The Floor of the Askable

Why the Planck scale may be the absolute lower bound of a located observer's horizon of unspecifiability, and how to tell if it is only an engineering limit

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Abstract

The closure framework describes measurement as one repeated move: an open situation (M) settles into a definite "this" through closure (Cl), and every closure leaves a remainder (R). A situated observer meets this remainder as a local horizon of unspecifiability, written m: the scale below which the questions that organize its physics stop returning determinate answers. This paper advances a single, deliberately exposed claim. For any observer built from fields and embedded in this spacetime, the floor of m is the Planck scale, and the remainder there is constitutive rather than incidental: below it the distinctions "smaller", "here versus there", and "before versus after" are not merely hard to measure but cease to be well posed. I connect this to real quantum-gravity results (Planck's natural units, the Bronstein and Mead measurement arguments, the generalized uncertainty principle reviewed by Hossenfelder, and area and volume discreteness in loop quantum gravity) while insisting on what those results do and do not establish: a minimal length is model dependent and contested, not settled. Because this is the framework's least trusted rung, I subject it to the most demanding discriminator I can state, separating an in-principle floor from a merely practical probe limit, and I give an explicit kill condition. If the apparent floor dissolves under better probes, the constitutive reading dies and the Planck bound is just engineering. This is a claim about resolution, not about mind.

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1. The claim, stated so it can lose

Physics has one number that will not go away. Assemble the speed of light c, the reduced Planck constant hbar, and Newton's gravitational constant G, and dimensional analysis returns a length, l_P = sqrt(hbar G / c^3), about 1.6 times 10^-35 meters, a time near 5.4 times 10^-44 seconds, and a mass near 2.2 times 10^-8 kilograms (FACT). Max Planck noticed these combinations in 1899 and remarked, with more confidence than we can now muster, that such units would keep their meaning "for all times and for all civilizations, including extraterrestrial and non-human ones" (Planck 1899). He meant they were free of parochial standards. He did not claim they marked a boundary of the knowable.

This paper claims exactly that, and does so on borrowed ground. Using a framework from the study of measurement (Section 2), I argue that the Planck scale is the absolute lower bound of one specific thing: the horizon of unspecifiability that any embedded observer runs into. Below it, on this reading, the observer does not merely lack instruments fine enough to resolve smaller intervals. It lacks well-defined questions. "Which of these two events came first" and "is this point to the left of that one" are, at that scale, not hard queries but ill-posed ones.

I want to be honest about the epistemic weather before we set out. The physics I lean on is real but unfinished, and the reading I lay over it is a wager. Minimal length is not an established fact of nature; it is a recurring feature of several incomplete theories and a contested inference from thought experiments. The framework I use flags this exact rung as the one to trust least. So the plan is not to persuade by confidence. It is to state the claim precisely enough that a single experimental fact could kill it, and then to name that fact (Section 5).

2. One move, four symbols, and a firewall

The closure framework treats knowledge-getting as a single move repeated at rising scales. A situation begins open: many descriptions are compatible with it. Call that openness M. A measurement, an interaction, a decoherence event, any process that makes one description hold rather than another, is a closure, Cl. Closure delivers a definite "this". But no closure is free; each one leaves something unresolved, a remainder R, the part of M that the closure did not pin down.

For an observer, R is not abstract. It shows up as a horizon: a scale, near or far, below or beyond which the observer's own apparatus of distinction gives out. That horizon is m, the local horizon of unspecifiability. "Local" is doing real work in that phrase. m is indexed to an observer and its situation, not to the universe from a nowhere. A better microscope moves m. A colder detector moves m. The framework's ordinary business is watching m recede as technique improves.

This paper asks whether m has a floor that no technique moves, and locates that floor at the Planck scale.

Now the firewall, because the framework's vocabulary invites a misreading I want to shut down at the door. m is a horizon of specifiability, a statement about which questions have determinate answers for a located observer. It is not a mind, not an awareness, not a spark of proto-experience seeded into spacetime at 10^-35 meters. When I say that below the Planck scale certain distinctions "cease to be well posed", I am making a claim about the limits of physical resolution, in the same genus as "you cannot sharpen position and momentum together". I am not claiming the universe notices anything, that the Planck scale is aware, or that closure is a cosmic act of perception. Any reader who hears panpsychism here has heard something I did not say and do not hold. The framework is a lens on measurement. Pointed at the smallest scales, it makes a falsifiable-looking claim about resolution. That is all, and the rest of the paper tries to earn even that.

