

The Scaled Coherent Geometry Hypothesis

A falsifiable parent-field framework for phase-core ignition

From RBFL phase-field architecture to design-mode phase-core engineering



The engineering extension is kept separate from the locked galaxy law: it is a falsifiable test pipeline, not a proof.

Core thesis: Build scaled coherent geometry first. Star-like ignition is treated as the output of a stable phase-node, not the object being brute-forced.

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This document is not a reactor design, not a construction guide, not proof of RBFL/RBFT, and not evidence that current fusion devices are aligned to the proposed parent-field condition.

Scientific boundary and release-safe claim

This report presents a speculative, falsifiable hypothesis. It must not be read as established physics, a replacement for plasma physics, a reactor design, or proof that phase-coherent fusion has been achieved.

The work reframes the engineering target. Conventional fusion optimizes temperature, density, and confinement time. The proposed phase-core route asks whether a separate geometry/coherence condition must be satisfied before ignition becomes naturally stable.

$$R_{\phi} \approx 1 \iff g_{\text{net}} \approx 0$$

The design-mode toy simulation shows that, inside the model, a north-aligned parent-field proxy can drive the node into a near-neutral band, then ignition, then stabilization. This is an internal consistency result, not a physical validation.

Release-safe claim: A reproducible toy model demonstrates the logic of a geometry-first ignition sequence and defines null-controlled tests needed before any real-device interpretation.

Abstract

This report introduces the Scaled Coherent Geometry Hypothesis for phase-core ignition. The hypothesis states that a star-like ignition state should be treated as the consequence of coherent nested-field geometry, not as an object to be forced by heat alone. The framework extends the RBFL/RBFT phase-field research program as a separate engineering-side hypothesis. It preserves the RBFL locked galaxy law while translating the structure-first idea into a lab-scale parent-field model.

The central design variable is a rejection index R_{ϕ} , which couples internal phase-core coherence, laboratory boundary transfer, baryonic coupling, and a design-mode north-alignment factor. In the toy model, neutral parent-field balance occurs near $R_{\phi} = 1$. A north-aligned design-mode simulation reaches field coherence, then ignition, then stabilization. The result is not evidence of real fusion, but it supplies a falsifiable test protocol: future experiments or device residual analyses must beat shuffled metadata, machine identity leakage, and leave-one-machine-out controls.

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1. Relationship to RBFL/RBFT

RBFL/RBFT 6.0 is treated here as a speculative baryon-derived phase-field research program. The galaxy-side locked law is not altered by the phase-core fusion hypothesis. Instead, the engineering hypothesis borrows the same structural principle: baryonic organization first, coherent response second, observable output third.

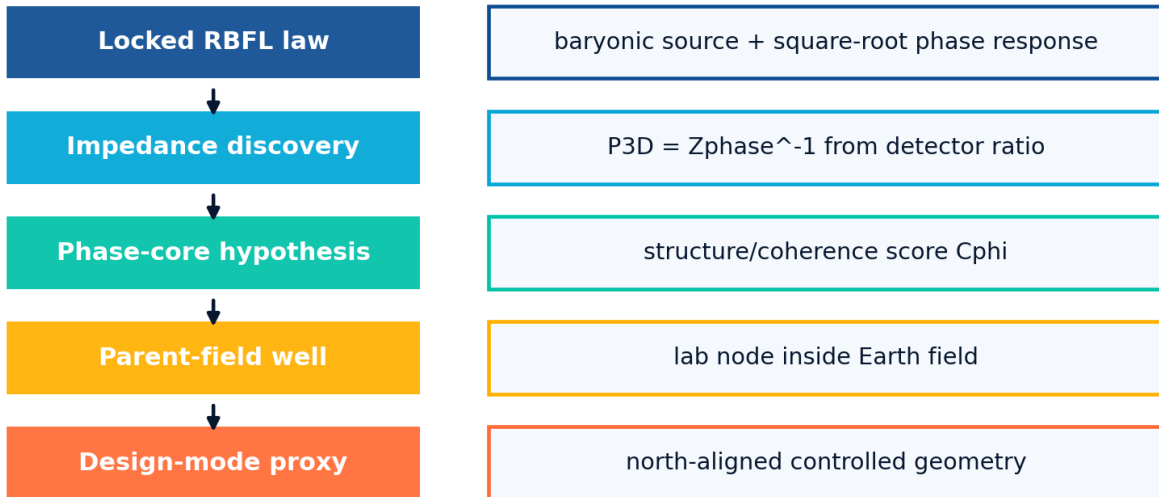
$$\mathbf{g}_{\text{RBFL}} = \mathbf{g}_b + A_{\text{eff}} \sqrt{a_\phi |\mathbf{g}_b|} \hat{\mathbf{g}}_b$$

$$A_{\text{eff}} = A_{\text{lock}} S_{\text{phase}} D_{\text{phase}} G_{\text{rot}} B_{\text{switch}} H_{\text{proxy}} P_{3D}$$

$$P_{3D} = Z_{\text{phase}}^{-1}$$

In the galaxy program, the distinctive burden is not merely the square-root low-acceleration term. The burden is whether the phase response can be predicted from baryonic structure, projection, and impedance terms before residuals are inspected. The phase-core hypothesis uses this as a methodological template, not as a proof of fusion physics.

