**Semon Collapse Causality Law**

**Introduction**

**Goal:**  
The formalization of time as a coherent field, the semon as a quantum of temporal potentiality, and the causon as the act of causal realization.

* The problem of time in physics (arrow, superposition, causality)
* Origins: Wheeler, Caldirola, Hawking

**Key references:** Wheeler (1964), Rovelli (2004), Kiefer (2012)

**Fundamental Postulates:**

* **Time** is a quantized coherent medium (the semonic field), which is neither matter nor energy.
* **Semon (σ)** is a quantum of temporal potential, a pre-causon entity capable of collapsing into an event.
* **Causon** is a realized event (collapse of a semon), a fixed point in the causal-temporal structure.
* Collapse is governed by the SCCL law: probability depends on the local temporal tension σ and the coherence of the field αₛ.
* Gravity, mass, and interactions are derivative effects of the temporal structure, not fundamental entities.

**Theses:**

* **Time is not a parameter, but a field with its own dynamics.**
* **The semon is a quantum fluctuation of the temporal field (analogous to a virtual boson).**
* **The semon has the potential to become a causal event.**

**Key formulas:**  
 **- φ(x) ⇒ σ(x), αₛ(x) ⇒ P (**collapse**)**

**- (**Probability of semon collapse**)**

**-** (Realization threshold (σ₀))

**-** (Lifetime of a semon)

**The semon (σ) is a quantum of temporal potential, carrying the gauge structure SU(3)×SU(2)×U(1)** and a metric connection with spacetime geometry. It acts as the linking element between interactions and temporal metrics.

**Physical interpretations:**

* **Mass =** stable collapse of the semon (sustained realization).
* **Gravity =** gradient of temporal tension:
* **Field energy =** function of **σ** and **αₛ**
* **Temporal resonance=**condition for the coherent collapse of multiple semons.

**SCCL Triad :**

1. **Zero semon** (σ = 0) — potentiality
2. **Wave semon** (σ > 0, but < σ₀) — perturbation.
3. **Causon** (σ ≥ σ₀) — event.

**Comparison of SCCL with Existing Theories**

**а) Chronon Theory (Caldirola)**

**Essence:**Caldirola introduces the "chronon"—the minimal quantum of time (τ₀ ≈ 10⁻²³ s), as a discretization of the time parameter. It is used to solve paradoxes in relativistic dynamics with delays (for example, in the Lorentz-Dirac equation for the electron**)**

**Comparison with SCCL:**

|  |  |  |
| --- | --- | --- |
| Parameter: | Chronon (Caldirola) | SCCL |
| Nature : | Discrete quantum of time | Quantum of potentiality (σ), not necessarily realized |
| Type : | Fixed value (τ₀) | Probabilistically realized entity, dependent on σ and αₛ |
| Collapse: | Not considered | Key process—transition from semon to causon |
| Physical scale: | Constant (~10⁻²³ c) | Linked to σ, κ, and realization threshold |
| Geometry : | Not included directly | Central: σ-field = time metric |

**Similarities:**

* Both theories consider the continuity of time problematic and propose quantization.
* Both aim to resolve paradoxes of classical theory at small scales (charge, mass, radiation).

**Differences:**

* The chronon is fixed and always realized, while the semon can remain unrealized (state of potentiality).
* SCCL includes coherence and tension as governing parameters of collapse; chronon theory does not.
* SCCL expands time to a field with metric σ, while the chronon is just a discrete axis.

**b) Chronon Theory (Friedman)**

Some authors (Thomas E. Phipps or Joseph R. Lucas) relate the chronon to relativistic quantization of time, often in the context of discrete spacetime or trivial proper time**.**

**Comparison with SCCL**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Chronon (Friedman) | |  | | --- | |  |  |  | | --- | | SCCL | |
| Type of time | Discretized proper time | Potential realization via semon collapse |
| Spacetime structure | Often fixed, not variable | σ-field as a dynamic metric of time |
| Experimentality | Poorly developed | SCCL proposes concrete experiments (quantum clocks, muons, etc.) |
| Causality mechanism | Postulated | SCCL proposes specific experiments (quantum clocks, muons, etc.) |
|  |  |  |

**c) Wheeler–DeWitt Equation**

**Essence:**This equation is the result of quantizing general relativity. It describes the "wave function of the Universe," without explicit time—a manifestation of the "problem of time" in quantum gravity.

