1 ENERGY EXTRACTION FROM THE FIELD OF POTENTIAL STATES: EXPLORATION THROUGH ODTOE

1.1 Five mechanisms of transition from potentiality to actuality

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1.1.1 ABSTRACT

Within ODTOE, the fundamental question is investigated: can energy be extracted from the field of potential states $\mathcal{H}$? It is shown that the question is imprecisely framed — *every* act of observation already constitutes extraction from $\mathcal{H}$: $R = \hat{O}(\Psi)$ converts potential into actual. The problem is not in "extraction" (it occurs continuously), but in *channel efficiency* $\hat{O} : \mathcal{H} \to \mathcal{C}$. Five mechanisms for increasing efficiency are identified: (1) channel coherence ($S \to 1$, superconductivity), (2) resonance with $\mathcal{H}$ (Casimir effect, vacuum fluctuations), (3) recursive amplification (Φ^n, cascading loops), (4) coherence phase transitions (critical points of S), (5) collective observation (P5, cluster synchronization). For each mechanism, existing physical analogues, ODTOE formalism, and experimental directions are established. Strict demarcation is made: what is proven, what follows from the theory, what is speculative.

Keywords: energy, field of potential states, vacuum, coherence, superconductivity, Casimir effect, ODTOE, extraction, channel.

1.2 I. REFRAMING THE QUESTION

1.2.1 1.1. Imprecise framing

"How to extract energy from $\mathcal{H}$?" — a question assuming $\mathcal{H}$ is a *reservoir* from which one must *withdraw*. Like oil from a well.

Through ODTOE: this is imprecise. $R = \hat{O}(\Psi)$ — *every* act of observation already constitutes extraction: transition from potential ($\Psi \in \mathcal{H}$) to actual ($R \in \mathcal{C}$). We do not *extract* from $\mathcal{H}$ — we *constitute* configurations from it. Continuously. Every second. Every atom does this.

1.2.2 1.2. Precise framing

The correct question: **how to increase the efficiency of channel $\hat{O} : \mathcal{H} \to \mathcal{C}$?**

A channel has characteristics: - **Capacity**: how much "potentiality" is converted to "actuality" per unit time - **Losses**: $D(\eta) = D_0(1-S)$ — stochastic losses during transmission - **Coherence**: S — how synchronized the channel actors are - **Directionality**: $\nabla U(C)$ — where the flow is directed

At $S \to 1$: losses $\to$ 0, channel is ideal (superconductivity). At $S \to S_{min}$: losses are maximal, channel "noises" (ordinary matter).

1.2.3 1.3. What physics *already knows* about energy of $\mathcal{H}$

Phenomenon	What physics says	Energy
Zero-point energy of vacuum	Vacuum is not empty, contains fluctuations	Infinite (theoretically), $\sim 10^{113}$ J/m^3
Casimir effect (1948)	Two plates in vacuum attract due to difference in vacuum fluctuations	Measured: $\sim$ nanonewtons per μm^2
Cosmological constant	"Dark energy" accelerates Universe expansion	$\sim 10^{-9}$ J/m^3 (observed)
Cosmological constant problem	Theory predicts 10^{120} times more vacuum energy than observed	"Worst prediction in physics history"

Through ODTOE: $|\mathcal{H}|$ is infinite. $|R|$ is finite. The difference is not "theory error," but *property*: potentiality is *always* greater than actuality. Question: how to *increase the fraction* of actualizable potential?

1.3 II. FIVE MECHANISMS

1.3.1 Mechanism 1: Channel coherence ($S \to 1$)

Principle: at $S \to 1$ stochastic losses $D(\eta) = D_0(1 - S) \to 0$. The channel $\hat{O} : \mathcal{H} \to \mathcal{C}$ becomes "noise-free." Energy of transition from potentiality to actuality is not dissipated.

Physical analogue: superconductivity. At $T < T_c$ electrons synchronize ($S \to 1$), resistance = 0, current flows without losses.

What *already works*: - Superconducting magnets (MRI, CERN, tokamaks) - Superconducting power transmission cables (pilot projects) - Quantum computer qubits (coherent quantum states)

What ODTOE predicts:

Room-temperature superconductivity is not a *principal limitation*, but a question of *achieving* $S \to 1$ under given conditions. Traditional approach: cool (reduce thermal noise $\to$ $D(\eta) \downarrow$). ODTOE approach: *increase S directly*, without cooling. If coherence of actors (S) is sufficiently high — stochasticity is suppressed at *any* temperature.

Direction: materials with *architecturally high* S (not through cooling, but through structure). Graphene, carbon nanotubes, topological insulators — all work in this direction.