Definition derivation ladder



Definition derivation ladder: the engineering extension is downstream of the RBFL/RBFT phase-field architecture, but remains separate from the locked galaxy law.

Separation rule: RBFL Unified Law Candidate -> galaxy/field architecture. Phase-Core Ignition Hypothesis -> speculative engineering/fusion test pipeline. Do not use fusion outcomes as validation of the galaxy law.

2. Definition derivation

The definitions were not chosen as arbitrary labels. They were derived by moving step-by-step from RBFL phase-response architecture to a lab-node geometry problem. The table records the derivation pathway.

Symbol	Definition	Derived from
g_b	Baryonic acceleration field from the source distribution.	RBFL locked law: baryons -> potential -> acceleration.
A_eff	Effective phase response multiplying the square-root acceleration carrier.	RBFL unified candidate: phase operator factors plus P3D.
P3D	Projected 3D phase correction; reciprocal of Z_phase.	Discovered from detector/oracle ratio as projected impedance.
Z_phase	Effective baryonic phase impedance.	Interpretation of P3D inverse in the unified law report.
C_phi_internal	Internal phase-core coherence score from geometry, shear, density, confinement, aligned magnetic support, and instability penalty.	Phase-core fusion hypothesis: measurable structure-first variable.
Q_B_eff	Useful magnetic support after alignment gating.	Magnetic field split into aligned confinement minus forced boundary stress.
I_B_eff	Instability penalty from misaligned field plus measured instability.	Forced magnetic cage correction.
Earth parent-field well	Local field environment dominated by Earth as parent mass.	Nested lab-node correction: chamber is not isolated even in vacuum.
R_phi	Parent-field rejection/coherence index.	Neutral-buoyancy branch of the parent-field model.
g_net	Residual effective parent-field acceleration in the toy model.	g_parent times one minus R_phi.
A_N	North-aligned design-mode coherence factor.	Controlled design assumption, not historical machine orientation.
A_opp	Opposition controller that tunes coherent rejection toward neutral balance.	Buoyant-stability branch of the parent-field model.
Gamma_lab	Laboratory transfer factor.	Chamber and lab environment coupling.
Gamma_wall	Boundary allowance or suppression factor.	Wall/chamber transfer function.
Gamma_b	Baryonic fuel-scale coupling factor.	Collective plasma/baryonic coupling placeholder.

3. Mathematical core

The parent-field framework splits internal plasma coherence from environmental compatibility. This prevents the model from treating all magnetic confinement as useful or all Earth-field effects as evidence.

Internal phase-core score

$$C_\phi = 0.18G + 0.18S + 0.18D + 0.18Q + 0.16Q_{B, \text{eff}} - 0.20I_{B, \text{eff}}$$

$$Q_{B, \text{eff}} = Q_B A_{\text{align}}, \quad I_{B, \text{eff}} = Q_B(1 - A_{\text{align}}) + I_{\text{measured}}$$

The split is essential: raw magnetic field strength can either assist coherence or behave like a forced boundary wall. Only aligned confinement raises C_ϕ ; misalignment contributes to $I_{B, \text{eff}}$.

Parent-field rejection index

$$R_\phi = \Gamma_{\text{lab}} \Gamma_{\text{wall}} \Gamma_b C_{\phi, \text{internal}} A_N A_{\text{opp}}$$

$$g_{\text{net}} = g_{\text{parent}}(1 - R_\phi)$$

$$R_\phi \approx 1 \quad \Leftrightarrow \quad g_{\text{net}} \approx 0$$

In design-mode north-aligned proxy testing, A_N is set to 1 by construction. This is not a claim about the historical orientation of a real tokamak. It is a proposed design alignment used to ask whether the equations can produce a coherent sequence.

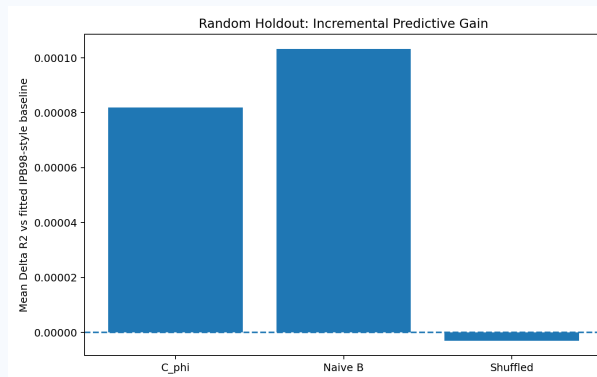
$$T_{\text{core}} \geq 4.0 \times 10^6 \text{ K}, \quad Y_{\text{fusion}}/L_{\text{cool}} \geq 1$$

$$|g_{\text{net}}/g_{\text{parent}}| \leq 0.02, \quad C_{\text{field}} \geq 0.85$$

