

Entanglement Paper by Dick Lowrie

Preface

Strange New Results in Physics:

In recent years, physicists have discovered that certain particles such as electrons and photons can influence other similar particles no matter how far away they are, instantaneously. The particles are said to be "entangled".

This seems to violate Einstein's principle that the fastest thing is light, because this particle influence is much faster than that, it is instantaneous.

Distance seems to have no effect whatever, violating the principle that forces usually diminish with distance, such as gravity and electromagnetism. Since the effects are not limited to the locality of the experiment but have an influence without space limitation, the term "non-local" is used.

And a third curious feature of these particles is that they remain in a suspended state of mysterious "probability" until they interact with a measuring instrument or a human observer. So the mind itself, human consciousness, is in play here as an integral part of the experiment, something unique in physics.

Another item is that the particles are not limited to the usual constraints of time. "These experiments... disclose yet another of the "strange" aspects of the quantum world - the past is inexorably mixed with the present in a temporal non-locality."

"If we can divest ourselves of the distorting lenses of classical assumptions, the case that the universe is a quantum system at all scales and times, is easily made. Since... quantum entanglement... reveals an underlying wholeness that remains a property of the entire system even at macroscopic distances, the seemingly inescapable conclusion is that the underlying wholeness associated with quantum entanglement...remains a property of the universe at all times and at all scales."

[Entanglement] "...is currently the most intensely studied subject in physics. Speculations abound as to its nature and implications."

Keep in mind that, "Quantum physics...is...the most accurate physical theory that has ever existed..."

Some believe that the entire universe is to some extent "entangled" and whatever we do will have an effect on everyone else regardless of who or where they are. "Non-locality is a new fact of nature [that] allows us to 'infer' although certainly not to 'prove' that the universe can be viewed as a conscious system."

Another quote: "Thus non-locality, in these experiments translates into the vastly grander notion of non-locality, as factual condition in the entire universe."

[A comment by Einstein]: For those of us who believe in physics, this separation between past, present, and future is only an illusion, however tenuous.

Maybe there is another dimension that is in play here in which space as we know it is irrelevant, time is not rigid, and mental effects are not limited to the inside of our heads. "We know absolutely nothing. Once we are aware of this fact, we are led to the conclusion that the existence of Logos is an entirely plausible hypothesis."

There are some suggestive parallels between entanglement and psi#. Both are instantaneous. Both are insensitive to distance. Both are insensitive to time constraints. Both deal with intangible interconnections. Both psi and entanglement are effective with small objects. Psi also works in the macro world, to what extent entanglement works in macro is not certain although there are some prominent theoretical physicists who claim that it must.

Both psi and entanglement are sensitive to mental efforts. The human mind is an important ingredient in both the entanglement process and the psi process. Quantum effects can be brought from the realm of probability to the realm of reality ("collapse of the wave function") by an "observation" by a human mind. This is shocking and confusing to physicists, that the mind itself can influence anything external. In psi this is called psychokinesis and is nothing new.

This brings up the problem of defining the mind. Secularists believe it is simply a brain function. Others believe the mind to be both part of and independent of the brain. Psi and entanglement show that the mind is capable of many things not previously suspected, and that it can generate non-tangible effects and forces. This is the basic conception of religion and of the hope for post mortem survival of the personality.

Entanglement, the Implicate Order, Synchronicity, and Parapsychology

Quoting from the start of Dickens's Christmas Carol: "Marley was dead to begin with. There is no doubt whatever about that. The register of his burial was signed by the clergyman, the clerk, the undertaker, and the chief mourner. Scrooge signed it. ...Old Marley was dead as a door-nail."

Dickens wanted the reader to know at the start that Marley was dead. It was important to the rest of his story. He had to emphasize it.

In a similar way, I want to assure the reader that "entanglement" is NOT dead. It is alive and well. "Indeed, it is currently the most intensely studied subject in physics. Speculations abound as to its nature and implications."

I want to state at the beginning that quantum mechanics is not just a theory; it is real and has many practical applications. Not only is entanglement an important feature of quantum mechanics, but it may well have important implications for parapsychology.

Entanglement is a central part of the rest of this paper for reasons to be gone into. It needs to be noted that entanglement and non-locality are practically the same thing.

Just what is entanglement? It is the characteristic trait of quantum theory according to Schrodinger. The explanation of quantum entanglement is difficult because no one knows much about what it really is. But we can describe what we see happens. Briefly, the quantum state is something like limbo. Particles in this state exist only as a "probability wave" with their location and velocity being undefined, but when their actual position is measured (or "observed") only then is the "probability wave" eliminated (collapsed, deciphered, de-entangled, enters the classical state, diagonalized the matrix, etc.), and the particle again joins the real world. (For the benefit of anyone interested, appendix #1 reviews the properties of electrons, photons, etc.)

When two quantum particles are "entangled" and have similar but opposite characteristics (such as "spin"), when one of the two is "observed" then the other particle, no matter how far away it may be, mysteriously pops into the real world all by itself with no time lag at all. The two particles seem to be tied together all the time they are in the quantum state no matter the distance apart, then "collapse" back into reality simultaneously upon the measurement of either one.

"You can instantaneously affect the physical properties of a particle on the other side of the universe simply by prodding its entangled twin. This is no longer just a curiosity of the quantum world, visible only in excruciatingly delicate experiments. Physicists now believe that entanglement between particles exists everywhere, all the time, and have recently found shocking evidence that it affects the far wider 'macroscopic' world that we inhabit."

