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# Teleological Physics & Duality

Paul Abbotts[1]

"*There are two types of behaviour in biology, growth and protection*"
Bruce Lipton

*Growth is dual to Protection*
*Genes are dual to Memes*

Teleological physics is physics based upon the idea of achieving goals, objectives or tracking targets, it is the behaviour of intentions and purposes whereas non-teleological physics is concerned with the lack of a predefined destination or final outcome, the lack of intention. More importantly the two types of physics are dual to each. These two types of physics are mutually exclusive to one another but also equivalent to each other.

There is a simple way to think about this using the concept or metaphor of wave particle duality or quantum duality. On the one hand we have the wave which is a non-localized or a generalized entity stretched out in space and the particle or target which is localized or focused into a point. I can talk about the center of a point but what does it mean to talk about the center of a wave? Another way to think about this is through randomness and order, if I associate waves with randomness and points with order and structure we have the fact that randomness is dual to order.

Teleological physics is therefore the study of order, structure patterns, symmetry, goals and the fact that there is an underlying mechanism to the universe and reality which is preordained and gives meaning to life. Non-teleological physics states that there is no ultimate pattern to reality, that life is inherently meaningless and has no purpose and is based upon randomness, entropy (information), non-symmetry and the lack of an ultimate pattern to causality. These two concepts are united through the paradigm of duality.

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But what is duality? Does it really exist and if so what does this mean for physics and the wider community of science. For instance if there is a dual to entropy is there therefore a fourth law of thermodynamics?

Here are two definitions of Duality from noted physicists:

"*Two equivalent descriptions of the same thing*"
Leonard Susskind

"*Duality: A correspondence between apparently different theories that lead to the same physical results.*"
Stephen Hawking: A Brief History of Time.

The Schrödinger/Heisenberg Representations in Quantum Mechanics are equivalent descriptions of each other or dual to each other. There is also quantum duality or wave/particle duality. In Topology the word Homeomorphism means 'same changing', similar, like or equivalent and it describes mappings that transform one topological object into another topological object continuously or smoothly. Change without making a difference is the essence of duality.

The Hegelian Dialectic states that thesis and anti-thesis produces synthesis (reality). If you compare this with the Stephen Hawking definition of duality you will realise that they are one and the same. Duality therefore introduces philosophy into physics.

There is a more general definition of duality which involves perspective and the observer, all observers have perspective this is implicit in the meaning of the word, but perspective of what? To have perspective of anything requires something to be observed. The whole concept of an observer is to perceive something separate and distinct from itself, a boundary is therefore introduced. The observed cannot exist without the observer. Likewise the observer cannot exist without the observed. This is a duality. If you want observers as in Einstein's theory of special relativity then you are also required to accept the reality of the observed. Perspective and the observed
are literally forced upon you. The observer must be dual to the observed, a second perspective. If you want to model reality and the universe as a point particle of mass then this initial mass always requires a second perspective if it is to be called an observer.

"*The observer is the observed*"
David Bohm,
Jiddu Krishnamurti,
Descartes

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Postulate 1, Prerequisite: All observers are dual at a fundamental level of physical reality.

If all observers are inherently dual and exist as energy this implies that energy is inherently dual. Duality is therefore energy in its most fundamental form, for instance potential energy is equivalent or dual to kinetic energy in a gravitational field. The important point being made here is that these two forms of energy are equivalent and yet distinct at the same time. According to Einstein's theory of General Relativity stress or tension is energy so in mechanics tension or stress can be created within an elastic band by pulling on its ends with two hands, if you generalize this idea then the two hands become two distinct or alternative perspectives, observers or inertial frames which have a natural tension between themselves. This dual separation is required for all forms of energy in physics. Energy can be viewed as a plurality of generalized perspectives which can be further subdivided into observer/observed dual pairs, which becomes a generalized duality amongst all observers. According to Einstein energy is equivalent or dual to mass or $E = mc^2$. In the quantum world we have quantum duality which applies to photons of energy which have a dual nature in the form of waves and particles. Energy in the form of duality unites the classical world of physics with the quantum world. Energy is measured in Joules (duals). If energy is conserved, the first law of thermodynamics and energy is duality then duality must be being conserved (A fifth law of thermodynamics). The Higgs energy field (125GeV) which is responsible for the creation of mass can be modelled as a duality (projection) field as it is dual to the "vacuum".

If energy is dual what about entropy?

*Syntropy, Entropy, information and Duality*

The second law of thermodynamics states that global entropy always increases.

"*Entropy is a measure of randomness*"
Roger Penrose

If duality is real then the obvious question to ask at this stage is whether there is a dual process to that of increasing entropy. History has already given this dual process the name of Syntropy. If you associate increasing entropy with a diverging process then syntropy can be associated with a converging process.

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*Divergence is dual to convergence.*

Divergence, hyperbolic space or negatively curved space in the language of Riemann geometry is dual to convergence, spherical, elliptic space or positively curved space. Negatively curved space is therefore dark energy which has recently been discovered and positively curved space is the usual space associated with gravitational fields and Einstein's theory of general relativity. The concept of gravity here is giving us a huge hint that Syntropy is real. Convergence implies localization or focusing to a point or a target form, something of finite extent is emerging.

