1 ETHER THROUGH ODTOE: IS IT NEEDED?

1.1 The field of potential states as what ether wanted to be

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1.1.1 ABSTRACT

The concept of ether is investigated through the lens of ODTOE. It is shown that ether in the classical sense (a material medium filling space) is not needed—but the *need* it expressed was deeply justified. Nineteenth-century physics intuitively sensed: light and interactions require *something* in which they propagate. The Michelson-Morley experiment "killed" ether as a *material substrate*. But the question "in what does observation propagate?" remained open. ODTOE provides the answer: observation propagates not *in* something, but *from* something—from the field of potential states $\mathcal{H}$. The field $\mathcal{H}$ is what ether *wanted to be* but could not: not a material medium, but a space of all possibilities from which the observer constitutes reality. A precise correspondence table is established: classical ether → quantum vacuum → field $\mathcal{H}$ in ODTOE. It is shown that three historical "murders" of ether (Michelson-Morley, GR, quantum field theory) did not eliminate the *need* for it, but transformed understanding: from material substrate to potentiality.

Keywords: ether, field of potential states, vacuum, ODTOE, observer, space, substrate, potentiality.

1.2 I. A BRIEF HISTORY OF ETHER

1.2.1 1.1. What is ether and why was it needed

Ether (from Greek αἰθήρ—upper layer of air, radiance)—a hypothetical medium filling all space in which light and electromagnetic waves propagate.

The need for ether arose from a simple question: **a wave is an oscillation of *what*?** Sound is oscillation of air. A wave on water is oscillation of water. Light is oscillation of… what? If we remove all matter, in a vacuum light still propagates. That means the vacuum is not empty; it is filled with *something*. This "something" was called ether.

Properties that physics required from ether:

Property	Why needed
Fills all space	Light propagates everywhere
Absolutely stationary	Reference frame for speed of light
Weightless and invisible	Not directly detectable
Absolutely elastic	Transverse waves (light) require rigidity
Offers no resistance to motion	Planets are not slowed down

1.2.2 1.2. Three "murders" of ether

Murder 1: Michelson-Morley (1887). The experiment showed: the speed of light is the same in all directions, independent of Earth's motion. If ether exists and is stationary—Earth moves through it, and the speed of light should depend on direction. It does not. Conclusion: ether as a *stationary material medium* does not exist.

Murder 2: Special Theory of Relativity (Einstein, 1905). STR postulated: the speed of light is constant in all inertial reference frames. There is no privileged reference frame (= stationary ether). Spacetime is not a background but a dynamic structure.

Murder 3: Quantum Field Theory (1930s–1970s). The electromagnetic field is not an "oscillation of a medium" but an independent quantized entity. A photon is a quantum of the field, not a "wave in ether." The medium is unnecessary—the field *itself* is fundamental reality.

1.2.3 1.3. But ether did not die completely

Despite three "murders," the need for *something that fills the void* did not disappear. It transformed:

Quantum vacuum. "Empty" space is not empty. It is filled with virtual particles, field fluctuations, zero-point energy. The Casimir effect (1948)—a *measurable* manifestation of the vacuum's "non-emptiness": two plates in a vacuum attract each other due to pressure difference of virtual photons inside and outside.

Higgs field. Fills all space, gives particles mass. Essentially a "medium" pervading the Universe. Sounds suspiciously familiar.

Dark energy. 68% of the Universe's energy—"something" filling space and accelerating expansion. Nature—unknown.

Einstein himself wavered. In 1920 (15 years after ether's "murder"), he said in the Leiden lecture: *"According to the general theory of relativity, space without ether is unthinkable; for in such a space there would be not only no propagation of light, but also no possibility of the existence of measuring-rods and clocks, and hence no space-time distances in the physical sense."*

1.3 II. ETHER THROUGH ODTOE

1.3.1 2.1. The question ether posed

Ether is the answer to the question: **"What is the substrate of reality?"** In what do things exist? What fills the "void"? What is space "made of"?

