Chapter 4: E=mc² Reconsidered – Time-Mass Duality

The New Meaning of Energy and Mass

Narrative Version of FFGFT

Introduction

Einstein's most famous equation, $E = mc^2$, tells us that energy and mass are equivalent. But in FFGFT, this relationship takes on a deeper meaning through the time-mass duality: time and mass are two aspects of the same fundamental field $T(x, t)$.

1 The Time-Mass Duality

In FFGFT, the vacuum field $T(x, t)$ can be interpreted in two equivalent ways:

- As a time field: describing temporal dynamics and fluctuations
- As a mass field $m(x, t)$: describing mass distributions

This duality is expressed mathematically as:

$$T(x, t) \leftrightarrow m(x, t) \tag{1}$$

2 Energy from Fractal Geometry

Energy in FFGFT arises from the fractal structure's dynamics. The fractal corrections modify the energy-momentum relation, leading to new insights about $E = mc^2$.

The total energy includes:

$$E_{\text{tot}} = E_{\text{classical}} + E_{\text{fractal}} \tag{2}$$

where E_{fractal} accounts for contributions from different fractal levels.

3 Implications

- Mass is not an intrinsic property but emerges from the fractal geometry
- Time dilation and mass increase are unified phenomena
- The speed of light limit arises naturally from the fractal structure

4 Conclusion

In FFGFT, $E = mc^2$ gains a deeper geometric meaning through the time-mass duality. Mass and time are not separate entities but manifestations of the fundamental fractal field.

Our central metaphor: The universe as a brain with increasing convolutions but constant volume. Space doesn't expand – the fractal structure becomes more complex.

Source: `https://github.com/jpascher/T0-Time-Mass-Duality`