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Measuring the Scale of the Solar System through Transits of Mercury

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Abstract

We discuss the history of finding the distance of the Earth to the Sun from observing transits of Venus and of Mercury, including our own observations from 2016 as a student and citizen-science exercise. We propose a similar exercise to find the distance of the Earth to the Sun by analysis of simultaneous observations of the 11 November 2019 transit of Mercury by widely separated locations on Earth.

1. Introduction

Following the discovery of transits of Mercury by Gassendi in 1631 and of Venus by Horrox in 1639, Edmond Halley in 1706 suggested a way of finding the scale of the solar system through observations of transits of Venus. Halley's method required exact timing of ingresses and egresses in order to determine the parallax as measured from widely separated points on Earth, beyond observational capabilities because of the black-drop effect (Schneider, Pasachoff, and Golub, 2004; Pasachoff and Sheehan, 2012).

2. Our recent observations

Today we can measure the parallax directly, using simultaneous photo-graphy from widely separated points on Earth, as was carried out at the 2016 transit of Mercury (Pasachoff, Gährken, and Schneider, 2017) and extended and elaborated upon by Backhaus: (https://sites.williams.edu/pasachoff/files/2017/02/PhysicsTeacher-Backhaus-addition.pdf), as we showed along with Big Bear Solar Observatory movies of the transit from southern California (https://sites.williams.edu/pasachoff/2016tom/). In addition, a widespread citizen-science and student observational and citizen-science project (http://www.venus2012.de/transit-of-mercury2016/) determined the solar parallax quite successfully (Backhaus, 2019). Also http://transitofvenus.info.

3. The proposed new effort

We now propose another citizen-science and student collaboration to again measure the solar parallax using simultaneous observations of the 11 November 2019 transit of Mercury taken in Europe, Africa and in the Americas (http://www.transit-of-mercury2019/ and https://sites.williams.edu/pasachoff/2019tom/). Because of its larger geocentric distance compared with 2016, this year it will be even more challenging to determine Mercury's parallax effect. We invite visitors and auditors to join the effort.

Acknowledgments

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Because of its larger geocentric distance compared with 2016, this year it will be even more challenging to determine Mercury's parallax effect.

We invite colleagues, students, and citizen-scientists to join the effort.

References

Backhaus, Udo, 2019, "Die Merkurtransits 2016 und 2019 und die Astronomische Einheit" (published in German), *Astronomie und Raumfahrt in der Schule* **56** (3-4), http://www.didaktik.physik.uni-due.de/~backhaus/publicat/MerkurtransitAR.pdf

Pasachoff, Jay M., and William Sheehan, 2012, "Lomonosov, the Discovery of Venus's Atmosphere, and Eighteenth-century Transits of Venus," *Journal for the History and Heritage of Astronomy* **15** (1), RP1, 1-12. http://adsabs.harvard.edu/abs/2012JAHH...15....3P

Pasachoff, Jay M., Bernd Gährken, and Glenn Schneider, 2017, "Using the 2016 transit of Mercury to find the distance to the Sun," *The Physics Teacher* **55**, 3 (March), 137-141: cover illustration plus article: http://doi.org/10.1119/1.4976653

Schneider, Glenn, Jay M. Pasachoff, and Leon Golub 2004, "TRACE Observations of the 15 November 1999 Transit of Mercury and the Black Drop Effect: Considerations for the 2004 Transit of Venus," *Icarus* **168**, 249-256.

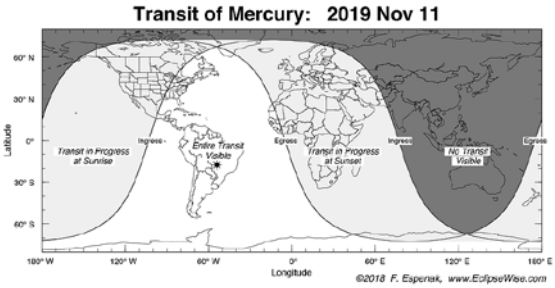

Figure 1. Visibility of the 11 November 2019 transit of Mercury.