

The Intrinsic Motions of Matter

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Abstract

The "intrinsic motions" of matter demonstrate conservation law and cosmic order in nature. The Universe, and everything in it, is always in some type of motion, whether absolute, relative, intrinsic, entropic, atomic, orbital, biological, or evolutionary. I distinguish between intrinsic *dimensional* motions such as time and gravitation (primordial entropy drives), and other non-dimensional types of intrinsic motion, such as that of electrons in atomic orbits. Both types of intrinsic motion create entropic domains, whether of space, history, or information.

Introduction

Intrinsic motions of any kind are expressions of the conservation laws (Energy and Symmetry conservation) and their corollaries (Entropy and Causality-Information) (see: "[The Tetrahedron Model](#)"). While in the case of free electromagnetic energy, the [intrinsic motion of light](#) can be traced to Entropy and Symmetry conservation in the service of Energy Conservation, the intrinsic (dimensional) motions of matter (time, gravity) involve in addition a third principle, [Causality-Information](#), also serving Energy Conservation. Bound energy is asymmetric information, essentially the matter half of the information contained in light's particle-antiparticle form. This information is carried as charge, spin, mass, momentum, identity, location, quantum numbers, etc., conserved attributes of the energy, entropy, symmetry, and

dimensionality of the light which created the particle-antiparticle pairs. The purpose of the charge component of this information set is to ensure and facilitate the immediate annihilation of the particle-antiparticle pairs, conserving and protecting the symmetry of the light which created them. Although matter is isolated from antimatter during the Big Bang, this symmetry-conservation purpose remains unaltered through time, resulting in matter's eternal search for antimatter, and in the ultimate return of bound energy to light via gravitationally driven processes such as the conversion of mass to light in stars, quasars, and Hawking's "quantum radiance" of black holes; or via radioactivity, particle and proton decay.

The development of life and the [Information Pathway](#) is a [probable outcome](#) of the intersection of the negentropic gravitational drive and the [4x3 Fractal Algorithm](#) of the material Cosmos. Not only does life allow the Universe self-awareness, self-knowledge, and self-appreciation, and a new creative possibility through humanity and the *abstraction of information*, but the information pathway also represents a parallel or biotic route for the conversion of bound to free energy, of which our development of the hydrogen bomb and the pursuit of fusion energy technology is only the most current and highly evolved of many lesser examples.

Noether's Theorem

In 1918 the German mathematician Emmy Noether published a theorem which has become of pivotal importance in the attempt to formulate a Unified Field Theory. "[Noether's Theorem](#)" states that in a multicomponent field, such as the metric field of spacetime or the electromagnetic field of light, where one finds a symmetry, one finds an associated conservation law, and vice versa. In Nature, the conserved charges (and spin) of particles, and the inertial and gravitational forces of spacetime, are Noether's Theorem enforced and demonstrated.

[Elsewhere in these pages](#) I have made much of the intrinsic motion of light or massless free electromagnetic energy. Below I consider the various intrinsic motions (dimensional and otherwise) of atomic matter or massive forms of bound electromagnetic energy.

The Dimensional Intrinsic Motions of Matter (primordial entropy drives of bound electromagnetic energy)

(Conservation of the symmetric characteristics of light's wave form: light's "non-local" metric and distributional symmetry - light's spacetime "Interval" = zero. The "location" charge of gravitation and matter's search for a return pathway to symmetric light: *gravity is matter's memory it once was light*.)

G, T (gravitation, time): these are the dimensional intrinsic motions of matter, the primordial forms of matter's historical Entropy drive (as required by the Conservation of Energy and Causality). (See: "[A Description of Gravitation](#)"; see also: "[Spatial vs Temporal Entropy](#)".)

