SHORING LABS · EXISTENTIAL ASTROPHYSICS

Vectors of the *Void*

Boundary Failure, Spatial Disorientation, and the Disappearing Sky

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SUBJECT Human Spatial Miscalibration

RISK DOMAIN Spatial Cognition / Ontological Stability

Speculative entities invoked 0

Unknown dimensions required 0

Reliance on direct observation 100%

00 DOCUMENT CONTROL

Control & Methodology

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0 · Methodology: Permitted Sources of Dread

This document introduces no speculative entities. It invokes no unknown dimensions, no hidden agencies, no mechanisms outside the established physical literature. The accounting is deliberate and may be audited: speculative entities invoked, zero; unknown dimensions required, zero; reliance on established physical models and direct observation, total.

The constraint is methodological rather than stylistic. The thesis of this series is that the unknown is not the principal hazard to ontological stability. The known is sufficient. Where prior treatments of cosmic scale have relied on the imagined, the unseen, or the unnameable, this paper restricts itself to quantities that are measured, replicated, and uncontested.

Data acquisition follows standard metrological and astrophysical protocols. All distance metrics use comoving coordinates where applicable, accounting for metric expansion; temporal references are anchored to proper or coordinate time as specified; biological thresholds derive from peer-reviewed aerospace medicine standards and terrestrial clinical baselines. The methodology explicitly excludes phenomenological interpretation. Where a phenomenon lacks an actionable human-scale intervention, it is classified as operationally irrelevant at human scale.

No supernatural mechanism is required. Every condition described below is documented in standard references and is, in the technical sense, mundane. The horror — if the term is admitted at all — is not located in the facts. It is located in the gap between the facts and the perceptual model the human organism maintains by default.

> *The object of correction is not the universe. The universe is not in error. The object of correction is the observer.*

The observer's error is not perceptual failure, but extrapolation. The senses report accurately within their operating range. The fault enters when the local report is treated as a global description. The analysis proceeds by isolating seven discrete boundary misclassifications, measuring their deviation from physical reality, and documenting the structural implications of those deviations. The findings are presented without editorial modification.

I ABSTRACT

The Fragility of the Local Environment

Human spatial confidence is an artifact of scale and perceptual misclassification. The organism evolved within a thin, pressurized, gravitationally oriented layer of a single planetary body and developed heuristics calibrated to that layer. Those heuristics are reliable. They are also local, and they are routinely mistaken for descriptions of the universe at large.

This paper identifies seven distinct perceptual misclassifications by which the human observer converts local survivability conditions into assumed universal conditions. In sequence: the mistaking of obstruction for **enclosure**; of a pressure gradient for a **boundary**; of local acceleration for universal **orientation**; of a narrow habitable exception for **normality**; of delayed signal receipt for **simultaneity**; of a horizon-limited access regime for a stable **inventory**; and finally, of the body itself for an independent **container**.

Each misclassification is individually harmless and operationally useful. Collectively they constitute the scaffolding of ordinary spatial experience. Boundary misclassification underwrites psychological stability. Each functions adequately within the local survivability envelope but fails catastrophically upon extrapolation. The failure is not in the environment; it is in the mapping protocol. The corrections that follow are not novel. They are assembled here in a single document for the first time, in sequence, with their numerical consequences stated plainly.

> *The human organism occupies a local survivability envelope and mistakes its constraints for universal conditions.*

The envelope is real, narrow, and contingent. The conditions outside it are not exceptional — they are the baseline. The remainder of this paper documents the baseline. The observer is not enclosed by the sky. The observer is suspended beneath an optical effect.

II PRELIMINARY NOTE

Local Fictions

Ordinary perception relies on a suite of heuristics that are functional but physically false. This is not a defect. A heuristic that is locally reliable and globally wrong is precisely what natural selection produces, because selection optimizes for the local and is indifferent to the global. The organism that correctly perceived its own contingency at all scales would gain no survival advantage and would incur substantial cognitive cost.

