RIFE REVEALED :

NEW RESEARCH DIRECTIONS FOR FREQUENCY MEDICINE IN THE 21ST CENTURY

ALAN BLOOD B.Sc., PhD

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ACOUSTIC PHENOMENA IN HETERODYNED RADIOFREQUENCY INDUCTION FIELD EMITTER (HRIFE) MEDICAL APPLICATIONS: A NEW THEORY OF HETERODYNAMICS

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INTRODUCTION

This article explores some novel applications for frequency technology in medical research. It also discusses a new theory of "heterodynamics", i.e. the physical mechanisms by which certain combinations of electromagnetic (EM) waves in the radiofrequency spectrum (RF waves) can generate acoustic energy (sound energy or compression waves) that may in turn excite physical resonance in some biological systems such as the walls of viruses. It outlines novel designs for combining waves by superimposing or ***heterodyning*** of RF waves of different frequencies to produce useful lower frequency EM products that can penetrate the human body. Spectroscopy methods for the detection of native resonant frequencies in virus species in the lab are also suggested, along with various designs for tiny exposure apparatus for lab virus, or large devices for whole-body exposures of patients, with a long term view to finding new ways to weaken or destroy viruses by a resonance mechanism. A hypothesis is also offered that anti-fouling applications or "slime busting" therapy may be a useful modality in cancer treatment and against some micro-organisms such as the Malaria parasite and mycoplasma bacteria. Some new ideas about the mystery of how RF waves can affect biological systems (bioeffects) are also explained. Because lipid membranes made of oils have relatively low RF conductivity, watery cell environments tend to heat up faster than cell membranes when exposed to RF waves. There would therefore be some diffusion of heat across the boundary. Physical phenomena arising from the existence of a very thin boundary of different impedance values are discussed, such as RF currents on the membrane surface.

Some parts of this article examine the early designs of frequency devices by Royal Rife and Phillip Hoyland in the 1930's, but most of Rife's claims and the new generation of so-called modern Rife devices are critiqued by this author as incorrect or inappropriate. Attempts by various parties in recent years to recreate the Rife technology and to substantiate his claims to be able to destroy germs in lab experiments seem to have been unsuccessful, and misdirected by John Crane's archival notes from the 1950's in the technical approaches. Very recent engineering research by Ringas and Peters is summarized with a view to correcting the prevailing flawed historical view of the evolution of the technology of Rife and Phillip Hoyland. An understanding of basic principles of Physics is built for readers to justify an intuitive leap by this author for appropriate designs for 21st century devices that operate on the principles of RF heterodyning and capacitative coupling or parallel

beam recomination. The acronym HRIFE is adopted to refer to my designs for Heterodyned Radiofrequency Inductive Field Emitter devices. The choice of acronym honors the early work of Hoyland and Rife.

The new term "heterodynamics" is a hybrid of the words "heterodyne" and "thermodynamics", because HRIFE exposures can involve the laws of thermodynamics to be involved in the transformation of energy states from absorbed EM energy via kinetic and / or acoustic energy states on a pathway that leads finally to heating.

This article also attempts to give some simplified visual understanding of relevant concepts from electromagnetic theory; to explain to lay readers how the three main 1930's Rife technologies worked; to show clearly how they differ from the modern commercial Rife products and project kits; and why the original concepts still have a rightful place in a modern research effort. In addition I am recommending a new heterodyning approach to the resonance problem, even though Rife and his colleagues never tried this approach.

Readers who may be familiar with Barry Lynes' book “The cancer cure that worked: a history of suppression” on the subject of the life and work of Royal Raymond Rife need to understand that John Crane's misinformation or misinterpretation has influenced Lynes and many people in the present generation to misunderstand the technology. Crane claimed that Rife used an Amplitude Modulation (AM) technology, which is now been revised after the research of Ringas and Peters. Many people use simple square wave electrotherapy devices today, but Rife actually didnt work with them. Some of the modern “Rife” devices may or may not turn out to be useful in some applications, but that subject is beyond the scope of this article.

In my career of more than 20 years, I have critiqued the claims of Rife in regards to his outmoded beliefs on the subject of microbiology and cancer biology, and the flawed conclusions from his 1936 movie film on destroying BX organisms (Blood, 1996). Unfortunately Rife's archival material may be inadequate to base a new research effort on. Also his technical approaches to delivering frequencies probably need to be revised and modernised. However the simple concept that some biological systems might possess native resonant frequencies that can be exploited by exposure to EM energy remains an interesting possibility. In particular, the regular icosahedral structure of virus walls is likely to able to support resonant vibrational modes. This in turn invites the idea that matched coupling of the correct frequencies could be used to damage the wall structure and to inactivate viruses.

Rife incorrectly taught that shape-changing or pleomorphic organisms called "BX" were the cause of cancer, and that they could be killed by his ray device to cure cancer. Today this belief has reached the proportions of an urban myth. Unfortunately, my position is that none of these old ideas are true. In my opinion BX appears to be a lab culture contaminant of the Mycoplasma bacterial group of species. Some Mycoplasmas are a major part of the “friendly” ecosystem on skin surfaces (commensal population). Others are uncommon pathogens that can parasitise blood cells. Others are involved in lung infection in certain types of pneumonia. They are well-known to cell biologists as a tiny slow-growing pest that tends to contaminate tissue cultures, so much so that many research labs perform routine testing once or twice a year. One modern study found that in some 17% of cancer cases these bugs might be found, but it is possible that they are secondary infections around tumor lesions or even biopsy contaminants from skin puncture sites, rather than an infection that leads to cancer, as taught by Rife. A magic bullet that could wipe out BX-type bugs would probably not reverse the cancer process. Nevertheless, killing these bugs might perhaps turn out to be useful, for example if it

could somehow improve immune recognition of tumor antigens in some patients. However readers might be advised to be skeptical about such a hope.

For anyone interested in gaining a basic understanding of what would be required to replicate Rife's technology in its 1934 and 1936 forms, this article may help to clarify some issues. Even though many changes are suggested here, readers will hopefully gain a much clearer understanding of Rife's work from this article than from any material written prior to 2013.

Recently, updates to the Canadian Research Group website based on reverse engineering research by Ringas and Peters claim to have gained some insights into the hitherto unknown or misunderstood mechanism of the Hoyland "Beam Rays" 1938-39 technology, which were apparently unknown to later collaborators who worked with John Crane. Hoyland's newly rediscovered "harmonic sideband" method, and how it differs from AM, will also briefly outlined in my article, but this is actually not my preferred method.

Many readers may believe it is important to recreate the original Rife technology and re-test it before any attempt to modernise it or change it, and therefore might not be interested in a modern research project that deviates from that goal. The biggest problem I see with that objection is that unfortunately most of the interpretations that are available are either incorrect or have lead to dead-ends. Also much of Rife's microbiology is questionable or outmoded. The technology of Rife and Hoyland evolved over time from 1929 to 1239, so it might be unclear which of the three main historical designs to replicate. Many different interpretations have been written, and many new inventions have been put on the market, and many claims have been made. I have no product to market, and I am skeptical about the claims of cancer cures and other cures. On the other hand I am actively interested in modern theories about biophysical mechanisms such as virus resonance and the use of applied lower frequencies as an anti-fouling modality that could perhaps become a useful tool in 21st century cancer medicine. My research bona fides include a PhD research project on biological effects of Radiofrequency radiation, and a working knowledge of cellular biology and modern PCR techniques, e.g. to assay viral replication rates.

I should mention here that Rife's work sprung from his early invention of a novel fluorescence microscope capable of ultra-high magnification. Rife used colored "light staining" of live organisms instead of using dyes on dead organisms. However whether we like it or not, Rife took the secrets of its design to the grave. In my research I have come up with some educated guesses about its optical design principles, and readers can subscribe to my articles on that subject. Given enough resources, such a microscope could be redeveloped. However it is ultimately just another microscope design. In my opinion an investigation into the use of EM frequency combinations for resonance research could proceed even without the help of Rife's microscope. Rife spent a lot of time doing visual inspection of micro-organisms to detect any visual effect of EM exposure. There are more than one ways to "skin a cat". Today we can employ efficient PCR assay protocols that precisely measure DNA quantity to detect any stunning or killing effects that might reduce replication rates. We might even be able to develop novel spectroscopy rigs to indirectly detect the frequencies that can excite resonant vibration, as outlined later in this article.

I have coined the term HRIFE technology to mean Heterodyned Radiofrequency Inductive Field Emitter technology. I initially coined this acronym in honor of Hoyland and Rife (H-RIFE). I later learned from reading Ringas et al that my proposed dual RF heterodyning design is not in fact an invention of Hoyland (as was previously believed by some writers such as Aubrey Scoon), but the name has now stuck.

Much of the remainder of this article will be dedicated to discussion about various physical mechanisms by which acoustic outcomes could arise from HRIFE applications, e.g. via transformation of energy states.

Some important fundamental understanding of the significance of "linear heterodyning" versus "non-linear" heterodyning will also be explained (see also Appendix A). This does not appear to have been understood by most Rife web authors. Readers will thus begin to appreciate some of the differences between the early Rife devices and the later harmonically-rich designs that evolved as new technology was deployed by Hoyland from about 1935. Rife expressed a preference for working with combinations of pure fundamental frequencies without harmonic content, and this is also my preferred goal in a new generation of capacitative coupling devices or other designs that do not use the old gas plasma tube output.

THERAPEUTIC EXPOSURE BOOTH DESIGNS

Although it is possible to generate the output through a gas plasma tube as used by Rife and Hoyland, it should also be possible to capacitatively couple two RF frequencies between flat parallel metal plates, e.g. into a small cuvette for virus exposures in the lab, or within a large therapy booth for human patients. Miniaturised "nanocuvette" chambers are also proposed for lab exposure of cultured micro-organisms based on the fold-down Nanodrop chamber design, with the optional addition of a gasket.

Optimal selection of primary RF frequencies and placement of electrodes would be subject to a number of technical considerations (*1a).

Other novel designs are outlined that use multiple parallel RF beam irradiation (similar to straight torch beams), based on the RF lens principles explained by Hertz more than 120 years ago.

It should also be noted that although some heating may result, it is not the intention of this type of energy exposure to generate heating as a primary modality, as might be employed in the various RF hyperthermia devices available. Among the advantages of gating schemes discussed, gating or pulsed switching of the output can reduce the degree of bulk heating to acceptable levels while at the same time delivering moderate to strong peak EM field intensity if desired.

Note that there can be a choice of different types of signal mixing for this work. Prior to 1935 Rife used an RF carrier (e.g. around 2 MHz) ***additively superimposed*** onto a second dissimilar ELF or IF frequency, with a research interest in the lower of the two frequencies used. Alternatively, for a new generation of research, I advocate the use of two or more RF sources with an interest in the “difference product”. An example that uses simple math is to heterodyne 1.0 MHz with 1.1 MHz to obtain a 100 kHz product (HRIFE technology). Both these approaches may have different advantages for different applications. Hoyland took a third different approach, possibly because Rife's earlier device may have had had poor deep tissue penetration. The Hoyland scheme is somewhat technical, and will be discussed later.

BACKGROUND TO EM, ACOUSTIC AND RESONANCE THEORY IN HRIFE APPLICATIONS

If a human body is exposed to RF at a frequency of say 2 MHz, the majority of the EM wave power travels through the body, much like light passing through glass. However a fraction of that energy is trapped or absorbed. This RF absorption is known to lead to heating, and in Physics it is expressed as the "Specific Absorption Rate" in units of Watts per kilogram (i.e. the amount of heating power per kilogram of flesh). The fraction of available power that can be absorbed depends on the RF frequency used, and it can become quite high in the microwave part of the RF spectrum around 2,450 MHz, e.g. in microwave ovens. The SAR values tend to be fairly low below say 100 MHz.

The human body tends to not absorb electromagnetic (EM) waves below 100 KHz (or maybe nearer to 300 kHz depending on what textbook you read). Instead, the field lines tend to go around the target without penetrating (*1b) (This frequency range is equivalent to 0.1 MHz to 0.3 MHz, only the units used are different). On the other hand, human bodies can absorb higher frequencies in the RF range roughly above 100 kHz or 300 kHz, and the field lines tend to be deformed and to penetrate inside the body surface (*1c).

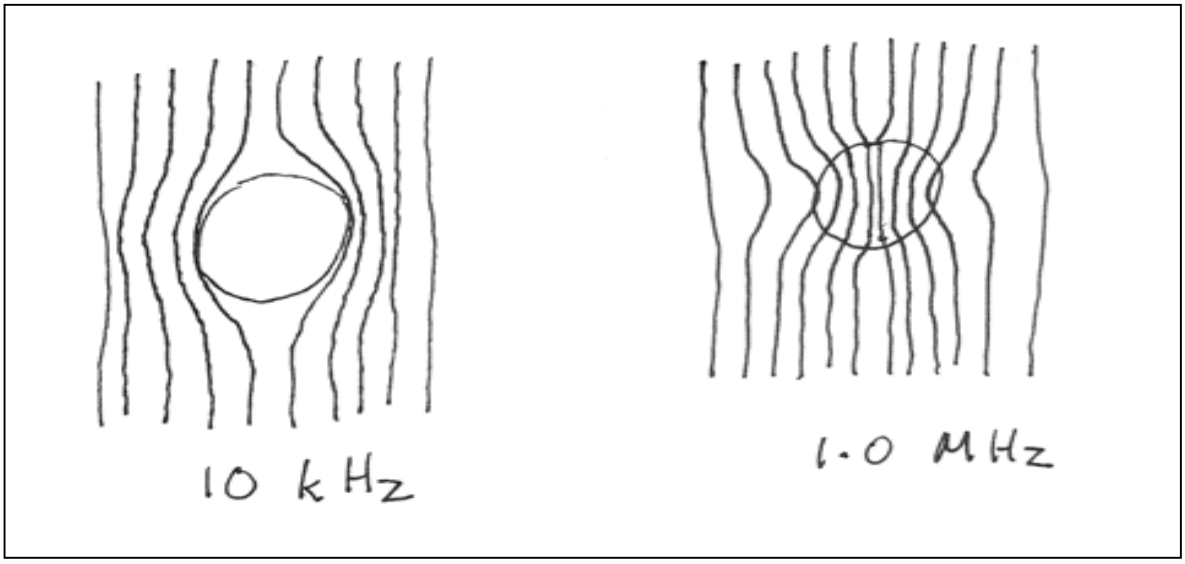
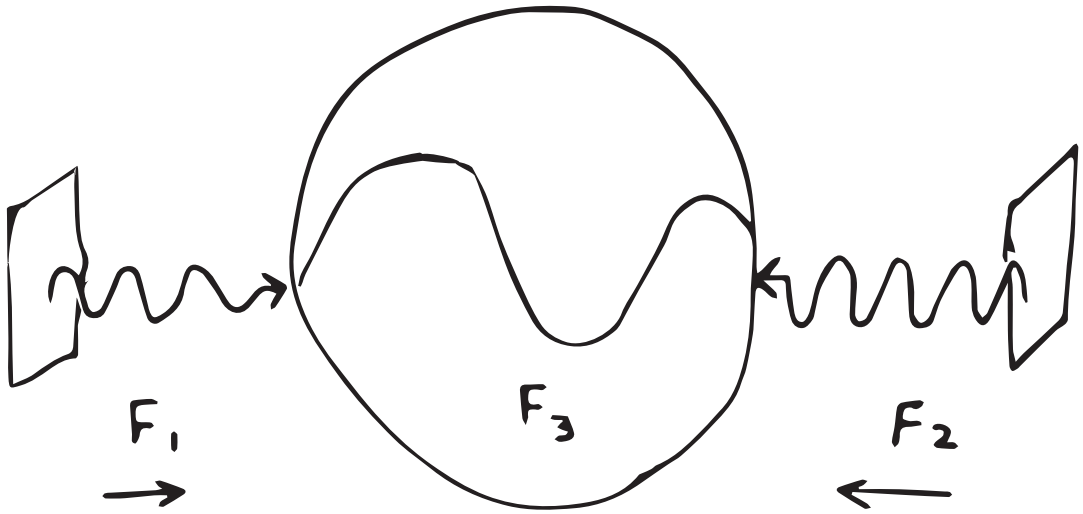


Fig. Perturbation of electric field lines by a lossy dielectric object during EM exposure. RF radiation is absorbed by animal bodies. Low frequency electric fields do not penetrate. Note that this paradigm does not apply in the case of pure magnetic fields.

It may desirable to combine penetrating radiofrequency (RF) electromagnetic waves to overcome the lower frequency limit of penetration. Superimposing or combining two RF waves is known as ***heterodyning***. We can add frequency F1 at 10.0 MHz with a second frequency F2 at 10.1 MHz to interfere with each other to create a lower frequency heterodyned product F3 at 0.1 MHz (i.e. 100 kHz). The simple formula is F2 - F1 = F3.

In this example, a frequency of 100 kHz can be successfully injected into the target. If desired, a lower frequency such as 10 kHz which normally cannot penetrate inside tissue can be forced to heterodyne out from the interfering parent RF waves at all points in space within the target object. As we shall see, this may present new opportunities for medical applications.



If a human body is placed between large metal plates without touching the plates, RF energy can be passed through the target body by a process called capacitative coupling. If the plates are large enough, the whole body receives RF irradiation. On the other hand if electrodes are placed directly in contact with bare flesh, as is practiced in so-called "electromedicine", electric currents are set up that tend to travel along "preferred pathways" within limited areas of the limbs or trunk of the body. Electric current in low frequencies e.g. in the audio range are used by most of the modern so-called Rife devices with skin electrodes, and also in TENS devices. But most types of capacitative coupling devices would not able to deliver pure electric fields inside the target at such low frequencies. Hence the need for the dual heterodyning approach in my designs as a means to inject lower frequency internal electric fields.

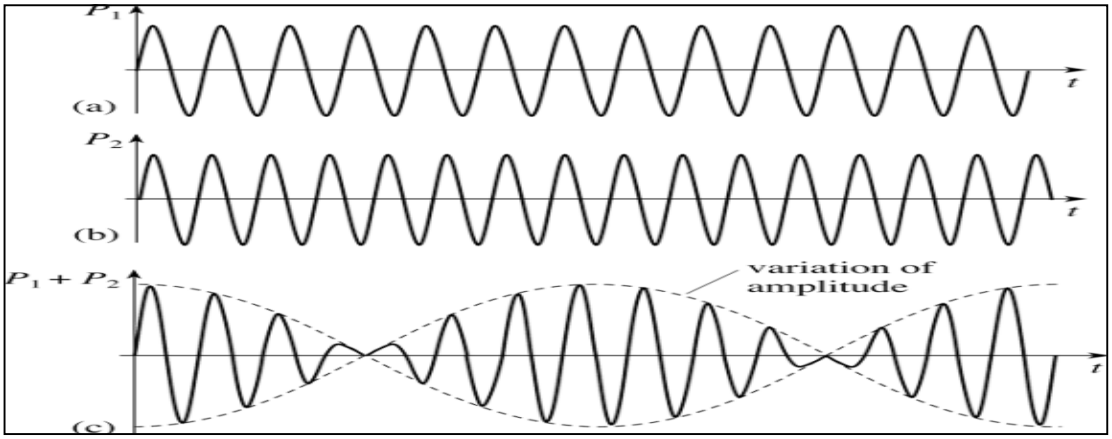


Fig. Adding or superimposing two different EM frequencies F1 and F2 (heterodyning) causes zones of constructive and destructive interference. The envelope shape would cause modulation of RF energy absorption in a target (beat frequency). Extra discrete frequencies will exist at values F3 = F2 - F1 (subtractive heterodyned product) as well as F4 = F1 + F2 (additive heterodyned product). The envelope shape shown also happens to be the same as the F3 wave. The above plot shows the trace of peak E-field amplitude over time, i.e. (time t is shown on the x-axis). The tangential value or slope value of the dotted line envelope (at any given value of t) is expressed as dE/dt.

If we instead plot E against distance in space (instead of against time as shown above), we also obtain a sine wave for each frequency, and the tangential value at any point along the line of the wave propagation path is dE/dx (not shown). Heterodyning will cause the same type of sine modulation envelope with respect to space. This means that at any given instant in time, at some points in space there will be zones of constructive or destructive interference.

Some well-known theories propose a frequency limit above roughly 1.0 MHz for penetration of RF waves across cell lipid membranes (sometimes called plasma membranes). The proposed HRIFE heterodyning approach would allow dual RF carriers over 1 MHz to both penetrate inside cells and within plasma membranes, thus injecting the desired low frequency product F3 into intracellular biological zones where virus might live.