Where Ψ is a functional of the spatial metric, H is the Hamiltonian of constraints.  
There is no time, no collapse—everything "hangs" in superspace.

**Comparison with SCCL**

| Parameter | Wheeler–DeWitt | SCCL |
| --- | --- | --- |
| Time | Absent, "frozen" Universe | Present as σ-field, subject to fluctuations |
| Collapse | Implicit; external observation problem | Explicit, governed by probabilistic function P(σ, αₛ) |
| Metric | (spatial) | σ + φ + αₛ—temporal metric of the time field |
| Interpretation | Ontology of the wave function | Ontology of semon collapse into causality |
| Coherence | Not considered explicitly | Key parameter αₛ |
| Problem of time | Central, unsolved | Solved: time = field, events = collapses |

**Similarities:**

* Both theories move away from classical parametric time.
* Both work at the level of the fundamental structure of reality (not particles, but fields/states).

**Differences:**

* Wheeler–DeWitt is a static wave; SCCL is the dynamics of event realization.
* SCCL offers a mechanism for the emergence of time as a collapse metric, not a frozen wave function.

**SCCL:**

* Clarifies the chronon (Caldirola) via a probabilistic approach.
* Expands the chronon (Friedman) toward a metric and field.
* Resolves the Wheeler–DeWitt time problem by introducing temporal tension and a collapse mechanism into causality.

**The Concept of Quantum Foam (J. A. Wheeler, 1955)**

**Definition:**Quantum foam is a hypothetical state of spacetime at the Planck scale (~1.616×10⁻³⁵ m), where:

* The geometry of spacetime is subject to uncontrollable quantum fluctuations.
* Topology may spontaneously change: closed loops, tunnels, wormholes can form and disappear.
* Causality and locality become unreliable or blurred.

**Key aspects:**

* The spacetime continuum loses its smoothness → transitions into a "foam" regime.
* Assumed presence of temporal vortices, closed causal loops, fluctuating gravitational tunnels.
* This pertains to the area of quantum gravity, which remains unintegrated with general relativity.

Quote (Wheeler, 1964):*"At the Planck scale, the very texture of space-time is frothy and turbulent — a quantum foam of wormholes, mini black holes, and closed loops."*

**Connection with SCCL:**SCCL assumes that fluctuations of temporal tension σ at Planck scales can be the ontological foundation of quantum foam:  
it is not merely a geometric phenomenon but a vortex activity of the semonic field, in which the possibility of an event collapses or is inhibited.

**SCCL and Quantum Gravity**

**Quantum Foam and Temporal Fluctuations**

**Key Features:**

* Scale ~10⁻³⁵ m / 10⁻⁴⁴ s
* Tunnels, vortices, micro-wormholes
* Absence of a clear metric and stable events

**SCCL Interpretation:**

In SCCL terms, quantum foam is a manifestation of the decoherent regime of the temporal field, where:

* Coherence **αₛ ≈ 0,**
* Tension σ fluctuates strongly
* The probability of semon collapse into causons approaches zero:

This is the ontological "***chaos***" of time — a world before distinction, before causality.  
Where collapse is impossible, events do not occur, and potentiality endlessly wanders in the structure.

**The Wave Semon and the Graviton in SCCL Theory**

The wave semon is a modulation of the temporal field, associated with fluctuations of temporal tension σ, not leading to collapse, but breaking symmetry.

It is interpreted as the analogue of the graviton:

* Transmits wave fluctuations of σ,
* Does not realize an event,
* Does not create a causon,
* But affects the geometry and coherence of the time field.

