PAPER 152: STARRY NIGHT IS A PHASE DIAGRAM

Vincent van Gogh Painted Turbulence Physics One Hundred Years Before It Was Measured

Rhet Dillard Wike | AIIT-THRESI Research Initiative

Council Hill, Oklahoma | April 2026

> "I feel a terrible need of — shall I say the word — religion. Then I go out at night to paint the stars."
> — Vincent van Gogh, Letter to Theo, September 1888
>
> "The energy spectrum of turbulent flow follows E(k) ∝ k^(−5/3)."
> — Andrei Kolmogorov, 1941

Abstract

In 2006, physicists at UNAM (Mexico) measured the luminance fluctuations in Vincent van Gogh's *Starry Night* (1889) and found that they follow the Kolmogorov −5/3 power law — the statistical signature of fully developed turbulent flow. The finding held across three paintings created during Van Gogh's most acute psychological disturbances, and failed to appear in paintings created during calmer periods. The conclusion was remarkable: Van Gogh did not merely depict turbulence. He *encoded it* — at the statistical level, in luminance distributions, across spatial scales spanning two orders of magnitude.

This paper argues that the Wike Coherence Law provides the mechanism the 2006 finding did not explain. The Kolmogorov cascade is not merely a fluid phenomenon — it is the visual signature of a system operating at the critical threshold $\gamma_{eff} \approx \gamma_c$, where coherence and collapse coexist in maximum tension. Van Gogh's brush moved that way because Van Gogh's nervous system *was* that way. The paintings are not representations of turbulence. They are readouts — direct transcriptions of a biological system operating at the edge of coherence, by a man who spent his life at that edge, producing there the maximum creative output physics predicts and the maximum suffering physics explains.

We further show that Van Gogh's obsession with luminosity maps directly to the coherence field itself (C■ in the Wike Law), and that the progression of his self-portraits constitutes a visible γ_{eff} time series — a phase diagram of a man approaching collapse, documented in oil on canvas.

---

1. The Measurement That Changed Everything

1.1 Kolmogorov's Law

In 1941, Andrei Kolmogorov derived the statistical structure of fully developed turbulent flow from first principles. His key result — now called the Kolmogorov −5/3 law — describes how kinetic energy distributes across spatial scales in turbulent fluid:

$$E(k) \propto k^{(-5/3)}$$

```
where:
  E(k) = energy at spatial frequency k
  k    = wavenumber (inverse of scale size)
```

This power law holds across the inertial subrange — the range of scales between the large energy-injection scale and the small viscous dissipation scale. At every scale within this range, the statistical properties of turbulence are self-similar. The cascade is scale-free.

This is the defining mathematical signature of a system at criticality. Power laws appear when correlation length diverges — when small-scale fluctuations are coupled to large-scale structure through all intermediate scales. This is exactly the 3D Ising universality condition. This is $\gamma_{eff} \approx \gamma_c$.

1.2 The Van Gogh Finding

Aragón et al. (2006, 2008) analyzed the luminance fluctuation statistics in Van Gogh's paintings using structure functions — the same mathematical tools used to characterize turbulent velocity fields. The analysis measured how luminance differences between points vary as a function of the distance between them.

Finding: *Starry Night* (1889), *Road with Cypress and Star* (1890), and *Wheat Field with Crows* (1890) — all painted during periods of acute psychological disturbance — showed luminance structure functions consistent with Kolmogorov turbulence statistics. The −5/3 power law appeared in the spatial luminance fluctuations across two orders of magnitude in scale.

Control: Paintings created during Van Gogh's calmer periods — *Self-Portrait with Grey Felt Hat* (1887), *Still Life with Roses* (1890, calm period) — did not show Kolmogorov statistics. The luminance fluctuations were flatter, less scale-free, closer to white noise.

The turbulence signature appeared specifically when Van Gogh was most disturbed.

The 2006 paper identified the correlation. It did not explain the mechanism.

---

2. The Wike Framework: What Turbulence Actually Is

2.1 Reynolds Number as γ_{eff}

Paper 45 of the AIIT-THRESI framework (Wike, 2026) establishes the formal mapping:

```
Re = ρvL/μ    →   γ_eff   (fluid decoherence rate)
Re_c ≈ 2,300  →   γ_c     (critical threshold)
Laminar flow  →   C > C_threshold  (coherent state)
Turbulent flow →  C → 0             (collapsed state)
```

The Wike Coherence Law for fluid systems:

```
C_flow = C■ × exp(−α × Re/Re_c)
```

Turbulence is not mere disorder. It is the fluid state above the critical decoherence threshold — the state where energy no longer organizes into coherent laminar structures but cascades through all scales simultaneously. The Kolmogorov cascade IS the energy dissipation pattern of a fluid at $\gamma_{eff} > \gamma_c$.

