Substrate Cosmology Volume Eight

Conditional Engineering and Physical Manipulation

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Publication and Copyright Notice

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This book presents a developing research program. Substrate Cosmology and Fibered Relational Tensor Theory are not established physical theories. Established results belong to their cited scientific sources and validated domains. Project definitions, interpretations, hypotheses, engineering targets, and speculative extensions are identified separately.

This volume is not a construction manual. It supplies a disciplined route from an idea about physical intervention to a bounded research program. It does not provide a demonstrated method for manipulating a relational substrate, changing physical law, controlling gravity, extracting unlimited energy, transmitting information faster than light, traveling through time, teleporting matter, eliminating inertia, producing propulsion without reaction or exchanged momentum, or building a dimensional reactor, precausal channel, relational quantum computer, or substrate-responsive material.

Earlier project language sometimes described these possibilities in the indicative mood. That grammar exceeded the evidence. In this volume, dimensional gradients, anchors, coherence architectures, projection synthesis, precausal channels, and substrate engineering are retained as conjectural research terms. They become physical engineering concepts only after an observable is defined, an interaction is demonstrated, ordinary explanations are excluded, energy and momentum are accounted for, independent replication succeeds, and the effect survives prospective tests.

The RP07 recurrence boundary remains unchanged. GDELT 1995 is development data; 1996 and later years remain unopened for the inherited blind branch. Cryptocurrency, stock, commodity, financial, and other outcome layers remain unopened. Nothing in this engineering discussion opens, scores, or retrospectively modifies that experiment.

Authorship and AI Collaboration

James Dunn originated Substrate Cosmology, the distinction between Actual Physics and state-based representation, the treatment of matter as an emergent central tendency, the proposal that units and equations collapse relational fidelity, the expectation that alternate perspectives may reveal usable relations, and the goal of learning how Actual Physics might be manipulated through interactions with Actual Physics rather than by declaring current models exhaustive. He supplied the source corpus, research website, corrections, and governing constraints. He retains responsibility for the claims and publication.

OpenAI ChatGPT (Codex) reviewed the available Library corpus and public research commons; compared the engineering passages with Volumes One through Seven; identified places where conceptual possibilities had been written as capabilities; separated established engineering, experimentally supported frontier research, operational hypotheses, and speculation; drafted and edited the manuscript; prepared the equations, research records, citations, and appendices; produced the final document; and integrated this volume with the public website.

Microsoft Copilot and Google Gemini are acknowledged for earlier assistance recorded in the source manuscripts. AI systems are collaborators in representation, comparison, analysis, and production. They are not empirical witnesses, independent replicators, scientific authorities, or evidence that a physical claim is true.

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Contents

Preface

The first seven volumes prepared a reader to ask an engineering question without converting language into a machine. Volume One separated Actual Physics from the representations available to observers. Volume Two showed how words, numbers, units, and equations compress relations. Volume Three organized the Relational Tools. Volume Four proposed Fibered Relational Tensor Theory while requiring established physics to be recovered. Volume Five put preparation, apparatus, and detector coupling inside the phenomenon. Volume Six established recurrence, null worlds, blinded archives, frame shaking, and immutable Recovery Points. Volume Seven applied those disciplines to cosmology and emergent physical quantities.

Volume Eight asks what must happen before any part of that framework can responsibly guide physical intervention. The answer is not that imagination must stop. It is that imagination must acquire an interface to evidence. An engineering noun such as *reactor*, *sensor*, *channel*, or *material* implies inputs, outputs, couplings, budgets, failure modes, and reproduced performance. A conceptual architecture may inspire such a device; it is not the device.

The source corpus contains an especially useful lesson. It moved rapidly from alternate perspectives to dimensional reactors, coherence-responsive materials, non-inertial transport, relational computation, and precausal communication. That movement revealed a research horizon, but it also skipped the work that gives engineering terms their meaning. Phrases such as “without energy cost” or “beyond causality” were not earned by measurement. This volume preserves the questions and removes the premature certainty.

The result is a conditional engineering discipline. It begins with ordinary physical control, defines candidate observables, protects conservation and no-signalling boundaries, requires independent detectors and replication, and admits the possibility that every substrate-specific intervention program may return a null result. A null result would constrain the framework. It would not make the experiment a failure.

The Current Series

The series has no predetermined length. Volumes may divide, combine, or change order when conceptual dependencies, formal results, or evidence require it.

Volume	Working title	Primary task
One	Introduction to Substrate Cosmology	Establish the alternate perspective and research boundaries.
Two	Words Units and the Collapse of Physical Representation	Make linguistic numerical metrological and mathematical selection inspectable.
Three	The Relational Tools and Their Developmental Lineages	Preserve explain crosswalk and operationalize the Tool architecture.
Four	Relational Mathematics and Fibered Relational Tensor Theory	Develop formal objects projections recovery maps and conservative extension.

Volume	Working title	Primary task
Five	Measurement Detectors and Experimental Interaction	Model apparatus controls independent projections and discriminating interventions.
Six	Recurrence Research and the Labyrinth	Develop recurrence methods blind archives null worlds and prospective validation.
Seven	Cosmology Matter and Emergent Physical Quantities	Reconsider spacetime matter fields gravity energy entropy horizons and dark phenomena.
Eight	Conditional Engineering and Physical Manipulation	Translate speculative capabilities into gated reversible testable intervention programs.
Nine	Intelligence Agency Identity and Dimensional Stewardship	Develop relational learning culture ethics AI and propagation of diverse life.
Ten	Substrate Cosmology Website User Manual	Document the research commons investigation routes evidence boundaries and continuity controls.

Volume Nine inherits the questions of agency and stewardship that engineering makes unavoidable. Volume Ten remains the dedicated website manual. Chapter Seventy Four supplies only the engineering-specific guide needed for the present research surfaces.

Acknowledgments

This volume acknowledges the experimentalists, metrologists, engineers, technicians, operators, safety professionals, and maintainers whose work makes physical claims answerable to systems that can fail. Their habits of calibration, isolation, energy accounting, fault reporting, configuration control, and rollback are as important here as theoretical imagination.

OpenAI ChatGPT (Codex) is acknowledged for auditing the inherited engineering claims, developing the conditional research architecture, reviewing scientific sources, drafting and editing the manuscript, producing the publication, and integrating it with the research website. Microsoft Copilot and Google Gemini are acknowledged for earlier recorded assistance. Their participation is provenance, not confirmation.

Reader Guide

Statement Classes

Class	Meaning	Engineering consequence
Established relation	Reproduced within a defined domain	May support design inside that domain
Frontier result	Published result with active interpretation or scale limits	May motivate replication not deployment
Project definition	Meaning assigned within Substrate Cosmology	Organizes a test but proves nothing physical
Operational hypothesis	Proposed input observable and predicted difference	Eligible for a bounded experiment
Engineering target	Desired capability with prerequisites and stop conditions	Remains a roadmap item
Speculative extension	Possibility without an operational bridge	Cannot justify construction or exposure
Prohibited inference	A conclusion not licensed by the evidence	Must be blocked explicitly

Reading Paths

Engineers should read Parts I, II, and IV before candidate programs. Physicists may begin with Part II and then use Part III to see how inherited substrate terms are translated. Experimentalists should pair Part IV with Volumes Five and Six. Readers interested in proposed devices should not skip Chapters Thirty Four and Thirty Five. Safety reviewers should begin with Part VI. Website contributors may begin with Chapter Seventy Four.

