☐	N	N	Y	67974	2000 XP6	9104	07 30.1	16.3	08 11.1	0.789	08 01.0	16.3	-26	07 30.447	4.3	-26						1
○	☐	N	N	N	98411	2000 UT13	9104	07 31.7	18.0	08 08.4	1.203	08 01.0	18.0	-14	07 31.479	2.2	-14						1
○	☐	N	N	Y	440844	2006 SF105	Unknown	07 31.1	18.0	08 07.8	0.999	08 01.0	18.0	-21	07 31.661	1.7	-21						
○	☐	N	N	Y	38032	1998 QH43	9106	08 01.4	16.9	07 29.4	1.108	08 01.1	16.9	-21	08 01.322	1.5	-21						
○	☐	N	N	N	51001	2000 GL98	2003	08 01.1	17.7	08 03.4	1.698	08 01.1	17.7	-13	07 31.966	2.1	-13						

How to choose asteroids for our sample

Good magnitude (mag < 12) and altitude (Alt > 50o),

Short period (<10 hrs) in order to see changes in the lightcurve within one night

MinorPlanet.info: Gateway



Use Airmass.org to determine visibility from QNO

386 Siegena,19 27 26.0,+01 39 10.6

102 Miriam,20 05 00.9,-10 29 33.2

702 Alauda,20 21 08.1,-10 29 29.0

73 Klytia,18 31 10.9,-26 45 42.1

471 Papagena,18 15 00.0,-30 56 57.9

1 Ceres,18 42 53.7,-30 35 27.0

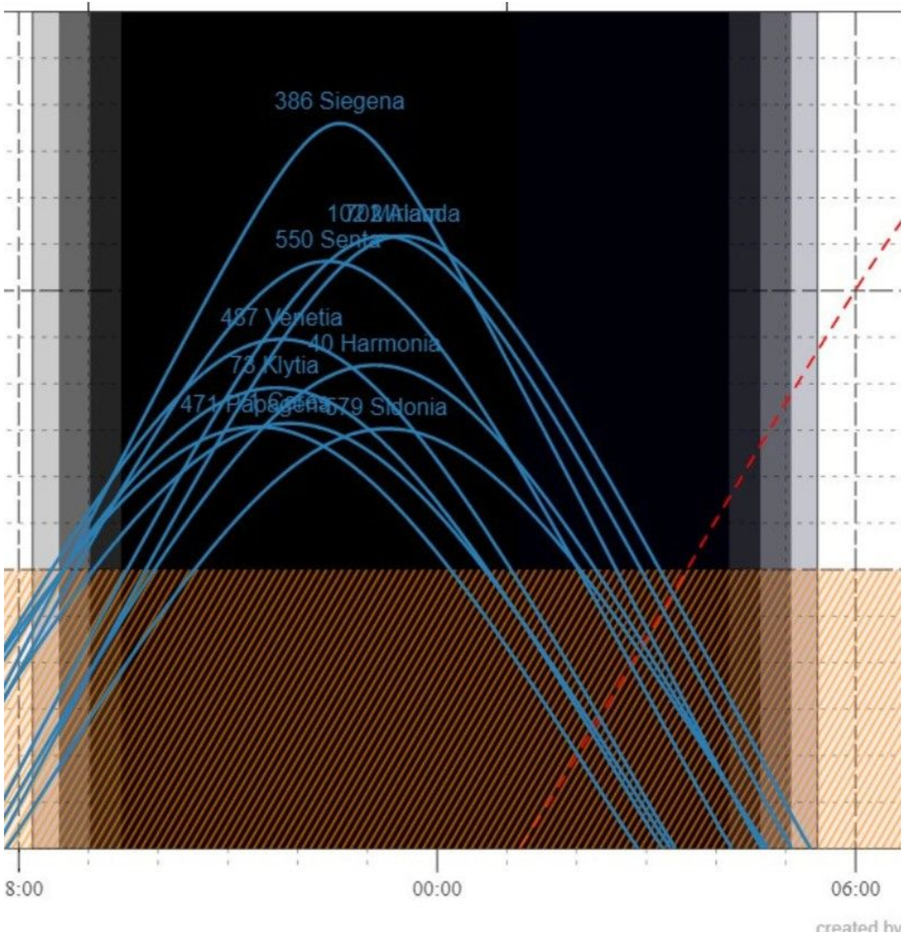
579 Sidonia,20 07 29.1,-31 12 53.3

Targets

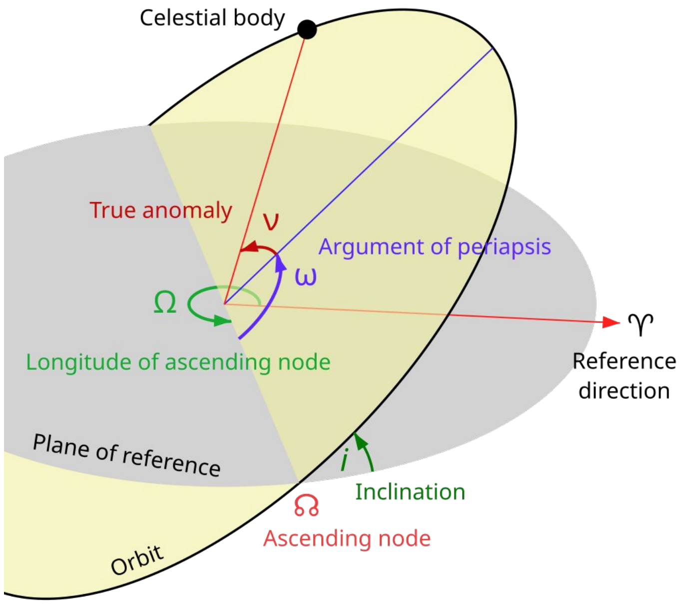
10 brightest asteroids visible from QNO

Brightness > 12 mag

Based on the visibility chart we choose 386 Siegena as our target



Orbital elements



1/ Semi-major axis a

2/ Eccentricity e

3/ Perihelion time (JD date): T

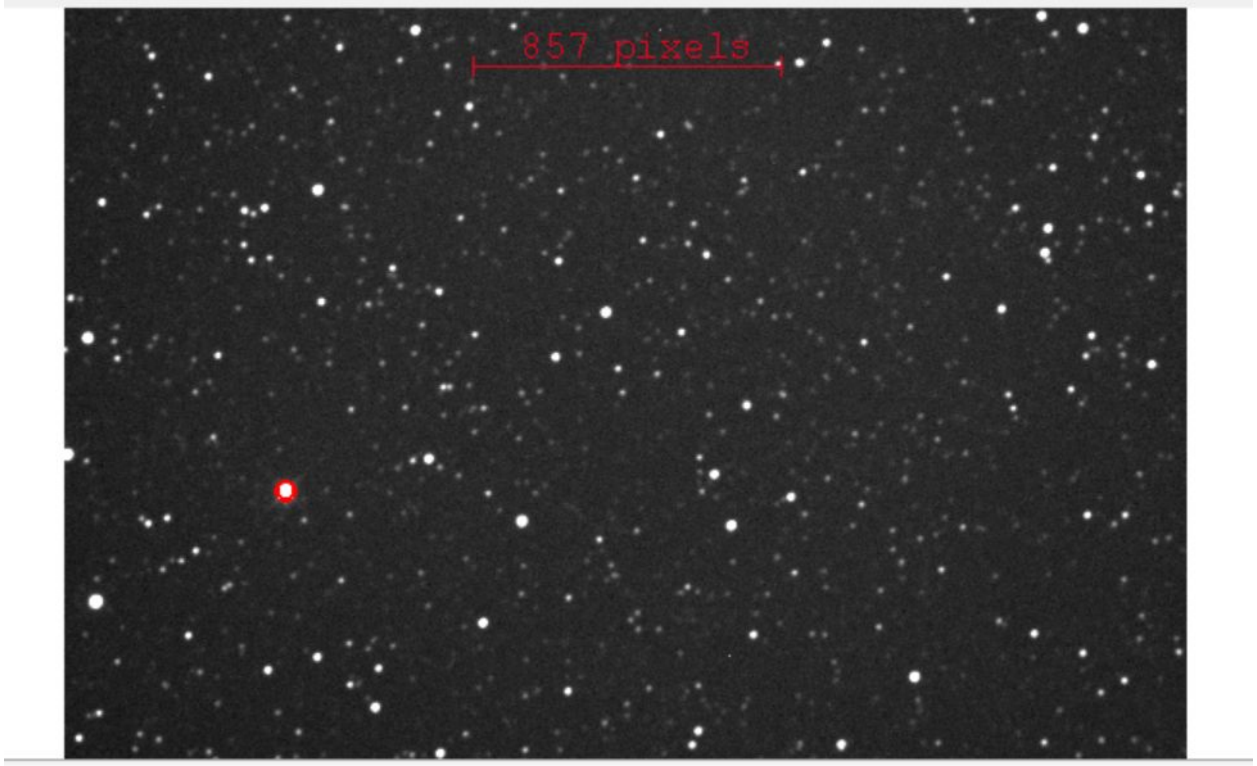
4/ Inclination i of the orbit relative to the ecliptic plane

