Section 10. Internal Consistency Checks

This section collects the internal consistency checks that the CUWF vacuum reconstruction must satisfy. These checks are not optional: vacuum discussions are routinely derailed by misunderstandings about energy extraction, conservation, and relativistic invariance. CUWF therefore states explicitly what the framework permits and what it forbids, and clarifies the regime in which the reconstruction is intended to operate.

10.1 No Free-Energy Machine

The most common misinterpretation of a 'non-empty vacuum' is that vacuum activity can be harvested as unlimited usable work. CUWF rejects this categorically. Vacuum DOF activity is baseline exploration within constraints; it is not a free-energy reservoir.

Core constraints:

Vacuum activity ≠ usable work in the absence of boundary/constraint change.

Observable vacuum effects require a coupling pathway: a boundary modification, constraint geometry change, or interaction that converts background structure into a measurable response.

Any apparent 'extraction' must be accounted for in the full system, including the work needed to impose or maintain constraints.

10.2 Local Conservation Constraints

A finite baseline term does not imply a violation of conservation laws. The confusion arises when the baseline reference level is treated as a dynamically accessible store rather than as a structural background parameter.

CUWF conservation stance:

In a closed system, conservation constraints apply to allowed transitions and couplings; they do not require the baseline reference term to be infinite or zero.

Finite entropic pressure is an effective background descriptor of vacuum structure under constraints; it does not provide a loophole for net energy gain.

When boundaries or constraints are changed, any measurable response must be balanced by the work required to change or maintain those constraints, preserving overall accounting.

10.3 Relativistic Consistency

CUWF does not claim that the microscopic accessibility structure must look like classical spacetime geometry. Instead, it requires that relativistic invariance is respected at the effective observable level—precisely where current experiments validate it.

Two-level consistency statement:

Effective level: local Lorentz/relativistic consistency must hold for observable phenomena in the regimes where SR/GR have been confirmed.

Microstructure level: the vacuum may possess accessibility constraints not representable as simple geometry, as long as they coarse-grain to an effectively invariant description for observables.

This is consistent with the CUWF program more broadly: geometry is treated as an effective descriptive language, while generative mechanisms can reside in deeper structural constraints.

10.4 Limit Cases

Finally, the reconstruction must behave sensibly in limiting regimes. These limit cases are useful for separating structural baseline properties from boundary-induced phenomena.

Vacuum with minimal constraints

In the limit of minimal external constraints—an idealized ‘open’ vacuum with no significant boundary shaping—the vacuum baseline should approach a near-homogeneous accessibility structure. In this regime, CUWF predicts that baseline response parameters are dominated by the intrinsic vacuum structure, and observable effects are minimal unless couplings or measurement interactions introduce asymmetry.

Vacuum under strong boundary conditions

In the presence of strong boundary conditions—sharp constraints, cavities, interfaces, or engineered coupling geometries—the accessibility manifold is reshaped locally. In CUWF terms, this induces a local reweighting of admissible micro-configurations, increasing the likelihood of measurable vacuum responses. The key point is that boundary-induced effects are not evidence of a particle-filled vacuum; they are evidence that constrained baseline structure can generate observable responses.

These internal checks conclude the foundational reconstruction. The next step is to outline what kinds of signatures, predictions, or explanatory advantages follow from a finite-baseline, accessibility-structured vacuum—especially in contexts where standard framing leaves the baseline conceptually ambiguous.