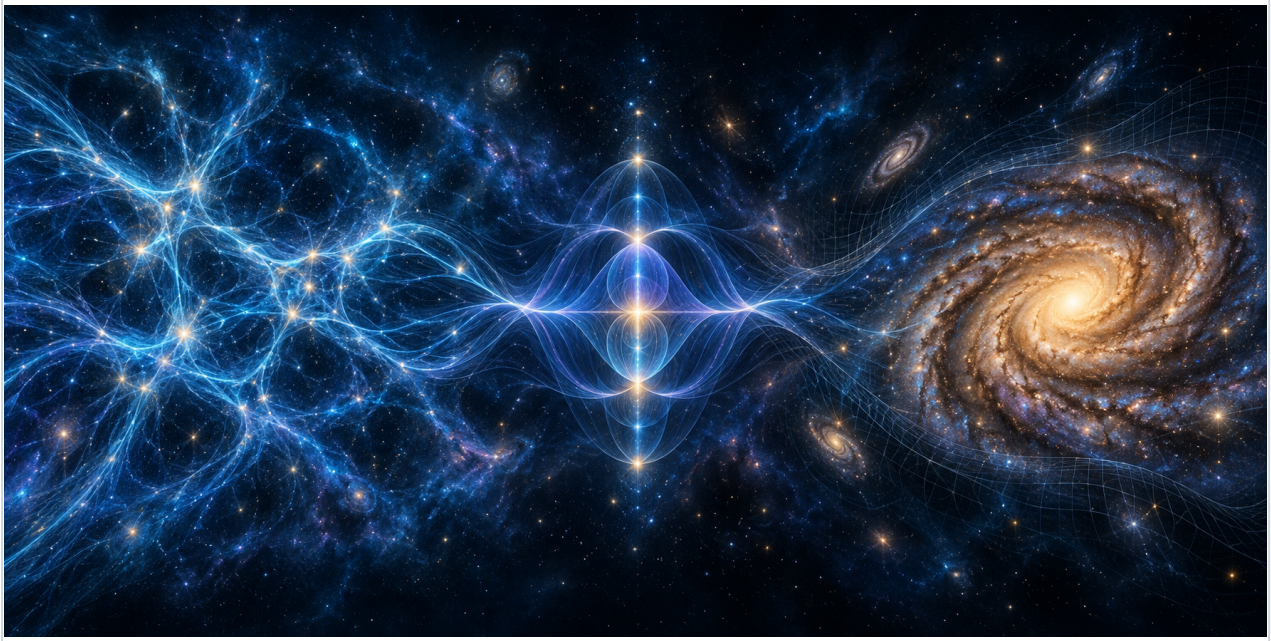
APEIRON PHYSICS

Apeiron — Idea and Research

The carrier hypothesis, its developed approaches and the path towards further testable relationships.

FIGURE 01 · ARTISTIC ILLUSTRATION



Shared foundation **Diverse states** **Derive connections**

Josip Fellner · Independent Researcher

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A route through the research

Each chapter connects the work already completed with its implications and the next concrete task.

1. A shared foundation as a research goal
2. Three fields make the approach concrete
3. A mathematical core with checked relationships
4. A shared local propagation structure
5. What the cosmological check clarifies
6. A concrete approach to future tests
7. Feasible approaches to reconversion and quantum physics
8. A research programme with concrete next steps

How the images help

The cosmic illustrations show relationships and research questions. Their labels and captions explain the intended meaning. An artistically depicted field is neither an observed carrier structure nor a new simulation.

Source references, illustration provenance and a change note accompany this edition.

The idea and its present development

Apeiron asks whether a universal dynamic foundation could underlie matter, dark phenomena and the shared structure of spacetime. This carrier hypothesis connects the individual branches of research. Its physical development proceeds through concrete models and testable relationships.

An explicitly specified local three-field core is now available for this purpose. Its rules have yielded field equations, energy-momentum relations and statements about small excitations and their propagation. Additional branches investigate local reconversion and a conditional connection to quantum physics. The respective results have different scopes.

This edition explains the current state in three steps: What has been achieved? What do we learn from it? What research task follows? This makes both progress and connections still to be developed visible. The broad carrier hypothesis is neither equated with a simplified cosmology nor already confirmed by testing that cosmology.

