

# Thermal Gravity: Vacuum Turbulence and the Refractive Geometry of Spacetime

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## Abstract

This paper explores two aspects. #1 Vacuum fluctuations are potentially amplified by gravitational waves, and electrons moving in atoms create gravitational waves (propagation of changes in gravitational influence). Atoms, thermally oscillating, also create gravitational waves. #2 Gravity as the different propagation rates of wave-like mass through quantum foam which causes a refraction effect, curving all random thermal oscillations to more generally curve in the direction of denser regions of quantum fluctuations. That means the average movement (Stochastic Drift, Net Vector), will be towards other masses.

**Keywords:** Spacetime, Vacuum Energy, Quantum Foam, Quantum Gravity, General Relativity, Refraction, Shapiro Delay, Emergent Gravity.

## Introduction

Fundamental Concepts and References. To understand the proposed mechanism of gravitational attraction as a result of thermodynamic interactions with the vacuum, we must first establish a lexicon of specific physical phenomena. These concepts, when viewed in isolation, describe known behaviors of matter and spacetime, however, when viewed together, they suggest a novel geometric interaction.

## Quantum Foam

At the Planck scale, spacetime is not smooth but is comprised of “quantum foam” which is a roiling landscape of virtual particles and energy fluctuations. This concept suggests that the vacuum is not empty space, but similar to a medium with texture and activity that constitutes the fabric of spacetime itself.<sup>1,2</sup>

## Gravitational Waves from Mass Movement

General Relativity dictates that the acceleration of massive objects disturbs spacetime, creating ripples known as gravitational waves. While typically observed from massive astronomical events, the fundamental principle remains that the movement of mass-energy generates propagating disturbances in the metric of space.<sup>3,4</sup>

## Interference and Turbulence

When waves emanate from two distinct, randomly oscillating points, their interaction creates a turbulent interference pattern.<sup>5,6</sup> In the region directly between these two points, the waves crisscross and superimpose, creating a zone of significantly higher “turbulence” or wave density compared to the outer regions where the waves propagate into open space without interaction. Like 2 people splashing around in a lake. The water between them will be much more turbulent than the water behind them.

## **Shapiro Delay**

The Shapiro Delay phenomenon demonstrates that light signals passing near a massive object take longer to travel than they would through empty space. This suggests that gravitational potential causes an effective lengthening of the path through spacetime. This has been observed and the experiment factored in curvature which was ruled out as the cause of the delay. Even with negligible spatial curvature, the time dilation implies the virtually straight spacetime path is much longer than expected because of the gravitational potential.<sup>7,8</sup>

## **Density Refraction**

In classical wave mechanics, refraction occurs when a wave enters a medium of different density. If a wavefront encounters a denser medium where propagation speed is slower, the wave curves toward that denser region because the side of the wavefront inside the dense medium travels a shorter physical distance than the side in the less dense region.<sup>6</sup> It's like a car pulling left when the left side drives through deep water, slowing the left side down as the right side continues unhindered.

## **The Double Slit Experiment**

This experiment confirms the wave-particle duality of matter. It demonstrates that electrons, despite being discrete particles, propagate as probabilistic wave packets, exhibiting interference characteristics identical to fluids or light waves until observed.<sup>9</sup>

## **Atomic Forces and Confinement**

In a hydrogen atom, the electrostatic force creates a potential well that binds the electron to the proton. This force acts as a container, confining the wave-like nature of the electron to a specific orbital probability cloud, preventing it from dissipating into space.<sup>10</sup>

## **Heat as Atomic Kinetic Energy**

Thermodynamically, heat is the manifestation of the kinetic energy of atoms. A "hot" atom is one that is physically shaking or oscillating with greater velocity and amplitude than a "cold" atom.<sup>11</sup>

## **Mass-Energy Equivalence**

Einstein's  $E=mc^2$  establishes that energy and mass are interchangeable.<sup>12</sup> Consequently, an atom with higher thermal energy (heat) possesses greater effective mass than the same atom at absolute zero, contributing more to the gravitational field and being more influenced by gravitational fields. Space tells matter how to move. Matter tells space how to curve.<sup>13</sup>

