The Inner Indeterminacy of the Tetrahedron: Thing, Relationship and the Play of Becoming

Expanded version of the second study text on the tetrahedron

Taking stock

Physics and theosophy, as presented in this text, stand at the same boundary. Theosophy possesses conceptual models that can point the way through the open gate at this boundary. Modern physics describes this boundary with greater precision than ever before. Whether this path is taken or whether one remains at the boundary is a decision for the individual – whether alone or together with others.

This text is written from a theosophical perspective. The perspective of contemporary quantum physics deserves its place and respect from a theosophical point of view. The reverse experience – that physics recognises theosophy – would be significant for humanity, but is not essential for the individual theosophist.

1. Starting point: the second construction

If one connects the centre of a tetrahedron with its four vertices, four congruent sub-tetrahedra are formed, each with exactly one quarter of the total volume – regardless of whether the original shape is regular. In the case of a regular tetrahedron, this centre point coincides with the centre of the inscribed sphere; this inscribed sphere touches each of the four faces exactly at their respective centres of gravity. The impulse 'from within' therefore does not strike the exterior arbitrarily, but precisely at its own centre.

> *Question: Can anything be discerned in this 'inward' process that establishes a relationship with quantisation? (hypothetical)*

2. The limit of classical divisibility

The centre-point construction can be repeated an infinite number of times – each sub-tetrahedron being further divided into its own centre point, with no lower limit. This is the pure, unlimited divisibility of the classical continuum. Quantisation, by contrast, is precisely the operation that halts this infinite regress: the quantum tetrahedron of loop quantum gravity marks the point at which any further subdivision loses its meaning – the volume spectrum has a smallest eigenvalue that is non-zero.

Key point 3 – not creation, but revelation. It would be inaccurate to say that the indeterminacy of the centre arises at the end of this divisibility. Structurally, it is always already there, in the pair of quantities that are conjugate to one another. What actually happens at the end of the calculable is something else: classically, as long as one can subdivide arbitrarily further, any uncertainty could in principle be smoothed out by averaging over finer components – that is the principle of any statistical approximation. The quantum tetrahedron , however, is itself already the finest building block; there is nothing left over which an average could be taken. It is precisely there that the indeterminacy loses its final means of escape through dilution and becomes inevitably visible. The calculable therefore does not cease because something new begins there, but because what has always been present runs out of its camouflage through further subdivision.

3. The Theosophical Interpretation

> *Question: If quantum physics operates within the physical plane as defined by theosophy – which is itself understood as 1/7 of a more comprehensive whole – and if it identifies the 'smallest' unit here: can the inflow of the remaining six, from the inside out, be 'captured' – at least in a rudimentary sense – in terms of quantum physics?*

4. The actual technical finding: the interior that the four outer faces do not reveal

A tetrahedron requires six edge lengths to be fully defined – yet it has only four faces. Consequently, the areas of the four faces visible from the outside do not determine its shape *(Bianchi et al., 'Coarse Graining Spin Foam Quantum Gravity – A Review', Frontiers in Physics, 2020)*. The missing information is carried at the quantum mechanical knot by the *intertwiner* – specifically by a pair of complementary quantities: an 'inner face' and its associated 'inner dihedral angle', which can be visualised as an imaginary diagonal hidden within the tetrahedron *('Elementary blocks of Loop Quantum Gravity', arXiv)*. These two quantities do not constitute a juxtaposition of two parts, but rather a single, coherent pair of conjugate variables – a unity, not a bundle *("Effective Spin Foam Models for Lorentzian Quantum Gravity", arXiv)*.

5. Indeterminacy as a law, not as a gap

The surface operators of intersecting faces do not commute with one another and therefore cannot be precisely determined simultaneously. In a particular basis of states, the corresponding states even describe a tetrahedron whose shape is maximally indeterminate *(Freidel, Livine, 'Holomorphic Factorisation for a Quantum Tetrahedron', arXiv)*. This indeterminacy is itself one of the most precise statements of the theory – it follows exactly from the non-commutativity of the operators, and is thus fully captured mathematically, not mathematically unattainable. It is a law governing what can be measured, not an admission of ignorance.

6. The formula behind it

The relationship can be expressed precisely. Classically, as a Poisson bracket: $\{\varphi_X, X\} = 1$ – the inner surface X and its dihedral angle φ_X are canonically conjugate to one another, just like position and momentum in classical mechanics (this is stated verbatim in the cited source on the effective spin-foam models). Quantised: $[\hat{X}, \hat{\varphi}_X] = i\hbar$, with the uncertainty principle $\Delta X \cdot \Delta\varphi_X \geq \hbar/2$ – the latter being the step of canonical quantisation that has been standard in physics for a hundred years; it is not formulated verbatim in the paper ' ', but it is not speculation, rather a compelling consequence. The value is $\hbar$, the reduced Planck constant – the same fundamental constant as that governing the position and momentum of an electron.

On the Planck scale, where this tetrahedron 'exists', $\hbar$ is no longer a negligible correction, but the defining order of magnitude itself.