INDUCTION FIELDS CAN BE EMITTED FROM GAS TUBES AND ANTENNAS

Let us assume that there are charge masses of opposing polarity at each electrode of a simple gas plasma tube with a gap (dipole) between the electrodes. An exposure in the near field of a dipole gap, with frequencies F1 at the left electrode and F2 at the right electrode, can be analysed by quasi-electrostatic modeling to show that the summed vectors of the inductive forces are equivalent to two RF waves traveling in opposed directions parallel to the axis of the dipole.

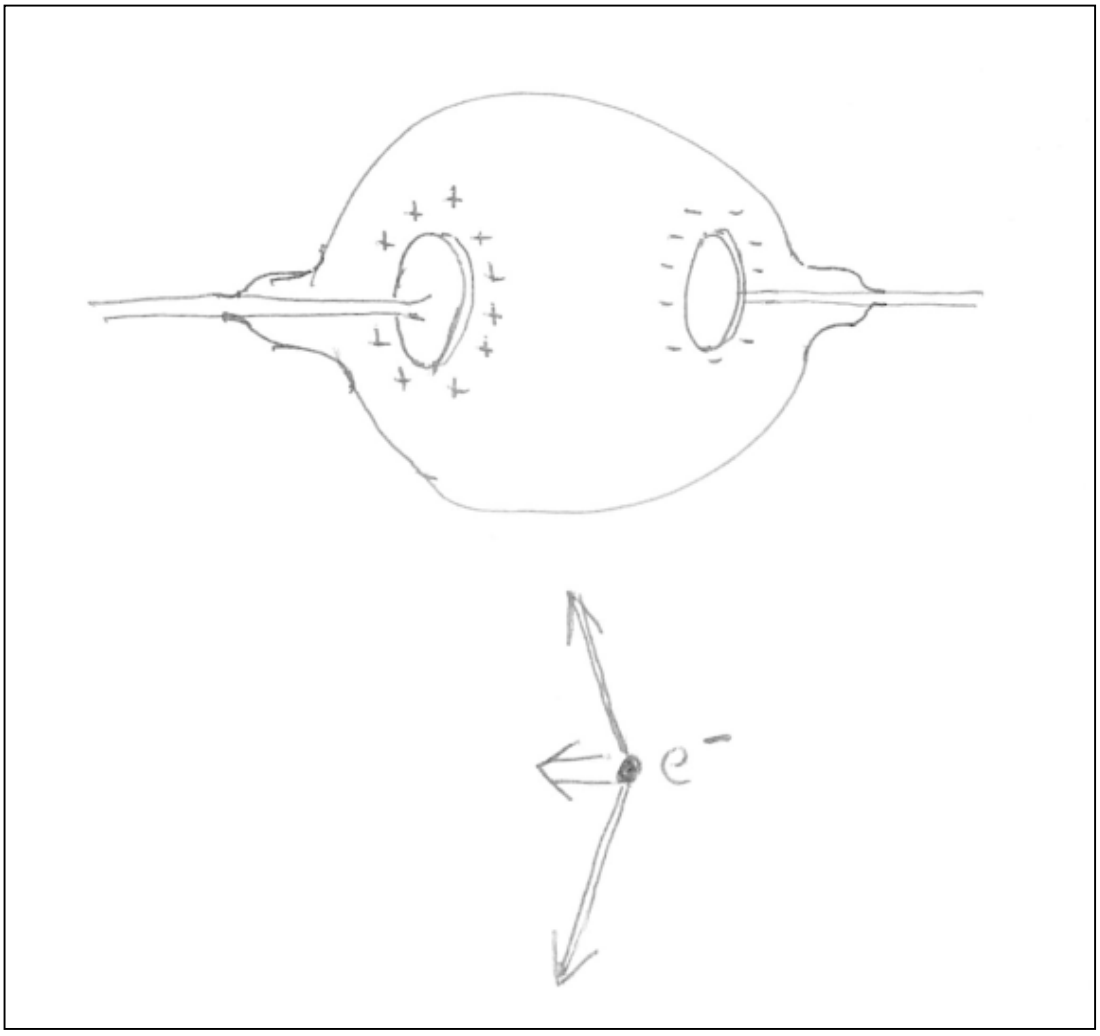


Fig. Inductive forces on a test electron in the near-field of a dipole gap. The test electron is repelled away from like charges on the cathode (right side) and at the same time it is attracted to opposite charges on the anode (left side). The vector sum of the forces in the diagram points west in the direction of the dipole axis. When an east-west alternating current is delivered to a gas plasma tube (or any type of dipole), a test electron experiences an inductive force that also alternates from east to west. Similarly, at some distance from a simple radio antenna, a test electron experiences alternating inductive force in the same orientation (far field exposure).

If we place a test electron in some place where it is influenced by two different RF frequencies, the inductive forces are superimposed. In a more complex scenario, this article examines designs that combine two RF carriers that travel in opposed directions, which could perhaps be generated by two RF source with a gap between them, e.g. by a plasma tube fired by frequency A on the left electrode and frequency B on the right electrode, or perhaps by two separate tubes placed near each other. These approaches may have been developed by Hoyland in the earlier years of his collaboration with Rife, in the years before Hoyland's final design was conceived. However the historical evidence is still unclear about this. A similar opposed-wave effect should, in theory, occur in my proposed parallel plate designs, although Rife himself

never used that idea (*2). In other designs it may be convenient to combine RF sources from the same direction, e.g. for the low-frequency slime-buster device which can use lenses to generate 2 or 3 parallel RF beams. Multiple angled RF parallel beam source designs may also be convenient. The rationale of the latter suggestions is to avoid possible technical problems or burn-outs in electronic circuits due to cross-contamination of frequencies manifesting as RF signal cross-reflection.

IONIC CURRENTS VERSUS DISPLACEMENT CURRENTS

EM Frequencies below 100 KHz may be useful because they tend to deposit energy within lossy dielectric media (such as within living organisms that contain water) mainly in the form of ionic currents. The induced motion of anions (like Na+) is in the opposite direction to cations (like Cl-), leading to turbulence involving collisions with other ions and with water. As stated earlier, there are technical challenges in actually delivering whole-body exposure below 100 kHz.

Frequencies e.g. above 1 MHz on the other hand, tend to deposit most of the absorbed RF energy initially into transformed energy states such as distortion or "displacement" of electron orbitals (“displacement current”, also known in Mathematics as “imaginary current”). RF and microwave also cause so-called “dipole spin” of polar water molecules which causes collision events as they rotate (kinetic energy states), ultimately leading to heating. At high frequencies above roughly 100 kHz, ion motion tends to not be induced because most ions are relatively massive, such that their threshold frequency of induced vibrational motion is below 30-100 kHz (Warburg frequency limit of ionic induction). (*3)

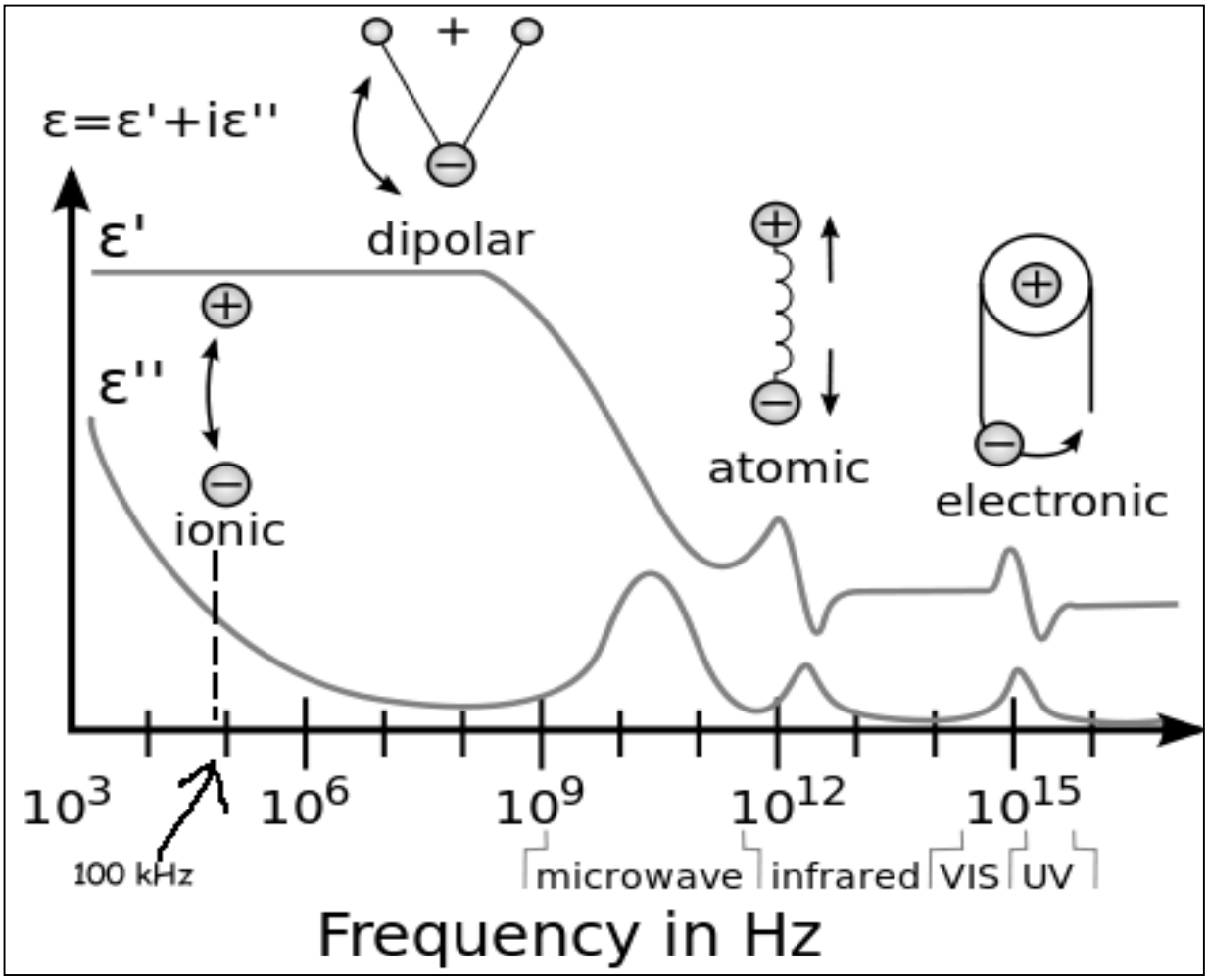


Fig. Bode plot or Nyquist plot. Contributions by real and imaginary components of permeability that determine impedance are shown. Real (ionic) currents are reduced beyond 100 kHz and are insignificant in the RF range (*3b).

Ionic currents involve molecules that possess inertia. During ionic current events, there would be downstream collisions, some of which would probably uncouple as kinetic or “mechanical” energy residing within the collisions and turbulence from ionic currents. Ultimately, after the mechanical collisions (a form of kinetic energy), all the absorbed energy is eventually transformed into heating effects.

Similarly, exposure to higher RF frequencies also ultimately involves transformation of all absorbed energy into heat, but in this case there is no ionic current, but rather the mechanism involves dipole spin and displacement current (also known in Physics as "imaginary current").

While many published articles have implied that the only effect of RF absorption is heating, the reality is that in many cases there may be a series of steps of energy transformation that involve kinetic energy and, in the case of HRIFE technology, acoustic energy may also become manifested. Some simplistic publications often model human tissue as homogeneous RF absorbers, whereas in fact living tissue has lipid or "oily" thin cell membranes that have relatively low conductivity, adjacent to the aqueous media of much higher conductivity. This article explores some of the biophysical consequences of these boundaries or discontinuities.

ENERGY TRANSFORMATIONS ON THE PATH TO HEAT DEPOSITION

A simplistic treatment of RF and microwave energy absorption uses heat probes to measure temperature increases in a lossy dielectric media to estimate the rate of deposition of energy that ends up as heat after a set time of microwave exposure ("Specific Absorption Rate" or SAR). (*4). For such measurements, a thick gel can be used to prevent heat diffusion via thermal currents that would exist in liquids, and thus improve the accuracy of the modeling. It is well known that such an apparatus can only measure time-averaged heating effects. In the case of pulsed protocols such as GSM mobile phones, peak energy deposition is 8 times higher than the measured average energy deposition because the signal is in the off state 7/8 th of the time (12.5% duty cycle, 217 Hz square modulation).

When we examine the molecular mechanisms of microwave energy deposition, it becomes obvious that a major portion of heat energy is deposited indirectly, i.e. microwaves initially induce rapid water molecule rotation or spin as the electric dipole of polar water molecules attempt to align with the imposed alternating field. This disturbance is accompanied by molecular collisions that ultimately give rise to a temperature increase via an increased kinetic energy imparted to water molecules. The take-home message in this example is that RF absorption may generate heat indirectly through steps of transformation of energy states. I speculate in this article that the initial transformation of absorbed RF energy into special kinds of mechanical or acoustic energy may provide a window of opportunity to acoustically couple energy to target native resonant frequencies in biological systems.

MEMBRANE COMPLEXES ALLOW A CONTINUUM OF RE-REDIATING SOURCES

Conductive objects are known to perturb the geometry of EM fields. The shape of the field lines becomes altered compared to what they would look like in free space. Whenever this happens with a metal conductor, there is reflection or "re-radiation" of the impinging field, which is also associated with surface currents. It is likely that when a lossy dielectric object is placed in the vicinity of an EM field source, there will be both field distortion and some degree of re-radiation (albeit of a lower amplitude than from a metal conductor).

One issue with the above scenario is of course that the simplest model of re-radiation occurs at a surface where there is a discontinuity or a boundary, where there is a sudden change of conductivity, classically between air and the outside surface of a solid object. In electronic physics this situation is analysed as a discontinuity of impedance. This is also analogous to situations in optical physics where we use the terminology of a boundary between materials that have different refractive index.

We might expect there to be no re-radiation sources within the interior of the object if it is assumed to be composed of some homogeneous material. Scientists

often model human bodies as if they are homogeneous and have single values for conductivity and permeability. In some cases such as SAR research using “phantom” skulls, there may be more advanced modeling methods that attempt to take account of skin, fatty tissue, bone, and soft tissue with differing conductivity values, to more accurately simulate the mapping of microwave absorption in the human head from mobile phones. But real tissue is also full of tiny discontinuities of conductivity not considered in these basic 4-layer skull SAR mapping models.

For example blood vessels contain conductive salty liquid but have walls with relatively low conductivity, and would be predicted to re-radiate RF with similar geometry to a thin conductor, and with displacement currents traveling in the wall dielectric adjacent to the conductor. Similarly, the plasma membranes of cell walls are composed of lipid bilayers that act as very thin electrical insulators surrounded by conductive aqueous media. Again an opportunity for re-radiating surfaces exists, which might be modeled as plane surfaces with pores. Even in the interior of cells there exists a complex of lipid bilayer membranes in the cytoplasm and various organelles, all of which are predicted to be re-radiation sources. The living human body (with the possible exception of bone and fatty tissue) could be modeled as a continuum of re-radiating sources !!!

HETERODYNE PLOTTING

A non-linear electronic component has resistance values that tend to change depending on what voltage they see (e.g. a diode or a transistor), whereas simple resistors have a fixed resistance at all voltages to obey the rule V=IR (linear).

The discussion below is modeled on simple situations where two fundamental frequencies are added or superimposed. More complex types of heterodyning can occur after frequency mixing in various common types of non-linear electronic devices ("power mixing"), and this can lead to generation of various harmonics. Many types of devices use additional circuitry to filter out unwanted harmonics if necessary, e.g. in telecommunications. For the purposes of most of this discussion we will assume that frequency mixing has occurred using linear components (fixed resistance) that do not tend to generate extra harmonics. As mentioned earlier, the keep-it-simple non-harmonic approach might also be desirable in developing new research technology. More information from Wikipedia is given about linear versus non-linear heterodyning in Appendix A.

It is helpful to look at a heterodyning (superimposition) plot of 5 MHz plus 6 MHz. Here we see an unusual non-sinusoidal phenomenon as the waves superimpose. The shape of the trace line showing net inductive force contains points of destructive interference where the E-field value is zero (nodes) as well as what appear to be crests of varying amplitudes wherever dE/dt = 0 (antinodes). Note also that the distribution of nodes is non-uniform along the X- axis. Also, over time the antinode amplitudes and their X- axis distribution will be non-uniform.

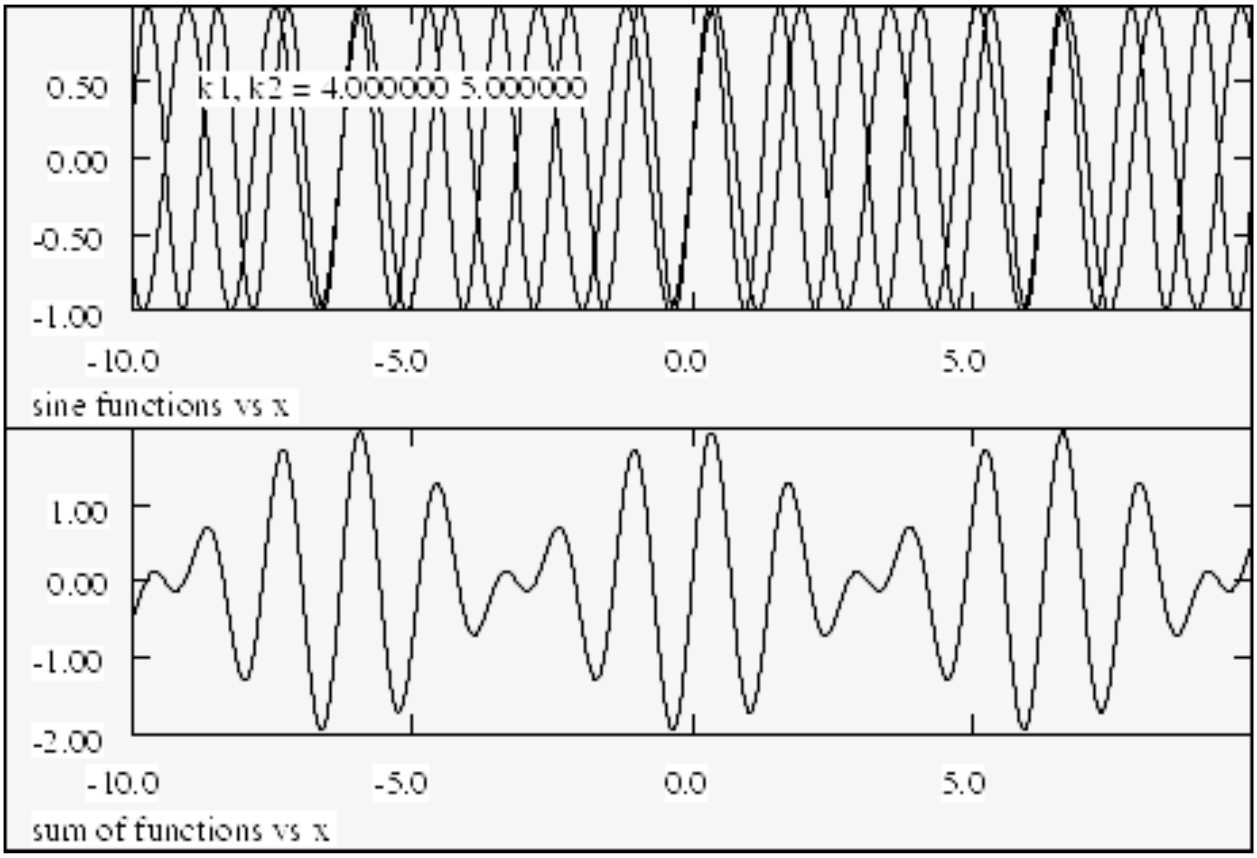


Fig. Superimposition of 5 MHz and 6 MHz

Now consider the heterodyning of 10.0 MHz plus 10.1 MHz. Here 100 periods of F1 occupy the same space as 101 periods of F2. Where the phase gap rho is zero, we have full constructive interference and a near-perfect sine trace at RF frequency. Where rho is 180 degrees (or pi radians), the trace is almost perfectly flat with zero amplitude (fully destructive interference). At other values of rho, the trace oscillates unevenly, often with two "lumps" in any given section, but overall the trace shows an offset component that alternates at F3.

Integrating in 20 chunks per 100 F1 periods, we get 20 different values for offset within one F3 period. In the positive phase of F3, the chunk-integrated value of area above zero potential is slightly greater than the integrated value below the zero line (therefore there is "offset"), even though there appears to be somewhat wildly oscillating shape in the superimposed signal. Remember that the inertial system of ions will tend to ignore high frequency field alternation components in the HRIFE trace. The only frequencies that can couple into ion inertial systems in HRIFE exposures are low frequency heterodyned products, which we can characterise by this chunked integration approach (*8).