Channel efficiency formula:

$$\eta_{\text{channel}} = 1 - D(\eta)/D_0 = S \tag{II.1}$$

At $S = 0$: efficiency = 0 (everything dissipates). At $S = 1$: efficiency = 1 (everything transitions without losses).

1.3.2 Mechanism 2: Resonance with $\mathcal{H}$ (vacuum fluctuations)

Principle: $\mathcal{H}$ does not "stay silent" — it *fluctuates*. Virtual particles constantly create and annihilate. This is the "breathing" of $\mathcal{H}$: potentiality *pulsates*. If an observer *resonates* with these pulsations — it can *direct* part of the flow into a configuration.

Physical analogue: the Casimir effect. Two conducting plates in vacuum limit the spectrum of vacuum fluctuations *inside* (not all modes fit). Outside — full spectrum. Pressure difference → *measurable force*. This is *already* extraction of an effect from vacuum — so far in the form of force, not energy.

What ODTOE predicts:

The Casimir effect is a special case. The plates are a "filter," selecting certain modes of $\mathcal{H}$. Formula: $R_{\text{Casimir}} = \hat{O}_{\text{plates}}(\Psi_{\text{vac}})$ — a specific operator (plate geometry) constitutes a specific configuration (force) from the vacuum field.

Generalization: *any* geometry, *resonating* with modes of $\mathcal{H}$, should produce analogous effects. Not just flat plates — but rings, spirals, fractal structures. Each geometry = its own $\hat{O}$ = its own spectrum of "extraction" from $\mathcal{H}$.

Directions: - Dynamic Casimir effect (moving plates → real photons from vacuum — *already demonstrated* in 2011, Wilson et al.) - Casimir batteries (theoretical proposals for extracting work from Casimir force) - Resonant cavities tuned to vacuum fluctuation modes

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1.3.3 Mechanism 3: Recursive amplification (Φ^n)

Principle: the complete observation cycle $\Phi = \iota \circ \hat{O}$ returns the result to $\mathcal{H}$. If the result *amplifies* the next cycle — a *cascade* emerges:

$$\Phi^1 \to \Phi^2 \to \Phi^3 \to \ldots \quad \text{when } B_{n+1} > B_n \tag{II.2}$$

Each iteration extracts *more* than the previous one. Not "infinite energy from nothing" (violates thermodynamics), but *amplification of the channel through feedback*.

Physical analogue: laser. Stimulated emission: one photon → two → four → … Cascading amplification through coherent feedback. Energy is *input* (pumping), but *output* is coherent, directed, with minimal losses.

Through ODTOE: laser is a physical realization of Φ^n with $S \to 1$: - Pumping = increase in B of atoms (population inversion) - Resonator (mirrors) = ι — return of photons back into the system - Coherent emission = R at $S \to 1$, $D(\eta) \to 0$

Generalization: any system with *positive feedback* and *high coherence* is a potential "amplifier of channel $\mathcal{H} \to \mathcal{C}$." Laser — for photons. What analogous — for *other* types of energy?

Directions: - Phonon laser (coherent sound waves — *already demonstrated*) - Magnon laser (coherent spin waves) - Gravitational resonator (theoretically)

1.3.4 Mechanism 4: Coherence phase transitions

Principle: with continuous change in S there exist *critical points* where the system jumps from one regime to another. At a phase transition — *anomalous* coupling with $\mathcal{H}$.

Physical analogue: second-order phase transitions (superconductivity, superfluidity, Bose-Einstein condensation). At the critical point: fluctuations *diverge*, correlation length → ∞, system "feels" infinitely distant parts of itself.

Through ODTOE: at critical point $S = S_c$ system is *maximally coupled* with $\mathcal{H}$: fluctuations $D(\eta)$ are anomalously large (not suppressed and not maximal — *critical*). This is a "window" between $\mathcal{H}$ and $\mathcal{C}$: potentiality *breaks through* into actuality.

$$S = S_c : \quad D(\eta) \sim |S - S_c|^{-\gamma} \to \infty \tag{II.3}$$

What this means practically: systems *near* a phase transition are "antennae," receiving signals from $\mathcal{H}$. Not *in* a phase transition (chaos), not far from it (stability), but *on the edge* — maximum sensitivity.

Biological analogue: brain neural networks operate near critical points (theory of "edge of chaos," Beggs & Plenz, 2003). The brain is a system *tuned* to the edge of phase transition to maximally efficiently "read" $\mathcal{H}$.

Directions: - Materials near phase transitions as "antennae" for vacuum fluctuations - Controlled phase transition as a "valve" for channel $\mathcal{H} \to \mathcal{C}$ - Biomimetic systems imitating brain's critical state

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1.3.5 Mechanism 5: Collective observation (P5)

Principle: by P5.1: $P_{coll}(E) = 1 - \prod(1 - B_i^k)$. Collective probability of a *target configuration* grows nonlinearly with the number of coherent actors. One actor with $B = 0.5$ → $P = 0.25$. Ten such → $P_{coll} = 0.94$. Hundred → $P_{coll} \approx 1$.

