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The Campaign for the Occultation of UCAC4-347-165728 (R=12m2) by Pluto on June 29th, 2015

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Abstract

The occultation of UCAC4-347-165728 (R=12m2) on the 29th of June 2015 by Pluto is the last important occultation by Pluto before the New Horizons flyby 15 days later. Therefore it is a great opportunity to measure details of Pluto's atmosphere from Earth at the same time as the “on-site” determination. Observations from mobile stations and from certain fixed site observatories are planned in an international campaign in Australia and New Zealand. The telescopes will be equipped with EMCCD or CCD cameras to record a frame sequence linked to the exact timing by GPS. With high resolution astrometry in the months and weeks before the event, we intend to define the central line of the occultation so accurate that a positioning of instruments in close proximity of the central line is possible. - First results of the campaign will be presented in this report.

1. Introduction

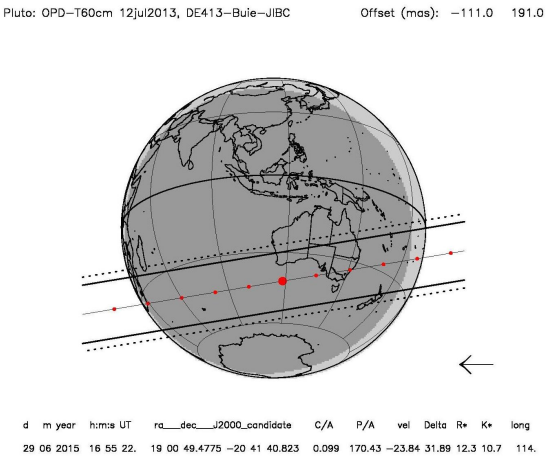
Occultation observations are one of the main techniques, to determine conditions of Pluto's atmosphere from earth. The New Horizons encounter will take place only 15 days after the occultation. It is a very unique opportunity to compare and link ground based and space based observations of Pluto and its atmosphere. In the past, Pluto's atmosphere has been detected and continuously monitored over the last 30 years by occultation astronomy. Important highlights were the discovery of the atmosphere in 1985 (Brosh [1] and 1988 (Hubbard [2]) and the determination of its expansion in 2001 [3], [4]. The brightness of the star (R=12m2, K=10m5) allows us to achieve a very good signal to noise ratio for this occultation. Frame rates and therefore spatial resolution can be high as compared to other past events. High precision astrometry in the months and weeks before the event is needed to be able to position mobile stations precise enough for recording the central flash of the occultation. Such observations allow the measurement of a possible oblateness of the atmosphere and absorption by aerosols. The main landfall of the occultation track is in Australia and New Zealand.

Cooperations between professional and amateur astronomers (PRO-AM) are essential for a good coverage of the occultation track as has been proved in the past [5], [3]. Space probes such as New Horizons can give precise data only for one time point. But a continuous monitoring of the variations of Pluto's atmosphere over years can only be achieved by occultation work. In case of Pluto with its highly eccentric orbit, its distance from the sun is increasing for the next 100 years and therefore the solar energy flux is decreasing strongly. This is a big meteorological experiment running already and should deliver insights in many processes of an atmosphere not only valid for Pluto. Using occultations over the next decades, we hope to monitor a possible “freezing out” of Pluto's atmosphere.

2. The Observations

2.1 The prediction and updates

The first prediction of this occultation has been published by M. Assafin et.al. in 2010 [6]. The central line crosses areas well populated with smaller and larger fixed site or mobile telescopes in southern Australia. The full shadow of Pluto moves across large parts of Australia and New Zealand. The graphics below results from an improvement in the star position and a new drift determination of Pluto's ephemeris as calculated based on Benedetti-Rossi et.al. [7].



Occultation track for Pluto occultation of UCAC4-347-165728 (29th of June, 2015, ~16h 55min UTC. Best prediction up to the time of 29th Apr 2015

This is the best occultation track available for the moment (29th of April, 2015). Further updates by astrometry to improve the prediction will be posted at http://devel2.linea.gov.br/~braga.ribas/campaigns/

Besides other information tools, the deployment of observers is shown in "OccultWatcher", a communication software written by Pavlov, H. (http://www.occultwatcher.net).

2.2 Observation technology

Because of the brightness of the star, instruments starting with about 8 inch diameter can be used for the observation campaign. The cameras in use are either EMCCD or CCD cameras either digital or video ones with inserted timing from GPS receivers. Determining the precise time for each frame is extremely important for data analysis afterward. The timing gives a fixed frame work which fits the different stations together.

Frame rates will range from 3 frames per second (fps) to 20 fps depending on instrument size. This gives a resolution of 8 km to 1.2 km based on the relative speed of Pluto's shadow of 24 km/sec. Stations will be distributed or fixed site observatories will be prepared at different distances from the central flash and also father away to capture the full body of Pluto.

Many observers use the Tangra software (Pavlov, H.,http://www.hristopavlov.net/Tangra/Tangra.html) for data analysis, specially suitable for video recording analysis.

2.3 The international campaign

For occultation work, international campaigns are essential as well as the cooperation of professional and amateur astronomers. A good overview of organizing and running full observation campaigns is given by Mousis et. al. [5]. For this event European observers will join with Australian and New Zealand observers and observers from other nations.

3. Expected results

Because of the brightness of the star, we intend to derive temperature and pressure profiles of the atmosphere with high signal to noise ratios. Data from the stations distributed close to the central track may lead to a study of the oblateness of the atmosphere as well as possible absorptions (central flash observations). The comparison of almost simultaneous space data (New Horizons) and ground-based occultation data will allow to improve the results derived from the ongoing monitoring of Pluto's atmosphere. Besides pure scientific results, the campaign should present one more good example of cooperations between professional and amateur astronomers as well.

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