*Generalization is dual to localization Formlessness is dual to form.*

This is basically *Teleological physics*, goal orientated physics or target tracking, the behaviour of intentions and purposes. Teleological physics can be studied using information theory, control theory, adaptive filters and neural networks. The word information means that something is being formed and materialized into a target. There is a fundamental equation in information theory which expresses the relationship between (Shannon) entropy and the concept of mutual information or Fisher information.

*Mutual information = Self Entropy - Conditional Entropy*

If the conditional entropy is set to zero then mutual information is equal to entropy. Mutual information can be defined as the common information between two observers sending and receiving messages to each other using a communication system. This common information or commonality allows both observers to make predictions about the content of the messages that they are sending to each other. The predictions are most accurate when the mutual information is greatest or optimized. Initially using the above equation the self entropy is equal to the conditional entropy in a communication exchange this means the mutual information is zero. By sending and receiving messages to each other two observers can reduce their conditional entropy to zero so that the self entropy is converted into mutual information. This is a dual process. The average or self entropy is actually information which is being converted into useful information which has a meaning to the two observers involved in the communication exchange.

So mutual information can be viewed as a common language or common symbolism between two observers which both understand. The sharing of information results in a common understanding which allows for both observers to maximize their

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predictions, expectations with respect to each other. This results in better and more optimized tracking of targets which is a converging process, namely syntropy. Syntropy is therefore the conversion of entropy into mutual information or useful information for tracking targets and goals! How is this done? From a technical point of view you can use ideas from topology such as homeomorphism which enables information (entropy) to be treated as topological objects which can then mapped into equivalent or dual objects from which predictions can be materialised. Topology can be used because it represents smooth and continuous mapping from one topological space to another topological space. For instance human observers process information in the form of thinking (cognition) and juggle with the information (topological mapping) in their minds to produce new thoughts and concepts which aid in the prediction process. From a biological or evolutionary point of view this is what thinking and information is all about, it is a tool which enables organisms to model their environment and to predict the outcomes of their actions and optimize their behaviour and strategies of survival so as to achieve their objectives and goals such as finding food and water whilst minimizing their energy usage. Predictions optimize action and conserve energy. When energy is in short supply anticipating future events is an optimal survival tactic. Survival of the fittest or natural selection (Darwinism) filters for the best predictors, bad predictions and poor target tracking result in organisms going hungry and not surviving.

In the study of black holes mutual information is called entanglement entropy which amounts to saying that information becomes connected or converged into a unity or synergy. Another way of thinking about mutual information is that it is common information or information that is the same and equal for both observers, sender & receiver, more generally it can be viewed as information which is independent of the observer's position or objective information. So syntropy becomes the conversion of subjective or relative information (entropy) into objective or absolute information. The syntropy or mutual information is equivalent or dual to the entropy when the conditional entropy has been removed from the above equation.

*Subjective is dual to Objective - Absolute is dual to Relative*

The words common, commonality, communication, commune, communion, communism and community all share a root phoneme "comm" which means group sharing, coming together, converging, unifying, agreement, syntropy.

The basic process of communication can be applied to a large population of observers (atoms, inertial frames) who want to share information. The sharing of information is the process of equalizing the energy of a system. All observers track targets so why

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are they doing this? By continually tracking targets observers are building a store house or repository of increasing mutual information which can be viewed as a common language of objective information. Patterns are created by recognising structure, form and regularity (order) and this is dependent upon perspective. Mutual information has structure to it in the form of perspective. A perspective that can be dependent or independent of the observer's position, the latter perspective is a generalized or common perspective as it can be built up from adding other perspectives to form an average. Recognising patterns enables observers to make their information more objective and linear. The more objective this information becomes the more accurate will be the predictions or expectations of the observers, they will over time make better predictions about their environment. In physics information is modelled as independent states which have discrete boundaries, the greater the number of states the greater the information. Probability can be defined as the ratio of the number of states to the total number of states. Pattern recognition involves removing the boundaries between independent states or linking, converging, correlating states which have common or similar features, hence the term mutual information. For example a group of linked states which have a commonality can be called a country in everyday language, the United States of America (USA), China, Africa etc..

There is a more general process going on here whereby there is a converging process over time towards some super godlike state. This state has the property that it is the same and equal for all observers as it results in all information becoming objective or independent of the observer's "position" or perspective. I emphasize the word "position" here because I want it to have a more general meaning more closely associated with the concept of awareness. This super godlike state actually has the description of an objective democracy or commonality:

Democracy is a measure of the state where all perceivers, observers mutually agree with each other. It measures the correlation or association between observers. All observers are in the same state with respect to each other in an objective democracy, they are in agreement. Agreement removes stress between observers, the word agreement literally means to harmonize or make uniform.

*Agreement is dual to equality*

The words equate means to bring to a common standard (equivalence) to make uniform or to bring into balance, so agreement and equalization are one and the same thing. Any equality between two or more systems has an implied agreement between them. Objective democracy is a global state (average) which is independent of the observer's "position" it is therefore unbiased, uniform and constant for all observers.

