The rotational periods of Jovian Irregular Satellites

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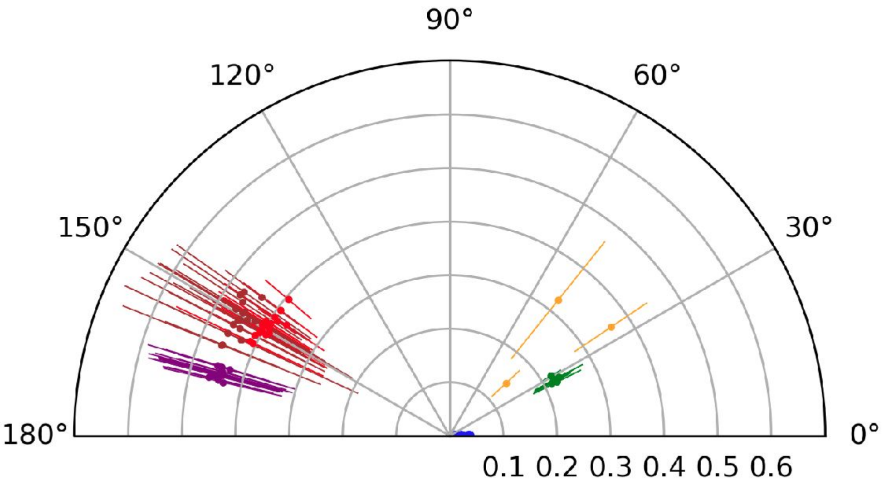


Fig. 1: Orbital characteristics of the Jovian satellites. Each point corresponds to a satellite. The radial axis is the distance in Jupiter's Hill radius. The angle is the inclination relative to Jupiter's equatorial plane, where those with inclination between 90º and 180º have retrograde orbits. The lines show the variation in distance for a satellite along its orbit, i.e. their eccentricities. In blue, we have the regular satellites, in green the Himalia orbital family, in red the Ananke family, in brown the Pasiphae family, in purple the Carme family, an in orange those that don't belong to any orbital family.

Introduction

- The Giant Planets of the Solar System have many satellites that are very distant, with eccentric, inclined, and, in most cases, retrograde orbits. Because of their orbital characteristics, they were classified as "Irregular Satellites".

- By February 2022, 146 irregular satellites are known, 71 Jovian, 59 Saturnian, 9 Uranian and 7 Neptunian ones. Compared to Jupiter and Saturn. The low number of Uranian and Neptunian satellites are probably due to observational bias.

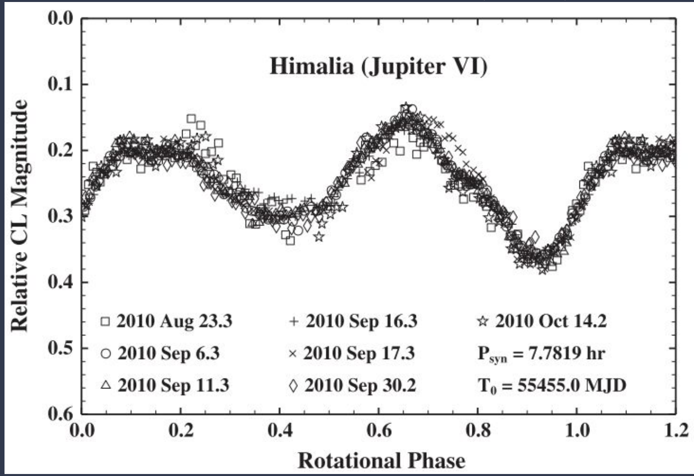
- The orbital configurations of irregular satellites are strongly associated with capture rather than in-situ formation. If they were captured, it remains the questions "What mechanisms are responsible for their captures?" and "Where do they come from?".

