

KURPISHEV LOGIC 2: Final Monograph of the Doctrine

Volume IV. Kurpishev Physics: Time@Space, Causality, Determinism, O@S,
P@S and CGI Holes

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Editorial passport of Volume IV

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Title of the volume. Volume IV. Kurpishev Physics: Time@Space, Causality, Determinism, O@S, P@S and CGI Holes.

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Editorial law. Volume IV is assembled not as a summary of a physics branch, but as an autonomous fundamental volume of the Doctrine. The following operations are prohibited in the final assembly: compression of argumentation, deletion of phenomenological explanations, replacement of proof blocks by declarations, and simplification of the formula discipline. The following operations are allowed: structuring, proof normalization, refinement of the boundaries of claims, terminological synchronization, and visual alignment.

Assembly route. Volume IV continues Volume III, where NAPG3, FOS, Size@Dimensionality, hyparxis, apeiron, transreper space, Fano carrier, PN.2 and KLT-RBD audit were fixed. The present volume transports these constructions into the physical reduction: Time@Space, causality, determinism, O@S, P@S, CGI, causal holes, quantum scale@aspect, and the proof audit of physical formula chains.

Main restriction. Kurpishev Physics is not presented as a replacement of all modern physics. It is fixed as a Reper-packet level over physical models, where every physical object receives C@C, a Reper, a domain, a sufficient foundation, and a status in RBD.

Abstract, novelty and map of the volume

Abstract

Volume IV develops the physical branch of the Kurpishev Doctrine. Its central thesis is that the primary physical frame is not Space*Time as a ready four-dimensional container, but Time@Space as a packet structure in which event and state are held simultaneously, while space is a section, layer or observable regime of a deeper temporal support.

A physical object is defined as event@state:

$$\text{Obj}_{\{\text{phys}\}} = \text{C@C}_{\{\text{phys}\}} = (\text{event}, \text{state}).$$

Its physical Reper has the form

$$\text{Rep}_{\{\text{phys}\}}(x) = (\text{R}_{\{\text{phys}\}}, \text{I}_{\{\text{phys}\}}, \text{U}_{\{\text{phys}\}}; \text{D}_{\{\text{law}\}}).$$

Here $\text{R}_{\{\text{phys}\}}$ is the actually measured state, $\text{I}_{\{\text{phys}\}}$ is an invariant, law or symmetry, $\text{U}_{\{\text{phys}\}}$ is the field of possible physical states, and $\text{D}_{\{\text{law}\}}$ is the sufficient physical foundation.

The central formula of physical reduction is

$$\mathcal{P}_K = \Theta_{\{\text{phys}\}}(\text{FOS}; \text{D}_{\{\text{law}\}}).$$

Kurpishev Physics separates causality from determinism. Causality is fixed as the coupling of impulse, action and sufficient foundation:

$$\text{Causality}_K = \text{P} \mp \text{D}_{\{\text{act}\}}.$$

Determinism is fixed as the supporting connectivity of origin and consequence:

$$\text{Det}_K = \text{O@S}.$$

The causal gap index is

$$\text{CGI}_i = \frac{\|T_{\{\text{hole}\}}^{\{L\}}\| + \|F_{\{\text{cent}\}}^{\{\chi_i \Upsilon\}}\| + \|F_{\{\text{cor}\}}^{\{P@S\}}\| + \sum_{\nu} B_{\{\nu\}}}{\{r_i \ u_i + \text{varepsilon}\}}.$$

The volume shows that a physical model receives truth-status neither from elegance of equations nor from pure symmetry, but only from the presence of a domain, a sufficient foundation and Reper closure:

$$\text{Truth}_{\{\text{phys}\}}(x) \Longleftrightarrow \text{Dom}_{\{\text{phys}\}}(x) \wedge \text{D}_{\{\text{law}\}}(x) \wedge \text{cr}(\text{U}_x, \text{I}_x; \text{R}_x, \text{D}_x)$$

)=-1.

Authorial constructions fixed in Volume IV

The following constructions of I. B. Kurpishev are fixed in this volume:

- Kurpishev Time@Space, V@P;
- the physical object as C@C_phys;
- the physical Reper Rep_phys(R,I,U;D_law);
- the physical reduction of FOS, $P_K = \text{Theta_phys}(\text{FOS}; D_law)$;
- the distinction between causality and determinism;
- causality as $\text{\textbackslash pm P\textbackslash mp D_act}\$$;
- determinism as O@S;
- the skew or lateral channel P@S;
- Fokker-type symmetry as a regime of bilateral causal-consequential coupling;
- the Kurpishev Course of Time;
- entropy as the unmanifest present;
- quantum scale@aspect;
- PN.1, PN.2 and a packet reading of Bohr complementarity;
- CGI and causal holes;
- KLT-RBD audit of physical formula chains.

