ValerieX (VXXX)
Volume II — Regime Classification

Constrained, Supported, Unconstrained: How the Same Drive is Realised Differently

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Abstract

Volume II is the regime-classification deep-dive companion to the main ValerieX manuscript. Volume I derives Valerie's Law $a = g\chi$ as the law of *available* motion. Volume II develops the structural distinction Volume I implies but does not elaborate: realised motion is not one kind of thing but a family of outcomes distinguished by whether motion is blocked, held, or free. These outcomes form three operationally distinct regimes — **constrained**, **supported**, **unconstrained** — each defined by a single directly observable pathway condition.

The same χ can express itself as a scale reading, a string tension, or a realised acceleration depending on regime. Valerie's Law sets the available motion; the regime sets the measured expression. This volume names that structure cleanly, applies it across observable systems, develops the regime-discriminator measurements that follow, and records as Appendix A an exploratory regime-classification observation about Cavendish-type torsion-balance configurations. The Cavendish observation is structural only; **no quantitative density-state competing prediction for the precision-G programme is asserted**, and the cross-method consistency of measured G (Gillies 1997, and subsequent precision-G literature) is acknowledged as genuine empirical confirmation of the conventional interpretation.

Keywords: ValerieX, regime classification, pathway availability, constrained motion, supported motion, unconstrained motion, realised weight, transmitted force of density, Atwood number, participating medium load, Cavendish torsion balance, experimental discrimination.

1 Why Regime Classification is Required

Valerie's Law gives one number — available acceleration $a = g\chi$ — for any pair (ρ_o, ρ_m). But the realised behaviour at the same (ρ_o, ρ_m) is not one number. A lead ball at rest on a table, hanging from a wire, and in free fall all share the same χ. They differ in how the available motion is expressed. That difference is not described by χ; it is described by the environment's relationship to the downward pathway.

A regime is determined by pathway availability. Whether downward motion is blocked, held, or free determines how the same density-state drive is expressed. The regime is read directly from the configuration — consistent with the ValerieX commitment that observable conditions precede interpretive machinery.

2 The Three Regimes

2.1 Constrained Motion

The downward pathway is physically blocked by a rigid surface beneath the object. Motion is prevented. Density-state disequilibrium cannot resolve through displacement and is instead expressed as a sustained, measurable contact interaction at the point of support. This is the regime in which **weight is realised**.

A weighing scale is a constrained-regime instrument; its reading is the force-response at the point of support produced by the environment's blocking of the otherwise-available resolution of χ.

Operational signature: a rigid surface is present beneath the object, the object is in contact with it, and the surface prevents further vertical resolution. All surface-supported rest states fall in this regime.

2.2 Supported Motion

The object is held from above by a string, wire, cable, fibre, or other tension element, while the downward pathway beneath the object remains physically open. No rigid surface blocks descent. Motion is not realised, but the non-realisation is accomplished by tensile support from above, not by obstruction from below.

This regime is structurally distinct from the constrained regime even though both share the observation of zero realised motion. In the constrained regime motion is blocked; in the supported regime motion is held. The measured tension in the supporting element is the **transmitted force of density**: the unresolved drive of non-realised motion, transmitted through the supporting element rather than through a blocking surface.

Operational signature: a tension element bears the object from above, with visible clearance — air, fluid, or vacuum — beneath it. A chandelier on a hook, a plumb bob, a mass on a spring scale, and a Cavendish-balance test mass all operate in this regime.

2.3 Unconstrained Motion

The downward pathway is fully open and no external element holds the object. Density-state disequilibrium resolves through motion itself. Available motion is realised to the extent that the medium permits; in vacuum, available and realised motion coincide and the object accelerates at the environmental ceiling g.

This is the regime in which Valerie's Law operates in its most directly expressive form. No interpretive layer sits between the density-state drive and the observed motion. The Apollo 15 hammer-and-feather demonstration (Scott 1971) is the canonical visual anchor: $\rho_{\mathrm{m}} \to 0$ collapses every positive-density object onto the same $\chi \to +1$, and the resulting realised acceleration is g for all.

The unconstrained regime also covers everyday cases in air where drag partially constrains the pathway. Valerie's Law still supplies the available drive; the realised motion is its expression under the available pathway conditions. Terminal velocity is the realised steady-state outcome of progressive pathway constraint; the regime remains unconstrained in the structural sense that no blocking surface or tensile support is present.

3 The Operational Criterion

The classification of any system is determined by a single observable condition:

> *Is the downward pathway physically blocked by a rigid surface beneath the object, held by a tensile element from above, or fully open?*

An observer needs to check three things: whether there is a rigid blocking surface in contact with the underside, whether there is a tensile element bearing it from above, and whether the surrounding medium constitutes a free pathway. The combination uniquely identifies the regime.