The heuristics in question are listed in Exhibit A. They are termed *fictions* not because they fail in practice but because they describe conditions that do not obtain. The sky is treated as a ceiling. The atmosphere is treated as an edge. “Down” is treated as a property of the universe rather than of the local field. Earth is treated as

ordinary. Sight is treated as contemporaneous. The catalog of visible objects is treated as fixed. The body is treated as sealed.

Functionality should not be confused with accuracy. A model may produce correct predictions across the entire range of inputs the organism will ever encounter and still misdescribe the system entirely. The perceptual apparatus is not malfunctioning. It is reporting the local condition with high fidelity and offering no flag to indicate that the local condition is unrepresentative. The system is functioning as designed. The design is local.

The Infinite Vector

FINDING

Humans mistake atmospheric obstruction for structural enclosure.

The daytime sky presents as a luminous surface overhead. Perceptually it reads as a dome, a ceiling, a covering — something that occupies the upper limit of the visible field and terminates it. This reading is the product of a single optical process. Sunlight entering the atmosphere is scattered by gas molecules, and the efficiency of that scattering is governed by Rayleigh's relation: scattering intensity is inversely proportional to the fourth power of the wavelength, approximately $1/\lambda^4$.

The consequence is wavelength-selective. Shorter visible wavelengths — blue light near 450 nm — scatter several times more efficiently than the longer red wavelengths near 700 nm; the fourth-power dependence yields a factor of roughly 5.5 between the two. Across the full sky, this redirected short-wavelength light reaches the retina from every angular direction, producing a continuous, bright, opaque optical field during daylight hours. The field has no surface. It has no upper boundary. It is the integrated glow of countless scattering events distributed through a transparent medium. The field is optically dense. It is not structurally dense.

The atmosphere near the surface contains approximately 2.5×10^{19} molecules per cubic centimeter — negligible compared to solid matter, but sufficient, integrated along a vertical column, to redirect a substantial fraction of incoming short-wavelength photons into a hemispherical distribution the visual system registers as a continuous surface. The scattering contribution diminishes with the same exponential falloff as the air itself; by the exosphere, where number density drops below roughly 10^7 particles per cubic centimeter, Rayleigh scattering is negligible. The measurement that dissolves the ceiling is trivial: the same atmosphere, observed at night when the scattering source is removed, becomes transparent, and the line of sight extends without obstruction across billions of light-years. Nothing about the atmosphere has changed between day and night. Only the illumination has changed. The "ceiling" was never a structure. It was a lighting condition.

> *The observer is not enclosed by the sky. The observer is suspended beneath an optical effect.*

The object perceived as a roof has none of the properties of a roof: it cannot bear load, resist penetration, or demarcate safety. The line of sight that appears to terminate at the dome in fact passes through the scattering regime and continues into unobstructed vacuum without limit. The transparency is not an anomaly; it is the baseline state. There is no enclosure. There is an open vector, and a transient glow that conceals it for the duration of the day.

EXHIBIT B — LINE-OF-SIGHT VECTOR

A single unbroken vector extends from the observer's retina, through the scattering regime, and continues into unobstructed vacuum. No upper boundary is drawn, because none exists.

SECTION 02 THE ATMOSPHERIC VEIL

The Atmospheric Veil

FINDING

Humans mistake a continuous pressure gradient for a physical boundary.

If the sky is not a ceiling, the next candidate for an enclosing structure is the atmosphere itself — conceived as a shell with an outer edge, a place where air stops and space begins. No such edge exists. The atmosphere is a continuous pressure gradient governed by hydrostatic equilibrium and gravitational compression: dense at the surface and thinning monotonically with altitude until it becomes indistinguishable from the surrounding medium. There is no phase change, no structural discontinuity, and no hard edge.

The distribution is steeply weighted toward the bottom. Standard sea-level pressure is 101,325 Pa, defined as one standard atmosphere. Roughly 75% of all atmospheric mass lies below 11 km — a layer thinner, relative to the planet, than the skin of an apple. Pressure decreases quasi-exponentially with altitude. By 100 km — the Kármán line — approximately 99.99997% of atmospheric mass lies below the observer, and ambient pressure has fallen to roughly 3.2×10^{-5} Pa. The remaining fraction thins through the exosphere, dissipating asymptotically across thousands of kilometers with no discrete termination.