"Although it seems like something from the realm of fantasy, many physicists now use entanglement as a kind of resource for experiments and applications. Entangled pairs of quantum particles such as photons are routinely created... their spooky properties are used to perform such feats as high-resolution imaging, quantum teleportation or quantum cryptography."

"...the quantum phenomena of entanglement, whose power was thought to be confined to the infinitesimal world of subatomic particles, can produce effects that remain measurable on macroscopic scales."

The idea of entanglement has been a subject of much research in physics over the past 20 years or so, and initially generated disbelief in the minds of many physicists because it seemed to be impossible to have one particle influence another particle instantaneously at a distance. The effect is not distance limited and was therefore called "non-local". It was also termed "entanglement" since the separated particles were still responding to each other, as if entangled. The particle interaction occurs instantaneously, not being limited by the speed of light and is one of the peculiar effects of quantum mechanics. But there is no question that it is real and reproducible. The philosophers are having trouble coping with it.

Many physicists believe that non-local entanglement also occurs in the macro world. Some have gone so far as to suggest that the entire universe is somewhat entangled or is "holographic" as per the title of one book (The Holographic Universe). Another author goes into more detail in his book on Entangled Minds. In the following we assume that entanglement is not restricted to atomic particles or photons, but that it occurs to some extent in the real world we see.

In addition to entanglement, other ideas of a similar nature include Jung's idea of synchronicity, Milton's morphogenetic fields and morphic resonance, Bohm's theory of implicate order, Hardy's semantic fields, Talbot's holographic effects, Lowrie's life force, Hu's pre-spacetime, and Stanford's goal-directed psi. (See notes 6 and 8 for definitions of synchronicity and the implicate order.)

All the above ideas are theories (except entanglement) which imply a degree of interconnection between people (and animals) which is considered to be part of a quite general interaction process, including for example, telepathy, clairvoyance and some types of pre and retro cognition.

This concept of interaction through entanglement is important. It means that to some extent we affect others and they us, unawares. It implies that the effect can be amplified in crowds, and if amplified still further may result in emotional conditions such as mass hysteria. Entanglement offers an explanation for many things as mentioned later including even the activities of social insects, which appear to exhibit certain entanglement abilities.

Entanglement interactions occur with no delay, even between people on different planets, if and when that situation comes about. This suggests that communication need not be limited by the speed of light since the quantum interaction is "non-local".

Evolution

Next, I digress into evolution as an example of an application of both entanglement and the related concepts of implicate order, synchronicity, morphogenetic fields, etc.

Much of the evidence for human entanglement is anecdotal, but it is an area that could provide insight into the nature of life and evolution, a subject now in vigorous debate between the Darwinists, the Intelligent Design advocates, and Creationists. I have sympathies for Darwinism, having studied anatomy, zoology, microbiology and psychology. Nevertheless I feel that there is something missing in Darwinism, as pointed out forcefully in Milton's book ***Shattering the Myths of Darwinism***. (Ref. #7)

I do not buy creationism, and have doubts that Darwin's process of natural selection plus random genetic mutations is entirely correct. Intelligent design implies action by God or some supernatural

agency, which is unsatisfactory for physicists or philosophers or logicians or engineers.

What is left? Perhaps a revised form of intelligent design founded on Lamarckism, which is the inheritance of acquired characteristics. This method of genetic change has been taboo for a long time (in spite of evidence), but with the help of morphogenetic fields, entanglement, and other general interaction processes mentioned above, Lamarckism is being revised, based on the evidence that somatic cells (which are not part of the genetic reproduction process, but which can be modified by life processes) can, with the aid of viruses which carry genetic changes from the somatic cells to the reproductive cells, affect the genetics of the reproductive cells, thus providing a mechanism for the inheritance of acquired characteristics. This is discussed in ref. #7 p. 227, but it originated in Genetic Selection and Adaptive Evolution, by Edward Steele, in a 1979 book.

This means that certain characteristics of an individual which are acquired through its life activities can be passed on, at least in part, to its offspring. Thus such changes from one generation to another need not wait millions of years for the accidental beneficial mutations which Darwinism requires. The efficiency and extent of genetic modification due to acquired characteristics is unknown but probably well worth investigating.

In addition to the above neo-Lamarckism process via the inheritance of acquired characteristics through biological processes, we also have possible genetic change through entanglement, goal-directed psi, the implicate order, morphogenetic fields, synchronicity, pre-spacetime (mentioned below), etc. If such interactions among and between species contribute to genetic changes, then the evolution time from one species to another species could in principle be reduced from millions of years to a few hundred years.

Why talk about evolution in terms of entanglement and neo-Lamarckism? Because evolution may occur primarily due to such effects. If so, Darwinists and creationists are both wrong. It may be that "intelligent design" can occur via entanglement with neo-Lamarckism allowing offspring to be genetically affected more directly than previously thought.

Human Relations and Entanglement

In the field of human relations, entanglement emphasizes the need for caution in what we do since we may affect others in ways we never suspected, and we may even affect our offspring more than expected. Conversely, others may influence us unawares. For example, this happens in many cases of crisis telepathy where the recipient is affected by a severely emotional event happening to someone emotionally close to them but far away at the time.

Human-to-human interactions may be affected unawares by entanglement. This may take many forms, for example, psychological co-dependence, instant like or dislike, or instinctively seeking another, as some animals do in long distance homing and trailing without any known means of guidance. Perhaps 99% of all interactions are natural, normal, and explainable by psychology. But some of our interactions are, I believe, due to entanglement, the implicate order, psychogenic fields, or the life force, and cannot be explained by psychology alone.

