

2025 PHEBAT OBSERVATION CAMPAIGN

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Abstract. We call upon the amateur astronomer community for the Saturn PheSat mutual events campaign, period 2024-2026. Occultations and eclipses with Saturn satellites occur every 16 years, during the planet equinox. The events are relatively easy to observe, and they are worth interesting because they allow to quickly complete the chain process with observation - analysis - light curve - astrometry/photometry. After presenting the scientific interest, we propose a review of the previous campaigns, details on the photometry of the PheSats and their observation, as well as a review of the events for the coming period.

Keywords: Saturn, Observation, Eclipses, Occultations, Astrometry, Photometry

1 Mutual events

Mutual events are eclipses and occultations between planetary satellites. They occur during the planets' equinoxes as on Earth, when the Sun crosses the equatorial plane, that is to say every 6 years for Jupiter, 14 years for Saturn, and 42 years for Uranus. The large satellites of these planets have their orbits in the equatorial plane and each planet has several major satellites. Because the Earth will cross the equatorial plane of the planet too, the satellites will eclipse and occult each other mutually for a groundbased observer during a one-year period around the equinox. Although, for astrometric purposes mainly, we use to follow each phenomena campaign: Jupiter in 2009 (?), 2015 (?) and 2021 (?), Saturn in 1995 (?), 2009 (?) and 2025 (now), Uranus in 2007 (?).

2 Observation campaign

2.1 What is recorded ?

With simple amateur or professional instruments and cameras, the final result consists in recording a light curve (see Fig. 1). During the event, eclipse or occultation, the light coming from the satellites varies in flux, and this is this variation that helps us to determine the timing of the minimum flux, i.e. the timing of the event. Note that defocusing could help to avoid camera saturation and thus, will not be a problem for mutual event observation.

2.2 Previous campaigns

With Fig. 2 we investigate simple results of previous campaigns involving amateur and professional amateurs at Paris Observatory.

With Jupiter mutual events, the key point is the increase in the number of observation sites and observations in time. This is obviously correlated to the number of observable events, but it mainly depends on the democratization of the instrumentation among the amateur community.

With Saturn mutual events, the numbers of sites and observations remain unfortunately low. In fact, such events were previously - and technically - complicated to observe due to the proximity of the satellites with the rings, yet very brights. With the democratization of fast cameras, we hope that this number will increase in time as well, in the future.

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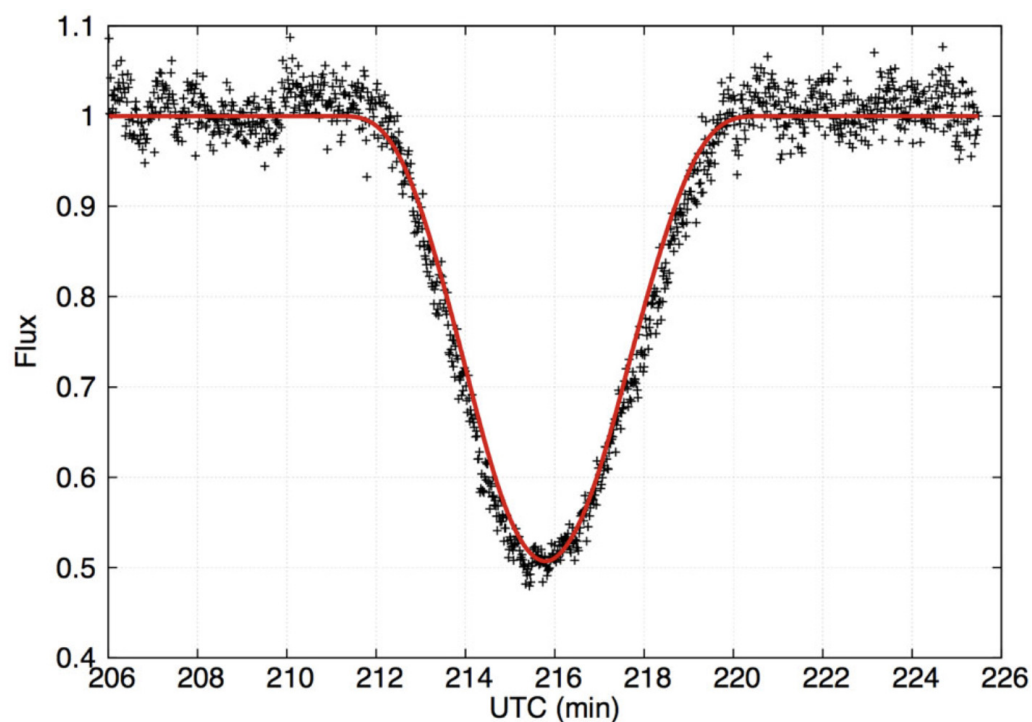


Fig. 1. Example of light curve: the light coming from the satellites varies in flux during the event.

	Observations	Sites	Observed events	Observable events
Jupiter				
1973	91	26	65	176
1979	18	7	9	60
1985	166	28	64	248
1991	374	56	111	221
1997	275	42	148	390
2003	361	42	116	360
2009	523	68	206	237
Saturn				
1980	14	6	13	213
1995	66	16	43	182
2009	26	15	17	131
Uranus				
2007	52	19	36	193

Fig. 2. Results of previous observation campaigns of mutual events at Paris Observatory.

2.3 Campaign interests

One should ask about the interest in observing Saturn mutual events in the framework of the Cassini mission. In fact, the motion of the satellites is now very well-known. That being said, we could infer on two scientific aspects with this observation campaign: 1) confirming that mutual event observations are still one of the best ways to provide astrometric accurate measurements from ground, and by improving general photometry of the satellites since their albedo maps are not enough accurate, as well as the corresponding photometric models.

2.4 Event selection

A webpage, created by M. Irzyk, is dedicated to the campaign at http://www.astrosurf.com/whitebridge/phesat/index_phesat.html. One could find all information about upcoming events, observation feasibility and 3D visualization. Fig. 3 shows an example of an extraction for 2025 PheSat mutual events.



Fig. 3. Results of previous observation campaigns of mutual events at Paris Observatory.

3 Conclusions

Our goal is to aggregate as many participants as possible for the 2025 PheSat campaign. Observing mutual events is one of the best way for amateur and professional astronomers to work together for scientific purposes. Astrometry comparison and photometry improvement in this case.

The number of main upcoming events are the following: 4 events at the second semester of 2024, 15 events in 2025, and 1 event in 2026. All participants interested in observing could send an email to the authors. All data should be sent through the Paris Observatory ZendTo application (<https://zendto.obspm.fr>) with V. Robert as the recipient (vincent.robert@obspm.fr).