

# Microvita and the Structure of Electrons and Photons

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Despite the progress and successes of modern physics in describing the physical world in terms of interactions of sub-atomic particles and fields, a fundamental question that has remained unanswered is the nature of the sub-atomic particles and fields themselves. That is, how are these fundamental particles and fields structured and how do they maintain their existence? Underlying this question is the question of the fundamental nature of matter and energy. Neither physics nor western philosophy has so far been able to give satisfactory answers to these questions. However, an emerging, more holistic approach has begun to shed further light on these issues. This article looks at how P.R. Sarkar's theory of microvita, introduced in 1986, may yield insights into the fundamental structure of electrons and photons, which are two of the basic sub-atomic entities of physics.

One recent view is that the structure of the physical world may be holographic in nature. One of the chief proponents of this view has been quantum physicist David Bohm. In his view, the mathematical interference patterns described by the quantum theory of matter can be interpreted as holographic patterns. But how energy interacts to produce these quantum interference patterns remains unclear. This is particularly true in the case of a single particle such as an electron. If an electron is itself an energy interference pattern, how is the electron's energy interfering with itself to create the electron? Quantum theory doesn't provide an answer to how an electron is formed. Bohm explained the dilemma in a seminar a few years back: (1)

"Bohm: Now current modern physics thinks of the electron as moving back and forth, approaching the speed of light, so its average speed is, whatever it will be less than the speed of light, right? Now in a way, the energy is being reflected. That is, instead of going straight on as with light, it gets reflected somehow back and forth. Now that reflection is what turns energy into matter. You see, the energy is condensed. And if the reflection ceases, the matter turns into energy. But it always was energy. So matter arises when there arises a pattern which reflects back and forth and becomes stable.

Q: What is it that is causing the reflection, then?

Bohm: Well, you see, we don't know. (laughter) That requires a deeper theory in physics, which we don't really have. But we could say that, in so far as there is reflection, then energy turns into matter. If the energy does not flow freely, it becomes a kind of matter; and that energy can be released by ceasing that reflection and making it go straight, right?"

So two of the fundamental questions in physics are how waves of energy actually gets bottled-up to form material particles, and why these particles continue to show wave-like properties, as described by quantum theory and the holographic principle. The answers to these questions are not only important for physics but for biology, psychology and medicine as well. This is because the physical body may be also described in holographic and multileveled, energetic terms.(2)

In this view, different levels of energy of varying frequency and subtlety in the human body may holographically control the development, maintenance and repair of the body in ways not generally recognized by western science but described in eastern and other esoteric literature, for example in yoga, theosophy and Chinese medicine. For example, an etheric body, composed of subtle energy, is said to guide the development and health of the physical body. Acupuncture meridians may be channels for the flow of subtle energy in the body, and yogic chakras may transform energies from higher to lower frequencies so that the etheric body and even subtler bodies can affect the functioning of the physical body and its glandular system.

Medical therapies may be developed or refined which rely on diagnosing and treating disease, as well as maintaining health, with methods which are understandable only in holographic and subtle energetic terms. Establishing the holographic nature of matter and energy could put these medical therapies on a sound scientific footing, which is currently lacking despite a growing body of scientific and medical research which tends to support this subtle viewpoint.

So studies of the nature of matter and energy have been unable to answer the fundamental question, how does energy become organized to form sub-atomic particles. The origin of this self-organizing capacity of energy has remained a mystery, one of the fundamental mysteries of science.

#### The role of microvita

The concept of microvita seems to have the potential to shed some light on this question. Microvita are living entities, millions of times smaller than an electron, that interact to form sub-atomic particles, atoms and molecules, according to Sarkar. Microvita can reproduce and die. They are conscious entities. They travel throughout the universe creating life and helping evolve new life forms. Created by a cosmic mind, these microvita play a significant role in the evolutionary processes of the universe, which is itself a thought-projection of the cosmic mind. Microvita may be positive, negative or neutral with respect to particular living beings. Microvita not only can move through physical space and different material media, but positive microvita can move through psychic space as well, carrying ideas from one mind to another. Microvita are the root cause of material forms, living beings and minds in the universe.