It is worth holding these figures against the planetary scale. Earth's equatorial radius is 6,378 km. The breathable layer is a few kilometers thick. The Kármán line sits at 100 km — roughly 1.6% of the planetary radius. The boundary that human cognition treats as the wall of the world is, dimensionally, a film. The line itself reveals the nature of the problem: it is set at 100 km not because anything physical occurs there but because it is a convenient round figure near the altitude at which aerodynamic lift becomes impractical and orbital mechanics dominates. It is an administrative convention.

> *The atmosphere is not a barrier. It is a survivability gradient. The transition to space is not a door but a thinning.*

There is no surface to cross, no membrane to breach. Biological systems do not fail because they cross a line. They fail because the partial pressure of oxygen drops below the metabolic threshold and the ambient pressure drops below the vapor pressure of water at body temperature. The gradient does not announce its failure. It simply continues to decrease. The atmosphere does not protect. It delays. The delay is finite.

EXHIBIT C — ATMOSPHERIC SCALE

METRIC	VALUE	CLASSIFICATION
Earth equatorial radius	6,378 km	Solid substrate
75% of atmospheric mass	0 – 11 km	Primary survivability envelope

METRIC	VALUE	CLASSIFICATION
Armstrong limit	~19 km	Pressure failure (ebullism onset)
Kármán line	100 km	Administrative boundary
Exosphere dissipation	~10,000 km	Asymptotic vacuum transition

The Myth of Orientation

FINDING

Humans mistake local gravitational acceleration for a universal coordinate system.

"Up" and "down" present to the human observer as fundamental axes of reality, as fixed and obvious as the existence of space itself. They are neither fundamental nor universal. They are the perceived direction of a single local quantity: the gravitational acceleration at Earth's surface, standardized at $9.80665\ m/s^2$.

The organism does not detect "down" as a direction in space. It computes a vertical from inertial cues. The vestibular otolith organs — the utricle and the saccule, in the inner ear — contain dense crystalline masses (otoconia) suspended in gel over hair cells. Under the 1G field, these masses are displaced in a consistent direction, and the nervous system interprets that displacement as the location of "down." The system requires a sustained acceleration field to resolve a vertical. It does not measure a cosmic direction. It measures the local acceleration vector and reports it as if it were one.

The fragility of this computation is documented directly in microgravity. When the gravitational cue is removed and the visual field is ambiguous, the brain reassigns "down" arbitrarily and rapidly. Astronauts report visual reorientation illusions — abrupt, involuntary reassignments of which surface is the floor — and inversion illusions in which the body is perceived as upside down with no stable resolution. The illusions are not pathological. They are the system operating without a reference signal. The vertical is not retrieved from a stored cosmic reference; it is recomputed from whatever cues are available, and when the cues vanish, it ceases to resolve.

> *"Down" is not a direction. It is a local acceleration vector. Verticality is not discovered. It is computed.*

It points toward the center of mass of the dominant gravitational body. It exists only where mass is present in sufficient concentration to produce a perceptible field. Across the overwhelming majority of the universe — the interstellar and intergalactic medium — there is no dominant local field of perceptible magnitude and therefore no down, no up, no floor, no ceiling, and no orientation of any kind. The nervous system attempts to impose a vertical on a frame that offers no axis, and the attempt fails to converge. The failure is not a malfunction; it is the correct response to an unbounded reference frame. The sense of being correctly oriented in the world is the output of a device that requires a planet to run.

EXHIBIT D — NESTED REFERENCE FRAMES

Three isolated frames. Under 1G the vertical resolves toward the floor; in orbital freefall it resolves only as a notional vector toward Earth; in deep space no reference signal is present. The absence of an arrow in the third frame is the data point.

The Habitability Exception

FINDING

Humans mistake their narrow local survivability envelope for the baseline condition of the universe.

