A CHB Prediction for a Build-Up Lag in Halo Residuals Following Post-Starburst Episodes

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Author note	Public timestamped prediction record for later comparison against young post-starburst dwarf galaxy kinematic and star formation history surveys.

Abstract. This note records a falsifiable prediction derived from one specific aspect of the Chronoholic Barrier (CHB) framework concerning the temporal relationship between starburst activity and the expression of inferred halo residuals in post-starburst dwarf galaxies. The relevant CHB claim is limited in scope: gravitational curvature may include a contribution from accumulated causal-information record, provisionally termed Causal Record Curvature (CRC), distinct from the immediate curvature of present mass-energy. The record associated with a starburst is not complete at peak luminosity. It accumulates as the burst's prolonged chain of interactions unfolds, with its stable expression as a measurable halo residual emerging only as ordinary feedback noise subsides. If that interpretation is correct, then young post-starburst dwarfs should show a systematically shallower stable record-like component of inferred halo residuals than older post-starburst systems of comparable cumulative entropy production, with a build-up profile in the record component distinct from the standard peak-and-decay evolution expected from feedback alone. The purpose of this note is not to establish the CHB framework in full, but to state one testable prediction, define its measurable form, specify provisional adjudication criteria, and identify the observations that would count against it.

1. Purpose of this note

This is a prediction note rather than a full theory paper.

Its purpose is to create a dated public record of one empirical consequence of the CHB framework before further high-resolution kinematic surveys of young post-starburst dwarf galaxies clarify the temporal relationship between burst activity and inferred halo residual structure. The note is intentionally narrow. It does not attempt a full defence of CHB, nor a complete account of dark matter phenomenology. It isolates one claim, states the reasoning that motivates it, and places that claim at risk of failure.

The underlying question is whether the inferred halo residual structure of a post-starburst system reflects only the immediate gravitational consequences of its present mass-energy and feedback dynamics, or whether a separable causal-record component contributes with a different time profile that builds rather than decays after burst termination.

The CHB framework permits and indeed predicts the latter. The present note records that prediction in a form suitable for later comparison with observation.

The scope is deliberately limited to dwarf and low-mass galaxies with sufficiently recent and well-characterised starburst termination, where the build-up signal can in principle be isolated.

2. Minimal CHB basis for the prediction

Only the minimum part of CHB needed for this prediction is stated here.

CHB treats physical reality as structured informational writing at a boundary-like interface. Gravitational curvature tracks the depth of localised informational anchoring. Two components of the curvature budget are relevant for this prediction.

The first is the immediate curvature of present mass-energy. Stars, gas, radiation, and moving matter all have ordinary gravitational significance while they are active in the local present. CHB does not dispute this for the purposes of the present note. The ordinary empirical relationship between present mass-energy and immediate curvature is treated as the baseline for the purposes of this note.

The second is the curvature contribution of retained causal record. The broader CHB framework holds that prior physical activity does not simply vanish once its visible configuration changes. Coherent or structurally significant histories may remain compressed into the substrate and continue to contribute gravitationally. This retained contribution is referred to here, provisionally, as Causal Record Curvature (CRC), with corresponding density-like quantity Causal Record Density (CRD). Neither is treated here as a fully formalised field. They function as constrained physical placeholders for the CHB claim that inferred halo structure may partly track accumulated causal history.

The relevant assumption for the present note concerns the time profile of the record component. A starburst is not a single instantaneous event. It is a prolonged, violent episode comprising star formation, radiation, supernovae, gas turbulence, outflows, reaccretion, and chemical enrichment. Each interaction in this chain writes causal record. The record associated with the burst therefore thickens as the burst unfolds and as its consequences continue to play out, rather than being complete at the moment of peak luminosity.

In this note, "burst termination" refers to the end of the dominant luminous star-forming episode, not the end of all causal consequences of the burst. Outflows, gas rearrangement, turbulence decay, reaccretion, chemical redistribution, and orbital settling may continue to write and stabilise the record after peak star formation has ceased.

The predicted lag is not a delay in the ordinary gravitational effect of present mass-energy. It is a proposed maturation interval for the causal-record component of curvature, which accumulates through the starburst's sequence of written interactions and becomes distinguishable only as the system settles.

