

Section 9. Boundary Regimes and Projection Failure

The previous sections established that geometry, metric, curvature, and spacetime belong to the projection layer of CUWF rather than to its foundational substrate. The present section completes that argument by identifying the regimes in which projection must fail. These regimes are not exotic exceptions added to protect the theory. They are structural boundaries where relational collapse dynamics no longer admit stable compression into geometric language.

In such domains, physics does not end. What ends is the validity of spacetime as the correct descriptive layer. Singularities, horizons, and apparent cosmic edges are therefore reinterpreted not as tears in reality, but as limits of geometric projection.

9.1 Geometry at the Edge of Recordability

A decisive example is provided by the stillness-boundary logic developed in Paper A-12. There, CUWF introduced the idea of a near-stillness or stillness boundary: a regime in which relational collapse dynamics approach maximal suppression of accessible variation. At such a boundary, the system no longer produces sufficiently differentiated accessibility gradients for stable projection to persist.

Operationally, the accessibility kernel $\mathcal{A}(S_i, S_j)$ may become effectively uniform or may diverge across relational neighborhoods. Pathway structures Π_{ij} lose their power to discriminate one route from another. Accessibility ordering collapses into either indeterminacy or total rigidity.

This is not a physical freezing of spacetime. It is more radical than that. It is the loss of relational contrast required to generate geometry in the first place.

Geometry is a record of relational order. At the stillness boundary, no stable relational memory is being written in a form that can be compressed into geometric description. Collapse dynamics may

persist at the substrate level, but the system no longer generates recordable relational contrast. Without contrast, there is nothing for geometry to encode.

For that reason, geometry does not successfully extend all the way to the boundary. It vanishes before the boundary can be represented geometrically.

9.2 Black Holes as Projection-Failure Zones

The same interpretive shift applies to black-hole regimes. In standard general relativity, the horizon is treated as a geometric surface separating causally disconnected regions. CUWF reinterprets the horizon as an accessibility boundary within the relational field.

As one approaches the horizon, observer-linked relational accessibility costs grow sharply. In symbolic shorthand:

$$\mathcal{A}(S_i, S_j) \rightarrow \infty$$

for the relevant observer-linked pathway families. At the projection level, this is encoded as extreme redshift, time dilation, or horizon asymptotics. At the substrate level, it is simply the progressive loss of mutual accessibility across collapse domains.

The interior should therefore not be treated as a geometric region whose metric merely becomes difficult to calculate. It is a non-geometric regime. Collapse dynamics continue, but the relational field no longer supports a stable accessibility ordering that can be compressed uniquely into metric description. The projection mapping becomes non-invertible and non-unique.

There is therefore no unique geometry in the deep interior—not because reality disappears, but because geometry is no longer the correct language there.

9.3 Why No Spacetime-Breakdown Paradox Is Needed

This CUWF picture removes the need for the traditional spacetime-breakdown paradox. In standard singularity language, one is often forced to say that curvature becomes infinite, spacetime tears, or the theory runs into a literal physical contradiction. CUWF treats the problem differently.

There is no need to posit a singular spacetime object whose pathology defines the boundary. What fails is not spacetime itself as if spacetime were a physical fabric. What fails is the assumption that spacetime remains fundamental and universally valid across all regimes.

Singularities are therefore not infinities of curvature in the deepest ontological sense. They are transition points between collapse domains whose relational structures no longer admit a common geometric compression.

This same principle applies across all major boundary regimes: early-universe pre-geometry, black-hole interiors, horizon limits, and stillness boundaries. There is no breakdown of physics. There is only a transition between relational collapse domains with incompatible or unavailable projection structures.

9.4 Core Claim of Section 9

The conclusion of this section may be stated in direct form. What appear as singularities, horizons, and cosmic edges are not failures of physics. They are the natural boundaries beyond which geometric projection ceases to be a valid language.

This is one of the deepest consequences of Paper A-13. Once geometry is relocated to the projection layer, the places where geometry fails no longer count as ontological disasters. They become exactly what one should expect: boundary regimes in which the shadow can no longer faithfully encode the substrate.