

Peer Review

Review of: "Primary Hairs May Create Echoes"

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I really enjoyed reading this paper. The idea that primary hair alone could produce echoes in the ringdown signal is fresh and exciting, and it's presented in a clear and accessible way. It's great to see new approaches like this being explored, especially because they could open new possibilities for testing gravity with gravitational-wave observations.

There are just a few places where adding a bit more context could make the work even stronger. It might help readers if you could say a few words about whether you expect similar echoes to appear for gravitational or Proca perturbations, since those are the kinds of signals we can actually observe. It could also be useful to briefly relate your chosen parameter values to some of the existing observational constraints – for example, the limits found from black hole–neutron star gravitational-wave events (Lyu, Jiang and Yagi 2022, *Physical Review D* 106, 124017), the recent reanalysis of the GW230529 event reported by Yagi and collaborators in 2024, or the strong bounds coming from the orbital decay of the X-ray binary A0620-00 (Yagi 2012, *Physical Review D* 86, 081504). Adding just a short note on how your parameters compare to these existing studies would give readers helpful context.

The echoes in your time-domain plots look clear, but the amplitude seems quite small. Even a rough idea of how strong they might be compared to the typical noise level in current gravitational-wave detectors could be very helpful.

Lastly, although Table 1 lists some frequencies, a small summary showing how the main frequencies and echo properties change when the amount of primary hair is varied could make it easier for readers to follow the overall picture.

Overall, I think this is a really interesting and well-written paper. With just a few clarifications like these, it could become even more impactful and useful for the community.

Declarations

Potential competing interests: No potential competing interests to declare.