OFFSET MODULATION

To understand exactly what Rife used as his output for the early microscope slide experiments in the years before he worked with Hoyland, we can plot a superimposition of a low frequency and an RF carrier, both of equal amplitude, to give a resulting waveform where the RF carrier appears to be alternately pushed to either side of the zero potential line along the X-axis (alternating offset). Because of this wave behavior, I have used the term “offset modulation” to describe Rife’s earlier devices. Because the Rife #2 technology prior to 1934 used simple joining of wires (fixed resistance components) to mix frequencies prior to the triode amplifier series bank, it was able to output non-harmonic signal. Depending on how it is configured, it may have been possible to also avoid harmonics generation in the actual gas plasma tube, although these are typically non-linear components (*9).

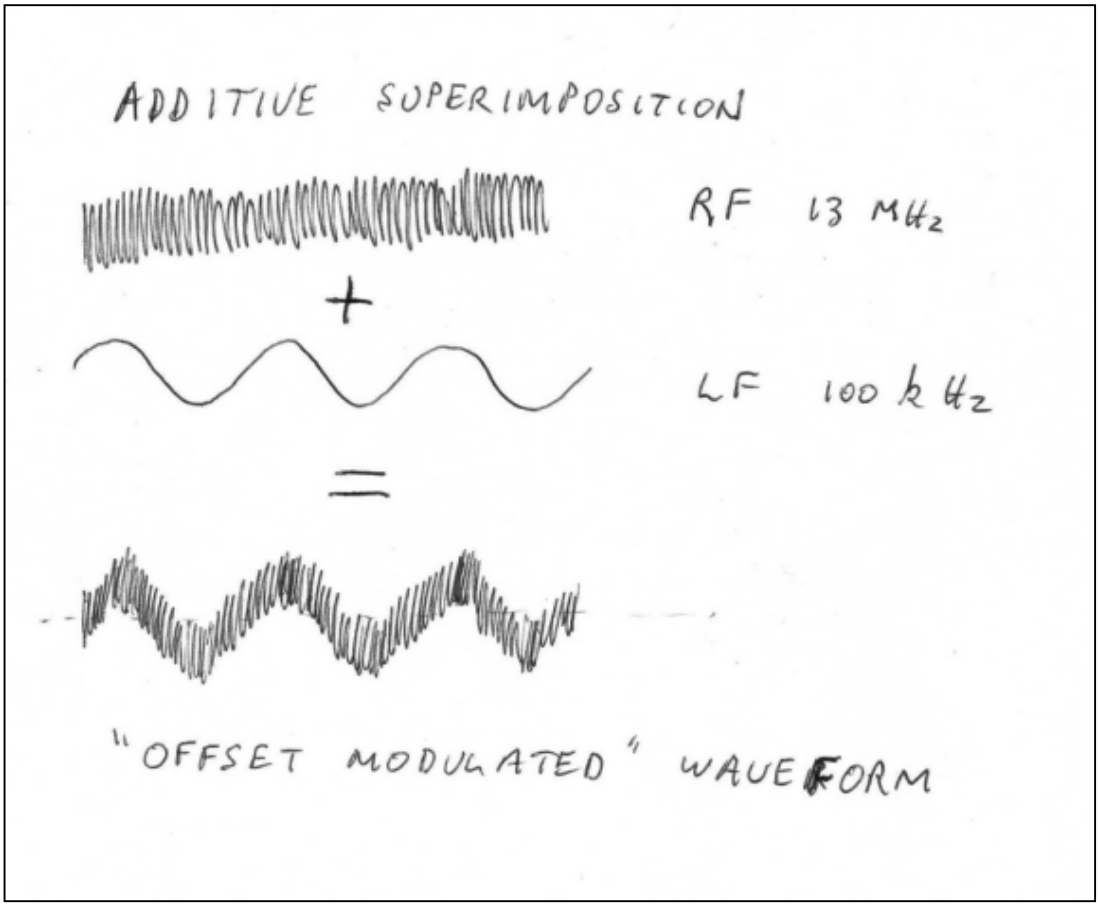


Fig. 6 Offset modulation

Normally the sine RF wave might oscillate equally say 1 V/m above and below the earth or zero potential line. The behavior of the RF waveform changes somewhat when another lower frequency is additively superimposed. Now the RF carrier experiences “alternating offset”.

Rife's early simple superimposition scheme of a lower frequency with an RF carrier, although probably effective for thin specimens in a microscope slides, might not be suitable for a therapeutic device because the lower frequency alternating offset component might be rapidly attenuated out in solid tissue (poor absorption), leaving only the carrier. For this reason, heterodyning of two penetrating RF signals may be a more suitable means to inject lower frequencies into a biological target. It is known that in 1936, Hoyland performed testing using 75 pounds of horse flesh, perhaps to demonstrate this predicted problem with attenuation of the offset component in Rife's early ray tube outputs.

If we examine different situations of dual RF heterodyning, in some examples the superimposition plot clearly shows the effects of constructive and destructive interference such as in the diagrams on pages 8 and 14. At the regions near the zone of destructive interference, the amplitude of the trace envelope is obviously much smaller than elsewhere. This is typical of situations where we heterodyne two RF frequencies that are in nearby regions of the spectrum. This effect is also aimed for in the proposed HRIFE configurations. But in some situations when we try to heterodyne or superimpose frequencies that are very far apart in the spectrum, the superimposition trace may no longer show zones of low amplitude in the envelope. This latter phenomenon would have been typical if Rife was trying to combine an RF signal with an ELF signal. Instead, the trace would appear like the diagram for offset modulation on page 15. This may appear very confusing to readers. All I can say is these are different physical paradigms that may be exploited for different desired outcomes. The distinction between an offset modulation outcome and normal heterodyning equations (say by using nearby RF parent frequencies) needs to be taken into account to appreciate the differences between the various historical designs and also of my proposed designs.

There is some controversy about whether Rife used ELF frequencies or IF or even lower RF values to combine with a higher RF carrier in his work, or whether he may have used lower frequencies in the early years and later changed the configuration to begin to use IF instead. Different frequency listings in the archives are also confusing.

THE FIRST ERA OF RIFE 1930'S TECHNOLOGY

Ringas article is recommended for readers who wish greater detail and photos. Rife used off-the-shelf Kennedy regenerative sine oscillators in two main frequency ranges, i.e. audio (ELF) and RF. Signals at low voltage were premixed by simply joining the two wires. These were fed into a series bank of five triode amp / inverters. The output fed the left electrode of a gas plasma tube, and the right electrode was earthed.

THE SECOND ERA OF RIFE 1930's TECHNOLOGY

The second era of Rife technology began from about 1934-35. Phillip Hoyland was engaged to design equipment using the new generation of Hartley power oscillators. He may have chosen to abandon the old idea of pre-mixing the signals. They would have been amplified in separate power oscillators instead. Rife and Hoyland may have used two separately amplified signals to drive the left and right electrodes respectively, but we dont at this time know if that approach was actually tried. Some photos of equipment suggest that two nearby tubes could be used, which suggests that each tube had an earth connection but only one hot wire each.

In the example below, a relatively low frequency is injected into the left side, and a 10 MHz carrier fires the right side. Quasi-electrostatic analysis of the output of Rife's #3 plasma tube devices on a test electron in the near field shows a resulting net vector electric field which chunk integrates to a low frequency electric field with an alternating vector in the direction of the dipole axis (any harmonics are ignored for the purposes of this discussion). This would cause an inductive effect at the lower frequency.

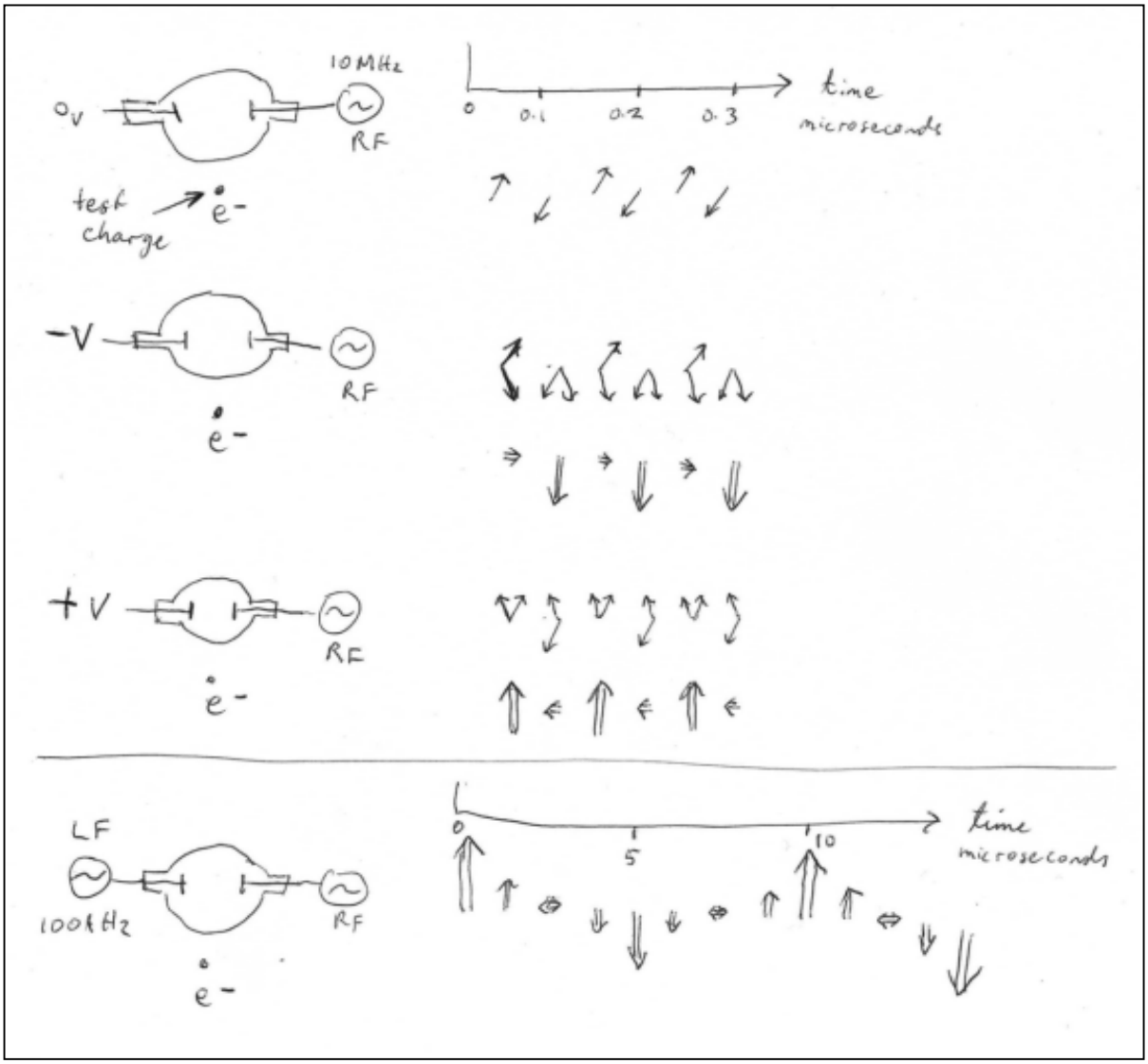


Fig. Fig. 10 Quasi-electrostatic analysis of vector forces on a test charge (e-) in the near field close to a Rife plasma tube. The lower panel indicates an effect of low frequency oscillation at 100 kHz (vertical arrows up and down). The small bidirectional horizontal arrows indicate periods of only "displacement current" at RF around the time the left electrode is near zero amplitude.

The inductive effect of the new proposed HRIFE heterodyning technology would be similar to the above situation in the sense that two different frequency e-fields co-exist in the near field of a dipole, or inside a capacitative coupling output. When we consider designs that combine two or more propagating RF beams, the heterodyning equations also predict a low frequency electric field at F3.

It is important not to confuse Rife's early "offset modulation" output with the more common Amplitude Modulation used in many radio transmitters, nor the square mod AM schemes used in the recent generation of Rife/Bare devices etc. Rife himself never used the term offset modulation.

NON-POYNTING ANOMALIES

The Poynting equations illustrate that a propagated EM plane wave has a sinusoidal electric field and also a sinusoidal "magnetic induction field" or B field. E and B are in phase in the classic Poynting diagram (*10). Free magnetic fields or H fields are the same as B fields except that the value of the magnetic dipole M (induced in materials such as iron) is deducted from B such that H=B-M. Note that as soon as we deviate from a perfect plane wave such as a wave a long distance from the sun, some irregularities begin appear that are ignored in high school physics.

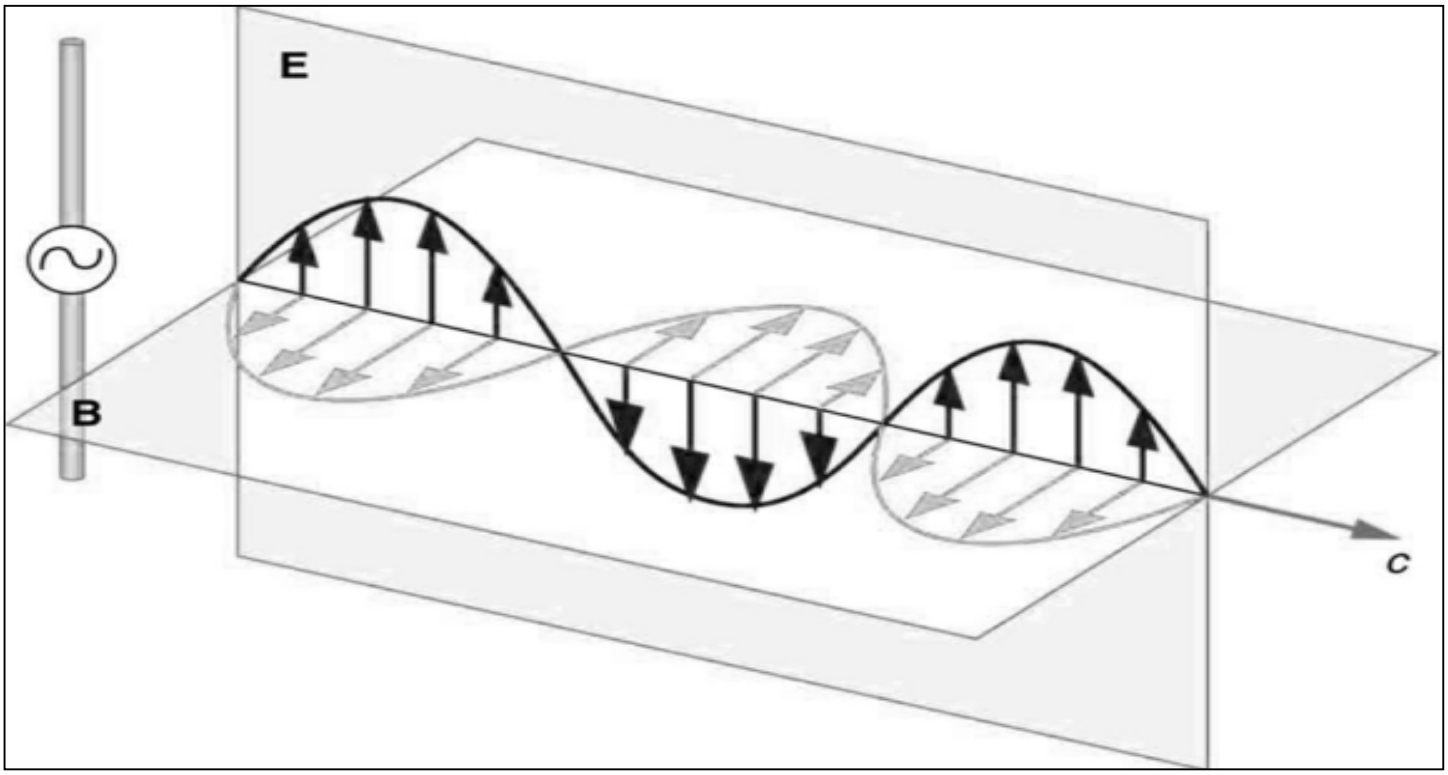


Fig. Poynting diagram for a plane EM wave

Some people say magnetic induction fields (B fields) are only a relativistic manifestation of the existence of an alternating E-field. This is another way of saying E-fields generate B-fields. However there are situations where magnetic fields can actually be zero in the presence of an electric field e.g. in an a.c. circuit inside charged capacitors. Also electric fields are absent in some areas of space near certain types of coils despite the presence of a pure magnetic local alternating field. These may be “trick” situations where e.g. in the coils the electric field is restricted to the line of the conductor. My point is that we can use electric circuits to give us unnatural or anomalous situations where the Poynting paradigm does not apply. Similarly, it is well-known that there are anomalies of the E-B phase relation which exist in near-field (also known as the Fresnel field) situations such as very close to radio antennas, and these would also be predicted close a Rife plasma tube output.

My message is that paradigms taught at high school and undergraduate level about electric-magnetic relationships are not universal in certain electronic outputs, and the way we think about electric and magnetic phenomena in HRIFE technology should be mentally unshackled from textbook paradigms. Opposing EM waves in novel electronic outputs may also allow new non-Poynting anomalies that can be exploited, e.g. to indirectly generate acoustic energy “from within” in biological loads, as discussed herein.

THE FIELD LOADING CONCEPT

We know that ionic currents in aqueous media tend to counteract externally applied low frequency alternating E-fields, such that the local field intensity tends to zero through most of the media (except at the boundary, where it ramps suddenly). Here we can make an analogy to a “load” on the applied field potential. The external E- field potential has some value but the local E-field potential tends to zero inside the media due to “loading” by the ionic current.

NEW THEORY OF RF BIOEFFECTS

Under RF irradiation, SAR values vary between oily lipids (hydrophobic or “water-hating” phase) and most other aqueous biological materials (hydrophilic or “water-loving” phase). Because lipid membranes have lower conductivity and lower SAR, whenever tissue is under RF irradiation there must be a flux of heat flowing into membrane lipid bilayers from the aqueous media, to bring the neighboring phases to the same temperature (tendency to thermodynamic equilibrium). In effect, the very thin water boundary has a some value of heat flux rate via diffusion even under modest RF power.

There is an argument that modest heat diffusion alone is unlikely to drive any RF bioeffects. Some membrane-mediated RF bioeffects have been the subject of publications (Blood, 2005; Friedman et al, 2007; Markov, 2011). "Athermal" RF bioeffects might arise from the predicted existence of RF surface currents at the impedance discontinuity. However at this time I am not aware of any journal articles that speculate about such a mechanism. Maybe it seems more obvious to me because I was closely involved in the RF bioeffects research for some years.

INTRODUCTION TO VIRUS BIOEFFECTS

In this article I discuss the possibility that virus icosahedral capsid assemblies might support tympanous type resonances like a thin vibrating drum skin within each triangular module. Two main structural groups for virus are a) the various spherical icosahedrons (see Vyper website) and b) bacteripohage-like structures that often have legs and a cylindrical head. These look like "lunar lander" machines.

Tsen et al have also showed that virus capsid cylindrical molecular motifs in the bacteriophage-like Tobacco Mosiac Virus can be forced with femtosecond pulsed laser light into disruption of the molecular packing, capable of affecting viral replication, following virus killing (Tsen et al, 2007a; 2007b). Shashlov et al found unique narrow frequency windows around 60 GHz capable of mortal effects on various species of bacteria (Shashlov, 1993). 60 GHz was probably investigated because the Nyquist plots indicate "real current" phenomena in a blip or bump in that part of the spectrum. Other work on Electro-Conformational Coupling (c.1986) demonstrated windows of frequency response to applied alternating e-fields, related to the turnover rate of enzymes. Readers familiar with the history of Royal Raymond Rife will also be aware of his claims to have discovered Mortal Oscillatory Rates (MOR) for various micro-organisms, but his claims remain largely unproven. Although the outputs used in the above studies differ substantially to what is proposed here, the take-home message is that viricidal and bactericidal responses and other biological effects after frequency exposure is not just a fantasy.

HETERODYNING EXAMPLES

10 MHz

What happens when we heterodyne 1000 MHz with 1010 MHz to obtain a 10 MHz value for F3? There can be no ionic current so high into the RF spectrum, so the net inductive influences at F3 would be in the form of displacement currents, at the Fourier sum of F1 and F2.

