



Statue of Nataraja at CERN: The Cosmic Dance of Subatomic Particles

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ABSTRACT

The European Organization of Nuclear Research (CERN) is having a statue of Nataraja at its headquarters. This paper analyses the scientific, mystic, as well as the historic meaning of this occurrence, that is, why such a spiritual symbol is placed at a place where deep rooted research involving subatomic particles takes place. For doing so, some literature pertaining to art-history and modern physics involving subatomic particles was consulted. It was observed that there exist a number of parallels between the observations of modern physics and Eastern mysticism. Finally, it turned out that for the modern physicists, Shiva's dance is the dance of subatomic matter. The metaphor of the cosmic dance thus unifies ancient mythology, religious art, and modern physics.

Keywords: *Statue of Lord Shiva, CERN, Cosmic Dance, Subatomic Particles, Eastern Mysticism, Scientific Exploration, Creation and Destruction, Hadron Collider, Bubble Chamber, Rhythmic Pulse*

INTRODUCTION

Twentieth century has seen some epoch-making developments in modern physics, specifically penetrating deep into the atomic structures of materials, identifying numbers of subatomic particles, and exploring their exotic world. During this period, precisely on 29 September 1954, 'The European Organization for Nuclear Research', (in French *Conseil Européen pour la Recherche Nucléaire* – CERN), was established. An intergovernmental (European Governments) organization, it stands at Meyrin, a western suburb of Geneva on the France – Switzerland border, and operates the largest particle physics laboratory in the world. CERN boasts of possessing the world's largest and most complex scientific instruments, mostly particle accelerators and detectors, tailor-made to study subatomic particles in minute detail. Using these excellent facilities, the physicists and engineers of CERN have made, and are making, wonderful contributions to the field of subatomic particle world, providing insights into the fundamental laws of nature.



Here, it is worth mentioning another event that occurred at CERN approximately fifty years after its inception. On 8th June, 2004, a six feet tall Lord Nataraja idol was unveiled at its head quarters, just in front of the Director General's office. We know that Lord Shiva is worshipped in India as one of the Trinity deities of Hinduism, and Lord Nataraja is his depiction as the divine cosmic dancer. Accordingly, on the base of this idol, "Adi Sankara's sloka (56th sloka of Sivananda Lahari) is engraved in Sanskrit with English translation" (Raja 2017, 63). A special plaque is also placed next to the idol and explains the significance of the metaphor of Nataraja's cosmic dance with several quotations from the book "The Tao of Physics" written by "Fritjof Capra, an Austrian born American Physicist" (63). Is it, then, a reality that the modern advanced science has found its visual three-dimensional expression in Nataraja's dance? Is it that science and spirituality meet here? And, is it that spirituality gives completeness and wholeness to science, and vice-versa? This paper makes an honest attempt to find answers to these questions. For this purpose, it makes an effort to analyze what the physicists like Capra have observed through their experimentations, and what the spiritualists have realized through their meditative experience.

The starting point has been chosen from the plaque placed near the Nataraja idol at CERN, where, Fritjof Capra explained that "Modern physics has shown that the rhythm of creation and destruction is not only manifest in the turn of the seasons and in the birth and death of all living creatures, but is also the very essence of inorganic matter," and that "For the modern physicists, then, Shiva's dance is the dance of subatomic particles." Thus, there are three aspects that need a discussion here; one, elements of Nataraja's dance; two, properties of subatomic particles of inorganic matter; and finally the relationship between the two. Obviously, the focal literature chosen here is the book *The Tao of Physics* (Capra 1975), and of course, supported by some other relevant literature.

Dance of Nataraja

Lord Nataraja, as mentioned above, is the depiction of Lord Shiva as the divine cosmic dancer; and has place of worship in India and the neighboring countries from time immemorial. The *Natyashastra* of Bharatmuni (2003), which was believed to be written approximately some 2000 years ago, mentions two Hindu deities to be "closely associated with the science of dance. Lord Siva is the primordial Nataraja (king of dancers) and Brahma is the author of Natya Veda" (10). Fritjof Capra, in his deliberations with the dance of Nataraja, has referred to two scholars, namely, Ananda Kentish Coomaraswamy (1877-1947) and Heinrich Robert Zimmer (1890-1943). The former was a Ceylonese metaphysician, historian and a philosopher of Indian art who was largely responsible for introducing ancient Indian art and culture to the West; and