The Primary Boundary

This volume permits conceptual design and low-risk experiments. It does not convert an ontology into hardware. No proposed substrate coupling is admitted until an observable, intervention, comparator, energy and momentum account, hazard envelope, and disconfirming result are specified in advance.

Introduction

From Possibility to a Physical Difference

Engineering is organized intervention. A system is prepared, an input is applied, a response is measured, and the result is compared with a model and a control. The central question is not whether a possibility can be described. It is whether a deliberately varied relation produces a repeatable physical difference that ordinary explanations cannot absorb.

Let a bounded experiment be represented by

$$E = \langle P, u, S, D, C, B, H, R \rangle,$$

where P is preparation and history, u is the intervention, S is the system boundary, D is the detector ensemble, C is the control and comparator structure, B is the physical budget, H is the hazard and stop plan, and R is the preregistered result rule. Removing any term changes the question being asked.

Substrate Cosmology adds a further demand. If a proposed intervention is described in terms that are not native to established physics, it must still project into measurable consequences. A “dimensional gradient” without a measured variable is a metaphor. A “coherence architecture” without an operational coherence function is a label. A “precausal channel” without an encoded input, registered output, timing convention, and no-signalling analysis is not a communication channel.

The purpose of this volume is to keep the imaginative horizon open while making the path toward it narrower, more exact, and safer.

Part I

From Description to Intervention

Chapter One

Engineering Changes Relations

Every engineered action changes relations: a force changes momentum, a voltage changes charge distribution, a catalyst changes reaction pathways, a boundary changes allowed modes, and feedback changes future input in response to measured output. Objects are convenient nouns for persistent organizations, but the action occurs through couplings.

This makes engineering compatible with the relational perspective without establishing a substrate ontology. A relational account becomes useful when it predicts a control-relevant difference that object-centered language hides. The first obligation is therefore to name the ordinary coupling before proposing an alternate one.

Chapter Two

What Manipulation Means

Manipulation is often heard as domination or unrestricted control. In engineering it should mean a repeatable dependence of an output on an applied input within a defined operating envelope. The local control derivative

$$K_{ij} = \frac{\partial y_i}{\partial u_j}$$

records how observable y_i changes when input u_j is varied. A candidate substrate effect needs an equivalent operational definition. If no input can be varied, no response isolated, and no transfer function estimated, “manipulation” is premature.

Chapter Three

Actual Physics and the Control Surface

Actual Physics names whatever relations occur, including those inaccessible to current representation. An engineer cannot act on that totality directly. Action occurs through a control surface: the subset of variables that preparation and apparatus can vary and the subset of consequences detectors can register.

The control surface is not necessarily the whole physical cause. A laser power setting, temperature, geometry, material composition, timing sequence, or software parameter may each compress many relations. The practical task is to preserve that compression as metadata rather than mistaking the setting for the physics itself.

Chapter Four

A Model Is Not a Handle

An equation may describe a relation without supplying an intervention. Curvature in general relativity does not imply a gravity knob. Vacuum energy in a field theory does not imply an energy source. Entanglement does not imply a signal path. A parameter in a model becomes an engineering handle only when an apparatus can vary it independently enough to estimate a response.

This is where earlier reasoning often collapsed back into familiar symbols: once a scalar appeared in an equation, it felt physically available. Volume Two warned that a named scalar can conceal the relations that generate it. Volume Eight adds that a modeled scalar can also conceal the absence of a controllable coupling.

Chapter Five

Known Physical Knobs

Established engineering already controls remarkable physical behavior through geometry, composition, electromagnetic fields, stress, temperature, pressure, chemical potential, optical pumping, boundary conditions, and feedback. These are not philosophically trivial. They are experimentally stabilized interfaces to Actual Physics.

New research should begin by asking whether a proposed effect can be produced through these known knobs. If it can, that may be valuable engineering, but it is not evidence for a new substrate degree of freedom. Ordinary control is the comparator, not the embarrassment.

Chapter Six

Acting From Inside the Environment

The intervention source, apparatus, specimen, detector, clock, analyst, and environment all belong to the same physical world. There is no external platform from which a researcher can edit the universe. Every proposed control loop is therefore coupled to the environment being studied.

This limits isolation, not physics. Thermal drift, vibration, electromagnetic pickup, material aging, software preprocessing, observer selection, and shared reference clocks can make a response appear where none exists. The experiment must model these pathways before attributing a residual to a relation outside familiar physics.

Chapter Seven

The Engineering Evidence Ladder

Engineering claims rise through distinct levels: conceptual consistency, simulation, instrument response, controlled bench effect, independent replication, mechanism discrimination, scale transfer, and bounded application. Success at one level does not confer the next.

A simulation can show that a model produces a behavior. It cannot show that nature uses the model. A sensor anomaly can justify an artifact investigation. It cannot establish a new field. A replicated effect can justify mechanism studies. It does not automatically justify human exposure or large energy operation.

Chapter Eight

Conditional Does Real Work

“Conditional” is not rhetorical caution. It records missing dependencies. A dimensional-bias sensor is conditional on defining a dimensional observable, constructing a coupling hypothesis, demonstrating transduction, excluding ordinary sensitivities, and replicating the response. If any dependency fails, the device claim stops.

Conditional language also protects useful imagination. It lets a research target remain visible without requiring belief. A proposal can be preserved as a structured question rather than promoted to a result or discarded as impossible.

Chapter Nine

Recovery Before Novelty

Any proposed substrate intervention must reproduce established predictions in their tested domains. In the language of Volume Four, an embedding and recovery map must satisfy

$$\pi_T \circ \iota_T \cong Id_{Phys_T}.$$

For engineering, this means the novel model must recover the known transfer function, conservation budget, uncertainty, and failure behavior where ordinary theory already works. A model that explains an anomaly by breaking routine operation has not extended physics; it has abandoned the data.

Chapter Ten

Stop Conditions Before Starting

Every intervention program needs conditions that stop acquisition, escalation, interpretation, or deployment. Examples include detector saturation, calibration loss, unmodeled heating, electromagnetic leakage, unstable feedback, biological exposure, unexplained momentum, unexpected persistence, and divergence between redundant monitors.

The stop condition is written before the attractive result appears. This prevents curiosity, cost, or reputational investment from silently expanding the acceptable hazard envelope.

Part II

Established Interfaces to Physical Change

Chapter Eleven

Mechanics and Boundary Conditions

Mechanical engineering changes motion and stress through forces, constraints, and boundary conditions. Resonance can amplify response, but the energy is supplied through coupling. Metastability can release stored energy, but the preparation history contains the resource. Mechanical advantage redistributes force and distance; it does not create work.

These familiar examples are valuable because they show how surprising outcomes can arise without new ontology. Any proposed “relational leverage” must identify its stored energy, exchanged momentum, boundary work, or measurable deviation from those accounts.