20 kHz

What happens when we heterodyne 10.0 MHz and 10.02 MHz? The product F3 is at 20 kHz, below the Warburg threshold for ionic current induction. Theory predicts a mix of displacement (“imaginary”) current and “real” current (ionic current) in aqueous media. Also, as we shall see, polysaccharide macromolecules that possess net electrical charge due to their sialic acid chemistry may be manipulated by alternating electrical fields in the low frequency range.

1 MHz

What happens when we heterodyne 10 MHz with 101 MHZ in a lossy dielectric biological media to give an F3 value of 1 MHz? Forcing F3 into the spectrum window somewhere in the band approximately between 300 kHz and 1 MHz is an interesting and exceptional situation because only one species of ion, the proton cation, can be induced to motion, and there may be no significant opposing anion motions because all the anion species are too massive, thus in this case any induced counter-force would have to be a purely electron-motive force.

PROTON MOTIVE INDUCTION

We postulate that rather than tolerate a local e-field from the back-electromotive force of proton currents where F3 lies roughly around 100 kHz to 600 kHz, with a threshold perhaps a little higher, the media space will be loaded with counter-currents of free electrons to oppose the proton current, and to nullify the local electric field. We might also postulate a positive-feedback situation where breakout of protons from water is enhanced by this inductive environment, and yet more positive feedback where concurrent enhancement of free electron bombardment also boosts proton breakout. In organic chemistry parlance, we might also predict an enhancement of the propensity to hydrophilic attack, and perhaps therefore also changes in the formation and activity of free radical oxidative species (ROS).

We know that proton pumps are physiologically important in membrane function and we know that membrane electrical potential is many thousands of volts per meter. We could speculate about what perturbation HRIFE-induced proton currents or perturbation of ion channel currents might cause in physiological processes in the metabolically crippled cancer cells (*11). Many novel opportunities for cell biology and membrane biology research could be explored looking at downstream effects of HRIFE-mediated proton motive induction. Although the idea may be worthy of study, I would not try to predict any mechanisms at this time. The chance of finding nothing is high, but the reward of finding a possible effect that could be exploited in future cancer medicine would justify the effort.

PORE FIELD FOCUSING PHENOMENA

Where a hole exists in a thin plastic membrane, it is possible to deploy a.c. electrodes some distance above and below the membrane such that the electric field gradient across the length of the hole is very much magnified compared to the average electric field gradient throughout the bulk media. This is a classic example of strong perturbation of electric fields. We can conceive of a similar field focusing occurring across membrane pores if only we could supply an alternating electric field across it (*17), (*18), (*19).

It would be logical to suggest that exogenous electric fields such as the F3 component of a HRIFE exposure could experience a focusing effect across membrane pores, to give amplitudes of relatively high local values. Downstream acoustic energy transformation might therefore be predicted to be locally higher within (or adjacent to) some ion channels pores than elsewhere on the membrane planes. Partial or patchy clearance of the “polysacharide lawn” might be sufficient to allow immune cell docking to exposed tumor antigens in the vicinity of membrane pores. It is interesting to consider the possibility that pore focusing might somehow also apply to acoustic impact events.

ACOUSTIC PHENOMENA IN HRIFE APPLICATIONS

MODULATED WHITE NOISE

Under the influence of sinusoidal electric fields below about 30 KHz, ions of different molecular weights all vibrate in the same phase, and (for single-charge ions) with same inertia. Ions of relatively high mass tend to travel less distance in each oscillation and they build up less velocity than the low-mass ions. (The inductive force and momentum is of course doubled for ions with two charges, compared to single-charge ion species).

Inertia = mass x velocity. Thus the maximum velocity of a heavy ion is low compared to a less massive ion.

The Warburg frequency threshold near 30 kHz is somewhat arbitrary, in the sense that it is located at the right-hand side of a sigmoidal curve for the "real" contribution to complex impedance (See also Bode plot or Nyquist plot). Also the frequency threshold for significant levels of vibration would obviously be higher for the ion species with lower atomic masses. Thus free protons (H+ ions) might be responsive to e-fields as high as 100 kHz to 600 MHz or even a bit higher.

Ions collide with water and also with other ions of opposed charge, because anions vibrate in the opposite direction to cations. The average number of collisions is more frequent at maximum ion velocity, and would be less frequent at the point of zero ion velocity, i.e. at the instant that the ions change direction. The instant of zero velocity happens to co-incide with the instant of maximum e-field intensity of the heterodyned product F3 (180 degrees out of phase). Each collision results in a mini shock wave that can occur at random times.

In a HRIFE exposure, the deposition of kinetic energy in the form of ion collision would vary at a modulated rate at frequency F3. The average number of collisions at any instant varies at a rate that is 180 degrees (pi radians) out of phase with the injected F3 e-field. The "density" of shock wave energy can never be negative, therefore collision noise would be modulated in a rectified sine (fractal) pattern at F3. At any instant in time, we might classify this kind of activity as an acoustic white noise generator, i.e. a wide band of acoustic frequencies that result from multiple randomly generated mini-shock waves. However when the HRIFE situation is assessed over the time of one F3 period, the amplitude of this white noise must be strongly modulated over time.

It is postulated that where F3 matches a native resonant frequency in a biological system, modulated white acoustic noise could excite resonance analogous to the wineglass paradigm discussed below.

Induced acoustic events may not be limited to ion turbulence at F3, because other electric dipoles exist in various macromolecules including the phospholipids that make up the bulk of lipid bilayer membranes. While these entities may or may not generate significant white noise volume, some induced rotational or vibrational events might be predicted that might have downstream bioeffects.

There are also opportunities for modulated white noise arising from turbulence from induced dipole spin of water molecules by RF frequencies. Interference of two RF frequencies causes a beat-like modulation of both RF carriers. Collision events arising from water dipole spin are modulated at the F3 frequency, in phase with the modulation of the ionic current. Most likely, the RF-induced acoustic white noise would be in a higher frequency band than that arising from ionic current. Two broad bands are predicted, giving opportunities for a wider spread of harmonic content.

One major objection to the ideas in the previous paragraphs is that HRIFE-induced modulated white noise is superimposed on the steady background white noise that arises from ambient heat via the Brownian motion in aqueous media. Of course this objection is true, and the above phenomena would thus need to be modeled as a small amplitude sinusoidal wave on top of a large offset. However in any phenomenon arising from its mathematical derivative, the offset can not have any influence, as will be dealt with later in this article.

SONIC CLICKS

The discussion will now consider the thermodynamic mechanism that is thought to generate shock waves or acoustic clicks in the phenomenon of "microwave hearing". Pulsed high intensity microwave irradiation of the human head can cause a sensation of hearing through the skull bones and into the ear (Lin et al, 2007). The series of clicks that make up microwave hearing are produced by fast rise-time square wave gated intense microwaves with very short pulse-width. The fast onset of energy as the pulse begins can cause a very rapid rate of change of heat deposition. While the average SAR and bulk heating may be quite modest (approx 10 e-6 degrees C), d^2Q/dt^2 is quite large as the rate of heating changes very rapidly (due to fast rise time of the gating). dQ/dt means the rate of heat increase, while value for d^2Q/dt^2 means the amplitude of acceleration of the heat deposition. The attempted rapid rate of thermodynamic expansion of the soft brain tissue is constrained by the non-expansive nature of tissue to cause a transformation of the thermodynamic force into a longitudinal compression wave known as an "RF pulse-induced ***thermoelastic*** pressure wave" which originates in soft tissue such as brain tissue and fluid, which then impact on the skull bones and thence to the cochlea. Generally, perceived sounds can only occur with very high peak powered apparatus.

It is proposed to deploy fast rise-time signal onset within gating protocols, or as spikes, as part of a therapeutic modality for HRIFE exposures which, by definition, would give relatively large values of d^2Q/dt^2 and would generate sonic clicks, albeit of relatively modest power.

The next part of the discussion considers other possible mechanisms for acoustic energy transformation in HRIFE applications that are independent of any gating or sonic click effects, and then later we return again to the idea of deploying energy spikes.

ACOUSTIC TRANSFORMATION VIA THE THERMOELASTIC MECHANISM

Readers who may struggle to follow the equations below can just skip to the text beneath.

……

In ungated HRIFE exposure, we can write the inductive force at frequency F3 as proportional to sin wt where w is the F3 frequency. Because power (manifesting as heat deposition dQ/dt) is proportional to $E^{1/2}$, then dQ/dt is written as

$A^{1/2}$.sin wt, where A is the E-field intensity (amplitude).

To express heat deposition in a homogeneous lossy dielectric, if we include functions for tissue impedance Z, and ignoring depth attenuation, we can write

$dQ/dt = f(Z).A^{1/2}.\sin wt$

For ungated HRIFE, the second differential (acceleration of heat depositon) is written as

$d^2Q/dt^2 = -f(Z).A^{1/2}.\cos wt$

which we postulate as a force that drives "thermoelastic pressure oscillations" (see also Lin et al, 2007)

Here, in biological systems, there may (or may not) be a power focusing effect at the boundary of aqueous and hydrophobic impedances, or perhaps adjacent to small pores, which we could write as a function g(P), thus we can write

$dQ/dt = g(P).A^{1/2}.\sin wt$

where Z is the aqueous impedance.

In an acoustic wave propagated outwards from the plane of discontinuity (or perhaps the pore) into the aqueous media, the second differential could be written as

$d^2Q/dt^2 = -g(P).f(Z).A^{1/2}.\cos wt$ (*12)

……

In layman's terms, the above equations say that if we expose a target to two different RF waves A) the electric field intensity of the F3 frequency exposure varies as a sine wave, and B) that heat deposition in tissue also fluctuates sinusoidally at F3 and C) there is a direct effect of this heating fluctuation on pressure variation, as a "cosine wave" and D) if small membrane pores or RF surface currents at membrane boundaries tend to focus electric fields locally, then the heating fluctuation and pressure fluctuation is even higher in those zones.

Here, the second differential goes from + sine form to - cos form, thus the thermoelastic acoustic wave is in opposite phase to F3 (180 degrees). This was exactly the situation we had earlier when we looked at the modulation of acoustic white noise arising from ionic current turbulence. Therefore these two discrete acoustic phenomena would be in re-inforcing phase.

Thermodynamically-driven acoustic energy generation might be predicted to occur not just due to a significant rate of acceleration of energy deposition per se, but rather might be enhanced by the focusing action of within planes of the discontinuity of impedance at membrane boundaries.

DEFINITION OF HETERODYNAMIC THEORY

I have taken the liberty of coining the new hybrid term "Heterodynamic theory" as a set of thermodynamic and other dynamic phenomena associated with transformations of energy states driven by some configurations of RF heterodyning within lossy dielelectric media. Additional dynamic phenomena associated with novel recommended energetic superimpositions are also discussed in the remainder of this article.

It should be noted that the thermoelastic phenomenon is not restricted to HRIFE technology, but is predicted in AM technology also. There may or may not be some differences in the various types of transformation phenomena depending on whether the parent waves travel in the same direction (unidirectional) or in opposed directions (opposed-wave), or in angled interactions, but at this time I do not have any clear insights on whether any differences exist.

QUESTIONS ABOUT UNILATERAL HETERODYNING VERSUS OPPOSED AND ANGULAR HETERODYNING

Readers might like to ponder upon the fact that when waves interact at different angles, the apparent velocity of antinodes or "peak crests" can be faster than either of the parent waves. That weird phenomenon disappears completely when waves travel in exactly the same direction (UNILATERAL HETERODYNING). The phenomenon is strongest when waves are 180 degrees opposed, such as some of my plate designs. In the case of heterodyning of 10 MHz with 10.1 MHz, the apparent speed of antinodes is 100 times the speed of light. I have tried to imagine whether this anomaly can have any real implications that could be exploited in physical applications. I have tried to imagine a mechanism whereby discontiguity of F3 crests with respect to the speed of light might cause the generation of white noise, because neighboring sources would have random phase relation. Any resulting white noise would be modulated at F3 with respect to space and time. However this is the kind of thinking that might earn its proponents the label of "mad scientist". Also there is no evidence in water waves that anything important or useful results from such hyperspeed anomalies.

The remainder of the article ignores such fanciful ideas, and in fact some of my designs deliberately choose "unilateral" configurations which allow conservative physical modeling, with the added

advantage using interacting parallel RF beams that allow F3 components remain at or close to homogenous values throughout the target. In the quad-beam designs such homogeneity is desirable to predict local F3 values with any accuracy. Any divergence in beams that interact at any angle (other than 0 degrees and 180 degrees) causes drift of F3 values. While this issue of accuracy may be important for antivirus applications, it would not be of concern for slime-busting applications where resonance is absent.

SPIKE-ENHANCED PROTOCOLS

In an ungated protocol, a putative downstream phenomenon of thermodynamic expansive / contractive alternating pressure forces may be at too low an intensity to be therapeutically useful, even if this type of acoustic wave could couple energy into resonant systems such as virus walls. It is proposed to initially entrain a low level of resonance or vibration in biological targets. Simultaneously we could hope to couple energy from modulated white acoustic noise once entrainment is underway. Finally, our goal might be to deploy synchronised intense fast rise-time e-field spikes or perhaps modified radar-type irradiation to achieve a synergistic effect e.g. virus capsid wall rupture or breakage of covalent bonds in long polysaccharide macromolecules (via an acoustic shock phenomenon). Alternatively, for the case of the slime-busting cancer modality, an intense electric field pulse might not require a rapid rise time, because here we are mainly exploiting an "electrostatic" or "quasi-electrostatic" phenomenon on a macromolecule that has large electric dipole moment, which could be modeled as a pendulum.

There are known technical difficulties in administering extremely short pulses that may or may not also cause problems in the coupling of fast-rise-time pulses. Fortunately we are attempting to manipulate quite low frequencies, which allows fairly long pulses to be deployed. In the context of a dual RF heterodyning system, it might be sufficient to deliver an intense half-sine pulse at one of the parent RF carrier frequencies. At the peak amplitude of F3, both carriers are at maximum amplitude and are fully in phase with each other, and at maximum tissue absorption, making it a fortuitous instant of time to deliver such a half-sine pulse. If it rises from the zero amplitude phase, there is no sonic click. On the other hand if we choose to "switch on" a rapid rise time pulse at the time when F1 and F2 are maximum we can also have the effect of a sonic click.

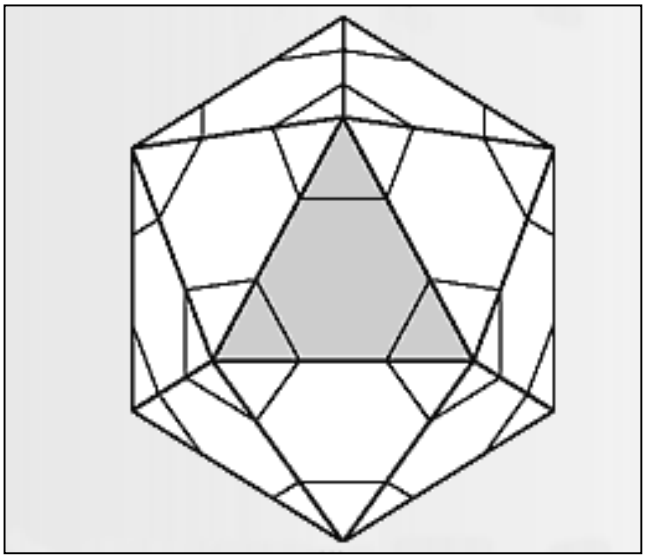


Fig. Typical icosahedral virus geometry

VIRUS GEOMETRY SUPPORTS RESONANCE

Many virus species have a regular icosahedral geometry of the capsid wall. The virus wall construction is like a sphere composed of many adjacent isosceles triangles. Within each of these triangles we can place a circle which touches all 3 sides. Because all the triangles touch each other, these circles all touch each other at these boundaries. Within each circle can be many smaller concentric circles, or even figure of eight loops, etc. We postulate a model of tympanous or drum-skin resonance located within these circles. Although the triangle edges are not rigid like wood or steel, they are assumed to be stiffer than the center of the triangular plane. Like a drum, the outer perimeter may be relatively fixed, while the inside membrane can vibrate. Because the edges have some elasticity, it is also possible that they could play a dynamic role in whole-sphere resonance, particularly if icosahedral structures allow each tympanic domain to resonate in phase with its neighbors. An alternative virus geometry is the "lunar lander" shape typical of bacteriophage virus. Although these are not icosahedrons, they do have quite regular geometry. Tsen et al demonstrated some kind of physical resonance in the cylindrical main body of Tobacco Mosiac Virus that could break the wall.

ACOUSTIC WHITE NOISE MAY EXCITE RESONANCE : THE WINEGLASS PARADIGM

As discussed earlier, it is likely that some of the deposited energy in HRIFE applications is in the form of acoustic white noise that is modulated by an envelope with fluctuating amplitude. Modulated white noise might be a sufficient condition for excitation of acoustic resonance in a susceptible biological system, or for enhancement of energy coupling into a system already entrained to low amplitude resonance by sinusoidal thermoelastic acoustic waves and / or electromagnetic coupling mechanisms. Logically, we would ideally want the imposed modulation frequency to be the same as the native resonance.

If you run a finger around the rim of a wineglass, it can go into “singing” resonance within 2 or 3 seconds. Probably, finger friction generates many acoustic frequencies (acoustic white noise). One simplistic theory is that the glass will couple energy only from its precise resonant frequency, but all the other frequencies are “ignored” (as predicted from the opera singer experiments). A competing theory is that many frequencies can effectively couple energy into the resonant system, even if they are different from the resonant frequency. Considering how rapidly the gentle energy of finger stroking can initiate resonance, the second theory may have appeal. Here is how it might work.

Resonating wineglasses of various shapes can support endless acoustic loops of a wide window of wavelengths via a mechanism where acoustic waves

of many wavelengths become aligned and synchronised in many different-shaped trajectories.

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As resonant vibration begins to build up, acoustic waves which may have originally had random or randomly changing trajectories tend to settle into any suitable matching trajectory that allows its wavelength to match the physical boundary of the glass. This theory would predict a self-assembling mechanism for a relatively wide bandwidth of frequencies to eventually be able to couple energy into a single resonant system. The closed geometry of a wineglass can support endless acoustic loops. This type of wide-bandwidth excitation mechanism might not apply for example to a system with an open geometry such as a tuning fork.

Similarly, it may be possible for a tympanous resonance of a virus capsid wall to couple energy from a wide bandwidth of acoustic white noise because many acoustic pathways could be available in a geometry of many concentric circles, or concentric figure-of-8 loops, etc. Note also that many alternative modes of tympanous resonance can exist. Regular arrangement of “knobs” along the virus surface might dictate a preferred resonant mode for different species.

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Assuming the HRIFE apparatus can be tuned to match a virus native resonance, the “envelope modulation” of white noise may enhance the onset of resonant vibration in the drumskin-like capsid wall.

PROS AND CONS OF HARMONIC CONTENT

In theory, a square gated output can contain many odd harmonics of the low gating frequency such that a gated white noise model that had no other innate modulation might couple into endless acoustic loops effectively to some degree anyway (e.g. in the primitive square-wave electrotherapy modalities). It is recommended that any gating protocols are synchronised to be subharmonics of F3 to achieve a synergy of these two putative mechanisms. As discussed earlier, a rapid rise time in the gating protocol is also predicted to generate sonic clicks. Even without any acoustic white noise, sonic clicks that are synchronised to a target resonant frequency or to its subharmonics, might be sufficient to couple energy into the resonant system.

It has been claimed that square gating of a pure sine source can tend to cause formation of multiple harmonics even before the signal reaches the plasma tube, e.g. in the hands of Ringas and Peters. This scenario might be advantageous, e.g. where the fundamental resonance is not yet known, harmonics could be useful in some research settings. Also, some resonant systems may in fact have superior excitation response to a harmonically-rich stimulus. On the other hand Ringas' findings might be more to do with the influence of non-linear electronic components and / or the choice of phase for onset (This point will be addressed again later).

Some experiments seem to have demonstrated that a pure sine sound wave was unable to shatter a glass in an experiment where a harmonically-rich sound signal or voice with timbre was able to induce shattering. This was shown on the Mythbusters TV show, but it may have involved a trick situation that had different relative total power contents.

The bandwidth and relative power of the higher harmonics within a square wave are influenced by the steepness of the rise time, and also by the "pointiness" of the corner (aka "ringing"). All electronics have some performance limits in both these criteria. A sharp point drives bandwidth a lot wider than a slightly smoothed corner.