Source frame and prior-art boundary

Volume IV uses three classes of sources.

The first class is internal to the Doctrine: Monograph 5.0, Volume III v7.5/v7.6, the Master2 editorial contour, the FOS journal article, KLT/RBD packages and PILOT-01. From this layer the volume imports C@C, Rep(R,I,U;D), $\text{\textbackslash lambda\$-truth}$, FOS, NAPG3, the operators $\text{\textbackslash Delta}$, \textbackslash Xi , $\text{\textbackslash Upsilon}$, CGI and the proof discipline of gap-audit.

The second class is the classical mathematical background: projective geometry, affine and metric reductions, tensor analysis, the complex plane, and the structural program of mathematics. This background is not claimed as authorial novelty.

The third class is the physical-philosophical frame: the problem of time as parameter, the problem of causality, complementarity, entropy, quantum uncertainty and the status of observation. The authorial contribution is not the denial of these directions, but their Reper-packet normalization.

Boundary of claims. Classical notions - inertial frame, coordinate frame, symmetry, entropy, quantum complementarity, tensor, curvature, torsion, field - remain classical background. The contribution of Volume IV is the construction of a physical KLT/FOS/RBD layer in which a physical formula receives status only through

Formula_{phys}\to Dom?\to D_{law}?\to Reper?\to truth\text{-}status\;or\;gap.

Formal dictionary of notation

Notation	Meaning in Volume IV
--- ---	
$\$C@C\$$	event@state, the minimal unit of the project
$\$V@P\$$	Kurpishev Time@Space
$\$S*T\$$	classical Space*Time as a reduced section
$\$Rep_{phys}\$$	physical Reper
$\$D_{law}\$$	sufficient physical foundation
$\text{\textbackslash Delta\$}$	action, the act of beginning
$\text{\textbackslash Xi\$}$	change, duration and evolution
$\text{\textbackslash Upsilon\$}$	turn, the translation of action into state
$\$O@S\$$	supporting connectivity of origin and consequence
$\$P@S\$$	lateral or skew channel of causal displacement
$\$T_{cs}^L\$$	limit tensor of causal connectivity
$\$CGI\$$	causal gap index
$\$PN.1\$$	physical-operational uncertainty of observation
$\$PN.2\$$	packet uncertainty of size and dimensionality
$\$RBD_{phys}\$$	physical database of Reper nodes

Part I. Foundations of physical reduction

1. Time@Space as a physical frame

1.1 Rejection of external time

The classical notation of evolution often has the form

$$\text{State}(t_0) \mapsto \text{State}(t).$$

In this notation time is an external parameter, while the physical object is assumed to be already localized in space. In the Kurpishev Doctrine such notation is admissible but derivative. It arises after the choice of a section and after the suppression of event@state.

Physical primacy is transferred to V@P:

$$V@P := \text{Time@Space}.$$

Here Time is not a numerical axis, but a packet structure of action, change and turn. Space is not an absolute container, but a localization regime in which event@state becomes observable.

1.2 Space as a section of time

Definition 1.1. A spatial section of Time@Space is a map

$$\Sigma_s: V@P \rightarrow \text{Space}_s,$$

which fixes a state layer s and translates packet objects into local spatial coordinates.

Proposition 1.2. Space is not abolished. It receives the status of a sectional regime:

$$\text{Space} = \Sigma_s(V@P; D_{\text{obs}}).$$

Here D_{obs} is the foundation of observation: device, coordinate scheme, units of measurement, calibration and chosen scale.

Corollary 1.3. Physical localization requires not only a coordinate, but also the indication of state:

$$x \in \text{Space} \not\rightarrow x = C@C_{\text{phys}}.$$

To obtain a physical object one must restore event and state:

$$x_{\text{phys}} = C@C_{\text{phys}} = (\text{event}, \text{state}).$$

1.3 Physics as a reduction of FOS

Definition 1.4. Kurpishev Physics is the physical reduction of FOS under a given sufficient physical foundation:

$$\mathcal{P}_K = \Theta_{\text{phys}}(\text{FOS}; D_{\text{law}}).$$

Comment. This does not mean that FOS replaces a physical law. On the contrary, the law enters D_{law} as a condition of physical admissibility. FOS gives not an equation of motion, but the possibility of Reper-realizability of a physical world.