1) Gravitation: *gravity is the spatial consequence of the intrinsic motion of time*; conversely, time is created by the [gravitational annihilation of space](#). Time and gravity induce each other endlessly, much as electric and magnetic fields induce each other. *Implicit* time (in the form of "frequency") is the hidden spatial entropy drive of free electromagnetic energy ("intrinsic motion c"); *explicit* time is the primordial historical entropy drive of bound electromagnetic energy ("intrinsic motion T"). Time is the common factor between c and G. The magnitude of "G" (the universal gravitational constant) is determined by the energetic difference between implicit and explicit time, the energy required to create asymmetric explicit time from symmetric implicit time (in other words, G represents the energy required to create the "one-way" entropy drive of matter (the intrinsic motion of time and history) from the "all-way" entropy drive of light (the intrinsic motion of light and space)). A "graviton" is a quantum unit of time or negative entropy. Gravity is both a symmetry and an entropy debt of light. The gravitational charge is "location", which specifies the spacetime

location of bound energy. Time is the active principle of the "location" charge, a charge with an intrinsic one-way dimensional motion. (See: "[The Conversion of Space to Time](#)", and "[Gravity Diagram No. 2](#)".)

The negative gravitational energy of matter is borrowed from the expansion of space (that is, borrowed from the positive spatial entropy drive of light), consequently decelerating the Cosmos. The negative gravitational energy of matter exactly equals the positive rest mass energy of matter, enabling the creation of bound energy from zero net energy during the process of symmetry-breaking in the "Creation Event" or "Big Bang". Even so, matter is created with symmetry debts conserved as charges (Noether's Theorem). The quality of energy must be conserved no less than its quantity. Gravitation pays the "entropy-interest" on matter's symmetry debts by converting space to the time dimension in which these debts must be conserved and eventually repaid. In the historical domain, charge conservation has a significance (for Information and Causality: "Karma") which goes beyond the immediate annihilation of particle-antiparticle pairs. In the creation of matter's asymmetric historical domain, the role of the alternative charge carriers (electrons, neutrinos, mesons) is also crucial. (See: "[The Origin of Matter and Information](#)"; see also: "[The Double Conservation Role of Gravitation](#)".)

1a) Gravity:

- 1) Provides the negative energy which balances the positive energy of the "Big Bang" (allowing creation of the universe from zero net energy);
- 2) Creates time via the annihilation of space and the extraction of a metrically equivalent temporal residue (entropy conservation role); this reaction is reversed by the gravitational conversion of bound to free energy in stars (symmetry conservation role); gravity and time induce each other endlessly in a self-feeding cycle. The gravitational charge is "location", which specifies the spacetime location of bound energy. Time is the active principle of the "location" charge.
- 3) Pays the entropy-"interest" on the symmetry debt of matter by creating a time dimension in which charge conservation can have an extended functional (historical) significance (and information can have a causal ("karmic") significance);
- 4) Pays the entropy-"principle" on matter's symmetry debt (partially) by the conversion of bound to free energy in stars and quasars and (completely) via Hawking's "quantum radiance" of black holes (the gravitational force vanishes when matter/mass vanishes);
- 5) Is the spatial consequence of the intrinsic motion of time;
- 6) Causes the deceleration of the spatial expansion of the Cosmos;
- 7) Provides a physical (inertial, dimensional) connection between bound energy and the conservation domain of light and space;
- 8) Is weak because matter is only tangentially connected to its historical conservation domain (via the "present moment"), and gravity provides only enough temporal entropy to service this tangential and ephemeral connection;
- 9) Causes the accretion and creation of planets, stars, galaxies and creates their orbital motions;
- 10) Is the abiotic source of negative entropy driving biological evolution;
- 11) Creates stellar life histories and final states (in conjunction with the weak and strong forces): supernovas, white dwarfs, neutron stars, black holes, quasars, etc.;
- 12) Replaces the symmetric spatial metric gauged by "c" with an asymmetric spacetime metric gauged by "G".

Gravity is matter's memory it once was light.

See: "[Gravity, Entropy, and Thermodynamics](#)"; "[A Rationale for Gravity](#)"; "[The Double Conservation Role of Gravitation](#)".

2) Time: the intrinsic motion of bound energy's time dimension (which causes the expansion of history) is derived from the intrinsic motion of free energy (which causes the expansion of space). The entropy drive

of matter (explicit time) is derived from the entropy drive of light (implicit time), a debit which causes the gravitational deceleration of the spatial expansion of the Cosmos. Similarly, the raw energy content of matter is derived from the raw energy content of light ($h\nu = mcc$), and the charges, spin, inertial and gravitational state of matter represent conserved debts of light's symmetric energy state (in accordance with Noether's Theorem). Both light and matter are entropic forms of energy, but the dimensional entropy drive and conservation domain of matter (the intrinsic motion of time, history) is at "right angles" to matter's spatial dimensions, whereas light's entropy drive and conservation domain (the intrinsic motion of light, space) is completely conjoined with light's spatial dimensions. (See: "[The Time Train](#)", and: "[The Half-life of Proton Decay and the 'Heat Death' of the Universe](#)".)