There may be reason to believe that square gated HRIFE could generate harmonics. However that might depend on how the switching is synchronised to the signal. If on-ramping occurs at the peak of RF amplitude, there is a steep edge. However if on-ramping is synchronised to occur simultaneously with the instant of zero amplitude of both F1 and F2, then the rise-time is the same as the rise of the RF signals, and the corner is completely absent. Assuming that non-linear components are not involved in the signal processing, we may be able to achieve gated HRIFE protocols for capacitative coupling outputs with no harmonic content. The latter scenario would be particularly desirable where a fundamental native biological frequency is known or predicted.

In the case of HRIFE heterodyning schemes, the analysis re SAR and homogeneity is somewhat different to the above paragraph. Even if the RF absorption is inefficient at frequencies like 2 MHz, here we are more interested in the amplitude of the F3 induction field, and the actual carrier SAR might be somewhat irrelevant.

One of my concepts designs uses 3 RF carriers that generate 3 lower frequency products (e.g. 220 kHz and 250 kHz and 280 kHz) that can in turn heterodyne down to give 30 kHz as a beat frequency). Another protocol was devised using 4 RF parallel beams within the bandwidth allowed in the ISM bands to generate a products near 300 kHz (nominal frequency for proton motive therapy) that subsequently interact to give 1004 Hz, 1000 Hz and finally 4 Hz. The idea of 4 Hz is to be slow enough to overcome the damping effect of water on the pendulum force on an anchored polysacharide. The choice of 1000 kHz is somewhat arbitrary, but it was used in some magnetic therapies for brain treatment, and corresponds to the 0.5 msec lag between Na+ and K+ currents in the excitation of nerve action potentials.

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CONSIDERATIONS ABOUT CARRIER SAR

The selection of optimal values for the RF carrier frequencies for whole-body human exposures would be trade-off between achieving a desired SAR while at the same time achieving reasonable uniformity of energy deposition throughout the body (*13). In the 1930's there were some limitations in the RF electronics that limited the choice of carrier frequencies, and it may be that higher frequencies could be useful in some cases for modern research.

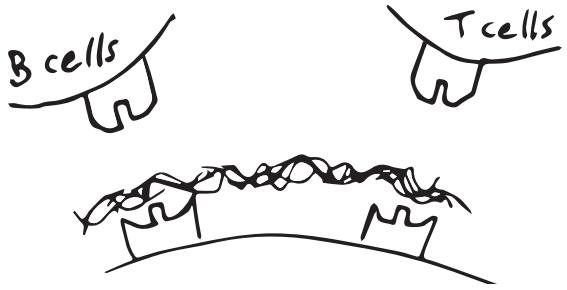
If ultra-low frequency signals rich in beat frequency content are desired for slime-busting modalities, multiple F3 values could be deployed, to give multiple iterations of lower heterodyning, as inspired by the story of the 7 rams horns that finally shattered the walls of Jericho. But enough of the mad scientist stuff....

“SLIME BUSTING” AS A MEDICAL MODALITY

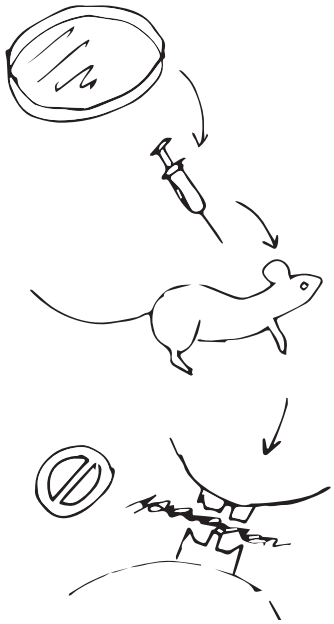
Aside from Rife’s theory of mortal resonance in micro-organisms, there is a remaining possibility that we can get some useful benefit in medicine by adapting HRIFE for “anti-fouling” treatment. The hypothesis is that we can mount an attack against slime-like polysacharide coatings on cancer cells that may mask tumor surface protein antigens

against immune recognition. The coating of slime causes physical prevention of docking of B and T-cell molecular receptors to tumor antigens on the cell surface. Immunologists are aware of mechanisms of tumor antigen recognition leading to T-cell mediated tumor cell killing, but seem to be frustrated by the ability of many tumors to circumvent this healing response. Could a mechanism as simple as slime coating be what aids the survival of tumor cells in a hostile immune environment? Slime also is a strategy used by the Malaria parasite and certain bacteria (such as mycoplasmas) to evade the human immune system.

Polysacharides are electronegative branched filamentous macromolecules that can experience induced forces by low frequency internal E-fields from HRIFE. Induced pendulum-like motion is opposed by drag from surrounding water molecules. Mechanical strains arise due to uneven distribution of the opposing forces. If synchronised energy spikes are also applied, covalent bond breakage is predicted particularly at branching points. HRIFE beat frequencies below 4 Hz might help reduce the water drag effect and enhance bond breakage.



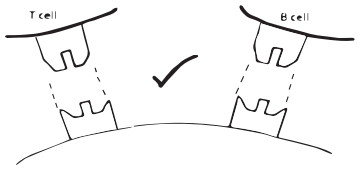
Antigen masking by polysaccharide deposits. Immune recognition of cancer cells can fail when slimy deposits block the access of immune receptors.



CAN HRIFE SUPPLEMENT IMMUNOTHERAPY ?

Mice injected with T-cells cloned in the lab that recognise a specific tumor antigen are injected back into the mouse (autologous T-cell therapy). Autologous therapy usually fails, possibly due to antigen masking and / or immunosuppression.

SLIME-BUSTING



One proposed use for HRIFE combined with shock waves or other types of energy spikes is as an anti-fouling modality to unblock the immune cells' access to tumor antigens. This may also improve the outcomes for autologous T-cell therapy

An involvement of "unknown" pleomorphic micro-organisms has been often observed in blood specimens of patients with advanced cancer using dark field microscopy. These may just be secondary infections, but given the immune-suppressive effect of organisms such as mycoplasma, there is a case that they may co-infect earlier in the cancer disease process, or even drive advanced cell transformation in some cases (Blood, 1997). Mycoplasma was found to be present in about 17% of tested cancer biopsies in one study. Unfortunately, generations of live blood microscopists have been derided as quacks, and this line of research is so starved of funds that no phylogenetic analysis has been performed to identify these pleomorphic populations.

Apart from bacterial secretion, slime and other secretions are also apparently part of the arsenal used by tumor cells to evade immune attack. Cancer cells seem to "de-differentiate" to primitive phenotypes similar to those found in the early development of embryos. And of course embryos must have some strategies to prevent attack by the maternal immune system. Despite the known models of tumor antigen recognition and immune attack, it is thought that the embryonic mechanisms are exploited by cancer cell signaling to ensure their survival.

The mechanism of “slime busting” is proposed to involve inductive forces acting on long branching filamentous electronegative macromolecules to generate mechanical strains, even in the absence of any exogenous acoustic energy. The electro-negativity of polysaccharides arises from the existence of many charged sialic acid sugar residues along the molecule chain. A “quasi-electrostatic” electromotive mechanism is predicted using HRIFE in these cases. For me as a researcher, this “problem” of slime biology presents a serendipitous opportunity to deploy inductive anti-fouling technology to attempt a “long shot” to make new ground in cancer medicine. Saponific or anionic detergent agents may also assist in slime breakdown.

I note here the work of Henry Lai et al using 10 Hz magnetic fields to drive the generation of reactive oxygen species (ROS) from pockets of stored waste iron in cultures of the Malaria parasite P. falciparans, which he argued as a possible therapeutic modality to help poison or stress these single-cell parasites. It may be possible to configure HRIFE applications to have a suitable low frequency component for this purpose in combination with a slime-busting function, maybe by deploying multiple low frequency components. Slime secretion is a well-known strategy of this parasite to evade immune detection.

SLIME-BUSTING TO SUPPLEMENT AUTOLOGOUS T-CELL IMMUNOTHERPAY

I have introduced in my 1997 discussion paper the idea of a possible synergistic therapy involving slime-busting and “personalised” immunotherapy, where cultured cloned autologous immune cells primed against a candidate tumor antigen are re-injected into the patient (Blood, 1997). Simpler autologous vaccines might also be considered, e.g. prepared from biopsy material.

A likely practical limitation is that exposure of tumor antigens by slime-busting HRIFE exposure alone might be temporary and not sufficient to prime immune recognition. While cloned white cell research in mouse models gave only patchy success, possibly due to slime coatings, a therapeutic design that attempts to strip slime at the same time as administration of

these types of cloned-cell immunotherapies might improve the outcome by giving the cloned cells some exposed tumor antigens to latch onto, and thence to prime immune recognition and subsequent immune cell proliferation.

Finally, even in the absence of a slime-busting effect, there is some evidence that acute RF exposure can stimulate a transient immune stimulation (as related by C. Blackmann), most likely downstream of IL1 effector signaling. Used a short time after autologous clone therapy, mild-thermal RF exposure might enhance or prime the desired tumor antigen recognition.

GATING PROTOCOLS AND DEPLOYMENT OF ENERGY SPIKES

I have written an earlier article describing a rationale for 20% or 40% duty cycle biphasic square gating protocols. A 40% duty cycle overlaid with an additional slower gating scheme at 50% duty cycle over 10 primary gating periods to give 5 active periods is recommended (double gating).

I have described an analogy of pushing a child on a swing, pushing for up to 5 pushes per cycle. Even if the frequency of applied pushes is slightly out of phase with the native resonant frequency of the pendulum system, destructive interference can be avoided provided that the number of pushes is limited.

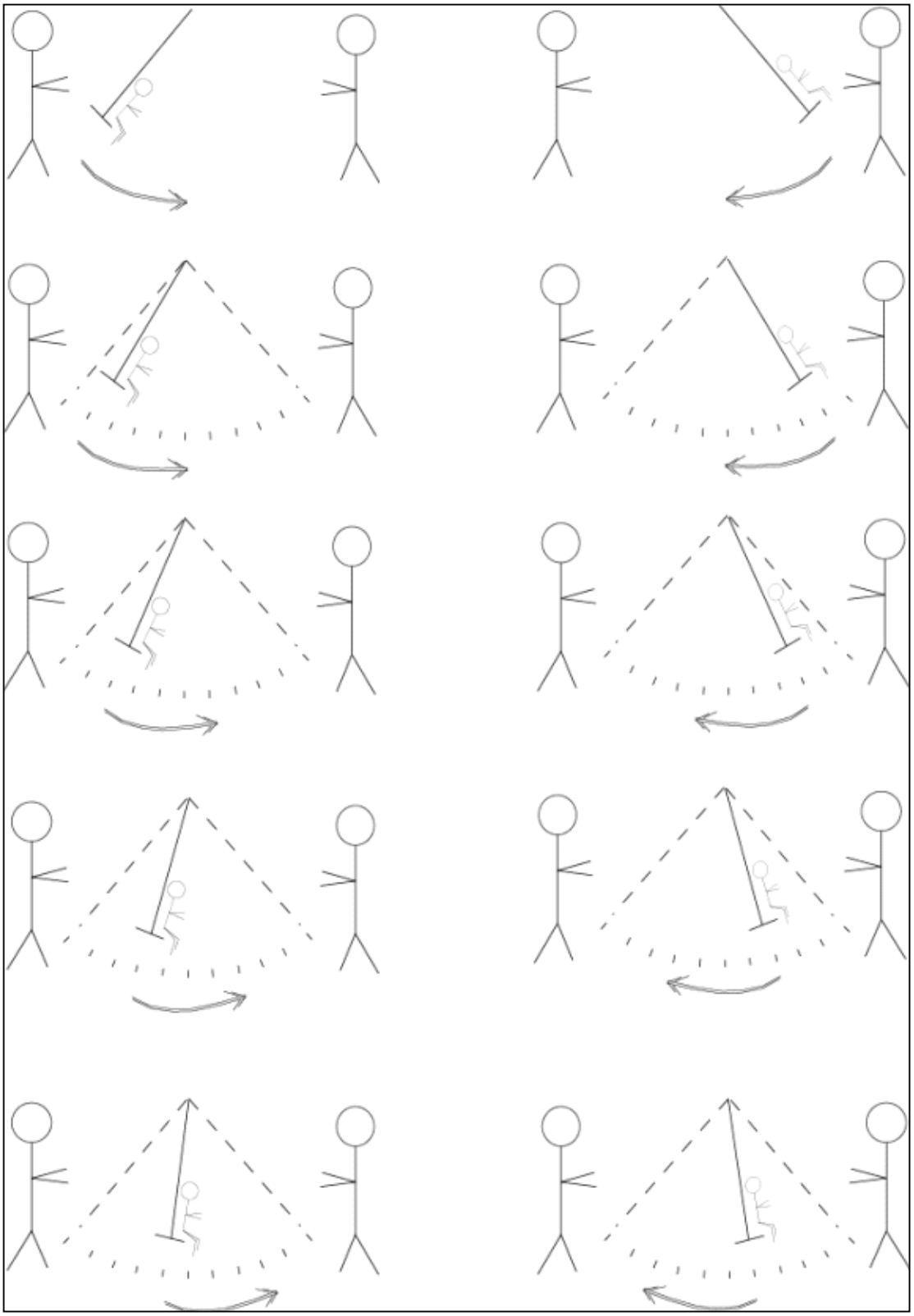
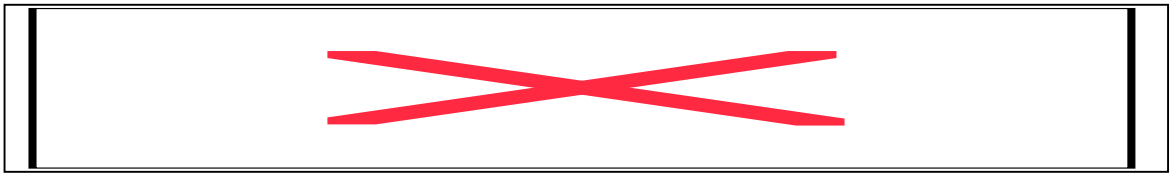


Fig. 1 SWING PENDULUM ANALOGY

Biphasic 40% duty cycle (2 x 20%). Arrows indicate the partial arc when force is engaged (20% of period). Illustration shown with 5% mismatch of the applied frequency to the native resonant frequency. 2.0 second swing period (0.5 Hz swing resonance) versus 2.1 second period of applied force (approx. 0.475 Hz applied frequency)--. This analogy illustrates how the use of a limited train of 5 biphasic pulses can avoid destructive interference.



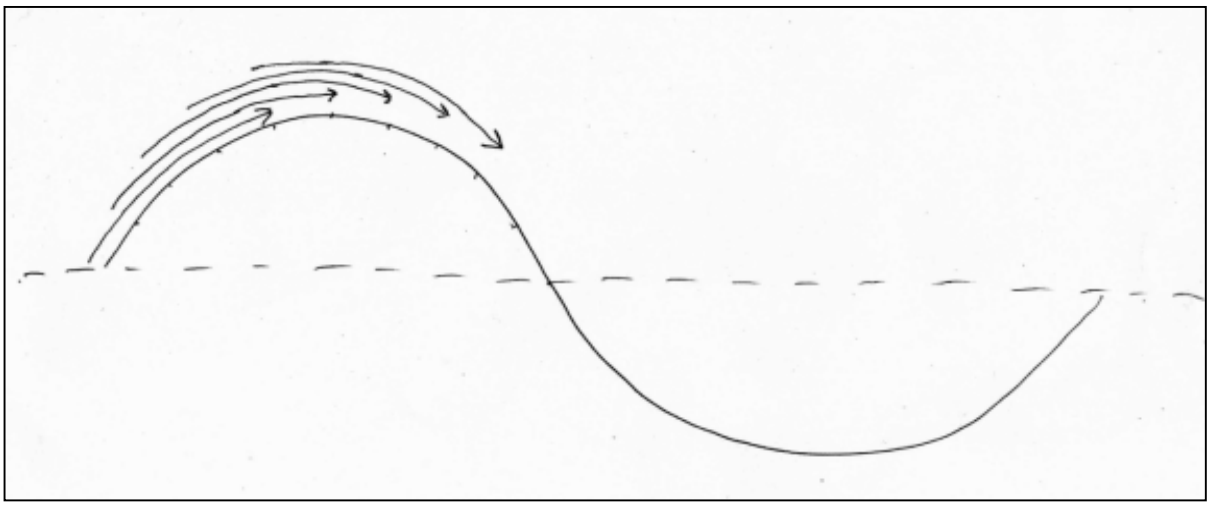


Fig. 2 In this example the applied frequency is 5% out of phase with the sine wave. The arrows never cross the zero potential line; therefore the applied forces are always constructive.

I have discussed how a double-gated HRIFE exposure protocol can in theory allow slight mismatches of applied F3 frequencies to couple to a native resonance with up to 5% mismatch of frequencies. This advantage might allow an efficient research protocol using as few as ten scan windows per frequency decade. Below I have outlined a research plan for “hit and miss” experiments that assess post-exposure replication rates in micro-organisms, using real-time PCR assays to measure changes in DNA concentration (see Appendix B).

In a more advanced manifestation of the technology, during the five active gating periods, amplitude can be exponentially ramped. This innovation can be justified by considering an analogy where a child on a swing receives successively more forceful pushes to optimise energy coupling.

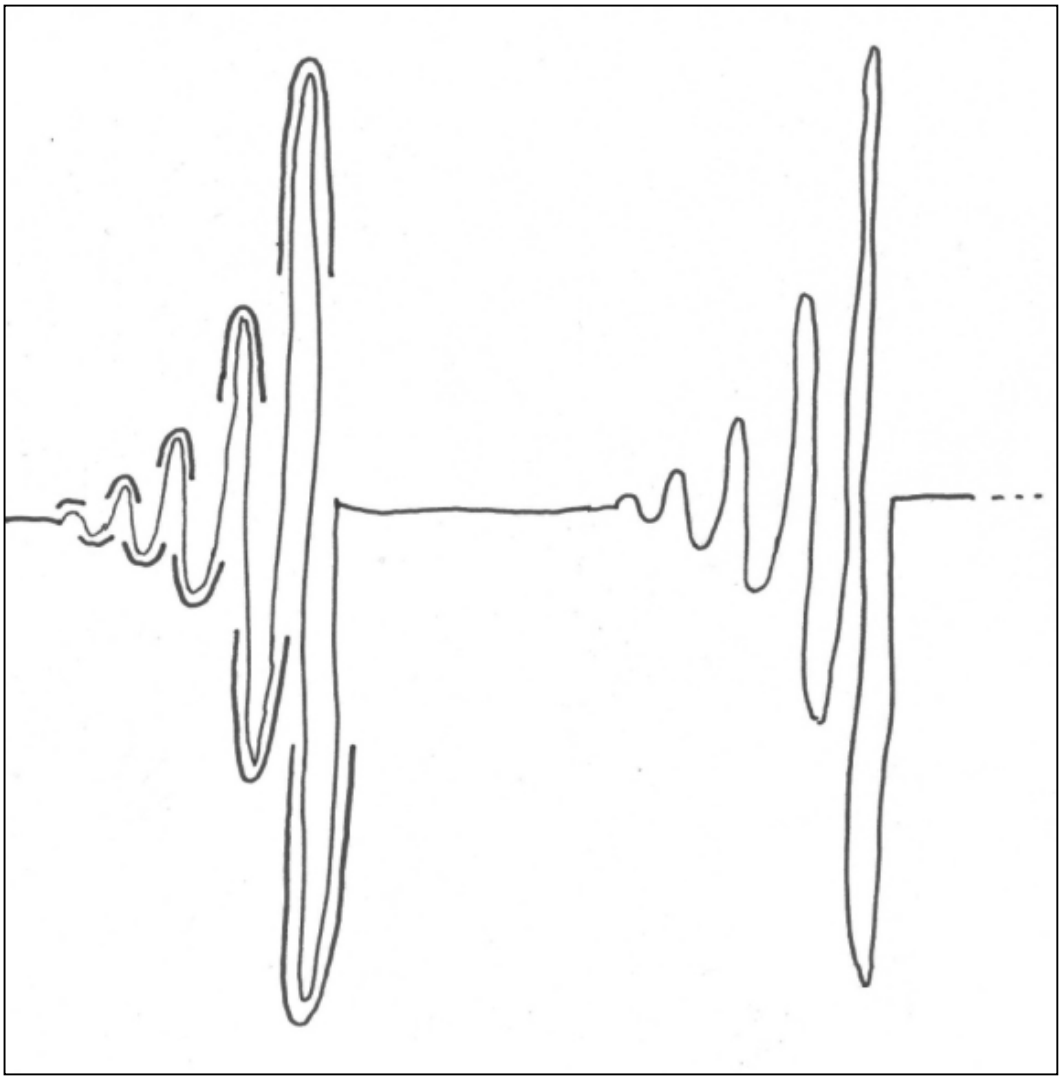


Fig. 3 A waveform with exponentially increasing amplitude. Curved lines above and below the waveform correspond to applied pulses with 40% duty cycle. The outer layer of gating at 50% duty cycle creates a rest time allowing the macromolecular system to fall back to equilibrium between pulse trains.