The conditions under which a human being can remain conscious and intact are narrow, and they coincide with conditions found, so far as direct observation confirms, in a thin shell on the surface of one planet. The organism treats these conditions as ordinary because they are the only conditions it has ever occupied. They are not ordinary. They are an exception with respect to the measured baseline of the universe. The human body is a pressure-dependent process, not an autonomous system; it requires continuous external maintenance to sustain metabolic function.

Consider the pressure requirement. Human cognition requires an oxygen partial pressure of roughly 16 kPa. Above the Armstrong limit — approximately 19 km altitude, where ambient pressure falls to about 6.3 kPa — the boiling point of water drops to 37 °C, body temperature. At and above this altitude, exposed bodily fluids, including the moisture on the eyes, in the mouth, and within the lungs, begin to vaporize. In a near-vacuum, hypoxic unconsciousness occurs within roughly 10 to 15 seconds as deoxygenated blood reaches the brain. The margin between survivable and lethal, in altitude, is approximately 19 km — a distance a person could walk in an afternoon were it laid out horizontally.

The full envelope is summarized in Exhibit E. In every parameter, the human requirement is a narrow band and the cosmic baseline lies far outside it. There is no adaptation, no gradual acclimatization, and no secondary mechanism; the body requires the differential to maintain structural integrity, and the failure upon its removal is immediate and total.

> *Earth is a non-representative habitat. The baseline condition is incompatibility.*

The pressurized, oxygenated, thermally regulated, radiation-shielded layer in which the organism lives is not a sample of universal conditions. It is a statistical anomaly of vanishing measure. The universe is not hostile in any intentional sense — hostility implies regard. It is thermodynamically indifferent, and the conditions it maintains by default are simply those under which a human being cannot persist for more than seconds. The universe does not accommodate. It excludes.

EXHIBIT E — LOCAL SURVIVABILITY ENVELOPE

PARAMETER	HUMAN REQUIREMENT	COSMIC BASELINE
Ambient pressure	> 6.3 kPa	$< 10^{-12}$ kPa
Oxygen partial pressure	16 – 160 kPa	≈ 0 kPa

PARAMETER	HUMAN REQUIREMENT	COSMIC BASELINE
Survivable thermal band	~310 K (narrow)	2.7 K (CMB)
Ionizing radiation	~several hundred mSv	Unshielded GCR / solar particle events

SECTION 05 TEMPORAL PARALLAX

Temporal Parallax

FINDING

Humans mistake the receipt of delayed photons for contemporaneous observation.

Sight is treated as immediate — as access to the present state of whatever is seen. This is accurate at conversational distances and false at all others. Vision is the reception of photons, and photons travel at a finite speed: exactly `299,792,458 m/s`, a defined constant. Every act of seeing is the receipt of a signal that left its source in the past. The interval is termed lookback time, and it scales with distance.

At human scale the delay is negligible and the heuristic holds. Across larger distances it does not. The Moon is seen as it was approximately 1.3 seconds ago. The Sun is seen as it was approximately 8.3 minutes ago; were it to cease, the observer would have no means of knowing for that interval. Alpha Centauri is seen as it was about 4.3 years ago. The galactic center is seen across roughly 26,000 years of delay. Andromeda is observed as it was approximately 2.5 million years ago — light that departed before the genus *Homo* had assumed its modern form. The cosmic microwave background, the oldest observable signal, encodes the state of the universe as it was approximately 13.8 billion years in the past.

The consequence is not merely that distant things are seen late. It is that the "present state" of a sufficiently distant object is not an observable quantity at all. There is no instrument, and no possible instrument, that can report the current condition of Andromeda. The information has not arrived and will not arrive for millions of years. To ask what Andromeda "is doing now" is to ask a question with no accessible answer — not because the answer is hidden, but because the geometry of spacetime forbids its delivery. Some fraction of the points of light catalogued in the night sky may, in their own proper present, no longer exist in the form recorded. The light received is a fossil.

> *The night sky is not a scene. It is an archive. The present is causally inaccessible beyond local scales.*

It is a composite image assembled from signals of radically different ages, arriving simultaneously at the retina but originating across millions and billions of years. No two distant points in it share a moment. What is called "the universe as it is" is a category error. There is only the universe as its signals arrive — a layered record of states that have already passed. The observer is reading a ledger that is still being written and whose latest entries cannot be read.

