

### **time reversal. Using IBM's Quantum Composer, we achieved time reversal. Using IBM's Quantum Composer, we achiev** time reversal. Using IBM's  $\mathbf{U}$  achieved time reversal in 85% of  $\mathbf{U}$

### Breaking Time's Arrow: Exploring Time Reversal Through Quantum Simulations and Classical Gravitational Disturbances simulations, providing evidence of time symmetry. Additionally, large-symmetry. Additional simula $t_{\text{ref}}$  using times times  $t_{\text{ref}}$ Rroaking Time's Arrow: Fu  $\Omega$ usptum Simulations and  $\Omega$

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**Corresponding Author:** Damont R Combs, Executive Director, Conceptualization, Writing – Original Draft, Visualization, Investigation, and Project Administration, Tell Your Truth, USA.  $t$  using  $B$  investigate time  $t$  in extreme conditions, including simulations with  $t$ 

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# $A$ bstract

*This study integrates quantum simulations and classical gravitational disturbances to explore time reversal. Using IBM's Quantum*  Composer, we achieved time reversal in 85% of quantum simulations, providing evidence of time reversal. Osing this Scientian composer, we achieved thre reversal in 05% of quantum simulations, providing evidence of thre symmetry. Raditionally, targeting imposed to the second simulations with a second simulations with a second law of the second la gravitational wave data and atomic clock measurements. These findings open new directions in quantum gravity and time<br>meninulation *manipulation.*   $gr\ddot{\mathbf{u}}$ 8 the gravitational simulations using Biender investigations.<br>Consistentional wave data and atomic clock measurement  *gravitations and classical gravitations and classical gravitational disturbances to explore time*  $*u*$ <sup>9</sup> integrates quantum simulations and classical gravitational disturbances to explore time re-

**Keywords:** Quantum Simulations, Composer, Gravitational Disturbances, Time Reversal, Gravitational Disturbances <sup>9</sup> integrates quantum simulations and classical gravitational disturbances to explore time re-Keywords: Quantum Simulations, Composer, Gravitational Disturbances

#### **1. Introduction 8 thermodynamics possibilities with possibilities with mechanics. This results in the study of**  $\mathbb{R}^n$ 1. Introduction is reversed. Both approaches of  $\mathbf{r}$

Time reversal, though seemingly impossible in classical black holes. physics due to the second law of thermodynamics, presents priysics due to the second raw of thermodynamics, presents<br>interesting possibilities within quantum mechanics. 2. Materi This study integrates quantum simulations and classical **2.1. Quar** gravitational disturbances to explore time reversal in different contexts, analyzing how gravitational forces and quantum systems behave when time is reversed. Both approaches offer insights into how time might behave in extreme environments, such as near black holes or within mate the environment quantum systems <sup>14</sup> A. Quantum Time Symmetry

## **1.2. Theoretical Foundations**

1.2.1. Quantum Time Symmetry: The time-dependent **1.2.1. Quantum Time Symmetry:** The time-dependent **2.2. Biender Wo**.<br>Schro dinger equation governs quantum systems and is modelled gravitat time-symmetric: etc. and is time-systems and is time-s

$$
i\hbar \frac{\partial}{\partial t} |\psi(t)\rangle = \hat{H} |\psi(t)\rangle
$$
   
was visualized,  
Blender's modif  
strong gravitation

However, real-world quantum systems experience<br>decoherence overcenting perfect time 17 general Theo decoherence, preventing perfect time 17 reversal. The below: Lindblad master equation describes the influence of the environment: including the environment: 17 reversal. The Lindblad master environment: the import of the environment of the enviro <sup>17</sup> reversal. The Lindblad master equation describes the influence of the environment:

$$
\frac{d}{dt}\rho = -\frac{i}{\hbar}[\hat{H}, \rho] + \sum_{k} \left( L_{k}\rho L_{k}^{\dagger} - \frac{1}{2} \{ L_{k}^{\dagger} L_{k}, \rho \} \right) \quad (2)
$$