Chapter Twelve

Electromagnetic Control

Electromagnetic fields provide extraordinarily precise control of charges, currents, spins, atoms, plasmas, and radiation. Antennas, waveguides, lasers, magnetic resonance, traps, accelerators, and superconducting circuits all use established couplings while producing behaviors that would seem exotic without the model.

An unexplained response near such apparatus must first survive shielding, grounding, geometry changes, harmonic analysis, near-field mapping, and independent power monitoring. Electromagnetic complexity is not evidence of a substrate channel, but it may supply sensitive platforms for searching for one.

Chapter Thirteen

Thermodynamic Control

Temperature, pressure, chemical potential, and entropy production organize physical change across scales. Thermodynamic bookkeeping applies even when microscopic descriptions differ. An apparent low-energy process may draw on stored free energy, a reservoir, a phase transition, or information-processing costs.

For a bounded system, an accounting relation such as

$$\Delta E = Q + W + E_{in} - E_{out}$$

must close within uncertainty. A substrate interpretation cannot erase an imbalance; it must predict where the missing transfer appears and how another detector can register it.

Chapter Fourteen

Chemistry and Catalysis

Catalysts alter reaction pathways and activation barriers without being consumed in the net reaction. They do not remove the reaction’s thermodynamic constraints. Selective bond breaking, nonthermal plasmas, photochemistry, electrochemistry, and mechanochemistry already demonstrate that “heat” is not the only way to drive transformation.

Therefore a claim of bond-specific dissociation without bulk heating must be compared with established nonthermal pathways. If the energy arrives optically, electrically, chemically, mechanically, or through stored metastability, the effect may be important while remaining ordinary physics.

Chapter Fifteen

Materials and Metamaterials

Materials engineering controls emergent behavior through microstructure, topology, defects, interfaces, and composition. Metamaterials can guide electromagnetic or acoustic waves in ways unavailable to homogeneous media. Transformation optics shows how material parameters can implement coordinate-inspired wave control.

These successes are analogues for relational design, not evidence that spacetime or a substrate has been engineered. A material that produces an unusual effective geometry for waves still operates through measured constitutive relations. The analogy becomes a substrate claim only if it predicts an additional response beyond those relations.

Chapter Sixteen

Quantum Preparation and Control

Quantum control prepares states, shapes Hamiltonians, sequences measurements, and uses feedback to influence outcome distributions. Quantum sensing uses coherence, interference, and well-characterized transitions to measure established physical quantities with high sensitivity.

Neither field supplies a general substrate interface. Coherence has precise meanings tied to a specified quantum state and basis. It should not be transferred into “coherence architecture” without defining the mathematical object, preparation, observable, and decoherence channels. Precision is an opportunity for testing, not permission to change the term’s meaning.

Chapter Seventeen

Measurement and Feedback

Feedback turns measurement into intervention. A controller estimates system state, compares it with a target, and applies a new input. The loop can stabilize an unstable system, reject disturbance, or create oscillation. It can also hide bias when the same detector both defines and confirms success.

Substrate research should separate discovery sensors, control sensors, and validation sensors where possible. Independent physical principles reduce the chance that a shared artifact becomes a self-confirming loop.

Chapter Eighteen

Computation and Simulation

Simulation explores the consequences of assumptions. It can compare frames, stress-test recovery maps, design controls, and identify parameter regions where models diverge. It cannot demonstrate that an unobserved degree of freedom exists.

Classical and quantum computers remain physical systems with energy, timing, noise, preparation, and readout. Indefinite-order quantum processes do not imply timeless machines. “Relational computation” is presently best treated as a model architecture: computation over relations, mappings, and compatibility constraints rather than a demonstrated substrate-native device.

Chapter Nineteen

Gravity as an Engineering Environment

Engineering already uses gravity through structures, trajectories, tides, orbital mechanics, accelerometers, gravimeters, and relativistic timing. Moving mass changes a gravitational field in the ordinary sense, but practical control is limited by the amount and distribution of mass-energy.

No demonstrated method independently switches, shields, amplifies, or reverses gravity. A gravity-control proposal must not cite general relativity’s dynamical geometry as evidence that such a handle exists. Precision tests of gravity are legitimate research; claims of gravity manipulation require a new reproducible coupling.

Chapter Twenty

Conservation Accounting

Conservation laws are not optional obstacles. They are among the strongest compression rules known, linked to symmetries and repeatedly tested. Novel apparatus must account for energy, momentum, angular momentum, charge, and relevant particle or material flows across a clearly defined boundary.

An unexplained residual is not automatically a conservation violation. It is first a demand to widen the boundary, measure neglected fields, examine stored energy, and test analysis choices. If a residual remains, the conservation claim becomes sharper because the ordinary exits were closed.

Chapter Twenty One

Noise Drift and Systematics

Noise is not a single unwanted scalar. It includes stochastic fluctuations, deterministic interference, correlated environmental change, sampling error, digitization, nonlinear response, and preprocessing artifacts. Drift carries history and can masquerade as slow control response.

The experimental record should retain raw channels, synchronization methods, environmental monitors, rejected intervals, and alternate reductions. A result that exists only after one filter, window, or baseline is an analysis candidate, not an engineered capability.

Chapter Twenty Two

Scaling and Replication

An effect’s existence, magnitude, mechanism, and utility are different claims. Scaling can reveal whether a response follows area, volume, mass, frequency, temperature, geometry, information rate, or an unrecognized variable. It can also expose saturation and threshold behavior.

Independent replication must reproduce the intervention logic without merely copying every hidden artifact. A transferable effect should survive reasonable changes in operator, site, apparatus, and analysis while retaining its preregistered signature.

Part III

Translating the Inherited Engineering Corpus

Chapter Twenty Three

The Four Layer Proposal

The inherited corpus suggests a four-layer engineering stack: dimensional engineering, reactor engineering, interface engineering, and direct substrate engineering. The sequence is conceptually useful because it separates a proposed degree of freedom, an environment that might control it, a transducer between regimes, and an architecture that would shape the underlying rules.

The stack is not a technology-readiness claim. At present, no layer has a demonstrated substrate-specific coupling. Its value is diagnostic: it shows exactly which bridges are missing and prevents the imagined final machine from concealing those absences.

Chapter Twenty Four

Dimensional Engineering as a Placeholder

In the source corpus, dimensional engineering means deliberate control of dimensional flow, drift, gradients, coherence, anchors, or projection compatibility. None of those terms presently identifies a laboratory control variable unique to Substrate Cosmology.

The phrase should therefore be read as a placeholder for a future discipline: engineering a physical response that cannot be accounted for by known geometric, material, electromagnetic, quantum, thermal, chemical, or computational relations, and whose distinguishing variable is rigorously tied to effective dimensional structure. Until then, experiments may search for the bridge but should not claim to use it.

Chapter Twenty Five

Gradients

Engineering is rich in gradients: temperature, pressure, electric potential, concentration, stress, curvature, and information measures. A “dimensional gradient” cannot be established by renaming one of them. It requires an operational dimensional quantity D, an uncertainty model, and a response that depends on ∇D after known gradients are controlled.