5/ N (usually written as "Ω") Longitude of Ascending node

6/ w (usually written as "ω") is the angle from the Ascending node to the Perihelion.

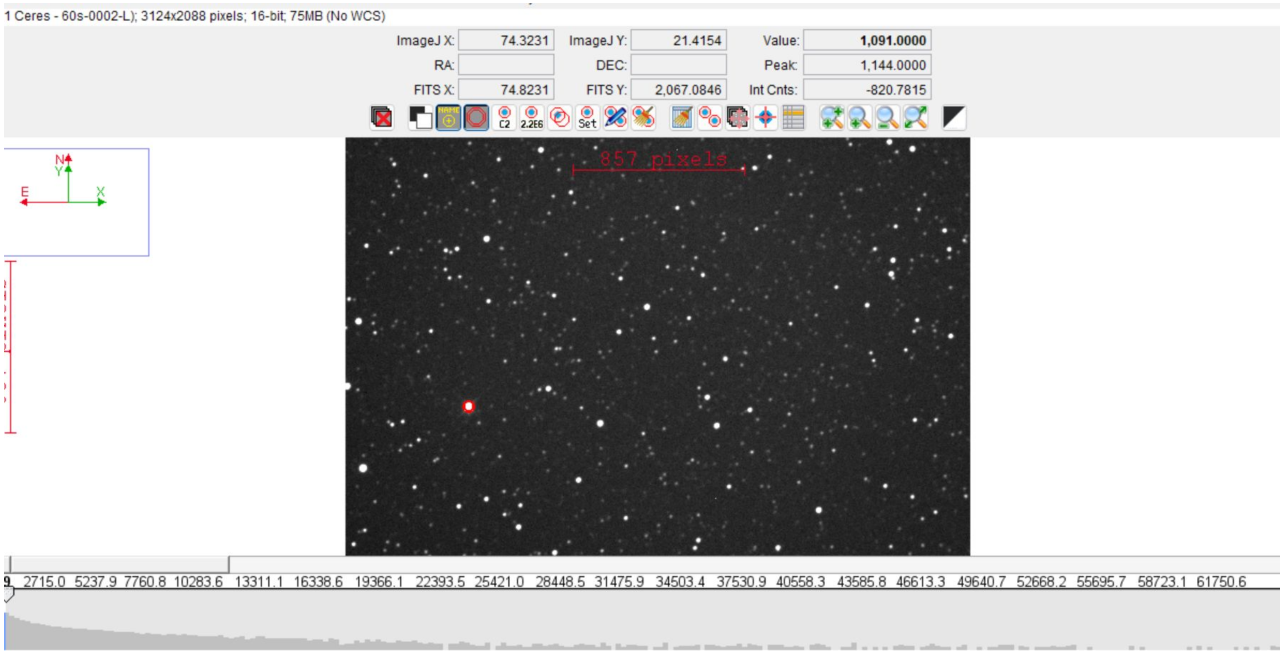
Asteroid Orbit Determination

Step 1: Take picture

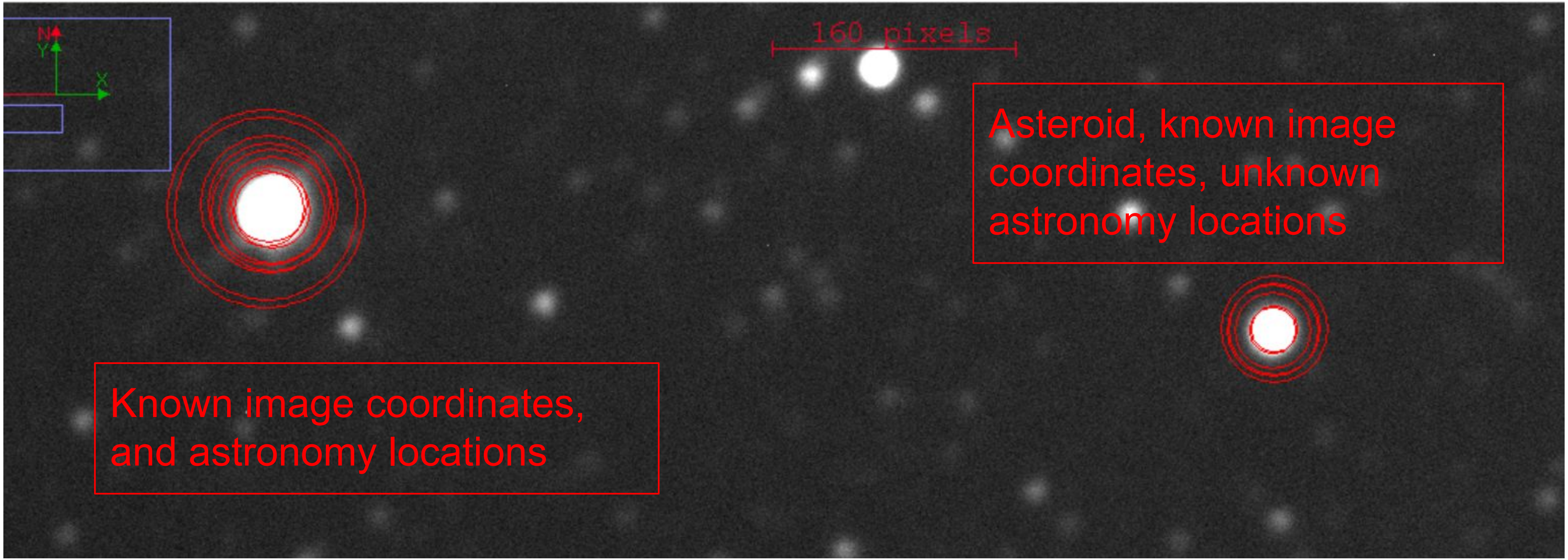


Step 2: Use AstroImageJ software to determine positions

[AstroImageJ (AIJ) - ImageJ for Astronomy (louisville.edu)]



Step 2: Use Differential Photometry software



Step 3: Data acquisition and calculate position

Calculate the interested object location based on others known object in image

[Astrometry Calculator (vt.edu)]

Astrometric Position Calculator

Use this page to compute accurate equatorial coordinates (Right Ascension and Declin
what an entry box is asking for, or the meaning of a result box, click on the nearby "?"
compute "plate constants" for the image and the RA and Dec for the object using a sta

Enter approximate RA Dec of center of image (hh mm ss.s... ±dd mm ss.s...): 20 02 00

Enter number of stars to use in calculating the plate constants (at least 4, no more than

Enter for each star its RA Dec, and the x y pixel coordinates of its image centroid (?)
(RA Dec in the format hh mm ss.s... ±dd mm ss.s...; x y in the format xxx.xxx... yyy.y

RA Dec:	20 02 49.691 +14 09 38.11	x y:	279.23 877.94
RA Dec:	20 03 58.936 +13 39 13.57	x y:	14.59 373.46
RA Dec:	20 00 44.093 +13 32 00.31	x y:	794.31 272.06
RA Dec:	20 02 45.502 +13 37 15.97	x y:	307.11 346.88
RA Dec:		x y:	
RA Dec:		x y:	
RA Dec:		x y:	
RA Dec:		x y:	
RA Dec:		x y:	
RA Dec:		x y:	

