Speculative Physics and the Ontology of Time in Particle Physics

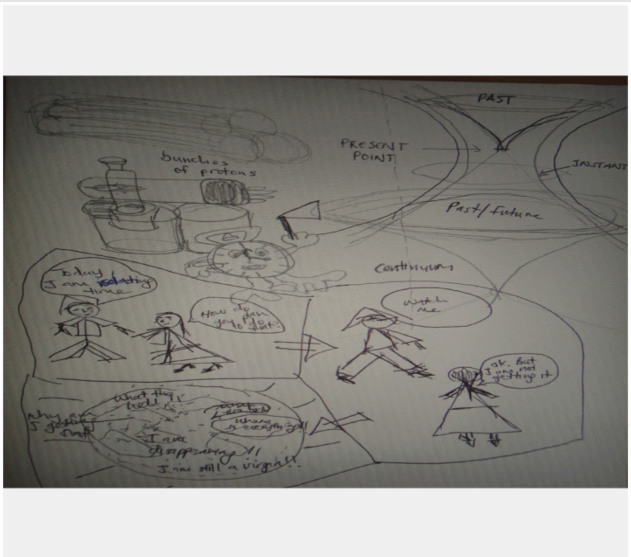
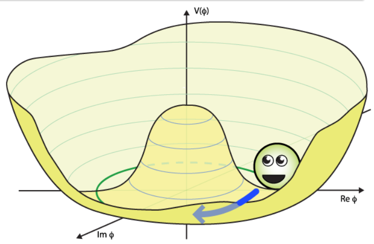


Image Credit: quantumdiaries.org



The Phenomenology of Observation

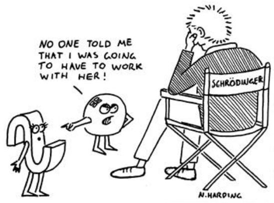
Measurements of specific time within the macro-scale of years, and the micro-scale of seconds, are important for thinking about how symmetry breaking can take place, beginning from the most important supplier of that energy, the luminosity of bunches as the result of the particulate ‘squeezing’. The luminous bunches of protons then have to go through the detectors. The detectors are radiation hard and fast, as the speed of the detectors is needed for setting the scale for the accelerator radiofrequency (r.f.) bunch structure. In fact, the event rate (the rate of detection of the collisions) is equivalent to the luminosity multiplied by the cross-section. The bunches of two circulating protons have to cross the detector at the right time phase for collisions to happen, and thus for their events to be counted. There are combinations of elastic and inelastic events, each of them important for tracing the different qualities of the sub-particle that are a result of that collision, especially through their property of charge.

Electroweak symmetry breaking (EWSB) is an example of a process that allows an observation to be made with regard to the logic of gauge particles. Electroweak symmetry is broken when the Higgs boson (a scalar particle) is discovered because of the existence of a vacuum expectation. The Higgs boson then couples to the already discovered gauge bosons of W and Z and provides them with a prescribed mass. The breaking of the symmetry is caused by the addition of Higgs potential to the Standard Model energy equation, which implies the existence of the Higgs Boson.

Overview

When we discuss physics at whatever scale, time is a dimensional quantity that must always be accounted for, as it is one of the building blocks in the ontology of physics. Time, an important quantity that once stood on its independent stead within is treated similarly to space with the onset of special and general relativity, even though the epistemology of its mechanics remain unchanged; time is interpreted within the same linear representation of the pre-quantum classical mechanics.

Image credit: stochastix.wordpress.com



However, when quantum mechanics was constructed and we begin to think about the movement of a single, small particle, within the potential well of its energy, one has to decide whether to maintain the particle within the well, or to solve its Schrödinger equation for obtaining the wave function of the particle.

What is even more important is how the matter of realism is constituted across different layers of conscious temporality, a temporality that situates the locations of the past and present of the entities undergoing decays and transformations, as well as that of production and reproduction, so that each node of that branching ratio representing that chain of decay represents a new set of temporality with branches of different temporal lengths represented by each unit of the particle. An example of this is when the Higgs boson is able to decay into two W bosons, with one W boson decaying into the electron and the other into a muon, both final states being leptons. Moreover, some elementary particles cannot be easily detected, and require the addition of the other observed particles’ momenta so that the presence of the more ‘hidden’ particles such as the neutrinos can be inferred.

