

Modules Are Not Walls but Limits

— A Distinct-Roots Census of Contraction, Deformation and Decoupling, and the Beautiful Temptation of
"Stability" — [Paper 113]

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August 2026

— *From thinking to syncing.* —

ABSTRACT

Physics **looks as though it comes in modules**: Newtonian mechanics carries you so far, then the rule seems to "change" into special relativity, and then into quantum theory. This paper answers that appearance with established results, as a Layer-2 **distinct-roots census**. **First answer**: the modules are not walls but **limits**, and the boundary always lies where a **dimensionless number crosses one** (v/c , GM/rc^2 , $\hbar/S$) — a statement independent of units, on which the convention/fact line of Paper 95 bears directly. **Second answer (the machinery)**: there are **three machines** joining the modules, and **all three are distinct roots**. (i) **Contraction** — İnönü–Wigner (1953): as $c \rightarrow \infty$ the Poincaré group **contracts to the Galilei group**. This puts a parent–child relation into the two branches of Paper 83. (ii) **Deformation** — quantum mechanics is a **deformation of classical mechanics in $\hbar$** (BFFLS 1978; the Moyal product; Kontsevich 2003). Contraction and deformation run in **opposite directions**. (iii) **Decoupling** — Wilson's renormalization group and Appelquist–Carazzone (1975): short-distance detail is **cut off** from long-distance physics. **This answers "why can physics be modular at all?"**, a different question from (i) and (ii). There is also a **geometric answer**: through Cartan's **Newton–Cartan theory** and Ehlers's frame theory, **Newtonian gravity too is geometry**, and the boundary lies not in "geometry or not" but in **whether the metric is degenerate** — Minkowski's ds^2 (Paper 108) splits into two structures as $c \rightarrow \infty$. As a map we place **Bronstein's cube** ($1/c$, G , $\hbar$; eight vertices; **one empty corner: quantum gravity**). **And the spine of this paper is a single brake**: there is a temptation to extend all this into the **stability argument** — "constants are deformation parameters, and since rigid algebras should be selected, c , $\hbar$, Λ cannot vanish" (Flato, Faddeev, Vilela Mendes). This paper presents that as a **heuristic principle**, a **criterion of theory selection**, and **never calls it a derivation of the values of constants**. The dividing line is the distinction between **existence and value** — a **jig Paper 83 already owns** (the **existence** of an invariant speed is forced; its **value** is settled by experiment). Where Eddington slipped was in trying to derive the **value** (Paper 101). **Scope**: a structural interpretation of established results. No new mathematics, no prediction. The empty corner of the cube (quantum gravity) is **not attempted (admire)**. Layer 3 is quarantined with a non-scientific label.

Positioning of this paper (discipline): This paper offers a **structural interpretation and distinct-roots census** of established results (İnönü–Wigner group contraction; deformation quantization; Newton–Cartan theory and Ehlers's frame theory; the renormalization group and the decoupling theorem; the $cG\hbar$ cube). It proves no new theorem and claims no new physics or prediction. **The three machines (contraction, deformation, decoupling) are not unified:** the first two concern the algebra of symmetries, the third concerns dynamics and scale — **they answer different questions.** **The most important discipline:** this paper **does not present the "stability argument" as a derivation of the values of constants.** What it states reaches only **the non-vanishing of the parameters (existence);** about **values** it says nothing. **The jig separating existence from value is one Paper 83 already owns.** Beyond that line lies Eddington's cliff (the four failure modes of Paper 101). **Newton–Cartan theory is a reformulation and changes no prediction.** **The empty corner of the cube (quantum gravity) is not attempted** (admire). "Resonance is a signature, not a proof" (Paper 100); "no post-hoc numerical adjustment" (Paper 101). A designer and the Universe OS are Layer-3 non-scientific lenses.