## **Null and Timelike Geodesics**

In spacetime geometry, massless particles (like photons) follow "null geodesics," a continuous direction without a rest state that can curve. Massive objects follow "timelike geodesics," inertial curves where one mass can accelerate toward another mass. A ball dropped from a height will propagate in one direction, slowly accelerating. A light will send out photons in all directions instantly at the speed of light with negligible curve.<sup>14-16</sup>

## **Light Propagation vs. Physical Lengths**

The propagation of light and gravity is determined by geodesic path lengths within the spacetime metric. Conversely, physical matter lengths (such as the size of a ruler or an atom) are maintained by strong atomic and nuclear forces, which are magnitudes stronger than gravity and resist the subtle stretching of spacetime.<sup>3,13</sup>

## **The Bose-Einstein Condensate Vacuum**

This is a theory that posits that the vacuum is made up of a fluid like a Bose-Einstein Condensate which has zero viscosity<sup>17</sup> therefore planetary orbits don't decay. Although it is a different medium and posited that matter was defects in the superfluid medium, it did mention the refraction. And with all the other elements lining up, this theory came together.

## **The Mechanism of Vacuum Refraction**

By synthesizing the references above, we can construct a coherent picture of gravity acting not merely as a bending of static sheets, but as a dynamic interplay of vacuum turbulence and refraction.

Consider an atom as a dynamic entity, violently shaking due to thermal energy. Nearby, a second atom mirrors this agitation. While the atom itself is a stable pattern of matter, its constituent electrons behave as wave-packets. The electron wave-packet "sloshes" around the orbital reaching a detectable threshold in random places at random momentum which require probability calculations. We can visualize the strong atomic forces as the walls of a bucket, and the electron as water sloshing around inside. Unlike a solid bucket, however, the "walls" of the atom are force fields, allowing the kinetic energy of this sloshing electron and the thermally oscillating nucleus to transmit gravitational ripples out into the surrounding vacuum.

These ripples propagate through the quantum foam, interacting with the background noise of the universe (every atom's subtle gravitational waves within causal range, all 13 billion light years worth). When two atoms are in proximity, the gravitational ripples they emit interact in the space between them. Just as waves in a lake between two people become chaotic when waves overlap, the region between the two atoms becomes a zone of "freak waves" of constructive interference. This creates a localized area of extreme vacuum turbulence (a region of high-density high amplitude fluctuations in the quantum foam) that is significantly more active than the "calm" vacuum on the far sides of the atoms.

This turbulence fundamentally alters the geometry of the space between the atoms. Following the logic of the Shapiro Delay, this turbulent region represents a "longer" path through spacetime. To traverse this denser region, parts of a wave packet must propagate along a more complex, fluctuating metric, effectively slowing down speeds over physical distances due to wiggly geodesics on a quantum scale that appear straight on a classical scale. The distance appears physically short, but the geodesic path length is increased by the "choppy seas" of the quantum foam.

The mechanism of attraction arises from the refraction of the atoms themselves. As an atom vibrates due to heat, it effectively “samples” the vacuum geometry in all directions. However, the vacuum is not uniform. The fluctuation amount between the atoms is “denser” (slower propagation) due to the turbulence, while the fluctuation amount away from them is “thinner” (faster propagation). As the wave-like components of the atom move, the side facing the other atom (the side in the denser vacuum), propagates slower than the side facing away. This differential speed causes the atom’s overall trajectory to curve (refract) toward the region of higher density.

While a light wave might pass through this region with a simple curved trajectory, a massive object is constantly “shaking” and re-evaluating its path. The atom does not move in a straight line along one instant calculation. It jitters in random directions. However, every time it jitters in one direction, that movement slightly curves toward the more fluctuation-dense region. If every random direction movement is slightly curved toward the denser region, then the average of the whole will tend to be slightly in the direction of the more dense region, directly toward the other atom.

Consequently, temperature plays a pivotal role in this gravitational model. The hotter the matter, the more violently it shakes, and the more gravitational wave “sloshing” occurs between the atoms. This generates more intense turbulence between the atoms. Simultaneously, the increased shaking of the atom itself means it interacts more frequently with the refractive gradient. Thus, energy manifests as mass: the more energy (heat) an object has, the more it creates vacuum turbulence and the more it refracts toward other masses, creating the phenomenon we perceive as stronger gravitational attraction.