Classical physics answered: from a material medium (ether). STR answered: there is no substrate; there is spacetime. QFT answered: from quantized fields. The Standard Model answered: from fields + Higgs condensate.

ODTOE answers differently.

1.3.2 2.2. The field of potential states $\mathcal{H}$—what ether wanted to be

By axiom (A) [1]: $R = \hat{O}(\Psi)$, where $\Psi \in \mathcal{H}$ is the **field of potential states**. This is an "infinite-dimensional space containing all possible configurations" [1].

$\mathcal{H}$ possesses *all* properties required of ether—but *none* of the properties that were refuted:

Property of ether	Refuted?	$\mathcal{H}$ in ODTOE
Fills all space	No	$\mathcal{H}$ is not *in* space; it *generates* space
Stationary (privileged frame of reference)	**Yes**	$\mathcal{H}$ has no reference frame—it is *pre*-spatial structure
Weightless and invisible	No	$\mathcal{H}$ has no mass—potentiality does not weigh
Light propagates in it	No	Photon = $\delta\hat{O}$ propagates "in" $\mathcal{H}$ (from potentiality to actuality)
Offers no resistance	No	$\mathcal{H}$ does not resist—but $I(C)$ (configuration inertness) does resist
Material substrate	**Yes**	$\mathcal{H}$ is not a material substrate but a *space of possibilities*

Key difference: ether is a *material medium* (a thing). $\mathcal{H}$ is *potentiality* (possibility). Ether is what things are *made of*. $\mathcal{H}$ is what things are *constituted from*.

1.3.3 2.3. Why Michelson-Morley does not refute $\mathcal{H}$

Michelson-Morley refuted: ether is *stationary* relative to absolute space → Earth *moves* through it → speed of light *depends* on direction.

$\mathcal{H}$ is *not stationary*—it has no spatial position at all. $\mathcal{H}$ is not *in* space. Space is *one of the*

configurations within $\mathcal{H}$. One cannot "move through" $\mathcal{H}$ because movement is a configuration, and $\mathcal{H}$ is the field *from which* configurations are constituted.

Analogy: one cannot "move through" the set of all numbers. Numbers are not a medium but a space of possibilities. One can move *along the number line* (within a configuration) but not *through the set* (it has no spatial structure).

1.3.4 2.4. Why STR does not refute $\mathcal{H}$

STR refuted: there exists a privileged reference frame (stationary ether).

$\mathcal{H}$ does not define a reference frame. On the contrary: *each observer* O_i constitutes *their own* configuration $R_i = \hat{O}_i(\Psi)$ from the *same* $\mathcal{H}$, but with *different* $\hat{O}_i$. There is no privileged observer—no privileged reference frame. This *agrees with* STR rather than contradicts it.

Moreover: the invariance of the speed of light ($c = \text{const}$) receives an ODTOE explanation: $c = v_{max}$—the maximum speed of reconfiguration [1, P2.1]. It does not depend on the observer because it is a property of the *transition* $\mathcal{H} \to \mathcal{C}$, not of a medium.

1.3.5 2.5. Why QFT does not refute $\mathcal{H}$

QFT refuted: light is a "wave in a medium"; a medium is needed as substrate.

$\mathcal{H}$ is not a substrate. Quantized fields are *configurations* within $\mathcal{H}$, not "waves in $\mathcal{H}$." A photon is not oscillation of $\mathcal{H}$ but $\delta\hat{O}$—a minimal change in the observation operator. It "propagates" not *in* a medium but *from* potentiality into actuality.