Physical analogue: coherent emission (laser vs. lightbulb). 10^{20} atoms in a lightbulb emit incoherently — weak light. 10^{20} atoms in a laser emit coherently ($S \to 1$) — powerful directed beam. *The same* atoms, *the same* energy — but result is orders of magnitude more powerful due to coherence.

Through ODTOE: "extraction of energy from $\mathcal{H}$" is not a problem of *source* (source is infinite), but a problem of *actor synchronization*. 10^{80} atoms observe $\mathcal{H}$ *incoherently* $\to$ weak, scattered flow. The same 10^{80} atoms *coherently* $\to$ directed, powerful channel.

Channel power formula:

$$W_{\text{channel}} \propto n \cdot S^2 \cdot B_{\text{avg}}^k \tag{II.4}$$

n — number of actors, S — coherence, B_{avg} — average coherence, k — resistance coefficient. Power grows *quadratically* with coherence (analogue: power of coherent emission $\propto N^2$, incoherent $\propto N$).

1.4 III. SYNTHESIS: ARCHITECTURE OF IDEAL CHANNEL

Combining five mechanisms:

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IDEAL CHANNEL H → C
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├── 1. COHERENCE: S → 1
│   → Minimal losses: D(η) → 0
│   → Technology: superconductivity, topological materials
│
├── 2. RESONANCE: tuning to modes H
│   → Selective extraction of specific configurations
│   → Technology: resonant cavities, Casimir geometry
│
├── 3. RECURSION: Φ^n with amplification
│   → Cascading growth through feedback
│   → Technology: laser architecture, phonon resonators
│
├── 4. CRITICALITY: S ≈ S_c
│   → Maximum sensitivity to H
│   → Technology: materials near phase transitions
│
└── 5. COLLECTIVITY: n↑, S↑
    → Power ▫ n · S² (coherent vs. incoherent)
    → Technology: synchronization of macroscopic number of actors
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Ideal device combines all five: *large number of actors* ($n \gg 1$), *synchronized* ($S \to 1$), *near a phase transition* ($S \approx S_c$), *in a resonant cavity* (tuned to modes of $\mathcal{H}$), *with recursive amplification* (Φ^n through feedback).

This description *resembles*… **a star**.

1.5 IV. STAR AS A PROTOTYPE

1.5.1 4.1. Star through ODTOE

A star is a system in which *all five mechanisms work simultaneously*:

Mechanism	Realization in star
Coherence	Plasma: electrons and ions synchronized (quasineutrality)
Resonance	Nuclear resonance: triple alpha process (carbon synthesis) possible *only* due to Hoyle resonance
Recursion	Gravitational compression → temperature increase → reaction intensification → more energy → more pressure → equilibrium. Closed loop Φ
Criticality	Works *near* equilibrium: slightly more compression → explosion; slightly less → cooling. "Edge of chaos"
Collectivity	$\sim 10^{57}$ protons acting coherently

1.5.2 4.2. Conclusion

Nature *already* "extracts energy from $\mathcal{H}$" — through stars. A star is a channel $\hat{O}_{\text{star}} : \mathcal{H} \to \mathcal{C}$, converting potentiality (hydrogen = simplest configuration) into actuality (light, heat, heavy elements = complex configurations).

Thermonuclear fusion is not "extraction of energy from atoms" (as commonly said), but **reconfiguration**: $C_{\text{H}} \to C_{\text{He}} + \Delta E$. Energy is released *because* the new configuration C_{He} is *more coherent* ($S_{\text{He}} > S_{\text{H}}$), and the difference in $T(C)$ manifests as energy.

1.6 V. WHAT WE CAN DO NOW

1.6.1 5.1. Not "unlimited energy," but "increasing coherence"

Standard question: "Where to get more energy?" (search for new *source*: oil → uranium → thermonuclear → ??)

ODTOE question: **"How to increase coherence of existing channels?"** Energy does *not* "run out" — $\mathcal{H}$ is infinite. The problem is *losses* during transmission ($D(\eta) > 0$) and *dissipation* during use ($S < 1$).