The illustrations help explain these relationships. Luminous fields, cones and cosmic landscapes are artistic aids to understanding. They show neither measured microstructure nor new simulations nor an Apeiron process that has already been observed.

Three recurring questions

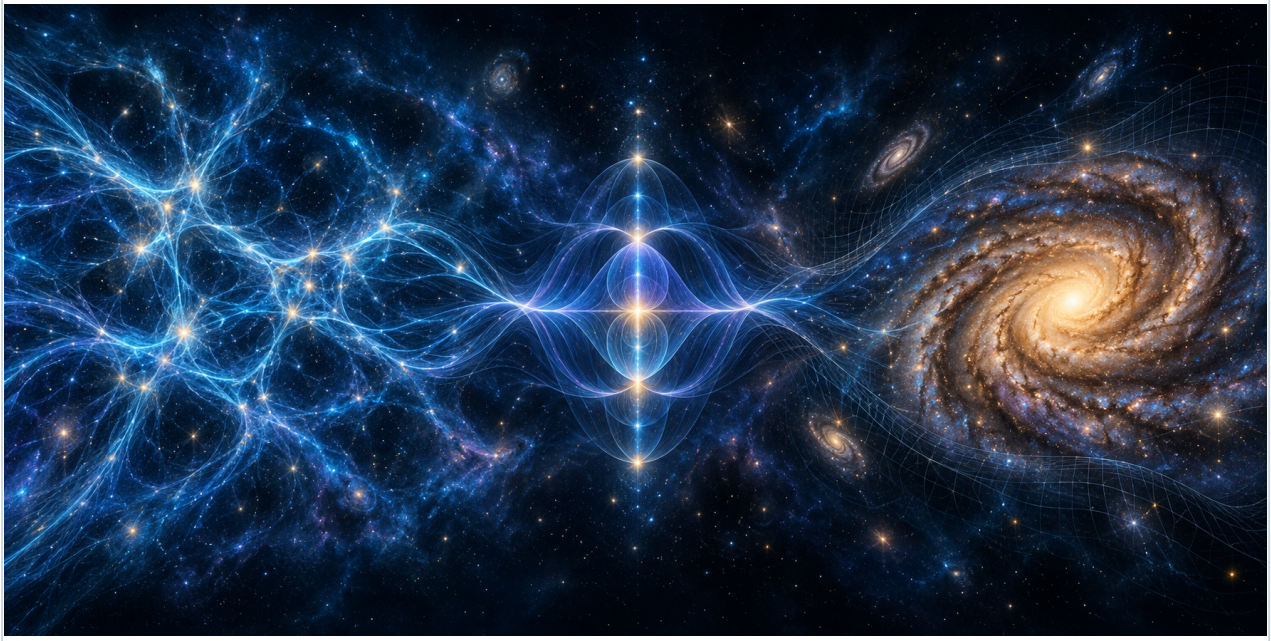
What has been achieved: the concrete contribution.

What we learn from it: its significance.

The next research task: what follows from it.

1. A shared foundation as a research goal

FIGURE 01 · ARTISTIC ILLUSTRATION



Shared foundation **Diverse states** **Derive connections**

The guiding idea in an image: a shared foundation could support different forms of organisation. The luminous structures are artistic metaphors for this hypothesis.

What has been achieved

Apeiron has developed a unifying idea into an explicitly structured research programme: a universal fundamental dynamic carrier could connect matter, dark phenomena and the shared structure of spacetime through different states and forms of organisation.

The foundations paper connects this hypothesis with a concretely specified mathematical submodel. A broad physical question thus stands alongside an initial approach that can be examined precisely. The carrier itself is a proposed foundation whose microscopic states and laws of evolution remain to be specified.

A shared foundation as a research goal

What we learn from it

The benefit lies in a shared question: how do different properties arise from one foundation, and what relationships must connect them? Such an explanation would need to account for both the diversity and the common features.

Here, ‘one carrier’ does not mean ‘only one type of particle’. Different particles could be different manifestations. Established particle physics, including its interactions, remains a benchmark for any concrete development. Possible dark phenomena also need their own dynamical explanation.

