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Gravity: the missing corner of the model

Where the octonionic story honestly stops (for now)

Key Insight. The octonionic/Albert framework goes remarkably far: it organises internal quantum numbers, masses, mixings, couplings and scales in a single operator toolbox. But one major block remains incomplete: gravitation. The proton–Planck mass ratio

$$\kappa = \frac{m_p}{m_P}, \qquad m_P = \sqrt{\frac{\hbar c}{G}}$$

still enters as an external constant. This is not swept under the rug: the model marks gravity as an open assignment for future spectral geometry and for a unified master action $S[D, \Psi]$ in which gravity and the octonionic internal sector are treated on the same footing, not as a solved problem.

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How much is already covered

Before talking about what is missing, it is worth recalling what is already under octonionic control:

- Internal quantum numbers are organised on an exceptional stage ($\mathbb{O}$, $H_3(\mathbb{O})$, G_2, F_4).
- Couplings and mixing angles appear as norms and angles of rotor commutators.
- Fermion masses and flavour structure arise as spectra of compressors derived from a vacuum $\langle H \rangle$.
- Characteristic energy scales (Planck, electroweak, QCD) are linked to invariants of the radius operator and attractor mechanisms.

Within this internal sector, the story is fairly coherent: many quantities that used to be independent inputs become different faces of the same exceptional geometry.

Enter gravity: a separate constant

Gravitation is encoded in general relativity by Newton's constant G, or, more conveniently, by the Planck mass

$$m_P = \sqrt{\frac{\hbar c}{G}}.$$

The proton mass m_p then defines a dimensionless ratio

$$\kappa = \frac{m_p}{m_P},$$

numerically of order 10^{-19}.

In the present octonionic framework, m_p is accessible in principle via the compressor structure (it is one of the low-lying eigenvalues of the mass map), but m_P is not yet derived: it is imported from gravitational physics. Consequently, κ appears as an external constant rather than an internal invariant.

Why this is not a minor detail

At first glance, an extra constant might look harmless. But conceptually it matters:

- Internally, the model claims a structural explanation of many numbers (charges, couplings, fermion masses).
- Externally, gravity fixes the overall scale at which quantum fields backreact on spacetime.

Without a link between the internal exceptional geometry and spacetime geometry, the story is incomplete: we know how fields behave on a given background, but we do not yet explain how that background itself emerges from the same algebraic structure.

Spectral geometry as the natural bridge

There is, however, a natural candidate framework to close this gap: *spectral geometry.* Instead of describing spacetime by a metric $g_{\mu\nu}$, one describes it by a Dirac operator D on a suitable Hilbert space. The spectral action principle then postulates an action

$$S_{\text{spec}} = \operatorname{Tr} f(D^2/\Lambda^2),$$

whose heat-kernel expansion generates:

- the Einstein–Hilbert term (gravity),
- a cosmological constant term,
- gauge and matter kinetic terms,
- and higher-order corrections.

In the octonionic context, the hope is clear:

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> Build a Dirac operator D that encodes both spacetime geometry and the internal octonionic/Albert structure, then read gravitational couplings and the scale Λ from its spectrum.

In the language of this project, such a Dirac operator D is not an add-on but the same master operator that already organises the internal rotors, compressors and mass maps. Later in the calendar, this idea will be made explicit in the form of a single master action $S[D, \Psi]$ that packages internal and gravitational dynamics into one object. Here, we only flag this direction; the actual construction is deferred.

This would turn G, κ and even aspects of dark energy into spectral invariants of the same operator that already knows about internal rotors and compressors.

What is missing right now

The present model does *not* yet provide a final construction of such a Dirac operator. Concretely:

- The exact Hilbert space on which D acts, combining spacetime spinors with octonionic internal data, has not been fixed.
- The interplay between nonassociative internal multiplication and the standard differential-geometric structure of D is not yet fully understood.
- The computation that would derive κ from the spectrum of D is not available; κ is treated as known input.

This is why gravity is called the “missing corner”: it is not absent because it does not fit, but because the necessary spectral-geometric machinery has not yet been fully built.

Why it is still worth taking the model seriously

Admitting an open gravitational block is not a weakness of honesty; it is a strength of design:

1. It clearly marks where the current octonionic explanations end and where new ideas are needed.
2. It suggests a concrete research programme rather than a vague hope: construct an octonionic spectral triple and compute the resulting gravitational sector.
3. It prevents overclaiming: the model explains many things about internal structure, but it does not pretend to have solved quantum gravity.

Seen this way, the gravitational day of the Advent calendar is less a conclusion than a pointer: it ties the exceptional internal geometry to the next natural step in modern mathematical physics.

A clear boundary, not a blind spot

The main message of this sheet is thus intentionally simple:

> The octonionic model currently stops at the boundary of gravity. The ratio $\kappa = m_p/m_P$ is acknowledged as an external input, and a spectral-gravity extension is needed to pull it inside the algebraic story, eventually in the form of a unified action $S[D, \Psi]$ whose gravitational coefficients are fixed by the same spectral data as the internal ones.

The rest of the calendar—especially the spectral-geometry and AQFT days— shows that this next step is plausible, but it is not taken yet. One hundred years after Heisenberg, it is intellectually healthier to draw a sharp line between what has been structurally organised and what remains to be done.

References

[1] A. Einstein, “Die Feldgleichungen der Gravitation,” *Sitzungsber. Preuss. Akad. Wiss.* (1915), 844–847.

[2] A. Connes, *Noncommutative Geometry*, Academic Press, 1994.

[3] A. Connes and A. H. Chamseddine, “The spectral action principle,” *Commun. Math. Phys.* **186**, 731–750 (1997).

[4] [Internal notes on constants and gravity: `arxiv-const.tex; appE_neu.tex; chap20_neu.tex`.]

The octonionic model organises internal physics but leaves gravity as an honest open corner: the ratio $\kappa = m_p/m_P$ still waits for a spectral-geometry explanation.

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