That is the limited theoretical basis for the present prediction.

The present note isolates a CHB causal-record-curvature consequence concerning a temporal asymmetry between feedback-driven residual evolution and record-component residual evolution. It does not depend on a completed CHB metric, action, or field-theoretic derivation, nor on a specific functional form for the maturation curve beyond the qualitative claim that the record component thickens as the burst's chain of interactions completes.

3. Informal explanatory summary

A starburst is a storm, not a bullet. Gas collapses. Stars form. Radiation pressure builds. Supernovae detonate. Turbulence propagates. Gas is expelled, sometimes reaccreted. Chemical enrichment proceeds. Orbital structure rearranges. Ordinary feedback effects rise and fall through this sequence. The visible burst eventually ends, but the system continues to settle for a long time afterward.

Standard models of dark matter and baryonic feedback predict that any halo modification associated with this storm is strongest during and immediately after the active episodes. Feedback-driven gravitational heating operates through potential fluctuations: it requires active outflows and damps through phase mixing once those outflows cease. The expected pattern is therefore peak modification during the burst, followed by gradual decay.

CHB expects an additional component with a different time profile.

CHB does not predict that the ordinary gravity of the starburst waits to appear. The stars, gas, and radiation gravitate while they are present. The proposed lag concerns a second component: the stable curvature contribution of the causal record written by the burst's full chain of interactions. Early after the burst, the system may be dominated by ordinary feedback noise. Later, as that noise settles, the record component should become more visible as a stable halo residual.

If part of the inferred halo residual reflects accumulated causal record rather than ordinary feedback heating, then this record component accumulates as the storm's interactions are written. It is not complete at the moment of peak luminosity. It thickens as the burst's chain of consequences plays out. The full record signature does not become a stable observable feature until the burst has run its course and ordinary feedback noise has subsided enough for the underlying record contribution to be distinguishable.

The prediction is therefore one of temporal asymmetry between two components. Feedback peaks early and decays. The record component builds and stabilises. The total inferred halo residual evolution should reflect both.

Visible burst signatures lead. Feedback follows the standard profile. The record component lags, accumulates, and matures.

The present note records that expected build-up.

4. Core prediction

Prediction: young post-starburst dwarf galaxies should show a systematically shallower stable record-like component of inferred halo residuals than older post-starburst systems of comparable cumulative entropy production, with a measurable build-up trend in the record component between burst termination time and the time of observation.

The claim here is deliberately narrow. Post-starburst systems often look unusual for reasons that have nothing to do with the present prediction, and those reasons are set aside. The prediction concerns one thing only: the temporal direction of the record component's contribution, whether it builds or decays once the burst ends.

If the CHB premise outlined above is correct, then carefully matched samples of post-starburst dwarfs at different post-burst times should reveal:

- young post-starburst systems (burst terminated within the last few hundred megayears) showing shallower stable halo residuals than expected from their cumulative entropy production
- intermediate-age post-starburst systems showing residuals approaching mature values
- older post-starburst systems showing residuals consistent with mature record expression
- an approximately monotonic population-level build-up curve relating post-burst time to residual depth, distinct from the peak-and-decay profile expected from feedback alone

The specific expectation is a positive temporal trend in the stable record-like residual: depth should increase, not decrease, as post-burst time increases, until the build-up plateaus at a mature value characteristic of cumulative entropy production.

5. Operational definitions

To keep the claim measurable, the prediction is expressed using four quantities. These are observational proxies, not direct measures of record maturation in the broader CHB sense.

5.1 Post-burst time

t_{pb} = time elapsed since the end of the most recent significant starburst

defined operationally as the time since the system's resolved star formation rate dropped below a defined fraction (typically 0.1) of its peak burst value, reconstructed from resolved colour-magnitude diagram fitting or equivalent age-mapping methods.

The prediction concerns systems where t_{pb} is well-determined and lies within a window from approximately 50 Myr to several gigayears. Systems with ongoing star formation (no clear burst termination) are excluded from the test.