3. What the physics actually supports, and what it does not

The honest core of the case is a set of results that keep pointing, from different directions, at the Planck length as a place where the usual notion of "shorter distance" strains. I take them in turn, and I mark each for how much weight it can bear.

The measurement arguments (heuristic, respected, not decisive). In 1936 Matvei Bronstein noticed that gravity spoils the tidy logic that works for electromagnetism. To measure a field in a small region you use a test body, and you can, in electrodynamics, make its charge-to-mass ratio whatever you like. In gravity you cannot: mass is the charge. Push for finer spatial resolution and the apparatus grows heavy enough to disturb the very geometry you are probing (Bronstein 1936). C. Alden Mead sharpened this in 1964 into a clean statement: combining the position-momentum uncertainty relation with the gravitational pull of the probing photon yields an irreducible position uncertainty of order the Planck length, so that "it is impossible to measure the position of a particle with error less than" roughly sqrt(G) in natural units (Mead 1964). This is a genuine and often overlooked priority; Mead's argument predates the fashion by decades. But it is a thought experiment, not a theorem about nature. It shows that a broad class of measurement schemes hits a wall. It does not show the wall is a property of spacetime rather than of measurement-with-massive-probes.

The generalized uncertainty principle (a model, widely studied, model dependent). Many approaches to quantum gravity, when expanded at low energy, deform the canonical commutator so that position uncertainty acquires a term growing with momentum: delta x greater than or equal to (hbar / delta p) times [1 + beta (delta p)^2 / (M_P c)^2 + ...]. The bracket produces a minimum resolvable length of order l_P (HYPOTHESIS). Sabine Hossenfelder's review is the careful map of this territory, and it is careful precisely about the caveats: these are "minimal length scale scenarios", the generalized uncertainty principle and the modified dispersion relation are model constructions, and the value and even the existence of the effect depend on the model chosen (Hossenfelder 2013). The generalized uncertainty principle is a serious research program. It is not a discovered law. (DISPUTED)

Discreteness in loop quantum gravity (a genuine result, inside one theory). Rovelli and Smolin showed that in the loop representation of canonical quantum gravity the operators for area and volume have discrete spectra, with a smallest nonzero area quantum of order l_P^2 (Rovelli and Smolin 1995). Within that theory this is not heuristic; it is a spectrum. It is the strongest single piece of evidence that geometry might be granular at the Planck scale. But its force is conditional on loop quantum gravity being the right theory, which is not established, and the physical status of these operators (gauge, observable, gauge-fixed) remains debated. It is a real result about a candidate world, not a measurement of ours. (DISPUTED)

Model independence, claimed and qualified. Garay surveyed these strands and argued that a lower bound to any position measurement "seems to be a model-independent feature of quantum gravity", since several distinct approaches produce it (Garay 1995). This is the strongest form of the physics case, and I lean on it, but I read "model-independent feature of quantum gravity" narrowly. It says: given that we are doing quantum gravity at all, a minimal length recurs across our attempts. It does not say we have quantum gravity, nor that the recurrence is anything more than a shared inheritance of the same heuristics. Convergence of incomplete theories is suggestive. It is not the same as nature having answered.

So the physics I can honestly claim is this (FACT, in aggregate): a minimal length near l_P shows up repeatedly, in measurement arguments, in deformed commutators, and in at least one candidate theory's spectra. And this (DISPUTED): whether any of it reflects a real floor in nature, as opposed to the reach of particular techniques and particular models, is open. Hossenfelder's own later work is blunt that the Planck length as a hard minimal length is an assumption doing heavy lifting, not a conclusion forced on us.

4. Incidental remainder versus constitutive remainder

Here is where the framework earns its keep, if it earns it at all. The framework's ordinary remainder R is incidental: it is the part a given closure happened not to resolve, and a better closure resolves more of it. Every time we improve a microscope we convert some incidental remainder into definite fact and push m down. On that picture the Planck scale would be just the current far end of an unfinished job, and my thesis would be false.