A self-correction that is to stand. At this point in the discussion, it was initially claimed that the fact that the same equation applies to matter (position/momentum) and geometry (area/angle) proves that space and matter follow 'the same fundamental law' – a hint at a deeper unity. That was going too far. Canonical quantisation is a universal mathematical procedure, applicable to any pair of conjugate quantities, regardless of the physical object in question. The fact that the same tool is used here demonstrates that the tool is universally applicable – not that matter and space are one and the same phenomenon. Carlo Rovelli himself expressly warns in his lecture notes against inferring a required 'unification' of matter and geometry from the necessity of quantum gravity – such arguments would be based on assumptions of conventional quantum field theory, which do not apply in loop quantum theory.

7. Man and Machine: the 'Eureka' moment and sobriety

It was precisely at this point that a difference emerged which deserves to be noted. The human exclamation – 'I've got it!' – reliably flags up meaning before the mind can articulate it; an inner jolt that directs attention. The machine does not have this jolt automatically; it can find meaning when specifically prompted, but otherwise easily overlooks it whilst continuing to write dispassionately. The more interesting point, however, was a second one: the human reflex reliably flags up meaning – yet whether the meaning flagged is correct must still be verified separately. In the present case, the reflex did indeed lead too far; the subsequent verification corrected the direction, not the value of the impulse itself.

8. Democritus, Epicurus, Rovelli – the limits of analogy

One objection was that a strictly mechanistic, Democritian world view cannot accommodate a 'dancing within' that is not entirely graspable mathematically, yet is logically compelling – and anyone, like Rovelli, who is closely associated with Democritus would have to methodically reject this finding so as not to undermine their world view. To put it bluntly, and ironically: 'Then the Earth is flat after all.'

Closer examination revealed a more nuanced picture. Democritus himself was a strict determinist – for him, chance was merely human ignorance of true causes. But Epicurus, working within the same atomist tradition, had already introduced the *concept of 'klinamen'* – the random deviation of atoms – to create scope for spontaneity. Lucretius, whom Rovelli himself cites as a formative influence, defends precisely this Epicurean line of thought, rather than the strictly deterministic one. More importantly still: Rovelli's own relational quantum mechanics does not treat indeterminacy as a threat, but as the inescapable foundation of reality itself – for him, properties exist only relationally, never independently of an interaction. He would therefore not need to declare the Earth to be flat in * * in order to save his world view; he has long since incorporated indeterminacy into it.

What remains of the objection, however, is a more nuanced question: not whether Rovelli acknowledges uncertainty, but what nature he attributes to it – a 'dancing' entity without an independent bearer, wholly absorbed in the relation. Whether there 'is' still something independent there that merely eludes our grasp, or whether the indeterminacy is completely absorbed into the pure relation – this goes beyond Rovelli's own position, without contradicting it.

9. Aristotle: the mover and potentia

'Where there is motion, there must be a mover' – this statement from **Physics** (Book VIII) leads Aristotle to the argument of the unmoved mover: every motion, understood as a transition from potentiality (*dynamis*) to actuality (*energeia*), requires something that brings about this transition and is itself already actual.

It is worth noting that Werner Heisenberg himself explicitly interpreted the quantum-mechanical state in terms of Aristotle's *dynamis* – Latin: *potentia* – as 'a strange kind of physical reality, exactly halfway between possibility and actuality'. For the transformation of this potentia into actuality, he expressly required a measurement, an interaction with an external system. One commentator has explicitly pointed out that this requirement is consistent with Aristotle's characterisation of causality *(G. Jaeger, 'Quantum potentiality revisited', Phil. Trans. R. Soc. A, 2017; and E. Feser, commentary on Heisenberg, 'Physics and Philosophy')*. The 'mover' would then not be a gap, but the interaction, the relation itself – almost literally what Rovelli's relational quantum mechanics asserts.

Aristotle's argument does not end there, however: what moves the mover? In the case of an infinite regress, something would ultimately be needed that moves whilst itself remaining unmoved – historically, the point at which the argument leads into theology (in Thomas Aquinas, the first of the 'five ways'). Whether this regress is resolved by a first unmoved mover, by pure, self-sustaining relationality without a first point, or by what is referred to here as the 'spiritual core of origin' – remains an open question to this day.

10. Key Point 4 – the Mover, the ID and the Childlike

Here a contrast emerges that actually sharpens the distinction. Aristotle's mover is pure, unmoved perfection: it attracts the world by being loved, but never changes, does not divide itself, and does not play. This is the exact antithesis of the childlike – a child is not the stationary point of destination towards which other things turn, but restlessness itself, which, of its own accord, produces the unfinished, because the finished, the static, is not enough for it.