As we approach relativistic speed, the indeterminacy of the particle increases, especially when one attempts to measure two particles in terms of their relationship to each other. The speed itself is less important than how we understand that speed. The temporality of the measurement, as well as the temporality measured, undergoes a range of uncertainty, though the width and range of that uncertainty changes depending on the level of interaction involved when the measurement and observation is enacted. Time, therefore, becomes probabilistic when viewed from the lens of the Heisenberg’s Uncertainty Principle, and even when we think about time dilation.

References Cited

Ricouer, Paul. Time and Narrative. Temps et récit. Trans. Pellauer, Kathleen Blamey and David. Paperback ed. Vol. 3. 3 vols. Chicago & London: University of Chicago Press, 1988. Print.

Whitehead, Alfred North. Process and Reality. Corrected Edition ed. New York: The Free Press, 1985. Print.

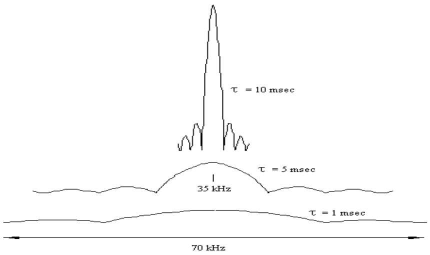
Clarissa AL Lee,
Program in Literature,
Duke University, Box 90670,
101 Friedl Building, 1316 Campus Drive
Durham, NC 27708
USA

email: clarissa.lee@duke.edu
webpage: modularcriticism.blogspot.com

Eruditio et Religio

Temporal Speculation

According to Whitehead, all "physical experience is accompanied by an appetite for, or against, its continuance (32)." However, when one speculates about the invisible composite that should logically be present an argument of symmetry representing a physical model, it is still important to think in terms of what is ontologically relevant, and if the issue of time adds up: "togetherness of form." If there is a temporality that is unrealized, relevance becomes important for expressing that point of "togetherness" or interconnection for the real to become actualized within the non-temporal. Therefore the constitution of the ontological in physics would be the unification of reality actualized within the temporal and meta-temporal (40).



Heisenberg
Uncertainty Principle
Probabilistic Measure
Credit Image: fas.havard.edu

The Ontology of Time

Nevertheless, time is seldom discussed independently as an isolated property of its own in theoretical physics, whether in classical or quantum mechanics. It is also a mostly neglected area of scrutiny within the philosophy of physics (except by those who write about the concept of space-time, but then, time is always correlated to space and matter) as an individual operator to be taken apart. Though time, and its relativistic property, plays a prominent role in the narrative of special and general relativity, it is seen as intrinsically bound to the other measurements under observation, be they length, mass, velocity, momenta, or rotation. Time is also bound to the decoherence and superposition of macro and micro-states since time is the shared ontology of both these states.

Time is taken on as an observing instrument that is embedded within both the classical and quantum reality that is observed. Even then, time is a macro-phenomenon with tangible units that exist regardless of the kind of observation undertaken. In most equations of different scales that tries to discern the boundary between the classical limit and the beginnings of quantum laws, simple equations of waves may preclude a direct consideration of time, but that is only when direct time relation can be extracted from the equations for the functions. This is necessarily done as a perturbation method to simplify an otherwise difficult and complex calculation of the interaction of two or more-body particles.

However, outside the immediacy of mathematically directed and distinct physical states and physical pointers, temporality must be taken into consideration when one deconstructs the different components that make up the design of the experiments. For instance, the timing between the movement of the particle bunches are important for calculating the transverse motion and momentum of the particles, since one would have to know at which phase space that the produced particles occupy at any time, taking into account the Uncertainty Principle. In addition, lifetimes of the measuring instruments undergoing wear and tear, such as exposure to hard radiation, have to be noted in advance, and calculated from the known physics of the materials of the measuring instruments. Moreover, the temporal range of the data collected has to be marked for the cut to be made.