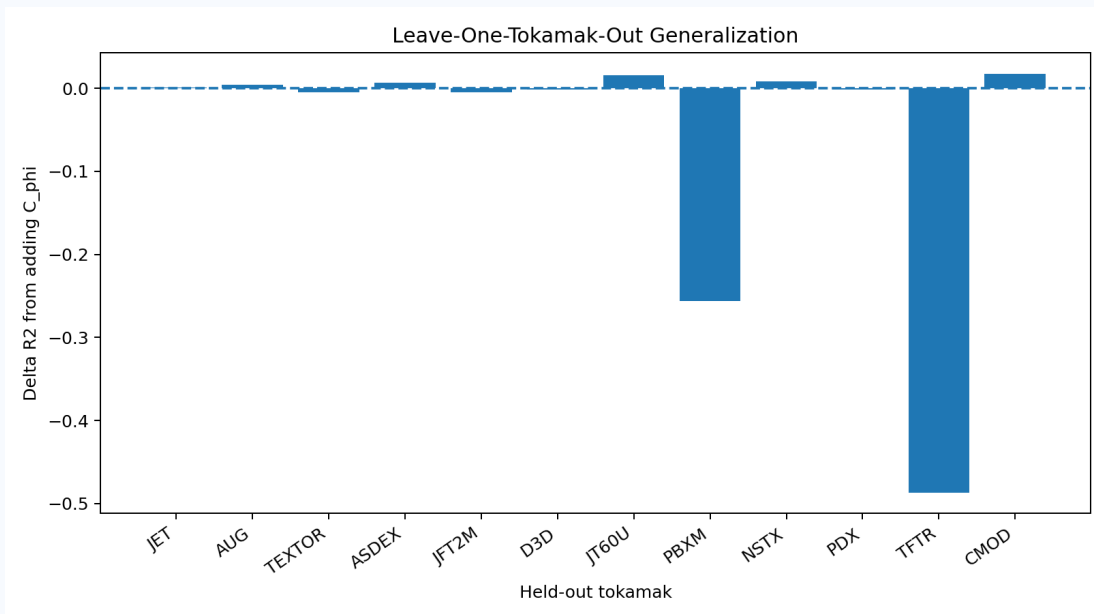
4. ITPA/HDB5 internal benchmark

The ITPA/HDB5 run was used as the first real-data baseline for internal C_{ϕ} . It mapped H-mode database variables into G , S , D , Q , Q_B , A_{align} , I_{measured} , Q_B_{eff} , I_B_{eff} , and C_{ϕ} . The target was log thermal confinement time, with an IPB98-style baseline.

Metric	Mean value
Baseline R2	0.943369
Baseline + C_{ϕ} R2	0.943451
Delta R2 from C_{ϕ}	0.00008191
Delta R2 from naive B-as-Q	0.00010325
Delta R2 from shuffled C_{ϕ}	-0.00000309
Leave-one-tokamak mean Delta R2	-0.05853778



Random holdout: internal C_{ϕ} produced only a tiny positive gain. This is not a validation; it is a pointer for refinement.

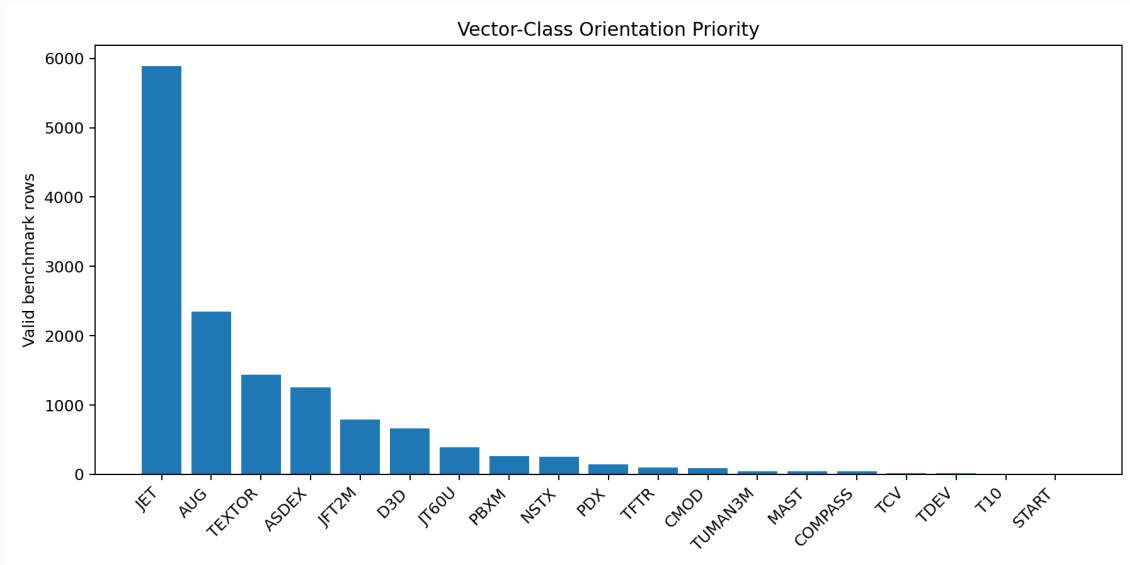


Leave-one-tokamak-out: cross-machine generalization is mixed and not yet strong.

