Mass-Emergence Equation in the Spectral Feedback Model

Overview:

In the emergent spectral feedback model, mass might be understood as a byproduct of internal entropy-regulating mechanisms, specifically spectral memory retention and feedback damping. As local entropy decreases, these internal mechanisms weaken, leading matter to exhibit increasingly light-like behavior.

Key Concepts:

Property	Matter	Light
Entropy	Higher; stabilized by spectral memory, feedback loops, local entropy sinks	Minimal, no feedback loops
Memory Retention	Active, energy-consuming	None needed
Phase Coherence	Partial; subject to internal fluctuations and external noise	Perfect phase coherence
Mass	Emergent from internal feedback & memory damping (spectral inertia)	Massless (no spectral feedback loops)
Relational Structure	Complex, nested, local entropy regulation	Simple, pure information exchange

1. Spectral Memory Dynamics Contribution:

Spectral memory dynamics are described by:

$$S_{\text{memory}}(t+1) = (1-\tau)S_{\text{memory}}(t) + \tau S(\omega, x, t) - \delta S_{\text{memory}}(t)$$

- (τ): Memory retention factor.
- (δ): Decay factor.

Interpretation:

- Higher (τ), (δ): Stronger internal damping, stabilizing feedback → greater mass.
- Lower (τ), (δ): Minimal damping → system transitions toward light-like behavior.

2. Spectral Entropy Contribution:

Spectral entropy is defined as:

$$H_S(t) = -\sum_{\omega} P(\omega, t) \log P(\omega, t)$$

- High entropy: Disordered, feedback-heavy system.
- Low entropy: Coherent, stable, low-feedback system.

3. Proposed Effective Mass Relation:

Linear Formulation:

$$m_{\text{eff}}(t) = \alpha\,(\tau(t) + \delta(t))\,H_S(t)$$

- ($m_{\text{eff}}(t)$): Effective mass at time (t).
- (α): Proportionality constant (units of mass).
- As ($\tau, \delta \to 0$) and ($H_S(t)$) decreases, ($m_{\text{eff}}(t) \to 0$).

Exponential Decay Formulation:

$$m_{\text{eff}}(t) = m_0 \exp(-\beta \left[H_S(t) + \gamma(\tau + \delta)\right])$$

- (m_0): Maximum mass when entropy and damping are maximal.
- (β, γ): Scaling constants.

4. Behavioral Summary:

Condition	Effective Mass Behavior
High entropy, strong memory retention	High mass/inertia.
Entropy decreases, ($\tau, \delta \to 0$)	($m_{\text{eff}} \to 0$), system behaves like light.

5. Potential Extensions:

1. **Relativistic Coupling:**
   - Incorporate relativistic gamma factors, connecting increased coherence with reduced inertia.
2. **Simulation Implementation:**
   - Simulate entropy and feedback damping parameter reductions over time.
   - Track emergent reduction in mass-like behavior, coherence increase, and light-like transition.

Conclusion:

In this spectral feedback model, matter transitions smoothly toward light-like behavior as local entropy approaches its minimal limit. The effective mass of any system is directly tied to its spectral entropy and internal feedback retention mechanisms, providing a coherent bridge between the nature of matter and light.