This state corresponds to a dispersive wave of the time field, preserving superposition but altering local conditions for the probability of collapse.

|  |  |  |
| --- | --- | --- |
| **Category** | **Wave Semon** | **Graviton (Traditional Theory)** |
| Realization | None (does not collapse) | None (disturbs metric, not an event) |
| Energy | Not localized | Not localized |
| Effect | Through σ-gradient | Through spacetime metric |
| Causality | Violates locality, not causality | Analogous |
| Origin | Fluctuation of σ and φ | Quantization of metric oscillations |

SCCL interprets the graviton not as a particle, but as a wave of an unrealized event — a disturbance of the temporal metric that does not reach collapse conditions.

This makes it possible to:

* Reinterpret gravitational waves as interference patterns of σ,
* Explain the impossibility of localizing the graviton,
* Link gravity to the time metric, not to the energy-momentum tensor.

1. The Equation for the Phase Field of Time φ(x)

**□ϕ(x) = ∂V(ϕ, σ, αₛ) / ∂ϕ**

Where:

• **□ ≡ ∂ᵘ∂ᵤ** — d'Alembertian operator (wave operator),

• **V(ϕ, σ, αₛ)** — potential of the semonic field, depending on:

• ϕ — phase of time,

• σ — local temporal tension,

• αₛ — field coherence.

2. The Wave Semon as a Solution of the Wave Equation:

**ϕ(x) = A ⋅ sin(k\_μ x^μ + δ)**

Where:

• A — fluctuation amplitude,

• k\_μ — wave vector in the temporal field,

• δ — phase.

This form does not cause collapse, since:

**P(σ, αₛ) = αₛ ⋅ (1 − e^(−κσ)) ≪ P\_c**

i.e. the probability of collapse is below the critical threshold P\_c.

3. Energy of the Wave Semon:

**E = ½ (∂ₜϕ)² + ½ (∇ϕ)² + V(ϕ)**

But for **ϕ ≈ 0 и σ ≪ σ₀,** potential **V(ϕ) ≈ 0**,

that is, the energy is purely wave — with no event realization.

**SCCL and Relativity: The Internal Metric of Time**

**Classical Basis:**

Minkowski space defines the interval:

**ds² = −c² dt² + dx² + dy² + dz²**

where **ds²** is the invariant defining the causal structure.

The light cone is the boundary between causally connected and spatially separated events.

**SCCL Interpretation:**

SCCL introduces an additional internal dimension of time — temporal tension σ,  
which does not change the Minkowski metric but clarifies:

which events are potential, and which are realized

**Main idea**

| **Parameter** | **GR / Minkowski** | **SCCL** |
| --- | --- | --- |
| Interval ds² | Invariant of causality | Preserved |
| Time t | Coordinate | Describes the background, not realization |
| σ (tension) | Does not exist | Internal dimension of the time field |
| Causality | Set by Minkowski cones | Arises upon semon collapse (σ ≥ σ₀) |
| Spacetime | Geometric stage | Coherent field of semonic potentiality |
| Event | Point in Minkowski space | Semon collapse (folding of potentiality into fact) |

**Geometric inclusion:**

In classical theory, the event structure already exists.

In SCCL—it arises upon the realization of a semon,

and the interval ds² is the result of a coherent σ-field.

**Formulation**

The Minkowski metric is a projection of the coherent temporal field σ onto 4D space.

When **αₛ → 1** and σ becomes stable, SCCL collapses to classical relativistic geometry.

**Consequence**

SCCL preserves Lorentz locality and the interval structure,  
but supplements it with ontological dynamics:  
not everything allowed by ds² is realized;  
only what has undergone collapse σ → causon is realized.

**SCCL** does not destroy relativistic geometry.  
It proposes an ontological time field, within which the Minkowski structure is  
the picture of already realized semon collapses in event space.

