1 The Homology of Meaning

1.1 RSVP as a Semantic Filtration Space

Let $\mathcal{M}$ be an RSVP manifold with fields Φ, $\vec{v}$, S. Define a filtration $K_\epsilon \subseteq \mathcal{M}$, parameterized by $\epsilon \in \{\epsilon_s, \epsilon_t, \epsilon_S\}$, representing scale, time, or entropy. The Čech complex $\mathcal{C}_\epsilon$ is constructed from agent trails, with simplices encoding semantic connectivity.

1.2 Persistent Sheaf Cohomology

Attach a sheaf $\mathcal{S}$ to $\mathcal{C}_\epsilon$, assigning CRDT merge states to simplices. The cohomology groups $H^p(\mathcal{C}_\epsilon; \mathcal{S})$ capture:

- H^0: Conceptual clusters (robust memes).
- H^1: Ambiguity loops (persistent contradictions).
- H^2: Knowledge voids (long-term blind spots).

Persistent cohomology yields barcodes, with bar length indicating semantic stability.

1.3 Torsion Events and Cognitive Crises

A torsion event occurs when $\frac{d}{d\epsilon} \dim H^1(\mathcal{C}_\epsilon; \mathcal{S}) \gg 0$, signaling dialectical breakdown or polysemic overload.

1.4 Circular Coordinates

For long-lived 1-cocycles α, define $\theta : \mathcal{C}_\epsilon \to S^1$ via $\theta(x) = \int_\gamma \alpha$, mapping semantic periodicity.

1.5 Robustness Index

Define Robustness $\text{Index}(\epsilon) = \frac{\text{Pers}(\epsilon)}{S(\epsilon)}$, where $\text{Pers}(\epsilon)$ is the length-weighted sum of persistent bars and $S(\epsilon)$ is average entropy.