3.1 Regime Summary

Regime	Pathway condition	Realised outcome	ValerieX reading
Constrained	Blocked by rigid surface	Motion prevented; force at contact	Weight realised
Supported	Held from above; clear beneath	Motion not realised; tension in support	Force of density transmitted; weight not realised
Unconstrained	Fully open beneath	Motion realised; $a \to g\chi$, bounded by medium	Valerie's Law expressed directly

4 Same χ, Different Regimes

The table below shows the same χ across regimes. The point is direct: the regime — not χ alone — determines the measurable signature.

Scenario	ρ_o	ρ_m	χ	a $(\mathrm{m\,s^{-2}})$	Regime
Brick on table, air	∼1800	1.225	$+0.9986$	$+9.79$	Constrained
Brick hung from string, air	∼1800	1.225	$+0.9986$	$+9.79$	Supported
Brick dropped in air	∼1800	1.225	$+0.9986$	$+9.79$	Unconstrained
Iron anvil in mercury	7870	13534	-0.2647	-2.60	Unconstrained (buoyant)
Volleyball under water	80	1000	-0.8519	-8.35	Unconstrained (buoyant)
Air bubble in water	1.225	1000	-0.9976	-9.78	Unconstrained (buoyant)
Cavendish test mass, air	∼11340	1.225	$+0.99978$	$+9.81$	Supported
Apollo 15 hammer, lunar vacuum	∼2700	$\to 0$	$\to +1$	$\to g$	Unconstrained (vacuum)
Helium balloon, air	0.179	1.225	-0.7451	-7.31	Unconstrained (rising)

Scenario	ρ_o	ρ_m	χ	$a\ (\mathrm{m\,s^{-2}})$	Regime
Swimmer, fresh water	~985	1000	-0.0076	-0.075	Unconstrained (near-eq.)

The first three rows make the point vividly. The same brick has the same χ in all three regimes. The signature it leaves in the world — scale reading, string tension, or realised fall — is completely different. The regime is where the difference lives; χ is where the drive lives.

5 Unified Interpretation

Every observable vertical-motion configuration in terrestrial experience is covered by the combination of one governing relation — Valerie's Law, $a = g\chi$ — and one regime condition.

System	Regime	Observed behaviour
Object on rigid surface	Constrained	Realised weight at surface contact
Object on string/wire	Supported	Tension in support; no realised weight at a blocking surface
Object in free fall	Unconstrained	$a \to g\chi$; co-falling scale reads zero
Object in fluid at rest	Unconstrained (buoyant)	Settles at equilibrium layer
Rising bubble in water	Unconstrained (buoyant)	Near-saturation negative χ; drag-limited rise
Helium / hot-air balloon	Unconstrained (rising)	Temperature- or composition-driven negative χ
Density column	Unconstrained (stratifying)	Each object rests at layer where $\chi = 0$
Cartesian diver	Unconstrained (pressure-switched)	Pressure flips sign of χ

A single underlying mechanism — density-state disequilibrium — produces all observed vertical-motion behaviours. What varies is not the mechanism but the regime in which that mechanism expresses itself. When the regime is recorded alongside χ, the complete realised outcome is determined.

This resolves the problem in force-first vocabulary where the same object is said to experience different forces in different contexts (gravity and buoyancy, gravity and drag, gravity and normal force, gravity and tension). Under ValerieX, the object experiences one density-state drive, and the environment expresses it in one of three regimes. There is no need to multiply forces to match the observations.

6 Experimental Discriminators

Two configurations sharing the same χ but differing in regime will produce measurably different results and should be analysed as separate tests. Three discriminators follow directly from the regime definitions.

6.1 Co-Free-Fall: The Zero-Reading Discriminator

An object resting on a spring scale, with the whole system placed inside a chamber that is then dropped, exhibits a scale reading that goes to zero during the fall. The object and scale are now in the unconstrained regime: the downward pathway is open for both, and no relative constraint between them exists.

ValerieX expects exactly this. In the constrained regime the scale reading is the environmental expression of the χ-drive blocked by the scale surface. In the unconstrained regime there is no blocking and no such expression. The χ-drive itself remains — both scale and object still have the same density contrast with surrounding air — but the regime has changed and the realised outcome is motion rather than constrained force. The scale reads zero not because the object has lost its weight but because weight, as ValerieX defines it, is a constrained-regime quantity that cannot be realised in an unconstrained regime.

6.2 Surface vs Suspension: The Structural-Distinction Discriminator

Two identical objects of identical $(\rho_\mathrm{o}, \rho_\mathrm{m}, V)$ are placed in the same room. One sits on a table; the other is hung from a spring scale attached to the ceiling. The tabletop object is in the constrained regime; the hanging object is in the supported regime. Both produce measurable readings, but the readings are structurally different quantities.

