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A stellar occultation by Ganymede

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Abstract

A detection of Ganymede's exosphere was attempted by taking advantage of a favorable stellar occultation event happened on 2016. Observations were conducted from NASA IRTF at Hawaii and from Sobaeksan Optical Astronomy Observatory in South Korea. The event was disturbed by unfavorable weather conditions, mainly at the Hawaii site. The results of light curves analysis will be discussed, as well as the next observing opportunities before the expected JUICE mission arrival in the Jovian system.

1. Introduction

The first clear evidence of an exosphere at Ganymede was found by Galileo-UVS through H Lyman-α emission [1], followed by the detection of far-UV atomic O airglow emissions by HST-GHRS [2] and further evidence for neutral H by HST-STIS [3]. These detections, together with their spatial distribution and to the detection of an intrinsic magnetic field of the satellite [4], reconnecting with the Jovian magnetic field and partially shielding the surface equatorial latitudes from the electrons impact, brought to ascribe the UV observations to auroral processes, signatures of dissociated molecular oxygen in an exosphere [5],[6]. Nevertheless, the physical mechanisms governing these processes are not known with certainty, e.g. whether the emissions morphology is determined by the spatial distribution of magnetospheric electrons or by an uneven O_2 exosphere or both [7]. Furthermore, an extended dust environment has been detected by in situ instruments on board Galileo spacecraft..

2. The 2016 stellar occultation

On 2016 April,13th the Jovian satellite Ganymede occulted a 7th magnitude star. The predicted occultation track crossed the Northern Pacific Ocean, Japan, and South Korea. Hence, it was a very favorable event due to the star brightness and to the visibility from the large aperture telescopes at Hawaii. While no other similar event is expected for the next 10 years, only two occultation events are reported in literature in the past, from Earth in 1972 [8] and from Voyager [9] and their results were in large disagreement in respect to the atmosphere detection.

3. The observations

Two main telescopic observations have been set up to look for exospheric signatures in the occultation light curves. At Mauna Kea (Hawaii) the NASA-IRTF telescope was used covering visible and near-infrared spectral ranges with two instruments simultaneously (MORIS [10] and SpeX [11]), while Sobaeksan Optical Astronomy Observatory (SOAO) acquired visible-range images from South Korea. IRTF instruments were fed by the same optical entrance through a dichroic beam splitter at 0.95μm. Given the short time of exospheric region crossing, all instruments were used with an acquisition frame rate as high as possible, which resulted in about 4 Hz for MORIS, 0.35 Hz for SpeX and 0.2 Hz for SOAO.

The occultation tracks were slightly different from the two observing sites, as shown in figure 1. Despite it was a very favorable event due to the star brightness and to the visibility from the large aperture telescopes at Hawaii, the event has been spoiled by unfavorable weather conditions, that severely reduced photometric accuracy at least at Hawaii. Observations, results, and future similar opportunities before the arrival of the JUICE mission in the Jovian system will be illustrated and discussed.

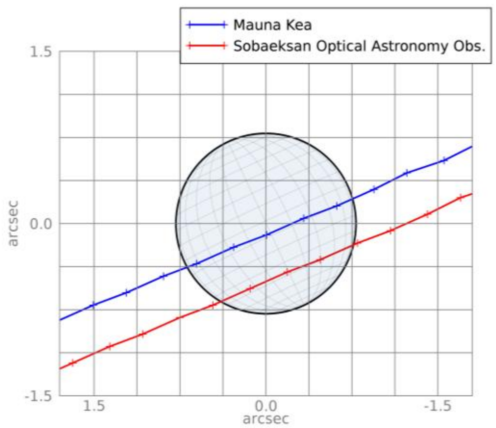

Figure 1: star tracks in respect to Ganymede from the two observing sites during the 2016,April occultation.

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