Some microvita are smaller than an electron. Millions of microvita compose an electron, while billions compose a carbon atom. Knowledge about microvita will create revolutionary changes in the physical, biological and social sciences.

According to Sarkar, all existing things have a particular rhythm and a particular wavelength. So this is true of microvita as well. We may interpret rhythm here as vibrational frequency, for example 500 cycles per second. Wavelength might be measured in meters. So any particular microvita will have its own frequency and wavelength. The photon or particle of light energy is also described in terms of frequency and wavelength. Photons should also be composed of microvita. Electrons and other sub-atomic particles have a wave nature and can also be described in terms of a wavelength and a frequency.

The energy of a photon is directly proportional to its frequency, while its momentum or quantity of motion is inversely proportional to its wavelength. The wavelength of an electron is inversely proportional to its wavelength, like the photon. The frequency of an electron is directly proportional to its total energy (its rest energy plus its kinetic energy or energy of motion.)

The concept of microvita can lead to useful quantitative predictions in the area of atomic physics, and particularly in the area of predicting the size and structure of elementary particles such as the electron and photon. The concept of microvita can then lead to a new description of how energy is stored within atomic and molecular structures. The idea that energy may be stored and transported by entities smaller than subatomic particles has implications for other areas of scientific research. For example, microvita could explain the medical action of homeopathic remedies made from highly diluted solutions which do not contain a single atom of an earlier dissolved chemical substance.

Microvita move in a rhythmic manner. According to Sarkar, "each and every existence has its own peculiar wavelength and its peculiar rhythm." In the present context, I take rhythm to correspond to frequency of vibration in cycles per second, while wavelength is taken in its common meaning of the distance between successive crests of a periodic wave.

According to physics, light and other electromagnetic waves have a frequency and a wavelength, and move in a vacuum with the velocity of  $c = 300,000$  kilometers per second, approximately. Photons or quanta of light are found to have energy proportionate to their frequency and momentum inversely proportional to their wavelength. Elementary particles with a "rest mass" such as electrons and protons are also found to have a wave length, called the de Broglie wavelength, and a frequency of vibration, depending on their momentum and energy, respectively.

So for both photons and particles with rest mass, the formulas for energy and momentum are

$$E = h f \text{ and } P = h/L$$

where  $h$  is a fundamental constant called Planck's constant. These formulas are also true relativistically, i.e. for particles with velocities approaching the speed of light. Photons always move at the speed of light, independent of their energy.

For particles with rest mass, the energy contained in the particle is given by  $E = m c^2$ , where  $m$  is the mass of the particle which depends on its velocity. The momentum of a particle with mass is given by  $P = m v$ , where also  $m$  depends on the velocity of the particle.

Since microvita are said to compose electrons and atoms, we can assume they compose photons as well. We can assume that they have a frequency and a wavelength, and that they carry energy and momentum related to their frequency and wavelength, respectively, similar to elementary particles. But the proportionality constant is not  $h$  but a constant much smaller than  $h$ , which I call  $S$ .

$h = N S$ , where  $N$  is the number of microvita in an electron, which Sarkar says is in the millions.

So for microvita,

$$E = S f \text{ and } P = S / L$$

for the energy and momentum of a microvita, respectively, where  $f$  is the frequency and  $L$  is the wavelength of a microvita.

Structure of a photon

A photon has a momentum given by  $p = h/L$  (where  $L$  is the wavelength and angular momentum or spin given by  $h/(2 \pi)$ ). The spin of a photon may be positive (in the direction of motion) or negative (in the opposite direction.) Light which is right circularly polarised consists of one type of photon, while left circularly polarised light consists of the other type. With circularly polarised light, the electric field direction (perpendicular to the direction of propagation) rotates 360 degrees as the light moves ahead one wavelength. The tip of the electric field vector follows a helical path. So I will assume that the microvita making up a photon also move in a helical path which rotates 360 degrees clockwise or counterclockwise for each advance of one wavelength.