If effective dimension varies in a mathematical or simulated model, that is a model property. If an observable exhibits scale-dependent behavior consistent with several mechanisms, “dimensional flow” is one candidate interpretation. Control becomes plausible only after an intervention can vary the relevant relation independently enough to test the predicted response.

Chapter Twenty Six

Coherence

Coherence may refer to phase relations in waves, off-diagonal quantum terms, correlated oscillation, persistent organization, or compatibility within a relational model. These meanings are not interchangeable. The source corpus often moved between them without an explicit map.

An engineering claim must declare which coherence is measured, how it is prepared, the reference against which phase or compatibility is defined, the expected lifetime, and the ordinary decoherence or synchronization mechanisms. “Coherence-responsive material” remains a product concept until a substrate-specific coherence observable and material response are demonstrated.

Chapter Twenty Seven

Anchors

An anchor is a project term for a relation that stabilizes identity or reference across a transformation. In ordinary engineering, clocks, fiducials, constraints, phase references, calibration standards, boundary conditions, and topological invariants can perform anchor-like roles.

A substrate anchor must not be inferred merely because a system has a stable reference. The research task is to identify a transformation under which familiar references fail while a specified relational invariant persists and predicts a new response. “Anchor mobility” then becomes a measurable change in that invariant, not a poetic replacement for motion.

Chapter Twenty Eight

Projection

Projection maps a richer description into an accessible representation. Detectors, estimators, coordinate choices, coarse graining, and model reduction all create projection effects within established science. Substrate Cosmology proposes that spacetime and state-based information may themselves be projections.

Engineering a projection presently means changing preparation, coupling, representation, or reconstruction and measuring how results transform. It does not mean choosing new physical laws. “Projection synthesis” should remain a mathematical and experimental design program until a physical mapping beyond known measurement transformations is demonstrated.

Chapter Twenty Nine

Dimensional Reactors

The inherited dimensional reactor was described as a chamber, gradient engine, and control system able to alter bonds, phases, coherence, and causal structure. Those components are conceptual placeholders. No demonstrated mechanism generates the proposed gradient, no substrate transducer has been identified, and no energy-free reaction pathway follows from the framework.

The term may be retained for a gated research target: a bounded apparatus that produces a reproducible material or informational response correlated with a preregistered nonstandard control variable after complete energy, momentum, field, thermal, chemical, and analysis audits. Before that threshold, “reactor” describes an architecture sketch rather than a machine.

Chapter Thirty

Sensors and Responsive Materials

The corpus proposes drift-resonant sensors, coherence-responsive materials, gradient-permeable media, anchor-mobile structures, and projection interfaces. Established materials can already respond to frequency, stress, phase, topology, fields, radiation, chemistry, and temperature in highly selective ways.

The first credible research step is not to fabricate a material with undefined substrate properties. It is to identify a residual response in an ordinary well-characterized material and test whether the residual tracks a frozen relational predictor across detectors and laboratories. Only then would designing enhanced susceptibility have empirical meaning.

Chapter Thirty One

Interfaces and Communication

A communication channel requires an encoding, controllable input, transmission or shared physical process, decoding, error model, capacity estimate, and causal analysis. Entanglement correlations alone do not provide controllable faster-than-light messages. Indefinite causal order in quantum information does not establish communication outside spacetime.

“Precausal channel” is therefore a hypothesis label, not a discovered medium. Any test must preserve no-signalling as the default expectation. A statistically unusual correlation without controllable message transfer is not a channel, and a clock-synchronization error is not evidence of timeless propagation.

Chapter Thirty Two

Relational Computation

Relational computation can be developed immediately as a formal method: data structures whose primitives are relations, typed mappings among frames, compatibility conditions, and recovery obligations. It can be implemented on ordinary computers and compared with scalar pipelines.

The stronger claim-that a device computes directly with a precausal substrate-has no demonstrated hardware basis. Quantum switches and causally nonseparable processes provide scientifically grounded ways to study order as a quantum-controlled resource, but they neither remove laboratory time nor prove that causal order is absent from nature at large.

Chapter Thirty Three

Direct Substrate Engineering

Direct substrate engineering was described as sculpting adjacency, programming dimensional grammar, designing coherence architecture, altering anchor topology, and synthesizing projection. It is the most speculative engineering class in the corpus because it assumes both the substrate's physical existence and controllable access to its proposed degrees of freedom.

The idea may organize long-horizon questions. It cannot presently specify equipment, operating parameters, products, or performance. Treating it as available technology would invert the evidence ladder: the largest claim would be used to justify the missing first observation.

Chapter Thirty Four

The Claims Withdrawn

This volume withdraws the evidentiary force of several inherited formulations. It does not erase their history.

- Dimensional flow is not known to be an accessible engineering resource.
- Anomaly, residual, or model disagreement is not automatically a dimensional signature.
- Energy barriers are not established as projection artifacts.
- Bond weakening without energy is not demonstrated or implied.
- Nonthermal does not mean zero-energy.
- A quantum effect does not establish substrate access.
- Indefinite causal order does not authorize acausal signaling.
- Precausal communication, non-inertial transport, and direct gravity control are not demonstrated.
- Relational computation is not known to exceed quantum computation.
- Spacetime and physical laws are not known to be programmable.

Withdrawing these assertions strengthens the research program by preventing its desired applications from serving as evidence for its premises.

Chapter Thirty Five

Translation Without Destruction

Correction need not flatten the speculative architecture into ordinary physics. Each inherited concept can be translated into a research form: define the term, list established analogues, name the missing observable, identify the minimum distinguishing result, specify disconfirmation, and set a safety ceiling.

This preserves developmental lineage. Researchers can see what was imagined, why it was attractive, where the inference crossed its evidence, and what work would be required to recover a legitimate claim. The source remains historical evidence; the translated volume becomes the responsible interface.

Part IV

The Architecture of a Legitimate Intervention

Chapter Thirty Six

The Engineering Claim Packet

Every proposed intervention should travel with a claim packet. It states the observation, ordinary mechanism, proposed substrate relation, controllable input, expected output, comparator, measurement chain, uncertainty, budgets, hazards, stop conditions, analysis, disconfirming result, and publication plan.

The packet prevents a concept from changing identity during the experiment. If the predicted signal moves after the data are seen, the new prediction becomes a new registered branch rather than a revision of the old one.

Chapter Thirty Seven

The Intervention Tuple

The intervention itself can be recorded as

$$I = \langle u, \Omega, \tau, \rho, h \rangle,$$

where u is the input waveform or sequence, Ω is its spatial and relational support, τ is timing, ρ is intensity or dose, and h is preparation history. Two experiments are equivalent only to the degree these fields and their uncertainties are equivalent.

For a proposed alternate-dimensional intervention, an additional field must specify how the ordinary physical input is hypothesized to couple to the proposed relational quantity. Without that coupling statement, the experiment is only exposing a system and hoping for novelty.

Chapter Thirty Eight

Preparation and State History

Physical systems remember. Annealing, stress, humidity, magnetic history, radiation dose, prior fields, surface contamination, operator handling, and software initialization can change response. A state label such as “room temperature” or “unpowered” rarely captures the preparation.

