

What is reality in the context of physics? G.P.Parry

Einstein said “ Reality is merely illusion..”¹ So it is, if one considers the appearance of reality to be the totality of what is real. Though is reality just the appearance of things? Einstein also said “The justification of the constructs, which represent "reality" for us, lies alone in their quality of making intelligible what is sensorily given.”² To answer whether reality is digital or analogue it is necessary to understand what reality is in the context of physics. That reality is both the appearance of things, the observed Image reality, modelled by the mathematics of space-time as well as the underlying cause of that appearance, the unobserved Object reality.

The description of reality is affected by the methods of investigation used, the pre-existing concepts applied and mathematical modelling employed. It is not enough that a model is not dis-proven by sound experimental techniques, corresponds to existing theory and is mathematically correct. If a description requires acceptance of paradox, unreality of all things, quasi reality or supernatural agents or realms, yet is a description that fits with observation, it must be incomplete if not incorrect or non science.

Objects spatially separate from an observer are not sensed directly, due to transmission delay between reflection or emission of potential data and its receipt. So the Image reality has temporal as well as spatial distribution. As an object is approached its image is formed from more newly generated data present in the environment. Where and when an image appears to exist is dependent upon the observer reference frame and is not intrinsic to the object itself.

The mathematical space-time model is a construct giving a mathematical representation that fits well with observations of Image reality but is not a complete model of reality. Though it contains Mc Taggart's “A series of time”, past present and future, it does not include “B series time”³ which is passage of time or change along a sequence spanning earlier to later. Used alone Space-time allows the possibility of time travel and associated paradoxes, is a completely deterministic static model that denies free will and does not allow causality due to non simultaneity of events.

Image reality does not require a conscious observer but a means of amalgamating information that *arrives* together, rather than that which was generated together. It is formed by biological and non biological reality interfaces, wherever data arriving over a short interval of time is amalgamated into an image. All sound recording, photography and filming record information at the time of exposure of the device to the input.

The experienced present of an awake, mentally healthy, individual observer and inter-subjective consensus reality, are Image realities. Through interaction with our human sensory systems, the Prime reality interface, there is detection of environmental "data", em waves, sound waves, chemicals reflected or emitted from objects in the environment. Directly or via an artificial aid or detector. Nervous impulses are generated or inhibited by the sensory system in response to physical or biochemical changes in the sense organs brought about by stimulation. This electrical impulse data, together with neurological processes, forms a representation of external reality. It is not identical to external object reality but is related to it, as it is built in response to interception of data from that underlying reality. The present is a composite formed from data, experienced simultaneously. The data contained in the image is not from contemporaneous origin so the image is not temporally homogeneous.

The Image reality becomes a manifestation when the simulation is formed from the available data . It does not exist prior to that process. Which is relevant to uncertainty, wave function and de-coherence ⁴Raw object reality cannot be observed. Interaction with a detector, which is also unavoidable physical interference with objective reality, forms the novel data that will be processed giving Image reality. The reality that is observed subsequent to detection is limited by the properties and sensitivities of available detectors or receptors and subsequent processing.

Current time when referring to the temporally homogeneous spatial arrangement of the Object (reality) Universe under consideration shall be called Uni- temporal, or Objective, Now to distinguish it from the present. It spans the whole Object Universe and can be regarded as a single co-existing spatial arrangement and distribution of objects in space, **not** space-time. The current and only existentially real configuration of objects, forming a part of a sequence or continuum of such arrangements (depending on how change is regarded).

Object reality is the actual ever changing position and arrangement of objects particles and waves relative not to any single observer but to the spatial positions of all other constituents of the temporally homogeneous object universe. Past present and future are not a part of this reality because: Old forms and arrangements are replaced by new forms and arrangements, the future does not have existence (though there is potential image reality within the wave and chemical data that exists in the environment.), the present is composed of temporally distorted image representations of former arrangements of objects and events, within the temporally homogeneous current object reality.