Goal

- Observe the major irregular satellites of Jupiter (Himalia, Elara, Pasiphae, Carme, Lysithea and Sinope) to obtain rotational light curves.
- Derive rotational period for these satellites from the observations made between 2019 and 2021 using the methodology provided by Kaasalainen & Torppa (2001a) and Kaasalainen et al. (2001b).
- Use the technique of sight curve inversion to determine the 3D shapes.
- Train students to observe at Pico dos Dias Observatory (OPD) and perform photometric analysis of the observations.
- Observations in 2020 impaired by COVID-19, which closed the telescope for a few months.
- Many nights in 2021 impaired by weather.

J6 Himalia

Previous work: Pilcher et al (2012).



Pilcher (2012) identified a rotational period of 7.7819 ± 0.0005 h.

Result

- Rotational period: 7.7821h.

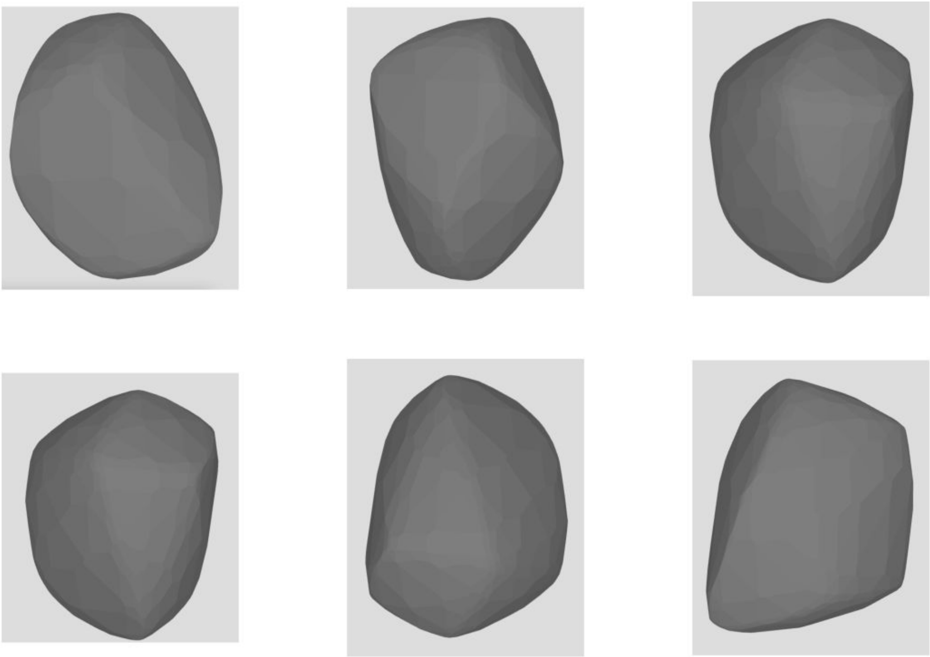
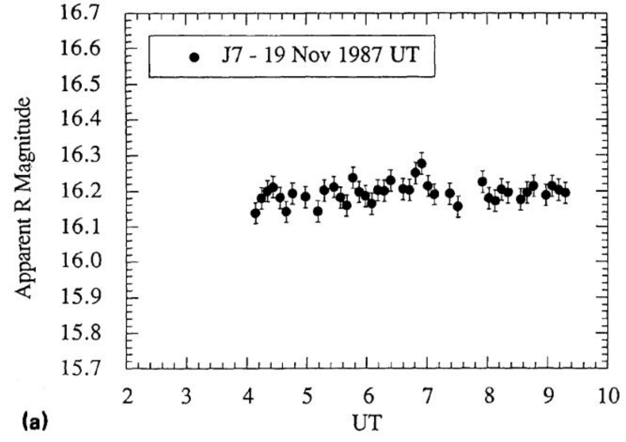


Fig 2: Preliminary solution for the 3D shape of Himalia.

J7 Elara

Previous work: Luu (1991).



No significant magnitude variation was identified.

Result

- Rotational period: 9.596h.