5.2 Cumulative entropy production proxy

$$E_{cum} = \int_0^{t_{burst}} SFR(t) \times f_{feedback}(t)\, dt$$

integrated over the burst duration, where SFR(t) is the resolved star formation rate during the burst and $f_{feedback}(t)$ is a dimensionless feedback efficiency factor capturing the energetic intensity of the burst. In simple implementations, $f_{feedback}$ can be set to unity and E_{cum} reduces to the total stellar mass formed in the burst.

The role of E_{cum} is to provide a normalisation: post-starburst systems with comparable cumulative entropy production should approach the same mature halo residual depth, but at different times depending on their t_{pb}.

Any test should report whether $f_{feedback}$ is modelled or set to unity, and should verify that the inferred build-up correlation is not an artefact of the chosen E_{cum} normalisation.

5.3 Inferred halo residual depth

D_{halo} = a quantitative measure of the inferred halo residual associated with the burst

evaluated relative to a control population of dwarfs with matched present-day baryonic mass but no recent significant burst. Possible operational forms include the inner rotation curve slope deviation from the control population mean, the integrated mass excess within a characteristic radius, or the spatial correspondence statistic from the companion spatial correspondence note evaluated over the burst region.

The specific implementation may vary by dataset. The key requirement is that D_{halo} captures the magnitude of the burst-associated halo residual at the time of observation.

5.4 Build-up correlation statistic

$C_{BU} = \mathrm{corr}(t_{pb}, D_{halo} \mid E_{cum})$

the partial correlation between post-burst time and halo residual depth after controlling for cumulative entropy production, computed across a sample of post-starburst dwarfs with well-characterised burst histories.

A statistically significant positive C_{BU} indicates that older post-starburst systems show deeper residuals than younger ones at matched cumulative entropy production, consistent with the build-up prediction. The claim is statistical: scatter from individual system properties is expected, but the trend should be detectable in an adequately resolved sample.

6. Combined CHB signature

The operational CHB signature proposed here is the joint appearance of:

- statistically significant positive C_{BU} at fixed E_{cum}
- D_{halo} values for young post-starburst systems systematically shallower than for intermediate and older systems
- an approximately monotonic population-level build-up profile rather than a peak-and-decay profile when residuals are plotted against post-burst time
- the build-up plateauing at a depth consistent with mature post-starburst systems of comparable cumulative entropy production

In plain terms, the relevant pattern would show that the stable record-like component of halo residuals associated with burst activity deepens rather than decays after the burst ends, and that this component approaches a mature value over a characteristic build-up timescale.

The claim is population-level rather than anecdotal. It is not satisfied by a single young post-starburst system with a shallow residual. Its force depends on whether the build-up trend holds across a sample large enough to control for cumulative entropy production, environment, and measurement systematics.

7. Distinctive content of the prediction

The build-up profile is the most temporally distinctive of the CHB causal-record-curvature consequences. No standard rival mechanism considered here straightforwardly predicts this specific build-up phase in a stable halo residual component following burst termination at fixed cumulative entropy production. The closest standard expectations generally favour either peak-and-decay feedback evolution, secular relaxation, or system-specific disturbance rather than a population-level build-up toward a mature residual plateau.

Feedback-driven gravitational heating predicts peak modification during active outflows, followed by phase-mixing decay over a few hundred megayears to roughly a gigayear. The expected residual contribution from feedback is peak-and-decay. CHB does not dispute this. The CHB-distinctive claim is that an additional component, the record component, has a different time profile that builds while feedback decays.

Because feedback heating and the gas turbulence that can mimic it in young systems both fade within this window of a few hundred megayears to roughly a gigayear, the discriminating power of the test concentrates at later post-burst times. A record component still deepening at t_{pb} of one to three gigayears, after feedback relaxation is complete and the youngest-system systematics no longer apply, is the part of the signal that no peak-and-decay or turbulence-damping account reproduces.

Self-interacting dark matter produces halo modifications through ongoing thermalisation processes that are not naturally synchronised to specific burst events. SIDM predictions for post-starburst systems would not differentiate strongly by t_{pb} at fixed E_{cum}.

Subhalo accretion is not synchronised to internal burst events at all. Substructure-driven residuals would be uncorrelated with t_{pb}.