Change or potential for change can be regarded as energy. Energy is never destroyed. So change is continual and inevitable. Even if a particular structure or particle does not change form or position in local space it will still change its universal position and therefore continues to undergo spatial change. Every change leads to further change giving the incessantly rearranging soup of causation within temporally homogeneous object reality space. The structure and spatial arrangement of the object universe is encoded in em and sound wave data transmitted across space and later may be formed into an image reality.

In order to guide an aircraft safely, air traffic control uses trajectory information from at least 3 radar stations. The trajectory given by each radar station will be different and will be the apparent direction of travel from that station. By finding the overlap of the 3 trajectories it is possible to ascertain the position of the aircraft. It is not a space-time position relative to any one observer reference frame. It can be seen that although momentum and space-time position is always relative and a particle does not have a fixed position, only an ever changing universal trajectory through space, by combining trajectory observation data from many observers it is possible to obtain a scale dependent super- relative position, relative to multiple observers. A single position in space at a single time that *must have existed* for each to have observed the reported trajectory.

Experimental results based on observation at the macroscopic scale will conform with the predictions of the space-time model of reality, as it is a model of the appearance of reality and not what *is* that allows that appearance to be observed without paradox. Super-relative positions could be used to more clearly understand the relationships of objects and particles in local *object reality space*. Rather than attempting to fit detections of underlying spatial reality into a space-time model that mathematically describes Image reality observations.

A representation of former objective Now could be viewed retrospectively, by taking into account transmission delay for many different observers. The Image reality could be de-constructed and only that data that has taken the same length of time to arrive at the different observers, from the origin of that data recombined. Assuming a constant observed speed of light in any single inertial frame of reference except where there is gravitational perturbation. Building from that new composite data a representation of the former co existing spatial arrangements. This could prove useful in understanding some astronomical anomalies and causality at all scales. It will still only be a representation, as it is only possible to know what is formed by the detection and processing procedure and not the raw unselected and unprocessed reality. We can only "see" what we choose to observe and are capable of observing.

The momentum of the aircraft is still relative to the scale of observation as all of the radar stations are situated on the earth. The trajectory observed is not just frame dependent but scale dependent. If an observation was made from a satellite not in geostationary orbit, then there will be a difference in observed trajectory of the aircraft as the rotation of the earth becomes relevant. An observation taken from a body in the solar system that is not a satellite of the earth would incorporate the the motion of the aircraft relative to the earth's surface, the rotation of the earth, the orbit of the earth. An observation taken outside of the solar system would incorporate solar system motion. Beyond the galactic scale there would be momentum of the solar system within the galaxy, rotation and precession. Scale of observation alters observed momentum.

There is thus an Object reality Universal momentum possessed by all matter that is unaccounted for when relative momentum at a single scale is considered alone. The Object reality Universal momentum is a trajectory through universal space which will resist perturbation. A body in motion continues in motion unless acted upon by an unbalanced force ⁵The seemingly stationary body resists being moved and the moving body resists being stopped. Because of the Object reality Universal momentum no mass is ever truly at rest, even when observed to be so with in a particular reference frame. A body in motion has not only the apparent relative motion that is observed but universal trajectory imparting momentum or inertia. The greater the mass of the the object, the greater the number of particles with similar universal trajectory resisting change to that trajectory.

Bodies with mass are changing position within the universe continually. Entire change in Object universal spatial position of an object is not represented within the coordinate system of space-time within any single reference frame. It is not shown along any of the spatial dimensions and is not merely time. It is continual *spatial change* over many scales comprising rotation, translation and scaling transformation.

Mass is not only inertial but also gravitational. The entirety of change in position of a body cannot be indicated within the $3n + 1$ spatial dimensions of the space-time coordinate system. It is missing, but never the less it is necessary to account for the resistance to change of inertia and momentum and the existence of gravity.