his essay *The Dance of Shiva* (1918) is on focal plane. In this essay, for interpretation, out of many dances of Shiva, Coomaraswamy has selected three dances; the first, the evening dance he performed in Himalayas with divine chorus; the second, his usual well-known dance of *tandava*; and the third, the Nadanta dance he performed before the assembly (*sabha*) in the golden hall of Chidambaram or Tillai, usually called the centre of the Universe. Again, out of the three, in his own words, “only one of them alone forming the main subject of interpretation,” there is no doubt that it is the last one (56). Further, he cites – “—without reliance upon literary references, the interpretation of this dance would not be difficult. Fortunately, however, we have the assistance of a copious contemporary literature, which enables us to fully explain not only the general significance of the dance, but equally, the details of its concrete symbolism” (59). The later scholar, Heinrich Zimmer, was a German Indologist, linguist, and a historian of South Asian art, mostly known for his book, *Myths and Symbols in Indian Art and Civilization* (1990), which is also relevant here. ‘The Dance of Shiva’ forms one of seven sections of a chapter in the book, thoroughly analyzed on the basis of numbers of historical statues found at various places, and relevant literature including those of Coomaraswamy.

Both these authors have dealt in detail about the dance of Nataraja, and Fritjof Capra has cited some statements from their work. To start with, it may be mentioned that, while, Coomaraswamy refers to Nataraja as “Lord of Dancers, or, King of Actors” (1918, 56), Zimmer addresses him as “King of Dancers” (1990, 151). Zimmer mentions, “On a universal scale Shiva is the Cosmic Dancer in his Dancing Manifestation (*nritya murti*) he embodies in himself and simultaneously gives manifestation to Eternal Energy” (1990, 152); whereas, Coomaraswamy states, “How many various dances of Siva are known to his worshippers I cannot say. No doubt the root idea behind all of these dances is more or less one and the same, the manifestation of primal rhythmic energy” (1918, 56).

Five Activities of Nataraja’s Dance

Zimmer states that “Shiva as the Cosmic Dancer is the embodiment and manifestation of eternal energy in its five activities (*pancha kriya*)” (1990, 154). Coomaraswamy, on the other hand, refers to the Saivas’ understanding of *Nadanta* dance – “Our Lord is the Dancer, who, like the heat latent in firewood, diffuses His power in mind and matter, and make them dance in their turn”, and then states that – “The dance, in fact, represents His five activities (*Panchakriya*)” (59). Of course, the five activities are the same, viz: (1) *Shrishti* (creation, evolution, pouring forth, or, unfolding), (2) *Sthiti* (preservation, maintenance, support), (3) *Samhara* (destruction,



taking back, or, reabsorption), (4) *Tirobhava* (Concealment, veiling of, or, masking, illusion, or, display of *Maya*, and also, giving rest), (5) *Anugraha* (Favor, release, salvation, grace) (Coomaraswamy 1918, 59; Zimmer 1990, 154). In fact, these five activities are believed to be separately and respectively performed by deities Brahma, Vishnu, Rudra, Mahesvara, and Sadasiva. Coomaraswamy goes further to explain that “Creation arises from the drum: protection proceeds from the hand of hope: from fire proceeds destruction: the foot held aloft gives release” (1918, 59-60). All the five activities are “made manifest simultaneously with the pulse of every moment and in sequence through change of time” (Zimmer 1990, 155).

Coomaraswamy summarizes the whole interpretation of Siva’s dance to have three-fold essential significance: “First, it is the image of his Rhythmic Play as the Source of all movement within the Cosmos, which is Represented by the Arch: Secondly, the Purpose of his Dance is to Release the countless souls of men from the Snare of Illusion: Thirdly the Place of the Dance, Chidambaram, the Centre of the Universe, is within the Heart” (1918, 65).