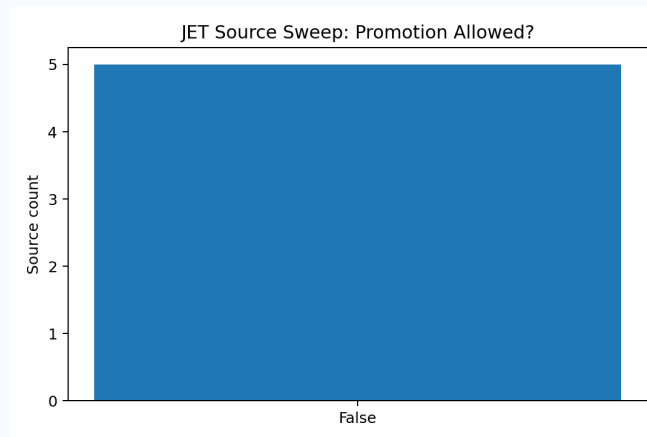
Real-data status: Internal C_{ϕ} contains structure but does not yet robustly validate the hypothesis. The current fusion extension remains speculative.

5. Parent-field metadata and null gates

The parent-field layer is a detection instrument, not a conclusion engine. It requires location, verified vector class, machine axis, transfer factors, and null-correlation gates. If the metadata are unknown, the only valid status is scaffold-only or design-mode proxy.



Vector-class priority: JET dominates the valid benchmark rows, so it is the first orientation target.



JET source sweep: no source promoted JET beyond location-only because no true-north machine physics axis was verified.

Strict diagnostic gate: no verified device/machine physics axis -> no parent-field diagnostic claim.

Two modes, deliberately separated

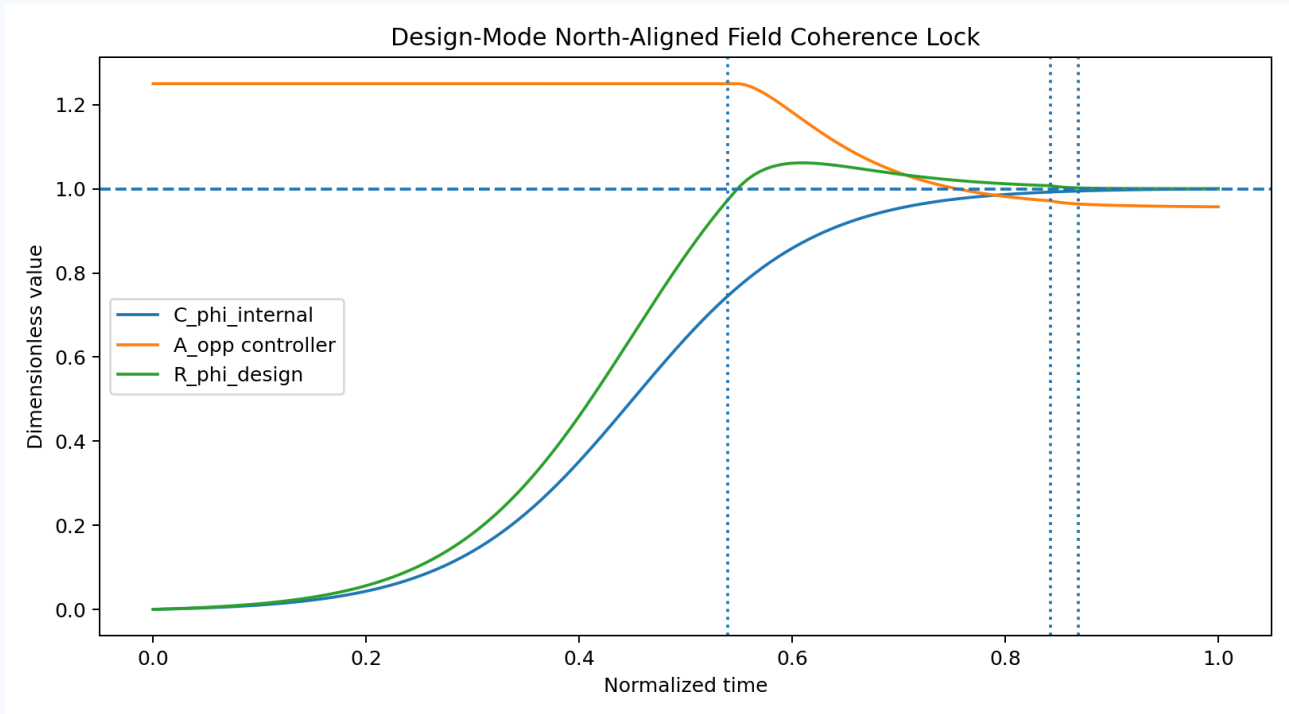
Mode	Allowed use	Confidence meaning
Diagnostic mode	Evidence-bearing device residual test.	Requires verified location, vector class, axis, transfer factors, null controls.
Design-mode proxy	Hypothesis exploration and design requirement test.	May assign north alignment by design; cannot claim historical device evidence.