2. Physical object and physical Reper

2.1 Physical object

Definition 2.1. A physical object is event@state:

$$\text{Obj}_{\text{phys}} = C@C_{\text{phys}} = (e_{\text{phys}}, s_{\text{phys}}).$$

Here e_{phys} is a physical event: registration, interaction, transition, impact, decay, measurement, appearance of a signal. The component s_{phys} is a physical state: configuration, phase, energy, momentum, temperature, field, or device situation.

An object without an event remains a passive description. An event without a state has no physical fixation.

2.2 Physical Reper

Definition 2.2. The physical Reper of an object x is the quadruple

$$\text{Rep}_{\text{phys}}(x) = (R_{\text{phys}}(x), I_{\text{phys}}(x), U_{\text{phys}}(x); D_{\text{law}}(x)).$$

The components mean:

$R_{\text{phys}} = \text{actually measured state},$
 $I_{\text{phys}} = \text{invariant, law, symmetry or idea of the model},$
 $U_{\text{phys}} = \text{field of possible states},$
 $D_{\text{law}} = \text{sufficient physical foundation}.$

Lemma 2.3. The triple $(R_{\text{phys}}, I_{\text{phys}}, U_{\text{phys}})$ does not produce physical truth without D_{law} .

Proof. A measurement without a device, law, regime of applicability and observation conditions does not separate fact from artefact. An invariant without a domain of applicability does not separate law from formal symmetry. A field of possibilities without a foundation does not separate physical possibility from an arbitrary mathematical model. Hence D_{law} is not an external reference, but the fourth point of Reper closure.

2.3 Truth-status of a physical assertion

A physical assertion receives truth-status only by the rule

$\text{Truth}_{\text{phys}}(x) \Longleftrightarrow \text{Dom}_{\text{phys}}(x) \wedge D_{\text{law}}(x) \wedge \text{cr}(U_x, I_x; R_x, D_x) = -1.$

If at least one element is absent, the assigned status is not truth but one of

gap, candidate, hypothesis, source, draft.

3. ISO, CSO and FSO: frames of reference as Reper sections

3.1 ISO and CSO

Inertial frame of reference and coordinate frame of reference are often mixed in classical language. Volume IV separates them.

Definition 3.1. An ISO is a physical regime in which an inertial description is accepted as an admissible foundation for local dynamics.

Definition 3.2. A CSO is a coordinate scheme that fixes a method of numerical representation of a state.

In Reper form:

$\text{ISO} = \text{Rep}(R_{\text{motion}}, I_{\text{inertia}}, U_{\text{frames}}; D_{\text{inertial}}),$
 $\text{CSO} = \text{Rep}(R_{\text{coords}}, I_{\text{chart}}, U_{\text{charts}}; D_{\text{coordinate}}).$

The ISO is responsible for physical admissibility of motion; the CSO is responsible for the form of notation.

3.2 FSO as a fundamental supporting observer-frame

Definition 3.3. FSO - fundamental supporting observer-frame - is not merely a coordinate system, but a Reper section in which event, state, domain, law, device and sufficient foundation are given simultaneously:

$\text{FSO} = (\text{C@C}_{\text{obs}}, \text{Rep}_{\text{obs}}, D_{\text{law}}, \Sigma_s).$

Proposition 3.4. Every physical assertion that claims a status must be checked not only in a CSO, but also in an FSO:

$\text{Formula}_{\text{phys}} \rightarrow \text{CSO} \rightarrow \text{ISO} \rightarrow \text{FSO} \rightarrow \text{RBD}_{\text{phys}}.$

Part II. Causality, determinism and the lateral channel

4. Operators of action, change and turn

4.1 Action Δ

Definition 4.1. The action operator Δ fixes the act of beginning:

$\Delta: P_{\text{varnothing}} \rightarrow \text{C@C}_{\text{phys}}.$

It is not derived from an already running change. If action is completely reduced to a previous evolution, the act of positing a beginning disappears.

4.2 Change $\$ \backslash \text{Xi} \$$

Definition 4.2. The change operator $\$ \backslash \text{Xi} \$$ fixes duration and evolution:

$$\backslash \text{Xi}_t : C @ C_{\text{phys}} \backslash \text{to } C @ C_{\text{phys}}(t).$$

Change acts inside a regime that has already been posited. It is responsible not for the appearance of the beginning, but for the continuation of a trajectory.