Matter is distinct from its entropy domain (history, historic spacetime - the conservation domain of information and matter's "causal matrix"), whereas light is identified with its entropic domain (space - the conservation domain of free energy and light's regulatory metric). Gravitation is a complex dimensional symmetry debt or energy penalty (involving both Entropy and Symmetry), which matter must pay for this separation from its entropy/conservation domain (and for which we, as sentient beings, also pay psychologically). Gravitation creates matter's separate time dimension via the annihilation of space and the extraction of a metrically equivalent temporal residue (light's implicit temporal entropy drive is converted to matter's explicit temporal entropy drive). The separate time dimension created by gravity is necessary to allow matter to move in time as fast as light moves in space, in other words, the entropy drives of matter and light are metrically equilibrated by the gravitational extraction/conversion of time from space (or the reverse - as in the gravitational conversion of mass/time to light/space in stars, quasars, Hawking's "quantum radiance" of black holes, etc.). Matter cannot move in space as fast as light, but it can do so in metrically equivalent time, which is the conservation rationale for the gravitational conversion of space to time. Matter's symmetry debts are quantized as charges which are payable (via matter-antimatter annihilation) in undiminished magnitude at some indeterminate, contingent, future position in the historical dimension. The Cosmos is a "buy-now pay-later" charge-conserved 4-dimensional entropic domain operating on the "credit card" of gravity, which pays the entropy-"interest" on the symmetry debt of matter, creating historic spacetime, a compound conservation/entropic domain simultaneously accommodating both free and bound forms of electromagnetic energy. (See: "[Entropy, Gravitation, and Thermodynamics](#)".)

2a) Time - Causality:

- 1) [Time is the implicit and explicit entropy drive](#) of both free and bound energy, creating the dimensions of spacetime;
- 2) Gravity creates time from space, paying the entropy-interest on matter's symmetry debt (conserved charges) by decelerating the Cosmos; matter's time dimension or temporal entropy drive is therefore funded by debiting light's spatial entropy drive;
- 3) Time is the necessary dimension for keeping and updating the energy accounts of matter in relative motion;
- 4) Time is the necessary dimension for contracting and paying the symmetry debts (charges) of matter;
- 5) The one-way character of time and gravitation is due to the one-way linkage of Causality;
- 6) Time is the local gauge symmetry current of "Lorentz Invariance", co-varying with space to maintain the invariance of velocity c , the "Interval", and causality for matter in relative motion or gravitational fields - the "warped" spacetime of Special and General Relativity;
- 7) Time is the necessary dimension for the evolution of the abiotic and biotic Cosmos;
- 8) The intrinsic motion of time creates history just as the intrinsic motion of light creates space: history is the analog of space. History (historic spacetime) is the conservation domain of matter's causal information matrix (see: "[A Spacetime Map of the Universe](#)");
- 9) Gravity is the spatial consequence of the intrinsic motion of time; time and gravity induce each other in an endless cycle;

- 10) Matter is connected through history; light is connected through space; gravity connects all;
- 11) Atoms do not age because matter is only tangentially connected to its historic conservation/entropy domain via the ephemeral "present moment"; this is also the reason why gravity is weak. Matter's tangential connection to history is necessary to protect bound energy's symmetry debts (quantized charges) from enervation by matter's entropy drive, and accords massive objects a certain degree of freedom of motion, and (in our case), freedom of action and intent (see: "[The Half-Life of Proton Decay and the 'Heat Death' of the Cosmos](#)");
- 12) Matter is local, temporal, causal, massive, immobile, with intrinsic motion in time, producing a gravitational field; light is non-local, atemporal, acausal, massless, with intrinsic motion "c", and when traveling in free space does not produce a gravitational field (hence the conversion of bound to free energy in astrophysical processes causes, over time, a reduction of the total gravitational energy in the Cosmos, producing the observational impression of an "accelerating" Universe). See: "[The Time Train](#)".