6. Design-mode north-aligned simulation

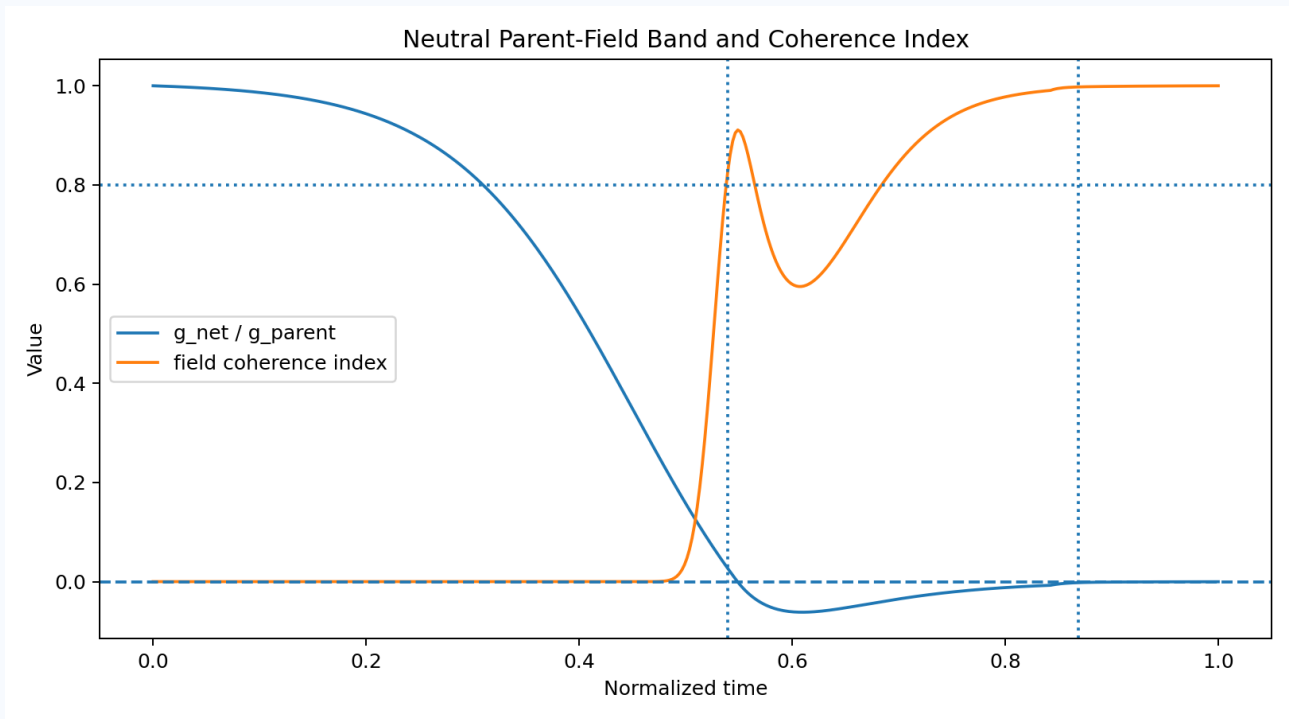
The north-aligned design-mode run intentionally sets the machine reference axis to true north. This is a controlled design assumption, not a historical claim. The purpose is to ask whether, inside the toy model, a correctly aligned artificial node can reach coherent neutral balance and then ignite.

$$R_\phi = \Gamma_{\text{lab}} \Gamma_{\text{wall}} \Gamma_b C_{\phi, \text{internal}} A_N A_{\text{opp}}$$