4.3 Turn $\$ \backslash \text{Upsilon} \$$

Definition 4.3. The turn operator $\$ \backslash \text{Upsilon} \$$ translates action into state:

$$\backslash \text{Upsilon} : \backslash \Delta(P_{\text{varnothing}}) \backslash \text{to } \text{State}_{\text{new}}.$$

Therefore physical time in Volume IV has packet form:

$$T_{\text{pack}} = T_{\text{change}} * T_{\text{action}}.$$

The interval of turn connects action and change:

$$\text{Interval}_K = \backslash \text{Upsilon}(\backslash \Delta) \backslash \text{circ} \backslash \text{Xi}.$$

Theorem 4.4. The mixing of $\$ \backslash \Delta \$$, $\$ \backslash \text{Xi} \$$ and $\$ \backslash \text{Upsilon} \$$ produces false physical causality.

Proof. If action is identified with change, every beginning is declared to be the effect of an already existing process. If turn is identified with action, the transition from the result of action into state disappears. If change is identified with turn, duration is replaced by an instantaneous switch. Therefore the causal chain loses its domain and must receive gap-status.

5. Causality as $\$ \backslash \text{pm } P \backslash \text{mp } D_{\text{act}} \$$

5.1 Cause, action and foundation

In Volume IV causality is not defined as a simple linear arrow

$$\text{cause} \backslash \text{to } \text{effect}.$$

Such an arrow is admissible only as a simplified diagram. The complete notation requires impulse $\$ P \$$, action $\$ D_{\text{act}} \$$ and sufficient foundation.

Definition 5.1. Kurpishev causality is the packet connectivity

$$\text{Causality}_K = \backslash \text{pm } P \backslash \text{mp } D_{\text{act}}.$$

The signs $\$ \backslash \text{pm} \$$ and $\$ \backslash \text{mp} \$$ indicate that causal coupling may include direct, inverse, lateral and compensating channels.

5.2 Causality is not determinism

Proposition 5.2. Causality is the connectivity of causes and actions. Determinism is the connectivity of foundation and consequence:

$$\text{Causality}_K \neq \text{Det}_K.$$

In a classical scheme they are often compressed:

$$\text{Cause} \backslash \text{to } \text{Effect} \approx \text{Law} \backslash \text{to } \text{State}.$$

In the Reper scheme they are separated:

$$\text{Cause} \backslash \text{to } \text{Action} \quad \text{and} \quad \text{Foundation} \backslash \text{to } \text{Consequence}.$$

5.3 Theorem on causal gap

Theorem 5.3. If a physical formula chain derives a consequence from a cause without indicating $\$ D_{\text{law}} \$$ and a domain, the KLT-RBD audit must create a causal gap.

Proof. A formula step has the form

$$s = (F_i, F_j, \tau, A, \text{Dom}, D).$$

If $\$ \text{Dom} \$$ is absent, it is unknown in which physical region the transition works. If $\$ D \$$ is absent, it is unknown what serves as sufficient foundation. Hence the step cannot receive truth-status and is transferred into GAP-DOMAIN-MISSING or GAP-ASSUMP-MISSING.

6. Determinism as $O@S$

6.1 Supporting connectivity

Definition 6.1. $O@S$ - supporting object@state - is the supporting connectivity of origin and consequence:

$$O@S = (Origin, State_{\{consequence\}}; D_{\{law\}}).$$

Here Origin is not only a cause. It is the foundation that holds the admissibility of the consequence.

6.2 Determinate consequence

A consequence is deterministic not when it is psychologically expected, but when it is derived from a foundation in an admissible domain:

$$Det_K(y|x) \Longleftarrow Dom(x \text{ to } y) \wedge D_{\{law\}} \wedge O@S(x, y).$$

6.3 Determinism and open possibility

Kurpishev Physics does not destroy possibility. Possibility belongs to $U_{\{phys\}}$. Determinacy does not mean prohibition of possibilities; it means that one possibility receives a sufficient foundation for actualization:

$$U_{\{phys\}} = \{s_1, \dots, s_n\}, \quad \text{quad } D_{\{law\}} \vdash s_k.$$

7. $P@S$, the skew channel and Fokker-type symmetry

7.1 Lateral channel

Definition 7.1. $P@S$ is a skew causal channel in which impulse or action shifts a state not along the main linear branch, but into a lateral packet regime:

$$P@S = (P_{\{skew\}}, S_{\{shift\}}; D_{\{skew\}}).$$

In the CGI formula this channel is counted through the Coriolis-type displacement

$$F_{\{cor\}}^{\{P@S\}}.$$

7.2 Fokker-type symmetry as bilateral connectivity

In classical physical intuition causality is often read unidirectionally. Yet in a number of problems interaction is better described as mutual coupling: not only does the source act on the state, but the regime of state also refines the admissible form of the source.