Abiotic Non-Dimensional Intrinsic Motions of Matter

(Conservation of the symmetric characteristics of light's particle form: light's particle-antiparticle symmetry - "particle number" = zero. Matter's search for antimatter: *the charges of matter are the symmetry debts of light*. See: "[Symmetry Principles of the Unified Field Theory](#)".)

The non-dimensional intrinsic motions of matter include, but are not limited to:

3) Electromagnetic Force:

- 1) Electron shell orbital motion (electrons);
- 2) Electron spin;
- 3) Exchange of virtual photons, magnetic and electric fields between all electrically charged particles.
- 4) Zero-point quantum "jitters" due to Heisenberg uncertainty relation regarding position vs momentum.

Matter's search for antimatter is carried out via the long-range electromagnetic force. Electrons, electrons shells, and electrical forces are carriers of charge, energy, and information. Electrons function as alternative charge carriers for the baryons, allowing charge conservation and balance without causing antimatter annihilations.

4) Strong Force: (within baryons - gluon exchange - Gell-Mann)

- 1) Gluons - color field exchange between quarks (at velocity c), resulting in permanent confinement of quark fractional charges to whole quantum charge units (baryons, mesons);
- 2) Quark orbital motions (within baryons);
- 3) Quark spin.

Quarks are chiefly carriers of mass, fractional charges, momentum, and concentrated energy ($E = mc^2$). The principle of "Asymptotic Freedom" makes possible [proton decay](#). Mesons also function as alternative fractional charge carriers for quark color, flavor, and charge, in baryon decays and transformations, and as the field vectors of the "Yukawa strong force", converting protons and neutrons into "nucleons" in compound atomic nuclei. The fractional charges of quarks are permanently confined to baryons and mesons by the exchange of gluons, protecting whole quantum units of charge and thereby protecting charge and symmetry conservation.

5) Strong Force (between baryons - meson exchange - Yukawa)

- 1) Exchange of mesons between protons and neutrons (in compound atomic nuclei - [Yukawa strong](#)

force binding "nucleons" in heavy elements)

2) nucleosynthetic pathway, fusion;

3) nucleon orbits and spin;

4) Heavy element building in stars and supernovas - creation of the 92 Periodic Table elements.

5) The nucleosynthetic pathway: determining (in conjunction with gravity) the life cycle and final states of stars.

6) Weak Force:

1) *Single* elementary particle creation, destruction, and transformation; particle and proton decay, radioactivity, fission, the creation of matter in the Big Bang, all mediated by the "Intermediate Vector Bosons" (IVBs) (see: "[The Particle Table](#)");

2) Neutrinos are the "bare" or explicit form of the weak force "identity" charge, which is also carried in implicit form by the massive leptons (and perhaps by the "[leptoquark](#)");

3) The "identity" charge of elementary particles - carrying the potential for existential reality (in 4-D "real time");

4) Neutrinos have a unique and poorly understood type of intrinsic motion, which causes them to travel at very nearly (but not quite) velocity c . Neutrinos apparently have such a tiny mass (perhaps 500,000 electron neutrinos equal an electron's mass) that:

a) in any process that produces neutrinos they are ejected with nearly light speed, and simply keep moving until they interact via the weak force, which is almost never;

b) neutrinos are so light that DeBroglie "matter waves" completely dominate their character, making neutrinos more wave-like than particle-like;

c) much about these "wavicles" remains a mystery, including their apparently spontaneous "oscillations" from one type of neutrino to another (quantum mechanical "superpositions").

The weak force IVBs (Intermediate Vector Bosons) [form a bridge](#) between today's 4-D "real" spacetime world of asymmetric manifest particles, and the primordial 2-D "virtual" vacuum world of the symmetric unmanifest particle-antiparticle "sea". The vacuum particle-antiparticle "sea" cannot ordinarily manifest because of symmetry conservation. The weak force IVBs are the symmetry-breaking bridge to manifestation (for *single* elementary particles) in the "real" asymmetric world of time - hence their exotic and massive character. (See: "[Identity Charge and the Weak Force](#)"; "[Introduction to the Weak Force](#)"; "[The 'W' IVB and the Weak Force Mechanism](#)"; "[The Higgs Boson and the Weak Force IVBs](#)".)