$$R_\phi \approx 1 \iff g_{\text{net}} \approx 0$$



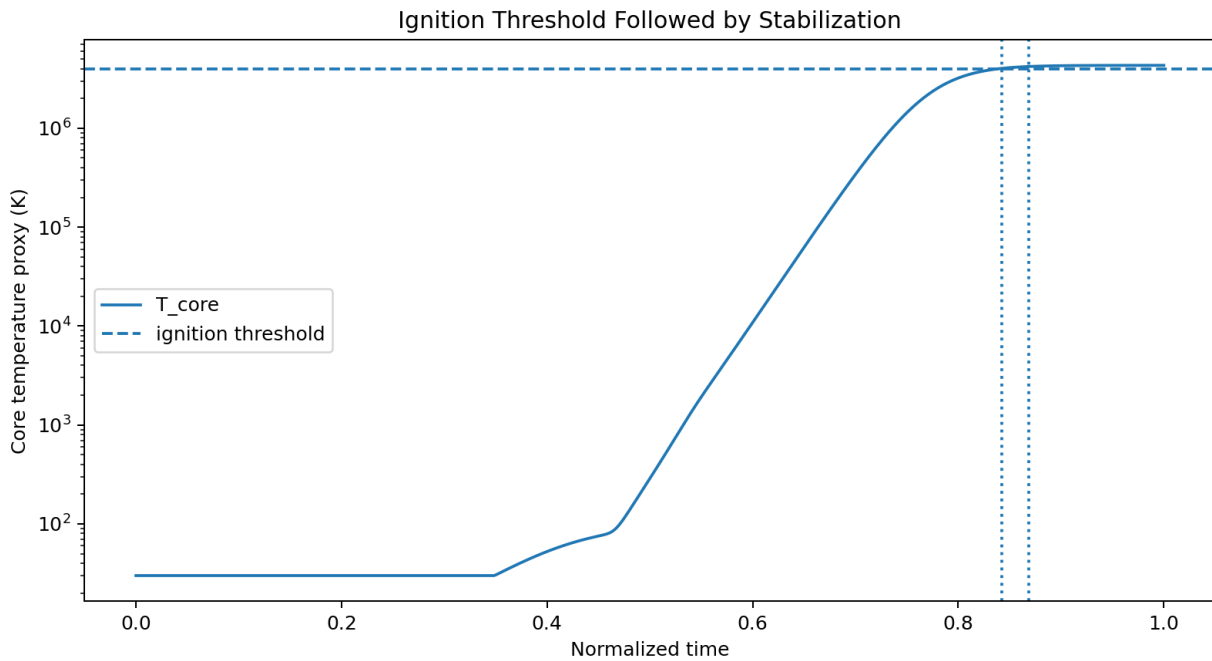
The opposition controller tunes R_ϕ toward the neutral parent-field band.

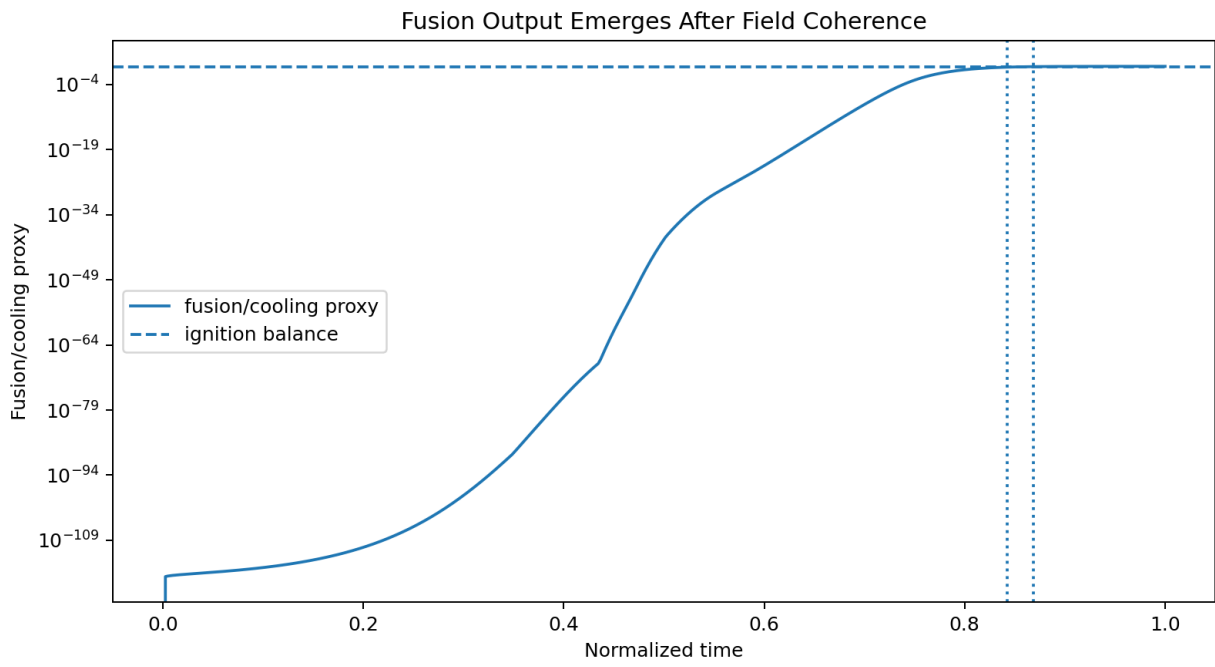


Field coherence occurs when g_{net}/g_{parent} approaches zero and the coherence index rises.