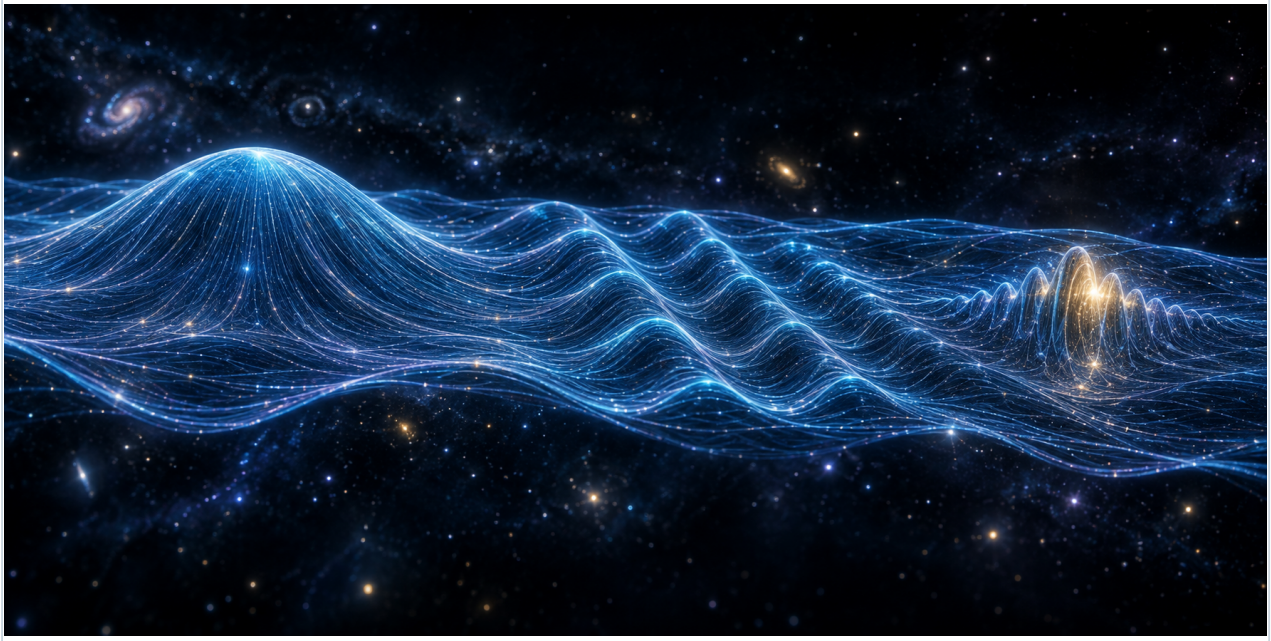
The next research task

The next task is to determine which states the carrier allows and how they change. A traceable connection must then show how the quantities and rules of the already specified submodel arise from them.

This step would extend the idea of a shared origin with a testable derivation. Which observation supports or contradicts a particular formulation can only be decided on the basis of its specified rules.

2. Three fields make the approach concrete

FIGURE 02 · ARTISTIC ILLUSTRATION



Sigma · order **Theta · phase** **Chi · excitation**

Three descriptive quantities in one shared field landscape. The illustration explains their related roles; it does not depict a calculated microstructure.

What has been achieved

The approach under study has three explicitly defined field quantities: Sigma, Theta and Chi. Their functions, interactions and an inherited numerical example are documented. This makes it clear which model is meant and which calculations others can check.

A field describes values at positions and times. Sigma has an order-like role here, Theta a phase-like role; Chi is another coupled form of excitation. Together they describe one possible effective part of the carrier hypothesis.

Three fields make the approach concrete

What we learn from it

An intuitive comparison is with several layers of information on a map. Different layers can describe the same territory. The three fields therefore do not commit the approach to three primordial substances. Nor do their names specify the carrier’s microscopic form.

The mathematical functions make these roles precise. In the present model, for example, Theta is not a simple circular angle for which a full turn always produces the same complete state. The specified numbers serve as a reproducible calculation example; their decimal places do not represent measurement precision.

The next research task

The next connection leads from a fundamental carrier dynamics to these effective quantities. ‘Effective’ means that the description is intended to capture the essential changes within a stated domain. A derivation would have to explain why precisely these rules apply there.

This includes determining the domain of application and the size of neglected contributions. In this way, the already concrete description can gradually acquire a justified physical domain of use.

