Wrinkles in Computation[1]

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Abstract

Quantum chromodynamics [2] reveals that the vacuum is teeming with quantum fluctuations, each representing an elementary quantum computation as proposed in [3]. This diffuse computation occurs continuously throughout spacetime. Gravitational waves (GWs), by stretching and compressing spacetime, modulate the density of these quantum events, influencing their interaction strength. This leads to a modified quantum computation model wherein gravitational waves act as quantum operators, modulating both entanglement generation and qubit evolution, effectively defining a 2.5-step quantum computational process rather than the traditional three-step model which has a full measurement step.

Furthermore, GWs also influence axonal quantum processes, meaning the same wave could couple vacuum quantum computations with neural quantum activity, inducing brief but real correlations. These correlations could leave signatures in brain activity, particularly through transient electric field emissions. Given that [4] human-like brains could have only emerged after ~11.9 Gyr post-Big Bang, we propose that the brain is not merely passively existing in spacetime but has become a quantum statistical witness of cosmic computations. This suggests that spacetime, quantum information, and cognition may be interwoven in ways yet to be fully understood.

Introduction and Overview

Suppose a GW traverses a nano-meter-cubed of spacetime. As it passes, the cube's opposite faces alternately separate further and come closer. When they are farther, the density of the quantum events goes down and so their interaction decreases. When they are closer, the density of the quantum events goes up and their interaction increases. With closer interaction adjacent quantum events may lead to entanglement whereas with farther separation, adjacent quantum events can evolve separately (see [8] for the relation between spacetime and embedded quantum objects).

If the contraction is thought to precede the expansion, then this constitutes the substrate of the first two steps of a quantum computation - namely, generate the entanglement and then evolve the qubits separately. Since this is all happening at the GW frequency and under its strain strength, the entanglement and subsequent evolution are affected in their "degree" by the GW's physical parameters. Thus, a generic entanglement-followed-by-evolution is now modulated

[1] The title is inspired by the book "Wrinkles in Time [1]."

[2] Prepared in collaboration with an LLM.

per the GW parameters. This means that the computation is precisely that given by treating the GW as applying a quantum operator.

This completes all but the quantum measurement. The latter can take place once the GW has passed and the individual final qubits randomly collide leading to part decoherence - of course, we must keep in mind that these quantum events dissolve back into the vacuum eventually. So the traditional model of three step quantum computation is modified to a 2.5 step model.

Thus, the GW modulates vacuum quantum computation and we know that it also carries out axon tract quantum computation [5]. And it could be the same GW implicated in both. Thus, there would be induced quantum correlations between the two computations. The correlations would last very briefly but in that brief period, in the brain subsystem at least, they could leave a signature via e-field emission.

Since measuring one part of an entangled pair, affects the possible outcomes in the other part too, regardless of separating distance, this means that the brain now has information flowing in it which tells it about the actual state of spacetime quantum computations. Given that such neural structures appeared after 11.9 Giga-years as per [4], it can be viewed as the emergence of the brain as a "witness" of the universe, in the precise sense outlined herein.

This paper is structured as follows. In Section 1, we discuss the role of gravitational waves as quantum operators. In Section 2, we lay out the modified 2.5-step quantum computation model. In Section 3, we discuss the coupling between the vacuum and neural quantum computations. In Section 4, this leads us to positing the mechanism by which the brain emerges as a witness. We conclude in Section 5.

1. Gravitational Waves as Quantum Operators

Gravitational waves (GWs) distort spacetime as they traverse it, alternately stretching and compressing volumes at the frequency of their oscillation. Consider a nano-meter-cubed region of spacetime experiencing this passage:

- As the cube expands, the density of quantum events decreases, reducing the probability of interaction between quantum states.
- As the cube contracts, the density increases, allowing previously isolated quantum fluctuations to interact, possibly leading to quantum entanglement.

This natural oscillation of interaction probability suggests that gravitational waves can be seen as a modulator of quantum entanglement and evolution.

2. A Modified Quantum Computation Framework

In conventional quantum computation [7], the process consists of three fundamental steps:

1. Entanglement Generation – creating correlations between qubits.
2. Unitary Evolution – allowing qubits to evolve independently under quantum gates.

3. Measurement and Decoherence – extracting classical information from the system.

However, under the influence of gravitational waves:

- The entanglement and evolution stages happen automatically due to the changing interaction density.
- Measurement occurs passively as quantum events eventually dissolve back into the vacuum.
- The entire process is modulated by the gravitational wave's parameters, such as strain amplitude and frequency.

Thus, we propose a "**2.5-step**" quantum computation model, where measurement emerges naturally from post-GW passage decohering interactions or dissolution rather than requiring an external observer.

3. Coupling Between Vacuum Computation and Neural Computation

We previously established that gravitational waves influence quantum computation in neural axon tracts, modulating spike timing through subtle metric perturbations. Given that:

- The same gravitational wave modulates both vacuum quantum fluctuations and brain quantum activity.
- Quantum correlations could briefly arise between the two computational domains.

These induced correlations are fleeting, yet their signatures could manifest in the brain as transient electric field emissions [6]. Since quantum entanglement allows state influence without classical signals, the brain may momentarily influence the state of quantum spacetime computation. When decoherence takes place in the neural quantum state, the resulting classical information stored in the brain will be statistically correlated with its distant spacetime cousin.

4. The Brain as a Quantum Statistical Witness of Spacetime

Given that human-like neural structures can only emerge after 11.9 Gyr in cosmic time (as per [4]), we can now reinterpret this event:

- The brain does not just passively exist within spacetime.
- Rather, it interacts with the quantum computational fabric of the universe.
- In this sense, the brain emerges as a wrinkle, a "witness" of quantum spacetime computations.

This does not suggest a conventional conscious observation but rather a physical coupling where the brain's quantum activity momentarily participates in the greater universal quantum computation.

5. Conclusion: Wrinkles in Computation

Gravitational waves do not just deform spacetime—they introduce dynamic modulation of quantum computation across vacuum fluctuations and neural systems. This suggests a deeper interwoven structure between cosmological quantum computation and biological cognition, with gravitational waves serving as the carrier of induced correlations. In this framework, human neural activity is not merely contained within spacetime; it is, for brief moments, computationally linked to the evolving quantum structure of the universe itself.

Just as wrinkles in the spacetime matter distribution during inflation resulted in galaxies with stars and planets [1], and eventually human brains, these very brains began to act as conscious[3] computational wrinkles in the soup of universal quantum computation, generating the appearance of witness-observed pairs. This mechanism of emergence of the witness resolves the paradox which often manifests in discussions of the anthropic principle – why is the universe the way it is? In answer we can now say, it is so only *apparently*[4].

References

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[3] Conscious only in the sense of possessing statistical information about another distant computation.

[4] Apparently connotes the fact that this quantum awareness of the universal field is merely an artifact of the slight initial anisotropies or wrinkles.