## **1.2.2. Space-Time Curvature and Time Dilation** k <sup>18</sup> B. Space-Time Curvature and Time Dilation

In general relativity, time is influenced by space-time curvature, as described by the  $\int$  if i earvature, as deseribed by \,<br>Schwarzschild metric:  $\frac{m}{c}$  $curv$  $2<sub>0</sub>$ 

$$
ds^{2} = -(1 - \frac{2GM}{r})dt^{2} + (1 - \frac{2GM}{r})^{-1}dr^{2} + r^{2}d\Omega^{2}
$$
 (3) retu

This results in time dilation near massive objects, such as black holes.  $\frac{1}{\sqrt{1-\frac{1$ 

### **2. Materials and Methods**

**2.1. Quantum Time Reversal Experiment:** We conducted quantum experiments on IBM's Quantum Composer platform. Quantum gates, including Hadamard and phase gates, were applied in sequence, followed by their inverses, to simulate time reversal. The quantum system was initialized in a superposition state, and time reversal was achieved in 85% of trials. The Lindblad equation was used to model the decoherence responsible for the 15% failure rate

*2.2.* **Blender Wormhole Simulation:** Using Blender, we modelled gravitational disturbances using Alice's atomic clock data and gravitational wave data. The spacetime grid was visualized, and gravitational strain was applied using Blender's modifiers to simulate how time reverses under strong gravitational forces. The code for handling the atomic clock data and updating gravitational disturbances is shown below:

import numpy as np import bpy #Load data in chunks for efficient memory usage (2) def load\_data\_in\_chunks (filepath, chunk\_size=1000): (2) data chunk =  $[]$ with open(filepath) as f: for i, line in enumerate(f): if i % chunk size  $== 0$  and  $i > 0$ : print (f"Loaded {i} lines") data\_chunk.append(complex(line.strip())) return np.array(data\_chunk) #File path for atomic clock data

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atomic\_clock\_path = 'D:/Atomic clock data/70 MHzAlice.txt' data 70MHzAlice = load data in chunks(atomic clock path) #Reverse time adjustment data data 70MHzAlice reversed = -data 70MHzAlice

#Load gravitational wave strain data

gw\_data = np.loadtxt('D:/Gravitational Data/LIGO\_GWOSC. txt') 57 gw\_data = gw\_data / np.max(np.abs(gw\_data)) # Normalize data

#Update the simulation per frame

def update\_simulation(scene):

current\_frame = bpy.context.scene.frame\_current

=data\_70MHzAlice\_reversed[current\_

frame % len(data\_70MHzAlice\_rever

cube\_obi.location.y = current\_frame  $* 0.1$ 

text\_obj.data.body = f"Time: {time\_adjustment.real:.2f} seconds"

displace strength = gw\_data[current\_frame % len(gw\_data)] grid.modifiers['Displace'].strength = displace\_strength

grid.update\_tag()

bpy.context.view\_layer.update()

bpy.app.handlers.frame\_change\_pre.append(update\_ simulation).

### **3. Results**

**3.1. Quantum Experiment Results:** The quantum experiment successfully demonstrated time reversal in 85% of trials. The failure rate of 15% was attributed to decoherence, which was modelled using the Lindblad equation. The fidelity of time-reversed states was consistently above 0.95 in successful trials.

**3.2. Blender Simulation Results:** In Blender simulations, time reversal was observed in environments simulating gravitational disturbances. Time dilation and reversal were particularly noticeable near simulated black holes. Figures 1 and ?? display the results of these simulations.



Figure 1: Time Reversal Observed in the Blender Wormhole Simulation at Frame **140** 

## **4. Discussion**

The successful demonstration of time reversal in quantum and classical systems provides insights into the potential unification of quantum mechanics and general relativity. While time asymmetry is dominant in classical systems due to entropy, the quantum experiments indicate that time reversal may be achievable under specific conditions [1-10]. Acernese, F., et al. (2016). Observa

## **5. Conclusion**

In conclusion<br>This study demonstrated that time reversal is possible under *6.* Penrose, R. (1965). Gravitational controlled conditions in both quantum and classical systems. Future research could explore time reversal in more complex systems and environments with stronger gravitational forces.

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