Thinking in terms of the arbitrary micro-level of physical state, is thev Planck constant for time, set at 5.4×10^{-44}, calculated from $t_P = (hG/2\pi c^5)^{1/2}$, whereby G is the constant for gravitation, h is the Planck constant representing the quantum of action in quantum mechanics, whereby it represents the proportional correlation between the energy of the photon and the frequency of its associated electromagnetic wave. The reason why the photon is chosen as the arbitrary measure is due to its lack of mass and the fact that its velocity is equivalent to the speed of light, c. At this point, not much data has been obtained on this time constant that represents the very limits of the physical constraints.

Just as the macro- and microstates represented within the quantum and classical scale are not necessarily superposed in clearly demarcated mechanical boundaries whereby either of the rules would apply exclusively, such as in the case of the diffusion of the Brownian particles whereby our interpretation of the molecular movements are dependent on the thermodynamical model of our choice, there is also a "duality of the instant and the present". The life stories of the particles, as a group, and as individuals, are both made continuous by the now and are divided by it, requiring nothing more than a "simple relation of before and after….[since the] break in a continuum distinguishes and unites (Ricouer 19)."

Machine-Time

The LHC, as the site of both macroscopic and microscopic mediation and an important actor in my dissertation, is also an object which will provide significant contributions to thinking about the generation, regeneration and coming into being of new physics knowledge. The LHC consists of an agglomeration of different experiments occupying the different sectors of its complex, with the four main ones being ATLAS (A Toroidal LHC Apparatus), CMS (Compact Muon Solenoid), ALICE (A Large Ion Collider Experiment), and the LHCb (Large Hadron Collider beauty/bottom quark). Each of these experiments is set up to look at different aspects of nature: ATLAS AND CMS both look at events that might have taken place during the genesis of the universe, properties of particulate mass, and dark matter; LHCb looks at the asymmetry between matter/anti-matter; and ALICE at the constituent of the primordial plasma. Each are meant to provide multi-faceted approaches to solving existing theoretical puzzles from the most plausible to the ones so exotic that one often see them appearing in speculative fiction i.e. dark matter and anti-matter.
However, in the process of reading the signals, signs and codes that contain the different fragments of the clues that put together a picture of our universe, the LHC requires parameters, conditions, and 'instructions' that will enable the manifestation of the desired signs, and these parameters are considered during the statistical analyses of the data collected. The steps for defining the necessary inscriptions involve the:

1) construction of the apparatus's blueprint with details of the role to be performed by each segment of the apparatus;
2) calibration of the constructed apparatus;
3) selection and the tuning of required 'raw' particles for injection into the apparatus.

The most essential parts of the LHC are the detectors built by the aforementioned experiments. While there are some variations, they all contain the electromagnetic calorimeter for electron and photon identification and measurement, the hadronic calorimeter for jets (quarks that had been hadronized or 'glued' together to form a hadrons) and energy measurement, the muon detector for muon identification and momentum resolution over a wide range of momenta, and the inner tracker that resolves the momentum of the charged-particle for efficient reconstruction at the inner tracker of the detector.

The events sparked by particulate interactions only become events when the detectors consider the end result as events to be inscribed as traces for analysis rather than as background noises to be eliminated. Therefore, in using the raw material produced through these events, the detectors enact their own 'selection process' through the bits of data considered while allowing for margins of errors that would enable a wider range and flexibility in data selection, so that any elements beyond the Standard Model that has not been discovered can be kept in the radar.

The operations of the detectors are grounded in electric and magnetic fields, and are complex structures of simple electrical forces surrounding electrons and its holes. In fact, the development of detector design involves understanding how the bunched protons are supposed to cross the detector in terms of synchronicity. The development in RF technology is the impetus behind the development of the shape and size of the accelerators through the decades, and for ensuring that specific layouts are adhered to: layouts that are necessary for the network timing between the different electronic circuits that become increasingly complex to synchronize due to the increasing size of the instruments that components are built into. At the same time, the nano-scale of many of these components also increases the experimenter's ability to have as many of the circuit-brain that is necessary to be able to collate sufficient data to create a poetical rendition of the narrative of space-time.