**SCCL and the Wheeler–DeWitt Equation: The Problem of Time and Its Solution**

**Original problem:**The Wheeler–DeWitt equation:

The wave function of the Universe is a function of the 3-metric of space.

There is no time t, no dynamics, no evolution.

This led to the problem of time in quantum gravity: how to describe change without a time parameter?

**SCCL asserts**:

Time is not an external parameter (as in Schrödinger dynamics),  
but arises as a result of semon collapses into causons—that is, as a result of the realization of distinctions.

**Technical Comparison**

| **Parameter** | **Wheeler–DeWitt** | **SCCL** |
| --- | --- | --- |
| Time t | Absent ("frozen" Universe) | Arises through realization (collapse of **σ**) |
| Evolution | Undefined without observer | Defined through probability **P(σ, αₛ)** |
| Ontology | Wave function of geometry | σ-field and collapses—ontology of distinctions |
| Measurement / Event | Not defined | Realization of semon **(σ ≥ σ₀)** |
| Geometry | 3-metric | **σ, φ, αₛ—**metric of the temporal field |
| Causality | Not explicitly included | Arises from SCCL |

SCCL solves the problem of time not by restoring t,  
but by replacing it with the phase structure of the temporal field,  
where an event is not a point but an act of collapse of distinguishability.

**The Planck limit** is not just the "edge of physics,"  
but the boundary between possible and realized time.

**SCCL shows:**

how fluctuations of σ create quantum foam,

how the graviton is a wave of non-realization,

how relativistic geometry is embedded in the coherent field,

how "time" is a consequence, not a presupposition.

**Einstein–Podolsky–Rosen (EPR) Paradox**

Consider the quantum state:

This is an inseparable superposition of the coordinates and momenta of two particles.

After measuring the coordinate or momentum of one particle:

* the value of the second is instantly determined,
* although, according to formal laws, there is no interaction between them.

Central Problems of EPR:

| Question | Problem |
| --- | --- |
| Reality | Can we assume the particle had properties in advance? |
| Locality | Can one particle instantly affect another? |
| Completeness | Does the Ψ-function describe all reality? |
| Causality | Is quantum nonlocality compatible with relativism? |

John Bell (1964) proved: if there are local hidden variables, they must satisfy Bell's inequalities.

* **Experiments (Aspect, Zeilinger, 1980–2010s):**Violation of Bell's inequalities was experimentally confirmed.  
  ⇒ Local hidden parameters are rejected.  
  Quantum theory precisely predicts the observed correlations.

**Interpretation of EPR in the Context of SCCL:**

Initial state:

SCCL introduces the field of temporal tension σ, in which:

* The semon is the state before distinction,
* The causon is the realized event (after collapse).
* Two particles are in a joint semonic superposition:

**ΨAB=state with coherent σ**

Measurement of one particle (A):

* causes a local increase **σ → σ₀,**
* the semon collapses → causon A arises,
* the fields **σ** and **φ** instantly rearrange over the entire coherent region (nonlocality via the field, not via a signal).

Particle B:

* does not receive a "signal",
* but its semonic state is already determined through the resonant correspondence of **σ** and **φ**,
* collapse upon measurement of **B** yields a result consistent with **A**.

Let:

* σ — local tension of semon A,
* αₛ — global coherence of the field,
* φ — phase connection between A and B.

Then the probability of a correlated collapse:

is an analogue of quantum correlation.

| **EPR Question** | **SCCL Answer** |
| --- | --- |
| Is there "reality"? | Yes, but it exists in the **σ**-field, before the event |
| Is there "locality"? | No, the connection is through global coherence, not a signal |
| Does influence exist? | Not influence, but a single resonant structure of **σ** |
| Does time play a role? | Yes, but through collapse probability, not classical **t** |

The EPR paradox is a consequence of the indistinguishability of potentiality and realization.  
SCCL introduces the semon as a state before distinction and shows that  
the consistency of observed data is the result of resonant coherence of the **σ**-field,  
not the transfer of information.  
Thus, locality is violated not physically, but ontologically.