One example of a possible human entanglement is in the case of identical twins. There is a well known case of identical twins who had been separated as babies. There is a list of amazing coincidences between them. They both bit their nails. They both smoked the same cigarette. They both had the same model car, with the same color. They both went to the same resort in Florida. They married on the same day. They both had dogs and the dogs had the same names.

Some of this duplication could be assigned to genetics. Some could be the result of coincidence, but that seems improbable, especially since such parallel actions are not uncommon with twins. The explanation may be that there was some sort of quantum entanglement between them. And if that is the case, then to a lesser extent there may be a similar entanglement between those of us who are well known to each other and especially if there is an emotional or genetic connection.

Questions arise as to the extent of entanglement in biology, together with the question of the efficiency of the transfer of somatic cell changes to reproductive cells. Other questions deal with the physical extent of the process, i.e. to what extent is it non-local; and is it limited to the immediate time situation or is it pretty much time-independent.

Pre and retro cognition provide evidence that entanglement is not overly time-sensitive. Psi tests have shown that it is not space-limited, while PK indicates that the effect is not limited to biological entities, that is, it may affect inanimate things as well.

The very efficient communication system and complex social structure that ants and bees have, which is becoming more surprising as research continues, points toward some form of entanglement in those societies, which would explain much of the amazing planning, cooperation, and communication within such societies.

Is it possible that there is, in the topology of space-time, a convoluted surface in which we can be effectively close together even when we are physically far apart in the usual three dimensional sense? This is certainly what quantum entanglement indicates. Perhaps some mathematician or theoretical physicist will discover something like this. If it turns out to be the case then it would help explain a lot of psi phenomena.

Mass hysteria and some other forms of mass action imply that something much greater than ordinary psychological interaction is at work. It may be that emotional effects enhance the entanglement process as well as the proximity of others with similar ideas, such as in simultaneous inventions. Entanglement may also be a part of the power of positive (or negative) thinking.

Other possible examples of entanglement include remote diagnosis (per Edgar Cayce), some apparitions, random generator effects, PK, and dowsing. These last three imply that matter as well as life forms may be a part of, and affected by, the entanglement process.

There are still other phenomena which defy even the above secular explanations and remain unacceptable to the even liberal physicists. These include: certain apparitions, poltergeists, séance-generated artificial "ghosts", and some miracles of a purely religious nature. Most of these phenomena deal with things that we can see, hear, photograph, and measure. Since they are much more physical than telepathy, etc., and have a common element of physical presence, entanglement alone will not explain such things, based on present knowledge.

Other phenomena which are not as physical but are still puzzling and may always elude any entanglement explanation include cosmic consciousness, deathbed visions, reincarnation, and some reliable mediumistic phenomena. Unless such things are finally dismissed as mental artifacts, delusion or pathology, there will be room for clerics to ply their trade, the devout to be comforted, and many to believe in a hereafter.

Scientists tread very carefully with anything dealing with religion or the supernatural. It seems that there will not be any change in this taboo by orthodox science until there is sufficient education that psi and its implications won't be ignored. Entanglement is a start in making science more open minded about non-physical events and the psi community should take advantage of it.

Psi research in this area of non-physical events should include gathering evidence and data in as careful a manner as possible, design of experiments to discover more details, tying it all together as part of the psi abilities of the mind, and publishing the discoveries, applications, and implications.

Reference #1 given above outlines some interesting ideas such as pre-spacetime. This is defined as. "...a holistic domain located outside spacetime but connected through [a] quantum thread/channel to everywhere in spacetime enabling quantum entanglement ..."

Further, "It [pre-spacetime] has similarity to Bohm's concept of implicate order." [ref #8] And, "...quantum entanglement occurs within a non-spatial and non-temporal domain."

Also, "It [pre-spacetime] means that quantum entanglement can influence chemical and biochemical reactions and other physical processes. Thus it plays vital roles in many biological processes and consciousness and is the genuine cause of many anomalous effects, if they do exist, in parapsychology, alternative medicine and other fields..."

"It [quantum entanglement] can alter the micro and macroscopic properties of all forms of matter such as solid and liquid." Farther along in the paper Brooks states, "...many if not all anomalous effects reported in parapsychology such as telepathy ...can be explained as the results of quantum entanglement..."

Further, "We are convinced that quantum entanglement can be harnessed, tamed and developed into revolutionary technologies to serve mankind in many areas such as health, medicine and even recreation, besides the emerging fields of quantum computation and communication."

As already mentioned, it appears that the physics of entanglement may offer an explanation for many of the phenomena of parapsychology including telepathy, remote viewing, precognition, and many spontaneous events.

Perhaps the answer to what the conditions for psi success will lie in discovering that a strong creative ability by certain talented people plus strong emotional states can combine to even generate shapes and forms such as apparitions. If so, then these strange phenomena of the psychic world can perhaps be explained in terms of a combination of entanglement plus unusual abilities of the mind. Such a secular, non-religious explanation which involves the equations of quantum mechanics would be pleasing to the physicists and secularists.

The basis for my own belief in a post mortem existence of the personality lies in the concept of a life force# as described in my book (ref. #10). Any such concept to be believable has to provide reasoning from the evidence available that the conclusions are logical. I believe that the life force idea as presented there is preferable to other arguments for post mortem survival.

In addition to the life force concept I described in my book, there are the concepts of the implicate order, synchronicity, entanglement, and parapsychology which can provide alternate routes to a conclusion that the material, secular world is only a part of the whole and that we have a lot to learn and a lot to be less skeptical about. Entanglement is a start in that direction.

