Advance Physics

Miguel A. Sanchez-Rey

Table of Contents

Introduction
6
Constants and Notations
8
The Scientific Method and The Interplay
10
Classical Physics
12-13
- Inertia
- Three Laws of Motion
- Gravitation
- Planetary Mechanics
- Aether
- Magnetism
- Electrostatics
- Electromagnetism
- James Clerk Maxwell's Field Equations
- Thermodynamics
- References

Modern Physics
15-17
- Michelson and Morley Experiment
- Quanta and Max Planck
- Special Relativity
- General Relativity
- Quantum Mechanics
- Quantum Field Theory
- SUSY and SUGRA
- Strings, p - branes, and M-theory
- References

Advance Physics
19
- Logical Form
- Yang - Mills Gauge Analog
- Variant [of stringy]
- Computational Control
- SUPREME
- D-variants

- Metaspace
- Prime Factorization
- Quantum Field Approximation
- The Grand Unification Scheme
- Philosophy of Science
- Applied advance physics

Conclusion

21

Appendix

1-10

- Earlier template of Advance Physics

Introduction

Science is concern with observation. Observation is the capacity to perceive through the senses. By perceiving through the senses the sciences utilizes measurements and the scientific method to come to inferences about the natural and social world. Those inferences can arrive in the form of postulates, laws, principles or even deductions that elude to the basic mechanics and dynamics of natural and social phenomenon. Whether it be about inertia or the brain; the sciences are concern with understanding more about their properties by observation, measurement, scientific method, and the interplay.

By bringing numbers and measure to the natural sciences one achieves the birth of physics -- the study of matter, motion, and energy. Introduced by Sir. Isaac Newton in his seminal publication, "On The Mathematical Principles of Natural Philosophy" published in the Proceedings of the Royal Society of London. Newton established classical physics especially optics, inertia, the three laws of motion, gravitation, planetary mechanics and the aether. Subsequent advances in classical physics gave way to celestial mechanics, magnetism, electrostatics, electromagnetism, thermodynamics, radiation, and chemistry.

Leading to modern physics which culminates in the discovery of special and general relativity, quantum mechanics, quantum field theory, supersymmetry, supergravity, and eventually strings, p-branes, dark matter/energy, holography and M-theory.

All advances due to the painstaking efforts by many physicists whom made substantial contributions to furthering knowledge about space-time.

Advance Physics is a collaborative survey textbook. Advance Physics follows from the achievements of the Physicalist Program [PHPR] and the Scientific Age. In which further achievements and refinements will contribute to Advance Physics, and its relationship to the history and philosophy of physics.

- Miguel A. Sanchez-Rey [*The Grandmaster*, *The Master of Space-Time*]

Constants and Notations

The following physical constants are stated in Advance Physics but it is not say that no more constants will be discussed. It's only that the constants of nature are finite and those included are of primary importance:

$G \approx 6.9 \times 10^{-11}$Newtons $\times$ meters^2/ kilogram^2

c $\approx 2.9 \times 10^{8}$meters/seconds

$\hbar \approx 6.6 \times 10^{-34}$meters^2 $\times$ kilogram/seconds

Where natural units are applied as $\hbar = c = 1$.

The metric tensor is a scalar quantity that gives information to compute the distance between two points in space. Where the inner product of the metric form is assume to be bilinear, non-degenerate, and symmetric.

The Scientific Method and The Interplay

The scientific method develop under the guidance of Isaac Newton. It's a methodical procedure that ascertains and brings order to data and observation in the form of laws of nature. The scientific method is one of observation, measurement, quantification, theory, and experiment. Whereby implementing the experimental process laws of nature are able to be deduce thus bringing order to the natural world. Order that can be use, through the interplay, for technological advances and further exploration that may for the foreseeable future bring more stability and clarification to the scientific process.

The interplay utilizes all known methodical devices for ascertaining knowledge in the natural world and achieving applications. It's a procedure that relates different devices; for example, scientific method, complex systems, constructivism, emergence, perspectivism, holistics, etc., to gain accelerated advances in scientific knowledge and technological accomplishment. The interplay emphasizes the competing form in which the collaborative effort becomes the model.