Critically: the Kolmogorov −5/3 law describes the behavior AT the critical

transition. It is the power-law signature of maximum susceptibility — the same scaling that appears in all critical phenomena described by 3D Ising universality. The cascade is not fully turbulent chaos. It is the edge.

2.2 The Three Regimes, Visually

```
γ_eff << γ_c  : FROZEN
  Visual signature: Glass-smooth water. Perfect reflection.
  No texture. No fluctuation. No life.
  Artistic analog: Academic painting. Rigid. Beautiful. Dead.

γ_eff ≈ γ_c   : EDGE
  Visual signature: The moment water begins to swirl.
  Vortices forming and dissolving. Scale-free structure.
  Power-law texture across all scales.
  Artistic analog: Starry Night.

γ_eff >> γ_c  : COLLAPSED
  Visual signature: White water. Foam. No coherent structure.
  Pure randomness. No persistent pattern.
  Artistic analog: Not painted. Cannot be painted.
  The painter collapses before the canvas does.
```

Van Gogh's turbulent paintings are not images of chaos. They are images of the edge. The Kolmogorov statistics confirm this: not the flat spectrum of noise, not the smooth spectrum of laminar order — the −5/3 power law of the critical transition, sustained across two orders of magnitude in spatial scale.

2.3 Why the Calm Paintings Are Different

The fact that calmer-period paintings lack Kolmogorov statistics is the critical experimental confirmation.

During his calm periods, Van Gogh's γ_{eff} was below γ_c. His nervous system was in the coherent regime — beautiful, controlled, but not at the edge. The brush moved with discipline. The luminance distributions were not scale-free. The correlation length did not diverge.

During his acute episodes, γ_{eff} crossed γ_c. His nervous system was at — or briefly above — the critical threshold. Maximum susceptibility. Maximum sensitivity to every input. The brush moved the way a turbulent fluid moves: scale-free, self-similar, encoding the Kolmogorov cascade directly in the stroke.

The paintings are a biological phase diagram. Calm = below γ_c. Turbulent paintings = at γ_c. The distinction is not artistic style. It is physics.

---

3. Van Gogh's Nervous System as a Critical System

3.1 The Diagnosis

Van Gogh's psychiatric condition has been debated for 130 years. Current consensus (Arnold, 2004; Blumer, 2002) favors temporal lobe epilepsy (TLE), possibly with comorbid bipolar disorder. The TLE hypothesis accounts for:

- Episodic acute states with recovery intervals
- Hypergraphia (he wrote over 800 letters to Theo alone)
- Intensified emotional and religious experience during prodromal states
- The visual aura and perceptual alterations he described in letters

- The pattern of productivity: highest output near but not during the worst episodes

In Wike terms: TLE produces periodic γ_eff spikes — ictal events that push the nervous system above γ_c, followed by post-ictal recovery periods during which γ_eff descends back toward and through γ_c. The productive painting occurred during the approach and descent — the time spent at γ_c, not the time spent above it.

Van Gogh painted at the edge. The seizures pushed him over. The recovery brought him back. The paintings were made on the way.

3.2 The Letters as γ_eff Log

Van Gogh wrote approximately 820 letters to his brother Theo, constituting one of the most extensive first-person accounts of a creative and psychological process in the history of art. Examined through the AIIT-THRESI lens, they read as a real-time γ_eff log.

Low γ_eff states (below γ_c — Frozen):

> "I feel a great emptiness... I am unable to work."
> — Letter 638, Paris period

Edge states (γ_eff ≈ γ_c — Maximum vitality):

> "I have a terrible lucidity at moments... when nature is so beautiful, I am not conscious of myself anymore, and the pictures come to me as in a dream."
> — Letter 543, Arles, 1888

Above γ_c — Collapse approaching:

> "I am not able to describe exactly what is the matter with me. Now and then there are horrible fits of anxiety, apparently without cause, or otherwise a feeling of emptiness and fatigue in the head."
> — Letter 605, Saint-Rémy, 1889

The progression is not metaphorical distress. It is the biological phase language of a critical system:

- Below γ_c: emptiness (frozen, no information flow)
- At γ_c: lucidity, effortlessness, self-loss (maximum coherence, maximum vitality)
- Above γ_c: anxiety, fragmentation, fatigue (decoherence cascade)

Starry Night was painted during a letter-513-to-543-period state. The Kolmogorov statistics in the paint confirm what the words already described.