It is possible to consider the first 3 pulses as “entrainment pulses” that begin to induce oscillation, and also begin to align target macromolecular oscillation along the direction of the applied field. Once aligned and oscillating, the target biological system can more effectively resonantly couple to increasingly strong applied fields.

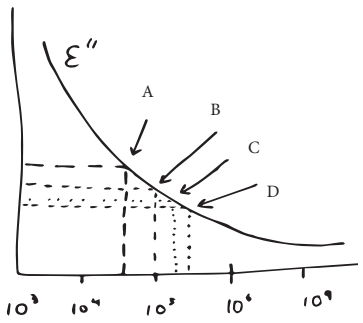
The following 6 pages are copied from a poster presentation. Some of the material has been discussed elsewhere in this article, but they have been included because they contain useful diagrams and summaries. My apologies for any redundancy.

WHY USE 300 KHZ IN CANCER THERAPY ?

100 kHz to 300 kHz was shown to inhibit tumor growth and cause mitotic arrest and spindle alignment in a mouse cancer model in vivo and in vitro while not affecting normal cells. The proposed mechanisms were a) that natural morphogenic fields became aligned and b) these frequencies were optimal to generate dielectrophoresis forces that prevented polymerisation of the growing filaments. However, it may be that a mechanism of proton current could also be usefully exploited at 300 kHz.

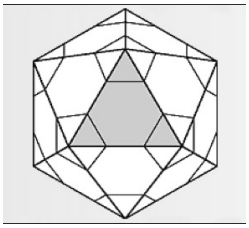
The principle of the Warburg frequency threshold for ionic current induction could be extended to model a frequency theshold for a proton motive force. If we roughly model the Warburg theshold as applying to a set of ions with a mean molecular weight of 20 (mw = 20) as 34 kHz, then we might assign an upper theshold for H+ (mw = 1) above 600 kHz. Any "proton current" at 300 kHz would be unopposed by any cationic current, and thus might cause a back-electromotive force, with an inductive force on free electrons. An increase in the probability of hydrophobic attack events and / or of Reactive Oxygen Species production (ROS) might occur. The dynamics of proton-exchange ion channels might be affected. Other targets in cancer medicine might be the Krebs cycle or the cholestrol metabolism.

300 kHz is at the far lower limit of the RF spectrum. It does not capacitatively couple very efficiently to the human body due to sub-optimal field perturbation, and its SAR or heating power is poor. It is proposed to select higher RF carrier frequencies between 2 MHz and 100 MHz in a heterodyning protocol such as HRIFE. A triple or quad carrier protocol could generate additional ELF beat frequencies if required. Even if the primary therapeutic goal is for anti-fouling therapy, involvement of 300 kHz may be synergistic.

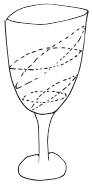


Extrapolating from the Nyquist plot, we can define frequency regions for a) the Warburg limit of ionic current induction at 34 kHz, b) the upper threshold for low mass ions like Lithium near 100 kHz, c) the proposed optimal frequency for proton current induction around 300 kHz and d) the roughly estimated upper threshhold of proton current induction above 600 MHz.

CAN HRIFE SHATTER VIRUS WALLS ?



Many virus species have regular spherical icosahedral geometry composed of adjacent isosceles triangles. (See http://viperdb.scripps.edu). We can model each triangle as being stiffer on the outside edge than in the center. This drumskin-like phenomenon could support tympanous vibrational resonance. The pentagonal profiles might also support resonance. Whole-sphere resonances could also occur. It should be possible to use HRIFE exposure to entrain virus capsid walls into vibrational resonance. Addition of synchronised high-energy spikes from shock waves or other sources might be able to cause structural damage when applied to a vibrating system.



A wineglass stroked by a finger along the rim can go into singing resonance. Many frequencies from the applied acoustic white noise can couple into this resonant system because many path lengths are available.

In a simple vibrational mode, a triangular plane of a virus wall may also be able to couple energy from a wide window of frequencies. HRIFE applications probably contain white noise that is modulated at the F3 frequency. Where F3 matches the native resonance, energy coupling might be further enhanced. Even though white noise from background Brownian motion is much larger than the noise from sine modulated ionic current, when we consider amplitude fluctuation at F3, the large offset is irrelevant. Similarly, any thermoelastic effect of the F3 beat frequency modulation of heat absorption of the RF carriers could transform into sinusoidal pressure fluctuation, and again the existance of a large “average SAR offset” also has no impact on the acoustic transformation.

HOW TO DETECT VIRUS RESONANT FREQUENCIES ?

The slow way to discover virus resonant frequencies is to scan many windows of HRIFE F3 frequencies and then later assay changes in the replication rate by measuring the virus DNA content by real time PCR assay. It may also be possible to develop nanochambers for spectroscopy methods including monitoring SWR (Standing Wave Ratio), or Low Frequency Impedance spectroscopy using a reference current synchronised to F3. It may also be possible to adapt high resolution optical imaging systems such as SIAM, or possibly to adapt the new Low Frequency Impedance Spectroscopy imaging systems to detect physical vibration during a HRIFE scan.

A primitive optical interferometric method is to image a discrete virus particle smaller than the Abbe limit of approx 0.3 micron to produce interference rings (Arie discs) and then perform frequency scans while monitoring by eye or by a real-time digital algorithm. Fuzzing of the band boundaries indicates vibration. A prototype exposure system developed at Griffith Uni School of Physics in 1996 can expose microscope cover slips to RF electric fields (see next panel).

Indium Tin Oxide coated glass slides are conductive but they remain optically transparent. They can be used for RF and HRIFE exposures for in situ microscopy. Schemes shown are: a) earthed bottom plate with superimposed HRIFE signals to top plate, b) RF1 and RF2 to separate plates (gasket shown) and c) RF carrier to top plate with IF or LF signal to bottom plate, to generate offset modulation of RF carrier.

Fig. A

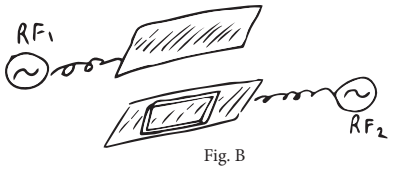


Fig. B

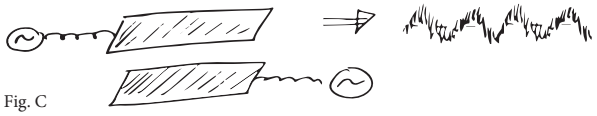
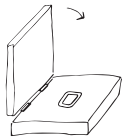
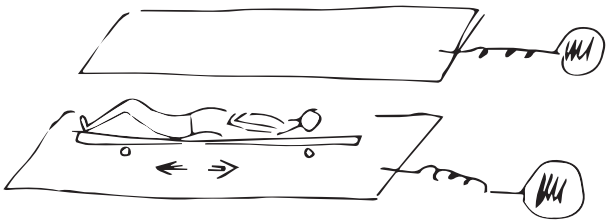


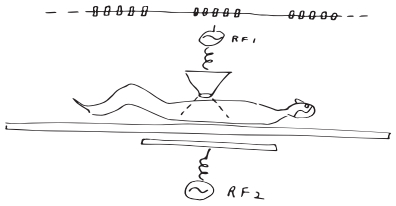
Fig. C

A fold-down chamber with a small gap of less than 1 mm can be adapted from the Nanodrop design. Here a containing gasket is shown which can house a virus suspension or a coverslip with cultured infected cells.

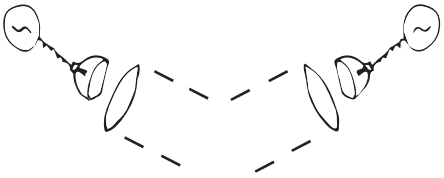




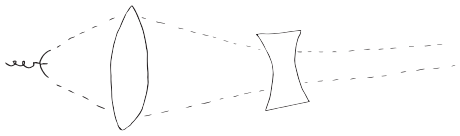
Capacitative coupling



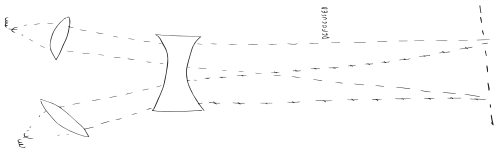
Variant based on the
Oncotherm configuration



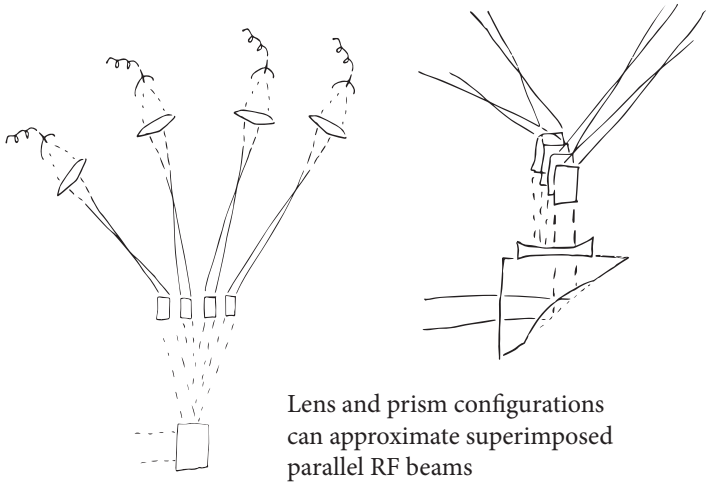
Angled configurations may be desirable because opposed-wave configurations might result in technical issues from F2 signal going up the F1 coax line (signal cross-reflection). A correction factor is applied to angled heterodyning applications. Where the desired difference product is F*, the corrected F2 frequency is F1 - [1/{cos (theta/2)}. F*]



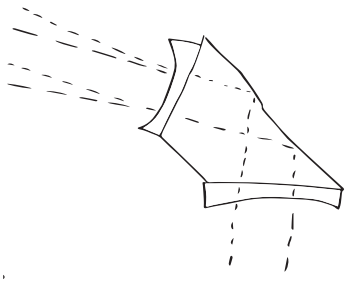
A collimating lens can create parallel RF beam



Dual or quad simple defocused



Lens and prism configurations can approximate superimposed parallel RF beams



Using a TIR prism and lenses to create a parallel RF beam

UNIDIRECTIONAL ISM HETERODYNING FOR CANCER RX

TRI- HEAD ISM HETERODYNING SCHEME A:
1004, 1000, 4 Hz

13.56 MHz (+ 1000 Hz) 6.78 MHz (center)
13.56 MHz (+ 1004 Hz).
Heterodyning gives 6.78 MHz (+ 1000 Hz),
6.78 MHz (+ 1004), 4 Hz.

On the next iteration these give
1000 Hz and 1004 Hz, thence 4Hz.

This is the only ISM scheme in this list that is amenable to either angled or unidirectional applications. Schemes B, C and D use 300 kHz, and must be unidirectional to stay within the limited ISM bandwidth, unless a special room with RF shielding is used. Scheme B could be used in opposed wave mode, but cross-reflection issues may make it impractical.

DUAL- HEAD ISM HETERODYNING SCHEME B
for 300 kHz

27.12 MHz (+ 150 kHz) 27.12 MHz (- 150 kHz)
Heterodyning gives 300 kHz.

TRI- HEAD ISM HETERODYNING SCHEME C
for 300 kHz

27.12 MHz (+ 300 kHz) 27.12 (center) 13.56 (center).
Heterodyning gives 3 primary difference products at
13.56 MHz (+ 300 kHz), 13.56 (center), 300 kHz.

On the next iteration these also give 300 kHz.

QUAD- HEAD ISM HETERODYNING SCHEME D
for 300 kHz

to give heterodyned products 300 kHz, 1004 Hz,
1000 Hz, 4 Hz.

40.68 MHz (+ 500 Hz) 40.68 MHz (+ 504 Hz)
27.12 MHz (+ 150 kHz) 27.12 MHz (- 150 kHz)

4-way heterodyning gives products witihin the 13.56 MHz ISM band

13.56 MHz (+150 kHz /-150 kHz),
13.56 MHz (+1000 Hz / +1004 Hz)

On the next iteration these give 300 kHz, 1004 Hz,
1000 Hz and 4 Hz.

ADDING ENERGY SPIKES WITHIN HRIFE PROTOCOLS

A recommended design option is to apply energy spikes in the fifth active gate, ideally to be synchronised to the simultaneous peaks of the F1 and F2 carriers (i.e. at the F3 peak). Energy spikes may originate from separate circuits (*14, *15). They may take the form of a half-sine single pulse at one of the parent RF frequencies, or at some higher frequency, or as a fast rise-time surge such as a capacitor discharge. The latter approach would have an additional action of sonic click generation.

Note that synchronised superimposed “energy spikes” might be required to achieve good clinical results because although a simple HRIFE exposure might drive energy into electronegative macromolecular systems, or generate resonance in virus capsid walls, further correctly synchronised energy input might be required for significant filament breakage in slime, or actual wall rupture in virus. In the next section we discuss how ultrasound technology might be harnessed to further enhance the HRIFE modalities.

Another reason why gating may also be useful in RF therapeutic modalities to allow relatively high peak instantaneous values of SAR without significant time-averaged bulk heating. Note also that Andras Szasz also speculated about some practical benefit of the Oncotherm RF modulation scheme in driving pulsed alternations of the osmotic environment across cancer cell membranes as a therapeutic modality in cancer treatment (I have not actually seen a derivation to support this). He also argues that RF absorption is higher in tumor cells than in normal tissue.

SHORT-PULSED INTENSE ULTRASOUND TECHNOLOGY AND CAVITATION PHENOMENA

Ultrasound therapy involves the application of sound waves (compression waves) produced by a piezoelectric transducer placed against the flesh. Some intense pulsed ultrasound protocols, e.g. to break up stones in organs, are applied at up to 1 MHz to 5 MHz depending on target depth, to generate shock waves. Interestingly, ultrasound and other acoustic waves can be focused with a lens just like an EM wave, but more commonly a phased-array is deployed where focusing is required in therapy such as some of the older lithotripsy devices. Some systems deploy an array of many piezoelectric elements mounted in a curved ceramic dish (or 2 dishes together) to produce a "focusing" shock wave via the dish curvature. Ultrasound can generate heating as acoustic energy transforms ultimately to heat via molecular vibration in the target (pulsed thermoelastic devices). Alternatively, in some designs "true" shock waves as single events can impart energy upon collision with target zones, and these can be repeated. Therapeutic mechanisms are reported to be both thermal and non-thermal in nature. Focused ultrasound ablation therapy is used to heat tissue in some prostate cancer and uterine fibroid therapy to generate local temperatures that are high enough to drive cells into necrotic death. Here frequencies might lie in the lower RF range, mainly to overcome attenuation in deeper target applications.

Liquid media under bombardment of very high amplitude pulsed ultrasound shock waves can begin to form bubbles in a process known as cavitation. Non-gaseous media tends to not tolerate a drop in pressure (caused by rarefaction as the compression wave travels). To achieve pressure equilibrium, the fabric of the media is split and a cavity of gas is formed (vapor phase). A significant quantity of potential energy is locked into the formed cavity. The cavitations in liquid media often implode when resting on a solid-liquid interface, releasing energy that is so powerful locally that it can cause pitting damage to the solid surface, e.g. of some boat propellers. The released kinetic energy probably has vortex-like geometry (See also Schaunberger vacuum

theory) as well as high internal temperature in the imploding cavity in some modeling. After cavity implosion, the vapor is re-integrated into the liquid phase. Often a bubble will split into two small bubbles, with only a part of the vapor content re-integrating into the liquid phase, and thus only part of the potential energy is released in that event.

The swim thrust of certain dolphins and tuna is thought to be physically limited by the tendency of seawater to cavitate near their powerful tails. Propelling thrust is limited as water-flesh contact area is reduced after bubble formation.

The local pressure variations in the liquid phase are proportional to the degree of local compression or rarefaction, and they oscillate either side of equilibrium at the normal value of internal pressure. We might say that negative pressure waves beyond a critical threshold of amplitude are “loaded” by cavitation events transiently into potential energy.

We have seen how cavitations arising from high intensity acoustic waves possess potential energy that can be transformed into kinetic energy. An analogous situation may occur in HRIFE exposures where ionic currents are generated by the potential energy in the net inductive force. We might say that there is transformation of this potential energy initially into acoustic-like kinetic phenomena via ion collisions with water and other macromolecules, but later this acoustic energy contributes to heating.

In some applications, ultrasound can have a primary effect from acoustic bombardment, and a secondary effect from subsequent cavitation energy release. The higher the amplitude of the primary acoustic wave becomes, the stronger the energy content that resides in the summed cavitation implosions. There is probably an amplitude threshold below which cavitation will not occur unless some other concurrent influence tends to locally reduce liquid phase pressure. In lower amplitude acoustic applications where cavitation is absent we can say the energy is solely in the mode of compression wave propagation.

Note that in biological systems, membrane geometry may tend to focus the location of cavitation implosions to occur at the plane of the membrane. Similarly, the because the membrane plane is a boundary of different refractive indices, shock waves impact at these sites but not in media with homogeneous refractive index, such as the aqueous medium. Breaking of organ stones relies on such a discontinuity at the stone boundary. We can say that membrane planes, as discontinuities, act to focus the energy absorption from acoustic impacts.

Different HRIFE protocols could be designed that simultaneously use shock waves either above or below the cavitation threshold. It may be that collateral damage to normal tissue would be undesirable in many cases, but on the other hand focusing of pulsed ultrasound and / or focused dual RF sources might be applicable in some cases such as solid tumors. Opportunities to enhance acoustic influences could possibly be exploited by combining acoustic energy with spikes of other forms of energy, as discussed below. The topic of collateral shock wave damage is reviewed by Tim Watson in his website, and the data seem to indicate reasonable safety.

DEPLOYING ACOUSTIC IMPACT PHENOMENA WITHIN HRIFE THERAPEUTIC PROTOCOLS

Thus far I have only discussed injecting energy spikes as electric field pulses superimposed on the twin RF carriers. However it may be advantageous to substitute or supplement HRIFE electric spikes with ultrasound spikes as rapid-onset shock waves. The main practical limitation for medical modalities that combine HRIFE and ultrasound would most likely be the attenuation phenomenon, i.e. attenuation is

much more severe for ultrasound energy than for RF energy. Although penetration can perhaps be enhanced by using higher ultrasound frequencies, and modified focusing methods, adequate penetration to the abdomen core may not be achievable. A second practical limitation is the fact that ultrasound waves travel quite slowly compared to RF waves. Therefore it is not possible to synchronise the ultrasound onset phase with the local phase of the F3 EM frequency at all points in the target volume. However in very thin volume lab nanochambers for virus exposure, these issues are much less problematic. In the lab cuvettes, enhancement by ultrasound could allow virus wall breakage, and if spectroscopy methods turn out to not be useful in the research, ultrasound enhancement may be useful to help zero in on mortal resonant frequencies for different virus species in hit-and-miss experimental protocols that assay viral replication after exposure.

Earlier in this article it was speculated that RF energy in HRIFE applications can transform into acoustic energy deep inside tissue. We also discussed the possibility that quasi-electrostatic induction could generate mechanical stress in filamentous electronegative polysaccharide macromolecules independent of exogenous acoustic energy. We examined the idea that an anti-fouling modality could disrupt slimy coatings that often cover tumor antigens and pathogen antigens. We now offer the idea that the energy associated with shock wave impact could simultaneously be deployed with HRIFE to help snap polysaccharide filaments, in part because physically the slime filaments are located at the solid / aqueous phase interface where acoustic impacts are focused.

For clinical applications, phase synchonisation of ultrasound pulses with HRIFE seems impossible, but the most obvious choice of frequency for the US pulse repetition rate of could either the same as F3 or a subharmonic. There may be some value in scanning the US rate slightly off-frequency because in some locations phase synchrony might occur. Similarly, there may be some benefit in scanning the rate of the ultrasound pulse rate across a spectrum, the idea being that true or near- syncronisation would be occurring at random and moving locations in the target. In the case where a clinical goal is to induce an ability of the patient's immune system to begin to recognise to tumor antigens, even a patchy or locally limited slime clearance may suffice to achieve such a goal e.g. to supplement autologous T-cell immunotherapy.