It is possible that a thousand years from now there may be universal appreciation of a non physical realm of which we now know very little aside from the hints of entanglement and parapsychology. As a result, the attitude toward religion by that time may have changed, with the parochial views now held so strongly being replaced by a universal understanding and appreciation that we all part of the same subtle and overall interaction process and that we need to cooperate rather than compete; to get along rather than fight.

Appendix #1 lists some of the properties of atoms together with other technical data which may be of interest.

Appendix #2 includes a few quotations from physicists which may add to the understanding of the topic and add a little verisimilitude to my musings on entanglement.

Appendix #3 is a short comment on possible implications and applications of entanglement and non-locality.

Appendix 1 - Properties of Electrons, Photons, etc.

The following notes on various items of physics are given to provide a general background for entanglement and its twin of non-locality. Since entanglement is found as a special property of atomic particles, some detail about the nature of these particles may be helpful. Some additional information is included for general interest.

The Atom

There are only four common "particles". They are photons, electrons, protons, and neutrons. Almost everything is composed of these in varying proportions.

For example, the simplest atom, hydrogen, has a nucleus with one electron in "orbit" around it. The hydrogen nucleus consists of just one proton. The proton has a positive charge while the electron has a negative charge, equal and opposite that of the proton. The positive and negative charges balance each other so that the atom itself is neutral as far charge goes.

Incidentally, there is such a thing as an electron with a positive charge. It is called a positron. Likewise there can be a negative proton. Atoms with the reversed polarity of a positron and a negative nucleus, called antimatter, are probably nonexistent in the natural universe. If antimatter meets normal matter they neutralize each other with a very large release of energy. Positrons can be created in the lab and when one encounters an electron the result is a large, if microscopic, pulse of energy.

As for the masses involved, if the electron has a mass of "one", (which it does, by convention) then the nucleus has a mass of 1836.

Relative Sizes

The atom is often compared to the solar system, with the sun being the "nucleus" and the planets being the "electrons". This isn't accurate either as to charge, size, or activity, although it is vaguely similar.

With the hydrogen nucleus the size of a grape (1 cm approx.), then the electron would be about 15" in diameter, located 260 feet away, orbiting the nucleus. The atom is thus seen to be mostly empty space. In spite of all this empty space, we have plenty of solid objects, like steel. Why it is that so much space is felt as solid to us is explained by "fields" of force.

With the sun the size of a grape, then the earth would be a speck one tenth millimeter in diameter and 45 ft. away.

Comparing the sun-earth to a nucleus-electron we see that the electron is proportionally much larger than the earth but five times farther from the center. Also the density of the nucleus is much higher than that of the sun.

Atoms

The electron's energy (and location) is somehow spread out around the nucleus similar to one of Saturn's rings or perhaps similar to a thin shell although the visualization of such things is not possible. The electron's actual size is indeterminate. Sometimes the electron acts like a particle and sometimes as a wave. Why this is so is not known. The mathematical description of the electron is called quantum mechanics.

All atomic nuclei consist of protons and neutrons. A proton has a charge of +1 while the electron has a charge of -1. There is a proton for each electron in each atom no matter what the element is, keeping the net charge of the atom zero, or neutral. The neutron is neutral and has no charge. If an electron is kicked out from an atom, then the atom is left with a charge of +1 and is said to be ionized.

The hydrogen atom has one proton and one electron. Helium has two protons, two neutrons, and two electrons.

Some of the other elements are lithium with 3 protons, beryllium with 4, boron with 5, carbon 6, nitrogen 7, oxygen 8, fluorine 9, neon 10, sodium 11, etc., up to the heaviest natural element, uranium 92.

The atomic number is the number of protons. The atomic weight is the total of protons and neutrons. Thus the atomic number of sodium is 11 while the atomic weight is 23. (Not 22 as expected, due to the presence of isotopes which are rouge atoms with extra neutrons.) Many atoms have more neutrons than protons so that the atomic weight is often greater than the atomic number.

Incidentally, in any one atomic weight (in grams) there are always 6×10^{23} atoms. This is Avogadro's number. Thus in carbon with atomic weight of 12, there are 6×10^{23} atoms in 12 grams of carbon. I find it amazing that we can specify the exact number of atoms in anything.

Potassium

I take a potassium chloride pill for blood pressure. The label on the bottle is 8 mEq (600 mg). This means that the molecular weight of the medication is the sum of potassium (atomic weight of 39) plus that of chlorine (atomic weight of 35.5) which gives 74.5 grams. This is the gram molecular weight. Since there are 8 of them per the label, the total molecular weight per pill is 596 grams. The lower case m on the label means mill or milligram or one thousandth, so the pill has 596 milligrams which is close to the 600 mg shown on the label. In this case the molecular weight and the atomic weight are the same since the molecule has only one atom of each. In the case of carbon dioxide (CO₂) for example, the molecular weight would be 12 (carbon) plus 2 times 16 (oxygen), a total of 44 for the gram molecular weight.

The Nucleus

Each proton and each neutron is composed of three quarks, of which there are two main types: up and down. Each quark also has three characteristics called red, green, and blue. The quarks are held together by "gluons". The quarks are theorized to consist of "strings" which in various configurations make up perhaps all of the elementary particles. That's enough of that.

Photons are different from the other particles of electrons, neutrons, and protons in that photons have no weight and no charge, and are never stationary, always moving exactly at the velocity of light which is 186,000 miles per second in free space. Light moves slower when not in free space. For example it slows down in glass which is the principle of using glass lens for focusing.

Although photons make up visible light, there are other photons with less energy which make up the radiation of radio, TV, radar, infra-red and other such waves; while photons with energy higher than those of visible light make up ultra violet light, x-rays, and gamma rays.