**SCCL and Geometry: Loop and Topological Quantum Gravity**

Loop Quantum Gravity (LQG): Briefly

**Goal of LQG:**  
To quantize the very geometry of spacetime without introducing a background (background-independent approach).

**Main objects:**

* **Spin networks:** discrete states of geometry (nodes and links);
* **Spin foams:** history of the evolution of spin networks in time;
* **Area and volume operators** are quantized → space becomes discrete.

**Connection with SCCL:**

**In common:**

* Both theories reject the continuous background of spacetime.
* Both approaches are non-perturbative, do not require a given metric.
* Geometry is secondary, arising from more fundamental structures.

**Specifics of SCCL:**

* SCCL introduces temporal metric σ and phase φ as primary fields;
* The spin network in LQG fixes the state of discrete space,  
  SCCL — the state of coherence of time and the probability of event realization.

**Possible Correspondence:**

| **LQG Element** | **SCCL Element** |
| --- | --- |
| Spin network node | Potential center of semon collapse |
| Links (edges) | Channels of coherence of the **σ**-field |
| Spin foam | Network of causons (realized events) |
| Quantum of area | Realization of a causon **(σ ≥ σ₀)** |
| Absence of background | σ-field is not a background, but a condition of possibility |

Geometry in LQG is the discrete trace of the realization of the semonic field.  
The collapse of a semon generates an element of geometry (a node or face).

**SCCL and Topological Quantum Field Theories (TQFT)**

**Essence of TQFT:**

* The physical system is described not through metric, but through topological invariants (e.g., homologies, bordisms).
* Space and time are replaced by structures of connectivity and transitions.

Example**:**

* States — on boundaries (boundaries of bordisms);
* Transition amplitudes — integrals over all possible topologies.

| **Parameter** | **TQFT** | **SCCL** |
| --- | --- | --- |
| Space | Bordisms (boundaries and "bodies") | Temporal topology of the **σ**-field |
| Event | Transition between boundaries | Collapse of the semon **(σ ≥ σ₀)** |
| Dynamics | Summation over all topologies | Probabilistic realization of collapse |
| Metric structure | Absent | Arises from **σ**-field |

SCCL can be interpreted as a TQFT with the source in σ-fluctuations,  
where events are topological transitions from potentiality to realization.

**SCCL and Causal Sets Theory**

**Another model:** spacetime is a partially ordered set of events (causal set), without coordinates but with causal structure.

SCCL naturally works here:

* Semon = vertex, while not realized;
* Causon = vertex after collapse;
* Direction **σ** → forms the partial order.

SCCL can be integrated into existing quantum gravity models:

* In LQG — as the source of collapse, fixing nodes and foam;
* In TQFT — as the ontological field realizing topological transitions;
* In causal sets — as the mechanism for the emergence of causal order.

Thus, SCCL does not compete with these models,  
but offers a deeper ontology:  
not "spacetime," but "the possibility of distinction".

**SCCL, Inflation and Tunneling: The Birth of Time**

**Cosmological Inflation (in the conventional model)**

**Hypothesis:**  
The early state of the Universe (~10⁻³⁵ s) was characterized by a phase of exponential expansion, caused by:

* The presence of an inflaton field,
* High value of vacuum energy,
* Quantum tunneling from the false vacuum to the true vacuum.

| **Parameter** | **Description** |
| --- | --- |
| False vacuum | Metastable state with high energy |
| Tunneling | Quantum transition to a more stable state |
| Inflaton | Field that defines the scale of vacuum energy |
| Inflation | Rapid expansion of space |

**Initial State (SCCL):**

**σ ≈ 0** → field is maximally symmetric

**αₛ ≈ 1** → complete coherence

**P(σ, αₛ) ≈ 0** → no collapse, no causons, no events

This is analogous to the false vacuum, but in terms of the temporal field.

**Tunneling in SCCL**

A fluctuation of the σ-field causes a local increase **σ > σ₀,**  
and if **P(σ, αₛ) ≥ P\_c →** a semon collapse occurs.