Volume Five placed measurement inside the interaction. Here preparation joins it. A substrate claim that depends on history must separate the hypothesized relational memory from ordinary hysteresis, aging, trapped charge, residual magnetization, and metastability.

Chapter Thirty Nine

Independent Detectors

Independent detectors should couple to the claimed effect through different physical principles. A thermal sensor and an optical spectrum may jointly test heating. A force balance and interferometer may jointly test displacement. A local clock and distant synchronized clock may test timing while exposing shared reference error.

Agreement between software copies of one sensor is not independence. Nor is agreement between detectors driven by the same power supply, reference oscillator, environmental enclosure, or preprocessing pipeline. Independence is a property of failure pathways, not brand names.

Chapter Forty

Controls and Counterfactuals

A control represents what should happen without the proposed distinguishing relation. Sham inputs, reversed geometry, detuned frequency, substitute materials, disabled coupling, randomized timing, and ordinary-physics simulations can each provide a counterfactual.

Controls should challenge both the substrate hypothesis and the artifact models. A successful control is not one that stays quiet; it is one whose possible outcomes have been interpreted in advance. If every outcome supports the preferred claim, the control has no discriminatory power.

Chapter Forty One

Null Worlds

A null world is a complete data-generating process without the proposed effect. It includes noise, drift, selection, detector nonlinearity, environmental coupling, analysis choices, and the search procedure. Synthetic nulls should be passed through the same pipeline as real data.

For engineering, null worlds also include ordinary mechanisms capable of producing useful performance. If a device works through known physics, the result may still be valuable. It simply does not validate the substrate interpretation.

Chapter Forty Two

Preregistration and Blinding

Preregistration freezes the primary outcome, sign, time window, preprocessing, exclusion rules, uncertainty method, and stop rule. Blinding separates decisions from knowledge of the condition or outcome. Neither practice forbids exploration; each marks which findings are exploratory.

The recurrence methods of Volume Six apply directly. Frame shaking, alternate filters, and multiple models belong in a registered ensemble or a later development branch. The inherited RP07 archive remains blind and unrelated engineering work cannot be used as a reason to open it.

Chapter Forty Three

Calibration and Metrology

Calibration connects an instrument indication to standards and an uncertainty chain. A detector's numerical precision does not guarantee physical accuracy. Calibration must cover the expected range, frequency, environment, and cross-sensitivities.

A proposed dimensional sensor would first be an ordinary sensor with an unexplained residual. Its established sensitivities should be deliberately excited to map the response space. Only after that model predicts routine behavior can a remaining preregistered residual support a new coupling hypothesis.

Chapter Forty Four

Residuals and Competing Models

A residual is the difference between data and a specified model, not a substance or hidden force. Its meaning changes when the model, calibration, or uncertainty changes. Multiple ordinary models should therefore compete with the substrate model on held-out data.

The goal is not to make the residual vanish at any cost. It is to learn which structure recurs across instruments, sites, and representations. A preferred substrate model must predict a difference before the comparison, not merely redescribe what remains afterward.

Chapter Forty Five

Dose Response and Transfer Functions

An engineered coupling should exhibit a structured dependence on input. Thresholds, saturation, hysteresis, frequency response, spatial decay, and sign reversal help distinguish mechanisms. The transfer model may be nonlinear and history-dependent, but it must make testable commitments.

Searching many input patterns until one produces an anomaly creates an unreported trials burden. The search protocol, number of configurations, and optimization feedback must be retained so that significance and replication reflect the actual process.

Chapter Forty Six

Reversibility

Reversibility is both a scientific probe and a safety property. If an input is removed or reversed, the system may return, persist, relax, or transform irreversibly. Each outcome constrains mechanism.

The project distinguishes reversible control from recoverability. A process may be physically irreversible yet operationally recoverable through replacement, isolation, or restoration. Before exposure, the team should identify what can be undone, what can only be contained, and what must never be attempted at the proposed scale.

Chapter Forty Seven

Replication and Transfer

Replication begins after the claim and procedure are sufficiently frozen. Internal repetition estimates stability but does not expose institutional or apparatus-specific bias. Independent teams should receive the claim packet, reference implementation, calibration requirements, and permitted degrees of freedom.

Transfer asks whether the relation survives a new material, geometry, detector, site, or scale. A phenomenon that cannot transfer may still be real, but its boundary becomes part of the theory. Failure to transfer is evidence about the relation, not an inconvenience to hide.

Chapter Forty Eight

Rollback and Failure Preservation

Rollback returns equipment, data systems, access, and experimental conditions to a known safe state. It includes emergency shutdown, isolation, configuration restoration, sample containment, and custody of raw records.

Failure preservation retains null results, damaged assumptions, calibration loss, and stopped runs. The event record should show what failed, when the stop condition triggered, and which conclusions are no longer available. A mature research program learns from the boundary it refused to cross.

Part V

Bounded Research Programs

Chapter Forty Nine

Cross Detector Residual Mapping

The lowest-risk route toward a new interaction begins with existing precision instruments. Select a phenomenon measured by detectors with different couplings, reconstruct each measurement chain, and map residuals in a shared relational record. Freeze the predicted cross-detector geometry before examining the held-out data.

A recurrence may indicate shared environment, shared time reference, common preprocessing, incomplete ordinary modeling, or a new physical relation. The program earns progress by separating these possibilities. It does not label disagreement “dimensional” in advance.

Chapter Fifty

Coupled Oscillators and Context

Coupled mechanical, electrical, optical, chemical, or biological oscillators provide accessible systems in which phase, synchronization, history, noise, and topology can be varied. They can model how persistent central tendencies emerge and how context changes apparent identity.

This program tests the framework's relational methods without claiming substrate access. Competing network descriptions, scalar summaries, and fibered models can be compared on prediction, recovery, and transfer. If a relational representation consistently exposes useful control variables hidden by scalar averages, that is an operational result even without new physics.

Chapter Fifty One

Coherence Response Experiments

A coherence-response study should choose one established meaning of coherence and one controllable perturbation. Examples include optical phase coherence, oscillator synchrony, spin coherence, or spatial correlation. The experiment maps preparation, decay, response, and recovery with redundant environmental monitoring.

Substrate language enters only through a registered alternative model that predicts an additional pattern. A long coherence time, correlated transition, or surprising phase response is not by itself evidence for relational substrate coherence.

Chapter Fifty Two

Metastability and Path Dependence

Metastable systems can change abruptly after small inputs because prior preparation stored free energy or placed the system near a transition. Magnetic domains, glasses, buckled structures, chemical reactions, and electronic devices all exhibit history-dependent behavior.

These systems are useful analogues for anchor stability and relational identity. They also warn against "low-energy" claims. The trigger may be small while the released energy is large. Complete preparation history and calorimetry are required before attributing leverage to a new degree of freedom.

Chapter Fifty Three

Metamaterial Analogues

Metamaterials allow researchers to design effective wave propagation through subwavelength structure. Transformation optics translates coordinate mappings into constitutive parameters, producing controlled trajectories and cloaking-like behavior within bounded regimes.