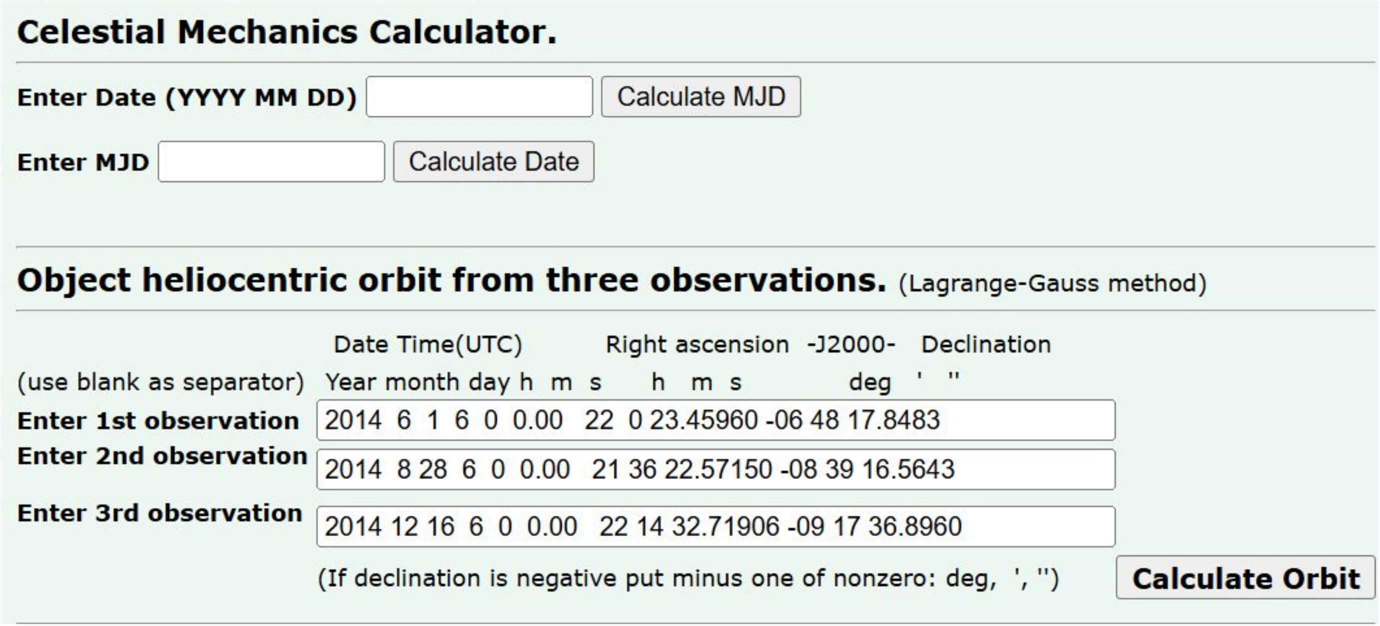
Enter x y pixel coordinates of the centroid of object of unknown RA Dec:
382.41 521.57 ?

Calculate

Step 4: Calculate orbit

From the object location through time calculate the orbit based on Gauss method

[Celestial Mechanics Calculator (msu.ru)](#)