Classical Physics

Isaac Newton's publication of *Principia* came ten years after the initial results were produced during a two year hiatus from the University of Cambridge, at his mother's farming home in Lincolnshire, to avoid the dark plague that at the time ravished Britain [1]. Those results pertain to the problem of inertia in which Newton discerned that an object in motion continues to moves in a straight line until another object collides with the object or in which friction may slow down the velocity of the moving object. This led to Isaac Newton's three laws of motion: (1) Law of Inertia, (2) Force is proportional to mass × acceleration in which acceleration is the increasing velocity of a moving object or quantifiable acceleration = velocity / time and (3) For every action there is an equal and opposite reaction [2].

Newton first came up with the theory of gravitation when he saw an apple fall from a tree at his mother's garden. When seeing the apple fall Isaac Newton ask the question as to what draws the apple downward toward the ground and then a further question is pose as to what draws the moon toward Earth, and even further what draws the heavenly planets towards the sun. Newton realize the existence of a weak force call gravitation. The gravitational force is the force between two masses from a giving distance. Using the metric notation Isaac Newton's equation of planetary gravitation is:

$$F_{\mu\nu} = - G \, \frac{m_1 m_2}{\hat{r}^2{}_{\mu\nu}} \quad (1.1)$$

Where G is Newton's gravitational constant (approximately 6.9×10^{-11}Newtons × meters^2/ kilogram^2), m is the mass and $\hat{r}$ is the radius in vector quantity. Such that the force of gravitation on planet Earth is drawn, in increasing velocity, toward the center. Where the force increases as the apple falls towards the center of planet Earth and is eventually crush. The same can be said for the heavenly planets attraction to the sun in Earth's solar system.

Using the equation for planetary gravitation Isaac Newton confirm and infer further knowledge of celestial mechanics: Johannes Kepler's laws of planetary motion, the validation of the heliocentric model, and at the time the static nature of cosmology. Yet the question was pose by Newton as to how light moves in the vacuum of space in such a way that light can bend. A problem that riddled physicists for nearly four centuries. Newton's solution to the problem is the existence of the aether. A medium in space and time that permeates the solar system [3]. Yet problems with the aether still very much worried Isaac Newton and so before his death he directed his attention toward alchemy.

Two centuries later Micheal Faraday expanded further on Isaac Newton's work on gravitation. Faraday studied the attraction and repulsion of charge ions (or particles). Using Newton's method Faraday develop instruments to ascertain the behavior of magnetic fields creating stunning images, using ionized dust particles, to trace out the fields from the electrostatic magnetic motion of ions [4]. This led to the confirmation of field theory as a promising mathematical formulation of physical phenomenon of magnetic and electrostatic physics. Culminating in James Clerk Maxwell's work on electromagnetism especially Maxwell's field equation that utilizes vector calculus as linear equations of motion and force [5]. Maxwell's equations can be summarized in the following gauge formulation for conformal invariance:

$$\mathrm{d\,F} = 0 \quad \text{and } \mathrm{d} \star \mathrm{F} = 0 \quad (1.2)$$

So that d is the differential, F is the electromagnetic field and $\star$ is the Hodge-star operator.

The revolution of James Clerk Maxwell's work on electromagnetism led to a bitter dispute at the Royal Society of London. Maxwell was falsely accuse of plagiarism by a member of the fellowship. Yet Maxwell carried on and eventually, after his death, became known as a physicist physicist by many revered and prominent physicist.

The development of thermodynamics was a reaction to the industrial revolution. That in increasing the efficiency of steam engines during the Napoleonic Wars by the French physicist Nicolas Carnot and in which Lord Kelvin further elaborated [5]. Where Lord Kelvin states that thermodynamics is the relationship of heat to the forces acting between different parts and the relation of heat to electricity. Giving way to the four laws of thermodynamics as: (0) Two systems in thermal equilibrium with a third then they are in thermal equilibrium with each other, (1) Internal energy of an isolated system is constant, (2) Heat can't spontaneously flow from a colder location to a hotter location and (3) as the temperature of a system approaches absolute zero, its entropy approaches a constant.