Gravity is not due to curvature of space- time, as space time is an image reality, an "illusion", and not object reality with concrete realism. The curvature of space-time is an interpretation fitting the observation of image reality, not underlying object reality. If space-time reality is an illusion, as confessed by Einstein, there must be other cause for gravitation than curvature of a non existent space-time manifold. Mass does not

cause gravity merely by its stationary presence in space-time but because the body is following a trajectory through space and affecting the environment through which it passes, causing the observed gravitational field effect. It allows the influence of gravity to be instantaneous, at the position of the affected body, rather than having to be transmitted at light speed from gravitationally attractive body to attracted body. There is no difference between gravitational and inertial mass as they are aspects of the same phenomenon.

It is a still night, a dog barks. Man A nearby hears the dog barking almost at once. That present dog bark that A is hearing might be said to be in Man B's future. As 5K away man B hears the dog bark only after approx 15 seconds. Once the information (sound wave) is on its way having left its source, the event that led to formation of that information cannot be prevented. It becomes a part of B's present when the information arrives not when it is sent. In that respect the experienced present, formed by interpretation of em wave data transmitted from distant objects, has been "pre written" and is not currently happening in object reality.

Just ahead of observation of objects very close to the position of the observer, there is unobservable Objective Now, that which currently exists, the causality front. Temporally beyond that object reality there is nothing, the future is unwritten and uncertain. Giving partial determinism and the indeterminacy necessary for free will and causality. Due to the complexity of variables in vivo, known / unknown / uncertain, lack of information on the positions of all objects and particles and not all causality being due to direct fermion particle interaction but diffuse environmental disturbance, interference, reinforcement and feedback. The tiniest of environmental disturbance could act upon a physical or chemical tipping point leading to a cascade of further events. When stable states or arrangements are formed, greater energy input will be required to alter them so they are more likely to endure. Structures can build up upon former structures, or there can be alteration or destruction of former arrangements.

The time dimension does not pertain to Object reality, only Image reality. The concept of past and entire future as concrete realities, (for which there is no proof and a paradox contradicting their existence), is therefore overcome. If they do not exist, with actual material content, but are imaginary, they cannot be visited or altered. So no Grandfather paradox and no twins paradox. There are no permanently fixed concrete atrocities, disasters and fate, unlike in a Block universe. The future beyond the causality front of objective/uni-temporal Now is non-existent, so is empty and unwritten. The past is no more, finished and no longer existent. All that remains is now a part of object reality and the uni-temporal Now.

In these respects, the appearance of things, the consensus ordering of events and the experience of the

individual, past, present and future are real. Newton's view of an absolute space and time and use of "fixed" stars bears resemblance to object reality though in object reality, objects will have hyper-relative positions rather than absolute positions, and Einstein's space-time with relativity models image reality. So the two different viewpoints can be reconciled as relating to different aspects of reality.

The transmission of data forming the Image reality is going from imagined future, as it is not yet experienced but already exists as potential, to present (experience). Irreversible as em wave data informing present experience flows from object reality to image reality only. In object reality though current structure is being built onto, and from, former structure or arrangement. Plus a proportion of former structures will endure due to stability or particular local circumstances. An imaginary direction of past to future. The object reality arrow is the direction of causality. Irreversible due to the momentum of the object universe. Causality is possible because in Object reality objects and particles have real, all scales hyper-relative positions in space, not merely relative positions in space-time depending on a particular observer reference frame. The arrows and their directions are imaginary. There is no time dimension in object reality and no possible causality in space-time due to non simultaneity. The reversible space- time mathematics arrow of time does not relate to the object universe, causality, or experience of passage of time, only the distribution of em data leading to the static space -time image.

Raw Object reality is still relevant to science. It is the objects and environment that interact in space without temporal spread that give causality, not orphan images. Fermions, atoms and material bodies must have their own existence independent of the position, momentum and em data about them. Image reality does not create the em wave information itself that gives rise to an image upon interpretation. There must be prior interaction with a body in space that is the origin of that data. Unless it is an artificial or virtual reality, constructed from information alone and not pertaining to an external reality existing outside of the simulation.

