

## Majorana Particles: A Dialectical Necessity and not a Quantum Oddity

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The confirmation of the existence of Majorana particles is the strongest ever imperative for a dialectical perspective for physics; and may have implications for epistemology from the sub-nuclear to the cosmic scale. As the Majorana particle suggests matter at its most fundamental level must be viewed as a composite of the “unity of the opposites” — a contradiction, the resolution of which imparts “motion” to matter and hence the dialectical assertion that “there can be no matter without motion and no motion without matter”. The existence of Majorana particles show that the anti- dialectical conception of matter as composed of distinctive and unitary particles like the fermions and the bosons at the most fundamental level, is faulty and is untenable. These types of sharp distinctions and categories of matter are indeed to be found in nature, but with relative and conditional validity.

For dialectics, any tangible material existence is a composite of the unity of the two opposites; or an “Absolute Identity of identity and non-identity” — a contradiction and a rationale for its change, motion, development, evolution and so on. At the most fundamental level this contradiction is the unity of the opposites of “being” and “nothing” — an inter-penetration of the opposites and/or their inter-conversion to each other. Any synthesis to a different level is infected with this and its own peculiar new contradictions. The newly confirmed [1] existence of the Majorana particle is an affirmation of this dialectical law and at the same time it is a negation of the (artificial) division into the absolute and the unitary categories of the fundamental particles in nature as bosons and fermions. This differentiation is indeed possible from an anti-dialectical perspective, but only with relative and conditional validity. The three laws of dialectics, namely i) the unity or the interpenetration of the opposites, ii) the inter-conversion of quality and quantity and iii) the negation of the negation mediated by chance and necessity; provide an essential basis for an understanding of nature from the microcosm to the macrocosm [2]. Any attribute, characteristics, manifestation, developments, etc. of matter in dialectical epistemology, therefore, must be found primarily within matter itself and through its contradictions and not through any external agency.

Official physics continues to operate under the perspective of what Hegel termed as the “view of understanding” which roughly corresponds to causality. This view follows the rules of formal logic, and Aristotle’s doctrine of “unity, opposition and the excluded middle” and with the mutual exclusion of the opposites. The opposites in this view stand in absolute opposition to each other and remain the same forever once brought into existence by an external agency. This “good old commonsense” view of the world though approximate and faulty at human scale; was in essence satisfactory enough to serve humanity and natural science reasonably well. But the

advent of the idea of evolution in biology and the quantum phenomenon in physics fundamentally undermined the validity of the notions of the “view of understanding” in epistemology, particularly in modern physics.

Even before the discovery of the quantum phenomena; thinkers starting from Heraclitus through Epicurus, Hegel, Marx and Engels showed that dialectics offers a better epistemological tool for an understanding of nature, life, history, society and thought. The existence of polarity and the “unity of the opposites” and hence motion, was shown to manifest itself in all aspects of the world. But of course, dialectics that denies the stability or the permanence of what exists is inimical to a class based social structure, which insists on permanence, continuity, certainty etc. Of necessity, and because of its very nature as the conservative, the resisting and the preserving side of what exists; the “view of understanding” historically became the dominant epistemological tool, including that of the natural sciences. The anti-dialectical notion of the unitary and the absolutely defined “fundamental building blocks” or fundamental elementary particles in nature and their classification into fermions and bosons as developed through the quantum field theories of modern particle physics is a case in point.

The Italian physicist Ettore Majorana in his 1937 paper [3] raised serious doubt about such absolute categorization and forced the dialectical perspective on modern particle physics; shortly after Paul Dirac gave the relativistic formulation of quantum mechanics for the electron [4] and conceived the theoretical basis for describing the spin  $1/2$  particles that would divide all possible matter particles into two mutually exclusive groups known as fermions and bosons, based on their spin properties. Following the mathematical logic and the symmetry rules of Dirac; Majorana in contradiction to Dirac, showed that such an absolute differentiation is not possible, because both the fermions and the boson can contain their opposites within themselves as the dialectical unity of

the opposites.

Paul Dirac ushered in the revolutionary idea of the anti-particles in nature as a dialectical necessity. Dirac's epoch making discovery that anti-particles must exist as part of the real world in the context of a real/virtual dialectical category and that the quantum vacuum is seething with virtual particles with momentary existence and which can turn into real particles through quantum tunnelling; for the first time gave validity to the dialectical speculation of Hegel's fundamental triad of "being-nothing-becoming" as the mode of "coming into being and passing out of existence" of matter as elementary particles in nature [5].

The developments in particle physics from the turn of the 20th century led to the discovery of multitude of so-called "elementary particles" of matter/energy. These were eventually rationalized based on their integral or fractional electric charge and fractional/integral spin values into two groups of matter particles, namely Dirac fermions with fractional spin values and bosons (named after the Indian physicist S. N. Bose) with integral spin values. In his attempt to develop a theoretical framework for describing spin 1/2 particles, Dirac thereby made a revolutionary discovery of hitherto unknown dialectical realm of the "unity of the opposites" of matter/antimatter. To describe the spin 1/2 particles, Dirac found it necessary to incorporate imaginary and complex quantities in his equations that gave rise to the complex-conjugate field  $\phi^*$  of the real field  $\phi$ , where the complex-conjugate fields  $\phi^*$  can accommodate the antiparticles. This is a new aspect of reality brought forth by the developments in quantum mechanics. Physics previously only dealt with integral spins of 0, 1 and 2 in its equations namely, the Klein-Gordon, Maxwell (electromagnetism) and Einstein (general relativity) equations, respectively; which readily accommodate real fields.