EXHIBIT F — LOOKBACK-TIME REGISTER

OBJECT	DISTANCE	SIGNAL DELAY
Moon	`384,400 km`	`1.3 seconds`

OBJECT	DISTANCE	SIGNAL DELAY
Sun	149.6 million km	8.3 minutes
Alpha Centauri	4.37 ly	4.3 years
Galactic Center	26,000 ly	26,000 years
Andromeda Galaxy	2.5 million ly	2.5 million years
Cosmic Microwave Background	46.5 billion ly	13.8 billion years

Accelerated Isolation

FINDING

Humans mistake a transient, horizon-limited access regime for a stable cosmic inventory.

The catalog of observable objects is treated as fixed — an inventory that may grow as instruments improve but does not, in itself, shrink. The opposite is true. For far-future observers, the observable universe is a contracting access regime, and the contraction is a consequence of the expansion of space itself.

The radius of the observable universe is approximately 46.5 billion light-years in comoving distance. This figure exceeds 13.8 billion light-years — the naive product of light speed and the age of the universe — because the space through which ancient light travelled has itself expanded during transit. That expansion is described by the Hubble constant, approximately `70 km/s` per megaparsec: every megaparsec of proper distance corresponds, at the present epoch, to an additional 70 km/s of recession. Beyond a sufficient distance, the recession velocity implied by metric expansion exceeds the speed of light.

This requires precise statement. The galaxies in question are not moving through space faster than light; no local velocity exceeds *c*. The space between the observer and those galaxies is expanding, and at sufficient separation the integrated expansion implies a recession velocity exceeding *c*. This threshold, the Hubble sphere, lies at approximately 14.4 billion light-years. Beyond it, recession is superluminal, yet light emitted in the past may still arrive, because the intervening geometry evolves and the Hubble sphere is itself receding. The cosmological event horizon, at approximately 16 billion light-years, marks the harder limit: light emitted *today* by an object beyond it will never reach the observer, regardless of how long one waits.

The trajectory of the system is established. As expansion accelerates under the observed dark-energy term, objects not gravitationally bound to the observer cross outward through these horizons and their signals redshift toward undetectability. The estimate in the literature is severe: in approximately 150 billion years, all galaxies outside the gravitationally bound, by-then-merged Local Group will have receded beyond the cosmological event horizon, their light stretched past any possibility of detection. For observers in that era, the extragalactic universe will not be faint. It will be absent. A civilization arising then, reasoning correctly from all available evidence, would conclude that the Local Group is the totality of the universe, and the conclusion would be unfalsifiable from within their light cone.

> *The observable universe is a transient data regime, not a stable inventory — a window that is closing, and whose closure is already underway.*

What can be known is not fixed. It is being subtracted, continuously, by the geometry of the universe itself. The universe does not hide its contents. It removes them from the light cone, and the subtraction does not return what it takes.

EXHIBIT G — RECESSION & HORIZON THRESHOLDS

BOUNDARY	DISTANCE / TIMELINE	CONDITION
Hubble Sphere	~14.4 billion ly	Recession velocity equals *c*
Superluminal Threshold	> 14.4 billion ly	Expansion implies recession > *c*; past light may still arrive
Cosmological Event Horizon	~16 billion ly	Light emitted today never arrives
Future Visibility Limit	~150 billion yr	Extragalactic evidence redshifts beyond detection

The Inward Vector

The preceding six sections describe the void as external: beyond the optical glow, beyond the pressure gradient, beyond the local field, beyond the survivability envelope, beyond the reach of present-tense observation, and beyond the closing horizon. Each correction relocates a boundary the observer believed to be solid and finds it to be local, contingent, or absent. The final correction relocates the boundary inward.