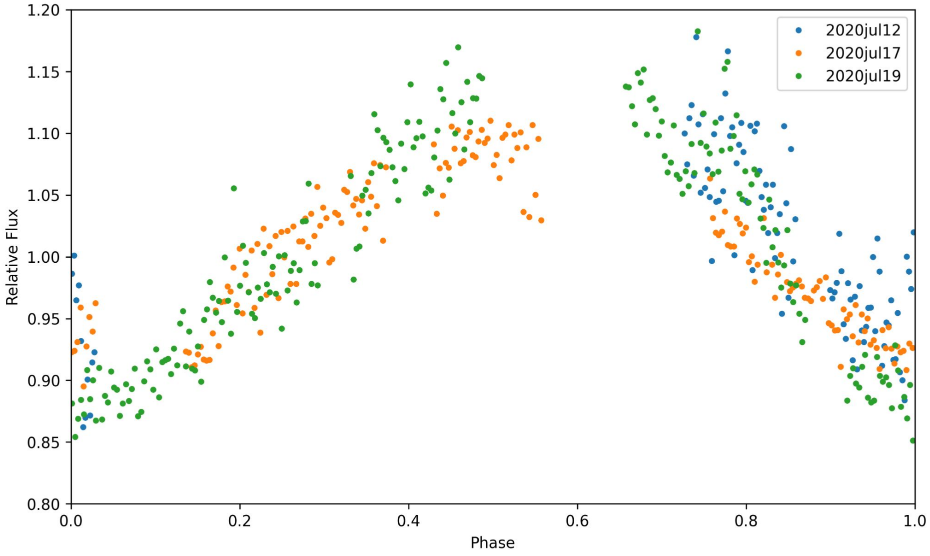
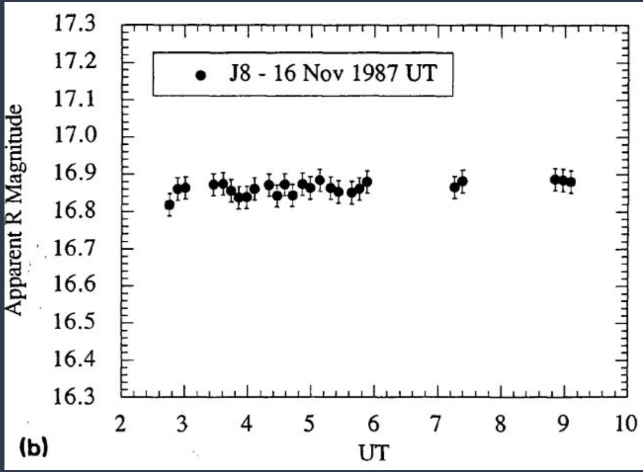


Fig 3: Rotational phase curve from 2020 observations obtained at OPD given rotational period of 9.596h.

J8 Pasiphae

Previous work: Luu (1991).



No significant magnitude variation was identified.

Result

- Rotational period: inconclusive;
- More observations needed.