X-rays

X-rays are photons with high enough energy to pass through flesh and bone, leaving a trace on a film for the dentist or doctor to see. The x-rays are created by accelerating electrons to high energy using a high voltage (from 12,000 to 120,000 volts) in an "electron gun" inside a vacuum tube. These electrons are focused to impact on a target of tungsten which is angled so that the photons generated from the impact are sprayed out to one side and pass out of a lead enclosure through a small hole.

Lead is used to soak up the extraneous photons, hence the lead vest used by dentists. However, the x-rays that pass through the film continue on through the wall and go to who knows where. Since they spread out with distance, perhaps the dosage that those in the waiting room get isn't serious. We hope.

X-Rays used in higher dosages are used for radiation treatment of cancer to destroy the cells. X-rays are used in lower dosages in fluoroscopes to observe things in motion within the body. Very high energy x-rays are called gamma rays. They are generated from the atomic nucleus rather than from the electrons.

Some x-ray systems instead of film use a matrix of a few million tiny photon-sensitive cells to receive the image. This is also what the digital camera does. Most digital cameras have 5 to 15 million such cells, thus we have for example, an 8 meg (8 million) pixel camera. Each pixel is a picture cell. Such tiny matrices of electrically separate cells, the output of which is stored in a similar matrix of "memory" cells, is one of the triumphs of recent engineering, chemistry, physics, and computer science.

Electron Energy and Jumps

Photons can have any energy level; they are not quantized or limited to certain values. Also, free electrons can have any energy level, being accelerated by a charge (voltage) to the desired energy level. On the other hand, electrons in an atom (considered "bound") are strictly limited to certain energy levels and can change from one level to another only by "jumps" or "quantum" amounts.

During these jumps the electron loses or gains energy in the process. The electron's loss of energy in dropping down to a lower energy level results in the emission of a photon of a characteristic energy which results in a specific spectral line characteristic of each molecule or atom. Usually the electron will spontaneously drop down to a more stable "orbit" after a very short time.

Electrons that take longer to drop down may appear as phosphorescence or luminescence. Certain chemicals have various phosphor emission times, ranging from a fraction of a second up to hours. A fluorescent tube has a phosphor that is fairly fast, resulting in flicker due to the 60 cycle voltage in the circuit.

Jumps to a higher energy level (an "excited" orbit) are caused by the addition of energy by heat, electric charge, or collision with other particles. For example, heating tungsten sufficiently will cause it to emit light which we see in the ordinary light bulb. This light comes from the electrons giving up energy in the form of visible light photons as they drop back down to a more stable orbit.

Most electrons are "bound" to the nucleus, forming various atoms and molecules and chemicals. If the electron is given enough energy it will jump entirely clear of the nucleus and then is a free electron. In many metals lots of free electrons are found, for example copper, silver, and aluminum.

Copper has 29 electrons in several discrete levels about the nucleus. These are "bound" electrons. Free electrons are plentiful in copper wire and an electric charge applied to one end of the wire will cause the electrons to move down the wire. This is electric current. As the electrons are moved they generate heat. This is called resistive heating, such as in an electric heater or a light bulb.

The topic of atomic orbital levels, what they are, how many, and the number and characteristics of electrons in each is quite involved and will be omitted.

Electromagnetic Radiation

If the applied charge is applied very rapidly, the electrons will form photons which escape from the wire as radiation such as radio waves. How does the generation of photons occur? A moving charge (electron) generates a magnetic field. The magnetic field expands out into space but when the voltage driving the electron rapidly decreases the magnetic field can't collapse that fast and keeps expanding. In this process, the magnetic field carries with it an electric field. This combination is a photon in the form of electromagnetic radiation.

Light

Often an atomic electron will spontaneously drop back down to a more stable orbit, losing a "quantum" of energy, and in the process emit a photon which we may see as light. This happens with a laser. The unusual thing there is that the photons drop back in synchronism, giving what is called "coherent" light which makes for a nice tight beam.

A confusing factor with light is that it shows up sometimes as waves, as in interference lines and diffraction, and sometimes as particles as when it collides with something, giving up its energy such as when it hits a photosensitive film. This dual nature of photons was extremely confusing to physicists for a long time and still is to some extent. The solution as to whether it is particle or wave has been resolved by saying that it can be either, depending on how it is observed. It is a "probability wave" in which the photon position is undetermined until it interacts with something (or is "observed") then the probability wave "collapses" and a "real" photon results with normal characteristics, such as visible light. If this is confusing, join the club.

Uncertainty

Both the position and the momentum (or energy level) of anything cannot be exactly determined at the same time, no matter how hard you try. This is called the Heisenberg uncertainty principle. It was discovered about 100 years ago and is very important in physics. Even if one cools down an electron to very close to absolute zero temperature so that its position motion is minimal and nearly stationary, then the wavelike nature of the electron prevents the energy level from being measured with accuracy. The limit of accuracy permitted is called Planck's constant. If the energy is known then the position of the electron as a "wave" becomes indefinite. More generally, we cannot observe anything without affecting it.

The Zero Point Field

This indefiniteness extends over wide limits so that there cannot be an absolute vacuum or any place without some residual particle energy. There will always be some "fields" or "waves" of energy there. This energy of fundamental particles is always in the vacuum and continually pops out as "virtual" energy, then drops back again. The upshot of it all is that there is always some zero-point (from the zero temperature) energy around. Since theoretically there is an enormous amount of energy in the zero point field, this is an energy bonanza that some inventors are trying to harness, so far with no known success.