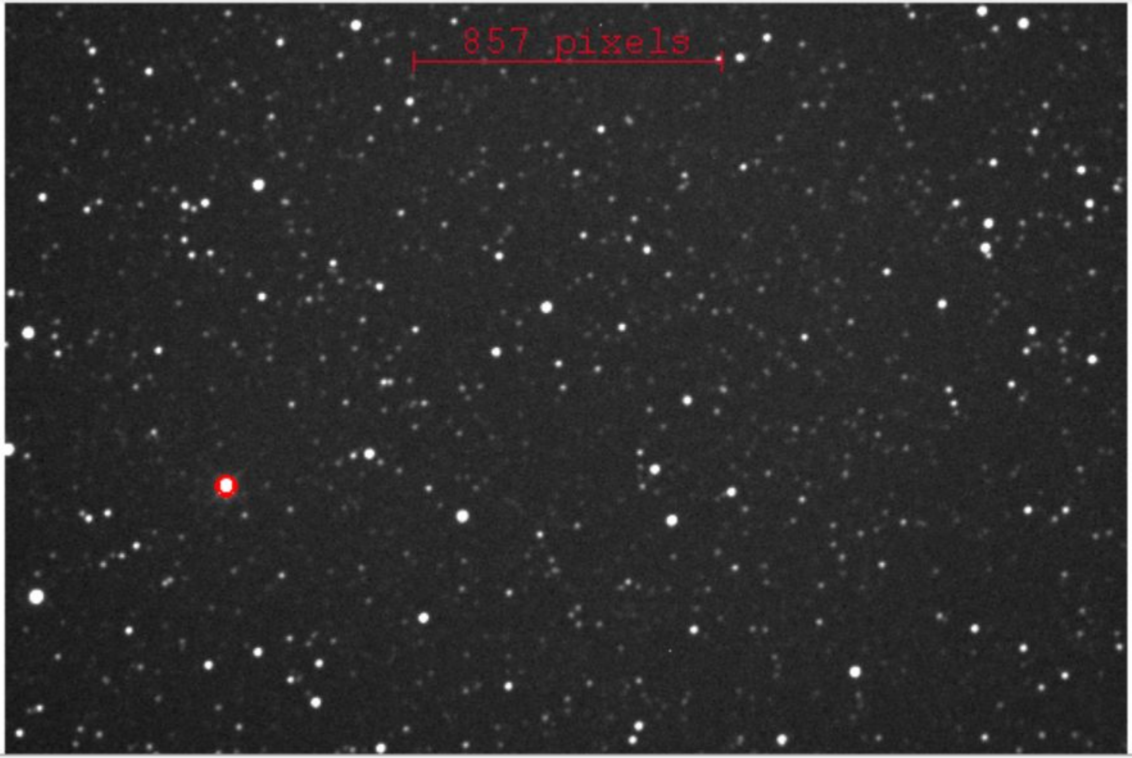
Step 4: Calculate orbit

Requirement: We need to sample through enough time to calculate the orbit

- Need to take data through multiple days, even months to have enough data

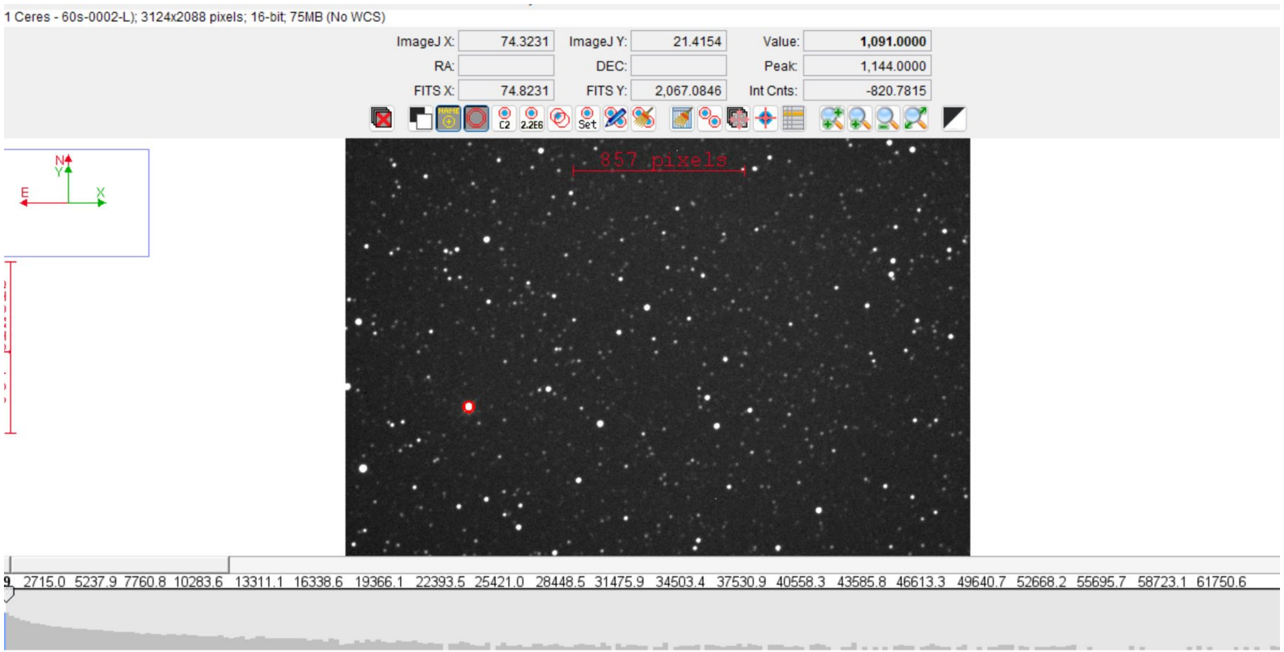
Asteroid Model from Lightcurve

Step 1: Take picture

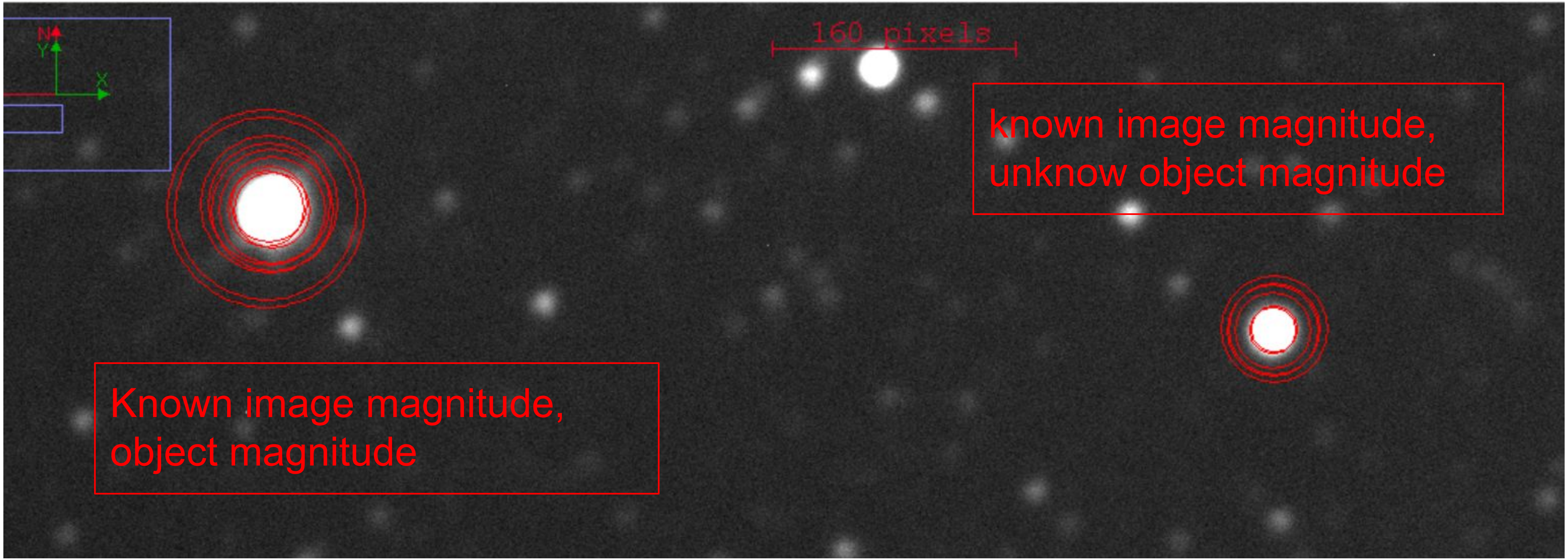


Step 2: Use Differential Photometry software AIJ

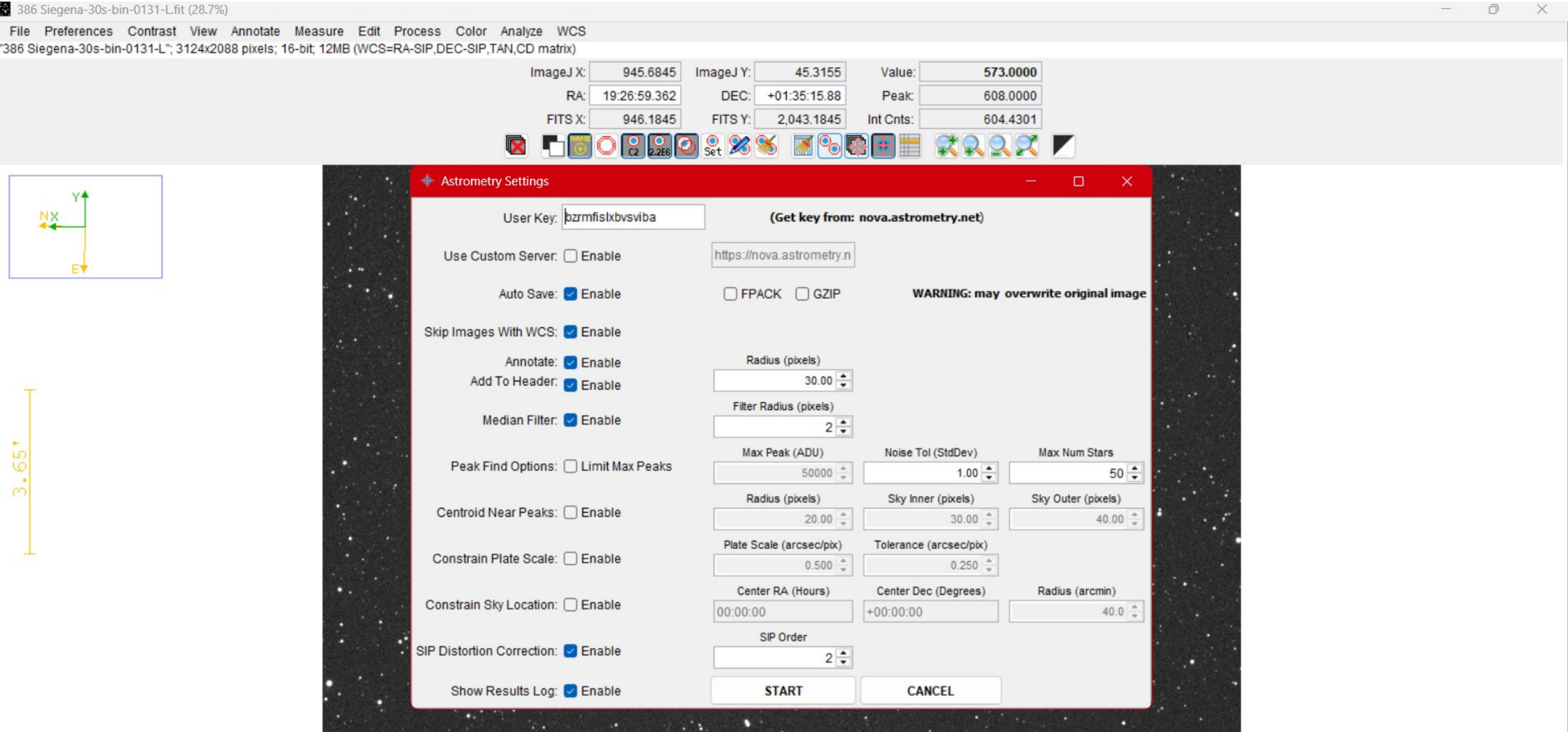
[AstroImageJ (AIJ) - ImageJ for Astronomy (louisville.edu)]