In the constrained regime the reading is the realised weight — the compressive expression of the blocked χ-drive. In the supported regime the reading is the transmitted force of density — the tensile expression of the held χ-drive. Numerically, in ordinary terrestrial conditions with minimal medium participation, the two readings can be close. Physically under ValerieX they are not interchangeable, because the pathway condition differs.

6.3 Accelerating Frames: The Regime-Transition Discriminator

As a system transitions from rest (constrained) toward free fall (unconstrained), the scale reading decreases continuously. The reading measures the constrained-regime response. As the environment progressively removes the constraint, a smaller fraction of the χ-drive is expressed as constrained force and a larger fraction is expressed as realised motion. In the limit of complete release, the reading reaches zero.

This continuous-transition discriminator can be realised in ordinary laboratory equipment with a decoupling platform, a descending elevator, or a parabolic-flight segment. Because the χ-drive is invariant under the transition, any reading change is attributable to the regime change rather than to any change in the underlying density-state relation.

6.4 Intermediate-Density Discriminator (Unconstrained Regime)

The unconstrained-regime measurement at $\rho_\mathrm{o} = 2\rho_\mathrm{m}$ is the sharpest discrimination region between members of the C-family. Volume III tabulates the predictions; Volume IV gives the protocol. The regime classification adds a precondition: the measurement must be taken in the unconstrained regime so that available motion is directly expressed as realised motion without constrained-regime distortion.

McKee & Czarnecki (2019) provide a positive published anchor for the $C = 0.5$ sphere branch in buoyant-rise initial acceleration; their measurements already require the added-mass renormalisation $(\rho_\mathrm{o} + 0.5\rho_\mathrm{m})V$ to reproduce the observed initial accelerations. The experimental gap that Volume IV is designed to fill is the equivalent published anchor for the cylinder $\perp$-axis ($C = 1$) branch and the continuous-parameter capsule discriminator.

7 Cavendish-Type Configurations: Regime-Classification Observation

This subsection records a regime-classification observation about Cavendish-type torsion-balance configurations. **It is not a falsifiable competing prediction.**

Under the regime classification developed above, suspended torsion-balance configurations occupy the supported regime — a structural classification that follows directly from the operational criterion. The test bodies are held by the suspension fibre and the downward pathway beneath them remains open. Realised weight in the constrained-regime sense is therefore not isolated by the configuration; the test bodies' density-state drive is held through the suspension fibre and is not expressed as surface contact.

Whether this classification can be developed into a quantitative density-state reading of the observed Cavendish torque is treated as an open question in Appendix A; **no such quantitative alternative to the conventional precision-G interpretation is asserted**. The cross-method consistency of measured G across torsion-balance, free-fall, atom-interferometry, satellite-orbit, lunar laser ranging, and Earth-tide determinations (Gillies 1997, and subsequent precision-G literature) is acknowledged as genuine empirical confirmation of the conventional interpretation, and is not contested.

The structural contributions of this volume — the regime classification of §§2–5 and the regime-discriminator measurements of §7 — do not depend on Appendix A.

8 Discussion

8.1 Classification-First Method

The regime classification is a methodological commitment. The question ValerieX asks of any vertical-motion configuration is not first "what force is acting?" but first "what regime is the system operating in?" That order of questions follows from the available-vs-realised distinction. If the two can differ, then no force-level analysis can proceed cleanly until the regime is specified, because the realised expression of the available χ-drive depends on the regime.

This inverts a habit embedded in the standard vocabulary of vertical-motion explanation. The standard habit is to identify the forces first — gravity, buoyancy, drag, normal force, tension — and then combine them to recover the observed behaviour. The ValerieX habit is to identify the regime first, then read Valerie's Law in that regime, then recover the realised outcome without multiplying force primitives.

8.2 What the Classification Is, and What It Is Not

The regime classification is not a new physical mechanism. It does not introduce any entity not already present in the underlying framework. It does not alter Valerie's Law, the uniqueness result for χ, the participating-medium-load derivation, or the ontological commitments. It is an interpretive structure built on top of the framework that organises how it is applied to observed and designed systems.

What it *is*, is a discipline. It disciplines the application of ValerieX by requiring that the regime be identified before any interpretation is offered. It disciplines the evaluation of experimental configurations by requiring that the regime of the measurement be reconciled with the regime of the observable that the interpretation assumes. And it disciplines the statement of results by clarifying which parts of a measurement are regime-dependent and which are not.