So the rotational movement of the microvita around the axis of the helix accounts for the spin of the photon, while the forward motion of the microvita parallel to the axis of the helix gives the photon its linear momentum.

There will be a relationship between the radius of the microvita helix for a photon and the wavelength of the photon. (For a photon, a radius is not defined, only a wavelength.) This radius will tell us something of the microvita structure of a photon.

Assume that a certain total momentum vector  $P$  is directed along the helical path of the microvita at some point on the helix. Let  $A$  be the angle that this momentum vector makes with the direction perpendicular to the photon's motion. Then the component of  $P$  that contributes to the spin is  $P \cos A$ . The component of  $P$  that produces the linear momentum of the photon is  $P \sin A$ . So if  $r$  is the radius of the helix, then the angular momentum or spin is  $\text{Angular momentum} = r P \cos A = h/(2 \pi)$  while the linear forward momentum is given by  $\text{Linear momentum} = P \sin A = h/L$ , where  $L$  is the wavelength (distance between turns of the helix). Dividing the above relations, we get

$$(P \sin A)/(rP \cos A) = (h/L)/(h/2 \pi)$$

$$\text{or } (\sin A)/(\cos A) = \tan A = (2 \pi r)/L \quad (1)$$

When the microvita move around one circumference ( $2 \pi r$ ), they also move forward one wavelength  $L$ . So according to this geometrical relationship,

$$\tan A = L/(2 \pi r) \quad (2)$$

Comparing formulas (1) and (2) we see that

$$(2 \pi r)/L = L/(2 \pi r)$$

This will only be true if the angle  $A$  equals 45 degrees and  $L = 2 \pi r$ , that is, the circumference of the microvita helix of a photon equals the wavelength of the photon. Therefore, the radius of the microvita helix of a photon is

$$r = L/(2 \pi) \text{ where } L \text{ is the photon's wavelength}$$

So if the wavelength of a photon increases or decreases (corresponding to a decrease or increase in the energy of the photon, respectively,) the radius of its microvita helix changes proportionately.

Mathematically, the coordinates of the points along the helix of radius  $r$  are

$$x = r \cos(2 \pi z/L) = L/(2 \pi) \cos(2 \pi z/L)$$

$$y = r \sin(2 \pi z/L) = L/(2 \pi) \sin(2 \pi z/L)$$

where  $z$  is the distance along the helix and  $x$  and  $y$  are directions perpendicular to  $z$ . The maximum slope of these sine and cosine curves is 1, that is, 45 degrees, independent of the wavelength of the photon.

A photon whose energy equals the rest energy of an electron, has a wavelength equal to  $h/mc$ . So the radius of the microvita helix for this photon would be, from the above results,

$$r = h/(2 \pi mc)$$

The length  $h/Mc$  is well known in physics and is called the Compton wavelength. It appears in the formula derived by Compton for the change in wavelength when a photon is scattered inelastically (with reduced energy) from a free or loosely bound electron in an atom:  $L_2 - L_1 = h/Mc (1 - \cos(\theta))$ , where  $L_2$  and  $L_1$  are the wavelength of the scattered and incoming photon, and  $\theta$  is the angle of scattering. The Compton wavelength equals  $.0243 \times 10^{-8}$  cm for an electron. A quantum of energy with this wave length would have an energy equal to the rest mass of an electron.

The structure of an electron

From the above microvita relationships, it is evident that dividing E by P we get

$$E/P = f L$$

where  $f L$  has dimensions of velocity. So for a photon made up of millions of microvita of frequency  $f$  and wavelength  $L$ ,  $f L$  is the speed of light  $c$ , which is also the ratio of the energy to the momentum of a photon.  $E/P = f L = c$ .