Atomic Fission

Uranium 238 has an isotope of atomic weight 235 which (U235) is an obese and hungry nucleus sort of like jelly. Uranium (U238) is naturally a bit radioactive and gives off a few neutrons a second. But if a stray neutron gets near the isotope U235 nucleus it can be absorbed. This can result in the U235 nucleus becoming so fat that it bursts into two, a process called fission, much like when one cell divides by splitting in two.

When this split happens (to the U235) it emits a couple of neutrons in the process plus quite a lot of energy. These free neutrons in turn get gobbled up by other atoms of U235 and if there is enough U235

around (I estimate 5 pounds minimum) then we get a vigorous chain reaction and voila: an atomic bomb. A similar process happens with plutonium (Pu 239).

The free neutrons have to be slowed down to be efficiently absorbed and a "moderator" such as heavy water can be used for this purpose. The fission of U235 results in isotopes of Krypton (Kr 92) and Barium (Ba 141). The combined weights of 92 and 141 add to 233 which is a little less than the 235 started with. This loss in mass is converted to energy in the form of atomic motion (heat), gamma rays (radiation), electromagnetic energy, and various other by-product elements. The literature indicates that a mass of 15 pounds of U235 will provide a bomb of about 500,000 tons of TNT equivalent (one-half megaton).

Many elements are naturally radioactive but only uranium and the artificially made plutonium are able to sustain the chain reaction of fission. Fusion reactions (the hydrogen bomb) is something quite different and applies to the conversion of hydrogen to helium in a chain reaction which is not fission but fusion, in the process emitting a lot of energy.

Some Basic Data

The electron mass is 9.1×10^{-28} grams.

The nuclear mass of hydrogen is 1.67×10^{-24} grams

The earth mass is 6×10^{27} grams.

The sun mass is 2×10^{33} grams.

The sun mass is about 300,000 that of the earth.

The electron mass is 1836 that of the nucleus.

The electron has a diameter of about 3.8×10^{-11} cm. (This is as a particle. As a wave it is indefinitely large, only described as a "probability wave". Actually, all the elementary particles are best described that way.)

The proton has a diameter of about 2.4×10^{-11} cm.

The neutron has a diameter of about 6×10^{-11} cm.

The diameter of the hydrogen atom nucleus is about 10^{-12} cm. # (?)

The electron's orbital radius is 0.8×10^{-8} cm.

The electron is about 8000 nuclear diameters away from the nucleus and is about 38 times larger than the nucleus.

The earth diameter is about 8,000 miles.

The sun diameter is 864,000 miles.

The earth's orbital radius is 92 million miles or 1.5×10^{13} cm.

The earth is about 106 sun diameters away from the sun and is 1/100 the size of the sun.

Neutronium

Certain stars degenerate into solid neutrons, called neutron stars, composed of neutronium. The density of these stars is very high, over 300 billion tons per cubic inch, the highest density known outside of a black hole. Rotating neutron stars may be detected by pulses emitted, these are called pulsars.

The density of common elements pales compared to neutrons. For example, the most dense metal is osmium at 22.8 grams per cc. Platinum is next at 21.5, gold at 19.4, mercury at 14.2, lead at 11.5, (lead floats on mercury), magnesium at 1.7, lithium at 0.53, and solid hydrogen is the lowest at 0.086. Water is the reference density at 1.000.

Neutronium (solid neutrons and nothing else) has a density of 500,000,000,000,000,000. grams per cc!! It would be nice to have some neutronium to play around with, but nothing could hold it since it would very rapidly sink down by gravity to the center of the earth. Then it would continue up the other side and in about 90 minutes return to the starting level, but a little lower down due to friction. After several of these oscillations like a pendulum, it would settle down at the center. And if it should get much more compressed, it might turn into a black hole, sucking all the earth into itself

in a matter of a few minutes, followed by the rest of the solar system. That would not be good. (The chance of this happening is zero.)

A ball of neutronium only 156 feet in diameter would have a mass equal to that of the entire earth and its gravitational force would be the same as earth.

Such a chunk of neutronium could conceivably be found in space somewhere as the result of a neutron star collision with another neutron star or a close encounter with a black hole. If such a fragment should come into the solar system it could cause real problems if it came close to the earth. The probability of something like this happening is, for all practical purposes, zero.

Appendix 2: Comments From Physicists on Non-locality and Entanglement

[See also the comments and footnotes in the main paper]

From ***The Conscious Universe, Part and Whole in Modern Physical Theory***, by Menas Kafatos Dept. Physics, and Robert Nadeau, (1990), Springer-Verlag. Both authors are at George Mason Univ.

Page 3: that non-locality is a new fact of nature allows us to "infer" although certainly not to "prove" that the universe can be viewed as a conscious system.

Page 47: These experiments...disclose yet another of the "strange" aspects of the quantum world - the past is inexorably mixed with the present in a temporal non-locality.

Page 50: Quantum physics...is...the most accurate physical theory that has ever existed.

Page 59: ...the discovery of a new fact of nature known as non-locality...completely confounds assumptions about the character of the real world ...

Page 73: Thus non-locality, or non-separability, in these experiments translates into the vastly grander notion of non-locality, or non-separability, as factual condition in the entire universe.

Page 197: If we can divest ourselves of the distorting lenses of classical assumptions, the case that the universe is a quantum system at all scales and times is easily made. Since ...quantum entanglement...reveals an underlying wholeness that remains a property of the entire system even at macroscopic distances, the seemingly inescapable conclusion is that the underlying wholeness associated with quantum entanglement...remains a property of the universe at all times and at all scales.