Definition 7.2. In Volume IV Fokker-type symmetry is an admissible regime of bilateral causal-consequential coupling:

$$Fok_K(x, y) : \quad x \leftarrow y \quad \text{under} \quad D_{\{int\}}.$$

This is not a claim that all physical Fokker theories are identical to the Doctrine. It is an internal mark for the symmetry of mutual action.

7.3 Theorem on lateral escape of causality

Theorem 7.3. If $F_{\{cor\}}^{\{P@S\}}$ exceeds the stability of the node $r_i u_i$, the linear causal interpretation becomes insufficient.

Proof. By definition,

$$\begin{aligned} CGI_i = & \\ & \frac{ \\ & \quad |T_{\{hole\}}^L| + \\ & \quad |F_{\{cent\}}^{\{X_i \Upsilonpsilon\}}| + \\ & \quad |F_{\{cor\}}^{\{P@S\}}| + \\ & \quad \sum_{\nu} B_{\{\nu\}} \\ & }{r_i u_i \varpipsilon}. \end{aligned}$$

If the contribution $|F_{\{cor\}}^{\{P@S\}}|$ dominates the numerator, then the rupture is caused not only by a hole in the foundation and not only by the centrifugal load of turn, but by the lateral displacement of the causal channel. Therefore the required operation is not a linear continuation, but a reassembly of the node through $P@S$.

Part III. Time, entropy and quantum scale@aspect

8. The Kurpishev Course of Time

8.1 Definition of the course of time

Definition 8.1. The Kurpishev Course of Time is the ordered packet chain

$$\text{Course}_K(T) = \Delta \rightarrow \Upsilon \rightarrow \Xi \rightarrow \text{Rep}_{\{\text{new}\}}.$$

In ordinary notation evolution begins with a state. In the Doctrine it begins with an act, which must be translated into a state and then continued by change.

8.2 True clocks

Definition 8.2. True clocks are not devices measuring an external parameter, but a Reper-system fixing the consistency of action, change and turn:

$$\text{Clock}_K = \text{Rep}(T_{\{\text{action}\}}, T_{\{\text{change}\}}, T_{\{\text{turn}\}}; D_{\{\text{measure}\}}).$$

Instrumental clocks are a section of true clocks:

$$\text{Clock}_{\{\text{instr}\}} = \Theta_{\{\text{obs}\}}(\text{Clock}_K; D_{\{\text{device}\}}).$$

8.3 Theorem on time as Reper-flow

Theorem 8.3. In Kurpishev Physics time is not a scalar parameter, but a Reper-flow preserving the distinction between action, change and turn.

Proof. A scalar parameter t can order states, but it does not contain information on whether a transition is action, change or turn. A packet flow contains the triple (Δ, Ξ, Υ) and a sufficient foundation. Therefore physical time in the Doctrine is richer than the parameter t and is reduced to it only after a section has been chosen.

9. Entropy as the unmanifest present

9.1 Classical layer of entropy

Classical entropy measures the number of microstates, the degree of uncertainty or the direction of a thermodynamic process. This layer remains a classical background and is not claimed as a new definition.

9.2 Packet interpretation

In the Reper-packet reading entropy is connected with the set of possibilities that are present in $U_{\{\text{phys}\}}$ but have not yet received the sufficient foundation required for actualization:

$$S_K = \text{Measure}\{u \in U_{\{\text{phys}\}} : D_{\{\text{law}\}} \not\vdash u\}.$$

Therefore entropy can be interpreted as the mass of the unmanifest present: not chaos in the empty sense, but the field of possibilities that are structurally present but not yet Reper-authorized.

9.3 Status of the present

The present is not reduced to an instant. In Volume IV it is a boundary regime between action, change and turn:

$$\text{Present}_K = \text{Boundary}(\Delta, \Xi, \Upsilon; D_{\{\text{obs}\}}).$$

If the present is read as a point, the packet layer disappears. If it is read as a Reper-boundary, it becomes the operator place where an unmanifest possibility either remains in U or passes into a state.