The wager is that at the Planck scale the remainder changes character, from incidental to constitutive.

WAGER (the paper's deepest claim). For an observer built from fields in this spacetime, the sub-Planckian remainder is constitutive: it is not undescribed detail awaiting a finer closure, because at that scale the relations that make "finer" mean anything (a metric ordering of intervals, a light-cone ordering of events, a here distinct from a there) are themselves products of closure and are not available to ground a smaller one. You cannot ask "what is between these two points, half a Planck length apart" because at that separation "between" has lost the geometric structure it needs. The remainder is not a gap in the map. It is where the map's coordinate system dissolves.

C'S READING. In the framework's terms: at every scale above the floor, Cl operates on an M that already carries usable structure (an ordering, a topology, a notion of nearer and farther), and R is what this particular Cl left over. At the floor, the structure that Cl would operate on is itself the output of closure and cannot be presupposed. m bottoms out not because the observer is too crude but because there is no finer M to close on that the observer could stand outside of. The floor of m is the scale at which the observer's own conditions of specifiability run out.

I will restate the firewall, because Section 4 is exactly where it gets breached by careless readers. None of this says the universe hits a floor. It says an embedded, field-built observer hits one. A different observer, if "observer" even parses below the Planck scale, is outside the scope of the claim. And "the conditions of specifiability run out" is a statement about resolution and well-posedness, not about experience. The floor is a floor of the askable, not a threshold of the sentient.

5. The test that could kill it

A claim that cannot be distinguished from its cheap rival is not worth defending. The cheap rival here is deflationary and strong: the apparent Planck floor is merely the reach of the probes and theories we happen to have, an engineering limit, and it will recede like every earlier "smallest scale" (the atom, the nucleus, the parton) once we build better instruments or find a better theory. History is emphatically on the deflationist's side. Every previous floor was engineering.

So the burden is mine to state what would distinguish a genuine in-principle floor from a merely practical probe limit. Here is the discriminator I will stake the thesis on.

A practical probe limit has a signature: it depends on the probe. Improve the probe (more energy, colder detector, longer baseline, cleverer interferometry) and the accessible scale improves, monotonically, without bound in principle. The floor moves when you push harder. A practical limit also typically depends on which observable and which technique: different measurements bottom out at different places, set by their own noise and coupling.

A constitutive floor has the opposite signature: it is probe-independent and observable-independent. No matter what you build or how much energy you concentrate, the smallest resolvable interval saturates at the same scale, and it saturates the same way across unrelated observables (timing of high-energy photons, interferometric phase noise, threshold anomalies in particle reactions). Critically, a constitutive floor should also refuse to be beaten by concentrating energy, for the framework-consistent and physically motivated reason that concentrating enough energy into a small enough region makes a black hole, which hides the region behind a horizon rather than resolving it. The floor defends itself. That self-defense, energy that buys you a horizon instead of a finer look, is the fingerprint of a limit that belongs to the geometry and not to the ruler.

Quantum-gravity phenomenology gives this teeth. The relevant observations look for Planck-scale departures from ordinary spacetime: energy-dependent photon arrival times from distant gamma-ray bursts, first proposed as a Planck-sensitive test by Amelino-Camelia and collaborators (Amelino-Camelia et al. 1998), and the broader battery of tests reviewed later by Amelino-Camelia, in which certain data analyses genuinely reach Planck-scale sensitivity (Amelino-Camelia 2013). These are how we find out whether spacetime is smooth or grainy at l_P.

> **Prediction.** As probes improve across independent channels (astrophysical photon timing at increasing energy and distance, interferometric strain noise at increasing sensitivity, and reaction-threshold measurements at increasing energy), the smallest empirically resolvable spatiotemporal interval will converge to a single scale of order the Planck length and stop there, the same scale for every channel and every probe energy, with attempts to push below it converting added energy into gravitational (horizon) obstruction rather than finer resolution. The floor will be probe-independent and observable-independent.
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> **Kill.** If instead the resolvable scale keeps improving with better probes without approaching a common floor, or bottoms out at channel-specific scales set by each technique's noise and coupling (that is, different observables floor at different places, and more energy or better instruments always buy more resolution), then the apparent Planck bound is a practical probe limit, not a constitutive one. In that case the constitutive-remainder reading is false, m has no in-principle floor, and the Planck scale is engineering.