7) Chemical Compounding (molecules):

1) electron shell bonding; spin; shared orbitals; virtual photon exchange between charged particles; magnetic interactions;

2) inorganic and organic molecules, compounds, and crystals.

Biological and Emergent States of Intrinsic Motion in the Information Realm

Dimensional intrinsic motions of light, time, and gravity create the entropic domains of space, history, and historic spacetime. The non-dimensional intrinsic motions of matter also create a dimensional entropic domain of Information, both in the abiotic realm of nuclear and chemical information, but especially in the biotic realm of life and genetics, which seems to be the whole point of the exercise. The universe achieves self-awareness through this ceaseless intrinsic and evidently purposeful activity which drives toward ever-higher states of information. Hence we must name life and the "life force" as the culmination of the Causality-Information apex of the "[Tetrahedron Model](#)", a force or conservation goal of equal importance with and supported by the conservation of Energy, Symmetry, and Entropy. Humans have carried the

evolution of information into the abstract realms of thought, imagination, language, math, music, art, science, and technology, including machine language. In the information domain, negative entropy drives are supplied by gravity and Darwin's Natural Selection, while positive entropy drives are seen in the forms of genetic mutation, aging, death, decay, and radioactivity. (See: ["The Information Pathway"](#).)

8) Life and Evolution (driven by negentropic gravitational energy and the 4x3 Fractal Algorithm of the material Cosmos). Creation of the information domain of biology by gravity, the nucleosynthetic pathway, carbon chemistry, DNA, genetics, and evolutionary forces (via Natural Selection).

See: ["The Information Pathway"](#), ["The Fractal Organization of Nature"](#), ["Newton, Darwin, and the Origin and Abundance of Life in the Cosmos"](#).

- 1) Reproduction, genetic recombination, mutation, Natural Selection;
- 2) Identity, self-interested survival drives, mechanisms, and adaptations ("agency");
- 3) Higher order intrinsic motions of complex interacting systems (evolution of least-energy and most efficient ecosystems; symbiosis, mutualisms, etc.).

9) The Self-Awareness Drive of the Biological Cosmos (the search for consciousness via the information pathway and the fractal algorithm of the Cosmos:

- 1) Individuality, consciousness, self awareness, intelligence, curiosity;
- 2) Emergent properties of higher multicellular organisms: drives, motivations, instincts, desires, emotions (fear, joy, love, hate, etc.).

10) Evolution toward humanity, language, spirituality, and aesthetic appreciation (the reprise or conservation of Cosmic Connectedness, Unity, Wholeness, and the higher system expressions of Noether's Theorem of symmetry conservation and the 4x3 Fractal Algorithm) (humans only):

- 1) Creativity, inspiration, revelation, the Muse, genius, art, the intrinsic motion of the Muse or Spirit;
- 2) Mythology, religion, occult practices, philosophy;
- 3) Science, Art, "Truth and Beauty";
- 4) Evolution of Society and Civilization;
- 5) Gaia; (world ecosystems or planetary life form).

11) Return of matter to light via all forces - proton decay, gravity, and matter-antimatter annihilations, including the technological, spiritual, artistic, and intellectual Information Pathway - via fusion energy, fast spaceships, "Enlightenment", aesthetics, and formulation of the "Unified Field Theory":

- 1) The dispersal of humans to space, the return to the intrinsic motion of the photon via light-speed spaceships; this (and the black hole "event horizon") is the ultimate return of atomic matter to the intrinsic motion of light.

12) Chardin's "Omega Point" of total, universal self-awareness and self-knowledge:

- 1) "Cosmic Consciousness", or the Cosmos everywhere awakening to itself, to its information potential, to its potential for experience and connection, and to new creative modalities and experience. (See: ["Chardin: Prophet of the Information Age"](#).)

The Motions of Time and Space

Readers may suppose that the intrinsic motion of space, time, and spacetime referred to in these pages is simply metaphorical or a mathematical formalism rather than literal motion, but these are actual motions,

usually in the sense or form of entropic expansions or contractions of spacetime. Below I list examples of (or evidence for) these metrical or spacetime motions (which usually serve some type of entropy function) that are either familiar or a commonplace of physics.