The key reasoning is:

1 CHB separates the immediate curvature of present mass-energy from the retained curvature of causal record.

2 The starburst's record is not complete at peak luminosity. It thickens as the burst's chain of interactions plays out.

3 Feedback's contribution to the inferred residual peaks early and decays through phase mixing.

4 The record component's contribution should build as the record matures and stabilises.

5 The total inferred residual should therefore evolve differently than feedback-only models predict, with the late-time profile dominated by the record component rather than residual feedback decay.

The distinctive content is the prediction of a temporal asymmetry between two curvature components. This is also what makes the prediction high-risk: a clearly detected pure peak-and-decay profile, with no detectable build-up phase or mature plateau, would be a clean negative result.

8. Rival explanations

Several classes of model offer alternative accounts of post-starburst halo phenomenology:

1. Baryonic feedback with gravitational heating produces peak-and-decay residual evolution.
2. Self-interacting dark matter produces ongoing thermalisation effects largely uncorrelated with specific burst events.
3. Subhalo accretion produces substructure uncorrelated with internal burst history.
4. Bar formation and other secular processes produce residuals on internal dynamical timescales unrelated to burst termination.
5. Measurement systematics in young post-starburst systems may bias inferred halo residuals through residual gas turbulence, ongoing outflow signatures, or stellar population modelling uncertainties.

None of these, as ordinarily formulated, straightforwardly predicts a positive C_{BU} at fixed E_{cum}. The temporal asymmetry of the build-up prediction therefore provides a relatively clean discriminant. The prediction would lose distinctiveness only if a rival mechanism were proposed that specifically generates a build-up profile, or if measurement systematics were shown to mimic such a profile artefactually.

The most serious systematic risk is in the youngest post-burst systems, where ongoing gas turbulence and residual outflows may make halo residual inference unreliable. The prediction must be tested in systems where burst termination is clean and the residual modelling is robust.

9. What would support the prediction

The present prediction would gain support if future observations of post-starburst dwarf samples show that:

- C_{BU} is statistically significant and positive at fixed E_{cum}
- young post-starburst systems show systematically shallower D_{halo} than intermediate and older systems
- the residual evolution traces an approximately monotonic population-level build-up curve rather than a peak-and-decay profile
- the build-up plateau depth is consistent with mature post-starburst residuals at comparable cumulative entropy production
- the trend holds across multiple choices of D_{halo} operationalisation and survives reasonable variations in t_{pb} reconstruction method
- the pattern is robust to selection effects in post-starburst sample construction

Such findings would not establish CHB in full. They would, however, count as successful prediction of the build-up lag claim stated here, and would constitute the temporally most distinctive evidence among the three CHB causal-record-curvature predictions.

Provisional adjudication criterion for support: the prediction should be counted as supported if a sample of at least twelve post-starburst dwarfs spanning t_{pb} from approximately 100 Myr to 3 Gyr, controlled for cumulative entropy production within a factor of three, shows C_{BU} positive at better than 3σ, with the residual evolution profile distinguishable from peak-and-decay alternatives at high statistical confidence. The specific thresholds (twelve galaxies, t_{pb} range, factor-of-three E_{cum} control, 3σ) are first-pass values; refinement may be warranted as sample quality and burst reconstruction methods mature.

10. Falsifier

This note is intended to be vulnerable to failure. Indeed, given its temporal distinctiveness, it is among the most cleanly falsifiable of the CHB causal-record-curvature predictions.

The CHB claim advanced here would be weakened if future observations show that:

- C_{BU} is consistent with zero across a well-controlled post-starburst dwarf sample
- young post-starburst systems show D_{halo} values consistent with or exceeding those of older systems at matched E_{cum}
- the residual evolution profile shows peak-and-decay structure consistent with feedback-driven gravitational heating predictions
- any apparent build-up trend disappears once measurement systematics in young post-burst systems are properly accounted for
- the trend, where present, is fully explained by gas turbulence damping or other baryonic relaxation processes unrelated to causal-record build-up

The prediction would also lose distinctiveness if a rival mechanism were proposed that specifically generates a build-up profile through processes not invoking accumulated causal record as a contribution to curvature.