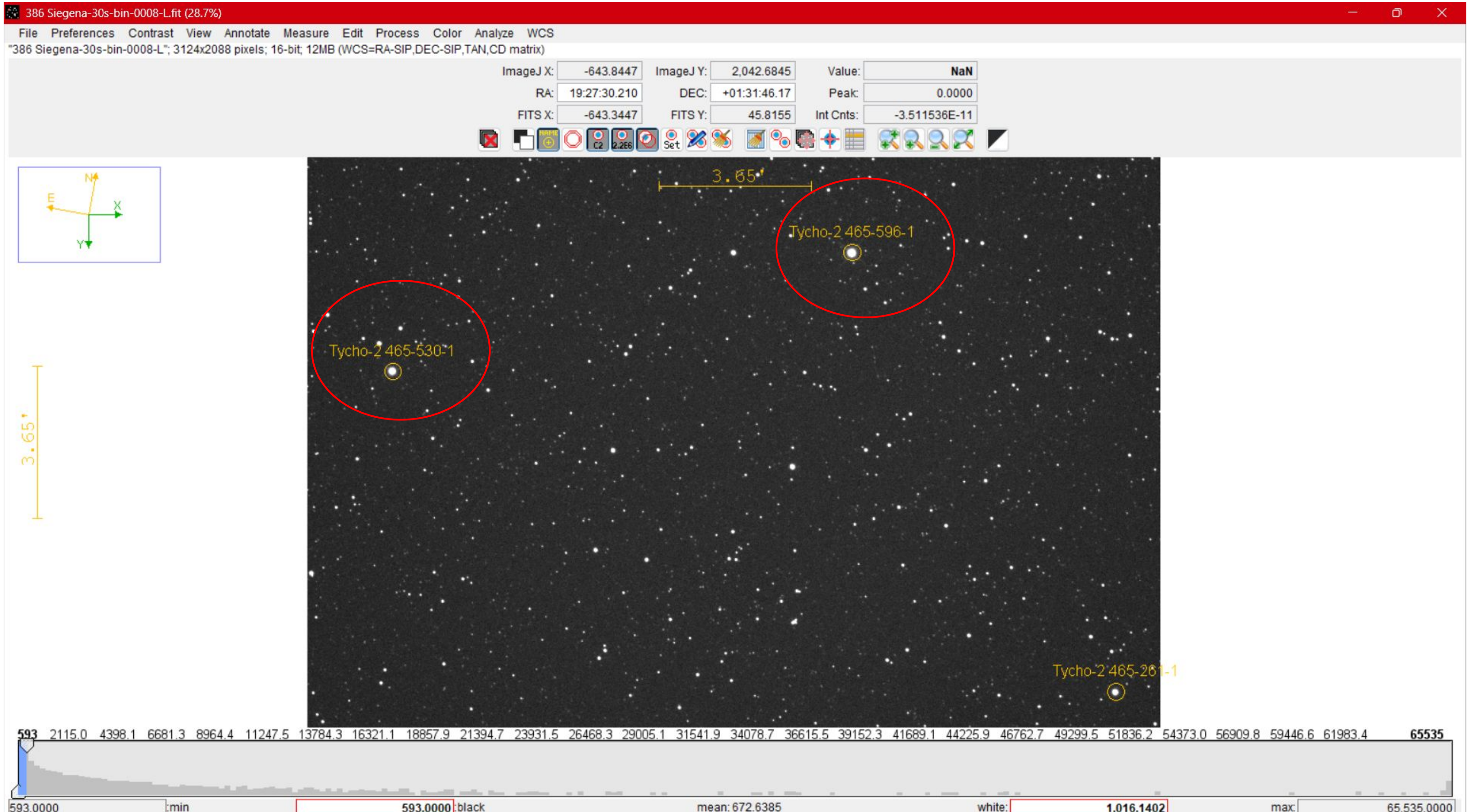
Step 2: Estimate relative magnitude from known object



From catalogue and image the program automatically determine known objects



Touch the known object to see its information



Known object information: **magnitude**

coord 19:26:20.880+01:32:49.84 (ICRS, J2000, 2000.0), radius: 0.25 arcsec

This mirror is hosted by the Cfa Team at the Harvard-Smithsonian Center for Astrophysics.

other query modes : Identifier query | Coordinate query | Criteria query | Reference query | Basic query | Script submission | TAP | Output options | Help

Query : coord 19:26:20.880+01:32:49.84 (ICRS, J2000, 2000.0), radius: 0.25 arcsec

19 26 20.88000000000 +01 32 49.840(0.25 arc sec submit query

Basic data :