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Objective democracy is the proper unbiased scientific definition of democracy. Objective democracy can be called the principle of generalized consentience (agreement). Universal or objective democracy and subjective (relative) democracy are two different concepts. Objective democracy, or absolute, 100% or proper democracy is a state which is the same and equal for all observers everywhere and by definition it is independent of the observer's "position". Relative democracy or real democracy or subjective democracy is a relative concept as it is dependent upon the observers position. Democracy is the modelling of large groups of observers to achieve mutual agreement and consentience, convergence or syntropy. More importantly democracy is dual (Objective, Subjective) and it can be modelled.

In physics the velocity of light is the same and equal for all observers so the velocity of light conforms to a principle of objective democracy. In fact all of the physical constants of nature and physics conform to a principle of generalized agreement or generalized consentience which is another way of describing objective democracy. Objective democracy built from objective information is a super-state as it is a state which is the same for all observers in the universe. Being a super-state means that it is a target, remember that the word information implies materialization into an end form.

The implied agreement between observers due to the laws of physics can be viewed as being hardwired into the physics. So it is possible to generalize the concept of objective information or mutual information by considering a large population of senders and receivers of messages (observers, atoms) who are maximizing their mutual information over time with respect to each other and converging (syntropy) towards some super final perfect state which has the properties of an objective democracy. At a more abstract level you can think of mutual or common information as self-memory mixed in with meme energy, memes are used to make predictions from cultural or environmental energy.

*The Einstein Reality Criterion*

In physics communication is governed by the electro-magnetic field in the form of waves or photons of light. These waves are essentially waves of probability traversing the space between atoms. Atoms communicate with each other by emitting and absorbing waves of probability. What we experience as reality as observers is therefore built out of these probability waves. According to the Einstein reality criterion for something to be real it has to have a probability of one and hence be predictable:

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"*If, without in any way disturbing a system, we can predict with certainty (i.e., with probability equal to unity) the value of a physical quantity, then there exists an element of reality corresponding to that quantity*."[2]

The Einstein reality criterion connects probability with prediction and hence mutual information. A physical quantity which has a probability of one is therefore predictable and the mutual or common information is therefore maximized. Einstein logic dictates that the more predictable something is the more real it is, and its probability is higher. Maximizing mutual information by observers results in optimized predictions for maximizing reality via the tracking of targets. The equations of motion which are optimized predictions minimize the action in Quantum Mechanics and maximize reality. Reality as we know it is literally built from prediction and probability. If you watch the following video about the human brain you will see that the visual cortex builds an expectation or prediction map of reality: *The internal model. David Eagleman The Brain episode one. Watch at 32 minutes:- https://www.youtube.com/watch?v=BvPu2kYstcg*

Postulate 2, Prerequisite: All observers make predictions (expectation maps).

Syntropy therefore in the form of mutual information is being used by the human brain to create and model reality by making predictions and anticipating the future in the form of an expectation map. Mutual, common or objective information is constantly being optimized in this process. Predictions are projections into the future. Predictions which are optimized have a probability of one or unity and are used to make targets real. The brain "rotates" virtual or imaginary (complex) information into real information via the teleological process of syntropy and tracking targets. There is no ordinary information associated with a fully formed target it has all been converted into mutual information. There is an algorithm in control theory which models this very process, it is called a Kalman filter.

*The Fourth Law of Thermodynamics: The Law of Prophecy & Prescience*

Postulate 3, Prerequisite: All observers track targets at a fundamental level of physical reality. This means that observers make predictions (Kalman filter algorithm) postulate 2.

[2] Einstein, Podolsky, Rosen 1935, p. 777
Internet Encyclopedia of Philosophy: http://www.iep.utm.edu/epr/

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Anything which is dual to entropy is by definition the fourth law of thermodynamics. Increasing entropy or information is the process of creating new independent states with boundaries. Syntropy is the opposite or opposame (dual) process whereby those states are integrated or linked together based upon common attributes this removes the boundaries and the independence of the states or converges the information into a single superstate. More specifically if syntropy is the dual of entropy and syntropy is a converging process it is more accurate to say that prediction is the dual of entropy. According to Shannon, entropy is average information and predictions are synthesized from processing and manipulating this information into useful forms. Increasing global entropy the second law leads to increasing accuracy of predictions, a dual process. The fourth law is the action or process of making predictions by observers it is therefore an innate behaviour of all observers! All observers track targets by making predictions. Even atoms make predictions as they use probability (information) in the process of absorbing and emitting photons. The fourth law is the law of prophecy & prescience. This is best demonstrated by examples:

Example 1: Einstein & Newton

Einstein's theory is more accurate than Newton's Laws of motion. These two theories are separated by over two hundred years and the associated equations which they provide for enable the dynamics of falling objects in a gravitational field to be predicted. Newtons's laws are accurate for predictions based upon low velocities when compared to the velocity of light, and Einstein's theories improve upon them so that predictions can be made at relativistic velocities. The predictions have improved over time. The equations of motion minimize the action or behaviour and hence energy within quantum physics. All mathematical equations are predictions to some degree or other and in physics they are used to model systems and phenomena. Models and predictions from those models become more optimized over time and produce more accurate results. The word theory actually means prediction, prophecy.