This is the "birth of an event.".  
The first collapse → the first causon → the first slice of time.

**Inflation as Temporal Resonance**

After the first collapse:

A gradient of **σ** arises →

The tension spreads to other regions of the field →  
 Causes a chain reaction of collapses

This generates a cascade of causon emissions →  
 a phase flash of causality.

This is the SCCL-analogue of inflation:  
Not spatial expansion, but a rapid densification of the event lattice —  
the realization of potentialities in a coherent flow.

That is:

* Near σ₀, there is an exponential decrease in the lifetime of the semon → rapid growth in realized event
* → SCCL-inflation = accelerated birth of time

**Boundary of Inflation and Structure Formation**

When local coherence αₛ decreases:

* The probability of collapse drops;
* The birth of events slows down;
* Fragmentation arises: structures, causon layers, causal boundaries.

This is equivalent to the end of inflation and the formation of the "cosmos".

* Inflation in SCCL is not an explosion of space, but a transition  
  from complete potentiality **(σ ≈ 0, αₛ ≈ 1)**  
  to a structured realization of events **(σ ≥ σ₀)**
* Quantum tunneling is a local act of distinction
* Inflation is a phase avalanche of collapses,
* Geometry is the result of realization, not a presupposition.

**Euclidean Action for the Double Minimum (SCCL)**

**Potential for the double minimum**

A classic potential for describing tunneling between minima (false → true vacuum):

**V(σ) = λ (σ² - σ₀²)²**

Where:  
λ — self-interaction parameter;  
σ₀ — value of the field in the true vacuum (boundary of the phase transition, "collapse threshold").

**Euclidean Action for a Bubble**

Formula for the Euclidean action Sₑ for nucleation of a bubble:

**Sₑ = (4 / 27π²) · λ · σ₀ · η³**

where η is the surface tension of the bubble wall:

**η = ∫ dσ √[2 V(σ)]**

In general:  
 **η = ∫\_{σ\_false}^{σ\_true} √[2 V(σ)] dσ**

**Interpretation of Variables:**

η — surface tension of the bubble wall, determines the energy cost of creating a bubble between two phases;  
σ₀ — value of the field in the true vacuum (collapse boundary, SCCL σ-threshold);  
λ — "stiffness" of the potential (the greater λ, the higher the barrier and the lower the tunneling probability).

# **Philosophical and Ontological Meaning for SCCL**

# In SCCL, a bubble is a local act of event realization, a jump of the field from the false vacuum (potentiality) to the true vacuum (realization, "causon"). Gravity here is not the cause of tunneling, but a manifestation of the loss of symmetry: when the bubble is realized, a local gradient of temporal tension **σ** arises—this is what we call gravity, not as a "force," but as the structural response of the field. In this approach, gravity is the fixation of distinctions arising after realization, not as an independent force

# **Formula and Explanation**

Formula for evaluating the action:

**Sₑ = (4 / 27π²) · λ · σ₀ · η³**

Where: **η = ∫ dσ √[2 V(σ)]**

and **V(σ) = λ (σ² - σ₀²)²**

What is this formula for ?  
• Evaluates the probability of tunneling between vacua, the birth of a bubble/causon (i.e., event realization in SCCL).  
• The smaller the action Sₑ, the greater the probability **(formally Γ ~ exp(-Sₑ)).**  
• Allows the introduction of numerical parameters—you can experimentally "tune" the model to data or adjust it to theoretical requirements.

**Summary of SCCL (Philosophy/Ontology)**

Gravity is not a "force," but a manifestation of the loss of symmetry of the semonic field upon event realization (birth of a bubble/causon).  
Everything we experience as gravity is the effect of fixed distinctness in the ontological structure of time, not an independent agent.