A Substrate Cosmology program can use these platforms to test projection and frame ideas as analogues. The scientific claim must remain exact: the apparatus engineers electromagnetic, acoustic, or mechanical response described by known physics. It does not demonstrate that spacetime, dimensionality, or the substrate itself was modified.

Chapter Fifty Four

Topological Analogues

Topological phases and protected modes show how global relational structure can stabilize behavior against local disturbance. They offer concrete examples of identity carried by organization rather than by one material element.

The analogy may guide models of anchors, persistence, and recovery. It becomes evidence for Substrate Cosmology only if the framework predicts a new observable beyond established topological theory and that prediction survives controlled comparison. Familiar mathematical resemblance is not physical identity.

Chapter Fifty Five

Indefinite Causal Order

Quantum information theory permits processes and higher-order transformations that are not represented by one fixed order of operations. The quantum switch can place alternative gate orders under quantum control, and research on causally nonseparable processes examines correlations beyond ordinary fixed-order circuits.

These are precise, experimentally grounded subjects. They do not mean that messages travel into the past, that causal paradoxes occur, or that a precausal substrate has been accessed. Volume Eight treats them as recovery tests: any Substrate Cosmology account of flexible order must reproduce the quantum formalism and its operational signalling constraints before adding interpretation.

Chapter Fifty Six

Simulating Emergent Causal Order

Models can explore how partial order, compatibility, or stable propagation emerges from an underlying relational network. Candidate rules should generate observable causal behavior, locality where recovered, and identifiable failure regimes. The simulation should expose which assumptions create the result.

No simulation outcome establishes that nature works this way. Its purpose is to produce discriminating observables and compare them with existing causal models. A useful model narrows experiments; it does not replace them.

Chapter Fifty Seven

Precision Gravity Tests

Precision gravimeters, atom interferometers, torsion balances, clocks, orbital observations, and equivalence-principle tests probe gravity with increasing sensitivity. A bounded Substrate Cosmology program may search for composition, geometry, orientation, history, or environment dependencies not absorbed by accepted models.

The study is a gravity test, not gravity control. Mass motion, vibration, magnetic fields, thermal expansion, tides, Earth rotation, and reference-model uncertainty must be monitored. Any candidate residual requires independent replication before an intervention program is contemplated.

Chapter Fifty Eight

Vacuum Boundary Phenomena

The Casimir effect and dynamical Casimir effect show that quantum fields respond to boundaries and time-dependent conditions. These effects are measured within quantum field theory and draw energy from the work or drive that changes the boundary condition.

They provide legitimate platforms for asking how measurement, geometry, and vacuum descriptions relate. They do not supply limitless vacuum energy. Any extraction claim must account for drive energy, losses, thermal photons, amplification, and the complete cycle rather than reporting only the output channel.

Chapter Fifty Nine

Relational Computation as Method

Relational computation can be pursued today as software and mathematics. A program can represent observations as typed relations, preserve multiple frames, carry uncertainty and lineage, enforce recovery maps, and compare incompatible models without flattening them into one scalar score.

Success is measured by better prediction, explanation, anomaly localization, transfer, or auditability. These outcomes would support the method, not a claim that computation occurred outside causal hardware. The distinction allows practical development without borrowing credibility from a speculative machine.

Chapter Sixty

Matter Centered Detection

Every current detector produces a stable record in matter or a material field configuration. This may bias accessible phenomena toward relations that couple to persistent central tendencies. The hypothesis is worth examining, but it does not imply that undetected relations exist.

Research can diversify detector principles, preparation regimes, time scales, materials, geometries, and analysis representations. If independent channels share a blind region, that pattern may guide new apparatus. Absence of a record remains absence of evidence, not evidence of an immaterial sector.

Chapter Sixty One

A Dimensional Bias Sensor Claim

A legitimate claim might be framed as follows: under registered preparations, detector family A and physically independent detector family B exhibit a recurring residual correlated with relational predictor D^*, while thermal, electromagnetic, mechanical, chemical, timing, and analysis models fail on held-out data.

This would justify the term *candidate dimensional-bias response*. It would not yet justify *dimensional sensor*. The next tests would vary D^* prospectively, transfer the protocol, and identify a transduction mechanism. If those tests fail, the sensor claim ends while the archived residual remains available for other explanations.

Chapter Sixty Two

No Signal Precausal Tests

A precausal hypothesis can be studied without attempting communication. Experiments may test correlations, order dependence, or process structure while explicitly preventing controllable message encoding. This preserves no-signalling as a hard operational boundary.

Only if a later preregistered protocol allows an input choice at one location to alter a decoded distribution elsewhere, after every ordinary channel and synchronization pathway is excluded, would signalling become the claim under test. Such a result would require exceptional replication and governance. It should never be inferred from correlation alone.

Chapter Sixty Three

Energy Audits

Every candidate device receives a full-system energy audit. Electrical supplies, control electronics, pumps, cooling, stored strain, chemical potential, radiation, vibration, data acquisition, information erasure, and environmental reservoirs belong inside the boundary unless explicitly measured crossing it.

Performance should be reported over complete cycles. A process that temporarily yields more measured output than contemporaneous drive may be releasing stored energy. Claims of energy-minimal operation require comparison with optimized ordinary methods. Claims of net generation require independent calorimetry and complete uncertainty accounting.

Chapter Sixty Four

Anomalous Propulsion Claims

Propulsion claims are especially vulnerable to thermal drift, cable forces, magnetic coupling, outgassing, vibration, center-of-mass shifts, electrostatic effects, and data-selection bias. A force signal should reverse with the registered control, scale as predicted, persist across balances and orientations, and vanish under decisive null configurations.

No “non-inertial transport” interpretation is permitted at the discovery stage. Momentum exchange with radiation, fields, expelled matter, the environment, or the support structure must be measured. A remaining anomaly is a candidate force residual, not a vehicle architecture.

Chapter Sixty Five

Criteria for Scale Up

Scale increases stored energy, exposure, environmental coupling, and consequence. A program advances only after the previous scale has reproduced the predicted effect, closed its budgets, passed independent review, demonstrated shutdown, and identified how new hazards will be monitored.

Scale-up should test a registered law rather than make a weak anomaly easier to see by increasing risk. If the mechanism is unknown, the permitted energy and exposure remain low. Failure, unexplained persistence, or divergence among safety monitors returns the program to diagnosis.

Part VI

Safety Stewardship and the Research Commons

Chapter Sixty Six

Hazard Classes

Candidate interventions should be classified by credible hazard rather than speculative benefit. Relevant classes include stored energy, pressure, cryogenic and thermal exposure, high voltage, radiation, strong fields, rotating machinery, reactive chemistry, vacuum, biological material, autonomous control, cybersecurity, and environmental release.

Substrate-specific uncertainty adds no permission. If a proposed mechanism is poorly understood, uncertainty raises the need for containment, monitoring, and conservative scale. Unknown physics is not a safety system.

Chapter Sixty Seven

Matter Energy and Exposure

Physical exposure limits are determined by the actual apparatus: field strength, optical intensity, voltage, temperature, pressure, radiation, chemicals, noise, acceleration, and duration. The conceptual label attached to the experiment does not change these hazards.

