EPSC Abstracts
Vol. 11, EPSC2017-829-4, 2017
European Planetary Science Congress 2017


# The 19th of July 2016 Multi-Chord Stellar Occultation by Pluto - A European PRO-AM cooperation

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## Abstract

The occultation of the 14th mag star UCAC4 345-180315 by Pluto on the evening of the 19th of July, 2016 could be observed from large parts of Europe, middle east and northern Africa as well. A campaign had been organized with many observers and observatories throughout Europe and other countries. Professional as well as amateur observatories and observers shared in a PRO-AM cooperation to achieve the highest possible coverage. The scientific goal was the ongoing monitoring of Pluto's atmosphere, waiting for a possible shrinking of its pressure due to the increasing distance of Pluto from the sun. The astrometric predictions were largely done by the RIO team and Bruno Sicardy's. An occultation of a fainter star 5 days before (14th of July) was successfully observed and used as a "pathfinder" for the main occultation on the 19th. In an unprecedented action, the GAIA team released the star position of the target star 2 months before the GAIA DR1 catalogue was made public. This helped to determine the occultation track for the 19th with extremly high precision (pre- versus post occultation calculation only differed in less than 100 km).

Because of relative good weather conditions for the event, observations of about 30 stations could be recorded and analyzed. This report will describe the observations, the lightcurve analysis and will give some insights in the atmospheric situation in the year after the New Horizons flyby.

## 1. Introduction

Because a space probe flyby can only determine conditions in the atmosphere for one single time point, a continuous monitoring of the status of the atmosphere of Pluto using stellar occultations has to be performed. Occultation astronomy is the only precise way to evaluate these data. The increasing solar distance of Pluto since 1988 leads to a decrease in solar flux down to 79.5% up to now and down to 47% for the next aphelion in about 100 years.

## 2. Observations

Observing stations with telescopes ranging from 0.20m to 3.58m diameter took part in the campaign. One of the main obstacles for many observatories was the close proximity of the target to the full moon. The angular distance was only about 10 degrees. Furthermore, the event took place for central Europe only low in the sky, the elevations were only between 10 and 20 degrees.

Images were recorded either using analogue video cameras or fully digital cameras with 12 or more bit A/D . In most cases timing was provided by GPS receivers or NTP connections, either implementing the time directly into the analogue videosignal or inserting it in the FITS images digitally. Video data files (avi files) were transferred to single FITS image files using ffmpeg software (Linux). All images were analyzed using a batch job written in MIDAS [5] image analysis software using varying aperture sizes dependent on the quality of the images. Plots and statistical analysis were mainly done using DATAPLOT software from NIST [4].

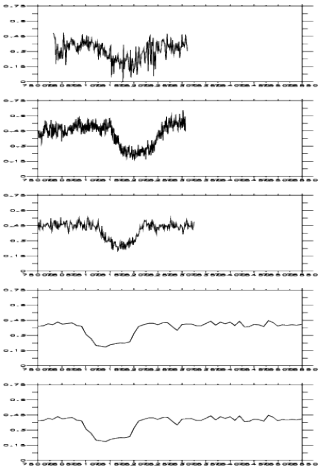

Figure. 1 Some lightcurves for instruments larger then 42 cm diameter

Nearly 30 light curves had been acquired with highly varying quality. This causes some problems in data fitting for further atmospheric analysis.

## 3. Main results

Getting all light curves together, the status of the atmosphere could be determined using fitting procedures as described in [3] and [4]. The post-occultation astrometry, derived from the observed light curves was in perfect agreement with the pre-occultation prediction. The knowledge of the GAIA position of the target star together with the Pluto astrometry from the "pathfinder" occultation 5 days before was a perfect prediction scheme.

The atmosphere has still not collapsed and did not undergo big changes in the year since 2016. A more detailed analysis will follow.

In terms of information of observers this campaign had shown, that in central Europe it is possible to motivate very different observers and observatories to take part in a true multinational observation campaign for professional and amateur observers.

## 4. Acknowledgements

The work leading to this results has received funding from the European Research Council under the European Community's H2020 2014-2020 ERC grant Agreement n°669416 "Lucky Star"

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