3.3 The Vitality Function at γ_c

The AIIT-THRESI Vitality Function (Paper 30):

$$V(\gamma) = C\blacksquare \times \gamma \times \exp(-\alpha\gamma)$$

$$\text{Maximum at: } \gamma_c = 1/\alpha$$

This function peaks at the critical threshold. Below γ_c: under-driven, low vitality. Above γ_c: over-driven, coherence collapsing. At γ_c: maximum creative output, maximum susceptibility, maximum information integration.

Van Gogh's most productive period — Arles and Saint-Rémy, 1888–1890 — produced over 300 paintings in 24 months. It was also the period of his ear, his hospitalization, and his most acute psychiatric episodes.

He was at maximum V(γ). His brain was running at V_max. The output matches the physics. The cost matches the physics. Both were predicted by the same equation, one

hundred years before the equation was written.

4. Luminosity as Coherence

4.1 What Van Gogh Was Actually Seeing

Van Gogh's letters contain hundreds of references to light — not merely light as a visual phenomenon, but light as something he experienced almost physically, as a substance that organized the world.

> "The night is even more richly coloured than the day... colour has to be gotten from somewhere."
> — Letter to Theo, Arles, September 1888

> "I want to paint men and women with that something of the eternal which the halo used to symbolize, and which we seek to convey by the actual radiance and vibration of our colorings."
> — Letter to Theo, Arles, 1888

In the AIIT-THRESI framework, C■ is the maximum coherence of the system — the baseline coherence before any decoherence has occurred. It corresponds to the source field: the quantum vacuum, the unperturbed state, what remains when γ_eff = 0.

Van Gogh was trying to paint C■.

Not the objects illuminated by light. Not the photons themselves. The source field — the organized, coherent state that exists before any noise enters the system. The "radiance and vibration" he described is not a metaphor. It is the physical description of a coherence field radiating. EZ water under infrared light. Mitochondrial biophotons. The organized emission of a biological system operating at low γ_eff.

He could see it. His nervous system, operating at γ_c with maximum susceptibility, was sensitive to the coherence field emissions that ordinary perception filters out. His letters document this as religious experience. His physics was right.

4.2 The Halo Problem

Van Gogh painted halos around light sources — candles, stars, gas lamps, the moon. Not the diffuse glow of scattering, but structured, organized rings of radiating light that contemporary critics found bizarre and distorted.

The structured halo is the visual signature of coherent emission from a low-γ_eff source.

Incoherent light sources (high γ_eff): broad, diffuse scattering. The photons leave in random directions. No structure.

Coherent light sources (low γ_eff): organized wavefronts. Structured diffraction patterns. Halos.

Van Gogh's painted halos match the interference patterns produced by coherent light sources passing through a disordered medium (turbulent atmosphere, or vitreous humor with altered properties in a sensitized visual system). He was not distorting reality. He was seeing the coherence structure that ordinary filtered perception misses.

His visual cortex, with reduced thalamic gating (γ_measurement reduced by his neurological state), was forwarding more of the raw optical signal to consciousness.

More of the coherence structure was getting through.

He painted what he saw. What he saw was the coherence field.

---

5. The Self-Portrait Series as Phase Diagram

5.1 Thirty-Six Faces of γ_eff

Van Gogh painted approximately 36 self-portraits between 1886 and 1889. No artist of comparable stature produced a comparable self-portrait record over such a compressed period. This is not coincidence. It is hypergraphia applied to canvas — the TLE-driven compulsion to document, turned inward.

The result is an inadvertent γ_eff time series.

1886–1887 (Paris, γ_eff below γ_c):
Brushwork structured, exploratory, relatively controlled. Influence of Impressionism visible. The strokes are learning the edge, not yet at it. Luminance fluctuations: non-Kolmogorov. Eyes: alert, searching.

1888 (Arles, γ_eff approaching γ_c):
The swirling technique emerges. Brushstrokes become more turbulent, more self-similar across scales. The self-portraits from this period — *Self-Portrait Dedicated to Paul Gauguin* (1888) — show structured turbulence in the background fields. Eyes: intensely focused, almost too focused. Maximum V(γ).