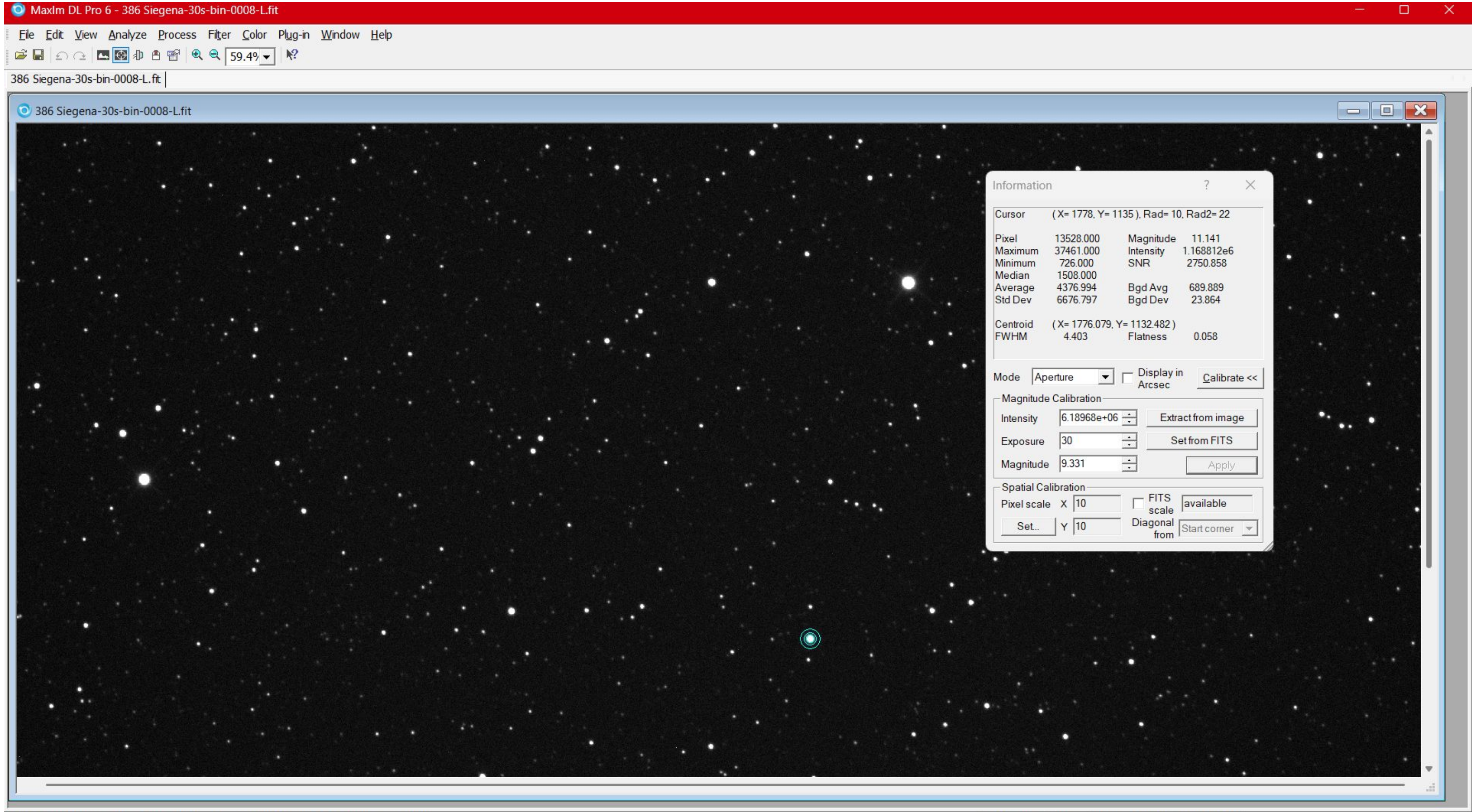
BD+01 3994 -- Star

SIMBAD Query around within 2 arcmin

2MASS DSS SDSS

Distance to the center *arcsec*:	0.04
Other object types:	* (BD,AG,...), NIR (2MASS)
ICRS coord. *(ep=J2000)* :	19 26 20.8793441928 +01 32 49.802977824 (Optical) [0.0148 0.0131 90] A 2020yCat.1350....0G
FK4 coord. *(ep=B1950 eq=1950)* :	19 23 48.7278047918 +01 26 46.478804994 [0.0148 0.0131 90]
Gal coord. *(ep=J2000)* :	038.3200897445278 -07.0469203738034 [0.0148 0.0131 90]
Proper motions *mas/yr* :	-0.892 -5.343 [0.022 0.018 90] A 2020yCat.1350....0G
Radial velocity / Redshift / cz :	V(km/s) 7.10 [0.32] / z(spectroscopic) 0.000024 [0.000001] / cz 7.10 [0.32] (Opt) A 2018yCat.1345....0G
Parallaxes *(mas)*:	0.8621 [0.0183] A 2020yCat.1350....0G
Spectral type:	K2 D ~
Fluxes (6) :	B 10.86 [0.07] D 2000A&A...355L..27H V 9.33 [0.02] D 2000A&A...355L..27H G 8.685355 [0.002767] C 2020yCat.1350....0G J 6.440 [0.024] C 2003yCat.2246....0C H 5.743 [0.042] C 2003yCat.2246....0C K 5.509 [0.027] C 2003yCat.2246....0C

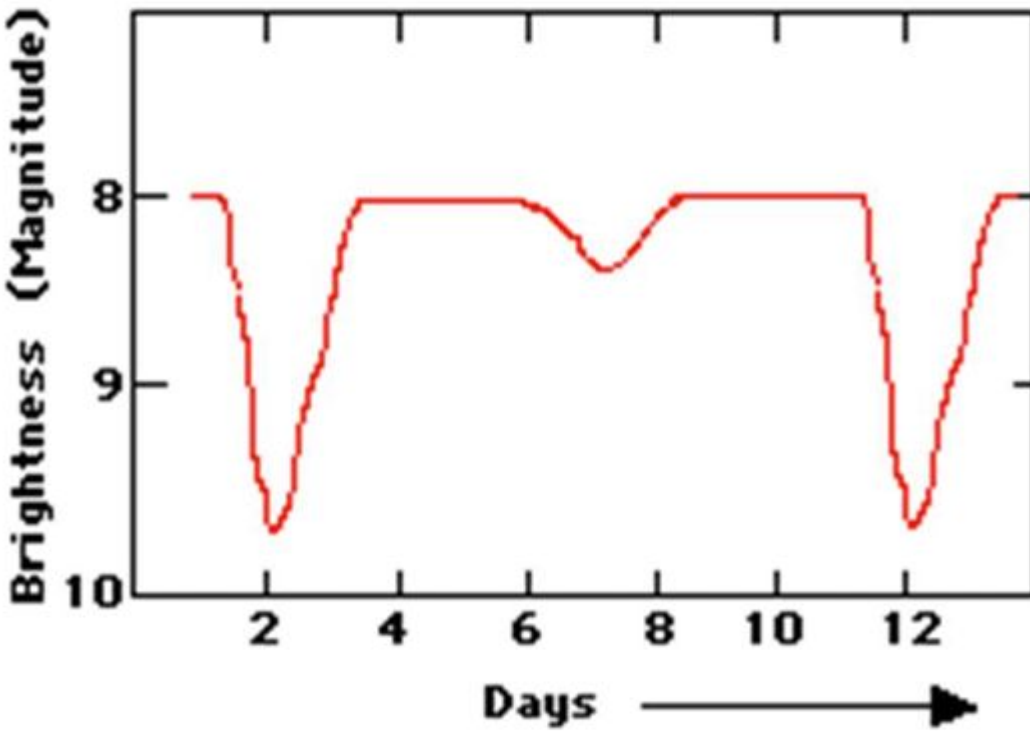
Calculate unknown object magnitude with Maxim DL pro



Step 3: Sampling through time to obtain light curve

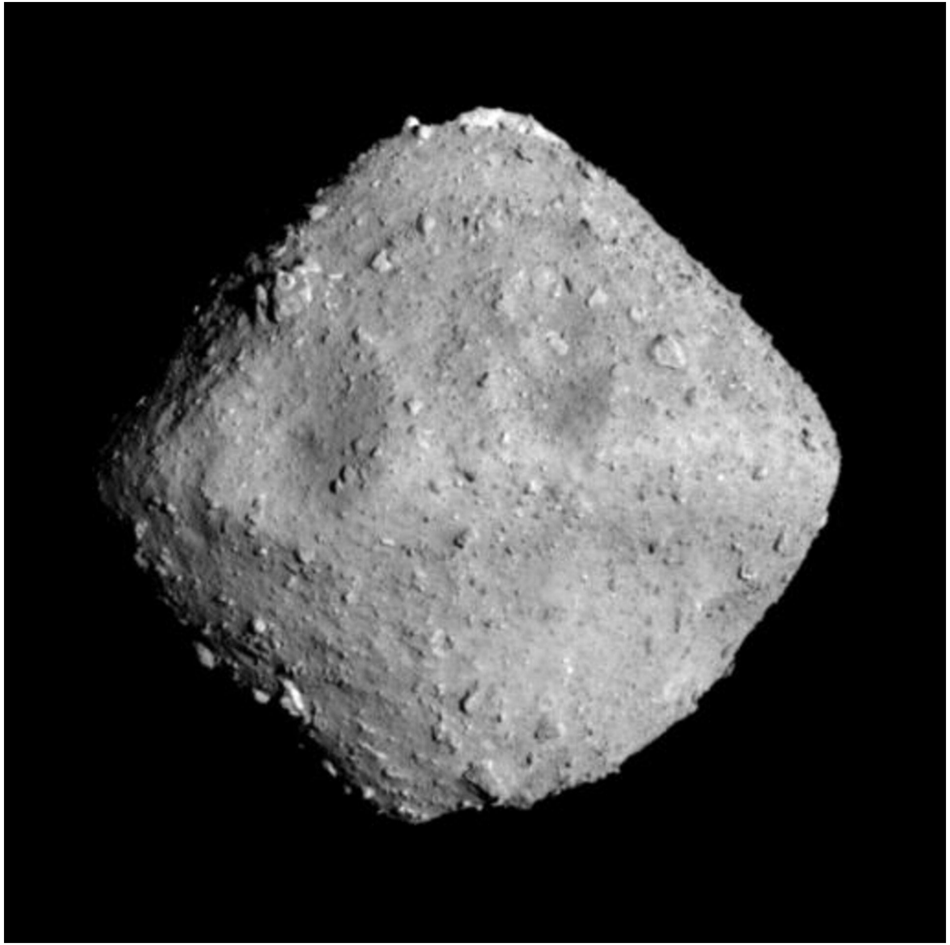
Light curve: magnitude vs time graph. As we can see the graph is periodical

[Light Curve Analysis - Boyce Astro (boyce-astro.org)]

