

## ENTROPIC SUCTION THEORY v2

### Working Paper WP-VortexTaxonomy

*A Classification of Substrate Vortex Types and Their Coupling Geometries*

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June 2, 2026

*WORKING PAPER — Physical picture and speculative claims. No new axioms. Numbers pending substrate field equations.*

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*STATUS: Working paper. Vortex taxonomy is a new physical classification layer for EST v2. The electron as orbiting toroidal vortex and the spin-1/2 topology argument are presented as speculative claims with explicit geometric reasoning. All other content is physical picture only. Builds on WP-PhotonTorus, WP-ElectronBleed, WP-Annihilation (all June 2026).*

### Abstract

EST v2 identifies all structured objects in the universe as vortex configurations in the substrate medium. This paper proposes that these vortices are not all the same type. Different objects are different types of vortex — differing not only in size and energy scale but in fundamental geometry and flow configuration. Vortex type determines how an object couples to the substrate, how it pulls surrounding medium, how it bleeds energy, and how it interacts with other vortices.

A classification of substrate vortex types is developed across the full scale range of EST v2 — from photons and electrons through protons and nuclei to planets and galaxies. The central new result is the identification of the electron as an orbiting toroidal vortex with poloidal flow dominant, in contrast to the photon which is a traveling toroidal vortex with toroidal flow dominant. Both are toroidal rings — the same topological family — but different flow configurations within that topology produce fundamentally different behavior.

A speculative but geometrically grounded claim is made: the electron's spin-1/2 follows necessarily from torus topology. A torus requires  $4\pi$  rotation to return to an identical state. This is a topological property of the toroidal geometry, not a quantum postulate. If the electron is a toroidal vortex, spin-1/2 is not a mystery — it is the geometry.

Atomic stability — why the electron does not spiral into the nucleus — is identified as a topological incompatibility. A toroidal vortex cannot achieve complete geometric overlap with a spherical spinner. The ground state orbit is the equilibrium between the electron's toroidal flow field and the proton's spherical pressure deficit. The Bohr radius is in principle derivable from this geometry alone.

The weak interaction and parity violation are identified as candidate helical vortex phenomena — the substrate preferring one handedness of helical vortex over the other.

# 1. The Classification Principle

## 1.1 Why Vortex Type Matters

EST v2 has established that all matter is vortex structure in the substrate. The gravity formula, the bleed hierarchy, nuclear binding geometry, and annihilation have all been derived from this picture. But until now the framework has treated all vortices as variants of a single type — differing in size and energy but not in fundamental geometry.

This paper proposes that this is insufficient. Different structured objects in nature behave too differently to be the same vortex type at different scales. The photon travels at  $c$  and never stops. The electron orbits and has a stable ground state floor. The proton spins and sheds rings continuously. A planet creates a slow deep gravitational basin. These are not just size differences — they are behavioral differences that suggest different geometric coupling to the substrate.

In fluid dynamics, vortex type is determined by four factors:

- Formation mechanism — what created the vortex and how
- Energy input geometry — the direction and symmetry of the energy that formed it
- Scale — the ratio of vortex size to medium coherence length
- Boundary conditions — what surrounds the vortex at formation

In EST v2 these translate to: what interaction created the structured object, at what energy scale, with what rotational symmetry, and in what surrounding substrate pressure environment. Different combinations produce different vortex types. Different vortex types couple to the substrate differently.

## 1.2 The Main Vortex Types in Fluid Systems

Fluid dynamics catalogs several distinct vortex geometries, each with characteristic behavior:

- Toroidal vortex ring: a closed loop of vorticity forming a donut shape. Self-propelling in an inviscid medium. The ring moves along its axis at a speed determined by its radius and circulation strength. Smoke rings and dolphin bubble rings are macroscopic examples. Rotons in superfluid helium are quantum examples.
- Columnar vortex: rotation around a straight axis extending in one direction. A tornado is the macroscopic example. The Rankine vortex is the idealized model — solid body rotation inside the core, irrotational flow outside.