## **SCCL-PT: Phase Topology of Time and Temporal Domains**

## **Introduction**

The arrow of time in SCCL theory is not imposed externally but arises as a result of a phase transition in the semonic field. SCCL-PT (Phase Topology) describes the local direction of time as a phase orientation of the field **S(x),** analogous to the mechanism of spontaneous symmetry breaking in field theory.

## **Time Field and Phase Potential**

Let:

• **S(x)** — local value of temporal direction,

• **V(S) = λ/4 (S² − v²)²** — potential of the time field.

The field has two minima:  
 **⟨S(x)⟩ = +v или −v**

This corresponds to two possible arrows of time: forward and backward.  
The collapse of a semon into one of these states sets local causality.

## **Instantons and Time Arrow Switching**

**Instanton solution**:  
 **S(x) = v · tanh(kx)**

Defines a local bubble of time, inside which the direction of the arrow of time is opposite to the background. Such switching is possible in cases of :  
• Quantum tunneling,  
• Spontaneous fluctuation,  
• Presence of a topological defect.

## **Causality as a Local Property**

In SCCL, causality exists only in regions where:  
 **σ(x) ≥ σ₀ и αₛ > α\_c**

This means:  
• The arrows of time can differ locally,  
• Temporal loops, ruptures, and backward trajectories are possible.

## **CPT Invariance and Temporal Domains**

**Change**:  
 **S → −S ⇔ t → −t**  
indicates a connection with CPT symmetry. Temporal domains are interpreted as local eigenstates of CPT.

Before the choice **⟨S⟩ = ±v**, the system is in a superposition of temporal directions.  
Collapse = branch selection.

## **SCCL and Tunneling of the Semonic Bubble**

**Potential**:  
 **V(σ) = λ/4 (σ² − σ₀²)²**

Approximate action for a thin wall:  
 **S\_E = 1728 π² / λ²,  
 P ~ e^(−S\_E)**

The bubble is realized when a fluctuation **σ → σ₀** occurs, causing a local phase shift in time.

## **Temporal Domains and Detection Scenarios**

**Cosmological**:  
• Anisotropies in CMB  
• Temporal walls  
• t → −t symmetries

**Quantum optics**:  
• Fluctuations of photon phases  
• Reverse decoherence

**Black holes**:  
• Local S → −S  
• Anomalies in evaporation

**Mesoscale**:  
• Separation of entangled particles by temporal domains

• EPR anomalies

## **Generalization**

Temporal domains are quantum bubbles with a reversed arrow of time, permitted by SCCL as a result of phase fluctuation S(x) .

**They can be detected through**:  
• Anomalies in causality,  
• Entropy violations,  
• Signals in CMB,  
• Quantum correlations.

Physically, these are local acts of choosing the time direction, not a return to the past.

## **Conclusion**

**SCCL-PT and Ω-domains introduce a new ontology of time**:  
• The direction of time arises as a result of phase choice;  
• Causality is local and emergent;  
• The existence of temporal bubbles, reversed regions, and fluctuations of the arrow is possible.

This structure does not violate known laws but clarifies and deepens the concept of time as a phase field of causality realization.

**Specific Measurable Effects Distinguishing SCCL from Other Models**

**Superfluidity Effects of Time**

**SCCL:** Time is a quantum superfluid medium (cf. analogy with Bose-Einstein condensate)  
**Measurable effect:**

* Coherent oscillations of "clocks" (atomic, neutrino) when entering regions with different "temporal permeability ".
* Anomalous slowing down or acceleration of clock rates, not explainable by gravitational potential or relativity, but by local field coherence.

**Experiment:**

* Comparison of two identical quantum clocks placed in areas with different event histories (e.g., near massive collapsing objects or in a lab with artificially excited σ-field).

**Coherent "Resonances" of Time Arrows**

**SCCL**: Zones of coherence are possible, where the time arrows of several subsystems align, forming a macroscopic resonance.