Modern Physics

At the beginning of the twentieth century, the physicists had two theories, namely, Newtonian mechanics and Maxwell’s electrodynamics, applied successfully to different physical phenomena. However, the first few decades of twentieth century, specifically the two separate developments – that of relativity theory and of atomic physics – totally shattered the Newtonian world view. The main Newtonian concepts, such as, the notion of absolute space and time, the elementary solid particles, the strictly causal nature of physical phenomena, and the ideal of an objective description of nature, had limitations to be extended to the new domains of atomic physics. By then, we were already aware that the Newtonian model is valid only for objects consisting of large number of atoms, and only for velocities which are small compared to the speed of light. When the first condition is not satisfied, then the Newtonian mechanics is to be replaced by quantum theory; and when the second condition is not met, relativity theory is to be applied. Basically, these two replacements, so to speak, have come from the revolutionary thoughts of Albert Einstein, a scientist-par-excellence. In 1905, he published two papers, one his special theory of relativity, and the other was a novel way of looking at electromagnetic radiation which practically led the way to formulate the quantum theory, may be called the theory of atomic phenomena.

Beginning in 1930s two further developments, one experimental and the other theoretical, took modern physics to altogether a different domain. The experimental techniques were refined to detect more and more subatomic particles, such that, by



1935, the number increased to *six* from *three*; by 1955, it became *eighteen*; and by 1975, it has been *more than two hundred*. This increase in number has strengthened one point that – none of these particles can be termed either ‘elementary’, or, ‘building block’. Further, the theoretical developments, on one side supported this view, and on the other brought out new ideas regarding the subatomic matters. By this time, the very strange dual property of matter and also of light, that each one is simultaneously matter as well as wave, have been accepted. The light quanta, which has given quantum theory its name, is already accepted as bona fide particles called photons, which are particles of a very special kind - mass-less, yet travel with the speed of light. Study of particles at this speed means relativity theory must be applied, and was applied. High-energy collision of subatomic particles, affected in large sized particle accelerators, not only produced subatomic particles, but also helped studying their properties, even took pictures in the bubble chambers. It was observed that most of these subatomic particles created in these collisions, live for a very short time, and disintegrate again to protons, neutrons, and electrons. Relativity theory showed that – mass of a substance is nothing but energy, and energy is a dynamic quantity associated with activity and processes. Existence of anti-particle of every particle was observed, and also observed symmetry between these pairs. With availability of energy, pairs of such particles can be created; and they can also be reverted to energy by the reverse process of annihilation. Matter has appeared in these high-energy experiments as completely mutable. All particles can be transmuted into other particles; can be created from energy and can vanish into energy.

Thus, in modern physics, the universe is experienced as a dynamic inseparable whole; the observer too is included within. In this experience, the traditional concepts of isolated objects, space and time, cause and effect are meaningless. “Such an experience, however, is very similar to Eastern mystics” - says Capra; and continues further to add that the theories, quantum and relativity, “combine to produce the most striking parallels to Eastern mysticism” (81). He clarifies that Eastern mysticism, here, means “the various schools in the religious philosophies of Hinduism, Buddhism, and Taoism” (81). We will present some of these parallels in the following lines.

A basic oneness of the universe

The spiritual tradition and the practice of getting experience may be different in the various schools of thought; however, the basic elements of the world view developed in all these traditions are the same. The most important characteristic of the Eastern world view is that – all things and events are seen as inter-connected, interdependent, and inseparable parts of this cosmic whole; as different manifestations of the same ultimate reality. Now, Fritjof Capra states that - “The basic oneness of the universe is not only the central characteristic of the mystical experience, but is also one



of the most important revelations of modern physics” (131). We can see what these revelations of modern physics are, and how they formulate the basic oneness of the universe. Basically, the interconnectedness of nature arises in quantum theory. Let us start with any ‘observed system’ which may consist of ‘observed particles’, and ‘observed phenomena’; the ‘observing system’ will include ‘experimental apparatus’, and ‘human observers’. The first point in quantum theory is that the observed systems are described in terms of probabilities. Then, since the subatomic particles are not stable, they disintegrate (or, decay), and again, the same term ‘probability’ applies to the decay ‘time’, and decay ‘mode’. Thus, what quantum theory brings out are not ‘definite’ characters of the particles, rather, ‘probabilistic relations’ between the ‘particle(s)’ and ‘phenomena’, mostly available in terms of probabilistic dynamic patterns. Further, the ‘experimental setup, or, measuring technique’ and the ‘human observers’ get merged into this ‘probabilistic relation’, as participators. Therefore, finally, quantum theory “has come to see the universe as an interconnected web of physical and mental relations whose parts are only defined through their connections to the whole” (141). Thus, ‘the unity of all things and events’ forms the first most significant parallel between the Eastern mysticism and modern physics.