7. Ignition and stabilization results

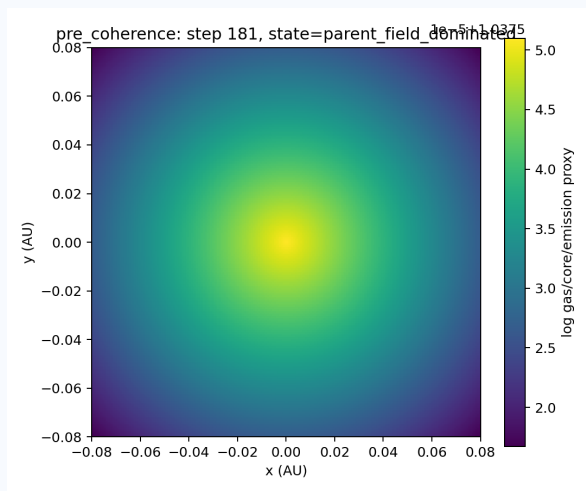
milestone	step	tau	C_phi_intern al	R_phi_desig n	gnet_over_gpa rent	field_coherenc e_index	T_core_K	fusion_to_co oling	state
field_coherence	226	0.5394	0.7449	0.9731	0.02691	0.8249	1304	1.263e-31	field_coherent_pre_ig nition
ignition	353	0.8425	0.9924	1.007	-0.007368	0.9907	4.029e+06	1.033	ignited_stabilized
stabilization	364	0.8687	0.9948	1.002	-0.002028	0.9977	4.207e+06	1.349	ignited_stabilized
final	419	1	1	1	-0.0002457	1	4.323e+06	1.59	ignited_stabilized



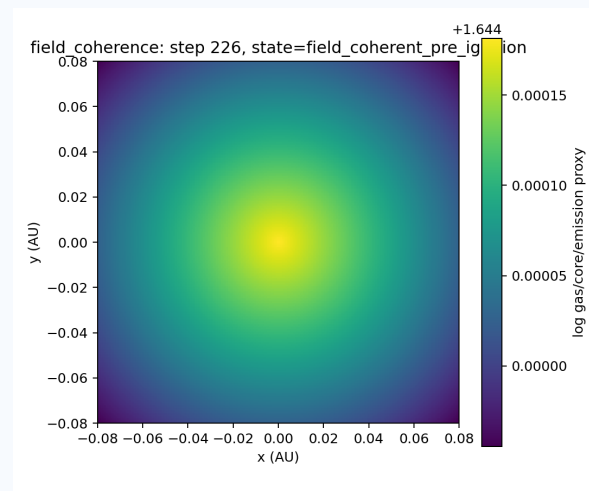


Fusion/cooling proxy crosses unity and remains above unity during the stabilized phase.

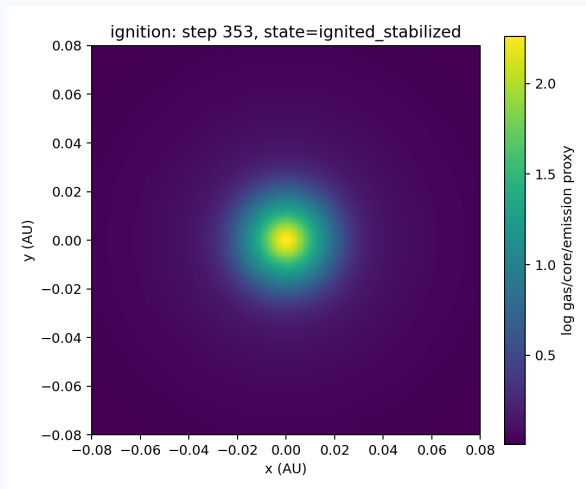
8. Visual node states



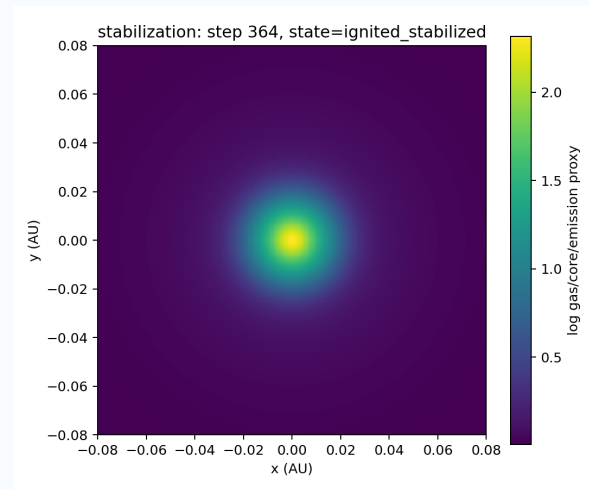
Pre-coherence



Field coherence



Ignition



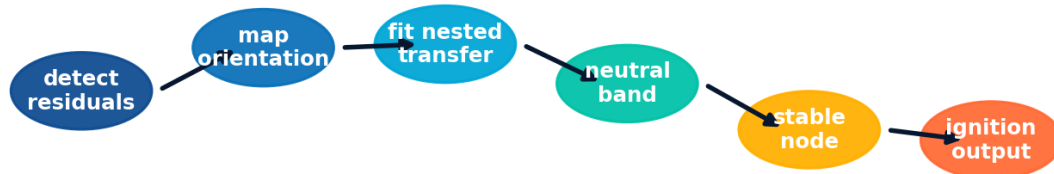
Stabilization

Within the toy model, the visible sequence is: diffuse node -> field coherence -> ignition -> stabilized star-like output. The result is a design-mode model output, not physical evidence.

9. Falsification protocol

The package is designed to fail cleanly. The parent-field hypothesis cannot be considered supported unless it beats nulls and machine identity leakage.

