BCQM VII Stage–2 Checkpoint Lab Note
Bin coarsening test for strict persistence (hits2) at long epochs (v0.1)

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Purpose

This checkpoint tests whether the failure of strict persistence (hits2) to yield a connected edge-cloth core is primarily a *binning artefact*. The hypothesis is that coarsening bins (fewer, longer bins) may increase cross-bin repetition and allow a hits2 cloth to span, while keeping the underlying dynamics unchanged. We also include a calibration run (hits1) to confirm the expected "connected cloth" regime at the same long epoch length.

Context (prior Stage–2 checkpoint)

In the initial Stage–2 cloth work:

- **hits1** (`min_bin_hits`=1) produced a connected edge-cloth core and stable ball-growth geometry across seeds, but exact edge identity remained seed-sensitive.
- **hits2** (`min_bin_hits`=2) tended to collapse to tiny recurrent pockets (or empties), behaving more like a motif detector than a cloth backbone at the tested epoch lengths.

This checkpoint asks whether that behaviour is due to "time chopped too finely" (bins) rather than the persistence definition itself.

Runs performed

All runs used the same long epoch length (x10 of the Stage–2 baseline), $W_{\mathrm{coh}} = 100$, 5 seeds per quadrant, and the same scan grid:

- $N \in \{4, 8\}$, $n \in \{0.4, 0.8\}$
- lockstep support threshold $w_{\mathrm{lock}} = 0.10$
- concurrency diagnostic threshold `min_concurrency`=2

We varied only the bin count and `min_bin_hits`:

- hits2, x10, **bins=20**
- hits2, x10, **bins=10**
- calibration: hits1, x10, **bins=20**

Outputs were analysed by set survival (Jaccard on `core_edges_used` and `core_events_used`) and metric survival (L2 distance between normalised ball-growth curves $|B(r)|/|C|$ across seeds).

Results

1. hits2 remains a motif detector under bin coarsening

Coarsening bins from 20 to 10 did not convert hits2 into a connected cloth backbone:

- For $n = 0.8$, hits2 edge cores remain small, with ball-growth component sizes ≈ 2.4–3 on average, and edge-set Jaccard across seeds remains zero in the non-degenerate regimes.
- For $n = 0.4$, hits2 often yields empty or near-empty edge cores; any Jaccard values near 1 are therefore dominated by "identical emptiness" rather than stable structure.

Thus, the failure of hits2 to yield a spanning cloth at this scale is not primarily a binning artefact.

2. Calibration (hits1, x10, bins=20) confirms the connected cloth regime

The calibration run (hits1 at the same long epoch length) produced large connected cloth components and very stable geometry diagnostics, especially in the high-cross-link regime:

- Event-core survival at $n = 0.8$ is near 1 (Jaccard ≈ 0.98 for both $N = 8$ and $N = 4$).
- Ball-growth metric survival is extremely tight (cross-seed L2 distances $\ll 10^{-3}$ in the $n = 0.8$ regime).
- Exact edge-set survival remains small (as previously), indicating that stability appears first at the metric/diagnostic level rather than at exact edge identity.

Interpretation

The bin coarsening test supports the "channel activity versus cloth" hierarchy:

- bin-level concurrency captures short-run channelisation,
- strict cross-bin repetition (hits2) isolates recurrent motifs,
- connected cloth geometry emerges in the permissive regime (hits1) and is stable as a geometry class even when microstructure varies.

Therefore, if a stricter-than-hits1 edge cloth is required, the next step is to change the persistence definition rather than to further adjust binning.

Immediate next options

Two minimalism-preserving edge persistence definitions are now prioritised for testing:

1. **Event-filtered edge core:** define persistent events first, then keep edges between persistent events (used by lockstep core), which may suppress seed-specific micro-loops.
2. **Quantile persistence:** keep the top $q\%$ most-used core edges over the epoch (rather than requiring cross-bin repetition), to obtain a stable backbone class without enforcing exact repeatability.

Files

This checkpoint corresponds to the consolidated summary table:

- `cloth_bin_coarsening_summary_W100_x10.csv`