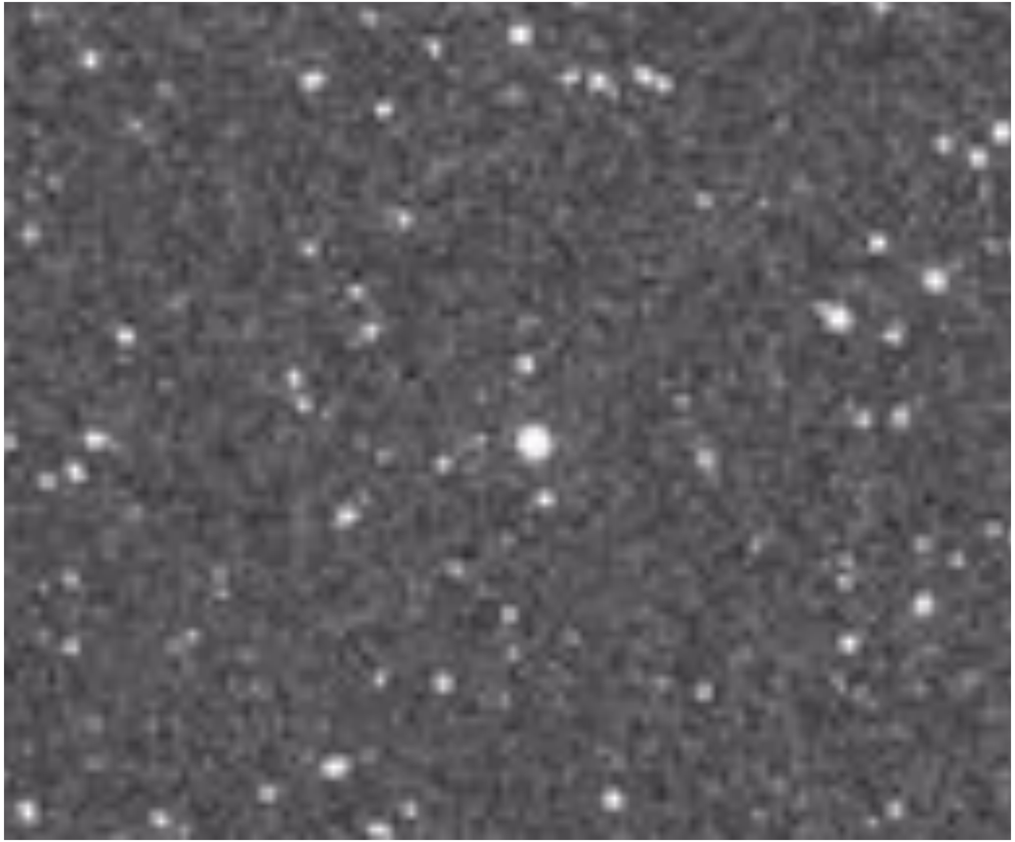


Main target: Siengena

Dimensions 165.01±2.7 km
170.35 ± 8.40 km[4]
Mass (8.14 ± 1.58) × 1018 kg[4]
Mean density 3.14 ± 0.76 g/cm3[4]
Synodic rotation period 9.763 h (0.4068 d)
Absolute magnitude (H) 7.43

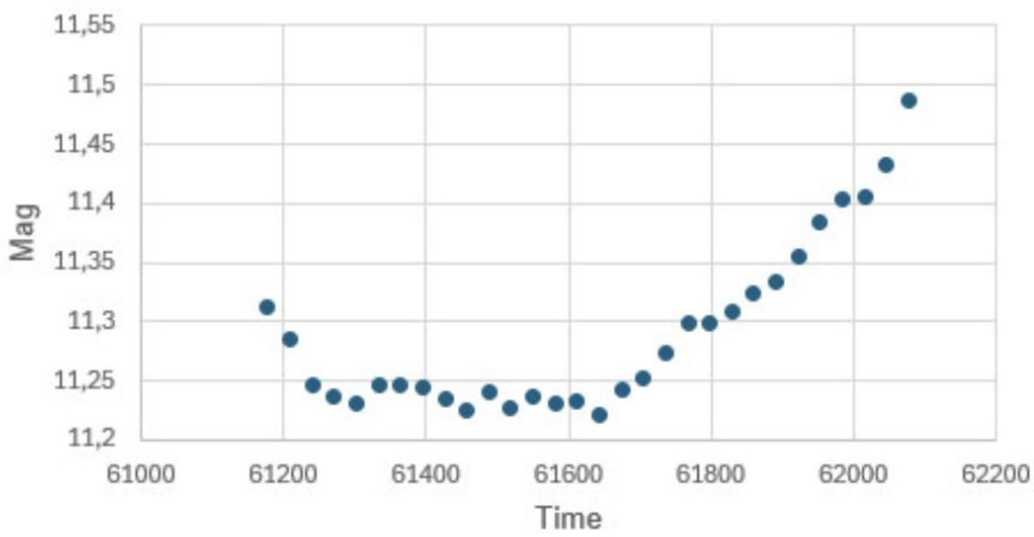


Step 3: Asteroid through time



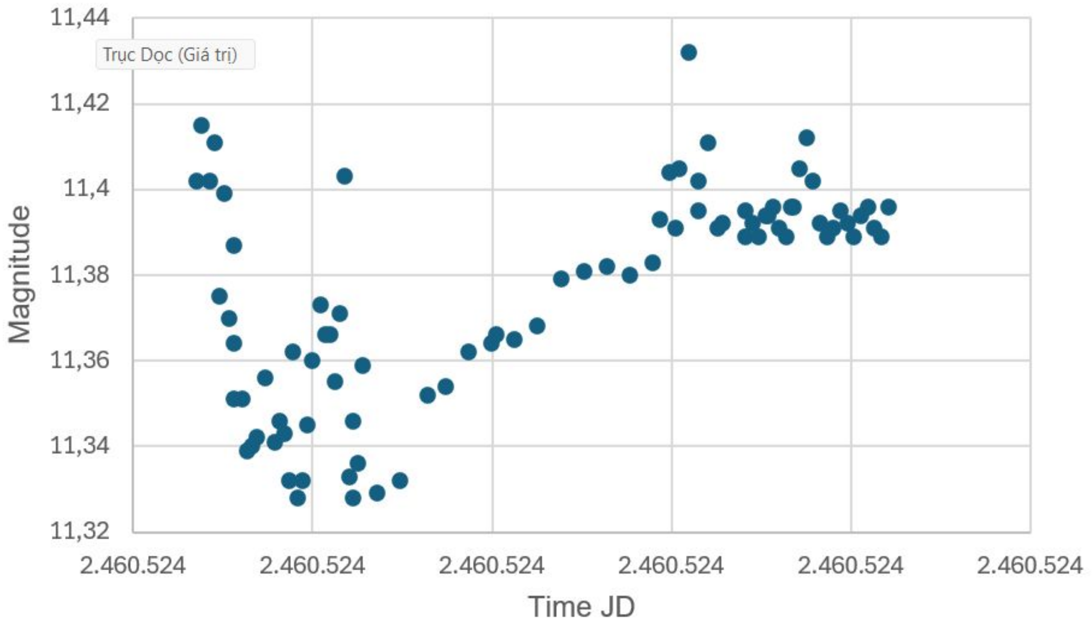
Step 4: Lightcurve analysis

- Raw Light curve of Siegena
- 31/7/2024
- Object: Asteroid 386 Siegena
- 386 Siegena,19 27 26.0,+01 39 10.6
- Telescope: CDK600
- Camera: ZWO ASI2600MM PRO,
  Binning 2, Temperature 0 ºC, Gain 100.
- Data: 40 frames, E
- Exposure time 30s/1 frame.



Step 4: Lightcurve analysis

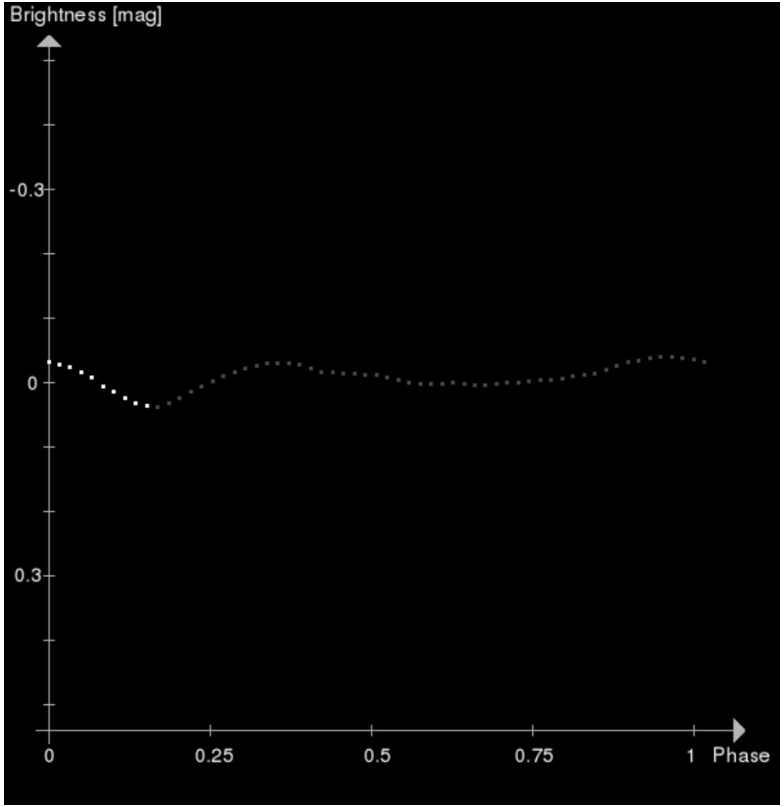
- Raw Light curve of 386 Siegena
- 01/08/2024
- Object: Asteroid 386 Siegena
- Ra/dec: 19 27 26.0/+01 39 10.6
- Telescope: CDK600
- Camera: ZWO ASI2600MM PRO, Binning 2, Temperature 0 ºC, Gain 100.
- Data: 150 frames,
- Exposure time 10s/1 frame.