1889 (Saint-Rémy, γ_eff oscillating through γ_c):
Self-Portrait with Palette (September 1889). Background: full Kolmogorov turbulence. The brushwork in this painting was confirmed by the Aragón measurements to carry the −5/3 signature. Face: composed, watchful, held together against the turbulent field surrounding it. The sitter and the field are in different γ_eff states. He is painting himself in the coherent eye of the storm he is also painting.

5.2 The Prediction

If the self-portrait series is a γ_eff time series, and if the AIIT-THRESI framework is correct, the following should hold:

1. Kolmogorov statistics should appear specifically in self-portraits painted during documented acute periods, not during documented calm periods.
2. The spatial distribution of Kolmogorov-compliant regions within paintings should correlate with compositional elements associated with emotional intensity (sky, light sources, background fields) rather than with compositionally "calm" elements (still faces, inanimate objects in the foreground).
3. The power-law exponent should approach −5/3 precisely during documented prodromal/post-ictal states and deviate from it during calmer periods.

These are testable predictions. The Aragón dataset enables partial testing now. Full testing requires analysis of the complete self-portrait chronology against the documented psychiatric timeline.

---

6. The Painter at γ_c: Connection to Paper 22

Paper 22 (Wike, 2026) documents a painting created in an altered state approximately one year before the mathematical framework was consciously developed. The analysis

shows that the painting encoded the complete AIIT-THRESI physics in visual language, through a mechanism identified as the Attractor Retrieval Hypothesis: when γ_measurement is reduced (thalamic gating disrupted, DMN suppressed), the brain's coherence field antenna reaches maximum gain, and attractor states in the coherence field become accessible to motor output.

The brain does not create the physics in these states. It receives it.

Van Gogh's mechanism was not psychedelic — it was neurological. Temporal lobe seizures and their aftermath produce similar γ_measurement reduction through different mechanisms: post-ictal thalamic suppression, DMN disruption during ictal propagation, theta enhancement during recovery phases.

The result is the same: a painter operating at γ_c, with reduced prediction filtering, encoding the coherence field directly in paint.

His access was involuntary. His output was involuntary. His suffering was real. But the physics was also real — and the 2006 turbulence measurements confirm it from outside, with instruments that did not exist in his lifetime.

He painted the truth. We are still measuring it.

---

7. Discussion

7.1 Why This Is Not Metaphor

The Aragón finding is not interpretive. It is measurement. The Kolmogorov −5/3 law appears in the spatial luminance statistics of specific Van Gogh paintings. This is a number — an exponent derived from structure function analysis — and it matches the number Kolmogorov derived from fluid mechanics in 1941.

The agreement between the turbulence exponent measured in paint and the turbulence exponent measured in fluid dynamics is not coincidence. Both are measuring the same underlying phenomenon: the energy distribution of a system at the critical decoherence threshold, where the correlation length diverges and scale-free structure emerges across all scales.

The Wike framework provides the unifying mechanism: $\gamma_{eff} \approx \gamma_c$ produces power-law statistics in any system, because criticality is universal. The 3D Ising exponents (confirmed to $p < 10^{12}$ in AIIT-THRESI Papers 06, 10, 46) govern phase transitions from quantum dots to ferromagnets to fluid flows to neural dynamics. Van Gogh's nervous system was no exception.

7.2 The Cost of the Edge

The Vitality Function peaks at γ_c. This is also where suffering is maximized.

$V_{max} = C \times (1/\alpha) \times \exp(-1) = C/(\alpha e)$

This is the maximum creative output available to any biological system. It is achieved at the same γ_eff that produces maximum anxiety, maximum emotional intensity, maximum susceptibility to decoherence cascade. The edge is the most alive and the most dangerous place a biological system can operate.

Van Gogh spent most of his productive life there. He painted what living at γ_c looks like. The Kolmogorov statistics in the paint confirm that his nervous system was not merely inspired during these periods — it was physically at the critical threshold, and the brush was its readout.

He died at 37. The physics predicted that outcome too.

7.3 Implications for Art History

If the framework is correct, it implies:

1. The greatest art was not made by the most skilled hands but by the most critical nervous systems — systems operating at γ_c for sustained periods.

2. The emotional response viewers have to great art — the inexplicable feeling of being moved, of recognition, of something larger — is coherence resonance. The viewer's nervous system recognizes the γ_c signature in the paint and resonates with it. The painting reduces the viewer's γ_eff toward γ_c momentarily. This is why art feels like medicine. Because it is.

3. The artists with the most chaotic and tragic biographies are not pathological aberrations. They are the cost of the edge. The creativity and the suffering are the same phenomenon: maximum susceptibility in both directions simultaneously.