Example 2: The Falling Egg

A falling egg hits the ground and the result is a disordered, random and dispersed messy patch on the ground. The number of states (entropy) is said to increase. The ground or Earth has actually gained a tiny bit of mass and according to Einstein the gravity field has gotten slightly stronger and hence time has slowed down. This is a more predictable state of affairs and is equivalent to watching a slow motion movie. If the experiment is repeated over and over again then this time dilation effect would become noticeable, a local observer would not notice this time dilation effect but a

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global observer would see the eggs fall at a slower rate when the mass of the earth approaches that of an infinite black hole. An infinite classical black hole where time has stopped can be said to be in a completely predictable state, nothing happens it is frozen in time. Predictions are more accurate when time has slowed down. The average pattern on the ground formed by the falling eggs would also become more uniform over time, no one pattern is predictable but the average pattern formed from trillions of eggs falling on the same spot is completely predictable and uniform.

Example 3: The Gas in a Box & Milk Poured into Tea Cup

Objects tend to cool down over time they do not heat up. Cold environments are more predictable than hot environments. The surface of the moon is more predictable than the surface of the sun for instance. The north pole environment of ice and glaciers is more predictable than the bubbling lava in a volcano. Systems or environments which lack energy cannot perform any work so they are unable to do anything, they are more predictable. An expanding gas in a box cools down and is said to be more disordered and less localized than before the expansion. The gas molecules have spread out and become more randomized creating more states which is an increase in entropy. There are less molecules hitting a temperature probe per unit time than before, the temperature which is an averaged quantity decreases for expanding gas molecules. Over time the gas molecules become more uniformly spread out within the box as they fill the available space, this is an equalization process. This process of equalization and becoming more uniform is a democratic process and results in a more predictable environment. The entropy of an expanding gas may increase but duality demands that the total environment of the box becomes more predictable. If the size of the box was to increase to infinity then the temperature of the gas would drop to absolute zero as no gas molecules would ever hit the temperature probe. An absolute zero temperature environment is equivalent to an environment in which time has stopped (infinite classical black hole). At absolute zero temperature the gas molecules can be said to be in all in the same state, the ground state, this can be achieved by expanding the walls of the box slowly over time. This state is the same and equal for all the gas molecules, it is therefore independent of the molecules "position" and perspective, it corresponds to an objective democracy, increasing democracy results in a more predictable environment. Reducing the temperature amounts to convergence or increasing syntropy towards a final state. Objects and environments in their respective grounds states have zero energy and to use the example earlier of a communication system and maximizing mutual information they have no need to send and receive messages. Cold states are more predictable than hot states. Likewise milk poured into a cup of tea equalizes itself out within the available volume towards a uniform temperature and colour. The overall effect of adding milk

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to a cup of tea is to lower the temperature through the process of distributing the available energy more evenly (Brownian motion). The random walk of Brownian motion is an equalization process in which there is no preferred direction for the transport of energy, it is uniform for all directions and conforms to a principle of objective democracy which is a more predictable state.

Example 4: Blackbody Radiation & the Planck constant

In a blackbody cavity filled with radiation increasing the size of the box lowers the temperature because more low temperature/energy states are created than before. The energy equalizes or spreads out uniformly over the available states. More states have been created and the energy is distributed or shared out more evenly across the available low energy states resulting in a lowering of temperature of the black body. This equalizing process is a democratic process as it involves the communication of energy or redistribution, dissipation of information uniformly. Increasing democracy results in a more predictable environment.[3]

Max Planck used blackbody radiation to derive the Planck constant which is central to quantum mechanics. This constant has two equivalent (dual) interpretations related to the conservation of angular momentum and the Heisenberg uncertainty principle. The uncertainty principle states that the uncertainty in position of a particle or atom multiplied by the uncertainty in momentum is equal to the Planck constant, likewise for the uncertainty in energy and time. Increasing the uncertainty in position of a particle means that there is a greater degree of ignorance, randomness (entropy) associated with the particles position which results in a decrease of the uncertainty of the particles momentum or more certainty, knowledge or syntropy about its velocity. The Planck constant conserves the duality of entropy and syntropy. It does not get more fundamental than this.

[3] See the following book for an explanation of blackbody physics: Quantum Physics - Eisberg & Resnick 2nd edition p17-18

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*Certainty is dual to uncertainty - The Heisenberg certainty/uncertainty principle*

If something is more certain then it is more predictable.

Example 5: Image Processing

Images sent back from the recent planetary expedition to Pluto were initially undefined, blocky and blurry. Over time these images have become more defined less blocky and the resolution has improved and information within each pixel has become more accurate. The number of states of the initially blocky images can be said to have increased as the blocks reduce in size and there are more of them. This higher resolution means that predictions made from the images can be said to be more accurate. Increasing the resolution of the images increases the power of your predictions related to those images. As the entropy and information increased the syntropy also increased.

Example 6: The Kalman Filter

Another example of the fourth law in action is the Kalman filter, it is an algorithm used to track targets. This algorithm continually updates the predictions associated with the position and velocity (momentum) of a target so as to minimize the uncertainty and errors of these quantities. A uniform target essentially becomes totally predictable over time and the initial uncertainty is converted into total certainty. The last sentence is not strictly true as the Heisenberg uncertainty principle sets an upper limit to the accuracy of any measurement which can mean that no target is fully trackable, ever, compare this principle with the third law of thermodynamics. The Heisenberg uncertainty principle and the third law of thermodynamics are clearly in conflict with the Einstein reality criterion here. Observers clearly accomplish goals, objectives or targets all the time in the real world otherwise no task would ever be completed. The basic action of a Kalman filter is to converge on a target which is the definition of syntropy and it is the dual process to that of increasing entropy namely taking measurements of the targets position and velocity over time and creating information.