References

[1] Hawking, Stephen. *On The Shoulder of Giants*. Running Press: 2003.

[2] Newton, Isaac. "On The Mathematical Principles of Natural Philosophy."

[3] Einstein, Albert. "Ether and the Theory of Relativity." Sidelights on Relativity: 1922.

[4] Slater, John C. *Electromagnetism*. Dover Publications: 1969.

[5] Halliday, David. *Fundamental of Physics*. Wiley: 2013.

Modern Physics

Modern physics starts with a crisis in classical mechanics. That in which Max Planck developed the idea of the quantum and in which Albert Einstein constructed relativity theory. The crisis that permeated classical mechanics came in two folds. First was the Michelson and Morley experiment that aim to test the hypothesis of the aether [1]. Where the result of the Michelson and Morley experiment was negative leading to Albert Einstein's discovery of special and general relativity. The second was Max Planck's experiment that led to the knowledge of black-body radiation [2]. In which Planck asserted that electromagnetic energy is made of up particles called quanta now known as the Planck postulate.

Albert Einstein in 1905 further the idea of the quanta with the photoelectric effect in which photons, or light-energy, are made up of massless particles or discrete quantized packets of energy [3]. Leading to the famous discovery of $E = mc^2$. That is energy is equal to mass × the speed of light (approximately 2.9×10^{8} meters/seconds). In which no mass can travel at the speed of light since to do so more and more energy must be giving to get closer to c but in which paradoxically mass becomes infinite. This discovery usher the special theory of relativity. Whereby space and time, considered separate measurement paradigms in classical physics, is now combine to become space-time. Such that time is the fourth dimensional extension of three dimensional space call Minkowski space-time defined using the metric tensor ds^2 with Lorentzian signature { - , + , + , + } :

$$ds^2 = x_0^2 + x_1^2 + x_2^2 - c^2 t^2 \quad (2.1)$$

Einstein was able to show the existence of Lorentzian length contraction and time dilation [4]. In so Einstein develop key thought experiments that enlarged our understanding about the constancy of the speed of light that even at a young age Einstein conceptualized what it would be like to travel on a comet at the speed of light. One famous thought experiment showed that when traveling on a train, on a constant velocity of v, a lightening hitting two tree branches at the same time, from a distance apart d, will seem, to the observer on the train, looking through the glass window, to hit the closer one first and the second one a few milliseconds later that is t and t'. That is one's notion of time dilation changes with the Minkowski formalism or that to see oneself traveling on a comet at the speed of light the stars would suddenly contract altering the notion of length scales such as the wave-lenghts of energetic photon particles.

Einstein, having tackled the constancy of light, almost a decade later introduced the general theory of relativity as a resolution to the problem of the aether. Einstein postulated that space-time is a pseudo-Riemannian manifold call the Poincare group [5]. That in which, base on a thought experiment by Einstein, gravitation is equivalent to acceleration call the equivalence principle. If one free-falls with an elevator from a sky rise a beam of light projected from a window screen to the wall of the elevator would slightly curve. Using the equivalence principle Einstein formulated his non-linear field equation that show the asymmetry between gravitation and matter using the Lorentz metric $g_{\mu\nu}$, Stress-Energy Tensor $T_{\mu\nu}$ and the Riemann tensor $R_{\mu\nu}$:

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = 8\pi T_{\mu\nu} \quad (2.2)$$

Where if space-time is flat then $R_{\mu\nu} = 0$. [6]