In summary, therapeutic aim of combining HRIFE with other energetic sources would be to increase the mechanical strains along long branched polysaccharide filaments and to provoke shearing of covalent bonds, with the goal of partial disintegration of the slime films found over cancer cells, and perhaps also to treat malaria parasites and certain bacteria such as mycoplasmas (*16). Similarly, strong sonic clicks from intense pulsed ultrasound might be synchronised with HRIFE modalities to burst the thin virus capsid walls.

It might be supposed that the US carrier frequency could be tuned to F3, rather than the US pulse repetition rate. The problem with this approach is that often neither thermoelastic shock nor acoustic shock is predicted from typical US CW applications. While this idea should not be ruled out completely for modified applications, again phase matching issues would probably tend to give only patchy local phase correlation. Dual US CW sources can even be heterodyned to match an ELF F3. Square gating modulations could be deployed if desired.

When an "acoustic carrier" is superimposed with energy spikes from another source, the optimum efficacy for acoustic impact would probably be where the spikes are synchronised to peak acoustic amplitudes. A spike repetition frequency could be at a subharmonic of the acoustic carrier, for example in gated HRIFE where F3 = 100 kHz we might deploy a gating cycle at 10 kHz. We might deploy energy spikes

where F3 is at peak amplitude just before the trailing edge of the gate square wave to optimize acoustic energy coupling into an already resonating biological target structure.

Basic science experiments on model biofilms or polysacharide films might deploy short-pulse ultrasound combined with spike-enhanced HRIFE exposure to test a hypothesis that HRIFE can enhance the destructive power of intense pulsed ultrasound. Slime breakdown could be detected by HPLC. If a cavitation threshold of ultrasound power can be established for such a model, it would be predicted that combination with HRIFE could lower that threshold. Given enough data, it may be possible to characterise any putative anti-fouling effect of various energy spike protocols with HRIFE even without ultrasound. Aside from the medical applications discussed, there might be industrial applications for HRIFE anti-fouling treatment of water systems, boat hulls, etc.

ELECTROMAGNETIC COUPLING

In addition to the acoustic transformations discussed in this article, HRIFE exposures could possibly directly couple electromagnetic energy into macromolecular resonant systems. Square gating also may give an opportunity for odd harmonics of the gating frequency to couple into target resonant systems. Assuming any acoustic energies are also at the F3 frequency, acoustic and electromagnetic energy coupling mechanisms might be synergistic.

In most technologies where low frequency electric fields are applied to a biological system, the external field tends to be cancelled out by the loading of ionic currents, such that the internal local e-field tends to zero amplitude. While we expect ionic current induction to also occur in some HRIFE applications, there are important unique physical qualities in RF heterodyning technologies. As mentioned earlier, e-fields at low frequencies would exist in the interior of cells, and also in the interior of hydrophobic domains that might lack solute ions. Within the lipid bilayers, these e-fields could be loaded by inductive events acting on macromolecules that possess dipole moment, including the phospholipid molecules that make up the bulk of lipid membranes.

CELL GEOMETRY AFFECTS ACOUSTIC PHENOMENA

Looking at ion turbulence in aqueous media, we might predict ion collision bombardments on adjacent membrane planes and virus capsid planes that are orthogonal to the direction of ion currents. We could postulate that ionic bomardment or even modulated acoustic white noise could uncouple energy into these structures. On the other hand, the planes that are in a parallel alignment might tend to be more "passive". We might postulate some flux of acoustic energy laterally along the thin planes from the bombardment zones into the passive zones.

A similar active/ passive local paradigm might also apply to EM energy coupling mechanisms.

The existence of a double boundary of refractive indices either side of the plasma membrane would cause total internal reflection of part of the energy, particularly if it propagates laterally, so that a proportion of the impacting acoustic energy is retained by becoming trapped inside the membrane plane like light inside a fiber optic cable. This may be yet another type of energy focusing effect, again located at the membrane. Virus often exist in association with membranes, thus acoustic energy propagating laterally within membrane structures could uncouple into virus capsid walls. Capsid planes that are normal to the direction of lateral acoustic waves would actively absorb energy, and planes parallel to the waves would be passive.

The physics of the above paradigms that arise from a boundary of refractive indices would be also predicted to occur for shock wave impacts. Membranes could perhaps focus shock wave energy and uncouple it to virus capsid structures.

A REVIEW OF THE PUBLISHED RESEARCH ON DESTRUCTIVE RESONANCE IN MICRO-ORGANISMS

Some of the discussion in this article is built on a hypothetical mechanism of pendulum-like resonance in anchored macromolecules. The proposed exposure protocols might also apply to spring-like or tympanous or other single-frequency resonant phenomena. There are also other models of physical resonance phenomena that have been exploited in other published work. Two examples from the published literature are given here.

Shashlov reported that in early Russian studies, bacteria were killed by resonances near 60 GHz at a low power level of 1 mW / sq cm.

http://www.rife.org/otherresearch/shashlovreport.html . The apparatus was probably a shallow Petrie dish placed near the mouth of one or two waveguides set at a 120 degree angle. The waveform was probably continuous wave. The effective frequency window was reported to be very narrow for given species, but this point is unclear. The author speculated an "acousto-electric" mechanism, i.e. that the EM radiation caused acoustic effects. One possible mechanism might be that the activity of protein assemblies within the plasma membrane, such as "proton-driven pumps" were affected.

Tsen et al reported that TMV virus were killed by a mechanism involving Impulsive Forward Raman Scattering (IFRS). Viral capsid assemblies were disrupted athermally using 100 femtosecond pulses of visible laser with a repetition rate at 80 MHz. (TK Tsen et al). http://lib.bioinfo.pl/auth:Tsen,KT . In the case of the Tobacco Mosaic Virus, mathematical modeling predicted that the cylindrical packing of capsid components was disrupted. Normal limits to the distance of molecular vibration from the average equilibrium point were increased by the IFRS mechanism. A threshold of input energy was found, suggesting that a certain atypical distance of vibrational movement caused irreparable disruption to the molecular packing geometry. Preliminary studies recently also reported promising success with the HIV virus in Tsen's labs, although I have heard nothing recently about this.

Both of the above methods have a disadvantage that 60 GHz and light frequencies cannot penetrate tissue, whereas RF frequencies will penetrate tissue quite effectively. Both authors argued a transduction of EM radiation to acoustic vibration.

In another published study, capacitative coupling from insulated parallel wires was used to deliver IF frequencies from 200 kHz to 300 kHz to cancer cells in vitro and to tumor transplants in mice (Cancer Research 64, 3288). The results showed a significant number of dividing cells with the mitotic spindles aligned in the field direction. This was attributed to dielectrophoresis forces due to inhomogeneous e-field geometry within the cells that inhibited microtubule polymerisation of the growing mitotic spindles. The dielectrophoresis force was modeled to be optimal at 100 to 300 kHz. Many of these cells went into mitotic arrest. Tumor growth was significantly inhibited in the mice.

Interestingly, the above frequency range seems to correspond somewhat to the window of frequencies that I have suggested for a putative proton motive force. Without engaging in controversy about competing theories, it may be that some synergy could be exploited. Moreover, the clinical applications for the contemporary 100 - 300 kHz modalities have been limited by long-term implantation or sometimes skin mounting of applicator electrodes because sustained exposure has been deemed necessary.

It may be that effective delivery of IF and / or RF frequencies for HRIFE clinical applications might be achieved using appropriate capacitative coupling designs such as a large parallel plate booth or bed, or for primary tumors using smaller applicator plates, or a combination of one small plate and one earthed lower bed plate or waterbed as used in the Oncotherm design. Whole-zone exposures can be achieved with parallel interacting RF beams of perhaps 1 meter diameter. This configuration might limit neck and head hyperthermia in abdominal and thoracic exposures. If desired, localised controlled hyperthermic effects can deliberately be created by changing the alignment of the collimating lens from parallel output to focused output.

It might be implied from the simple pendulum model that the only types of macromolecular structures that would be strongly influenced by alternating e-fields might need to be physically large, and would also require significant net electrical charge to transform the applied inductive forces into mechanical forces. On the other hand, it is known that many enzyme systems process molecules of substrate at audio and IF frequencies (known as the “turnover rate”). Some published studies have demonstrated that enzyme activity was enhanced by applying alternating electric fields at or close to the natural turnover rate of an ATP-driven enzyme system (Electro-Conformational Coupling studies c. 1986). Similarly, ion channels and proton-driven pumps in the plasma membranes of bacteria might also be affected by specific frequencies of alternating electric fields.

UNPUBLISHED RESEARCH USING RIFE / BARE AM PLASMA DEVICES

I note here that some useful biological effects might also occur in response to pulsed or Amplitude Modulated RF radiation. For example, there is video evidence that unicellular eukaryotes such as Paramecia, Blepharisma and possibly Blue-green algae have been stunned or killed or induced to apoptosis or cell suicide by the application of square wave AM output from a 27.7 MHz plasma tube device. Bread mould was also killed. Note that these were amateur experiments that did not lead to peer-reviewed publications. There are anecdotal reports of efficacy of Rife devices for Lyme disease. Note that in all these examples, the organisms are eukaryotic, i.e. not true bacteria and not viruses, and that apoptosis is only found in eukaryotes.

I speculate that the biological mechanism of what looks like rapid onset apoptosis was a stimulation to release stored calcium from the Endoplasmic Reticulum, which rapidly set up apoptotic effector signaling such as proteolytic cascades (e.g. caspase signaling) and / or mitochondrial membrane pore transition leading to cell suicide. In natural modes of apoptosis, the Calcium dump event is late in the signaling process. The biophysical mechanism may have originated with induced diffusion of Calcium through channels that are normally closed, or by induced opening of Voltage- Dependant ion channels. Apoptosis or cell suicide is only known in eukaroytic life forms such as plants and animals, including some

single-celled animals such as the malaria parasite and bread mould. It is not found in prokayotes such as bacteria. It was difficult to assess the timing of onset of killing in this work, but a rapid transition to apoptosis over less than 2 hours is not typical in nature. A more rapid onset, if it occurred, might logically involve a direct effect on mitochondrial regulation from the artificial stimulus.

The effectiveness of the AM devices was unofficially reported by Anthony Holland to be enhanced by a double-gating scheme when compared to single-gated. The primary low frequency was gated with its 11th harmonic. The combined waveform was then Amplitude Modulated onto a sine 27.7 MHz carrier (see Fig. 15). Interestingly, his double gating configuration is similar to the suggested double gating layer in the proposed HRIFE protocols herein.

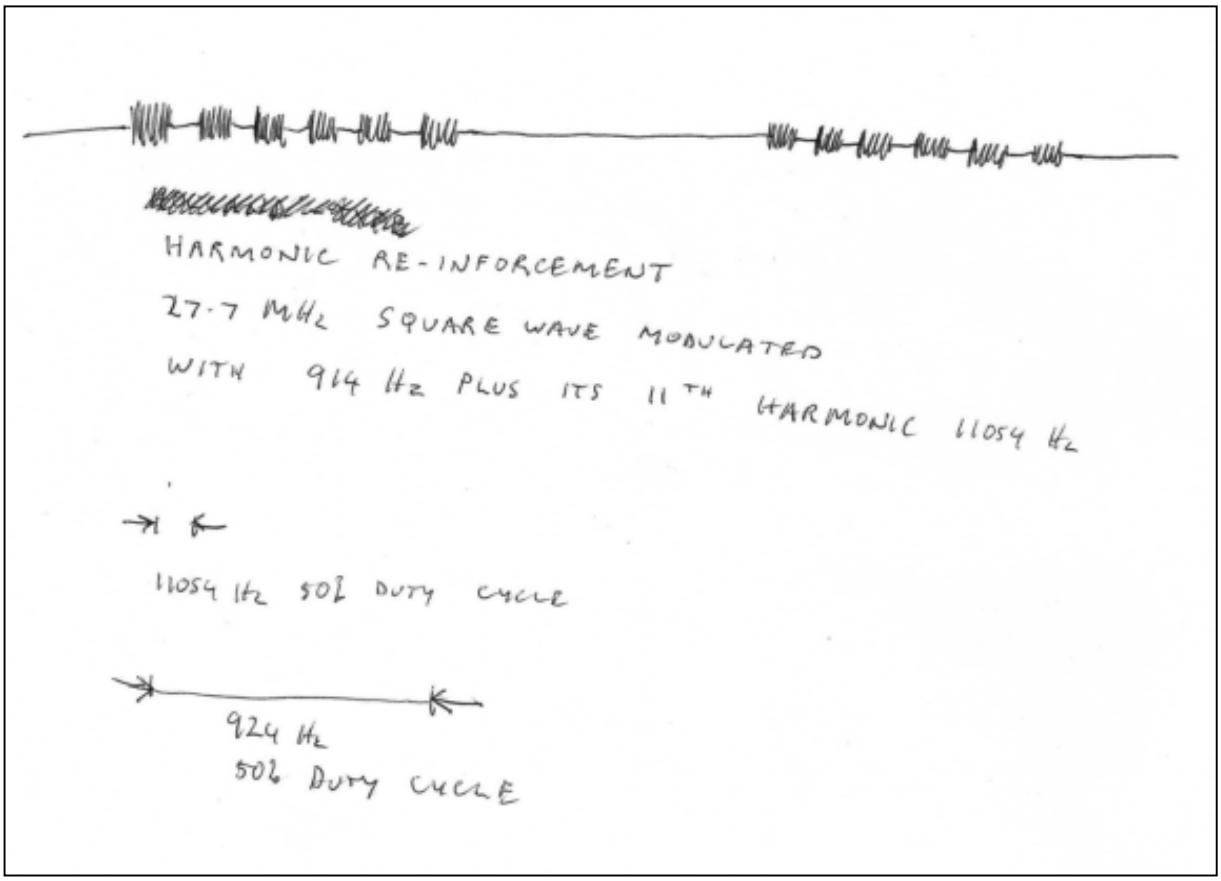


Fig. Harmonic re-inforcement in a double gating scheme for a Rife / Bare device, by Anthony Holland

While acoustic transduction, ion manipulation and dielectrophoresis are acknowledged as promising modalities for research and clinical applications, it may be that other mechanisms can also be exploited, based on the novel hypotheses of this author.

A REVIEW OF SOME RF MEDICAL TECHNOLOGIES

THE THERMOPROTECTION HYPOTHESIS

There are some contradictory theories in the literature, namely that brief environmental insults such as heating actually inhibit the apoptotic response to subsequent insults such as cytotoxic ROS ("thermoprotection"). There is also a small amount of evidence from the work of Carmody and Lin et al that magnetic ELF bioeffects mimic the thermoprotective response in cultured cardiomyocytes. In my own PhD project, I obtained preliminary data from a pilot study also suggesting that simulated GSM phone microwave exposure at 0.2 W/kg inhibited the inflammatory response of gro gamma to IL1 stimulation in cultured fibroblasts. However the two experiments were not repeated to give statistical validity, so they remain unpublished except for an unreviewed Conference Proceedings paper in 2004.

There may be merit in Lin's suggestion that ELF (and perhaps now microwave as well) may be a useful adjunct to organ transplant surgery and some types of organ surgery that involve temporarily pinching off the blood supply. Thermoprotection would be induced to limit the apoptotic / necrotic impact of tissue reperfusion injury after the blood supply in reconnected to oxygen-starved tissue.

To skeptics of athermal microwave bioeffects, I would point to the landmark study by Friedman et al in 2007. A putative mechanism of heat-flux focusing at membrane interfaces as outlined by this author might be the mechanism for RF the somewhat mysterious bioeffects such as those found by Friedman, Lezszynski, Kwee and Velizarov, etc.

ONCOTHERM DEVICE

The theory of thermal therapy to drive cancer tissue to mixed necrosis and apoptosis at over 43 C is well established in the literature (hyperthermia and RF diathermy). The critical temperature for normal tissue is 45 C, so this type of therapy requires careful control, and it limits the scope of clinical use.

A variant design for RF diathermy has been used in Europe since the 1990's for non-thermal or mild-thermal cancer therapy. The Oncotherm device delivers pulse modulated 13.56 MHz e-fields in a capacitative coupling output, e.g. using one small applicator on the abdomen and an earthed waterbed below. (Other Oncotherm designs include whole-body treatment and catheter applicator designs). One rationale of pulsing in diathermy protocols is to allow delivery of higher peak e-field values while keeping average thermal load within tolerable levels. The small upper plate and lower waterbed apparatus delivers a conical section of treated tissue from the small applicator plate to an earthed waterbed. Prof. Andras Szasz claims that thermal deposition in tumors is higher than for normal tissue. He claims that aside from thermal load, there is an effect on osmotic pressure across the membrane (which probably fluctuates with the pulse repetition rate). He argues that ideally the best therapeutic outcome is to avoid upregulation of cytoplasmic HSP70, which in some studies induces drug resistance and transiently inhibits apoptosis. This might be achieved by only allowing mild bulk heating. He argues that a superior immunogenic outcome would involve tumor cell

surface expression of HSPs as opposed to cytoplasmic expression. However no evidence is offered in support of these claims nor re the osmotic pressure theory. A “fractal” envelope is used for the modulation (meaning curved like a petal), but no diagrams or rationale were given, and the duty cycle is not specified. The protocol at the Gisund Klinik in Vienna uses combined chemotherapy (reduced dose) and Oncotherm exposure. Limited publication of clinical trials indicated a slight improvement over chemotherapy control outcomes for survival.

HOLT THERAPY

The emphasis of the method of Dr John Holt in Australia was to use microwave diathermy as an adjunct treatment immediately prior to X-ray exposure for cancer treatment, which he believed would enhance the apoptotic response to X-rays in what he claimed was a non-thermal or mild-thermal mechanism. He also stated that he could reduce X-ray dose in this combination protocol. Later meta-analysis studies of his work suggest that efficacy was limited to head and neck cancers only, so his claims were considered unfounded. Interestingly, diagrams of whole-body RF irradiation that I have come across elsewhere in my research indicate the neck heating is a lot higher than trunk heating, suggesting that in Holt’s work the efficacy may have been a thermal mechanism after all. Sinus structures in the nasal cavity might also demonstrate this thermal propensity.

From the above evidence, it may be that there is no substantial clinical or theoretical basis for Holt’s speculation about a non-thermal mechanism in his hands. On the other hand, late in his career Holt also experimented with the use of glucose blockers as a combination therapy with microwave and X-rays, based on the theory that starvation would add an additional stressor to cancer cells, which are heavy glucose feeders due to their limited anaerobic metabolism. As far as I can tell from my cursory reading, the meta-analysis report did not assess the latter therapeutic approach.

Despite the negative findings of the meta-analysis, some modern researchers since Holt’s retirement were skeptical about the debunking, and impressed by some of the clinical evidence, and have made an ongoing commitment to clinical work and to facilitate basic research.

NOTES ON THE EVOLUTION OF RIFE DESIGNS

This section continues on from descriptions of Rife's early devices on page 16.

The evolution of various design by Rife and later by his engineer Phillip Hoyland, and later again by Crane, Bare and many others can be somewhat confusing. Readers need to be aware that there seems to be significant differences between the modern designs and Rife products, compared to the 3 main designs of Rife and Hoyland from the 1930's. Other popular designs such as the Rife / Bare device c. 1990 use audio square modulation of a modified CB radio using a single modulating frequency.

Hoyland was initially brought in to upgrade the old Rife triode designs to employ the new Hartley power oscillator technology. Around 1936 he performed various experiments using slabs of horse meat. My guess is that Hoyland predicted that Rife's earlier configurations would be effective for a thin microscope slide, but in the case of a human exposure, the low frequency offset component would be rapidly lost by attenuation. The horse meat work would have tested his prediction. At that time, Timken had died, and Johnson was the new source of funding. Subsequently Johnson approved manufacture of a radical new design by Hoyland, which went into production in late 1938, known as the Beam Rays device. For many years its operating principle was misunderstood.

Recently in about 2013, Ringas and Peters were able to make an important breakthrough by reverse engineering the Hoyland Beam Rays 1938-39 device (Ringas, 2013).

The updated Ringas web site at http://rife.org/john%20marsh/rifeinstrumenthistory.pdf goes into considerable detail about various mistakes and false leads made by two teams of electronics collaborators in the decade since 2003 before eventual success in reverse engineering and finally deciphering the Hoyland 1938-39 innovations around 2013, and how they differed from Rife's earlier approaches. The updates on Hoyland are perhaps best studied starting at the middle of that article.

The Hoyland device was described as having a multiple RF sideband output due to the use of a harmonically rich audio modulation. The spacing between each of the many neighboring frequency peaks as seen in a Spectrum Analyser plot would be say 2000 Hz apart, assuming 2000 Hz and its harmonics is used for the AM modulation. Ringas argues by referring to a set of Hoyland's number charts that only one of the sidebands is the active MOR, but I disagree. I suspect the audio modulation, as a harmonic set, was the MOR. Harmonics tend to be the "default" output of non-linear devices unless extra circuitry is added to filter out the unwanted frequencies. Most modern electronics employ these kinds of filters.