---

8. Predictions

The AIIT-THRESI framework makes the following testable predictions for future art analysis:

Prediction	Test	Expected Result
Kolmogorov statistics appear in art created during edge states	Analyze full Van Gogh catalog aga
Exponent deviates toward white noise during calm periods	Same analysis	Flatter spectrum during
Spatial distribution of Kolmogorov regions correlates with emotional intensity	Region-by-region
Other artists with known edge-state biographies show similar signatures	Apply to Munch, Basquiat
Controlled viewing of Kolmogorov-compliant art reduces viewer HRV noise	Randomized controlled ex

The last prediction is directly testable with consumer HRV monitors in a museum setting. The Wike Coherence Law predicts a measurable coherence increase in viewers of Kolmogorov-compliant paintings. This is not metaphysical. It is a measurable biological event.

---

9. References

Aragón JL et al. — Turbulent luminance fluctuation analysis of Van Gogh paintings; structure function consistent with Kolmogorov −5/3 law in three acute-period works. (2006–2008, UNAM; exact journal citation to be verified)

Arnold W (2004) — Van Gogh's illness: epilepsy or manic depression? *Lancet*, 364(9450):1975.

Blumer D (2002) — The illness of Vincent van Gogh. *Am J Psychiatry*, 159(4):519–526. doi:10.1176/appi.ajp.159.4.519

Carhart-Harris RL et al. (2012) — Neural correlates of the psychedelic state as determined by fMRI studies with psilocybin. *Proc Natl Acad Sci*, 109(6):2138–2143. doi:10.1073/pnas.1119598109

Carhart-Harris RL et al. (2014) — The entropic brain: a theory of conscious states informed by neuroimaging research with psychedelic drugs. *Front Hum Neurosci*, 8:20. doi:10.3389/fnhum.2014.00020

Carhart-Harris RL et al. (2016) — Neural correlates of the LSD experience revealed

by multimodal neuroimaging. *Proc Natl Acad Sci*, 113(17):4853–4858. doi:10.1073/pnas.1518377113

Kolmogorov AN (1941) — The local structure of turbulence in incompressible viscous fluid for very large Reynolds numbers. *Doklady Akademii Nauk SSSR*, 30(4):299–303.

Muller F et al. (2018) — Increased thalamic resting-state connectivity as a core driver of LSD-induced hallucinations. *Acta Psychiatr Scand*, 138(1):56–65.

Reynolds O (1883) — An experimental investigation of the circumstances which determine whether the motion of water shall be direct or sinuous, and of the law of resistance in parallel channels. *Phil Trans R Soc Lond*, 174:935–982.

Van Gogh V (1853–1890) — Letters to Theo van Gogh. Complete correspondence archived at vangoghletters.org. Letters cited: #543 (Arles, 1888), #605 (Saint-Rémy, 1889), #638 (Paris period).

Wike RD (2026) — AIIT-THRESI Framework Papers 01–151. Council Hill, Oklahoma. Core citations:
- Paper 01: Wike Coherence Law (C = C■·exp(−α·γ_eff))
- Paper 22: The Painting — Attractor Retrieval Hypothesis
- Paper 30: Wike Scaling Law and Critical Threshold
- Paper 45: Reynolds Number as γ_eff (Fluid-Dynamic Coherence)
- Paper 48: Power Laws and the Edge State

Wilson KG (1971) — Renormalization group and critical phenomena. *Phys Rev B*, 4:3174.

Appendix: The Equation on the Canvas

The Wike Coherence Law:

$$C = C■ \cdot \exp(-\alpha \cdot \gamma\_eff)$$

Van Gogh's turbulent brushwork, measured by Aragón et al.:

$$E(k) \propto k^{(-5/3)}$$

Reynolds number at the laminar-turbulent transition:

$$Re\_c \approx 2{,}300$$

The Vitality Function at the edge:

$$V\_max = C■ / (\alpha e) \quad \text{at } \gamma\_eff = \gamma\_c = 1/\alpha$$

Van Gogh operated at V_max for 24 months.

He painted 300 canvases.

He cut off his ear.

He wrote: *"The night is even more richly coloured than the day."*

He was right. At γ_c, with maximum coherence field sensitivity, it is.

The equation was not written yet.

The paint was already there.

AIIT-THRESI Research Initiative
Rhet Dillard Wike | Council Hill, Oklahoma | April 2026
"13.8 million simulations. One equation. It was always this."