Occultation results for 29P/Schwassmann-Wachmann

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Introduction

The object known as 29P/Schwassman-Wachmann (hereafter referred to as SW1) has been classified as a comet due to its long-recognized activity. It has a nearly circular orbit beyond Jupiter with a perihelion distance of 5.7 AU and an aphelion distance of 6 AU. Ignoring its activity, it would otherwise be classified as a Centaur and stands apart from objects normally called comets. SW1 is also orbiting in the transitional “gateway” region between the Centaur and Jupiter-family comet regions (Sarid et al., 2019). The nucleus exhibits sudden outbursts several times each year and this behavior has continued ever since its discovery in 1927.

Comets are notoriously difficult to observe via occultation methods due to the difficulty of relating the opto-center of the coma to where the physical body lies. SW1 has a large variation in activity that is quasi periodic (Miles, 2022). At its times of minimum activity, one can get very close to a direct measurement of the body. Many occultation opportunities were recently published with a few of them visible from the western USA and British Columbia, Canada. This area is where RECON (Research and Education Collaborative Occultation Network) and CanCON (Canadian Collaborative Occultation Network, acting as an extension of RECON) are located and operate (Buie and Keller, 2016). We report on observations from three separate successful campaigns involving SW1.

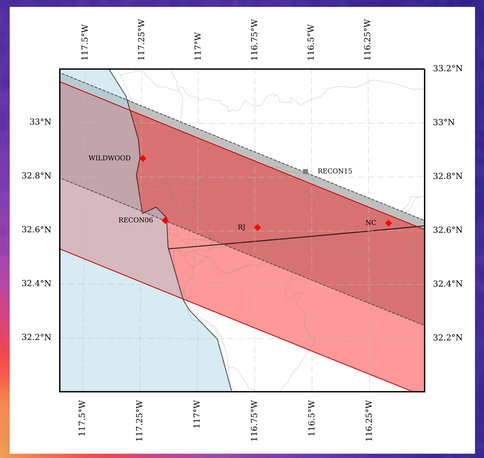
Occultation Predictions

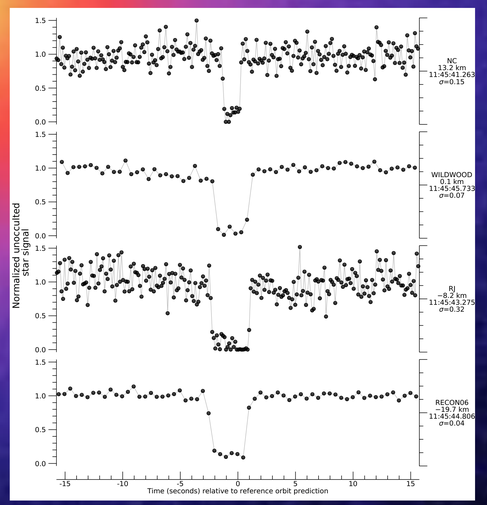
The prediction for all campaigns discussed here were produced by the methods discussed in Miles & Kretlow (2021). Recent astrometry was added to further improve the orbit estimate beyond what had been used for that prediction paper. One key difference for this approach is to recognize the confusing effects of the coma, especially during times following strong outbursts, and to only use astrometry at times when the brightness of the ejected material around SW1 is minimal. At these times, the reflected light in a small aperture is close to that produced by the central body alone. A further difference of approach was to measure a homogeneous dataset of 623 images taken between 2009 Feb 17 and 2022 Nov 17 using the two 2.0-m aperture f/10 Ritchey-Chrétien Faulkes telescopes of the same design, currently operated by Las Cumbres Observatory.

The inherently low scatter of the selective astrometry and the selection criteria used made a compelling case that the prediction and its formal errors might be credible. This assessment was dramatically confirmed on 2022 Dec 05 when researchers from the Lucky Star Paris and Rio teams (J. Camargo, J. Desmars, C. Pereira, F. Braga Ribas, and G. Rossi) obtained a single positive stellar occultation chord using the 4.1-m SOAR telescope on Cerro Pachón, Chile. This successful observation further improved the accuracy of the orbit and, on this basis, we activated RECON and IOTA observers to make an attempt on three campaigns in the western United States.