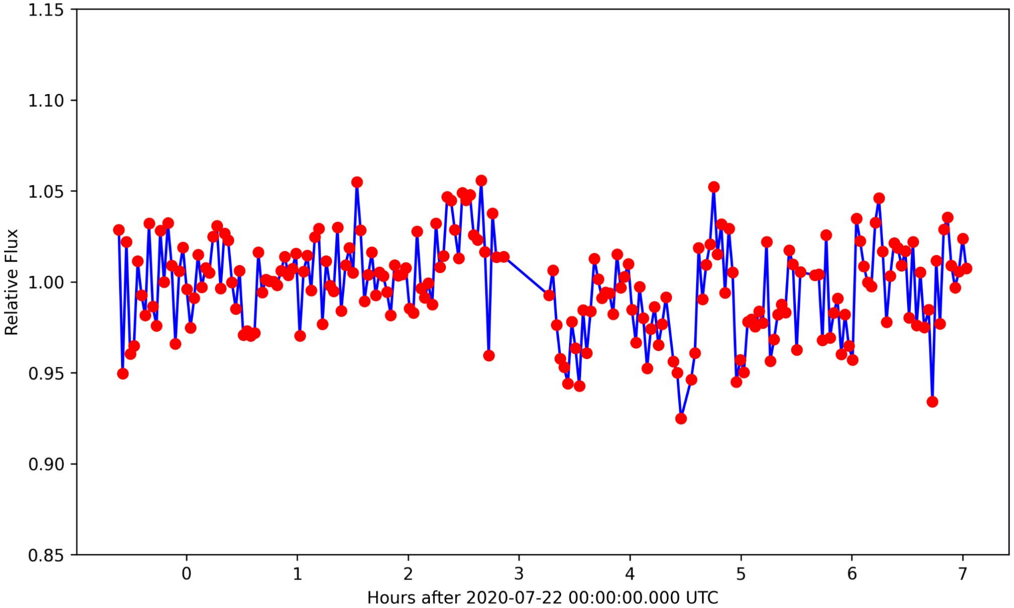
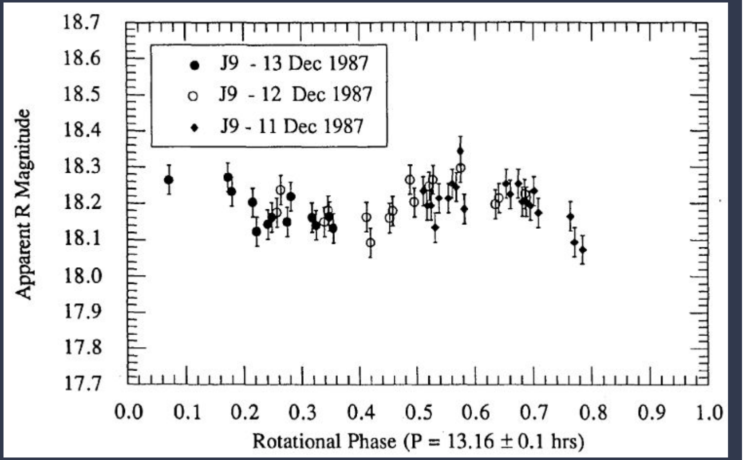


Fig 4: Rotational light curve observed in July 21, 2020 at OPD. No significant magnitude variation was identified in the course of 7h.

J9 Sinope

Previous work: Luu (1991).



Luu (1991) identified a rotational period of 13.16 ± 0.1 h.

Result

- Rotational period: inconclusive;
- Longest observation: 4h
- More observations needed.

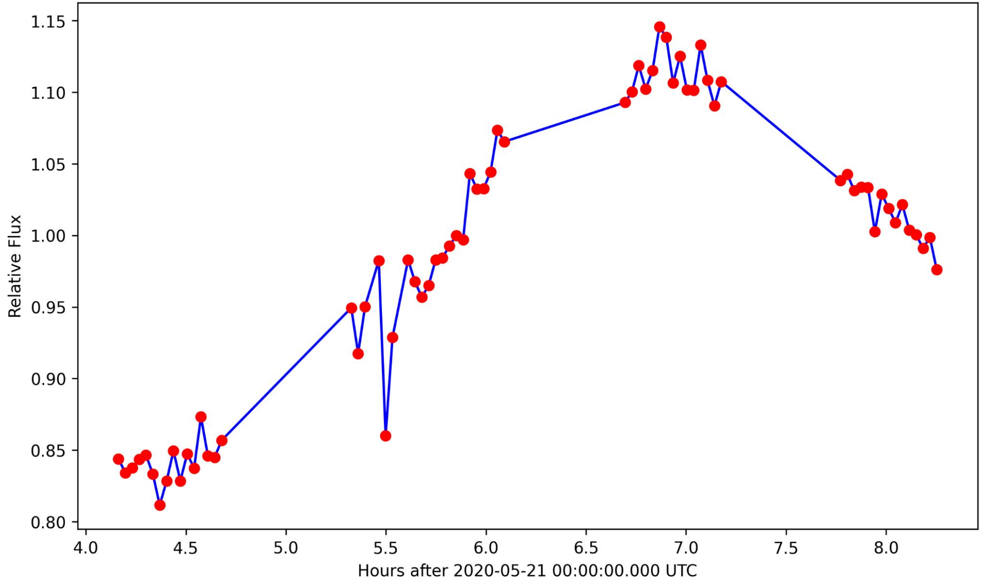
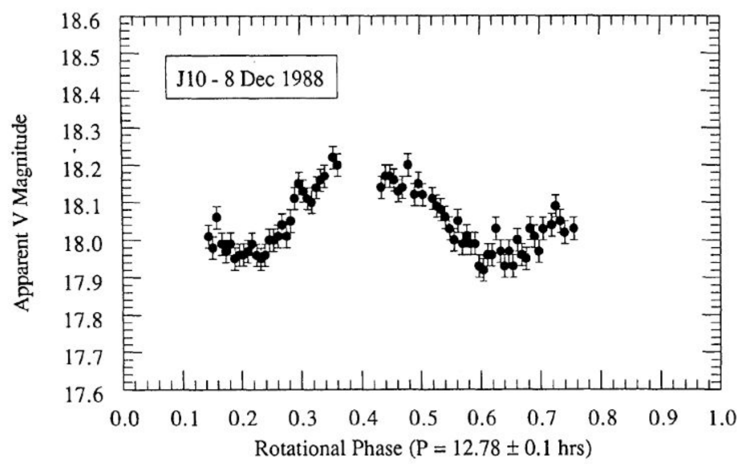