Now sub-atomic particles with rest mass carry, a do photons, a certain amount of angular momentum, or spin. Physicists do not know what is spinning to give particles their angular momentum. Let us assume that each microvita in a sub-atomic particle is joined end to end, forming a circular vibration. All the microvita in the particle are vibrating in parallel in a single circular structure. The wave motion moves around the circle at the speed of light.

Now assume that the circle's circumference, the distance around the vibrating circle of microvita is the minimum length. That means the circumference of the circle is one wavelength. The radius of the particle can then be calculated by knowing its circumference.

All the microvita in the particle vibrate together at a common frequency and common wavelength, so that the particle's wave pattern is a simple circular one.

How is the radius of the particle calculated? Let us assume that the rest mass of the particle is  $M$ . Then it contains energy  $M c^2$ , by Einstein's formula. This energy is the total energy of all the microvita vibrating together in the particle. From that total energy, the frequency of the vibrating microvita can be calculated by

$$E_{\text{total}} = N (S f) \text{ for } N \text{ microvita vibrating at frequency } F$$

$$= h f \text{ since } N S = h$$

$$\text{so } M c^2 = h f \text{ for the vibrating particle.}$$

Since the microvita wave travels in a circle at the speed of light, the relationship of the wavelength  $L$  to frequency  $f$  is

$$L f = c \text{ or } f = c/L$$

$$\text{so } M c^2 = h c/L$$

$$\text{or } M c = h/L \text{ or } L = h/Mc$$

$$\text{but } L = 2 \pi R \text{ where } R \text{ is the Radius of the particle and } \pi = 3.14$$

$$\text{so } 2 \pi R = h/Mc$$

$$\text{or } R = h/(2 \pi Mc)$$

So the radius of this particle depends on  $h$ , its rest mass  $M$ , and the speed of light  $c$ .

The angular momentum or spin of the particle is calculated by  $\text{Spin} = R P$  where  $R$  is the radius and  $P$  is the momentum at the distance  $R$ ,  $P = E/c = M c^2 / c$  or  $P = M c$

so Spin = R P =  $h/(2 \pi Mc) \times Mc$

or Spin =  $h/(2 \pi)$ .

In units of  $h/(2 \pi)$ , this particle would be said to have spin equal to 1 unit.

But an electron is known to have spin of 1/2 unit. How can a particle be structured from microvita so that its spin equals 1/2?

The simplest way is that the microvita move around in a double loop before joining together. The total length of the double loop is still one wavelength  $L$ , and the wave motion still moves around its length at velocity  $c$ . But the radius is now smaller because the structure is two loops instead of one. So the circumference of the smaller loop is  $L/2$ . The radius of the electron is then given by

$$2 \pi R = L/2$$

So  $R = 1/(2 \pi) \times (h/Mc)/2$  where  $L = H/Mc$  as before

$$\text{or } R = 1/(4 \pi) \times (h/Mc)$$

That is, the radius of the electron is half that of a particle of the same Mass with spin 1.

Checking the spin of the electron, we find that

$$\text{Spin} = R P = 1/(4 \pi) \times (h/Mc) \times Mc$$

$$\text{or Spin} = 1/2 \times h/(2 \pi)$$

So this gives the predicted spin of the electron of 1/2 .

What is the calculated value of  $R$  for an electron made from microvita in the double loop structure described? We must substitute the values for Planck's constant  $h$ , the mass  $M$  of the electron and speed of light  $c$ .

Using  $h = 6.63 \times 10^{-34}$  joule sec

$M(\text{electron}) = 9.11 \times 10^{-31}$  kg

$c = 3.00 \times 10^{+8}$  meters/sec

$$R (\text{electron}) = 1/(4 \pi) \times h/Mc$$

$$= 1.9 \times 10^{-13} \text{ meters}$$

This calculated value for the radius of an electron contrasts with the radius of an atom of about  $10^{-10}$  meters and the radius of a small atomic nucleus of around  $10^{-15}$  meters. That is, the electron's radius is calculated to be roughly 1/500 times the radius of an atom but around 200 times the size of a small nucleus.