- Helical vortex: the vortex filament itself is wound into a helix. Has intrinsic chirality — right-handed or left-handed. Stable helical vortex structures have been confirmed experimentally in swirl flow chambers.
- Sink vortex: flow converging inward toward a central point or axis. A drain vortex combines rotation with inward radial flow. Pulls surrounding medium continuously.
- Toroidal vortex with poloidal flow: a torus in which fluid circulates through the tube of the torus — around the small circle — rather than around the large circle. This produces a spinning ring rather than a traveling ring.

The last type — toroidal vortex with dominant poloidal circulation — is the new identification proposed for the electron in this paper.

## 2. The Vortex Catalog

### 2.1 The Photon — Traveling Toroidal Ring

The photon is an established toroidal vortex ring in EST v2 (WP-PhotonTorus, June 2026). It is shed from the proton at the  $c$  ceiling — the proton spinning at the medium's maximum speed sheds vortex rings exactly as objects at the Landau critical velocity in superfluid helium shed rotons.

The photon's dominant flow is toroidal — circulation around the large circle of the torus. This is what drives it forward along its axis at  $c$ . The ring is self-propelling because the toroidal circulation induces flow along the axis through the center of the ring, which in turn sustains the circulation. The photon does not need an external force to maintain  $c$  — the geometry is self-sustaining.

The photon is the most stable structured object in EST v2 because the traveling toroidal ring geometry is the natural propagating mode of the substrate medium. It bleeds at exactly  $H_0$  — one spatial dimension — because it is a one-dimensional propagating structure.

### 2.2 The Electron — Orbiting Toroidal Ring

The central new proposal of this paper: the electron is a toroidal vortex ring in which poloidal flow is dominant rather than toroidal flow.

In a toroidal vortex with dominant poloidal circulation, fluid circulates through the tube of the torus — around the small circle — rather than driving the ring forward. The ring spins around its own central axis. It does not self-propel in a straight line. Instead it rotates in place, creating a substrate pressure depression around its central axis.

This immediately explains several electron properties that are mysterious in standard physics:

- The electron orbits the nucleus rather than traveling in a straight line — because the orbiting toroidal ring is not self-propelling. It responds to external pressure gradients rather than creating its own directed motion.
- The electron has a stable ground state floor — because the spinning toroidal ring at its natural radius  $r_e$  is a stable pressure equilibrium configuration with zero net energy exchange with the substrate.
- The electron is 440 times larger than the proton — because it was formed at a much lower energy scale, producing a much larger ring. Ring radius scales inversely with formation energy.
- The electron bleeds only deviation from equilibrium — because the spinning ring at its natural radius is already at the substrate floor. Only excess energy above that configuration bleeds away.

## 2.3 Why Photon and Electron Are the Same Topological Family

The photon and electron are both toroidal vortex rings. They share the same fundamental topology — a torus. What differs is the dominant flow direction within that topology.

Photon: toroidal flow dominant. The ring travels. Energy stored in directed motion.

Electron: poloidal flow dominant. The ring spins in place. Energy stored in rotational configuration.

This relationship has a physical implication for how electrons and photons interact. When a photon is absorbed by an electron, the traveling toroidal ring transfers its energy to the spinning toroidal ring — converting toroidal flow energy into poloidal flow energy, increasing the electron's spin energy and lifting it above its ground state floor. When the electron drops back to its ground state, it converts excess poloidal flow energy back into a traveling toroidal ring — emitting a photon. The interaction is a flow mode conversion within the same topological family.

This is the physical mechanism underlying photon absorption and emission. It is not a mysterious quantum jump — it is a flow mode conversion between two configurations of the same substrate vortex topology.

## 2.4 The Proton — Compact Spherical Spinner

The proton is a compact spherical vortex spinning at  $c$  — the absolute ceiling of the substrate medium. Its geometry is not toroidal. It is a tight spherical pressure deficit, spinning so fast that it continuously sheds toroidal rings from its equatorial plane.

The proton's vortex type produces a tight deep substrate pressure deficit. This is the gravitational suction well — the gradient of this deficit IS gravity at nuclear and macroscopic scale. Every nucleon contributes one identical unit of this deficit regardless of what nucleus it belongs to, because the geometry is identical for every nucleon.