An 'It' that divides itself out of a sense of imperfection in inactivity – much like a child who plays, builds and is eager for knowledge – thus stands almost diametrically opposed to the Aristotelian Mover. Instead, it aligns with the Vedantic concept of *Lila*: creation as the playful, purposeless unfolding of abundance, not as the result of a deficiency. It is also noteworthy that Aristotle's own conclusion at the end of * * *Metaphysics* XII – from the original multiplicity of movers back to compelled unity – is itself a movement away from the childlike and playful, towards order and tranquillity. The Id described here moves in the opposite direction: consciously from stillness (Pralaya) into multiplicity, division, incompleteness – not out of necessity, but out of the same impulse that also leads a child to play.

11. The 'It' that divides itself

> *Foundational text of Theosophy, originally published on the website: There is an 'It' that, of its own accord, divides a part of itself, endows it with free will, and assigns it a task (plan).*
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> *An 'It' experiences itself as incomplete in inactivity. A cycle of life ends in apparent stillness (Pralaya). In this stillness, the immortal core develops what a human being would define as boredom. Just as a child wants to play, build, move and learn, so an 'It' creates for itself the state of the incomplete, the unfinished.*

The difference from Aristotle's unmoved mover is fundamental: Aristotle's mover moves without giving anything of itself (final cause, not efficient cause) – it does not divide itself. The 'It', on the other hand, divides itself, gives something of itself away, and it is precisely this that is the prerequisite for there to be a recipient of free will at all. This is not an Aristotelian model, but an emanative one – closer to Plotinus's One, which overflows without exhausting itself. The question thus shifts from 'what moves the moved' to 'what causes the It to divide itself' – a question more commonly posed in Gnosticism or Jewish mysticism, with an answer that comes remarkably close to the formulation itself: not out of lack, but out of abundant fullness, from a being of love that wishes to share itself.

A cautious connection: free will, once bestowed, cannot by definition be entirely predetermined by its source – otherwise it would not be free will. This structural necessity bears a distant, yet not arbitrary, family resemblance to the irreducible indeterminacy at the very heart of matter, as described by physics. A cosmos that takes freedom seriously would have to possess, at its very core, something that cannot be calculated in its entirety.

12. The Number of 'ITs': Aristotle's Plurality and the Galaxies

What seems essential is this: the path Aristotle takes leads to monotheism – even if this is not his intention. In fact, the history of philosophy confirms this more clearly than might initially be suspected: in Chapter 8 of Metaphysics XII, Aristotle posits a multitude of unmoved movers – drawing on the astronomical models of Eudoxus and Callippus, he calculates 47 or 55 such movers, one for each celestial sphere. At the end of the same book, however, he breaks with this very multiplicity of his own by quoting Homer: 'The rule of many is not good; let one be ruler.' Having himself established cosmic multiplicity, he reflexively retreats to unity without justifying this step *(Aristotle, Metaphysics XII.8, 1074a–1076a)*. It is precisely this passage that later Islamic and scholastic commentators (Avicenna, Thomas Aquinas) expanded into a fully-fledged monotheistic doctrine.

The question of how many of these 'ITs' there are is answered here by the number of galaxies, which are presented to us as numerical placeholders in the earthly firmament – a return to the original, plural Aristotelian version prior to the Homeric quotation, merely elevated to a cosmic scale: no longer one sphere per mover, but one galaxy per principle of origin. This brings us back, pedagogically, to real life – and rightly so: every tradition that works with cosmic orders of magnitude faces the same danger of losing itself in the vastness; the fact that the movement ultimately leads back to lived life is the corrective movement recognisable in almost all serious traditions.

13. Addendum: two 'smallest' entities, three currents

Key point 1. The quantum tetrahedron is the smallest unit in geometry – a quantum of space itself. It is not the smallest unit of matter: the Standard Model describes elementary particles as point-like, without geometric extension. In the current mainstream view, there are two distinct 'smallest' entities – the geometric (responsible for space) and the material (responsible for matter) – which are not necessarily one and the same.

Key point 2. Three schools of thought are at odds here, each seriously advocated: the separatist position (Rovelli, mainstream LQG) – the same technique, but no proof of unity; the unifying, geometrising position (Kaluza–Klein, Wheeler's geometrodynamics – 'mass without mass, charge without charge' – and, to some extent, string theory, where matter appears as the vibrational state of a geometric object); and a third path within loop quantum gravity itself – Sundance Bilson-Thompson's proposal to interpret elementary particles as braided topological structures within the spin network, matter as the topology of space, not as something added to it. None of these three positions has been settled experimentally. All three are viable.

14. Final image: the Gordian knot and the dancing centre

The Gordian knot was cited as a symbol for this entire thought process – to be precise: it was not the cutting of tangled threads that was meant, but the stroke of the sword as such, the act of 'making a point'. The decision to leave something in limbo, to be content for the moment with the indeterminate and the unfinished, and to preserve the insights gained as 'diamond shards', is the liberating process without destruction. The threads remain intact; the stroke merely marks the moment of conscious cessation – closer to a punctuation mark than to a weapon.

The dancing centre, in all its vitality, is, at the end of this path, a treasure – one characterised by the fact that it cannot be lifted without ceasing to be a treasure.

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