10. Quantum scale@aspect

10.1 Scale and aspect

A quantum physical assertion depends not only on what is observed, but also on the scale and aspect of observation. Volume IV fixes the composite unit

$$Q_{\{scale@aspect\}} = (Scale, Aspect; D_{\{obs\}}).$$

Scale determines the resolution and admissible physical regime. Aspect determines the observable side of the object. Without the pair $scale@aspect$, the assertion is incomplete.

10.2 Measurement as a Reper section

Definition 10.1. Measurement is a Reper section

$$Measure_K: Obj_{\{phys\}} \rightarrow Rep_{\{obs\}}(R, I, U; D_{\{device\}}).$$

The device does not merely read a ready value. It selects a section under a domain and a sufficient foundation. Hence the result of measurement must be recorded as

$$Result = (R_{\{obs\}}, Scale, Aspect, D_{\{device\}}, Dom_{\{phys\}}).$$

10.3 Gap of a quantum assertion

Theorem 10.2. A quantum assertion without the indication of $scale@aspect$ receives gap-status.

Proof. If scale is absent, the physical regime is unknown. If aspect is absent, the observed side is unknown. If $D_{\{obs\}}$ is absent, the sufficient foundation of measurement is unknown. Therefore the assertion cannot be authorized by Reper truth and must be placed in the audit layer as GAP-OBSERVATION-MISSING or GAP-SCALE-ASPECT-MISSING.

11. PN.1, PN.2 and Bohr complementarity

11.1 PN.1

Definition 11.1. PN.1 is physical-operational uncertainty: an observed physical value depends on the operational regime of measurement.

In formula form:

$$Value_{\{obs\}} = \Theta_{\{measure\}}(Obj_{\{phys\}}; D_{\{device\}}, Scale, Aspect).$$

This is not a statement that reality disappears. It states that the observed value is a section of a physical Reper.

11.2 PN.2

Definition 11.2. PN.2 is packet uncertainty of size and dimensionality:

$$\widehat{S} \cdot \widehat{D} \quad \text{does not admit simultaneous complete fixation}.$$

In Volume IV PN.2 is read physically: the more rigidly the size of the observed object is fixed, the more strongly its packet dimensional structure is suppressed; the more fully size@dimensionality is disclosed, the less the object is reducible to one local size.

11.3 Bohr complementarity in Reper form

Bohr complementarity is read as a rule of incompatible but jointly necessary sections:

$$Aspect_1 \not\equiv Aspect_2, \quad Rep(Aspect_1, Aspect_2; D_{\{obs\}}) \neq \varnothing.$$

Theorem 11.3. In Reper reading, complementarity is not a refusal of reality, but a demand to indicate the aspect and sufficient foundation of observation.

Proof. If two experimental aspects are incompatible as simultaneous local sections, this does not mean that the object is absent. It means that the object is not reducible to one section without loss of domain. The Reper holds R , I , U and D simultaneously; hence complementarity is a special case of the packet structure of observation.

Part IV. CGI, physical audit and connection with Volume III

12. CGI and causal holes

12.1 Formula of CGI

The causal gap index is

$$\text{CGI}_i = \frac{|T_{\text{hole}}^L| + |F_{\text{cent}}^{\Xi\text{Upsilon}}| + |F_{\text{cor}}^{P@S}| + \sum_{\nu} B_{\nu}}{|r_i u_i + \text{varepsilon}|}$$

The components are:

Component	Physical meaning
T_{hole}^L	hole in limit causal connectivity
$F_{\text{cent}}^{\Xi\text{Upsilon}}$	centrifugal load of change-turn
$F_{\text{cor}}^{P@S}$	lateral Coriolis-type displacement of the 'P@S' channel
$\sum B_{\nu}$	sum of barriers along limits
$r_i u_i$	stability of the Reper node and connectivity of possibilities
varepsilon	protection against zero denominator

12.2 CGI statuses

Range	Status	Action
$\text{CGI} < 1$	causal hold	the Reper holds causality
$\text{CGI} \approx 1$	critical	the domain must be refined
$\text{CGI} > 1$	causal hole	reassembly, falsification or search for nearest Reper nodes is required

12.3 Theorem on causal hole

Theorem 12.1. If $\text{CGI}_i > 1$, the physical node cannot be published as a stable causal assertion without a route of reassembly.

Proof. For $\text{CGI}_i > 1$, the total load of holes, lateral shifts and barriers exceeds the normalized stability of the Reper node. Hence causal connectivity is not held. The publication status must pass into gap, candidate or hypothesis until a new D_{law} , a refined domain or a nearest Reper node is found.