It would likewise lose force if the apparent build-up were shown to result from selection effects in which post-starburst samples preferentially include young systems with shallow residuals because of detection biases tied to ongoing star formation visibility.

Provisional adjudication criterion for weakening: the prediction should be counted as weakened if a sample of at least twelve post-starburst dwarfs, controlled as above, shows C_{BU} consistent with zero or significantly negative, or if the residual evolution profile shows clear peak-and-decay structure inconsistent with an approximately monotonic population-level build-up.

A particularly strong negative result would be the demonstration that young post-starburst dwarfs systematically show deeper inferred halo residuals than older counterparts at matched cumulative entropy production. This would directly contradict the build-up prediction and would constitute a clean negative outcome.

11. Limits of the present note

This note does not claim that CHB explains the full dark matter budget. It does not claim that CRC replaces collisionless dark matter, self-interacting dark matter, or modified gravity as a complete theory. It does not claim a completed CHB metric, action, or field-theoretic derivation. It does not claim a derived value or scaling for the maturation timescale itself; that timescale is treated here as a phenomenological quantity to be measured rather than predicted.

This prediction tests a stronger CHB claim than the companion population-level and spatial correspondence notes require. Predictions A and B only require that retained causal record contributes to inferred halo curvature. Prediction C requires the additional claim that newly written record has a measurable time profile of stable expression in the local present, distinguishable from ordinary feedback evolution. The present note explicitly tests this stronger possibility.

The build-up prediction has both a physical claim and an observational difficulty that should not be conflated. The physical claim is that the record component of curvature accumulates as the burst's chain of interactions unfolds, since the record is not complete at peak luminosity. The observational difficulty is that early post-burst data is contaminated by ongoing feedback noise, residual gas turbulence, and outflow signatures that obscure any underlying record contribution. Both contribute to the predicted apparent build-up, but they are different things. The physical claim is what makes the prediction CHB-distinctive. The observational difficulty is what makes the test demanding.

Resolved star formation histories with sufficient temporal precision to determine t_{pb} at the precision needed for the test are currently available primarily for Local Group dwarfs and near neighbours. The youngest post-burst systems are also the most systematically uncertain, since residual gas turbulence and outflow signatures can bias halo residual inference. The prediction gains testability as resolved star formation history reconstruction and two-dimensional kinematic modelling extend to larger samples and cleaner systems.

The note also acknowledges that the build-up prediction overlaps thematically with the temporal reach prediction in the companion population-level halo structure note concerning ancient bursts contributing to present halo residuals. Both predictions concern the temporal behaviour of the record component, but they make distinct empirical claims: the present note concerns the rising phase, while the companion note concerns the persistence of mature record into the present. Together they constitute a coherent temporal programme within the CHB causal-record-curvature framework.

This is therefore an advance prediction record rather than a retrospective reinterpretation.

12. Compressed statement

If part of the inferred halo residual budget reflects accumulated causal record rather than ordinary feedback heating, and if the record associated with a starburst thickens as the burst's chain of interactions plays out rather than being complete at peak luminosity, then young post-starburst dwarf galaxies should show a systematically shallower stable record-like component of inferred halo residuals than older post-starburst systems of comparable cumulative entropy production. The residual evolution should display a build-up component distinct from the standard peak-and-decay profile of feedback alone, with the build-up plateauing at a mature value as the record stabilises and feedback noise subsides. The predicted lag is not a delay in the ordinary gravitational effect of present mass-energy, but a maturation interval for the causal-record component of curvature. If future observations instead show pure peak-and-decay residual evolution consistent with feedback-driven gravitational heating, or show no systematic relationship between post-burst time and residual depth at matched cumulative entropy production, this CHB prediction is weakened.

Author note: This document is intended as a public timestamped prediction record for later comparison against young post-starburst dwarf galaxy kinematic and star formation history surveys.

Changelog

v1.0 (April 2026): Initial public timestamped version. Frames the prediction as a CRC/CRD-layer consequence concerning the temporal build-up of a stable record-like component of inferred halo residuals following starburst termination, with provisional adjudication criteria, an explicit distinction from peak-and-decay feedback alternatives, and the discriminating signal located in the late post-burst regime where feedback relaxation is complete.