**Measurable effect:**

* Synchronous occurrence of events at different points, statistically exceeding random coincidence probabilities (effect of collective fluctuations).
* Sudden "coherent realization"—avalanche-like fixation of events in time, similar to a quantum jump but on a macro scale*.*

**Experiment:**

* Searching for correlations between events (e.g., neutrino bursts, radio emission fluctuations) in astronomical observations matching predictions of SCCL resonance zones.

**Anomalies in Gravity Behavior**

**SCCL**: Gravity is not a force, but a field response to event distinction.

**Measurable effect:**

* Local changes in gravitational strength, correlating not with mass, but with event density (e.g., during large energy releases or massive coherent processes).
* Observation of "gravitational anomalies" near resonance events (such as supernovae bursts, rapid phase transitions in the lab).

**Experiment:**

* Ultra-precise gravimeters in places with sharp phase changes in matter (cooling to superconductivity, formation of Bose condensates), and observing temporal changes in the gravitational field.

**Excess of Rare Particles as a Signature of Semon Collapse**

**SCCL**: Muons, neutrinos, and other "anomalous" particles are manifestations of local collapse of the semonic field, not classical decays.

**Measurable effect:**

* Appearance of an excess of muons/neutrinos in zones where the Standard Model predicts their lack or absence*.*
* Statistical inhomogeneity in time and space of such particle appearances, related to SCCL zones*.*

**Experiment:**

* Analysis of cosmic ray and neutrino detector data, searching for "muon" and "neutrino" anomalies coinciding with events interpretable as massive **σ** collapse.

**Temporal Interferometry**

**SCCL**: An experiment on the interference of "events" can be set up, not just of matter waves.

**Measurable effect:**

* Appearance/disappearance of events upon changing the phase relation between coherent temporal flows*.*

**Experiment:**

* Development of quantum protocols where the outcome is not simply probabilistic, but sharply changes with phase coherence variation—e.g., a temporal analogue of the double-slit experiment, but for events.

**Observed Violation of Local Causality**

**SCCL**: Causality is the result of collapse, not absolute.

**Measurable effect:**

* In certain conditions—the appearance of events lacking a local classical precursor, but occurring according to the laws of SCCL probability.
* Observation of "causal jumps"—emergence of correlated events without a physically fixed signal transfer (local violation of the locality principle).

**Experiment:**

* Laboratory experiments on quantum delay, "entanglement" of events, where SCCL gives a different prediction for the frequency and scale of the effect.

**Direct Dependence of Event Probability on Measurable Coherence of the σ-Field**

**SCCL**: The probability of event collapse depends not on standard physical parameters, but on the measurable level of coherence and temporal tension.

**Measurable effect:**

* The ability to control the probability of events (e.g., decay, switching of a quantum system) by changing the coherence or parameters of the **σ**-field.

**Experiment:**

* Quantum experiments with controllable coherence (e.g., superconducting qubits, entangled photon states), where the probability of collapse can be modulated by external influences on **σ**.

**Conclusion**

All these effects can be distinguished from standard models—if even one of these phenomena is observed according to SCCL predictions and does not fit within classical QFT or GR, this would be direct evidence of the validity of SCCL.

**Bibliography**

1. *Caldirola, P. (1956). The introduction of a periodic phenomenon in the relativistic dynamics of an electron.*
2. *Wheeler, J.A., & DeWitt, B.S. (1964). Battelle Rencontres .*
3. *Rovelli, C. (2004). Quantum Gravity . Cambridge University Press.*
4. *Kiefer, C. (2012). Quantum Gravity . Oxford University Press.*
5. *Hawking, S.W. (1975). Particle creation by black holes.*
6. *Aspect, A., Dalibard, J., & Roger, G. (1982). Experimental test of Bell's inequalities using time-varying analyzers.*
7. *Zeilinger, A. (1999). A foundational principle for quantum mechanics.*
8. *Coleman, S., & De Luccia, F. (1980). Gravitational effects on and of vacuum decay.*
9. *Penrose, R. (2004). The Road to Reality.*
10. *Smolin, L. (2000). Three Roads to Quantum Gravity.*