In our microvita model therefore, an electron consists of this quantum of energy circling at the speed of light on a double-loop path of length equal to the Compton wavelength.

Physicists have not been able to measure a non-zero radius of an electron. In quantum electrodynamic calculations an electron is assumed to have zero radius. But it is known to have spin as well. It may be that the electron has a finite size microvita structure which can account for its spin as above, while other quantum electrodynamic effects give it an apparently point size. Certainly it is difficult to reconcile conceptually a finite spin with a point size for an electron. To call the spin an "intrinsic property" of a point-like electron does not really solve the problem, but rather attempts to cover it up.

What is the calculated radius of a proton made of microvita? A proton also has spin = 1/2, so it would also be made of a double loop of microvita. It would be smaller than the radius of an electron by the ratio of the mass of the electron to the mass of a proton, or 1/1836 of the radius of an electron.

$$\text{So } R(\text{proton}) = 1/1836 \times 1.9 \times 10^{-13}$$

$$\text{or } = .10 \times 10^{-15} \text{ meters}$$

This is a bit smaller than the measured size of a small nucleus, but apparently in the right size range for a proton.

It was found that to obtain a spin of 1/2 for an electron, the microvita structure requires a double loop of radius  $r = h/(4 \pi m c)$ . This double looping occurs in two dimensions, such as x and y. It corresponds to microvita producing a circular wave motion in the x and y dimensions with velocity c, the speed of light. But there must be some structure of the electron in the third dimension as well, as in the case of the microvita structure of a photon.

What is the amplitude of the microvita motion around the loop? We saw in the photon case that the microvita amplitude in the direction of motion could be expressed in one dimension as a sine or cosine function. Let us take the coordinates for the microvita structure in time as

$$x = r \cos(2 \pi(2F)t)$$

$$y = r \sin(2 \pi(2F)t)$$

$$z = r \sin(2 \pi F t)$$

where  $r = h/(4 \pi m c)$  is our previously calculated radius of the double loop microvita structure of an electron. F is the intrinsic frequency of oscillation of the electron (obtained from  $E = hF = m c^2$ ) while 2F causes the wave pattern to loop twice in the xy dimensions during each full period of oscillation. The amplitude of 2r in the z dimension is chosen so that the wave motion reaches a maximum velocity in the z direction of c when  $z=0$  (the centre of the structure), corresponding to the constant circular velocity of c in the xy dimensions.

The three dimensional structure obtained by the above equations is a two-lobed structure with one lobe in the +z direction and the other in the -z direction. The structure is traced on a cylinder of radius  $r = h/(4 \pi m c)$  whose axis is the z axis of the coordinate system. The pattern circles the cylinder twice—once for positive z and once for negative z before starting again.

The electron structure is traced on a cylinder of diameter 2r and length 4r, where r is the microvita electron radius of  $h/(4 \pi m c)$ . Compare this with the cylinder of diameter 4r and length  $2 \pi (2r)$  or  $4 \pi r$  of a cylinder holding the helix pattern for a microvita photon of the Compton wavelength (whose energy is that of the rest mass of an electron.) The 4r length of the electron structure is twice the amplitude of the circling microvita wave, while the 4r diameter of the helix in the photon corresponds to twice the amplitude of a microvita wave

moving freely as a photon. The microvita difference between an electron and a photon is that the microvita wave closes upon itself to make an electron and remains unclosed to make a photon.

The existence and stability of particles

The microvita view of particle structure permits us to say something about the condition for existence and stability of elementary particles. In this view, if a particle with mass is said to exist, at least for a short time, then the circling wave motion that is the particle must make at least one complete circuit around the particle's circumference (a double loop in the case of particles like the proton with spin 1/2). That is, at least one wave length in distance must be travelled by the particle's internal circular wave motion. A particle must exist for at least this amount of time in order to create the full circular structure and for the internal wave motion to close upon itself in order to stabilize the particle's existence.