1) Einstein's "Equivalence Principle": the physical acceleration of an observer through spacetime is indistinguishable from the action of a gravitational field (gravitation is the actual accelerated motion of spacetime). The "g" forces of gravity and accelerated motion are identical (at small scales).

2) Inflation; the inflationary expansion of spacetime during the "Big Bang" (?) (remains controversial)

3) The cosmic expansion of spacetime (the "Hubble flow" - cosmological red shift) - including the acceleration and deceleration of the cosmic expansion by gravitation.

4) Entropy - the intrinsic motions of time, light, and gravitation (c, T, G), and the creation of dimensionality (space, history, historic spacetime); the "infinite velocities" of time and light (and of gravity or spacetime in black holes).

5) Causality - time; the one-way march of time and the temporal-causal ordering and linkage of material events ("karma"); the expansion of history and historic spacetime ([a rationale for gravitation](#)). (Historic spacetime is the (abiotic) conservaton domain of information and matter's "causal matrix". The "genome" is a molecular or biotic conservation domain for information, lacking most of the one-way temporal component of history).

6) Gravity and the effects of General Relativity - the warpage or "curvature" of spacetime by gravitational acceleration. The gravitational bending of light rays. All things (including light) fall with the same velocity in a gravitational field due to the uniform accelerated flow of spacetime (which is the spatial consequence of time's intrinsic motion into history).

7) Black holes - spacetime moves at velocity c, time stands still in the "event horizon", where $g = c$.

8) "Frame dragging" and the distortion of spacetime by rotating black holes or other gravitational sources. (Recently confirmed. See: *Science* Vol. 332, 6 May 2011, page 649.)

9) Gravity waves.

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[Global-Local Gauge Symmetries in Gravitation](#) (Part 2, Section A)

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Entropy

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References

Bekenstein, J. D. Black Holes and Entropy. *Physical Review D*, **1973**, 7(8), 2333-46.
Brewer, J. W. and M. K. Smith, eds. *Emmy Noether: A Tribute to her Life and Work*. M. Dekker, New York, **1981**, 180 + x pp. + 10 plates.
de Chardin, Pierre Teilhard: *The Phenomenon of Man*. French: Editions du Seuil, Paris, **1955**;
English: Harper and Row, New York, 1959.
Close, Frank: *Lucifer's Legacy*. 2000. Oxford Univ Press.
Cronin, J. W. CP Symmetry Violation: the Search for its Origin. *Science* **1981**, 212, 1221-8 (Nobel lecture).
Gowan, J. C. (Sr.) **1975**. "[Trance, Art, Creativity](#)"
Greene, B. *The Elegant Universe*. W.W. Norton & Co. **1999**, 448 + xiii pp.
Greene, B. *The Fabric of the Cosmos*. A. A. Knoph, **2004**, 569 + xii pp.
Gross, D. J. and F. Wilczek. **1973**. Ultraviolet Behavior of Non-Abelian Gauge Theories. *Phys. Rev. Lett.* 30: 1343.
Gross, Politzer, Wilczek: *Science*: 15 October **2004** vol. 306 page 400: "Laurels to Three Who Tamed Equations of Quark Theory."

Hawking, S. W. Particle Creation by Black Holes. *Communications in Mathematical Physics* **1975**, 43 (3), 199-220.

Lederman, Leon with Dick Teresi: *The God Particle*. 2006. Mariner Books.

Lederman, Leon and Christopher Hill: *Symmetry*. 2008. Prometheus Books.

Lovelock, J. E. *Gaia. A New Look at Life on Earth*. 1979. Oxford University Press.

Oerter, Robert: *The Theory of Almost Everything*. Penguin (Plume) 2006.

Pais, Abraham 1986. *Inward Bound: of Matter and Forces in the Physical World*. Oxford University Press, NY

Politzer, H. D.. **1973**. Phys. Rev. Lett. 30: 1346.

Resnick, Robert: *Introduction to Special Relativity*. 1968. John Wiley and Sons, Inc.

Stewart, Ian. "Why Beauty is Truth". **2007**, Basic Books

Trefil, James: *The Moment of Creation*. Macmillian (Collier) 1983.

Weinberg, S. *The First Three Minutes*. Bantam. **1977**, 177 + x pp.

Wilczek, Frank. *The Lightness of Being*. 2008. Basic Books.

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