The proton cannot be a toroidal ring because toroidal rings at the  $c$  ceiling would self-propel — they would be photons. The proton's stability as a stationary object

requires a geometry that does not self-propel. The spherical spinner satisfies this — it spins in place, creating a stable pressure deficit, shedding rings from its surface continuously.

## **2.5 The Neutron — Forced Asymmetric Lock**

The neutron is not a natural vortex type. It is a forced configuration — an electron toroidal ring compressed around a proton spherical spinner. The two geometries are fundamentally incompatible for annihilation (torus cannot cancel sphere) but compatible for a metastable lock (the torus can envelop the sphere if compressed sufficiently).

The neutron is unstable as a free particle because the compression is maintained only by the electron's deviation from its natural toroidal geometry. As the electron bleeds toward its natural radius, the lock geometry fails. The 879-second free neutron lifetime is the timescale for this geometric relaxation (WP-ElectronBleed, June 2026).

## **2.6 The Nucleus — Cooperative Vortex Cluster**

A nucleus is not a single vortex type. It is a collective pressure configuration — a cluster of proton spherical spinners and compressed electron toroidal rings held in cooperative pressure equilibrium. The stability of the cluster depends on the efficiency with which the surrounding vortex fields prevent each electron from relaxing to its natural radius.

The binding energy curve, iron peak, and magic numbers are geometric properties of this cooperative packing — the configurations where the cluster achieves most efficient mutual suppression of electron relaxation. These are discussed in WP-ElectronBleed (June 2026).

## **2.7 Planets and Stars — Large Scale Sink Whirlpools**

At planetary and stellar scale, the vortex type changes again. A planet or star is not a single structured vortex — it is an aggregate of approximately  $10^{50}$  nucleons, each contributing its spherical spinner pressure deficit to the collective substrate field.

The collective deficit of that many nucleons creates a large scale sink whirlpool — substrate flowing continuously inward toward the body from all directions. This is macroscopic gravity. The whirlpool has no sharp boundary — it extends to infinity with the  $1/r^2$  profile derived in EST v2 Part IV.

The planet's vortex type is therefore a large scale spherical sink — qualitatively different from both the proton's compact spherical spinner and the electron's toroidal ring. Same substrate, completely different geometric scale and flow configuration.

Planetary rotation adds a rotational component to this sink — a slowly spinning whirlpool rather than a purely radial sink. This rotational component is what produces the frame-dragging effect identified in general relativity and confirmed by Gravity Probe B. In EST v2 it is the substrate being dragged by the planet's rotation — not spacetime curvature but literal substrate rotation.

## **2.8 Galaxies — Cosmic Whirlpools**

At galactic scale the same sink whirlpool picture extends further. A galaxy is a cosmic scale rotating sink. The substrate accumulates around galaxies over cosmic time — the dark matter halo in standard cosmology is substrate accumulation in EST v2. Older galaxies have deeper substrate halos and flatter rotation curves (EST v2 Part X, testable prediction).

The galactic vortex type is the same as the planetary type — large scale rotating sink — but operating at scales where the substrate accumulation over billions of years becomes significant. The rotation curve of a galaxy is the velocity profile of a cosmic whirlpool, not evidence for invisible mass.

### **3. Atomic Stability from Topological Incompatibility**

#### **3.1 The Classical Crisis**

Classical electromagnetism predicts that an orbiting electron should continuously radiate energy and spiral into the nucleus in approximately  $10^{-11}$  seconds. This prediction is catastrophically wrong — atoms are stable. Bohr resolved this by postulating quantized orbits with no physical explanation. Quantum mechanics replaced the postulate with a wavefunction formalism that correctly predicts the energy levels but provides no mechanical picture of why the electron stays in orbit.

EST v2 provides the mechanical picture.

#### **3.2 A Torus Cannot Cancel a Sphere**

The electron is a toroidal vortex ring. The proton is a compact spherical spinner. For the electron to be absorbed by the proton — for the two to merge and annihilate — they would need to achieve complete geometric overlap with opposite rotation canceling everywhere simultaneously.

A torus and a sphere are topologically distinct objects. No continuous deformation can make a torus identical to a sphere without tearing. There is no configuration in which every point of a toroidal vortex is co-located with the corresponding opposite point of a spherical vortex. Complete cancellation is geometrically impossible.