Fig 5: Rotational light curve observed in May 20, 2020 at OPD.

J10 Lysithea

Previous work: Luu (1991).



Luu (1991) identified a rotational period of 12.78 ± 0.1 h.

Result

- Rotational period: inconclusive;
- More observations needed.

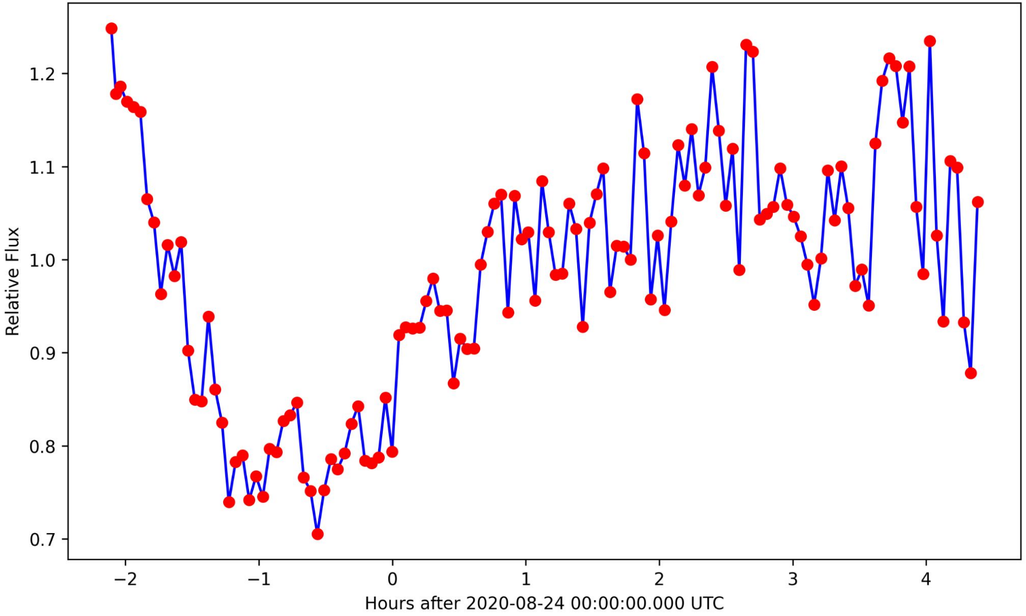
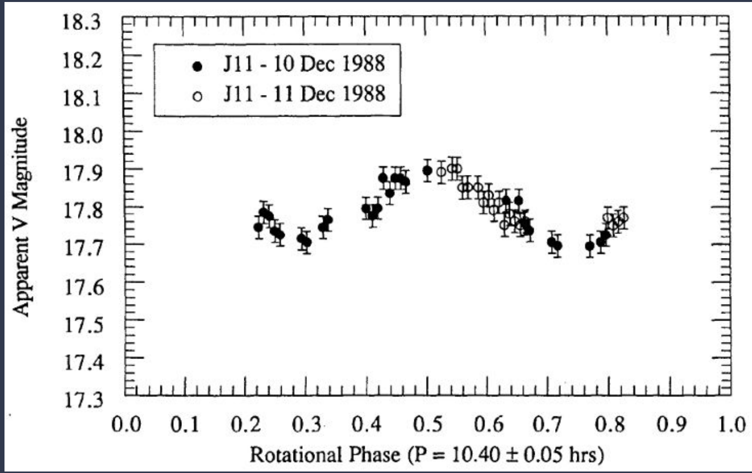