The human body is treated as a sealed self — a discrete container with an inside and an outside, a thing that persists by its own integrity. It is not a container. It is a pressure-dependent process, maintained against the surrounding medium by a differential. At the surface of the Earth, the internal state of the organism is held against the external environment by a difference of approximately one atmosphere: about 101 kPa. The fluids remain liquid, the dissolved gases remain in solution, the tissues remain intact, because that differential is maintained. Remove it — reduce the external pressure below the Armstrong limit — and the boundary fails from within. The water in the tissues vaporizes at body temperature. The separation between the organism and the vacuum was never a wall. It was a pressure, and pressure is a condition, not a structure.

> *The void is not only outside the habitat; it governs the substrate.*

This is the seventh and final misclassification in Exhibit A, and it closes the sequence. The same gradient that thins into vacuum above the observer is the gradient that holds the observer together. The body does not exclude the void. The body is a local region in which the void's conditions are temporarily and precariously suspended, by a differential narrow enough to state in a single number.

The seven misclassifications documented here are not anomalies. They are systematic. They arise from the extrapolation of local heuristics into non-representative regimes, and the extrapolation fails because the regimes do not share the same parameters. The observer is not enclosed. The observer is not oriented. The observer is not contemporaneous. The observer is not cataloged. The observer is suspended in a gradient, reading delayed signals, in a universe that is actively removing its contents from the observable frame.

No supernatural mechanism has been invoked. No unknown has been required. Every figure in this document is measured, published, and uncontested. The corrections are available in any standard reference and provoke no alarm when encountered in isolation. They have been assembled here in sequence, and the sequence is the only contribution this paper makes.

> *The most frightening thing is not the unknown. It is the known, stated clearly. The universe does not need to hide anything from us. The disclosed facts are sufficient.*

No mitigation is proposed. The condition is not actionable at human scale.

EXHIBIT A LOCAL FICTIONS REGISTER

Local Fictions Register

The seven misclassifications, in the order documented above, with their corrected conditions and structural consequences.

#	PERCEIVED CONDITION	CORRECTED CONDITION	CONSEQUENCE
1	Sky as roof	Optical scattering regime	No enclosure
2	Atmosphere as boundary	Graded pressure layer	No hard edge
3	Down as universal	Local acceleration vector	No absolute orientation
4	Earth as normal	Non-representative habitat	Narrow survivability envelope
5	Sight as present	Delayed signal receipt	No distant present
6	Observable universe as inventory	Horizon-limited access regime	No stable catalog
7	Body as sealed self	Pressure-dependent process	No independent containment

APPENDIX A FACTUAL ANCHORS

Measured, published, and uncontested.

PHYSICS / OPTICS

- $c = 299{,}792{,}458$ m/s (defined)
- Rayleigh intensity $\propto 1/\lambda^4$
- blue ≈ 450 nm; red ≈ 700 nm; ratio ≈ 5.5
- surface n ≈ 2.5×10^{19} /cm³
- exospheric dropoff < 10^{7} /cm³

EARTH / ATMOSPHERE

- equatorial radius = 6,378 km
- Kármán line = 100 km (≈ 3.2×10^{-5} Pa)
- ~75% mass below 11 km
- ~99.99997% below Kármán line
- sea-level pressure = 101,325 Pa

GRAVITY / PHYSIOLOGY

- $g = 9.80665$ m/s²
- otolith organs: utricle, saccule
- sensing masses: otoconia
- Armstrong limit ≈ 19 km / 6.3 kPa
- vacuum unconsciousness ≈ 10–15 s
- min O_2 partial pressure ≈ 16 kPa
- NASA limit: order of hundreds mSv

COSMOLOGY / DISTANCES

- Moon ≈ 1.3 ls; Sun ≈ 8.3 lm
- Alpha Centauri ≈ 4.37 ly
- Galactic Center ≈ 26,000 ly
- Andromeda ≈ 2.5 Mly
- CMB lookback ≈ 13.8 Gyr
- observable radius ≈ 46.5 Gly (comoving)
- H_0 ≈ 70 km/s/Mpc
- Hubble sphere ≈ 14.4 Gly
- event horizon ≈ 16 Gly
- Local Group isolation ≈ 150 Gyr