1.4 III. $\mathcal{H}$ VS. ETHER VS. VACUUM: PRECISE TABLE

Parameter	Ether (19th c.)	Quantum vacuum	$\mathcal{H}$ (ODTOE)
Ontological status	Material medium	Ground state of quantum fields	Space of potential states
Located *in* space?	Yes (fills it)	Yes (= space + fields)	**No** (space is one of its configurations)
Has reference frame?	Yes (stationary)	No (Lorentz-invariant)	No (pre-spatial)
Has energy?	No (weightless)	Yes (zero-point energy)	No (potentiality ≠ energy)
Observable?	No (invisible)	Indirectly (Casimir effect)	No ($\mathcal{H}$ unobservable; observable is $R = \hat{O}(\Psi)$)
Depends on observer?	No (objective)	No (objective)	**Yes** (constituted R depends on $\hat{O}$)

Parameter	Ether (19th c.)	Quantum vacuum	$\mathcal{H}$ (ODTOE)
What "propagates" in it?	Light (wave)	Excitations (quanta)	Nothing "propagates"—from it *constituents are formed*
Refuted?	Yes (Michelson-Morley, STR)	No	No (not refutable: it is a *meta*-structure)

1.4.1 3.1. Key shift

Ether: "something *is* in space, *in which* light propagates." Quantum vacuum: "space *itself* is full of energy and fluctuations." $\mathcal{H}$ (ODTOE): **"space is one of infinitely many configurations constituted from potentiality"**.

Shift: from "medium *in* space" through "space *as* medium" to **"space *from* potentiality"**.

1.5 IV. IS ETHER NEEDED?

1.5.1 4.1. Answer: no—in the old sense. Yes—in the new sense

Not needed—if "ether" = material medium filling pre-given space. This has been refuted three times. Bringing back this ether is impossible and unnecessary.

Needed—if "ether" = answer to "what constitutes reality?" This question is not settled by STR, QFT, or the Standard Model. Quantum field—*from what?* Vacuum—*why is it not empty?* Spacetime—*where does it come from?*

ODTOE gives the answer: *from* $\mathcal{H}$. The field of potential states—infinite-dimensional, pre-spatial, pre-temporal, pre-material. Reality (R) is constituted *from it* through the act of observation ($\hat{O}$).

1.5.2 4.2. Why physics "killed" ether but did not solve the problem

Physics killed a *specific model* of ether (material medium). But the *need* ether expressed—"there must be *something* from which reality is constituted"—remained. It manifests as:

Problem	Essence	"Etheric" need
Dark energy (68% of Universe)	Unknown energy accelerating expansion	*Something* fills "empty" space
Dark matter (27% of Universe)	Invisible mass holding galaxies together	*Something* invisible structures reality
Measurement problem	What causes wavefunction "collapse"?	*Who/what* constitutes a specific configuration?

Problem	Essence	"Etheric" need
Quantum gravity	How to reconcile GR and QM?	What is the *substrate* of spacetime?
Cosmological constant	Vacuum energy by factor 10^{120} greater than observed	*Why* is potentiality so great but reality so small?

Each of these problems is a *disguised question about ether*: what is reality "made of"?

1.5.3 4.3. ODTOE answer to each problem

Problem	ODTOE answer
Dark energy	$\mathcal{H}$ is infinite-dimensional. Reality R is *one* configuration from an infinite field. "Dark energy" = pressure of *unrealized* potential states on the actualized configuration
Dark matter	Configurations with $S > S_{threshold}$ but $d(O) < d(C)$: *invisible* (by D-Prot) observer clusters affecting dynamics
Measurement problem	$R = \hat{O}(\Psi)$: "collapse" = act of observation constituting R from $\mathcal{H}$
Quantum gravity	Spacetime is a *configuration*, not substrate. No need to "quantize" space—derive it from $\mathcal{H}$
Cosmological constant	$\lvert\mathcal{H}\rvert$ is infinite, $\lvert R\rvert$ is finite. Difference $\sim 10^{120}$ is not a "problem" but a *property*: potentiality is always greater than actuality

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1.6 V. SPACE AS CONFIGURATION

1.6.1 5.1. Main thesis

Ether assumed: space is a *background*, ether is its *content*. STR: spacetime is a *dynamic background*. QFT: quantized fields are *on the background* of spacetime.