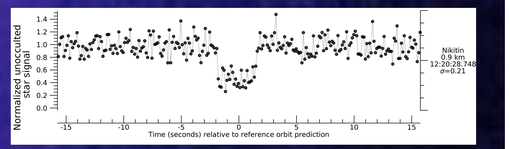
The measurements presented here were collected by RECON, CanCON, and IOTA citizen science volunteers: 20221219 Event - N. Carlson, J. Heller, K. McCandless, A. McCandless, Robert Jones, J. Wise, L. Guiga; 20221227 Event - V. Nikitin; 20230128 Event - V. Nikitin, M. Buie, G. van Doren, Bruce Palmquist, B. Dean, J. Sowell, J. Popchock, Russ Jones, J. Keller, Z. Schierl, C. Kinkead, B. Gowe.

2022 December 19 UT

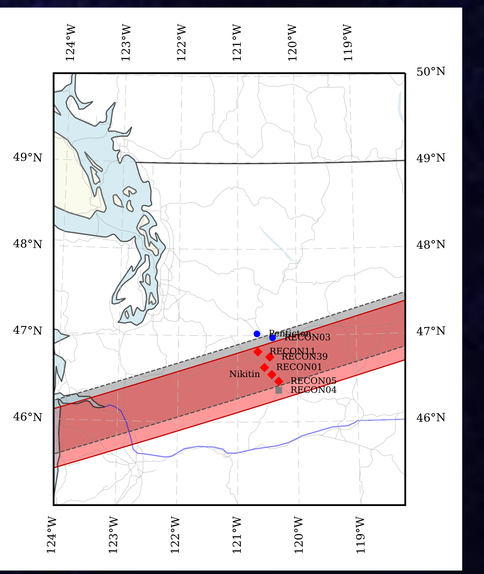




2022 December 27 UT

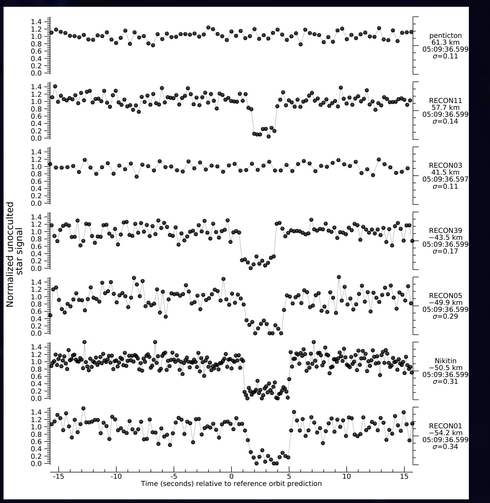


2023 January 28 UT



Occultation Measurements

Successful observations of the SW1 nucleus were obtained in each of three deployed occultation campaign attempts. No obvious signs of extended structures around the body were detected in these events. Four chord were recorded on 2022 Dec 19. While extremely well positioned for the 2022 Dec 27 event, eight RECON sites were clouded out that night and only one chord was obtained in New Mexico. This observation was 18.8 ± 1.7 hours after a significant outburst was seen. There is a noticeable level of residual flux seen during the occultation that may prove interesting. On 2023 Jan 28, five positive chords were obtained.



References

Buie, M. W. & Keller, J. M. (2016) AJ 151, 73.
Miles R. (2022) BAAS, 54, 414.03.
Miles R. & Kretlow M. (2021) JOA, 11, 3.
Sarid, G., et al. (2019) ApJL, 883, L25.

Final results are not yet available. To see the current version of the sizes, shapes, and to discuss implications, find Marc Buie at the meeting (or contact via email). The story is still evolving, but we have an exciting new dataset to help understand this intriguing object.