### **Predictions and Experiments**

This model allows for testable predictions regarding vacuum energy and thermal mass interaction. One primary prediction involves the Casimir effect, which measures the force of vacuum fluctuations between two plates. If this hypothesis holds, the Casimir effect should be measurably amplified if the experimental apparatus is surrounded by distinctively hot, dense material. The thermal agitation of the surrounding matter would send a barrage of quantum gravitational waves into the MEMS device, increasing the vacuum turbulence and thereby increasing the measurable force between the plates beyond standard zero-point energy predictions.

### **Future Research: A Toy Model Simulation**

To explore the validity of this refractive mechanism, future research should focus on the development of a computational “toy model.” This simulation would utilize fluid mechanics on a 2D plane to represent the vacuum. The grid would be subjected to “background noise” (random waves generated from 20 to 50 off-grid points). These waves would be adjusted to be extremely weak, serving only to simulate the Heisenberg uncertainty principle and the inherent froth of quantum foam.

Within this noisy plane, we would introduce two “hydrogen atom” analogues. These would be modelled as sources emitting gravitational ripples. The parameters would be adjustable: the radius of the atom, the amplitude of the electron “slosh,” and the frequency of the waves. Crucially, the model would govern the movement of these atoms based on propagation speed. The atoms would shake in random directions (simulating heat), but their movement through the medium would be constrained by local wave density. The simulation would test if the atoms, solely through the mechanics of wave interference and refractive slowing in turbulent zones, naturally migrate toward each other over time.

### **Potential Issues**

The primary flaw in this reasoning lies in the ability to test the increase in thermal velocity, causing increased gravitational waves, for increased quantum fluctuations, for increased Casimir effect. The quantum foam increase may be far below the detectable range, requiring incredible amounts of heat and mass to generate observable results. Additionally, the extreme thermal radiation given off by the heat may influence the MEMS device results.

### **Discussion**

If validated, the ramifications of this “Thermodynamic Gravity” would be profound for the scientific community. It implies that gravity is not a fundamental force, but an emergent property of thermodynamics and quantum mechanics working in concert. This would effectively bridge the gap between General Relativity and Quantum Mechanics, negating the need for a discrete “graviton” particle. Instead, gravity would be understood as a statistical inevitability of wave mechanics in a medium (but without the need for a medium since it’s just the Shapiro Effect and Quantum Foam geometry acting like a medium). It’s simply different geodesic lengths for wave elements to curve through due to different propagation speeds for different parts of the atoms.

This perspective would also necessitate a re-evaluation of cosmology. If temperature and vacuum turbulence are directly responsible for the strength of gravitational interaction, our understanding of the early, superheated universe would change drastically. The intense heat of the Big Bang would have created a vacuum viscosity/turbulence far exceeding current models, potentially altering expansion rates and structure formation. It could offer alternative explanations for Dark Matter, suggesting that “missing mass” is actually “unaccounted vacuum turbulence” in active galactic regions.

Furthermore, this model reframes the concept of mass. Mass becomes a measure of interaction with the quantum foam (a drag coefficient determined by internal energy states). It suggests that by manipulating the vibrational states of matter (or “cooling” the local vacuum), we might one day manipulate gravity itself. While speculative, the unification of heat, light, and gravity into a single geometric framework represents a promising path forward for theoretical physics.

## **Conclusion**

In summary, this hypothesis proposes that gravity is a refractive phenomenon caused by the interference of waves generated by thermal agitation in matter. By viewing the vacuum as “medium-like” and capable of turbulence and variable density, we can envision a universe where atoms “shake” the space around them to alter fluctuation densities, and then where different parts of atoms propagate slower, curving the atom’s random movements toward fluctuation denser regions between masses. It’s just matter making high fluctuation regions, and when moving through the regions, wave propagation in the atoms curves the atom toward denser regions. While facing significant challenges regarding the scale of observational viability, this model offers a novel geometric lens through which to view the relationship between thermodynamics and gravitation.

AI assistance was used for grammar, typos, finding references and assistance with better phrasing of sentences. However, most of the text, the structure, hypotheses and theory were created entirely by the author.

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