Of Lenses and Wrinkles

Aman Chawla[1]

Abstract

Gravitational lensing magnifies signals from distant sources, including gravitational waves. When a supermassive black hole binary (SMBHB) is strongly lensed, the gravitational wave strain received at Earth is amplified, effectively increasing the number of detectable sources. This lensing effect extends the radius of the gravitational wave influence shell from approximately 1 Gpc to 4 Gpc, increasing the number of SMBHBs contributing to the gravitational wave background from 4 million to over 128 million. These additional signals increase the density of gravitational wave fluctuations in the quantum vacuum, potentially strengthening short-lived entanglement correlations between vacuum quantum computations and neural quantum processes. This suggests that gravitational waves may not only modulate local quantum states but could also provide a lensing-enhanced channel for deeper connectivity between cosmic-scale quantum fluctuations and biological cognition. The brain, as a structured quantum system, may thus be partially shaped by an expanded, lensing-modulated cosmic computational framework.

Gravitational Lensing and the Expansion of Influence

Gravitational lensing occurs when massive structures bend spacetime, magnifying and focusing distant signals. For gravitational waves, lensing does not change the intrinsic physical size of a source but increases the amplitude of the observed wave, making distant sources appear stronger. When an SMBHB is lensed, the strain reaching an observer is amplified by a factor of the square root of the magnification. For a strong lens with a magnification factor of 16, the observed strain increases by a factor of 4. This allows SMBHBs up to 4 Gpc away to produce signals detectable as if they originated from only 1 Gpc. As a result, the gravitational wave influence shell is significantly expanded.

Increase in the Number of Relevant SMBHBs

The volume within a 4 Gpc shell is 64 times larger than that of a 1 Gpc shell. Adjusting for a decrease in the SMBHB merger rate at higher redshifts, approximately half of these additional sources remain relevant for gravitational wave influences on neural systems. This increases the estimated number of gravitationally active SMBHBs from 4 million to over 128 million, substantially increasing the complexity and density of gravitational wave signals intersecting with neural quantum processes.

Implications for Brain Quantum Computation

Gravitational waves couple vacuum quantum fluctuations to structured quantum systems, including biological cognition. With the lensing-enhanced increase in gravitational wave influence, several effects emerge:

---

[1] Prepared in collaboration with an LLM.

- The greater density of SMBHB sources results in a more structured gravitational wave environment.

- More overlapping signals increase the probability of transient entanglement between vacuum fluctuations and neural quantum states; potentially more cosmic quantum statistical information is stored and processed in the brain.

- Lensing-induced signal echoes may introduce periodic reinforcements of quantum correlations, subtly affecting neural phase coherence.

Conclusion

Lensing extends the reach of gravitational wave influences on neural quantum computation, creating a more interconnected cosmic computational framework. The additional SMBHBs brought into influence by lensing increase the number of entanglement opportunities within both the vacuum and biological systems. This raises the possibility that spacetime fluctuations, modulated by lensing, play an indirect but non-negligible role in shaping neural information dynamics. If gravitational waves act as quantum operators, as previously hypothesized, then lensing serves as an external tuning mechanism, refining which quantum fluctuations are most likely to contribute to transient correlations. The brain, emerging after 11.9 billion years of cosmic evolution, does not simply passively exist within a gravitational wave background; it interacts with an expanded, dynamically focused structure of cosmic-scale quantum computation. Lensing, often seen as an amplifier of distant signals, may also serve as a selective filter that enhances the connection between the largest scales of the universe and the localized cognition of biological observers.

Bibliography

1. Chawla, Aman (2025). Wrinkles in Computation. *Zenodo Preprint*.