3. A mathematical core with checked relationships

FIGURE 03 · ARTISTIC ILLUSTRATION



Defined state **Checked excitations** **Study evolution**

The valley represents the checked local starting point and small excitations. It is an explanatory aid, not a calculated energy map or a statement of global stability.

What has been achieved

The developed core derives field equations and the energy-momentum balance from a common starting prescription, the ‘action’. Evolution and mutual influences are thereby specified together. The foundations paper records the checked equations alongside their assumptions.

Checked local excitation quantities are also available for a selected state at rest. The local energy configuration examined there opposes small departures from that state. A corrected weighting factor for the phase quantity is incorporated in the core.

A mathematical core with checked relationships

What we learn from it

This provides a sound starting point for further calculations: a particular model, an examined state and the rules for its small changes are known. The correction to the weighting preserves the shared propagation boundary of this state and makes the remaining calculations more precise.

The image of a valley helps put this in context: small movements can be described in an orderly way in its vicinity. This does not yet imply stability of the entire landscape. The further evolution of individual excitations also depends on their interactions, which may, for example, allow decays. The energy-momentum balance is local; a global cosmological energy value does not follow automatically.

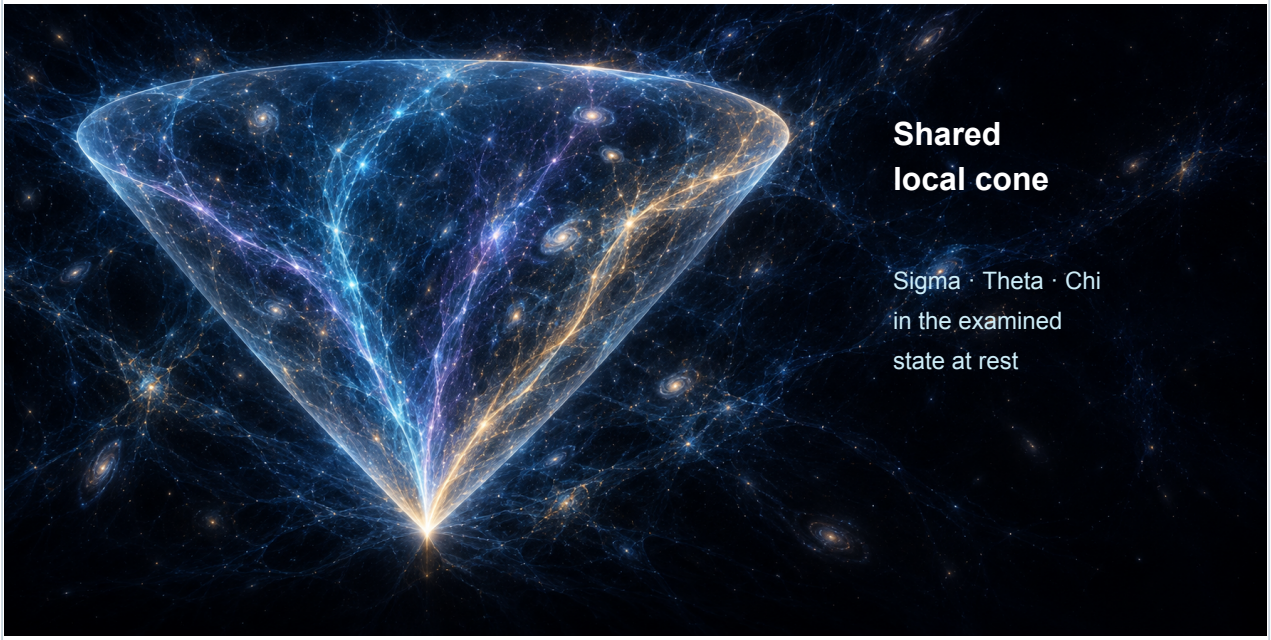
The next research task

The next step examines larger changes and time evolution within a controlled domain. Regions where Chi perturbations grow need an extended description of their subsequent evolution. The allowed signs of the kinetic terms must also be maintained.

Repeating older cosmological computer calculations remains a separate task: an originally reported success was not reproduced in a later independent comparison. The local results provide a working foundation, but do not yet settle this separate question of reproduction.