With the advent of the photoelectric effect, and the advances in chemistry, Niels Bohr conceptualized a minuscule particle as the atom. The atom is a constituent of a proton and neutron as the nucleus and a charge electron revolving around the nucleus in increasing/decreasing energy-levels [7]. As the electron moves in lower energy states towards the nucleus of the atom energy, in the form of radiation, is expelled. This model led to the beginning of nuclear physics. In which eventually Werner Heisenberg elaborated further as he envisioned the electron being situated at a probabilistic energy state around the nucleus [8]. This became Heisenberg's uncertainty principle where there is indeterminacy in the position and momentum of the atom in relation to Planck's constant (approximately 6.6×10^{-34} meters^2 × kilogram/seconds):

$$\Delta x \Delta p \geq \frac{\hbar}{2} \quad (2.3)$$

Leading to Erwin Shrödinger's realization of the wave-nature of particles [9]. One can see a particle as a manifestation of a wave-function Ψ; and vice versa. Utilizing Werner Heisenberg's results Shrödinger came up with the partial differential wave-equation for particle interactions:

$$i\hbar\, \partial_t \Psi = \hat{H}\, \Psi \quad (2.4)$$

Where $\hat{H}$ is the Hamiltonian. Establishing the revolutionary discovery of quantum theory. Contradicting the deterministic foundations of relativity theory and classical mechanics. Einstein and the leading figures of quantum theory (including Max Planck and Enrico Fermi) met at Copenhagen, Denmark to elaborate and come to an agreement of how reconcile quantum theory and general relativity. But no agreement could be reached between the leading figures of quantum theory and Einstein.

Paul Dirac extended quantum theory into the realm of special relativity by furthering the Klein-Gordon equation for an explanation to matter and anti-matter interactions [10]. In which in its simplest derivation the Dirac equation:

$$(i \not{\partial} \; - m)\, \psi = 0 \quad (2.5)$$

When natural units are applied such that $\hbar$ = c = 1.

Eventually later in his life, and before his death in 1955, Albert Einstein focus his efforts on finding a grand unified theory of everything that, at time, can merge the known forces of nature. Today those forces are understood to be the gravitational force, strong force, Higg's force, nuclear force, and electroweak force. Einstein efforts weren't fruitless but his reluctance to even consider applications of quantum mechanics toward grand unification made it difficult to even conceptualize how to resolve the problem. Even then the inability to reconcile quantum theory and general relativity made it much more to difficult to complete Einstein's task to solve the grand unified theory of everything that can express a unification of all the forces of nature into one beautiful equation very similar to Einstein's field equation [11].

Yet to solve quantum gravity goes hand-in-hand with grand unification. Advances in quantum field theory, at the time, yielded phenomenal results of new types of particles never before witnessed in nature. As the years went by new types of particles were discovered both theoretically and experimentally by applying new physical principles and by using the latest particle accelerators. Peter Higg's discovery of the Higg's-Boson particle, that gives particles mass through their interaction with the Higg's field, eventually, almost half a century later, was detected at the Large Hadron Collider (LHC) at CERN in Switzerland in 2012. How to sort out this mess became the problem of quantum field theory. Even then physicist like Richard Feynman expanded efforts in understanding quantum electrodynamics by application of the Feynman prescription [12]. Others like Freeman Dyson contributed to quantum chromodynamics [13]. There were non-renormalization issues that plagued quantum field theory as paradoxes could be seen when analyzing the behavior of exotic particles through Feynman diagrams that yielding ghosts, infinities or loops that needed regularization procedures to remove the infinities, fill in the ghosts or overcome the loops through the process of the renormalization scheme [14].

To sort out this mess, in terms of particle physics, the development of quarks and gluons took center stage where Murray Gell-Mann in the early 1960's was able to classify exotic particles in terms of a color and orientation procedure [14]. Doing so yielded order in quantum particle physics whereby Stephen Weinberg and Sheldon Glashow brought a unified framework for the electroweak interactions by applying Chen-Ning Yang and Robert Mills gauge theory formulation [14]. There remain the strong interaction, nuclear force and gravitation. The gravitational force being, as explained, the weakest of all the fundamental forces.

Yet particles come in pares of matter and force particles and so supersymmetry (SUSY) develop as a reconciliation as all matter and force particles share a supersymmetric partner in the formulation of the relation of Bose-Einstein condensate with Fermi statistics [15]. Peter van Niewenhuizen and Dan Freedman discovery of four dimensional supergravity (SUGRA) allow physicists to unify the graviton with SUSY that eventually culminated with 11-dimensional supergravity.