1. Introduction: Why Does Physics Look Modular?

Seen from outside, physics **looks like a staircase.** Newtonian mechanics works splendidly up to a point; beyond it comes special relativity; where gravity is strong, general relativity; where things are small, quantum theory — **the rule changes, as if modules were being switched.**

The impression is naive, but **as a question it is excellent.** Why can one go so far and then suddenly meet a different rule? And — **is there one rule that subsumes them all?**

This paper answers **within the range of established results.** To put the conclusion first:

**The modules are not walls. They are limits.
And there are three machines that cross the limits — all three distinct roots.**

The paper has **one further task.** Travelling this road, one meets a **very beautiful but hazardous** claim: "**constants are deformation parameters, and since rigid algebras are to be selected, neither c nor $\hbar$ nor Λ can vanish.**" This paper **presents it, and applies the brake at the precise place.** Section 7 is that section, and it is **the spine of this paper.**

2. First Answer: The Boundary Lies Where a Dimensionless Number Crosses One

Observation 2.1 (The boundaries of the modules are written in unit-independent quantities)

An older theory is a **limit** of a newer one, and where it fails is decided by a **dimensionless ratio**.

- Newtonian mechanics → special relativity: v/c
- Newtonian gravity → general relativity: GM/rc^2 (the ratio to the Schwarzschild radius)
- Classical mechanics → quantum mechanics: $\hbar/S$ ($\hbar$ against the action)

All are **dimensionless**, and **their values do not change with a change of units**.

This point matters for this series. "The speed at which Newton fails" changes with units, but "**it fails as v/c approaches one**" does not. **The line between convention and fact drawn in Paper 95** applies directly here: to state the **location** of a boundary one must use a dimensionless quantity.

An honest line. But this is **description, not explanation**. It answers neither "why that ratio" nor "why the older theory reappears in the limit." The next three sections do.

3. Machine (i): Contraction — At the Level of Groups, Newton Is a Limit of Relativity

Established Fact 3.1 (İnönü–Wigner 1953)

Lie groups (Lie algebras) admit an operation called **contraction**, in which sending a parameter to a limit yields another group. In particular, contracting the **Poincaré group** as $c \rightarrow \infty$ yields the **Galilei group**.

This is **not an approximation of equations but a relation between the symmetries themselves**. That Newtonian mechanics is the $v \ll c$ approximation of relativity is common knowledge; what İnönü and Wigner stated is that **the relation holds at the level of group structure. The symmetry of spacetime degenerates, in the limit, into another symmetry.**

Corollary 3.2 (Connection to Paper 83: a parent–child relation enters the two branches)

Paper 83 (Ignatowski) showed, from the relativity principle, isotropy and group structure alone, that **relativity is confined to two kinds: Galilean and Lorentzian**. But 83 says no more than that **the two branches stand side by side**. İnönü–Wigner puts **an orientation** into that: **the Galilean kind is a contraction of the Lorentzian kind, and not the reverse. 83 counts the branches; 113 joins them.**

Contractions **chain**: the de Sitter group $\rightarrow (\Lambda \rightarrow 0) \rightarrow$ the Poincaré group $\rightarrow (c \rightarrow \infty) \rightarrow$ the Galilei group. **The staircase descends in this direction.**

4. The Geometric Answer: Newtonian Gravity Was Also Geometry

To think of the boundary of the modules as "whether or not geometry is used" is **a mistake**.

Established Fact 4.1 (Newton–Cartan theory (Cartan 1923–24) and Ehlers's frame theory)

Cartan showed that **Newtonian gravity can be rewritten as a geometry with a curved connection** (Newton–Cartan theory). There, spacetime carries a **degenerate metric structure**: instead of a single ds^2 , **a spatial metric and a temporal one-form exist separately**. Ehlers (1981) constructed a **frame theory** with $\lambda = 1/c^2$ as a parameter, giving a **smooth limit** from general relativity to Newton–Cartan theory.