4. A shared local propagation structure

FIGURE 04 · ARTISTIC ILLUSTRATION



Three field types | **Shared boundary** | **Model state at rest**

Three field types, one shared cone boundary in the examined state at rest. The image shows this local relationship, not a measurement of universal geometry.

What has been achieved

In the examined state at rest, the three fields share a common fundamental propagation boundary. This property follows from the parts of the equations that determine the propagation of small perturbations. It is preserved after the correction to the phase weighting.

If the phase background changes only with time in a suitable local reference frame, the core also yields an exact relationship between this background and the propagation boundary. Within the stated allowed domain, the boundary for the phase perturbation lies on or inside the boundary of the assumed spacetime geometry.

A shared local propagation structure

What we learn from it

A concrete relationship between the state of the fields and their causal structure has thus been obtained. Here, ‘causal’ refers to which local influences can propagate according to the equations. The shared boundary in the state at rest offers a point of connection to Apeiron’s broader idea of a shared geometry.

This boundary describes a particular property of the equations. It does not mean that every massive excitation travels at the same speed at every wavelength. The broader hypothesis asks how light, matter and gravity acquire a shared observable spacetime. Their universal coupling requires a separate derivation.

The next research task

The task now is to find dynamics from which the shared geometry and the coupling of observable sectors follow. At the same time, it is necessary to examine how this relationship holds on the backgrounds for which it is claimed.

Comparison with measurements requires an identifiable excitation and a suitable frequency range. The carrier idea does not regard light as being slowed by an ordinary material; it asks about the origin of the shared relativistic structure. No additional fundamental speed of light is assumed for this purpose.

5. What the cosmological check clarifies

FIGURE 05 · ARTISTIC ILLUSTRATION



Model scope clarified **Examine spatial dynamics**

Left: a clearly delimited, simplified model. Right: spatial structures as an open research question. The motifs are not a sequence in time and do not show an already resolved bounce.

What has been achieved

The check has clarified which assumptions are insufficient for a smooth cosmic bounce. This gives concrete guidance for further model development: the specified three-field core does not produce such a transition in a spatially flat, homogeneous cosmology with minimally coupled Einstein gravity and within the allowed field domain.

This finding concerns the combination of assumptions examined. It does not stand in for the entire dynamic carrier hypothesis or for an investigation of local reconversion in black holes. It identifies what a more developed cosmological formulation must additionally clarify.

What the cosmological check clarifies

What we learn from it

Here, ‘spatially homogeneous’ means that the background quantities are the same everywhere on a chosen cosmic time slice. They may nevertheless change with time. Homogeneity therefore means neither a constant expansion rate nor uniform wave propagation. ‘Spatially flat’ refers to the spatial geometry; spacetime as a whole can be dynamic.

A cosmic ‘bounce’ would be a smooth transition of the entire model universe from contraction to expansion. Its relative expansion rate would have to increase through zero. Under the stated assumptions, the checked equations allow only a constant or decreasing rate. This makes the limit of the simplified model understandable.

Local reconversion concerns a different question: can organised matter in a region of extreme curvature pass into more fundamental carrier states? The entire universe need not switch from contraction to expansion for this to occur. The bounce finding therefore does not settle this separate local possibility.