The concept of antiparticles in nature means that, as a dialectical necessity all particles must have or be their own antiparticles. This "unity of the opposites" may manifest either in the same body like the two poles of a magnet or on separate bodies like the positive and negative electric charge or in the same body simultaneously containing the opposites continuously exchanging into their opposite polarity; depending on the nature of the exchange force that keep the two opposites together and the external circumstances under which this force operates. The latter case is manifested for example in positronium or meson where (though very unstable) matter and antimatter reside together as the unity of the opposites. Both positronium and mesons can exist even as their dimers like the dipositronium and the mystery meson (X3872) respectively. Even the most pure and holy of all things in the world, namely the light photon has opposite characteristics of a particle and a wave and also is a composite of two matter — antimatter particles and can be resolved into a pair of the particles such as the electron-positron pair if the photon has enough energy equivalent of the mass of the particle pair.

All these particles probably exist in Majorana type formation where the two opposites exist in the same body through rapid inter-conversion of the one opposite to the other.

The conundrum for anti-dialectical official physics is that the existence of antiparticle itself is problematic. In the narrative of the big bang theory all matter (and admittedly now antimatter) was created in one fell swoop. Any antimatter that was created was conveniently annihilated by reaction with matter, so that only matter (which arbitrarily was in relative excess) now prevails in the universe. Any new antimatter can now only be produced in negligible quantity through secondary processes; but the existence of any tangible amount (or even in large scale equivalent to matter); of antimatter is therefore, impossible. This author has previously challenged this contention of official physics; as many cosmic phenomena and the dynamics of the galaxies can be attributed to large-scale presence of antimatter in the universe [6].

The existence of anti-particle as such is not a big problem for anti-dialectical official physics. Because neutral and integer spin particles (like bosons) can be viewed as their own antiparticles, as they must be created by fields  $\phi$  that obey  $\phi = \phi^*$  — that is, real fields, like electromagnetism and gravity discussed above. What is "fundamentally confusing" (to use the term expressed by some famous physicists) for official physics is that some fermions with electric charge and spin 1/2 must also be their own antiparticles as Majorana (and dialectics) asserted. These fermions already have their anti-particles that exist separately. For example the neutron even with 0 charge and spin 1/2 has its antiparticle — the anti-neutron, as electron and proton have their antiparticles as positron and anti-proton respectively. Why then the Dirac fermions still should behave as their own antiparticle in one single body as the unity of the opposites under special circumstances like for example positronium or pion? It is simply that matter and antimatter in the Majorana particles has undergone a qualitative change and now reside in the same entity (instead of different ones) like the two opposites poles of a magnet or to take the analogy further, like a transgender person. The matter and antimatter characteristics in the Majorana particle did not vanish, but are maintained in a different way, probably through rapid inter-conversion of the one to the other through the exchange of some force particles. This is the same as in the case of positronium or meson (or even in the inter-conversion of nucleons in the atomic nucleus). In meson for example (a simpler case) the quark and the antiquark must undergo rapid interchange of identity into each other (through exchange of force particles) to remain in a stable form. This seems evident; for example in the case of pi-meson, an up and anti-down quark combination has a mass-energy of only 140 MeV; yet the same quark combination but only with different spin in a rho-meson has a mass-energy of 770 MeV!

How the Majorana particle emerges in the experimental setup of Ali Yazdani's group described in [1] is a matter of

speculation at this stage. It seems that the super-conducting magnet (two opposing factors) somehow polarizes the electron, probably through some new kind of unifying electro-magneton coupling interaction, forming the end-to-end linear chain of the polarized electrons within the magnet, turning them into particles like the neutrinos, or mesons or even photons with the unbalanced opposite polarity emerging at the two ends of the magnet

The random and catastrophic gamma ray bursts (GRBs) observed in the cosmos can be attributed to the chance accumulated cosmic scale Majorana type formation of matter and anti-matter clusters, or somewhat like speculated boson stars [7]; probably mediated by the magnetic fields of the host galaxies and their instant annihilations as gigantic cosmic “fire-balls”; emitting high energy gamma rays, triggered spontaneously or by some outside events [2]. GRBs are short duration (10 milliseconds to several minutes) intense flashes of high energy (from KeV to MeV to GeV range) gamma rays associated with extremely energetic events in distant galaxies that appear from random locations isotropically distributed in the celestial sphere. The progenitors of these astrophysical phenomena remain largely unknown [8]. These energetic events mostly emitting gamma ray photons probably occur from various scale matter-antimatter annihilation processes. Indeed in the lower energy range, the most dominant peak centered around  $\sim 1$  MeV probably corresponds to the mass equivalent of the electron-positron pair.

Like the quantum phenomena itself, dialectics and the Majorana particle are counter-intuitive for anti-dialectical physics. The discovery of the Majorana particle represents another blow to the anti-dialectical perspective of modern physics and shows the futility of hunting for absolutely unitary fundamental constituents of matter in nature, like the magnetic monopole.

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