9 Conclusion

The classification admits three regimes, each defined by a directly observable pathway condition: constrained (blocked by rigid surface, weight realised); supported (held by tensile element, transmitted force of density expressed but realised weight not); unconstrained (pathway fully open, Valerie's Law expressed directly).

Every principal observable vertical-motion system in ordinary experience is uniquely classified by χ together with regime. The same χ can appear in all three regimes, and the regime determines the measurable signature. Weight, in this reading, is a regime-dependent expression of a regime-independent drive.

The regime-discriminator measurements of §7 are reorganisations of well-known tests under the regime-first reading. The intermediate-density and shape-controlled measurements (Volumes III–IV) probe the C-family within the unconstrained regime. Appendix A applies the classification to Cavendish-type configurations as an exploratory open question only; the conventional precision-G interpretation is not contested.

A Exploratory Note on Cavendish-Type Configurations

This appendix is exploratory and outlines a possible future extension of the framework. **No quantitative alternative prediction is yet derived.** The structural contributions of this volume do not depend on the content of this appendix.

A.1 The Cavendish Configuration in Regime Terms

Cavendish's torsion-balance experiment (1798) consists of a horizontal beam suspended by a thin torsion fibre, with two small test masses at its ends. Two larger attracting masses are brought close to the test masses; the beam rotates slightly; the angle of twist is taken as a measurement of the attractive effect.

The test masses are suspended by the torsion fibre from above. An air gap — or a partial vacuum, in modern variants — is maintained beneath them. There is no rigid blocking surface in contact with the underside. Under the operational criterion of §3, this is unambiguously the supported regime.

The observable signature of the experiment — the twist of the fibre — is therefore a supported-regime observable. This does not invalidate the experimental observations. The twist is a real, repeatable, position-dependent deflection. The narrower ValerieX claim is that the measured effect arises in a configuration where motion is held rather than blocked, and must therefore be interpreted within that regime structure before it is used as evidence for any underlying mechanism.

A.2 Modern Precision-G Measurements (Acknowledgment)

Modern precision measurements of the Newtonian gravitational constant G use a range of methods including torsion balance, angular-acceleration feedback, pendulum, atom interferometry, satellite tracking, lunar laser ranging, and Earth-tide analysis. These methods occupy a wide variety of experimental configurations spanning different physical regimes and substantially different environmental conditions.

The consistency of measured G values across this diverse set of methods is properly read as cross-method confirmation of the Newtonian gravitational framework within its validated scope. The methods involve genuinely independent measurement principles operating in different regimes and at different scales, and their convergence on a consistent value provides empirical support for the conventional interpretation that does not depend on any single configuration. This appendix does not contest that confirmation. Whether a quantitative density-state reading could in principle reproduce the measured G across the full set of methods is the open task referred to throughout.

A.3 What This Appendix Does and Does Not Claim

- The torsion-balance experiments produce real, reproducible deflections.
- The canonical classical interpretation of those deflections is coherent and productive within its own framework, and has yielded the best current numerical estimates of G.
- Under ValerieX, those deflections are supported-regime observables, and realised weight as defined by the framework is not expressed in that regime.
- Whether the regime classification can be developed into a quantitative density-state reading of the observed deflections is an open question for future work.
- **No claim is made here that ValerieX has quantitatively reproduced the numerical results of precision-G experiments.** That is future work, and the structural argument does not depend on it.
- The structural claim is that these experiments, in their current form, occupy a single regime and therefore do not distinguish between interpretive frames that disagree only in constrained-regime predictions.

The cross-method consistency of measured G involves genuinely independent measurement principles operating in different physical configurations, and that consistency constitutes empirical confirmation of the Newtonian gravitational framework that does not depend on any single configuration. The appendix records the regime classification of supported-regime configurations as a structural observation, and leaves open the question of whether a quantitative density-state reading can be developed; it does not assert that the conventional interpretation is unsupported.

A.4 Candidate Mechanism Sketch (Exploratory)

A candidate route for future quantitative development may involve local perturbation of the field-conditioned medium and an asymmetric participation-load response around the suspended test bodies. Because the electromagnetic field structures differentiated substance and density-states, a nearby dense source body could plausibly induce a small position-dependent perturbation in the participating medium surrounding a suspended test body. In the supported regime, where the test body is held vertically but is free to respond horizontally, such a perturbation could in principle express itself as a small lateral component of the density-state drive or as an asymmetric participation-load response. If so, that small lateral expression would be realised as torque on the free-to-rotate beam.

Whether such a mechanism could in principle reproduce the observed Cavendish functional form or its numerical scale is an open quantitative question. **No derivation is offered here.** The field-participation integrals, the explicit form of any medium-response function, and the geometric coupling between source and test bodies are all undeveloped at this stage. The sketch is presented strictly as a candidate route for future investigation.

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