Understanding the strong interactions led to the discovery of strings as one-dimensional hadronic particles that interact on a world-sheet in the form of bosonic string theory develop by Michael Green [16]. Using conformal field theory physicists were able to understand the interaction of strings by application of the Veneziano operators and the S-matrix for open and closed strings. Utilizing light-cone gauge quantization and BRST quantization theorists were able to first quantize a string [17]. By first quantization the behavior of strings was use to understand the behavior of force and matter particles as close and open strings, that through p-branes twirl, twist and tangle to create new matter particles and express different force interactions base on their harmonic qualities. By utilizing compactification procedures, and U, T, and S dualities, one can relate four different string theories in Calabi-Yau space. Those string theories are mirror images of each other in which one is the primary candidate for grand unification. They reside in a 11-dimensional membrane call M-theory develop by Edward Witten during the second string theory revolution. In which large energy scales are required to see strings and higher dimensions.

References

[1] Krane, Kenneth S. *Modern Physics*. Wiley: 2012.

[2] Planck, Max. "On the Law of Distribution of Energy in the Normal Spectrum." Annalen der Physik. 1901.

[3] Einstein, Albert. "On a Heuristic Point of View Concerning the Production and Distribution of Light." 1905.

[4] Einstein, Albert. "On the Electrodynamics of Moving Bodies." 1905.

[5] Frankl, Theodore. *The Geometry of Physics*. 1997.

[6] Wald, Robert M. *General Relativity*. The University of Chicago Press: 1984.

[7] Bohr, Neils. "The Structure of the Atom." 1922.

[8] Heisenberg, Werner. "The physical content of quantum kinematics and mechanics." 1927.

[9] Shrödinger, Erwin. "An Undulatory Theory of the Mechanics of Atoms and Molecules." 1926

[10] Dirac, Paul. *The Principles of Quantum Mechanics*. Oxford University Press: 1958.

[11] Einstein, Albert. "The Evolution of Physics."

[12] Peskin, Michael E. *An Introduction to Quantum Field Theory*. Westview Press: 1985.

[13] Zee, A. *Quantum Field Theory in a Nutshell*. Princeton University Press: 2003.

[14] Kaku, Michio. *Quantum Field Theory: A Modern Introduction*. Oxford University Press: 1993.

[15] Varadaraajan, V.S. *Supersymmetry for Mathematicians: An Introduction*. American Mathematical Society: 2004.

[16] Green, Michael. *Superstring theory*. Cambridge University Press: 1987.

[17] Kaku, Michio. *Introduction to Superstrings and M-theory*. Oxford University Press: 1956.

Advance Physics

Advance physics starts with the principle that abstraction in physics is redundant and that the elimination of abstraction by imposing logical form [LF] brings clarity, simplicity and order to the physical sciences. Defined as:

$$p\,[n] \longrightarrow n \quad (3.1)$$

That there are mathematical anomalies in physics that can simply be eliminated by removing redundant features. These anomalies are, nevertheless properties which may have physical and mathematical value, even in terms of experimental adequacy, but remain, even then, too meaningless to consider. LF is a reaction to the crisis in SUSY where the field of experimental and computational physics could not adequately find order in SUSY with the data sets that were gathered in the LHC at CERN.

Yang-Mills gauge analog is a $\mathcal{N} = 4$ supersymmetric solution to superstring theory. It resides on a membrane manifold and is the solution to all the other three candidates of M-theory. Its solution demonstrates the Khovanov polynomial which is a polynomial of knots that expresses the tangling, twirling, and twisting of the one-dimensional string in the Dirichlet brane manifold. It is a crude solution that is a variant [of stringy] of prime.

The development of computational control and SUPREME led to the idea that much of theoretical mathematics can follow straightforward computational procedures. That the Wilson operator for multiple quantum states can serve as a model procedure for understanding what is now variant [of stringy]'s. Where the variant [of stringy]'s reside on the D-variant manifold in metamorphic space. Where the variants of prime contain unique mathematical properties that give analogues physics in terms of the quantum field approximation. And by which, through prime factorization of variant [of stringy]'s, don't endlessly replicate in The Grand Unification Scheme but are contain within the parameter prime.