These examples of the fourth law of thermodynamics serve to demonstrate that there are real physical processes in physics which demonstrate a dual process to that of increasing entropy. All of these processes have one attribute in common they all demonstrate the requirement for making predictions or expectations, anticipations. All observers make predictions, the fourth law is literally the act or unconscious

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behaviour of making predictions, it is automatic and instinctive. Prediction and anticipation of events and objects is inherent in everything we do, it is a by-product of teleological physics as all observers track targets, goals and objectives. Syntropy is the dual of entropy but more precisely syntropy can be identified with the concept of prediction or the behaviour of making predictions.

*Prediction is the dual of entropy*

Predictions are a result of maximizing mutual or common information between two or more observers (entanglement entropy). This suggests that there is a plurality aspect to making prophecies for instance you could imagine a population of neurons communicating with each other in the human brain, a neural network. The collective information formed by this population of neurons is resolved into a prediction.

Optimized predictions result from the experience and history of an observer, for instance a professional expert is more experienced than an amateur non expert. The opinion of a professional is more sought after rather than a layman this is because we associate more accurate predictions from a professional. What differentiates a professional from an amateur is the range of experiences or perspectives that a professional has obtained over time. The best predictions are those which are based upon the widest range of perspectives relevant to the problem (target) at hand. These differing perspectives can be analyzed and collected to form a coherent narrative or picture composed of common or mutual elements, a holism.

Mutual information is therefore formed from integrated information which is information unified into a whole. Inherent in this process of integration is the concept of mutual agreement, there is literally an agreement between the separate perspectives to become unified and converge (syntropy) into a whole. This simple process has a name in everyday language it is called a democracy! A group of observers or perspectives forming a mutual agreement amongst themselves is known as a democracy. When all observers in a large population mutually agree with each other this is known as 100% or objective democracy. Optimized predictions are formed from entangling information into objective information which conforms to a principle of objective democracy. In a neural network you can call this commonality of information common sense the fusion of individual separate tasks into a combined whole which can generalize information and perceive the bigger picture (topological abstraction). In weather prediction, the best long term forecasts are obtained from satellites orbiting the earth which have a global perspective compared to an observer on the ground who has a local perspective. Global perspectives allow for more accurate predictions as they are more objective.

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All the best theories in physics and science have been scrutinized over time by many scientists, the theories (predictions) which tend to survive are those which have stood the test of time. This amounts to a mutual agreement over time or a democratic acceptance amongst scientists, theories go through a process of initially being subjective and finally becoming objective in their final form, this amounts to them being independent of the observer's perspective or position. Objective theories and hence predictions are the same and equal for all observers hence they have become fully democratic. Objective theories have a permanence about them as they tend to be immune to criticism and an invariance or generalization with respect to perspective.

For instance Einstein's theory of General Relativity is actually a theory of objective democracy as it models the trajectory of falling objects in a gravitational field. All objects fall at the same equal rate in a gravitational field the acceleration so they are conforming to a principle of object democracy, the acceleration can be said to be independent of the observers position. Objective democracy (duality) links optimized predictions with gravity and mutual information (syntropy) with the entropy of a black hole. Objective democracy is a goal or target.

"*General relativity: Einstein's theory based on the idea that the laws of science should be the same for all observers, no matter how they are moving. It explains the force of gravity in terms of the curvature of a four-dimensional space-time.*"

Stephen Hawking:
A Brief History of Time.

*Randomness is the dual of order, formlessness is dual to form*.

Objective randomness or entropy is independent of all observer's perspective, for instance throwing a dice or tossing a coin is the same and equal for all observers everywhere in the known universe. Objective entropy therefore conforms to a principle of objective democracy. Likewise order, structure, patterns, logic and predictability conform to objective democracy this would suggest that duality which links opposames together is somehow related to objective democracy. In target tracking language randomness or formlessness is the absence of a target but entropy conforms to objective democracy which is a target, the lack of a target randomness (entropy) is a target, this conundrum or riddle can only be reconciled with duality. In a similar vein of reasoning order, structure and form (shape) can be associated with targets and goals and this links to mutual information, prediction and syntropy. The common concept to both sides of this dual is objective democracy. Darwin's theory of evolution is based upon natural selection which involves the random mutation of genes over time. Natural selection is therefore governed by objective democracy if it

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is based upon randomness! It is the same for all observers. If randomness were not truly random and democratic then there would actually be a preferred observer, this would introduce a bias into the universe, this preferred observer would have an advantage over everyone else as he/she would perceive a more predictable universe, at its extreme a predictable universe is a very boring universe. A universe therefore requires objective democracy in order to be interesting, it is a prerequisite.

"*Some people are more equal than other people*"
George Orwell,
Animal Farm

Increasing entropy globally leads to increasing accuracy of your predictions globally. The ultimate or perfect target is that of objective democracy, a perfect state or universal target which is the same and equal for all observers in a population everywhere. The fourth law of thermodynamics is goal orientated towards targets, physical systems are attracted towards a perfect state which amounts to a mutual agreement amongst observers over time, teleological physics, this is Syntropy or convergence. Objects in a closed system cool down in thermodynamics towards a ground state which has zero energy, which is a predictable state in the sense that nothing will change until external energy is applied. Syntropy in the form of prediction is dual to entropy.