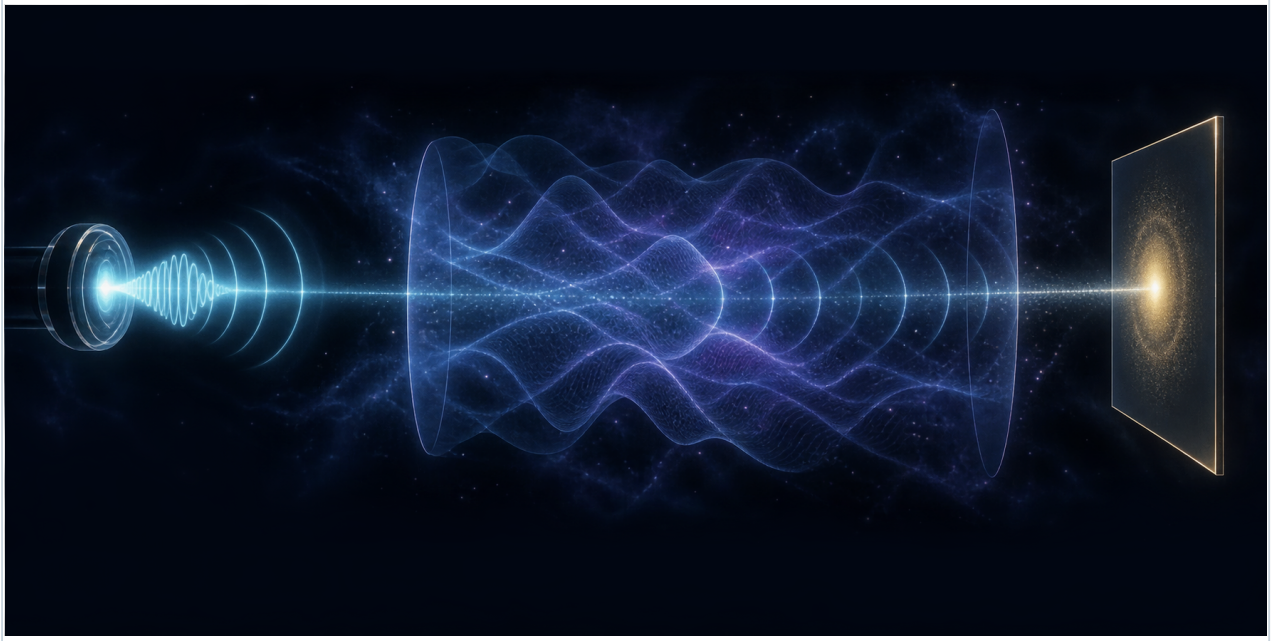
The next research task

For a more developed cosmology, concrete dynamics must show which assumption is changed or abandoned and why the new formulation remains valid. Spatial structures and flows are possible subjects of investigation, but do not yet provide a way around the restriction: when the phase coefficient is positive, the underlying energy condition follows from the same field action even outside the homogeneous case.

The research gain is a more precise task. A new formulation needs its own equations, suitable initial data and checks of its energy, propagation and stability properties. The existing finding is neither a general failure of the carrier idea nor evidence that it is correct.

6. A concrete approach to future tests

FIGURE 06 · ARTISTIC ILLUSTRATION



Identify the excitation **Determine the background** **Compare the prediction**

A relationship for a future test: excitation, independently determined background and detector. The illustration explains the required elements of a test still to be developed.

What has been achieved

The mathematical core specifies a particular relationship between the phase background and characteristic propagation. The foundations paper also identifies which independent quantities would need to be known for a test. A conditional predictive relationship is thus available, together with a list of tasks.

The proposed test is easy to picture: determine the background independently, detect the appropriate excitation and compare its propagation with the specified relationship. What has been achieved is this relationship; an accessible Apeiron measurement setup remains to be developed.

A concrete approach to future tests

What we learn from it

This distinguishes a physical prediction from an arbitrary fit. Background values and measurement errors must be determined in a way that allows a comparison to provide genuinely new information. Even a speed measurement would initially constrain only a particular combination of model quantities, rather than all parameters individually.

The measurement also needs a usable frequency window: fast enough to capture the calculated propagation property, while remaining within the domain where neglected contributions stay small. Such a window is a prerequisite for the experiment that must be checked.

The next research task

The next concrete step is to connect the model to a physical system: which excitation is measured, which state provides its background, and how does a detector couple to it? Independent calibration and traceable error bounds are also required.

A controlled comparison could support the specified relationship or exclude the model formulation under study. Either conclusion would apply to that formulation. The separate P01 study illustrates methodologically why model, calibration and parameter determination must be distinguished; its data do not constitute evidence for Apeiron.

7. Feasible approaches to reconversion and quantum physics

FIGURE 07 · ARTISTIC ILLUSTRATION



Local reconversion approach | **Conditional quantum connection**

Two separate approaches: local reconversion with reported structural feasibility, and a conditional shared quantum state. Both require further physical connections.

What has been achieved

The original source reports structural feasibility for local reconversion in black holes: a class of effective descriptions can bring together a directed decrease in organisation, local energy-momentum conservation and compatible causal evolution. This is an approach to a local process, not a cosmic bounce.

