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Peer Review

Review of: "Outer Solar System Spacecraft Without Drag-Free Control to Probe the µHz Gravitational Wave Frontier"

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In this manuscript, the authors perform a careful and thorough analysis of future hypothetical microhertz gravitational wave detectors based on spacecraft in the outer system. The authors argue that the reduced acceleration noise and long periods of the gravitational waves at these frequencies would enable gravitational wave detection without the need for drag-free control and with modest laser or RF powers or with atomic clocks with frequency instabilities that were already demonstrated with the Deep Space Atomic Clock mission. The manuscript is well-written and clear, and the analysis is convincing.

I have only two minor suggestions/comments that could potentially improve the manuscript:

- 1. Unless I missed it, the manuscript lacks discussion of the considerations for gravitational wave source localization. Presumably, at such a large orbit, the orbital period of the detector will be very long, meaning that it could take a long time for the detector's orientation with respect to the source and/or gravitational wave polarization to meaningfully change. How could a supermassive black hole merger be localized with the proposed detector? I feel the manuscript (and proposed concept) would benefit from some discussion/analysis of this important consideration.
- 2. I feel Figure 1 is overly simple and even confusing. I assume the detectors would be in ~10-30 AU orbits around the sun, not the Earth as depicted in that diagram, and I feel it might be helpful to readers to also show the orbits of some of the other planets in the solar system (and maybe even the paths of some prior/existing space probe missions) to give a proper sense of the scale.

Declarations

Potential competing interests: No potential competing interests to declare.