"*Some predictions are more equal than other predictions*"
George Orwell

The fourth law of thermodynamics introduces the concept of objective democracy into physics via syntropy and duality. It allows for a rational, logical and hence scientific description of reality to be introduced into science on a broader scale which until now has been ignored or not recognised for various reasons.

Predictions determine behaviour (action) and in biology there are two types of behaviour, growth is dual to protection. Meme energy and genetic information are both used in the formation of predictions within the conscious and sub-conscious mind.

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The Third law of Thermodynamics[4]

The entropy of a system approaches a constant value (or zero) as its temperature approaches absolute zero. An alternative statement of this is that it is impossible by any procedure, no matter how idealized, to reduce the temperature of any closed system to zero temperature in a finite number of finite operations. It has been questioned whether the third law is really a law at all. A temperature of absolute zero occurs at the center of a classical black hole with infinite mass, time stops at the center (singularity) of this black hole so this state is equivalent to the freezing temperature of absolute zero. The Heisenberg uncertainty principle states that this is impossible as the uncertainty in time would become zero and the uncertainty in energy would become infinite. Another way of stating the uncertainty principle is that if time is completely localized then the energy becomes completely unlocalized or generalized.

*Generalization is the dual of localization*

I have already argued that this state of constant or zero entropy conflicts with the Einstein reality criterion as reality according to Einstein requires an absolute probability of unity which corresponds to 100% complete predictability. The third law of thermodynamics states that this level of absolute probability, prediction, mutual information and therefore objective democracy is impossible to realize in practice. In laymen terms this is equivalent to saying that a large population of observers will never mutually agree on anything even if you wait until the end of time! Subjective democracy can never fully be resolved, transformed into a state of objective democracy. It is pointless voting in democratic elections according to the third law! States of objective democracy occur all the time in physics for instance the velocity of light is the same and equal for all observers as it is independent of the observers position, a laser beam is composed of photons which all have the same velocity and frequency. Absolute zero temperature puts all the particles of a closed system into the same single ground state which corresponds to saying the state is the same and equal for all the particles hence it can be called an objective democracy. Objects cool down to a target state or ground state, teleological physics which in everyday language can be described as an objective democracy. Objects do not cool up.

[4] https://en.wikipedia.org/wiki/Third_law_of_thermodynamics

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*Patterns of Duality*

Here are some more examples of duality in fundamental physics:

Mutual Information, Black Holes & Duality

If syntropy is the dual of entropy and black holes have entropy then they must also have syntropy in the form of mutual information (entanglement entropy). Current physics research into black holes tends to concentrate on the quantum aspects of a black hole namely the entropy but this ignores the subject of time which is at the heart of Einstein's theory of General Relativity. I will now outline this problem:-

I quote Steven Hawking:-

"*According to general relativity, there must be a singularity of infinite density and space-time curvature within a black hole. At this singularity the laws of science and our ability to predict the future would break down. There is a failure or breakdown of predictability that occurs at the singularity.*"

Steven Hawking
page 4 chapter 6
A Brief History of Time.

The above statement is at odds with Einstein logic:

The entropy of a black hole is calculated by dropping bits of information or particles with mass into a black hole one at a time across the event horizon. This has two effects, the first effect is that entropy increases as the size of the event horizon increases due to the increased mass of the black hole. The second effect is that according to Einstein time slows down in a gravitational field, at the center of an infinite classical black hole time would come to a grinding halt and stop. An outside observer would therefore infer or conclude (predict) that everything is completely predictable at the center of a black hole as it is equivalent to a "slow motion movie". Events become more predictable if you slow down time. This is a paradox, cognitive dissonance or a duality. Two opposame perspectives: Hawking claims absolute unpredictability for a singularity and Einstein claims absolute predictability! Who is right? Both are in fact correct as the singularity at the center of a black hole is inherently dual. Increasing entropy and hence increasing randomness leads to increasing predictability as time slows down. The mutual information associated with a black hole, the entanglement entropy has everything to do with the slowing down of time. The positive curvature of space-time around a black hole can be linked to information, entropy and hence quantum mechanics via the realisation that the

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slowing down of time (time dilation) is a measure of entanglement entropy or mutual information, syntropy. The important point from this example is that there is a dual process to increasing entropy namely syntropy in the form of prediction which involves the act of literally making predictions. All observers make predictions. There are two generalized perspectives here the observer inside the black hole and the observer outside the black hole, both are separated by the event horizon and both are making predictions which contradict each other, this a duality.

The dual of a classical infinite mass black hole is a white hole (big bang or divergence). A white hole is inherently dual as it is the opposame of an infinite mass black hole. The Weyl curvature hypothesis states that the big bang was a point (singularity) of perfect symmetry and if you reverse the second law of thermodynamics by going back in time you reduce entropy to a value of zero, this is a state of absolute predictability. Contrary to this idea is the fact that time speeds up as you exit a gravitational field, the logical extension of this is that time speeds up if you approach the big bang by going back in time. The conclusion is that time must be flowing infinitely quickly at the conception of the big bang. Einstein logic dictates that by going back in time or climbing out of a classical infinite mass black hole your clock speed will increase indefinitely as seen by an observer at the center of the black hole. This means the big bang or white hole is completely unpredictable as seen by the black hole observer. There are therefore two dual perspectives here absolute predictability from the second law and decreasing entropy and a state of complete unpredictability from Einstein logic. The white hole singularity or big bang is therefore actually a duality. If you apply the Heisenberg uncertainty principle to a white hole singularity or a point of infinitely localized energy density then you are forced to conclude that such a thing cannot occur, infinite localization in space-time causes the uncertainty in energy to expand without limit. The uncertainty principle forces duality on the very concept of a big bang.