We have seen that one complete path length around a particle is path length =  $L = h/Mc$

Travelling at the speed of light  $c$  within the particle, the time taken to complete one cycle is

$$T = \text{distance/velocity} = (h/Mc)/c = h/(Mc \text{ squared})$$

So the existence of the particle requires that  $T$  exceed this value, that is,

$$T > (\text{greater than}) h/(Mc \text{ squared}).$$

Put in another form, this gives

$$(Mc \text{ squared}) \times T > h$$

That is, (energy of particle)  $\times$  (duration of particle)  $> h$

This is one form of the Heisenberg Uncertainty Principle, which implies that if

$$(\text{energy of particle}) \times (\text{duration of particle}) < (\text{less than}) h$$

then the particle does not fall in the range of detectability.

Rather, it may be said that the Heisenberg uncertainty condition for a particle's existence follows from the nature of the microvita structure of a particle. If the microvita wave motion within a particle cannot complete one wave length of travel around a single (for spin 1 particles) or double-looped (for spin 1/2 particles) circuit, then the structure of the particle cannot form and stabilize properly and it can be said that the particle does not exist (although the microvita trying to form the particle do exist).

At some distance away from a particle, we can say that the particle is localized to a particular region of space, corresponding to the diameter  $D$  of the microvita-created particle structure ( $D = 2 \times R = 2 \times h/(2 \pi \times Mc)$ ). But closer up, the structure is seen not as a particle at all but a microvita and energy wave structure of diameter  $D$ .

Due to the circling momentum of the wave motion within the particle, the internal linear momentum  $P$  of the particle, may be said to be uncertain at least by an amount given by

$$\text{Uncertainty in linear momentum} = (P \text{ in positive direction} - P \text{ in negative direction}) \text{ (where } P = \text{Energy}/c = (Mc \text{ squared})/c = Mc)$$

Uncertainty in linear momentum =  $Mc - (-Mc) = 2Mc$

This gives the condition of minimum uncertainty in the position and momentum of a particle, measured in any spatial dimension, of

(Uncertainty in momentum) x (Uncertainty in position) =  $2Mc \times D$

=  $2Mc \times 2h/(2\pi \times Mc)$

=  $2h/(\pi)$

=  $h$  approximately

This is the Heisenberg uncertainty condition for the relation between the minimum uncertainties in simultaneous measurement of the position and momentum of a particle. This condition is, like the one above for energy and duration of a particle, seen to arise naturally out of the microvita structure of the particle.

Microvita and the theory of chaos

It is not known in physics why electrons and photons are internally stable when not being annihilated or absorbed in interactions with other particles. A key to their stability may lie in the fact that they are composed of millions of microvita. It is known from the mathematical theory of chaos (see "Ordering Chaos" in Scientific American, August 1991, p.82) that chaotic systems can be described by patterns of unstable orbits. But regular corrections to the orbits can make them indefinitely stable. Perhaps elementary particles are actually chaotic but self-stabilizing systems of microvita, where the microvita correct each other's orbits within the structure, creating an indefinitely stable structure until the particle interacts with other microvita structures, at which time structural transformations of the microvita may take place to create new particles or absorb old ones.

Such a non-linear feedback system could also keep an electron from spreading out over space, as would be found if the mathematical relations describing the electron were purely linear, as are the wave functions that are the solutions to the Schrodinger equation in quantum theory. It was the rapid spreading out of the "wave packet" describing an electron that led to the probabilistic interpretation of quantum wave functions, as electrons themselves were never observed in a spread-out form, but as localized particles, which however sometimes display wavelike properties.

Conclusion

This article has offered several suggestions about quantitative approaches to the microvita structure of electrons and photons. It is hoped that it will stimulate discussion and lead to further quantitative developments along these or related lines. Suggestions and comments are welcome.

1. David Bohm, *Unfolding Meaning*, Arc Paperbacks, London, 1987, p. 123.

2. Richard Gerber, M.D., *Vibrational Medicine*, Bear and Company, Santa Fe, New Mexico, 1988

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