**The boundary is not "geometry or not."
It is "metric nondegenerate, or degenerate."**

This is a particularly beautiful connection for this series. The invariant interval of Minkowski, $ds^2 = c^2 dt^2 - dx^2 - dy^2 - dz^2$, treated in **Paper 108**, splits into two structures as $c \rightarrow \infty$ — one measuring time alone, one measuring space alone. **Newton's world is the world in which the interval can no longer be bound into one.** The tools are those of **Cartan (Paper 92)**, and the one who made the limit precise is **Ehlers — the same Ehlers as the EPS of Paper 111. 92 and 111 converge here.**

An honest line. Newton–Cartan theory is a **reformulation, not new physics**. It changes no observational prediction. What it gives is **the right way of seeing**, not a new result.

5. Machine (ii): Deformation — Quantum Mechanics Is a Deformation of Classical Mechanics

Established Fact 5.1 (Deformation quantization: BFFLS 1978; Moyal 1949; Kontsevich 2003)

Quantization is not a leap into another world; it can be formulated as **a deformation of the algebra of observables in $\hbar$** . The commutative product is deformed into a **star product** (the Moyal product), and the Poisson bracket into the **Moyal bracket**; as $\hbar \rightarrow 0$ the original classical algebra returns. Kontsevich proved that **every Poisson manifold admits a deformation quantization** (preprint 1997, published 2003; Fields Medal 1998).

Observation 5.2 (Contraction and deformation run in opposite directions)

Contraction degenerates an algebra (Poincaré $\rightarrow$ Galilei). **Deformation** runs the other way, from a degenerate algebra back to a general one (classical $\rightarrow$ quantum; Galilei $\rightarrow$ Poincaré). **They walk the same map in opposite directions.**

In this series, **Paper 77** (Liouville and phase space) and **Paper 112** (the Planck cell $\hbar^3$) are the neighbours of this address. On the same stage of phase space, **classical and quantum are not "different theories" but the same theory at different values of a deformation parameter.**

An honest line. Deformation quantization is a **precise statement about the algebra of observables**; by itself it **resolves neither the measurement problem nor the interpretive questions**. That the algebras connect is one thing; that observation is explained is another.

6. Machine (iii): Decoupling — Why Can Physics Be Modular at All?

So far the question has been how the modules connect. But **there is a deeper question:**

**Why need one not know quantum gravity
in order to compute a falling apple?**

Established Fact 6.1 (The renormalization group and the decoupling theorem: Wilson; Appelquist–Carazzone 1975)

In field theory, **short-distance (high-energy) degrees of freedom are automatically cut off from long-distance (low-energy) physics**. The effects of heavy fields are suppressed at low energy and absorbed into a redefinition of the couplings of the effective theory (the decoupling theorem).

This is the reason for modularity itself. If every scale bore on every other, **nothing whatever could be computed until the ultimate theory was known**. Because decoupling holds, an effective theory closed at each scale can be written, and physics becomes possible.

Observation 6.2 (Modularity is not a bug but a condition for physics to exist)

That physics "looks divided into modules" is neither a flaw in nature nor a limit of human understanding. It is the manifestation of **a structural fact: the flow of the renormalization group separates the scales.**

This series already owns the machinery: **Paper 110** (Ricci flow = renormalization group flow), **Papers 77 and 78** (coarse-graining). **Inside the flow treated in 110 lay the answer to "why are there modules?"**

And an important note on distinct roots: decoupling (iii) is **not the same machine** as contraction (i) or deformation (ii). The first two are about **the algebra of symmetries**; the third is about **dynamics and scale**. **The questions differ:** (i) and (ii) ask how the modules connect; (iii) asks why there are modules at all. **The answers look as though they mesh because the questions complement one another, not because the machinery is the same.**

7. The Brake: The Beautiful Temptation of "Stability" (The Spine of This Paper)

Setting the three machines side by side, **a viewpoint arises:**

$c, \hbar, G, \Lambda$ are not "constants" but deformation parameters.
Newtonian mechanics sits at the singular point $1/c^2 = 0, \hbar = 0$.

The rule seemed to change abruptly **because one was standing on a singular point**. This reading is correct and illuminating. And from here **one further step** has been proposed.