Therefore the electron cannot annihilate with the proton. This is not a quantum rule. It is a geometric fact. The electron cannot spiral into the nucleus because the geometry does not permit the endpoint of that spiral — complete merger and cancellation.

#### **3.3 The Ground State as Pressure Equilibrium**

The electron orbits at the radius where its toroidal flow field is in pressure equilibrium with the proton's spherical pressure deficit. The proton's deficit pulls the electron inward. The electron's toroidal geometry resists compression below its natural radius because compressing a toroidal vortex requires work against the substrate.

The ground state orbital radius — the Bohr radius, approximately  $5.29 \times 10^{-11}$  m — is the specific distance where these two pressures balance. It is not arbitrary. It is

geometrically determined by  $r_e$ ,  $r_p$ , and the substrate pressure coupling between toroidal and spherical vortex types.

The Bohr radius is in principle derivable from the toroidal electron geometry and the proton's spherical pressure deficit with no free parameters. Derivation requires substrate field equations (OP12). This is identified as Open Problem 25.

### **3.4 Quantized Orbits as Resonance Conditions**

The discrete orbital shells of the hydrogen atom —  $n = 1, 2, 3 \dots$  — are the discrete stable resonance configurations of the electron's toroidal ring in the proton's pressure field. Not every orbital radius is stable — only those where the toroidal ring's poloidal circulation frequency resonates with the substrate standing wave pattern set up by the proton's pressure deficit.

This is the physical content of the de Broglie wavelength condition — the electron's circumference must be an integer number of wavelengths. In EST v2 terms the toroidal ring's poloidal circulation must complete an integer number of cycles in one orbital period. Non-integer configurations produce destructive substrate interference and are unstable. Integer configurations are stable resonances.

The energy levels of hydrogen are the energies of these stable resonance configurations. The Rydberg formula is the energy spectrum of the toroidal electron ring resonating in the proton's spherical pressure field. In principle derivable from geometry. Derivation pending substrate field equations (OP25).

## **4. Spin-1/2 from Torus Topology — A Speculative Claim**

### **4.1 The Quantum Mystery of Spin-1/2**

In standard quantum mechanics, spin-1/2 is a postulate. Particles either have integer spin or half-integer spin. Half-integer spin means that rotating the particle by 360 degrees does not return it to its original state — you need 720 degrees. This has no classical analog and no mechanical explanation in standard physics. It is simply imposed as a rule.

EST v2 proposes a geometric explanation.

### **4.2 The Topological Property of a Torus**

A torus has a topological property that a sphere does not. Consider the two independent circles on a torus — the large circle going around the outside (toroidal direction) and the small circle going through the tube (poloidal direction). These two circles are not equivalent. The torus has two distinct axes of rotation.

When a torus rotates around its central axis by 360 degrees, the large circle returns to itself. But the small circle — the tube — has rotated around the large axis while simultaneously going around the small axis. The combined motion of the two coupled

rotations means the torus as a whole does not return to its original configuration after 360 degrees of rotation around the central axis.

More precisely: a toroidal vortex ring spinning around its central axis while simultaneously having poloidal circulation through its tube requires 720 degrees of rotation around the central axis to return to an identical physical state. The poloidal circulation adds a phase that only completes after two full rotations.

This is the geometric origin of spin-1/2.

### **4.3 The Speculative Claim**

SPECULATIVE CLAIM: If the electron is a toroidal vortex ring with dominant poloidal circulation, then spin-1/2 is a geometric necessity, not a quantum postulate. The electron requires 720 degrees of rotation to return to its original state because the torus topology with coupled toroidal and poloidal flow has this property built into its geometry.

The photon, by contrast, is a toroidal ring with dominant toroidal flow and no significant poloidal circulation. A single rotation returns it to the same state. Spin-1 follows geometrically.

The proton is a spherical spinner. A sphere returns to the same state after 360 degrees around any axis. But the proton is spin-1/2, not spin-1. This suggests the proton also has an internal circulation geometry that is not purely spherical — consistent with the known internal structure of the proton and the three-quark picture in standard physics. In EST v2 terms the proton's internal circulation geometry may have a toroidal component that produces its spin-1/2 character. This is identified as Open Problem 26.

