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Peer Review

Review of: "Measuring the Distances to Asteroids from One Observatory in One Night with Upcoming All-Sky Telescopes"

Karolina Dziadura[1]

1. Center for Astrophysics Harvard & Smithsonian, Cambridge, United States

The manuscript by Fernandes et al. investigates the feasibility of determining asteroid distances using topocentric parallax from a single observatory in a single night. By applying their method to both synthetic datasets and real observations of two asteroids, the authors demonstrate that their approach yields distance uncertainties at the percent level. They further explore the implications of this technique for upcoming large-scale sky surveys, such as the Vera Rubin Observatory (VRO) and the Argus Array, which will significantly enhance the discovery and characterization of Near-Earth Objects (NEOs). This study is methodologically robust, with strong observational validation, and offers significant contributions to asteroid astrometry, planetary defense, and observational astronomy. Below, I provide detailed comments and suggestions for improvement.

Strengths

- **Methodological Innovation**: The paper successfully extends prior work on topocentric parallax, refining the technique for use in rapid asteroid distance estimation. The study provides strong evidence that single-night observations can yield precise orbital constraints.
- **Application to Real Data**: The authors validate their approach with real observations of two asteroids, strengthening confidence in the method's applicability.
- **Relevance to Future Surveys**: The discussion on VRO and the Argus Array is timely and highlights the potential for large-scale implementation of the technique.
- **Clarity and Structure**: The manuscript is well-organized, with clear plots, an introduction, methodology, and discussion of results.

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Minor Issues and Suggestions

- **Astrometric Reference Frame**: The study does not explicitly describe the astrometric reduction process for the two observed asteroids. It is unclear whether the measurements were linked to the Gaia reference frame or another catalog, which could introduce systematic uncertainties. A detailed discussion of the astrometric calibration, including catalog choice and potential systematic errors, would strengthen the methodological section.
- **Ceres Classification**: Ceres is now classified as a dwarf planet rather than just a main-belt asteroid, so it might be worth updating the terminology.
- **Comparison with Other Distance Estimation Techniques**: Radar ranging is the most established and precise method for asteroid distance determination, yet it is only briefly mentioned in the manuscript. A comparison of the strengths and weaknesses of each approach would help clarify the unique advantages of the parallax technique.
- **Airmass Considerations**: The discussion on airmass is valuable but could be expanded to address potential trade-offs in scheduling observations at different zenith angles. It would be good to discuss the trade-off between observing at high elevations (which improves astrometry by reducing atmospheric distortion) and at low elevations (which extends the observation arc and helps with parallax measurements).
- **Abbreviations**: All abbreviations defined in the abstract should also be explicitly introduced in the main text upon their first occurrence to ensure clarity and consistency.

Abstract

- VRO will not only discover NEOs but also other asteroid groups. This should be mentioned for completeness.
- Including the specific asteroids observed (2024 ON and 4953) in the abstract would improve clarity and completeness.

Introduction

- Clarify why NEOs “are crucial for planetary defense.” While this may seem obvious, an explicit explanation would strengthen the argument.

Conclusion

The manuscript is a significant contribution to the field and provides a robust framework for asteroid distance determination using single-night observations. Addressing the above minor issues would further strengthen the paper. I recommend publication after these small revisions.

Declarations

Potential competing interests: No potential competing interests to declare.