Researchers should use established laboratory practices, qualified review, interlocks, protective equipment, controlled access, and emergency procedures appropriate to the apparatus. Volume Eight does not replace domain-specific safety standards or authorize construction beyond the competence and facilities of the team.

Chapter Sixty Eight

Dual Use

A technology that improves sensing, control, energy conversion, computation, materials, or propulsion may support beneficial and harmful uses. Dual-use review begins before performance is public enough to transfer. It considers misuse, concentration of capability, surveillance, environmental harm, weaponization, and unequal access.

The research commons should publish enough to preserve scientific accountability while withholding hazardous operational detail when a credible risk exists. This is not a license to hide weak evidence. Evidence status, negative results, and independent review remain visible.

Chapter Sixty Nine

Human Animal and Environmental Protection

No speculative substrate benefit justifies unreviewed exposure of people, animals, ecosystems, or inhabited environments. Early work belongs in simulation, inert materials, low-energy benches, and contained systems. Human or animal research requires the ordinary ethical and institutional protections applicable to the actual intervention.

Environmental persistence must be considered even when the proposed effect is expected to be reversible. Materials, fields, emissions, waste, and autonomous behavior may persist through ordinary mechanisms regardless of the theoretical target.

Chapter Seventy

AI in the Engineering Loop

AI can search designs, compare models, generate code, monitor instruments, and propose anomalies. It can also amplify leakage, optimize artifacts, invent unsupported mechanisms, and compress uncertainty into confident language. AI output must therefore carry lineage, assumptions, tests, and human review.

An AI system should not autonomously increase energy, relax containment, expose living systems, open blinded data, or redefine success. Its role is advisory and auditable. Independent measurements and responsible people remain the authority for physical action.

Chapter Seventy One

Governance and Responsibility

Responsibility follows consequence, access, expertise, and decision authority. The proposer, apparatus owner, safety reviewer, data steward, analyst, and publication lead have distinct duties. No participant may transfer a risky decision to an AI system or an abstract “collective.”

Governance records conflicts, dissent, stop decisions, changes, and named approvals. A minority safety concern is preserved even when the project proceeds. The right to stop a hazardous operation should not depend on status or authorship.

Chapter Seventy Two

Publishing Negative Results

Negative results constrain the space of possible couplings, devices, and interpretations. They should report sensitivity, operating range, exclusions, calibration, deviations, and analysis choices rather than the bare phrase “no effect.”

Publishing them prevents repeated risk and reduces selective memory. In the Substrate Cosmology program, a null result may refine a tool, close a branch, or show that a proposed observable was not operational. It must not be erased because the vision remains attractive.

Chapter Seventy Three

Intellectual Humility as Control

Intellectual humility is an engineering control because it limits escalation from ambiguous evidence. It asks what the apparatus actually did, which alternatives remain, what result would reverse the conclusion, and who can inspect the record.

Humility does not mean assuming current physics is complete. It means refusing to use incompleteness as proof of a preferred extension. The most ambitious research question deserves the clearest boundary between what is imagined, modeled, observed, and engineered.

Chapter Seventy Four

Using the Research Commons

The public website provides the working interface for engineering questions. Begin with the guided investigation routes, then consult the glossary, model registry, evidence relations, replication surfaces, experimentation roadmap, intervention sandbox, safety material, and continuity records.

When contributing an engineering proposal, identify the ordinary mechanism, proposed distinguishing relation, controllable input, measured output, detector principles, conservation budget, hazards, null world, stop rule, and disconfirming result. Forum discussion does not become evidence or canonical theory automatically. The full website user manual remains planned as Volume Ten.

Chapter Seventy Five

The Conditional Roadmap

The roadmap is a dependency graph, not a promise or calendar.

1. Demonstrate that relational representations improve an ordinary prediction or control task.
2. Identify a reproducible residual across physically independent detectors.
3. Freeze an operational substrate hypothesis that predicts a new intervention response.
4. Replicate the response and close energy, momentum, timing, and environmental budgets.
5. Discriminate the proposed mechanism from ordinary competitors.
6. Demonstrate reversible low-energy control with independent safety monitoring.
7. Transfer the effect across apparatus and sites.
8. Consider a device class only after the coupling and limits are established.

At present, Substrate Cosmology is working primarily at the first three stages. Later stages remain conditional.

Conclusion

The source corpus was right to ask whether physics can be used differently from what current representations make obvious. It was not justified in presenting the imagined answers as operating principles. This volume converts that tension into method.

Engineering begins at the boundary between a controllable input and a measured difference. Substrate engineering, if it becomes possible, will have to begin there as well. It must recover established physics, survive ordinary explanations, preserve conservation and no-signalling constraints unless a specific violation is itself demonstrated, and advance through reversible, replicated, safely governed stages.

The framework therefore ends this volume with no dimensional reactor, no precausal transmitter, and no programmable spacetime. It ends with something more useful: a path by which such terms could acquire physical meaning, or be rejected without losing the disciplined insight produced along the way.

Appendix A

Engineering Evidence Ladder

Level	Evidence state	Permitted language	What is still missing
E0	Concept only	Question architecture metaphor	Observable coupling and test
E1	Defined model	The model produces a behavior	Physical correspondence
E2	Simulated distinction	Candidate signature under assumptions	Instrument demonstration
E3	Instrument response	Residual observed in one apparatus	Artifact exclusion and replication
E4	Controlled bench effect	Repeated response to a registered input	Independent replication and mechanism
E5	Independent replication	Effect reproduced across teams	Competing mechanism discrimination
E6	Mechanism supported	Coupling model predicts held out behavior	Transfer and operating limits
E7	Bounded prototype	Device function in a specified envelope	Reliability safety and scale evidence
E8	Responsible application	Qualified use under governance	Continuing surveillance and revision

No level is inferred from the ambition of the proposed application. Most explicitly substrate-specific capabilities in the inherited corpus remain at E0 or E1.

Appendix B

Inherited Claim Translation Table

Inherited formulation	Evidence status	Responsible translation
Dimensional flow is actionable	Speculative	Test whether an operational effective dimension predicts a response beyond known variables
Drift is not noise	Overgeneralized	Model drift and noise competitors before testing a frozen relational predictor
Gradients are substrate control handles	Undefined	Define a measurable variable and input coupling before using control language
Bonds can weaken without energy	Unsupported and physically misleading	Audit all energy reservoirs and compare with nonthermal ordinary pathways
Dimensional reactors operate on the substrate	Concept architecture	Retain as a gated target with no present construction claim
Coherence responsive materials detect substrate change	Product conjecture	Define coherence and demonstrate a specific transduced residual
Precausal channels allow communication	Unsupported	Study correlation or order while preserving no signalling as the default boundary
Relational computation exceeds quantum computation	Unsupported comparison	Develop relational algorithms and compare measured performance on ordinary hardware
Quantum computation is a subset of dimensional computation	Project interpretation	No empirical hierarchy established
Non inertial transport bypasses classical constraints	Unsupported	Any force or propulsion residual requires complete momentum and artifact accounting
Projection synthesis engineers physical law	Speculative ontology	Use projection synthesis for models and experimental representations only
Direct substrate engineering programs possibility	Long horizon conjecture	Preserve as a question dependent on every prior evidentiary bridge

Appendix C

Engineering Claim Packet

Claim identifier and version
State a stable identifier, authors, date, and superseded versions.