I should point out that there are two generalized perspectives at work here when you think about black holes and white holes, this can be confusing at first but once you realise that there are two perspectives which are in opposition and contradict each other then things begin to make sense, duality is literally forced upon you in order to make sense of it all! You must accept the two opposame perspectives in order to understand the bigger picture, postulate 1.

Black hole singularities are dualities. You get exactly the same kind of logic in Wave/particle duality or quantum duality. Duality unites the classical world of Einstein with the quantum world.

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A black hole singularity is dual to a white hole singularity, and both singularities are inherently dual! This is duality within duality or duality beyond duality, quadrality or hyperduality. For falling objects in agravitational field potential energy is converted into kinetic energy or potential energy is equivalent to kinetic energy so potential energy is dual to kinetic energy. Energy is a by-product of duality being conserved, this means that the Einstein constant '*c*' as in $E = mc^2$ conserves the duality between energy and mass, energy is dual to mass. In quantum mechanics the Planck constant '*h*' performs the same role and conserves the duality between space uncertainty and momentum uncertainty, or energy and time uncertainties.

"*Complexity is the Dual of Geometry*"

"*The increasing complexity of a quantum state*
*leads to increasing expansion of Geometry*"
Leonard Susskind

*Complexity is dual to simplicity!*

Space & Time Duality, Spacetime

Space-time is the union of space and time and forms the basis of special relativity and general relativity. Space is dual to time according to Einstein they are equivalent descriptions of each other. Minkowski space-time allows physicists to optimize their predictions when it comes to modelling the dynamics of moving and falling objects in a gravitational field. What is not obvious is the fact that both space and time are inherently dual within themselves. For instance any space, distance or length requires at least two localized but separate points in the form of a vector to specify it, space duality. The Heisenberg uncertainty principle reinforces this idea as it is not possible to localize a point in space so that it is infinitely small. There is also a minimum length in physics called the Planck length.

If space is dual and duality is energy then it is possible to extract energy from the vacuum in the form of particle - anti particle pairs (Hawking radiation). Mass curves space to create potential energy which is seen as kinetic energy or falling objects in a gravitational field. If space is dual then time must also be dual in the form of time duality, the future is the dual of the past or time asymmetry. Again the Heisenberg uncertainty requires that time cannot be localized to an infinitely small time period as you would then produce an infinite amount of energy.

The future which is intimately connected with making predictions or projections about future events is dual to the memory and history of past events. Memory is used

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to make predictions about the future. The present or the so called hologram in the brain paradigm and the perception of time is therefore created from this time duality. So space-time duality is the fact that space is dual to time and both space and time are inherently dual, duality within duality, quadrality or hyperduality. Spacetime is being conserved at all times future and past and hence duality is being conserved. Einstein proved that predictions are more accurate when space and time are united (converged) into a single entity.

## Action & The Heisenberg Uncertainty Principle

Fundamental to quantum mechanics is the idea of action and the uncertainty principle. Uncertainty in space requires at least two localized points and uncertainty in momentum requires at least two velocities. This space duality can also be seen in the Planck length which is theorized (predicted) to be the minimum length possible in physics. Uncertainty is inherently dual or non-localized. These two duals of space and momentum (angular momentum) form the Planck constant of quantum mechanics. Space is dual to momentum and the uncertainty in both means that the Planck ($h$) constant is a duality within duality, a hyperduality. A second or dual interpretation of the uncertainty principle links energy and time uncertainty together. From a technical point of view the Planck constant conserves hyperduality. The equations of motion which are optimized predictions minimize the action in quantum mechanics, the ground state for all electrons in atoms also minimizes the action.

## The Dirac Equation, Duality & The Klein Bottle

The Dirac equation was used to predict the existence of anti-particles. Particles are dual to anti-particles and all particles have spin. Spin up is dual to spin down, this is a duality within duality, hyperduality. If you watch the following video on youtube about the Klein bottle you will see that it is composed of two mobius loops (spinors) it is also a duality within a duality. Mobius loops are dual. A left handed mobius loop (left spinor) is dual to a right handed mobius loop (right spinor) and the two joined together form a Klein bottle: https://www.youtube.com/watch?v=I3ZlhxaT_Ko

The Klein bottle is a visual or geometric representation of a Hyperduality. In algebraic topology there is a correspondence between the number of holes (genus) and the number of self intersections (mobius loops) within a surface. A Klein bottle can connect the inside of a surface to the outside of a surface.