This claim is speculative because it has not been derived quantitatively from the substrate field equations. It is grounded in the topological argument above. The argument is geometric and does not depend on numerical values. If the electron is toroidal with poloidal circulation, spin-1/2 follows from the topology. This claim is falsifiable: if the electron is shown to have a different vortex geometry, the spin-1/2 argument fails.

## **5. The Weak Interaction and Helical Vortices**

### **5.1 Parity Violation as Geometric Asymmetry**

The weak interaction is the only force in standard physics that violates parity — it distinguishes left from right. In every other interaction, mirror-image processes occur at identical rates. In weak interactions they do not. This was discovered by Wu in 1957 and has no mechanical explanation in standard physics.

EST v2 proposes a candidate mechanism: the weak interaction involves helical vortex structures in the substrate, and the substrate has a preferred handedness — one helical orientation is energetically favored over its mirror image.

### **5.2 Helical Vortices in Physical Fluids**



Helical vortices are distinct from toroidal and columnar vortices. A helical vortex has the vortex filament itself wound into a helix — the axis of rotation is itself curved into a spiral. Helical vortices have been confirmed experimentally in swirl flow systems and have an intrinsic chirality: right-handed helices and left-handed helices are physically distinct structures that interact differently with a surrounding medium.

In a medium with no preferred handedness, right and left helical vortices are mirror images and behave identically. In a medium with a preferred handedness — where the substrate has some asymmetric property — right and left helical vortices would have different energies, different stability, and different interaction rates.

### **5.3 The Candidate Picture**

The weak interaction in EST v2 may be the interaction between helical substrate vortex structures. Beta decay — the neutron decaying to proton, electron, and antineutrino — involves the electron being ejected from the neutron lock. The ejection geometry may produce a helical vortex structure — the antineutrino — as a helical substrate exhaust pulse from the lock failure event.

The neutrino was identified in earlier EST v2 work as a substrate exhaust pulse (Supplement 40, V28). The helical vortex picture adds geometric specificity: the neutrino is a helical substrate pulse with a specific handedness determined by the geometry of the beta decay event.

Parity violation follows if the substrate itself has a preferred handedness — if right-handed helical pulses and left-handed helical pulses are not equivalent in the substrate medium. The substrate's preferred handedness would be a global property of the medium, not a local interaction rule.

This is identified as a speculative picture requiring development. Open Problem 27: identify the helical vortex structures involved in weak interactions and derive the handedness preference from substrate properties.

## **6. The Cascade Intermediates — Mixed Geometry Vortices**

### **6.1 Beyond Simple Scale**

WP-Annihilation (June 2026) identified pions and the particle zoo as cascade intermediates in the substrate energy cascade following proton-antiproton annihilation. This paper adds a geometric dimension to that picture.

The cascade intermediates may not be simply smaller versions of the proton vortex type. They may be qualitatively different vortex geometries produced by the specific energy release conditions of the annihilation event. A violent spherical-on-spherical cancellation at  $r_p$  scale releases energy in a pattern that may preferentially excite specific non-spherical vortex geometries in the substrate.

### **6.2 Vortex Geometry and Particle Properties**

In this picture, each particle in the zoo corresponds to a specific vortex geometry type produced under specific energy conditions:

- Pions — the lightest mesons at approximately 135-140 MeV — may be toroidal ring structures at an intermediate scale between the proton (938 MeV) and photon (0 rest mass). Their rapid decay to photons is the toroidal ring relaxing to the photon-scale toroidal floor.
- Kaons — heavier mesons at approximately 494 MeV — may be a different geometry type, possibly helical, produced when the annihilation cascade has sufficient energy to excite helical modes. Their decay through the weak interaction is consistent with helical vortex involvement.
- Muons — at 106 MeV, heavier than pions but decaying through the weak interaction — may be a toroidal ring structure at intermediate scale with a helical component that couples to the weak sector.

This classification is speculative and currently not derivable without substrate field equations. It is recorded as a physical picture for development. Open Problem 28: classify the particle zoo by substrate vortex geometry type. Identify which particle properties — mass, lifetime, decay mode, spin — are determined by which geometric features of the vortex type.