It has seemed that at a foundational level there are only particles and waves. Though electrons, and even larger particles can exhibit wave properties and photons give discreet and so particle like detections.⁶ However there is experimental evidence that the void or empty space is not empty, but an environment that can be be influenced and exert influence, even in a vacuum.

A foreman is not just a man found in a particular location in the factory or moving with particular momentum across the factory floor. He has an influence that is discernible by the output of the workforce. Seeing the build up of a banded film in a double slit experiment it is not reasonable to consider the electrons, photons or

other particles to be merely the isolated objects, identified by a snap shot detection of position or momentum. Rather they are something interacting with and altering its environment. Giving a cumulative manifestation resulting from that behaviour and its effect. The presence and influence the particle has in space, as it interacts with its environment, fluctuates in space with time i.e. unseen change in Object universal spatial position. Causing diffuse change, an environmental effect or wave like disturbance.

Consider a medium that can be disturbed by movement within it. The movement of an electron through it could set up sympathetic vibration of a surrounding medium as well as any wave motion resulting from vibration the apparatus components. There could then be feedback from the vibration of the medium to the movement of the particle. In the double slit experiment upon reaching the double slits the medium will pass through in wave style leading to interference of the waves giving an interference pattern.

That interference will also feedback onto electron particle position. This explains why electrons fired individually through the apparatus will build up a wave interference pattern built from the detected positions of the individual electrons. The electron itself is not a wave, but environmental feedback onto momentum and final detected position results in perception of a wave like phenomenon in perceived image reality. This experiment provides experiential evidence for a medium of transmission of sub atomic particles and light in an unobserved object reality.

The medium itself cannot be observed because it is inert, does not reflect em radiation or sound waves or have an odour or taste and so does not provide information about itself for detection by the senses and inclusion in Image reality. Being unseen does not mean that it is not there. Its existence is implied by the experiment. All em radiation passes through it. It is the medium for wave transmission of em energy. All energy is change in spatial position. All em is a spatial change that flows through the medium.

The wave formed in the medium is not merely a hypothetical wave function of probabilities, giving many possible paths in different universes or a mathematical pilot wave⁷ describing a particle path. Such a mathematical hypothetical construct on its own has no concrete realism and no ability to influence an actual spatial position of a particle. An actual wave within a medium has the ability to feed back into the momentum of the carried object and influence the position of the particle when detected or the pattern observed. This explains why even electrons fired singly will build up a banded interference pattern.

The medium is undetectable, except indirectly in experiments such as this, and so forms no part of the image reality built from observation. Yet it must exist in underlying object reality to account for the observations that

are made without having to resort to many worlds supernatural interpretations of reality or the belief that hypothetical constructs formed from mathematical equations without real counterpart in the object universe control the position and momentum of real particles, or that nothing is real. Though these are possibilities they do not solve the time paradoxes or answer other foundational questions that are answered by the existence of an Object reality with concrete realism. The space-time field model does not require a medium, but it is a mathematical model of the illusion of reality and so lacks realism.

The electron is not a wave but is influenced by a waves of environmental disturbance. A photon is a wave or perturbation of the medium formed by the amount of energy released by change in position of an single electron in a single atom and is that amount of perturbation necessary to cause a change in position of an single electron in a single atom and so allow detection. Lesser amounts of energy would be undetectable but not necessarily non existent. Meaning there is the possibility of continuous analogue energy variation within object reality. While discreet particles unconnected by a medium, in space time gives a digital view of reality.

This is also relevant to the ERP⁸ paradox. If highly manoeuvrable and elusive particles have diffuse influence upon their environment and that environment is able to feed back influence onto that particle and others in temporally homogeneous objective Now, ahead of the *observed* present, then this overcomes the concept of an insurmountable restriction upon causality due to locality or position in space and information travelling no faster than the speed of light.