Fig 6: Rotational light curve observed in August 23, 2020 at OPD.

J11 Carme

Previous work: Luu (1991).



Luu (1991) identified a rotational period of 10.4 ± 0.1 h.

Result

- Rotational period: 6.48h.

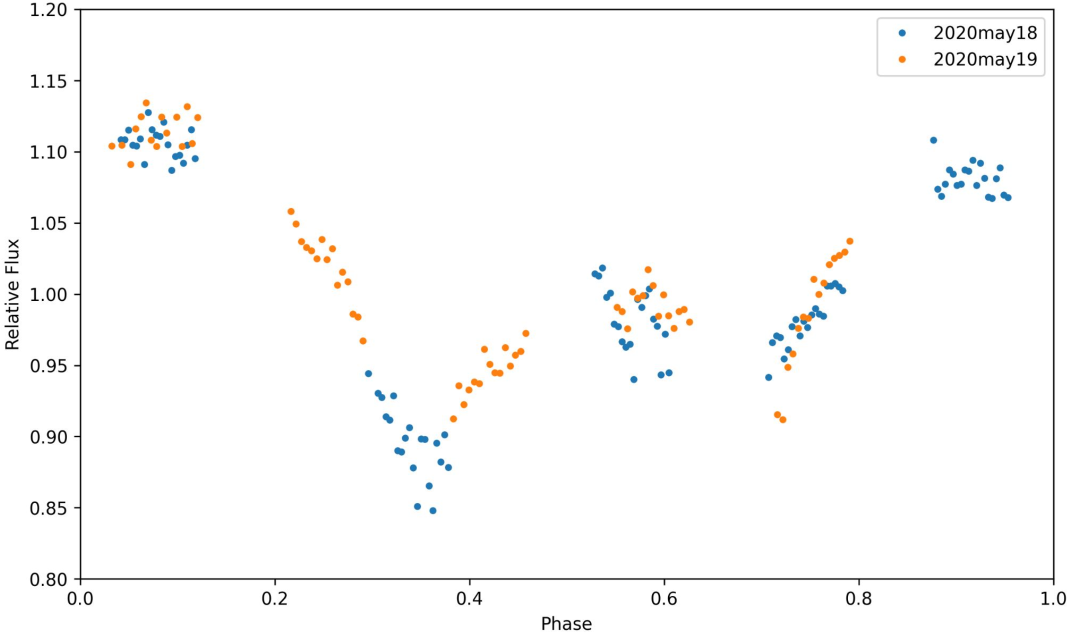


Fig 7: Rotational phase curve from 2020 observations obtained at OPD given rotational period of 6.48h.

Conclusion

- Possible rotational periods for Elara (9.596 h) and Carme (6.48 h) determined.
- Improved rotational period for Himalia and preliminary 3d shape obtained.
- Pasiphae has a long period or it was with its pole at our direction, generating a flat light curve.
- Sinope and Lysithea had magnitude variations detected, but the rotational period could not be obtained.

Perspectives

- Apply the technique of image subtraction to obtain rotational light curve from the 2019 observations (denser FoV).
- Obtain more light curves from new observations (24 nights at OPD in 2022).
- Obtain the 3D shape for the satellites, if possible.
- Publish the results.