Established Fact 7.1 (The stability argument: presented as a research programme)

Deformation theory of Lie algebras has a notion of **stability (rigidity)**: an algebra that remains isomorphic under small deformation. Both the Galilei and the Poincaré algebras are **unstable**; the de Sitter algebra is **stable**. Erecting from this the principle that **"the fundamental theories of physics ought to be written in stable algebras"**, one obtains the requirement that **$c, \hbar$ and Λ do not vanish** — an argument that has been proposed (Flato 1982; Faddeev; Vilela Mendes 1994).

This is beautiful. It attempts a structural answer to a question normally unanswerable: why do the constants fail to vanish? **And this is precisely the lip of the cliff.**

Corollary 7.2 (The dividing line is existence versus value — the jig of Paper 83)

What the stability argument states reaches only the non-vanishing of the parameters. It says **nothing** about their values. How large c is, how large $\hbar$ is, how large Λ is — **these are still settled by experiment alone**.

This distinction is a jig this series already owns. Paper 83 (Ignatowski) showed that the group axioms force **the existence of an invariant speed**, and stated explicitly that **its value is settled by experiment**. **The stability argument has the same shape:** existence from structure, value from measurement.

Observation 7.3 (The parting from Eddington: Paper 101 in practice)

Where Eddington slipped was in trying to derive a **value** from pure number ($1/\alpha = 136$, later **137**). Paper 101 decomposed that failure into four modes: **(1) post-hoc adjustment; (2) a fixed target; (3) absence of independent derivation; (4) absence of a falsifiable new prediction**.

Apply these four to the stability argument. **(1) does not apply** (no value is being fitted). **(2) and (3) call for caution:** what is being explained ($c, \hbar, \Lambda \neq 0$) is **an already known, fixed target**, so the argument is for now **retrospective**. **(4) is decisive: as things stand the argument carries no differing prediction** — no testable statement that departs from existing theory.

This paper therefore records it as a **Layer-2 "heuristic principle, a criterion of theory selection"** and **does not promote it to Layer 1** (an established claim about nature). The proper gate for promotion is **a differing prediction**, and that gate has not been passed.

The position of this paper in one line: reading the constants as deformation parameters gives perspective; but it does not say "therefore the constants must be thus." Structure can speak as far as **existence**; **value** is the province of measurement — and keeping that line is the only thing separating this road from numerology.

8. The Map: Bronstein's Cube

Established Fact 8.1 (The $cG\hbar$ cube: Bronstein, 1930s; systematised by Okun)

Taking $1/c$, G and $\hbar$ as three axes, theories arrange themselves at the **eight vertices** of a cube: origin = Newtonian mechanics; the $1/c$ axis = special relativity; the $\hbar$ axis = quantum mechanics; the G axis = Newtonian gravity; two axes = quantum field theory, general relativity, non-relativistic quantum gravity; **all three axes = quantum gravity (vacant)**.

This cube is **a map of what this paper has been doing**. The three axes are **three independent directions of deformation**, and the modules stand at its vertices. And **the empty corner is still exactly one**.

An honest line. The cube is **a mnemonic and a map, not a theory**. That there are eight vertices proves nothing. And **the empty corner (quantum gravity) is not something this paper attempts** — it belongs to the admire-don't-attempt class this series has maintained (Papers 100, 103, 105).

9. Census: Three Distinct Roots Joining the Modules, and One Principle

	What it states	Tools	Status
(i) Contraction	The symmetry group degenerates in a limit (Poincaré → Galilei)	Contraction of Lie groups / algebras	Theorem (İnönü–Wigner 1953)
(ii) Deformation	The algebra is deformed by a parameter (classical → quantum)	Deformation theory, star products	Theorem (BFFLS 1978; Kontsevich)
(iii) Decoupling	The scales are cut off from one another	The renormalization group	Theorem (Appelquist–Carazzone 1975)
Geometric face	Newtonian gravity is geometry too; the metric degenerates	Newton–Cartan / frame theory	Reformulation (changes no prediction)
Stability	Rigid algebras ought to be selected ⇒ the constants do not vanish	Deformation theory run backwards	Heuristic principle. Yields no value; no differing prediction

Observation 9.1 (Why they must not be unified)

(i) and (ii) are statements about **the algebra of symmetries**; (iii) is a statement about **dynamics and scale**. Since **the questions differ, they cannot be called the same machinery**. The geometric face is **a reformulation that changes no prediction**, differing in status from a theorem. Stability is **a principle**, not a theorem. **Bundle the five as "the theory of modules" and these differences of status vanish** (Papers 58, 86, 100).