ODTOE: **space is one of the configurations $\mathcal{C}$ constituted from $\mathcal{H}$.** Not background, not container, not medium—but *result* of collective observation.

By P5.1: $P_{coll}(E) = 1 - \prod(1 - B_i^k)$. As $n \to \infty$ observers with non-zero B_i, collective probability of "space" configuration → 1. Space is *so stable* that it seems a "background"—but this is an effect of $T(C) \to$ enormous by P3.1 with high $S_{cluster}$.

Analogy: air seems a "void"—but it is a configuration of 10^{25} molecules per liter. "Empty" space is a configuration of 10^{50+} co-observers.

1.6.2 5.2. What is “empty” space in ODTOE

“Empty” space = configuration C_{vac} co-constituted by minimal number of observers with minimal S. This is the *poorest* configuration but *not zero*. In it:

- $S \to S_{min}$: minimal coherence (maximum “versions of reality” by P1.2)
- $I(C) \to 0$: minimal inertness (maximal lability—hence virtual particles)
- $T(C) \to T_0$: minimal configuration lifetime (hence fluctuations)

Quantum vacuum “boils” not because it is “full of energy” but because $I(C) \approx 0$ and $S \approx S_{min}$: configuration is unstable, continuously reconfigures. Virtual particles = fleeting configurations with $T \approx T_0$.

1.7 VI. TESLA’S ETHER

1.7.1 6.1. Tesla and ether

Tesla did not abandon ether—he considered it real and fundamental. Unlike most 20th-century physicists, Tesla insisted: there is no “empty” space; everything is filled with “primary substance.” His resonant experiments, in his view, demonstrated interaction with this substance.

1.7.2 6.2. Tesla was right—but not as he thought

Tesla is right: space is not empty. Quantum vacuum confirmed this experimentally (Casimir effect, 1948). ODTOE goes further: space *itself* is a configuration constituted from $\mathcal{H}$.

Tesla is wrong: ether ≠ material medium. There is no “primary substance” in the sense of matter. There is *potentiality* ($\mathcal{H}$) from which *everything* is constituted, including space.

Tesla’s resonance through ODTOE: $S \to 1$—observer coherence. Resonance is not “oscillation of ether” but *synchronization of observers*, at which $P_{coll} \to 1$ and configuration is amplified.

1.8 VII. CONCLUSION

1.8.1 7.1. Is ether needed?

No—as a material medium filling space. Refuted. Closed.

Yes—as an answer to “from what?” This question is open and fundamental. ODTOE answers: from $\mathcal{H}$—the field of potential states.

1.8.2 7.2. What is $\mathcal{H}$

$\mathcal{H}$ is not medium, not substance, not energy, not space. $\mathcal{H}$ is **pure potentiality**: an infinite-dimensional space of all possible configurations from which the observer constitutes reality through $R = \hat{O}(\Psi)$.

$\mathcal{H}$ is what ether *wanted to be* but could not: not "something in space" but "that from which space is."

1.8.3 7.3. Evolution of the answer to "what is reality made of?"

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Ether (19th c.)    → "From material medium"                    → Refuted
Fields (20th c.)   → "From quantized fields"                   → Partial (does not
Spacetime          → "From geometry"                           → Partial (does not
H (ODTOE)          → "From potentiality through observation" → Not refute
                                                                 (meta-level)
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1.8.4 7.4. Formula

Ether $\rightarrow$ Vacuum $\rightarrow \mathcal{H}$. Not "in what" but "from what." $R = \hat{O}(\Psi)$. Reality from potentiality.

Nineteenth-century physics felt correctly: *something* must be. But it got the answer wrong: this something is not a medium but a *possibility*. Not ether but $\mathcal{H}$. Not substrate but potentiality. Not what things *exist in* but what they are *observed into being*.

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