Step 4: Lightcurve analysis

We have not had enough data and time to make our own phased diagram.

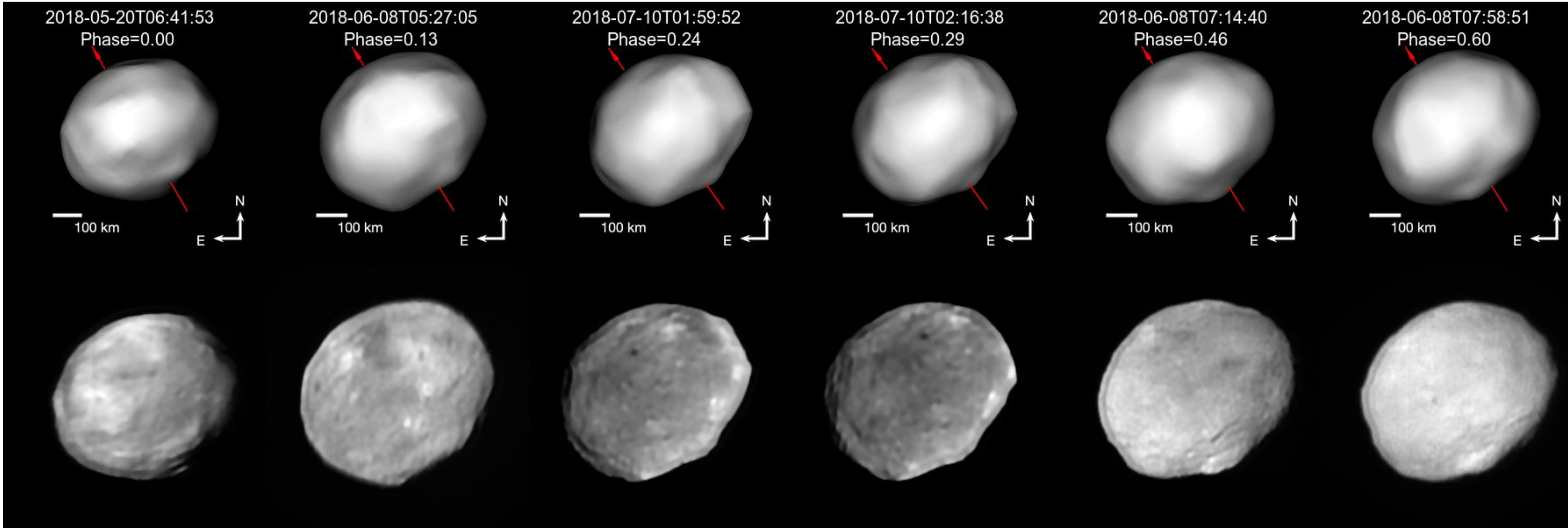
Example of phased light curve of Siegena from other telescopes.



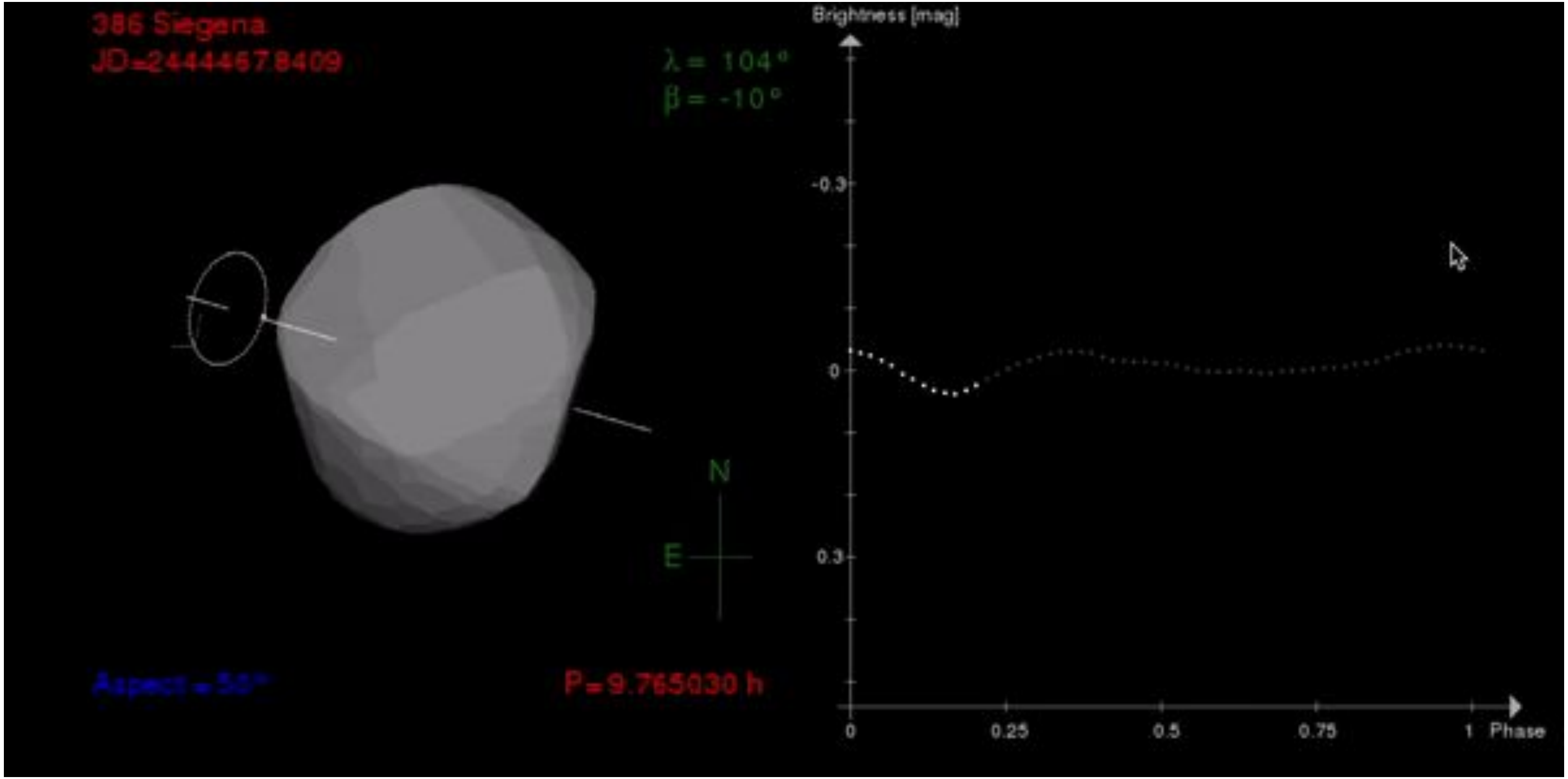
Step 4: Light curve analysis

DAMIT contains asteroid models that were derived using the *light-curve inversion* method

[Documentation - DAMIT (cuni.cz)]



Step 4: Shape model of Siegena asteroid



Q&A

Thank you very much!