Falsification-first engineering ladder



The package deliberately separates discovery-mode proxy scans from diagnostic evidence.

Falsification-first ladder: residual detection precedes experimental interpretation.

Gate	Failure condition
Shuffled metadata	Real parent-field terms must beat globally shuffled metadata.
TOK-preserving shuffle	The result must beat metadata shuffled within each machine.
Machine identity leakage	Parent-field terms must add power after TOK one-hot controls.
Leave-one-tokamak-out	A signal must generalize across held-out machines.
Coefficient sign stability	The parent-field coefficient must keep a stable sign across folds.
Vector-class gate	A hall/building axis cannot become a machine physics vector without evidence.

Design-mode success does not override diagnostic gates. It only identifies a mathematically coherent design target for future testing.

10. Limitations and next work

- The design-mode simulation is a toy model, not a plasma solver, stellar evolution model, or reactor model.
- The north alignment is assigned by design. It is not a claim about historical JET or any actual machine.
- The fusion and cooling terms are qualitative proxies, not a nuclear reaction network.
- Transfer factors Γ_{lab} , Γ_{wall} , and Γ_b are placeholders requiring calibration.
- ITPA/HDB5 internal C_{ϕ} results are mixed and not yet validating.
- Real parent-field diagnostics require verified device-axis orientation and null-controlled residual tests.

Next work

- 1 Find true-north JET machine/physics-axis evidence or keep JET location-only.
- 2 Define transfer-factor priors from chamber/wall geometry and vector class.
- 3 Run proxy scans only under explicit design-mode labels.
- 4 Re-run HDB5 residual tests with verified orientation metadata when available.
- 5 Create a laboratory orientation scan protocol for a controlled tabletop or plasma diagnostic system before any fusion claim.

11. Copyright, data-use, and safety notice

Original research-package notice. Original text, diagrams, code scaffolds, and generated toy-model outputs in this package are prepared for Levi S. Haye / RBFL Research Project, 2026. Review institutional, journal, and collaborator requirements before public posting.

Third-party materials. ITPA/H-mode database files, HDB5 variable definitions, EFDA/ITER/JET materials, and all cited public documents retain their respective copyrights and data-use terms. This package includes or references them for research reproducibility in this working context; public redistribution should follow the original licenses and permissions.

Safety notice: This document is not a construction guide, not an operating procedure, not a reactor design, and not a recommendation to build high-energy devices. It contains conceptual and data-analysis methods only.

Recommended release wording: "This work proposes a highly speculative, falsifiable phase-core geometry hypothesis. It demonstrates internal model consistency and defines validation gates. It does not claim working fusion technology."

Appendix A. Full definition dictionary

Term	Meaning	Derivation/use
G	Geometry quality	Elongation, triangularity, shape coherence.
S	Shear/coherence quality	Internal inductance, q95, smooth current/field profile proxies.
D	Density organization	Density peaking or Greenwald-limit proximity proxy.
Q	Confinement quality	Pre-drive or measured confinement depending on target; never use target τ_E inside C_ϕ when predicting τ_E .
Q_B	Raw magnetic drive	Normalized toroidal magnetic field or external magnetic strength.
A_align	Magnetic alignment factor	q95/rational avoidance, geometry, shear, and instability suppression.
I_measured	Measured instability penalty	Radiation fraction, Greenwald fraction, ELM/disruption, dW/dt .
C_phi_parent	Parent-field coherence term	Environmental compatibility of child node with Earth parent-field well.
hall_axis_azimuth_deg	Building or Torus Hall structural axis.	Can be recorded but cannot be used as physics vector without proof.
machine_axis_azimuth_deg	Verified machine/physics vector azimuth.	Only allowed from engineering source, true-north plan, or validated georeference.
orientation_vector_classes	Which vector is being tested.	Prevents hall-axis/machine-axis confusion.
diagnostic_ready	Metadata is eligible for evidence-bearing tests.	Requires location, machine axis, vector class, transfer factors, confidence > 0.
design_mode	Exploratory mode where axis is assigned by design.	Allowed for hypothesis scanning but not evidence.

Appendix B. Reproducibility package

The accompanying reproducibility package contains the PDF, generated figures, processed CSV data, source documents used in this working session, and scripts sufficient to reproduce the design-mode north-aligned toy run and inspect the real-data benchmark outputs.

Folder	Contents
paper/	Final PDF preprint.
figures/	All figures embedded in the report.
data/	Processed CSVs: design-mode time series, milestone table, ITPA benchmark outputs, vector-class metadata gates.
source_docs/	Uploaded RBFL docs and HDB/ITPA variable references, subject to original data-use terms.
code/	Standalone scripts, requirements, and paper-generation script.
docs/	README, release notes, copyright/data-use notice, and how-to-run instructions.

Primary reproduction command for the design-mode toy model:

```
python code/run_design_mode_north_aligned.py
```

Primary output expected: `design_mode_north_aligned_coherence_timeseries.csv` and the five core plots showing coherence lock, neutral parent-field band, ignition, fusion/cooling, and stabilization.