From ***Quantum Philosophy***, Roland Omnes, 1999, Princeton Univ. Press. (Professor of physics at the Univ. Paris)

Page 238: ...these principles [common sense] collapsed one after the other when they were confronted with the world of the "infinitely small": intelligibility (or the possibility of representing reality in our own minds), locality (each thing has a place of its own), causality (every effect has a cause), discernability (two things that are not the same can be distinguished by the mind), [and] cognizability (if an idea concerning the world can be thought it can in principle be decided whether it is true or false).

Page 272: The nature of the laws leave us even more perplexed. They are extraordinarily subtle, and yet apply to objects that are, so to speak, structureless: electrons, protons, or quarks. Consider for instance, an electron and a photon in an otherwise empty region of space. Can we image anything more insignificant? They are mere particles, almost nothing, monsters of simplicity compared to a grain of sand. How could each of them carry more than an elementary symbol, 1 or 0, to mark their presence or absence at that point, how could they conceal anything else? And yet, they behave accordingly to laws whose predictions can only be obtained through long

calculations on a powerful computer - and the two particles verify, with a precision of ten one-millionth, the results of those calculations. What guides those two dumb, blind balls (not balls, really points, without a well-defined position)? How do the laws act? On what do they take hold? We know absolutely nothing. Once we are aware of this fact, we are led to the conclusion that the existence of Logos is an entirely plausible hypothesis. [Emphasis added]

Page 275: Similarly, Logos introduced itself to us in the ascetic nakedness of logic and mathematics, which appear to so many people as dreary, lofty, and unwelcoming. It is, nonetheless, the same name Plotinus used to speak of the Soul of the World, the object of his blissful contemplation.

Page xx of the Prelude: These principles [the foundations of physical science] exhibit such a harmony that with them we can reach some previously unconquerable pillars. They are formal, though, as I have already told you; that is, the essential concepts involved are closer to mathematics than to anything our eyes can see or our imagination represent, such as wave functions - and there is still worse. The laws of physics are of course based on those concepts, and the properties of matter they express take the form of mathematical rules. No science could be more formal.

From ***The Non-Local Universe***, Robert Nadeau and Menas Kafatos, 1999, Oxford Univ. Press. Both authors are at George Mason Univ.

Page 13: The wave aspect of a quantum is continuous and spread out over space and time, and the particle aspect is a point-like something localized in space and time. In quantum physics, the wave aspect of a quantum is completely deterministic, and the future of this system can be predicted with complete certainty until it is measured or observed. But when a measurement or observation occurs, the wave becomes a particle and some aspects of the wave function...disappear.

Page 4: non-locality is a fundamental property of the entire universe.

From ***The Elegant Universe***, Brian Greene, 1999, W.W. Norton & Co. (Professor of physics and math at Columbia Univ.)

Page 4: ...the hostility between quantum mechanics and general relativity cries out for a deeper level of understanding. Can it really be that the universe at its most fundamental level is divided, requiring one set of laws when things are large and a different, incompatible set when things are small?

According to superstring theory, the marriage of the laws of the large and the small is not only happy but inevitable.

Page 386: By this measure, quantum mechanics and the theories of relativity are deep beyond anyone's wildest expectation: wave functions, probabilities, quantum tunneling, the ceaseless roiling energy fluctuations of the vacuum, the smearing together of space and time, the relative nature of simultaneity, the warping of the spacetime fabric, black holes, the big bang.

From ***Quantum Profiles***, Jeremy Bernstein, 1991, Princeton U. Press. (Professor of physics at Stevens Institute of Technology) [This book is largely comments by and stories about three eminent physicists that Bernstein knew.]

Page 138: [A comment by John Wheeler, physicist]: I continue to say that the quantum is the crack in the armor that covers the secret of existence.

Page 165: [A comment in a letter by Einstein to his friend Besso who had just died]: So in quitting

this strange world he has once again preceded me by a little. That doesn't mean anything. For those of us who believe in physics, this separation between past, present, and future is only an illusion, however tenuous.

From *Entangled Minds*, Dean Radin, 2006, Paraview Pocket Books

Page 231: Quantum theory and a vast body of supporting evidence tell us that something unaccounted for is connecting otherwise isolated objects.

Page 235: This is why I propose that psi is the human experience of the entangled universe.

Page 239: Some may regard all the excitement about entanglement a fad... Experiments have demonstrated that the world view implied by classical physics is ... fundamentally wrong in just the right way to support the reality of psi.

Page 261: The first issue is whether the fabric of reality allows for nonlocal connections. As we've seen, this question has been answered in the affirmative for 80 years theoretically and for 20 years experimentally. It would be astonishingly unlikely to find that one small domain, the one that our bodies and minds happen to inhabit, are somehow not best described as quantum objects.

Page 264: Because of this "nonlocal Jell-O" in which we are embedded, we can get glimpses of information about other people's minds, distant objects, or the future or past. We get this... because at some level our mind/brain is already coexistent with other people's minds, distant objects, and everything else. This suggests an alternative explanation of psi. Maybe it doesn't involve information transfer at all. Maybe it's purely relational and manifests only on correlations.

Page 270: Anything that resides, even momentarily, in a quantum indeterminate state may be susceptible to influence from nonlocal minds. This predicts that the more indeterminacy there is within an object, the more likely it can be influenced via thought (PK). Thus it should be more difficult to mentally influence a rock than a bacterium.

From U.S. Patent #7126691 by Erann Gat, published 10/24/2006 entitled "**Communications method and apparatus using quantum entanglement.**"

[This patent involves methods to set up various entanglement links. It does not describe a method of faster than light communication.]