The universe is intrinsically dynamic

This is the second most significant world view of the Eastern mysticism. All the Indian philosophical texts, starting from *Vedas*, *Upanishads* to *Bhagavad Gita*, give an organic, growing and rhythmically moving picture of universe where everything is fluid and ever-changing. The picture is similar with the other Eastern philosophies such as Buddhism and Taoism. Each of these philosophies views the universe as an inseparable web whose interconnections are dynamic and not static. Thus, the cosmic web is alive; it moves, grows, and changes continually. Modern physics, too, has come to conceive the universe as such a web of relations and, has recognized that this web is intrinsically dynamic. In fact, both quantum and relativity theories have established that the properties of subatomic particles can only be understood in a dynamic context; in terms of movement, interaction and transformation. Not only with the smaller dimensions of subatomic particles, modern physics have also recognized the larger dimensions of stars and galaxies to be dynamic. They are continuously spinning, contracting, expanding, and even exploding. Actually, in this world, we deal with large, atomic, and nuclear dimensions; and in case of the later, the particles move very fast. At this stage, once the relativity theory told us that mass is nothing but a form of energy, we had to change our view. Material is no more understood as consisting of some basic ‘stuff’; rather, it is a ‘bundle of energy,’ a part of a ‘dynamic pattern’ within the framework of space and time fused into a four-dimensional continuum. When we observe them, we



don't find any matter; we only observe dynamic patterns continually changing into one another. Thus, 'the universe is intrinsically dynamic' forms the second most significant parallel between the Eastern mysticism and modern physics.

The unity of opposites

Usually, opposites are abstract concepts of our thought process, but well entrenched into our regular life such as, 'good and bad', 'pleasure and pain', 'life and death', 'light and darkness', 'winning and losing', 'virtue and vice', 'male and female' etc. We also realize that these are not absolute experiences, but are merely two sides of the same reality; extreme parts of a single whole. However, the awareness that all opposites are polars and, thus have unity, is seen by the Eastern spiritual tradition as one of the highest aims of man. Instead of trying to eliminate the bad ones, rather, an attempt made to maintain a dynamic balance between the good and bad ones is preferred.

Now, we will have to see how modern physics view this. The examples of opposite concepts in atomic physics are: 'force and matter', 'particles and waves', 'motion and rest', 'existence and non-existence' etc. Probably the best example of unification of contradicting concepts is 'particles and waves' in atomic physics. This dual behavior is already discussed above. It may be mentioned that the waves associated with particles are not 'real' three-dimensional waves like 'water waves', or, 'sound waves', but are only 'probability waves'; which are abstract mathematical quantities related to the probabilities of finding the particles at various places and with various properties. Here, 'probability wave' may apparently show unity of 'particle and wave', however, it throws out another pair of fundamental opposite concepts of 'existence and non-existence' of atomic reality. We cannot say that an atomic particle exists at a certain place, nor can we say that it does not exist. To show this parallel between atomic physics and Eastern mysticism, Capra brings out this statement - "In the words of Robert Oppenheimer, if we ask, for instance: Whether the electron's position remains the same? Our answer is— 'No'. Whether the electron's position changes with time? Our answer is – 'No'. Whether the electron is at rest? Our answer is – 'No'. Whether it is in motion? Our answer is – 'No'." "Oppenheimer's words thus seem to echo the words of the *Upanishads*: It moves. It moves not. It is far, and it is near. It is within all this, and it is outside of all this" (1975, 154). Probably, this example provides the best possible parallel.