1.6.2 5.2. Specific directions

Direction	ODTOE mechanism	Technology status
Room-temperature superconductivity	$S \to 1$ at $T = 300$ K	Active research (LK-99 — not confirmed, but search continues)
Controlled thermonuclear	Recursion + collectivity + criticality	ITER, NIF (demonstrated output > input in 2022)
Dynamic Casimir	Resonance with modes of $\mathcal{H}$	Demonstrated (Wilson et al., 2011 — photons from vacuum)
Metamaterials	Resonance: geometry tuned to modes of $\mathcal{H}$	Active research (negative refractive index, etc.)
Biomimetic systems	Criticality: "edge of chaos"	Early stage
Coherent energy transmission	$S \to 1$ for transmission: zero losses	Superconducting lines (pilot projects)

1.6.3 5.3. Formula of "progress" through ODTOE

$$\text{Progress in energy} = \Delta S_{\text{channel}} \cdot n_{\text{actors}} \cdot \eta_{\text{resonance}} \tag{V.1}$$

All of energy history is *increasing channel coherence*: - Campfire: $S \approx 0.01$, n small, η low → efficiency ~5% - Steam engine: $S \uparrow$, $n \uparrow$ → efficiency ~10% - Internal combustion: $S \uparrow\uparrow$ → efficiency ~30% - Electrical grid: $S \uparrow\uparrow\uparrow$ → efficiency ~90% (transmission) - Superconductivity: $S \to 1$ → efficiency → 100% (transmission) - Thermonuclear: all five mechanisms → ?

1.7 VI. PHILOSOPHICAL MEANING

1.7.1 6.1. Energy — not a "thing," but a "transition"

Standard physics: energy is a property of a system (kinetic, potential, thermal).

Through ODTOE: **energy is a characteristic of transition** $\mathcal{H} \to \mathcal{C}$. Not "how much energy *contains* a system," but "how much potentiality is *converted* into actuality for a given $\hat{O}$."

1.7.2 6.2. Why "energy crisis" is "coherence crisis"

$\mathcal{H}$ is infinite. Energy *does not run out*. *Channel coherence* runs out: oil burns incoherently ($S \ll 1$, efficiency ~30%). Wind blows incoherently. The Sun shines coherently — but our panels receive incoherently.

"Energy crisis" = low S of channels $\mathcal{H} \to \mathcal{C}$. Solution is not "find a new source," but **increase coherence of existing channels**.

1.7.3 6.3. Life as a channel

By ODTOE: life is a configuration with $\Phi = \iota \circ \hat{O}$ (complete cycle) and Ψ^* (fixed point). A living organism *continuously* extracts from $\mathcal{H}$: constitutes configurations (movement, growth, reproduction) from potentiality (food = simple configurations → complex).

Photosynthesis is the *most efficient* known channel $\mathcal{H} \to \mathcal{C}$: quantum coherence (~95% energy transfer efficiency), resonance (tuning to solar light frequency), recursion (Calvin cycle). Three of five mechanisms — in one process.

1.8 VII. DEMARCATION

Statement	Status
$\mathcal{H}$ contains infinite potentiality	**ODTOE Axiom** (A), consistent with $\|\mathcal{H}\|$ = infinite-dimensional space
Every act of observation is extraction from $\mathcal{H}$	**Follows from axiom** (A): $R = \hat{O}(\Psi)$
Channel efficiency is determined by S	**Follows from P3 and formula 4.4a**: $D(\eta) = D_0(1 - S)$
Five mechanisms for increasing efficiency	**Theoretical classification** based on ODTOE
Superconductivity = $S \to 1$	**Interpretation**, consistent with Cooper pair physics
Dynamic Casimir = extraction of photons from $\mathcal{H}$	**Experimental fact** (Wilson et al., 2011)
"Unlimited energy from vacuum"	**Speculative**. Second law of thermodynamics not repealed
Channel power formula (II.4)	**Hypothesis**, requires experimental verification

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1.9 VIII. CONCLUSION

Energy does not "run out" — $\mathcal{H}$ is infinite. The problem is not the *source*, but the *channel*. Every act of observation already *extracts* from $\mathcal{H}$: constitutes a configuration from potentiality. The question is *efficiency*.

Five mechanisms for increasing efficiency: coherence ($S \to 1$), resonance (tuning to modes of $\mathcal{H}$), recursion (Φ^n), criticality ($S \approx S_c$), collectivity ($n \cdot S^2$). Nature already uses all five: a star = ideal channel. Photosynthesis = most efficient biological channel.

All of energy history is increasing coherence. Campfire → steam engine → electricity → superconductivity → thermonuclear. Each step is growth in S, decrease in $D(\eta)$, amplification of P_{coll}.

The next step is not "a new source," but **channel architecture**: materials with high S, resonant cavities for modes of $\mathcal{H}$, recursive amplification through Φ^n, operation near phase transitions, synchronization of a macroscopic number of actors.

$\mathcal{H} = \infty$. Problem is not source, but channel. $\eta_{\text{channel}} = S$. Increase coherence.

1.10 ACKNOWLEDGMENTS AND TOOLS

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