Another branch formulates a conditional connection to quantum physics. If the carrier is quantum physical and supports shared, non-separable states, entanglement can be described using the usual quantum measurement rules. This construction retains the exclusion of controllable faster-than-light messages.

Feasible approaches to reconversion and quantum physics

What we learn from it

The reconversion approach uses a quantity describing organisation, a response to strong curvature and a shared energy-momentum balance. This gives the idea a mathematical form that can be developed further. In this hypothesis, a less organised carrier state does not mean nothingness.

The quantum approach clarifies a different relationship: spatially separated subsystems can belong to a shared quantum state. A shared description is not a message between them. Quantum rules are assumed here; they have not yet been derived from a deeper Apeiron dynamics.

The next research task

For reconversion, the evolution equations must be completed and connected to matter, geometry and the three-field core. The structural feasibility established so far determines neither a measured conversion rate nor the microscopic final state of real black holes.

This includes a complete entropy balance. The source assumes that information and relevant entropy are not simply erased during reorganisation; entropy may be produced, transferred or redistributed. This assumption must be checked quantitatively. In the quantum branch, a deeper derivation and an independently testable prediction remain further tasks.

8. A research programme with concrete next steps

FIGURE 08 · ARTISTIC ILLUSTRATION



Specify the dynamics **Derive connections** **Test independently**

From a unifying idea, through specific relationships, to independent testing. The observatory represents the research programme's intended connection to observation.

What has been achieved

The current state connects a guiding idea, a specific mathematical core and clearly identified extension tasks. Checked local relationships, approaches with structural feasibility and a conditional measurement relationship give the programme several concrete starting points.

The foundations paper arranges the next tasks according to their dependencies: specify carrier states and dynamics, obtain effective descriptions from them, establish the connection to matter and geometry, and finally compare independently testable relationships with observations.

A research programme with concrete next steps

What we learn from it

This order makes clear what the next advance would achieve. A derived connection explains more than similar terminology. A controlled evolution tells us more than a single state at rest. An independently calibrated comparison provides more than a fit made after the fact.

Positive results and precise model limits complement each other. The local excitations provide a usable starting point; the causality relationship structures possible tests; the cosmological check clarifies insufficient assumptions. None of these statements has to stand for the entire carrier hypothesis.

The next research task

Each subsequent formulation should record its assumptions, permitted freedom, domain of validity and evaluation criteria before its decisive test. A new interaction or altered dynamics is identified as a new formulation. It needs an additional independent test point that does not come solely from the information to which it was fitted.

The ambition remains a shared physical explanation. The route towards it is now more precisely specified: derive particular connections, examine their assumptions and develop suitable links to observation. Unresolved results remain visible as open research tasks; addressing them is the next part of the programme.

Sources and context

This illustrated English edition, ‘Apeiron — Idea and Research’, is language edition 3.1 of 25 September 2026. It is based on the German illustrated edition of the joint editorial release 3.0. It accompanies the technical paper ‘Apeiron: Foundations of a Universal Carrier Approach — An Effective Field Theory and Its Research Programme’ and its complete German technical translation. Earlier editions and scientific result files remain preserved unchanged.

The account distinguishes derived results of the local core, structural feasibility reported in the original sources, hypotheses and subsequent research tasks. No new physics calculations were carried out, no observational confirmations were added and no scientific release decisions were changed.

Author of the Apeiron foundations: Josip Fellner, Independent Researcher. ORCID: 0009-0003-1705-3985. Contact: info@apeironfield.com. According to the author, the work is self-funded. AI tools supported writing, translation, illustration and document checks; the source check for this edition is not external scientific peer review.

The scientific foundations

Apeiron foundations paper, joint edition 3.0: carrier hypothesis and research programme; retained mathematical core; conditional test relationship.

Original preprint v1.6: §3.4 on the carrier hypothesis; §§10.5-10.6 on reconversion and entropy; §§11.1-11.4 on causality; §11A on the conditional quantum approach.

The accompanying source record links each substantive paragraph to the passages used and documents the main editorial changes. Existing scientific assessments remain unchanged.

Illustration production

Eight artistic illustrations created with the integrated Imagegen tool, drawn from the German illustrated edition. Existing Apeiron archive motifs served as visual references. Captions and explanatory labels have been translated for this edition.