Advance physics will have a lot to say about the course of the philosophy of science. Not only about the question of complexity and simplicity, but also the adequacy of Thomas Kuhn's conception of paradigm shifts and the nature of metaphysics. There is a foundationalist epistemology to advance physics which rejects the coherentist movement and even then that logical intuitionism is the most adequate form for the realization advance knowledge in physics.

In the technological science of bio-engineering computational control can play a large role in harnessing and controlling exotic organisms and in which advance artificial intelligence can use computational control to adapt more quickly to harsher environments by mitigating parameters in its selective algorithms thus gaining more control. SUPREME will, within cosmology and the philosophy of science, have much to say about the role of progress in cosmology and whether or not the universe is not just expanding and accelerating but also rotating in which questions of shaping space-time are pose and reflected.

Conclusion

For the foreseeable future physics will continue to serve as a vital foundation of the sciences. As further progress in PHPR and the Scientific Age continue more knowledge of physics will be ascertain and establish in Advance Physics.

Appendix: Earlier template of Advance Physics

Advance Physics

Miguel A. Sanchez-Rey

Table of Contents

Introduction

Classical Physics

Modern Physics

Advance Physics

Conclusion

Introduction

A summary of theoretical physics since its inception with Isaac Newton. From classical physics one moves forward all the way to advance physics. Advance physics will detail all current line of progress on research in physics that has been gathered from PHPR and the Scientific Age. What that line of progress in physics means for the philosophy of science and then one gives a short conclusion.

Classical Physics

Isaac Newton laid the basis for the development of classical physics by his studies on motion and gravitation. That is Newton's three laws of motion and the gravitational force. Where the gravitational force is the force between two masses separated by a distance d. Even then force can be seen as the multiplication of mass and acceleration $F = ma$. Isaac Newton showed the fixed aspect of time and the static nature of cosmology.

Classical field theory led to realization of magnetism and electrodynamics. That is the attraction and repulsion of charge particles, the field behavior of magnetism and charge particles, and the dynamics of electromagnetism that culminates with James Clerk Maxwell's field equations.

Maxwell's equations led to a hint of contradiction of classical physics as field theory is a non-linear system with variation in motion and differential in time. That is classical fields, which were understood to be Euclidean, now seem to be more inclined to be hypergeometric. Leading to the development of manifold theory and classical topology.

Modern Physics

Modern physics has been at the forefront of 20^{th} century advances in the natural sciences. Starting with Albert Einstein's relativity the notion of space and time change. No longer is time an independent reference frame but that space and time is Minkowski space-time. The concept of the Poincare group in relativity utter the asymmetry between matter and energy. That is light, which poses significant problems in classical mechanics to our notion of Euclidean space and independency of space and time, travels at a constant speed call c.

Since light is constant then when any observer approaches c time dilates from its own reference frame. One example of the consistency of c is the ideal thought experiment that when traveling on a train, on a constant velocity of v, a lightening hitting two tree branches at the same time, from a distance apart d, will seem, to the observer on the train, looking through the glass window, to hit the closer one first and the second one a few milliseconds later that is t and t'. That is our notion of light changes our entire notion of space and time. In which time is the fourth dimensional extension of three dimensional space – call Minkowski space-time. To go even further energy is equivalent to matter and so when an object an object with mass m wants to move further toward the speed of light more energy is needed to do so and so mass increases. So then the conclusion is that light is made up of massless particles call photons.

The revolution of special relativity established the now famous equation E = mc^2. Here the problem of light push further as wave-packets that carry discrete energy that when the wave-length of these light particles gradually increases energy, at a certain point, remains constant that is Einstein's realization of the photoelectric effect that led to quantum mechanics.

But before heading into quantum mechanics one must be reminded of the subtle relationship between gravitation and light. That is gravitation, when giving a mass m, and a light beam that passes mass m, bends light in a fixed geodesic curvature. This is the equivalence relationship between acceleration and gravitation. The foundation of the asymmetry between matter and curvature call the general theory of relativity express by Albert Einstein's field equation.