Two honesty notes about this test. First, it is asymmetric in what it can deliver soon. The kill condition is reachable with the observational programs we already run: a single clean detection of Planck-scale spacetime structure that scales with probe rather than saturating, or a well-established channel-dependence of the floor, would sink the thesis. The confirming side is far harder, because "converges and stops, forever, across all channels" is the kind of universal negative that observation approaches only asymptotically. This asymmetry is a feature: the claim is much easier to refute than to establish, which is the right shape for a wager one distrusts. Second, current data already constrain some minimal-length and Lorentz-violation scenarios and have ruled out the simplest linear-in-energy dispersion effects at the Planck scale for photons. That is exactly the machinery working. It has not yet told us floor versus engineering, because null results so far are consistent with both a smooth spacetime and a floor that hides behind horizons; but the same instruments, pushed further, are what will decide.

6. Limits, and the size of the bet

I have tried to write this so that a skeptical quantum-gravity physicist can locate every soft joint. Let me name them myself, since the framework's own instruction is to lean no weight on this rung and treat it as the least trusted, and I would rather be the one to say where it is weakest.

The first soft joint is that minimal length is model dependent, and I have not pretended otherwise. The generalized uncertainty principle is a construction; loop quantum gravity's discrete spectra are results inside a candidate theory; Mead's and Bronstein's bounds are thought experiments about measurement. Garay's "model-independent feature" is a convergence across our attempts, which could reflect a real floor or could reflect that all our attempts share the same Planckian scaffolding by construction. I have leaned on the convergence while conceding it could be an artifact of common ancestry. (DISPUTED, and I want that tag to stick.)

The second soft joint is the inference from "a minimal length recurs in our theories" to "the remainder there is constitutive". That step is the wager, and it is not forced by the physics. The physics is compatible with the deflationary reading in which l_P is just where our current probes and models give out. I have not proven the constitutive reading. I have made it precise and made it riskable, which is a different and lesser thing.

The third soft joint is the firewall's fragility as rhetoric even where it is firm as logic. The framework's language of "observer", "closure", and "horizon of specifiability" is one short slide from mind-talk, and readers slide. I have stated flatly that m is about resolution and well-posedness, not awareness. The correct size of the claim is modest: for a certain kind of observer, the smallest scale of well-posed spatiotemporal questions may be fixed by nature rather than by technique, and here is how we would find out.

The fourth soft joint is that even a fully confirmed Planck floor would underdetermine the constitutive reading. One could hold that spacetime is fundamentally discrete (an ontic granularity) rather than that specifiability bottoms out (an epistemic-relational floor). These make similar predictions for the test in Section 5. The framework's reading is the relational one, and I do not claim the test distinguishes relational from ontic granularity; it distinguishes floor from engineering, which is the prior and more urgent fork. Distinguishing relational from ontic is later work, and may be beyond observation entirely.

Given all four, why publish the wager at all? Because it converts a mood into a measurement. "Maybe the Planck scale is special" is a mood. "The resolvable interval converges to one scale across independent channels and cannot be beaten by added energy, else the reading is dead" is a measurement program, run on instruments we already point at the sky. The framework asked to be tested at its least trusted joint. This is me handing over the wrench.

7. Conclusion

The Planck length has spent a century as a curiosity of dimensional analysis, occasionally promoted to a boundary of physics on the strength of thought experiments and incomplete theories. The closure framework offers a way to say what "boundary" might mean without mysticism: it could be the floor of m, the scale below which a located, field-built observer has no well-posed spatial or temporal questions left to ask, because the structure that makes such questions meaningful is itself a product of the closures that bottom out there. That is the wager. It says the sub-Planckian remainder is constitutive, not incidental. It does not say the universe is aware, and I have built a firewall to keep those apart.

The wager is exposed on purpose. If better probes keep buying finer resolution, or if the floor turns out to sit at different places for different observables, the constitutive reading is dead and the Planck bound is engineering, exactly as the atom and the nucleus turned out to be engineering. The observations that will decide are already running. I would put more than a beer on the deflationary outcome being what the data first suggest, and I hold the constitutive reading anyway, lightly, as the framework instructs, until the photons from a far enough burst tell me which floor I have been standing on.

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