All spatial and temporal specifications are relative

The notion of space and time figure prominently, not only in our everyday life, but also in our understandings of nature, philosophy, and science. For example, formulation of each of the laws of physics requires the concepts of space and time. We know that our classical physics is based on a concept of space and time as absolute, separate, and are independent of the material world. On the other hand, Eastern philosophy, has always maintained that space and time are constructs of mind, and are like all other intellectual concepts; as relative, limited, and illusory. Then where is the parallelism? True, there is no parallelism here. However, the modern physicists believe that the modification in the concept of space and time brought out by relativity theory is one of the greatest evolutions in the history of modern physics, and it provides the parallelism. What, then, is the new concept of space and time in relativity theory? “It is based on the discovery that all space and time measurements are relative”(Capra 1975, 164). This, in fact, is the starting point of formulation of relativity theory. Then relativity theory showed that space is not three-dimensional and time is not a separate entity; both are intimately and inseparably connected to form a “four-dimensional continuum which is called ‘space-time’” (168). This unification of space and time may also be viewed as the unification of other basic concepts in the previous section of *the unity of opposites*; only difference here is that space and time are not opposites, but kept unrelated so far in classical physics. Of course, the notions of space-time are based on experience; on scientific experiments in case of the modern physicists, and on meditative experience of the Eastern mystics. Thus, the full meaning of space-time in relativistic physics turns out to be – “space and time are fully equivalent; they are unified into a four-dimensional continuum in which the particle interactions can stretch in any direction” (185). In conclusion, we can say that – “Eastern mysticism is liberation from time, in a way; the same may be said of relativistic physics” (187).

The void and form

In the Eastern mystical view, the reality underlying all phenomena is beyond all forms and defies all description and specifications; therefore, often said to be formless, empty or void. The term *Brahman* used by Hindus in India, *Sunyata* used by Buddhists everywhere, and *Tao* used by Taoists in China; all represent void or emptiness. However, this emptiness should not be taken to be mere nothingness; rather, on the contrary, this void has an infinite creative potential. Now, the modern physicists have come up with a statement that “the void of Eastern mystics can easily be compared to the quantum field of subatomic physics”(Capra 1975, 212). Originally, the classical, mechanistic world view had the notion of solid as indestructible materials moving in the



void. But, when quantum theory and relativity theory were combined to describe the force fields of subatomic particles through the 'quantum field theories,' the distinction between particles and the space (void) surrounding them lost its original sharpness and the 'void' is recognized as a dynamic quantity of paramount significance. It could be shown through numbers of experimental evidences that virtual particles can come into being spontaneously out of the void, and vanish again into the void, without any nucleon being present. According to field theory, events of that kind happen all the time. The vacuum is far from empty. On the contrary, it contains an unlimited number of particles which come into being and vanish without end. "Here then, is the closest parallel to the void of Eastern mysticism in modern physics. Like the Eastern void, the 'physical vacuum' – as it is called in field theory – is not a state of mere nothingness, but contains the potentiality for all forms of the particle world. These forms, in turn, are not independent physical entities but merely transient manifestations of the underlying void"(222-223).

There are more parallels between the Eastern mystical experiences and experimental observations of modern physics, such as *symmetries*, *patterns of change*, and *interpenetration*; however, we stop here describing them and make a shift to *the cosmic dance*, which is our main theme and it is also another strong parallel.

THE COSMIC DANCE OF NATARAJA

Even before describing the cosmic dance of Nataraja in a specific chapter, Capra has mentioned that - "Through his dance, Shiva sustains the manifold phenomena in the world, unifying all things by immersing them in his rhythm and making them participate in the dance – a magnificent image of the dynamic unity of the universe" (1975, 191). The chapter *The Cosmic Dance* starts with what the modern physicists have gathered through the exploration of the subatomic world in the twentieth century. It has already shown that the subatomic particles are dynamic patterns, not isolated entities, but are integral parts of an inseparable network of interactions. These interactions involve a ceaseless flow of energy manifesting itself as the exchange of particles; a dynamic interplay in which particles are created and destroyed without end in a continual variation of energy patterns. "The whole universe is thus engaged in endless motion and activity; in a continual cosmic dance of energy"(225).

These phenomena are observed, not only in the collision experiments of high-energy physics, but also occurs naturally, yet more intensely all the time in the Earth's atmosphere. A continual flow of energy is going through a great variety of particle patterns in a rhythmic dance of creation and destruction all the time. Capra cites many examples obtained from the high-energy collision experiments, and refers to the



American physicist Kenneth William Ford who has constructed a complicated example of such a network involving the creation and destruction of eleven virtual particles in his book *The World of Elementary Particles*. He has also cited Ford's comment – “Every proton occasionally goes through exactly this dance of creation and destruction” (1975, 240). Capra goes further – “Ford is not the only physicist to have used phrases like ‘dance of creation and destruction’ and ‘energy dance’. The ideas of rhythm and dance naturally come to mind ---”(240). Again, modern physics has not only shown us that all matter, whether here on Earth or in outer space, is involved in a continual cosmic dance, but also has shown through field theory that, “each particle does indeed ‘perpetually sing its song’, producing rhythmic patterns of energy (the virtual particles) in ‘dense and subtle forms’”(242).