The author's personal reflection (Layer 3; labelled non-scientific / not a claim about mechanism)

I have long wondered why physics is divided into modules. It looked as if **each module had been assigned a range of responsibility** — and if there were a designer, perhaps that is how they would build it.

What writing this paper taught me is that **the staircase was really a slope**. Between Newton and relativity there is no wall but **a road along which the group smoothly degenerates**. Between classical and quantum there is no wall but **a road along which the algebra is deformed in $\hbar$** . It looked abrupt because **I was standing on a singular point**. I find this **far more beautiful** than separate rules being handed out.

And what moved me most was **the decoupling theorem**. **Precisely because not everything bears on everything, we can compute anything at all**. Without knowing the whole universe, one can still write down a falling apple. Without this **modest severance**, the enterprise of physics itself could not exist.

So I set aside, here, the temptation to call the modules an "allotment." **The stability argument is beautiful, and I am strongly drawn to it**. But the line this paper kept — **structure may speak as far as existence; value is the province of measurement** — is exactly what my own series learned from Eddington (Paper 101). Being drawn to something is fuel, not evidence. **I record the joy of having found a slope. But I do not claim that the gradient of the slope can be got out of the equations.**

10. Scope / Conclusion

What is shown (descriptive; a distinct-roots census): that the boundaries of the modules lie **where a dimensionless number crosses one** (§2); that contraction degenerates the Poincaré group into the Galilei group, so that **a parent–child relation enters the two branches of Paper 83** (§3); that Newtonian gravity is geometry too, the boundary lying in **degeneracy of the metric** — the confluence of Papers 92 and 111 (§4); that quantum mechanics is a **deformation in $\hbar$** of classical mechanics, and that contraction and deformation run in **opposite directions** (§5); that the decoupling theorem answers **"why can physics be modular at all?"**, a different question from (i) and (ii) (§6); **the status of the stability argument** — a heuristic principle that speaks as far as **existence** and not **value** (§7); the **$cG\hbar$ cube** as a map, with **its one**

empty corner (§8); and a census of five statuses (§9).

What is not shown (restraint): the stability argument is not presented as a derivation of the values of constants (it speaks only as far as existence — the jig of Paper 83; Eddington's cliff — Paper 101); **it is not promoted to Layer 1** (it carries no differing prediction as yet); **the three machines are not unified** (they answer different questions); **Newton–Cartan theory is not presented as new physics** (a reformulation; it changes no prediction); **the empty corner of the cube — quantum gravity — is not attempted** (admire); **nothing is inferred from the cube's having eight vertices** (it is a map, not a theory); no post-hoc numerical adjustment (101); no new mathematics or prediction (Layer 2); Layer 3 quarantined with a non-scientific label.

"One can go so far, and then the rule suddenly changes" — starting from that appearance, this paper visited **three machines and one temptation**. What emerged is that **what looked like a wall was a slope**. Groups contract, algebras deform, and scales decouple. Newton's world is **the world in which the interval can no longer be bound into one**; the classical world is **the world with $\hbar$ set to zero**. Neither is a different rule; both stand at singular points of the same terrain. And because **the decoupling theorem** carves that terrain into pieces closed at each scale, we can compute parts without knowing the whole. **Modularity turned out to be the reason physics is possible**.

Finally, the thing this paper handled with most care. **Reading the constants as deformation parameters does give perspective**. But the road from there to "**and therefore the constants must be thus**" has **a cliff on it**. Structure may speak as far as **existence; value** is the province of measurement — **the line Paper 83 showed and Paper 101 defended**. What this paper has done is not to make a new claim, but **to redraw the staircase as a slope, and to put a proper handrail at the cliff beyond it**. And it returns address number 113.

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