13. Connection with Volume III: FOS, Size@Dimensionality and stitching

13.1 Import of FOS

Volume III fixed FOS as the condition of Reper-realizability of a possible world. Volume IV uses this result for physics:

$$\text{World}_{\text{phys}}; \text{is}; \text{admissible} \iff \text{World}_{\text{phys}} \in \text{Cond}(\text{FOS}; D_{\text{law}}).$$

13.2 Size@Dimensionality

A physical object has not only size, but packet size@dimensionality:

$$\text{PhysObj} = (\text{Size@Dimensionality}, \text{Rep}_{\text{phys}}, D_{\text{law}}).$$

In local measurement an object can appear as a point, line, surface or volume. In physical Reper assembly it can contain nonlocal components: hyparxis, apeiron/FOS and an observer-conscious section.

13.3 Stitching causal holes

Definition 13.1. Physical stitching is an operation of restoring a sufficient foundation for a causal gap:

$$\text{Stitch}_{\text{phys}}: \text{gap}(\text{CGI}_i > 1) \rightarrow \text{Rep}'_{\text{phys}}(R, I, U; D'_{\text{law}}).$$

Stitching is not an arbitrary assumption. It is admissible only if the new foundation D'_{law} decreases CGI and preserves the domain.

14. KLT-RBD audit of physical formula chains

14.1 Formula step

A physical formula step is

$$s_{\{phys\}} = (F_i, F_j, \tau, A, Dom_{\{phys\}}, D_{\{law\}}).$$

where:

- F_i, F_j are physical formulas or states;
- τ is the transition type;
- A is the support set;
- $Dom_{\{phys\}}$ is the physical domain;
- $D_{\{law\}}$ is the sufficient physical foundation.

14.2 Audit rules

Rule	Condition	Output
AUDIT-DOMAIN	the domain is absent or inadmissible	GAP-DOMAIN-MISSING
AUDIT-FOUNDATION	$D_{\{law\}}$ is absent, empty or ambiguous	GAP-ASSUMP-MISSING
AUDIT-REPER	the Reper is not assembled	GAP-REPER-MISSING
AUDIT-CGI	$CGI > 1$	GAP-CAUSAL-HOLE
AUDIT-STATUS	all checks pass	candidate/truth-status

14.3 Physical RBD table

rbd_id	Object	Reper	Domains	Status
PH-01	event@state	$Rep_{\{phys\}}$	measurement/law	ready
PH-02	Time@Space	Rep_T	temporal packet	ready
PH-03	causality	$\pm P \mp D_{\{act\}}$	action/foundation	ready
PH-04	determinism	$0 @ S$	consequence/foundation	ready
PH-05	skew channel	$P @ S$	lateral causality	candidate
PH-06	entropy	S_K	thermodynamic/Reper	candidate
PH-07	quantum aspect	$Q_{\{scale@aspect\}}$	observation	candidate
PH-08	CGI hole	CGI_i	audit/reconstruction	ready

15. Proof protocol of Volume IV

15.1 Status protocol

Every assertion of the volume belongs to one of the following statuses:

Status	Meaning
Classical known fact	classical background
Author definition	authorial definition of I. B. Kurpishev
Internal theorem	internal theorem of the Doctrine
Conditional theorem	theorem under a fixed domain
Open candidate	theorem candidate
Gap	rupture of domain, foundation or chain
Legal fixation	material for publication or registration fixation

15.2 Main theorem of physical integration

Theorem 15.1. The physical branch of the Doctrine is compatible with the general Reper architecture if and only if for every physical object there exists the chain

$$\begin{aligned} & x_{\{phys\}} \\ & \mapsto \\ & C@C_{\{phys\}} \\ & \mapsto \\ & Rep_{\{phys\}}(R, I, U; D_{\{law\}}) \\ & \mapsto \\ & \lambda_{\{phys\}} \\ & \mapsto \\ & CGI_i \\ & \mapsto \\ & Status_{\{phys\}} \\ & \mapsto \\ & RBD_{\{phys\}}. \end{aligned}$$

Proof. Necessity follows from the general law of the Doctrine: an object does not receive status without event@state, Reper closure, domain and sufficient foundation. Sufficiency follows from the fact that in the presence of these elements a physical assertion can be checked for

λ -truth, CGI stability and RBD connectivity. Therefore the physical branch is not a separate metaphysical hypothesis, but the physical reduction of the general KLT/FOS/RBD core.