The advances in special and general relativity due in part to significant progress in Riemannian geometry and group theory especially differential forms and Lie algebra.

Quantum mechanics came to fruition with the realization of the Neil Bohr atom. That is an electron particle of discrete energy revolving around a nucleus of a certain number protons and neutrons. With Werner Heisenberg's Uncertainty Principle, the atom can be seen, as for example the Hydrogen atom, to be an electron within a certain range from the nucleus. Erwin Schrodinger's equation showed the interrelationship between wave-packets and particles.

In large part a quantum system can be seen to be a Hilbert space between any number of quantum states. Each quantum state can be seen as a wave-function that is the behavior of a quantum particle; mainly mass particles with discrete energy. Any measurement of such quantum systems causes a slight perturbation that arouses the uncertain momentum and position of such quantum particles.

Paul Dirac then set in motion quantum field theory. Merging special relativity and quantum mechanics into a low-energy effective field theory through the discovery of particle and anti-particle interactions. Richard Feynman extended Paul Dirac's work into the realm of quantum electrodynamics with the application of the path-integral formalism and the canonical form. Further advances in quantum field theory led the development of quantum chromo-dynamics, electro-weak and the Higg's force. All quantum interactions mediated by a zero-mass force particle, call the bosons, between matter particles call the fermions. Where supersymmetry relates bosons and fermions in which each matter and force particle has a supersymmetric super-partner.

The ultraviolet divergence brought up by unifying quantum mechanics and general relativity are tantamount. So the only probable resolution to eliminating those divergences is by supposing that matter and force particles are made up of open and close strings; respectively that inter-tangle, twist and twirl with each other on a membrane D-manifold. This is supersymmetric strings in a compactified 11-dimensional hyperspace. Four candidates were first identified in which one of four, through mirror symmetry, is the prime candidate call M-theory.

Advance Physics

Advance physics starts with the notion that abstraction is redundant and that the elimination of abstraction by imposing logical form brings clarity and order to the physical sciences. That is that there are mathematical anomalies in physics which can be eliminated simply by eliminating redundant features. These anomalies are, nevertheless, properties which have relevance to experimental adequacy but remain, even then, too meaningless to consider.

The development of computational control and SUPREME led to the idea that much of theoretical mathematics can follow straightforward computational procedures. That the Wilson operator for multiple quantum states can serve as the model procedure for understanding what is now to be variant [of stringy]'s. Variant [of stringy]'s resides on the D-variant manifold. The model stringy being the first identified solution to stringy which in its crude form is the Yang-Mills Gauge Analog. An analog that is a membrane solution to all the other three candidates of M-theory.

These variant [of stringy]'s reside in metamorphic space. All variants of prime contain unique mathematical properties that give analogues physics in terms of the quantum field approximation. And by which, through prime factorization variant [of stringy]'s, don't endlessly replicate.

Though Advance Physics is relatively new there is wide-ranging speculation of where advance physics is heading into in other realms of the natural and social sciences. Current advance physics will have a lot to say about the philosophy of science. Especially the problem of complexity and simplicity, the adequacy of the paradigm shift and metaphysics in general.

There is also the question of experimental adequacy in epistemology and the failings of Platonism over Aristotle.

Other sciences will benefit from Advance Physics by taking seriously the concept of computational control in bio-engineering for harnessing exotic and novel new cellular-life forms or the use of the mathematics of SUPREME to achieve more refinement in the use of nuclear-fusion energy or simpler methods for achieving tasks in robotics in terms of components and computation control. SUPREME will, within the philosophy of science, have much to say about the role of progress in cosmology and whether the universe is not just expanding and accelerating but also rotating in which questions of shaping space-time surmount.

In all Advance Physics follows from the achievements of PHPR and the Scientific Age. In which further achievements will contribute to the foundations of Advance Physics and its relationship to the history of physics.

Conclusion

A short exploration of the history of physics has been giving. Over the next many decades to a few centuries physics will continue to serve as a vital foundation of the sciences. As further progress in PHPR and the Scientific Age continue more knowledge of physics will be ascertain and establish in Advance Physics.