The influence does not have to come from a separate particle but can come from the environmental medium, with numerous inputs able to cause perturbation of the unseen medium , in which the influenced particle is immersed. Though information transmission informing present Image reality is still limited to light speed. This also allows electric and magnetic fields to be understood, as specific sub atomic environmental disturbances caused by the aligned movements of many electrons. It allows gravity to be understood as the perturbation of the surrounding environmental medium by the movement of a macroscopic body within it.

The reality that is observed is made up from processing of selected data that it was possible to detect and encode, given the properties and sensitivities of available detectors or receptors. Not the full spectrum, range of intensity and variety of data existing in external reality. If the minimum change acknowledged is merely the limit of measuring or detection capability then the digital units created are an artefact not a reflection of an intrinsically digital reality.

Hearing is a digital and analogue process. Vision is digital. The digital camera imitates the visual processes.

Photographic film chemically alters due to exposure. Each atom of reactant could be regarded as a digital unit. Sound recording can be analogue or digital or include a combination. So image reality is the product of both digital and analogue processing of data from the greater object reality. The human experience of image reality includes limits to discrimination of all variables. Which might be considered the smallest possible units of experience. There is a fine "moving graininess" to vision.

If unseen holistic change in object reality is considered real, including cumulative behavioural effects of bodies upon the environment creating causality and feedback, then this Object reality could be considered analogue. If every imperceptible change along the whole universal trajectory of an object or particle is taken into account it is analogue change. If only regular intervals of an oscillation, or smallest detectable change, or the snap shot identification of position and momentum of discrete objects and particles are considered, it would appear to be digital. So the construct used for the description determines whether that description is analogue or digital.

Realising the origin of image reality space-time, paradox is avoided and foundational questions can be answered. Reality is more than superficial appearance perceived via detection, observation and measurement. The limited experience of space-time image reality, and its description are digital. The underlying object reality necessary for those observations without paradox, supernatural agents or realms or unreality may be analogue.

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- FQXi blogs, John Merryman discussions on the direction of time, absolute space and time and other topics and Peter Jackson highlighting the importance of emphasising the non conscious aspect of image reality formation.

Notes.

Quote from Isaac Newton, The Principia, A new translation by I.B. Cohen and A. Whitman, University of California press, Berkeley 1999.

“Law I: Every body persists in its state of being at rest or of moving uniformly straight forward, except insofar as it is compelled to change its state by force impressed.”

(True within any single inertial frame.)

Mathematical Foundations of Quantum Mechanics. John Von Neumann. Princeton University Press. Princeton. Translated by Robert T. Beyer. 1932/1955 In this work Von Neumann concludes that the universe in its entirety can be made subject to the Schrodinger equation . He also concludes that wave function collapse is caused by the consciousness of the experimenter. As something else outside of the calculation was required. A view expanded upon by Eugene Wigner.

In a letter of condolence to the family of his friend Michele Besso Einstein wrote.. “For us believing physicists the distinction between past, present and future is only a stubborn illusion.

“Einstein concluded that past, present and future are on an equal footing, that they are all real. Time is an illusion.” E=Einstein. His life , his thoughts and his Influence on our culture Edited by Donald Goldsmith and Marcia Bartusiak. Published by Sterling New York/London 2006

Quote from McTaggart The Unreality of Time (1908) first published in Mind 17: p 457-73

“For the sake of brevity I shall speak of the series of positions running from the far past through the near past to the present, and then from the present to the near future and the far future, as the A series. The series of positions which runs from earlier to later I shall call the B series.”.....

“The first question which we must consider is whether it is essential to the reality of time that its events should form an A series as well as a B series. And it is clear, to begin with, that we never observe time except as forming both these series. We perceive events in time as being present, and those are the only events which we perceive directly. And all other events in time which, by memory or inference, we believe to be real, are regarded as past or future - those earlier than the present being past, and those later than the present being future. Thus the events of time, as observed by us, form an A series as well as a B series.”

“Richard Feynman was fond of saying that all of quantum mechanics can be gleaned from carefully thinking through the implications of this single experiment.”The Elegant Universe: Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory. Greene, Brian (1999). New York: W.W. Norton. pp. 97–109