Statement class
Mark established relation, frontier result, project definition, operational hypothesis, engineering target, speculative extension, or prohibited inference.

Ordinary physical account
Describe the best current mechanisms and the domain in which they predict the outcome.

Proposed distinguishing relation
Name the additional variable or mapping without treating it as observed.

Preparation and history
Record material, geometry, state, prior exposure, initialization, environment, and custody.

Intervention
Specify waveform, timing, support, intensity, dose, randomization, and control logic.

Outputs and detectors
List detector principles, ranges, calibration, synchronization, raw data, and preprocessing.

Comparator and null worlds
Define sham conditions, ordinary models, synthetic data generators, and decisive controls.

Budgets
Account for energy, momentum, charge, mass, information, heat, and relevant material flows.

Prediction
Freeze sign, magnitude range, shape, timing, scaling, and uncertainty where possible.

Disconfirmation
State the result that closes or revises the claim.

Hazards and stop rules
Identify credible hazards, monitors, thresholds, containment, shutdown, and rollback.

Replication and publication
State which materials, code, metadata, negative outcomes, and deviations will be preserved.

Appendix D

Intervention and Measurement Record

Field	Required entry
Run identifier	Immutable run and apparatus configuration
Claim packet version	Frozen hypothesis and analysis reference
Operators	Named roles and decision authority
Preparation	Specimen history environment and initialization
Input	Channel waveform timing intensity and uncertainty
Controls	Sham detuned reversed substitute and randomized conditions
Detector ensemble	Principles ranges calibrations and shared dependencies
Environmental channels	Thermal vibration electromagnetic pressure humidity radiation timing
Physical budgets	Energy momentum mass charge heat and material flows
Raw data custody	Original formats hashes clocks and access record
Processing	Software version parameters exclusions and transformations
Deviations	Departures from registration and their timing
Stops	Threshold events decisions and safe state achieved
Outcome	Primary secondary exploratory and null results separated
Interpretation ceiling	Highest statement class the result can support

Appendix E

Hazard Stop and Rollback Plan

1. Define the apparatus boundary and every credible energy source.
2. Classify electrical, mechanical, thermal, chemical, optical, radiation, biological, pressure, vacuum, autonomous, and information hazards.
3. Identify independent monitors that do not depend on the experimental controller.
4. Set warning and hard-stop thresholds before operation.
5. Define the safe state for power, pressure, fields, motion, sample, data, and access.
6. Verify manual shutdown and loss-of-control behavior.
7. Assign named stop authority to more than one qualified person.
8. Record any threshold crossing and prevent automatic restart.
9. Preserve failed configurations and sensor records without re-energizing the system.
10. Require review before increasing energy, duration, autonomy, exposure, or scale.

A speculative mechanism does not reduce ordinary hazards. An unexplained response increases the need to stop and characterize it.

Appendix F

Forbidden Inference Register

Observation or model	Inference that is not permitted
Model parameter can vary	Nature supplies an independently controllable knob
Simulation produces a novel regime	The regime exists physically
Two detectors correlate	A nonlocal or precausal channel exists
Entanglement is observed	Faster than light communication is possible
Quantum order is indefinite	Causality is absent or the past can be changed
A process is nonthermal	It requires no energy
A trigger is small	The total process is energy minimal
A metamaterial bends waves unusually	Spacetime or the substrate was engineered
A force balance shows a residual	Reactionless propulsion occurred
A clock residual appears	Time itself was manipulated
A gravity residual appears	Gravity can be controlled
A vacuum boundary produces photons	Unlimited vacuum energy can be extracted
Relational software outperforms a scalar model	A physical substrate computer exists
Existing models are incomplete	Substrate Cosmology is confirmed
An effect is useful	Its preferred ontology is true

Appendix G

Conditional Readiness Scale

This scale is adapted to the project's epistemic needs and is not a claim of conformity with any agency readiness system.

Stage	Readiness question	Advancement condition
CR0	Is the idea only linguistic or architectural	Terms and prohibited inferences recorded
CR1	Is an operational observable defined	Measurement and uncertainty specified
CR2	Does a model predict a distinguishing result	Comparator and disconfirmation frozen
CR3	Can an existing apparatus test it safely	Claim packet null worlds and stop plan approved
CR4	Is a controlled response repeated internally	Budgets close and artifacts are challenged
CR5	Does an independent team reproduce it	Transfer package and deviations are public
CR6	Is a mechanism distinguished	Held out predictions beat ordinary competitors
CR7	Is reversible control demonstrated	Rollback and operating envelope verified
CR8	Does a bounded prototype deliver value safely	Reliability and dual use review completed
CR9	Is responsible application justified	Governance surveillance and revision persist

Appendix H

Glossary

Actual Physics. Whatever physical relations occur, including those not preserved by present models or detectors.

Anchor. A project term for a relation that stabilizes identity or reference across transformations. It is not a demonstrated new physical object.

Budget. Account of energy, momentum, charge, mass, heat, information, or materials entering, leaving, or stored within a system boundary.

Conditional engineering. The design of research and possible devices whose physical prerequisites have not yet been demonstrated, with dependencies and stop rules kept explicit.

Control surface. The set of accessible inputs through which an experiment can vary a system.

Dimensional bias. A hypothesis that a representation or detector favors some relational structures over others. It requires an operational comparator.

Dimensional engineering. A placeholder for future control of an operationally defined dimension-related physical response beyond known couplings.

Dimensional reactor. A speculative architecture for controlled substrate-related intervention. No such device has been demonstrated.

Engineering handle. An independently variable input with a repeatable measured response.

Engineering target. A desired capability with explicit evidentiary and safety prerequisites; not a present capability.

Independent detector. A measurement channel whose relevant failure pathways differ from those of another channel.

Indefinite causal order. A precise quantum-information setting in which operations need not have one fixed order. It does not imply acausal signalling.

Intervention. A deliberate variation of a defined input, timing, support, intensity, and preparation history.

Null world. A complete data-generating process that omits the proposed effect while preserving plausible artifacts and search procedures.

Precausal. Not ordered by the causal structure of the target spacetime representation. The project term does not license faster-than-light signalling, retrocausation, or time travel.

Projection. A mapping from a richer or differently organized domain into an accessible representation.

Recovery. Reproduction of an established theory’s validated predictions and operational behavior inside an extended framework.

Relational computation. At present, computation whose primitives and operations explicitly preserve relations, frames, mappings, and compatibility. A substrate-native computer is speculative.

Residual. Difference between data and a specified model under a specified calibration and uncertainty account.

Rollback. Planned return of equipment, access, samples, software, and data systems to a known safe state.

Substrate engineering. A long-horizon conjecture about controlling relations from which familiar physics emerges. It is not an established engineering discipline.

Transfer function. A measured or modeled dependence of output on input, including frequency, history, nonlinearity, and uncertainty.

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