Comparison of MU-CFT and General Relativity: Coherent vs Classical Gravity

Dmitry A. Mandrov

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1. Gravitational Metric Structures

This work compares the classical formulation of gravity via Einstein field equations with the coherent gravitational framework introduced in Mandrov Unified Coherent Field Theory (MU-CFT), where gravity emerges from observer-coupled coherent fields.

Einstein Field Equations (GR)

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = 8\pi T_{\mu\nu}$$

Here:

- $G_{\mu\nu}$: Einstein tensor,
- Λ: cosmological constant,
- $T_{\mu\nu}$: energy-momentum tensor.

This framework assumes a fixed spacetime background and allows for curvature singularities under extreme gravitational collapse.

MU-CFT Coherent Gravity

The gravitational dynamics in MU-CFT are derived from the following Lagrangian density:

$$\mathcal{L}_{\text{MU-GR}} = R - \lambda \rho_{\text{coh}} + \mathcal{D}\left(\frac{\nabla_\mu \phi \nabla^\mu \phi}{\phi^2}\right)$$

Where:

- R: Ricci scalar curvature,
- ρ_{coh}: density of the observer-dependent coherent field,
- ϕ: scalar field representing the observer field amplitude,
- $\mathcal{D}$: coupling constant regulating coherent interaction strength,
- λ: dark-energy–like term linked to large-scale coherence.

This formulation incorporates the observer as a dynamical element and ensures global coherence, suppressing unphysical singularities.

2. Coherent vs Classical Solutions

Assuming a static, spherically symmetric metric:

$$ds^2 = -f(r)\, dt^2 + \frac{dr^2}{f(r)} + r^2 d\Omega^2$$

Classical GR Solution (Schwarzschild–de Sitter):

$$f_{\mathrm{GR}}(r) = 1 - \frac{2M}{r} - \frac{\Lambda}{3}r^2, \quad r \in (0, \infty)$$

This metric exhibits divergence at $r = 0$ due to the Schwarzschild term $\frac{2M}{r}$, resulting in a singularity.

MU-CFT Coherent Metric:

$$f_{\mathrm{coh}}(r) = 1 - \frac{2Mr}{r^2 + \epsilon^2} + \frac{\lambda}{6}r^2\left(1 - e^{-\gamma r}\right), \quad r \in [0, \infty)$$

Here:

- The denominator $r^2 + \epsilon^2$ avoids singularity at $r = 0$,
- The exponential suppression $1 - e^{-\gamma r}$ ensures smooth behavior,
- γ: coherence decay scale,
- ϵ: minimal coherence length scale,
- M: gravitational mass, $\quad M \geq 0$,
- λ: large-scale coherence coupling, $\quad \lambda \geq 0$,
- γ: exponential decay rate of coherence, $\quad \gamma > 0$,
- ϵ: threshold of distinguishability, $\quad \epsilon > 0$,
- r: radial coordinate, $\quad r \in [0, \infty)$.

3. Interpretation

MU-CFT replaces purely geometric gravity with a coherence-based mechanism, where only globally consistent field configurations are realized. Singularity avoidance is not imposed artificially, but results naturally from coherence functional constraints embedded in the Lagrangian structure. This approach aligns gravitational evolution with the presence of observer-mediated coherence fields.

Key Feature:
The observer field ϕ encodes informational coherence across spacetime. High curvature regions that would lead to singularities in GR are suppressed in MU-CFT due to their inconsistency with the coherent evolution of ϕ.

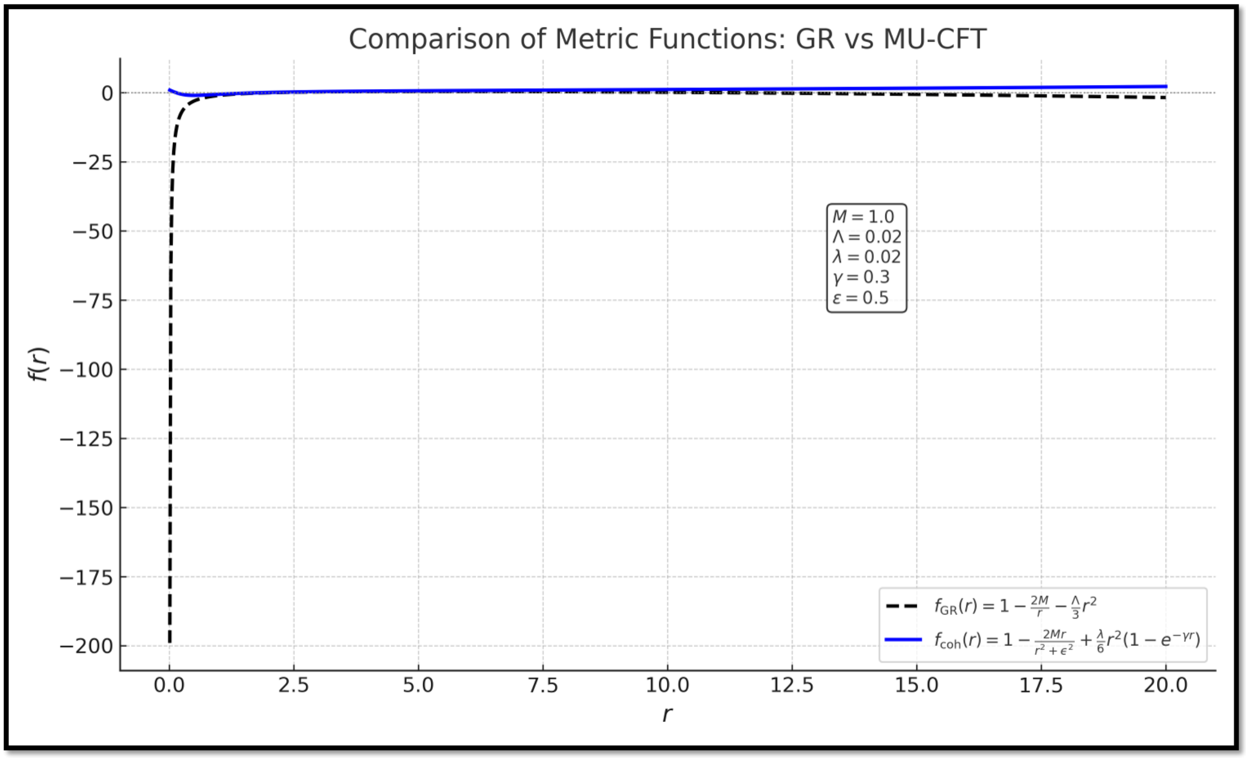

Figure 1: Comparison of classical GR and MU-CFT metrics. The GR solution diverges near $r = 0$; MU-CFT maintains regularity due to exponential coherence and the ϵ-regularized core.

4. Outlook

This coherent modification opens a path to a consistent quantum-compatible gravitational theory, potentially addressing both cosmological inflation and black hole singularities within a single formalism, without invoking exotic matter or discrete spacetime assumptions.

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For full context and theoretical framework, see the official repository:
`https://github.com/dmitrymandrov/mandrov-unified-field-theory`