Now, Capra makes the comment that – “the metaphor of the cosmic dance has found its most profound and beautiful expression in Hinduism in the image of the dancing god Shiva. ---. According to Hindu belief, all life is part of a great rhythmic process of creation and destruction, of death and rebirth, and Shiva's dance symbolizes this eternal life-death rhythm which goes on in endless cycles” (242). To take the metaphor deeper, he has cited a long passage from Coomaraswamy - “In the night of *Brahman*, nature is inert, and cannot dance till Shiva wills it: He rises from his rapture, and dancing sends through inert matter pulsing waves of awakening sound, and lo! Matter also dances, appearing as a glory round about him. Dancing, He sustains its manifold phenomena. In the fullness of time, still dancing, He destroys all forms and names by fire and gives new rest. This is poetry, but none the less science”(242). This passage has all features and phenomena what Capra looks for – the creation starts with his dance, which means that he creates, he sends pulsing waves through inert matter that awakens sound, the matters also dance, through dancing he sustains all the phenomena, through dancing he also destroys all the forms, and gives new rest. To have the parallel, he shows that modern physics has also revealed that every subatomic particle not only performs an energy dance, but also is an energy dance; a pulsating process of creation and destruction. The patterns of this dance are an essential aspect of each particle's nature and determine many of its properties. Further, not only matter, but also the void, participates in the cosmic dance, creating and destroying energy patterns without end.

At the same time, Shiva reminds us that the manifold forms in the world are *maya* – not fundamental, but illusory and ever-changing – as he keeps creating and dissolving them in the ceaseless flow of his dance. This has relevance to the creation and destruction of virtual particles in subatomic physics. Capra is not just content with this reference to *maya*, he further quotes - “As Heinrich Zimmer has put it: ‘His gestures wild and full of grace, precipitate the cosmic illusion; his flying arms and legs and his swaying of torso produced – indeed, they are – the continuous creation-destruction of



the universe, death exactly balancing birth, annihilation the end of every coming-forth” (243).

Capra’s conclusion of the chapter is - “For the modern physicists, then, Shiva’s dance is the dance of subatomic matter. --. The bubble-chamber photographs of interacting particles, which bear testimony to the continual rhythm of creation and destruction in the universe, are visual images of the dance of Shiva equaling those of the Indian artists’ beauty and profound significance. The metaphor of the cosmic dance thus unifies ancient mythology, religious art, and modern physics. It is indeed, as Coomaraswamy has said, ‘poetry, but none the less science’” (245).

CONCLUSION

In conclusion, two issues can be put forth. The first one is that – “The conception of physical things and phenomena as transient manifestations of an underlying fundamental entity is not only a basic element of quantum field theory, but also a basic element of the Eastern world view” (Capra 1975, 211). Scientists of high standing such as Einstein, as well as the Eastern mystics, are of the view that – this underlying entity is the only reality; all its phenomenal manifestations are transitory or illusory. The scientists are attempting to unify the various fields into a single fundamental field, called ‘unified field’ which would incorporate all physical phenomena. Capra makes a statement – “The *Brahman* of the Hindus, like the *Dharmakaya* of the Buddhists and the *Tao* of the Taoists, can be seen, perhaps, as the ultimate unified field from which spring not only the phenomena studied in physics, but all other phenomena as well”(211).

The other one is that, like a few questions are raised in the introduction, Capra has also raised some questions. Those are: is modern science merely rediscovering what the Eastern sagas discovered thousands of years ago? Should physicists abandon their scientific exploration and meditate? Can there be a mutual influence between science and mysticism, or, even a collaboration or synthesis? While answering these questions in negative, Capra has concluded that – “Neither is comprehended in the other, nor can either of them be reduced to the other, but both of them are necessary, supplementing one another for a fuller understanding of the world” (306).



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