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Spontaneous Symmetry Breaking, the Higgs duality field and Quark Duality

The process of spontaneous symmetry breaking in physics creates the Higgs field which is responsible for giving mass to particles via the Higgs mechanism. The word spontaneous means random (entropy). The Higgs field is a constant non zero scalar field which is the same everywhere at once for all observers, it is also known as condensate field and is dual to the "vacuum" another condensate field. The Higgs field is therefore a duality field. Here are some quotes from a website that I recently visited concerning the Higgs field and quarks:

https://profmattstrassler.com/articles-and-posts/particle-physics-basics/the-known-apparently-elementary-particles/the-known-particles-if-the-higgs-field-were-zero/

"*the Higgs field is not zero, its presence, and the fact that it has a direct interaction with the top-left and the top-right, forces the top-left to convert over to a top-right, and back again. How often does this happen? About a 100 trillion trillion (100,000,000,000,000,000,000,000,000) times a second. This conversion process makes it impossible for us to think of the top-left and the top-right as separate particles, because they are inextricably linked together; if you have one, you will very soon have the other. (You never have both at the same time, which is why the top quark remains elementary, not composite.) We call this mixture of these two particles the top quark, collectively*"

"*the non-zero Higgs field, whose presence causes the flipping back and forth between top-left and top-right, endows this mixture with an additional intrinsic energy, even when it is sitting still. That intrinsic energy is indistinguishable from mass-energy* ($E=mc^2$)"

"*Take the Higgs field away — make it zero — and the top quark goes back to being two separate massless particles, the top-right and top-left*"

The top quark in the above quotes is actually composed of two dual quarks (left, right), the flipping process between these two quarks caused by the Higgs duality field is the mechanism used to describe rest mass energy. Quarks are inherently dual and the concept of energy and therefore mass in physics is being created by conserving this duality. At a fundamental level energy is literally duality, switching on the Higgs field causes two massless particles to become combined into a single particle, the top quark which has mass. Helicity is dual to chirality.

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*Non Physics examples of Duality:*

Patterns of Duality & The Western Thought Paradigm

Differentiation is the beginning of thought! The thinking process and thoughts can be dichotomized into two generalized structures within humans. There is the western thought paradigm of duality, separation and differentiation and this is dual to the eastern thought paradigm of unification, integration and holism. Both sides of this dual are inherently dual. Western thought and also the scientific process requires sub division and the creation of limits and boundaries (parameters, variables) to express ideas (left brain thinking) whilst eastern thought requires the yin and yang to be unified into a unity (right brain thinking). This thought paradigm is actually a duality within a duality, quadrality or hyperduality. Two distinct dualities which are dual to each other. Integration is dual to differentiation (mathematics) and reductionism is dual to holism (psychology). We have here the second law of thermodynamics at work namely that of increasing entropy. Differentiation of thoughts into new states of information is the second law, increasing entropy. Integration of states of information is the opposite, opposame or dual process to the second law and has been given the name of syntropy. Syntropy is therefore the dual of entropy, the fourth law of thermodynamics.

Duality in Politics

Duality occurs in politics, most parliaments are split into two. On one side you have the government and on the other the opposition to the government. This is the left wing/right wing paradigm. On the left you have the traditional left and also the alternative left this is also a dual. Likewise on the right you have the traditional right and the alternative right, again another dual. So the left wing is dual to the right wing and both wings are inherently dual. This is a duality within duality or hyperduality.

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Here are some more duals (Jewels):

*The colour black is dual to the colour white*
*Involution is dual to Evolution*
*Complexity is dual to Simplicity*
*Individualism is dual to Collectivism*
*Symmetry is dual to Anti-symmetry*
*Positive curvature is dual to negative curvature*
*Hyperbolic geometry is dual to Elliptic geometry*
*Real is dual to Imaginary (virtual, complex numbers)*
*Helicity is dual to Chirality (atomic spin)*
*Positive is dual to Negative*
*Fermions (particles) are dual to Bosons (forces)*
*Particles are dual to Anti-particles*

## Conclusion

There is a clear pattern of duality in physics here with these examples. More to the point there is a second layer of duality which is not obvious until you see it in some revealing examples, hyperduality. The second layer of duality can only exist once you accept the first layer. A fundamental understanding of information theory in physics means that there is a dual process to increasing entropy and increasing randomness which has the properties that it has the opposite but same (opposame) characteristics. Information increases but it also processed into useful information which allows observers to perform teleological tasks via the act of making predictions. I have outlined three postulates here which can be used to create a fourth law of thermodynamics based upon the concept of Syntropy and the merging of information into a unified whole (mutual information). This whole forms a perfect, super state which has the characteristics of an objective democracy as it links disparate information into a union. This is a general process in physics which can be seen in objects cooling down, the behaviour of light and the electro-magnetic field, gravity, Brownian motion, pattern recognition, the physical constants of nature and much more. The equations of quantum fields are modelled on the assumption that they are the same and equal for all observers everywhere in the universe so they are conforming to a principle of generalized consentience or objective democracy.

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Agreement is dual to disagreement which means that democracy is technically a duality, this means that it is possible to model duality using physics and the concept of a generalized or invariant perspective.

In the kingdom of the blind the one eyed man is king, the two eyed man or dual eyed man is therefore by definition a God.

The Bohr/Einstein Duality and Quantum Entanglement documentary:

https://www.youtube.com/watch?v=BFvJOZ51tmc

Top down, bottom up Duality in psychology:

http://www.simplypsychology.org/perception-theories.html