However, it seems to me that a faster than light method might be developed using entanglement, the only requirement being that the quantum superposition has to last for a period of time greater than the time required for light to pass over the distance between the sender and receiver. If several such superposition links are arranged between two points by using at least two sources of entangled particles, and these entangled states persist long enough, then by deliberately collapsing the links selectively we can achieve an instantaneous collapse of the appropriately paired particles, enabling information to be sent and received with virtually no time delay by using a time code, that is, a code in which the time between the collapse of two links has significance. The only possible error would be that of the time of collapse of the wave function itself, which is, experimentally, probably not a limitation. The state of polarization or of "spin" of the particles is of no significance in this method; only the time between the decoherence of the two links, which has to be measured accurately for best information transfer via the time-delay code used. Incidentally, "decoherence" is synonymous with "collapse of the wave function" or "de-entanglement", or "return to the classical world".

Along this line, Georgia Institute of Technology recently reported a 6 millisecond quantum memory (coherence) time.

Another report from Physics showed that quantum repeaters can be made to extend the distance that information can travel while in a state of entanglement... Six milliseconds is equivalent to about 1000 miles and with repeaters this could be extended indefinitely, at least in principle.

From these developments it appears that the superposition state can be extended sufficiently long to considerably exceed the velocity of light flight time over a considerable distance, thus negating the velocity of light as a limitation on the communication capacity, using methods as mentioned above. One catch is that the exact time of decoherence of entangled particle at the receiving end has to be noted accurately.

As far as I know, no method such as this of doing this has been accomplished, but it does not seem to be impossible. For example, if quantum repeaters can be made to work sufficiently well, then a particle could be put into a loop of repeaters set up as a delay line at the receiving station, maintaining the decoherence until the sending collapses the entangled state. The decoherence time itself is negligible for all practical purposes.

Appendix 3 - Implications and Applications

Why is entanglement important? And what are the practical implications?

In addition to photons and electrons, entanglement of entire atoms has been accomplished in the lab. To what extent this entanglement extends from atoms to the larger world is under debate. Some claim that all things are entangled, even the entire universe. For example, note a few book titles: *The Non-local Universe*, *The Conscious Universe*, *The Elegant Universe*, *The Holographic Universe*, and so forth.

But this entanglement is not something we experience daily. We don't connect to others except occasionally and then only to a limited extent. There is no obvious entanglement between people on a practical basis. When you say (for example) "Lowrie is way off base", the entire world doesn't say the same thing in unison (I hope). So the act of entanglement is quite subtle and actually no one really understands it.

It seems that human entanglement (based on psi evidence), is based on strong emotions between persons, or on gross emotional feelings by masses of people such as in great disasters or having been stirred up by a very charismatic speaker.

So where and what is this entanglement? It must be something hidden, operative at large distances, and sometimes outside of time constraints. It is something of which we know little at this point. Perhaps entanglement is a sort of "field" which can affect us unawares even if we are not emotionally connected. (I think it is).

Some have suggested another dimension of some sort in which our minds (not brains) operate, in which a complete but intangible part of our personality exists, in which "dimension" we can experience a form of survival of personality after death.

On another practical level, entanglement can be a factor in goal-directed psi, in synchronicity, telepathy, the implicate order, pre-spacetime, the life force, and even psychokinesis effects. It could be the cause of mass hysteria events, and the hidden source of the power some have of unusual charisma and propaganda. There is some evidence that social insects may use entanglement to control and organize their societies. Possibly the process of evolution is partly directed through the entanglement field in addition to the Darwinian processes.

Other applications include cryptography, rapid computing, improving superconductivity, information theory, teleportation, causality studies, and understanding ESP.

A better understanding of entanglement will lead to many new and important applications lie in the future.

Is entanglement related to psi?

Quantum entanglement has been shown to be effective with electrons, photons, and atoms. Is it scalable up to molecules and larger items, and in the limit does it apply to the universe as some have suggested?

We know that gravity has no practical effect when dealing with atomic forces. Yet it applies to the universe. It is effective only at relatively large distances.

We know that entanglement is effective when dealing with atomic items but it may have no practical effect when applied to the universe. It may be effective only at small distances, but it is not at all certain that this is a limitation.

There are some suggestive parallels between entanglement and psi. Both are instantaneous. Both are insensitive to distance. Both are insensitive to time constraints. Both deal with intangible interconnections. Both psi and entanglement are effective with small objects. Psi also works in the macro world, whether entanglement works macro is not known although there are some prominent theoretical physicists who claim that it must. Both are sensitive to mental efforts. The human mind is an important ingredient in both the entanglement process and the psi process.

In a report by Huping Hu and Maoxin Wu (see ref. #1) they state that all the results from the Princeton Engineering Anomalies Research program over the last 26 years can be explained as the result of quantum entanglement between the quantum entities capable of invoking action potentials in one person and those in a second person and the effect of one on the other.

Another surprising report (taken off the internet) comes from Caslav Brukner of the University of Vienna. "They have shown that moments of time can become entangled too. The entanglement between moments of time is so bizarre that it could expose a hole in the very fabric of quantum theory. Brukner's result suggests that we might be missing something important in our understanding or how the world works." [emphasis added]

Since quantum effects are brought from the realm of probability to the realm of reality ("collapse of the wave function") by an "observation" by a human mind, this brings up the problem of defining the mind. Secularists believe it is simply a brain function. Others believe the mind to be both part of and independent of the brain. This is the basic conception of religion and of the hope for post mortem survival of the personality.