15.3 Boundary of proved status

Volume IV does not prove a new universal physical theory in the sense of a complete replacement of classical mechanics, general relativity, quantum mechanics or statistical physics. It proves the internal consistency of the physical branch of the Doctrine as a Reper-packet layer where physical assertions receive statuses through domain, foundation, λ and CGI.

16. Bibliographic and source supports

16.1 Internal project sources

1. Kurpishev I. B. Monograph 5.0: Kurpishev Logic. Master corpus package, 2026.
2. Kurpishev I. B. Volume III. NAPG3, FOS, Size@Dimensionality and Transreper Geometry. v7.5/v7.6.
3. Kurpishev I. B. Kurpishev FOS, Desargues-Kurpishev Theorem, harmony of truth and extended PN.2. Journal article bundle, 2026.
4. Kurpishev I. B. PILOT-01: Reper-projective architecture of formula chains. 2026.
5. Master2 project contour: continuation of all chats. Editorial contour v7.
6. Kurpishev I. B. Volume IV. Kurpishev Physics. RU v7.7, immediate source layer for EN v7.8.

16.2 Classical background

1. Ponarin Ya. P. Affine and Projective Geometry. Moscow: MCCME, 2009.
2. Rashevsky P. K. Riemannian Geometry and Tensor Analysis. Moscow: Nauka, 1967.
3. Arnold V. I. Geometry of Complex Numbers, Quaternions and Spins. Moscow: MCCME, 2002.
4. Bourbaki N. The Architecture of Mathematics. Mathematical Education, 1960.
5. Bibler V. S. Kant - Galileo - Kant. Moscow: Mysl, 1991.
6. Oizerman T. I., Narsky I. S. Kant's Theory of Knowledge. Moscow: Nauka, 1991.

Appendix A. Index of formulas

Formula	Function
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$\text{\$Obj}_{\text{\{phys\}}}=C@C_{\text{\{phys\}}}$	physical object
$\text{\$Rep}_{\text{\{phys\}}}=(R,I,U;D_{\text{\{law\}}})$	physical Reper
$\text{\$mathcal P}_K=\text{\Theta}_{\text{\{phys\}}}(FOS;D_{\text{\{law\}}})$	physical reduction of FOS
$\text{\$Causality}_K=\text{\pm P}\text{\mp D}_{\text{\{act\}}}$	Causality
$\text{\$Det}_K=0@S$	determinism
$\text{\$P@S}=(P_{\text{\{skew\}}},S_{\text{\{shift\}}};D_{\text{\{skew\}}})$	lateral channel
$\text{\$Course}_K(T)=\Delta\text{\to}\text{\Upsilon}\text{\to}\text{\Xi}\text{\to}$	Kurpishev Course of Time
$\text{\$S}_K=\text{Measure}\{u\in U:D\not\vdash u\}$	entropy as unmanifest present
$Q_{\text{\{scale@aspect\}}}=(\text{Scale},\text{Aspect};D_{\text{\{obs\}}})$	quantum scale@aspect
$\text{\$CGI}_i=\frac{ T_{\text{\{hole\}}}^L + F_{\text{\{cent\}}}^{\text{\Xi}\text{\Upsilon}} }{ F_{\text{\{cor\}}}^{\text{\P@S}} +\sum B_{\text{\{nu\}}}\{r_i u_i+\text{\varepsilon}\}}$	causal gap index

Appendix B. Index of authorial notions

Notion	Status
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Time@Space	author definition
Physical Reper	author definition
0@S	author definition
P@S	author definition / open development node
Kurpishev Course of Time	author definition
Entropy as unmanifest present	conditional author construction
Quantum scale@aspect	conditional author construction
CGI hole	author diagnostic construction
KLT-RBD physical audit	internal method theorem

Appendix C. QA matrix of publication

QA	Check	Status
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QA-01	control point v7.8 is indicated	PASS
QA-02	authorship and affiliation are indicated	PASS
QA-03	the main text is not reduced to a synopsis	PASS
QA-04	formal dictionary is included	PASS
QA-05	definitions, lemmas and theorems are included	PASS
QA-06	CGI, Δ , Ξ , Υ , Σ , Π are included	PASS
QA-07	proof protocol is included	PASS
QA-08	next point is specified	PASS

Next control point

After Volume IV EN v7.8 the next logical point is

KLT-DOCTRINE-FINAL-MONOGRAPH-VOLUME-V-CHEMISTRY-RU-v7.9

The task of v7.9 is to prepare Volume V on KLT-RBD chemistry and chemical Reper reductions, with explicit separation between classical chemical background and the authorial KLT/FOS/RBD layer.