## 7. The Vortex Taxonomy — Summary

The following table summarizes the proposed vortex type classification across the EST v2 scale range. All entries marked SPECULATIVE are physical pictures pending quantitative derivation.

**Photon** — Traveling toroidal ring. Toroidal flow dominant. Self-propelling at  $c$ . Spin-1 from single-rotation torus topology. Most stable substrate structure. Bleeds at  $H_0$  (one spatial dimension).

**Electron** — Orbiting toroidal ring. Poloidal flow dominant. Not self-propelling — responds to external pressure gradients. Spin-1/2 from coupled toroidal-poloidal torus topology (SPECULATIVE). Stable ground state floor. Bleeds only deviation from equilibrium.  $r_e = 440 \times r_p$ .

**Proton** — Compact spherical spinner at  $c$  ceiling. Sheds toroidal rings continuously. Tight deep pressure deficit. Fundamental gravitational bleeder. Spin-1/2 may indicate internal toroidal component (SPECULATIVE, OP26).

**Neutron** — Forced asymmetric lock. Toroidal electron compressed around spherical proton. Not a natural vortex type. Metastable. Free lifetime 879 seconds from electron toroidal relaxation (WP-ElectronBleed).

**Nucleus** — Cooperative vortex cluster. Collective pressure packing of proton spherical spinners and compressed electron toroidal rings. Stability from cooperative suppression of electron toroidal relaxation.

**Pions / Mesons / Particle Zoo** — Cascade intermediates. Transient vortex geometries produced by violent energy release at nucleon scale. Geometry type varies by particle — toroidal, helical, or mixed. Mass encodes scale position in cascade. Lifetime encodes geometric stability (SPECULATIVE, OP28).

**Planet / Star** — Large scale rotating sink whirlpool. Collective nucleon bleed accumulation. Slow deep gravitational basin with rotational component. Substrate dragging produces frame-dragging effect.

**Galaxy** — Cosmic scale rotating sink. Substrate accumulation over Gyr timescales produces dark matter halo equivalent. Rotation curve flatness is whirlpool velocity profile, not hidden mass.

## 8. Open Problems

- OP25 (NEW): Derive the Bohr radius from toroidal electron geometry and proton spherical pressure deficit. No free parameters. Requires substrate field equations (OP12).
- OP26 (NEW): Explain proton spin-1/2 from internal vortex geometry. The spherical spinner should give spin-1 or integer spin. The proton's spin-1/2 suggests an internal toroidal flow component. Identify and derive.
- OP27 (NEW): Identify helical vortex structures in weak interactions. Derive the substrate handedness preference that produces parity violation. Connect to neutrino as helical exhaust pulse.
- OP28 (NEW): Classify the particle zoo by substrate vortex geometry type. Identify which particle properties are determined by which geometric features. Test whether particle masses follow the substrate vortex scale hierarchy.
- OP12 (existing, highest priority): Derive substrate field equations from observed vortex behavior. Gateway to all quantitative results in this paper.

## 9. Summary Statement

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*EST v2 proposes that the universe contains not one type of substrate vortex but a taxonomy of types — each with a distinct geometry, a distinct coupling mode to the substrate, and distinct behavior. The photon and electron are both toroidal rings but with different dominant flow configurations: toroidal flow produces a traveling photon, poloidal flow produces an orbiting electron. The proton is a compact spherical spinner*

*shedding toroidal rings at the c ceiling. Nuclei are cooperative vortex clusters. Planets and galaxies are large scale sink whirlpools. The particle zoo is a turbulent cascade spectrum of transient geometries produced by violent energy release.*

*Atomic stability is topological: a torus cannot merge with a sphere. The ground state orbit is pressure equilibrium between the two geometries. Spin-1/2 is proposed as a geometric consequence of the coupled toroidal-poloidal flow in the electron's torus — a speculative but topologically grounded claim. Parity violation in the weak interaction is proposed as evidence of helical substrate vortex structures with a preferred handedness.*

*The framework needs no new axioms. Every vortex type in this taxonomy arises from the same substrate medium under different formation conditions. The four axioms of EST v2 generate the full taxonomy.*

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#### Vortex Ring Shedding at Critical Velocity

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#### Energy Cascade and De Broglie Condition

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