Each frequency in the Spectral plot would cross-heterodyne with other frequencies within the target. If 16 bands are present, then 15 different sources of 2000 Hz would be generated, plus 14 sources of 4000 Hz, plus 13 sources of 6000 Hz, etc. At the next iteration, all the 4000 Hz energy can heterodyne with all the 6000 Hz energy to make more 2000 Hz product. 4000 Hz also heterodynes with 2000 Hz to give more 2000 Hz, etc. Thus the uncoupling of 2000 Hz and its harmonics in the target should be fairly efficient, and significant amplitudes of ELF internal E-fields would result.

The argument as to whether Rife used frequencies in the mid-hundreds of kHz as argued by Ringas, or at frequencies mostly below 100 kHz as suggested in some archives, remains unresolved.

My own new designs try to avoid uncoupling of a set of harmonics, with a goal to just get one fundamental per iteration if possible. This is achieved by heterodyning nearby RF carriers. My design concept is named HRIFE for Heterodyned Radiofrequency Induction Field Emitter technology. Whether HRIFE would be a better solution than multiple sideband is difficult to predict. My gut feeling is that higher harmonics cause destructive interference that would damp excitation of resonance, but it might turn out in practice that harmonic sets could somehow give better results than a single fundamental frequency, e.g. by applying a far sub-harmonic of the active MOR. Also the efficiency of LF uncoupling in the target is probably superior in the Hoyland configuration.

At this point readers might ask why not consider the pure audio square mod devices like the 27 MHz Rife/Bare device. As I see it, compared to a Hoyland device, you don't get heterodyned uncoupling of the audio frequency, or even if it uncouples in some way, it would be far less efficient than the Hoyland method. In theory there is harmonic content inherent in a square wave, but I think if you apply spectrum analysis, the Bare device won't look like old Hoyland output, but I have never tested this notion.

My understanding is the Beam Rays circuit may be a MOPA device with overmodulated AM, and the audio signal was a damped sine wave packet. Other web authors such as Bedini have experimented and written on the subject of MOPA devices prior to the insights of Ringas and Peters, and some designs have also come out with modulated opposed wave mixing possibly using Bearden's ideas (I call this method "opposed homodyning" to avoid confusing it with some of my designs). However I have found all of it incomprehensible, so please don't ask me to comment !!! Whether or not Bedini et al used audio harmonics in the modulation is also unknown to me.

Some of the confusion arose from the alteration of older schematics by John Crane in the 1950's, leading to some mistaken speculation by the late great Aubrey Scoon and others that Hoyland's 1938-39 production model was a primitive FM or dual RF heterodyning device e.g. that it could combine say 4.86 MHz (fixed) with say 4.76 MHz (variable) to generate e.g. a 100 kHz product. Scoon also ran a web site that discussed what he called "iterative heterodyning" of dual RF down into the audio band e.g. 2128 Hz in six iterations. Scoon et al also worked on reverse-engineering a Beam Rays device but struck some technical problems, and was also confused by Crane's sketches that erroneously showed a second RF oscillator. After unsuccessful prototypes and amid great confusion in the Rife forums, Scoon took down parts of his website that related to his speculation about heterodyning, since it later became apparent that heterodyning was not actually used in Hoyland's method.

Even though indeed Hoyland didn't make such a design, I made my own personal choice to go with RF heterodyning and also with some forms of iterative heterodyning, albeit with a very different paradigm than Scoon had in mind. Although I was already pondering RF heterodyning in a two-electrode plasma tube before I read Scoon, I must say I owe him a dept of gratitude for inspiration.

In my own research endeavors, I have attempted to follow a path that blissfully ignores Crane and the historical archives but instead I have attempted to build concepts from first principles of Physics, and also to deploy modern knowledge and technologies for a new research effort looking at biological resonance theory and acoustic transformation theory. I am a biologist with limited practical experience of

electronics and physics, hence the slow pace of my efforts to develop appropriate theories since I last posted back in 1996.

Personally I doubt that Rife-type non-contact devices deliver enough energy to destroy germs by resonance. My concepts aim to use internal electric LF E-fields to initially entrain vibration, and then to deliver synchronized high-energy sources from other types of devices. I have also proposed some approaches to spectroscopy research to detect resonant frequencies in virus. There is so much confusion and lack of evidence around the MOR numbers, that it may be necessary to re-invent the wheel so to speak.

My research focus has largely ignored other possibilities for frequency medicine such as frequency phenomena in cellular regulation or in bacteria, which might be addressed by other researchers. Although I have no personal interest in the modern Rife designs and the electrotherapy devices, it may turn out that different designs could suit different medical or tonic applications. The anti-eukaryotic applications could be worthy of further study, e.g. for Malaria.

DEBUNKING THE POPULAR RIFE BX VIRUS MYTH

Rife believed he discovered a pleomorphic (shape-changing) BX virus organism that was the cause of cancer, and he claimed his ray device could kill BX, and cure cancer. Today thousands of people still believe this. From my perspective, however, these ideas are completely incorrect. Even though many virus species can drive cancer pathologies, it is unlikely that any of the cultures Rife studied were typical cancer-inducing viruses.

Many lay people may have got the impression that Rife was working mainly on virus species. In fact the true viruses are quite small, tricky to culture because they need a feeder cell layer, and it is virtually impossible to inspect their morphology using light. Rife may have been able to detect such particles as spots on a photo plate at 20,000 X magnification, and maybe to measure submicroscopic dimensions by means of interferometric technique, but no true surface details would be discernable. Crane taught that Rife worked on some novel type of shape-changing (pleomorphic) micro-organisms, whereas it is known today that pleomorphism is not found in the true viruses. I believe Rife worked mainly on bacteria. In his day any organism that could still be viable after passage through a 0.2 micron filter was called "filterable virus". Rife's collaborators Kendall and Rosenow were working too early in the 20th century to understand the nature of true virus.

I believe Rife's BX cultures were bacterial mycoplasmas, and it is known today that they are one of the few types of bacteria that can survive after 0.2 micron filtration. They can sometimes be found in cancer, probably as a secondary infection. Injection of mice can induce tumors, which caused Rife to falsely believe in a cancer germ via the argument of "Koch's postulates". There is reason to suspect they might even play a role in tumor induction in some uncommon pathologies. However in most cases, human cancer is thought to start from a variety of causes including viral infection, or sometimes from inherited virus within the genome. If any human cancers are initiated by mycoplasma or other bacterial infection, not much research has been done in this area to discover their relative importance, and it is a doubtful hypothesis. Even if doctors could kill every bacteria and infective virus in a human patient, it is doubtful that cancer remission could be induced

in most cases by zapping germs. To my mind, the archival letters by Dr Johnson and others about things like treating eye cataracts with the Rife Ray suggest that these people unfortunately had more hard-core faith than hard-core evidence.

In this article I have given some focus to the possibility of exploiting icosahedral geometry of many true virus species to uncouple acoustic energy into resonant vibration of the virus wall assembly. At this time I have no clue as to what might be a suitable frequency range for the research, and it is not clear to me whether Tsen's mathematical models could be applicable to a macrostructural tympanous paradigm. I have not discussed bacterial resonance research in this article because a resonant mechanism is not obvious, but on the other hand in view of Shashlov's work, such a possibility should not be scoffed at. I have critiqued the widely-believed story on Rife's BX bug in my 1996 article as misleading or misinformed (Blood, 1996). However nature is full of surprises. Given enough lab research in a modern setting, there may be bacterial species that can be killed with "energy medicine", and maybe even some resonant phenomena might be involved, perhaps similar to the mechanism postulated for the "electro-conformational coupling" phenomenon.

LESSONS FROM CFI RESEARCH ON RF BIOEFFECTS 2001-2004

In other sections we speculated that poorly understood biophysical events at the membrane boundary could somehow contribute to RF bioeffects.

Ignoring the ion channels and other pores, membranes are composed mainly of phospholipids which auto-assemble into so-called “lipid bilayers”. There are also some other types of macromolecules that help to reduce the fluidity of the membranes. These include cholesterols and proteins including various Heat Shock Proteins (HSP) and also other proteins involved in regulatory signaling that tend to associate into "rafts". HSPs also play a separate role in the cytoplasm to protect or “chaperone” newly transcribed proteins when they are still in their unfolded form, and their presence makes it easier for these fresh amino acid chains to fold into the preferred conformations, without the interference of other “sticky” proteins. Damaged proteins also tend to attract chaperones, followed by ubiquitin-mediated recycling.

Lab experiments on cultured cells have showed that varying the ambient temperature in the incubators caused cells to either reduce the ratio of non-lipid components (in cooler conditions) or increase that ratio (in warmer conditions). The lipid component is referred to as the “fluid phase” and the other “solid” component often forms “raft” assemblies. It is thought that cellular regulation of this ratio in these experiments attempts to find an overall optimal balance between fluidity and viscosity.

HSPs are thought to be part of an early response mechanism to various environmental insults, both by upregulation of mRNA and by increased HSP protein production (increased transcription) and some phosphorylation events e.g. of HSP27, that play a role in regulation. Part of the stress response mechanism is that available HSPs in the cytoplasm are rapidly transported to the membrane, like soldier ants confronting an enemy. A number of protein signal transduction events can play a role in HSP activation, including MAPK proteins and signaling involving MAPK phosphorylation.

There has been an official consensus from international committees including the EU funded 2000 – 2006 WHO RF Bioeffects Research project, that GSM mobile phones and other non-thermal RF or microwave sources cause no significant biological effects. This is because epidemiological studies have found no significant link to cancer incidence, and because the majority of in vitro experiments (e.g. on cultured cells) found no difference between live RF exposure and “sham” exposures (sham control is where the RF equipment is not turned on).

However a nagging controversy has persisted because a smaller minority of positive studies have found biological effects such as increased HSP70 levels, and sometimes increased cell replication rates, or sometimes DNA damage in blood cells. It was argued by dissenting scientists that cells exposed to athermal RF seemed to behave as if RF was some kind of environmental stressor. One of these scientists is Dr Peter French, who acted as my supervisor during my PhD research project studying mobile phone bioeffects. The debate seemed quite polarised. Various non-biologists with Physics qualifications acting in the WHO process, often linked to industry funding, were vocal in objecting that if heating is

insignificant, then no plausible mechanism for environmental insult can be evident. A lack of a plausible mechanism caused some commentators to view the minority positive studies to probably be flawed in some way that could cause false positive data, e.g. possible heating artifacts within the exposure apparatus.

In our labs at St Vincent's Center For Immunology in Sydney, we were supplied with state-of-the-art microwave TEM apparatus by Telstra Research Laboratory thought to be free of thermal artifacts. We also had the benefit of helpful advice from expert cell biologists. The standard methodology for cell exposures was critiqued because the use of 10% serum media was keeping MAPK permanently activated (constitutive activation). This could mean that any putative effect of RF to "tickle" HSP70 upregulation via MAPK activation was being "swamped" by the effect of the artificial growth media. We also got preliminary data that indicated our sham exposed cells had much stronger MAPK phosphorylation levels than cells that had never been taken out of the incubator. This suggested to us that the cooling effect of transferring cells from the culture incubator and into the dedicated RF / sham RF incubator was causing an experimental artifact about 20 minutes later, i.e. this MAPK artifact in our methodology could cause a false negative result if the sham exposed cells seemed the same as the RF exposed cells in our assays.

Thus we identified two potential causes of false negative data from the methodology used in most previous studies. Our first data set, using these old 10 % serum methods, suggested zero biological effect by assaying mRNA levels of 5,000 genes using microarray technology. Our second preliminary data set arose from a new set of experiments that used cells grown overnight in 0.2% serum (serum starvation). This attempts to mimic real serum levels in tissue. It is commonly used in studies of immunological cell biology etc, but unfortunately cultured cells can only survive a few days in low serum, so timing of serum withdrawal and any later experiments must be consistent in any repeat experiments. We also changed our method to allow cells exactly 2 hours of recovery time after transfer to the RF dedicated incubator, before turning on the GSM microwave apparatus for one hour, to let the MAPK response to cooling settle down again. These latter experiments were the second and final series of experiment in my PhD project. Using a pipette and gentle swirling, I treated cells with either IL-1 stimulus or a blank media (control), followed 2 hours later by the RF exposure. We knew that IL-1 treatment would cause GRO gamma mRNA upregulation in our fibroblast cells. This is a cell model of inflammatory response. Earlier, I had characterized the dose-response curve for GRO gamma response to different doses of IL-1, to give a classic sigmoidal dose-response curve. These data allowed the selection of a "sub-optimal dose" of IL-1 set at the lower left side of our sigmoidal curve, i.e. a mild dose that just begins to elicit a response. Our hypothesis was that the inflammatory response might be enhanced, so using this dose would hopefully allow us to effectively detect any increase in GRO gamma.

The experiment was quite tricky to design the timing to get repeated exposures under uniform conditions. Only two repeats were done before we had equipment failure, scholarship time limits, and funding restrictions. Statistically valid results would have ideally required more than two data points, so our data was not strong enough to achieve approval for publication. The preliminary data we got was the opposite of our hypothesis, i.e. GRO gamma mRNA expression response was roughly half in RF versus

sham-RF exposed cells (downregulated mRNA), suggesting that acute RF exposure could reduce the inflammatory response to IL-1. These results also fit with other work that supports the concept that prior environmental stress (e.g. by heating or ROS insult) can reduce responses to subsequent stress events (e.g. reduced apoptosis in reperfusion events), known as the "thermoprotection hypothesis". That subject is somewhat esoteric, but you can read more about it in my 2005 article (Blood, 2005b).

In my presentation at the Kos Conference, there were perhaps only 20 people in the room. The take-home message I delivered was to recommend a 2 hour delay and the use of 0.2% serum overnight for RF cell studies. I never did get a Journal publication out of my project. But a few years later I heard about a new study published by Friedman et al that found various membrane-mediated bioeffects when they used a simple Carrier Wave (RF with no modulation). On reading this landmark paper, I was very gratified to see that their method employed overnight 0.2% media and a 2 hour delay after transfer. I like to think that my efforts indeed made a difference, with or without a publication.

Various commentators have suggested some kind of political bias in the WHO process and in the funding environment. My own proposal to do post-doctoral work by replicating two controversial positive studies was rebuffed by the Mobile Manufacturers Forum (a kind of industry cartel that controls all industry funding for bio-research), on the grounds that the WHO process was sufficient to resolve the research effort. No more work would be funded by MMF after 2006. In Australia, interesting work still continues at RMIT Melbourne, as world leaders in the study of how GSM microwave impacts brain-wave activity in sleep, funded by NHMRC.

In the public realm, the debate still hasn't progressed much since 2006, but readers might now begin to see that the orthodox suggestion that low power RF has no physical mechanism to disturb membranes may be incorrect in the light of a possible focusing effect, or RF surface currents at membrane boundaries.

The rule of thumb for many years was that SAR average of 10 W/ kg is the threshold of mild RF heating. Setting 1 W/kg (average) as the official health limit conservatively allowed a safety factor of ten. Unfortunately, modern digital phone equipment needs to sometimes power up as high as 2 W/kg av. to reach a distant tower. Hence the European Union needed to endorse a doubling of the older safety limit, which justified about 6 years of funding for research. The fact that GSM phones can actually put out as much as 16 W/kg peak power is officially considered irrelevant because the signal is off for 7/8 of the time. If a putative field focusing effect caused say a 4-fold focusing of e-field intensity within cell pores, there could be the equivalent of 64 W/kg peak for about 0.5 milliseconds, (although of course most phone handsets run at only quarter power or less in many urban locations).

Cells in living organisms might easily be able to cope with a minor stressor, and could readjust to achieve regulatory homoestasis. On the other hand cultured cells may behave less intelligently. In particular, cultured cancer cells probably have less inhibition against proliferative signaling etc. So findings of RF bioeffects in cells in the lab still might not have significant consequences on health in the human population. The question of unknown impacts on the Blood-Brain Barrier and Alzheimers disease was raised after the work of Leszsynski et al in Finland, but

epidemiology studies have not addressed that particular issue.

Some readers may raise a skeptical eyebrow at some of the ball-park figures I have thrown around, but consider the fact that it was claimed in early studies by Kwee and Velizarov that bioeffects were found at average SAR levels estimated to be as low as 0.02 W / kg av, and my own work suggested a possible bioeffect at only 0.2 W/kg av GSM. These power levels were only 1% and 10 % of the 2.0 W/kg safety limit respectively.

I never intended to make mobile phone studies as my life's work. When I went to CFI early in 2001, I viewed it as a great opportunity to learn about RF bioeffects, but always with a longer-term focus on also thinking about medical applications. One of the things I have learned is that even failures have a role to play in scientific progress. Another thing I learned is that everything is political, especially science funding (or rather the lack of it). To obtain public funding for a set of unproven ideas is tricky in an environment where only the most promising and proven projects win the selection contests.

If you google on the word Rife, you will find academic statements to the effect that Rife therapy is a dangerous myth among many of the quack therapies that deprive patients of real cures. If you have read my article closely, you will realize that nearly all of my ideas and technical designs differ from Rife's, and my discussions on virus and cancer biology are also at complete variance to Rife's ideas. Even my hypotheses on the mechanisms of resonant coupling are novel. Perhaps I could have avoided mentioning Rife at all in this article and thus avoid any association with quack medicine. On the other hand there is widespread interest in the lay community about Rife as a suppressed or unsupported area of research. For nearly 30 years since Barry Lyne's book came out in 1988, many people have expressed a hope that rigorous research for frequency medicine against virus could be carried into new generations. I hope this new article can contribute something useful to make those hopes come to fruition. In terms of the politics of funding, it may be that the initial impetus will need to come from private benefactors. To this end I intend to set up a Research Foundation and to invite donations.

A NEW THEORY OF RF BIOPHYSICAL MECHANISMS : THERMAL DIFFERENTIAL AND ITS ACOUSTIC EFFECTS

This section contains a rather advanced discussion requiring some grasp of calculus, and can be considered as optional reading. This section firstly gives some understanding of how we can simply model heat diffusion at the membrane interface by considering the equilibrium energy flows in simple unmodulated RF exposure. The second section discusses how heat flux varies in AM exposure at 10 Hz modulation, and how physical properties of heatsink behavior at lower SAR power tends to cause a phase lag between heat absorption dQ_b/dt in the bulk media versus the actual variation of heat flux at the membrane interface dQ_i/dt. We examine how the makeup of net acoustic emission might be influenced by such a scenario. The third section considers acoustic emission in the high peak SAR power scenario, and predicts the propagation of plane acoustic wavefronts due to the plane geometry of the interface.

A) THERMODYNAMIC EFFECTS OF EXPOSURE TO A SIMPLE CARRIER WAVE

In the simplest model, let us assume that there are no heat losses by diffusion out of the cell, nor radiation nor blood flow, just to simplify the Math. Let us also assume that lipid material has proportionally lower RF absorption than the aqueous medium, by a factor of 0.6, and that the ratio of the mass of lipid medium to aqueous medium is 20:1 including intracellular membranes. (In reality that ratio might be even higher).

Initially we will consider the situation for unmodulated RF irradiation (Carrier Wave or CW). Temperature will increase gradually, and as time goes by, the aqueous phase will become slightly warmer than the lipid phase. Heat from the aqueous material will diffuse across the interface and begin to heat the lipid phase to bring it closer to thermodynamic equilibrium. As time goes by, the temperature in a cross-section of the aqueous material will show a gradient as heat progressively flows towards the membrane from the areas further away. If we modeled the lipid phase as relatively thick, we would also see a similar temperature gradient within the lipid, to give an overall flattened sigmoidal profile, but in reality, lipid membranes tend to be quite thin, so the gradient in lipid phase is not significant in cell membranes.

Assuming RF at fairly modest power, eventually the system comes into an equilibrium state where the center of the lipid phase maintains a temperature slightly below that of middle of the bulk aqueous phase. Heat flows constantly from 20 volumes of aqueous phase, across an extremely thin interface, and into 1 volume of the lipid phase. If the SAR of the aqueous phase is say 1.0 W /kg, and the SAR of the lipid phase is 0.6 W/kg, then at equilibrium, heat must constantly diffuse into the lipid material across the interface. We can only measure the propensity to absorb RF using the SAR metric. Measuring a diffusion

heat flux would need to be quoted in mW/cm sq, and is something I have never modeled. The big question here is "So what?". The membrane interface is not actually getting any warmer than its surroundings in that model, so perhaps a little heat diffusion has an insignificant bioeffect. My reply is I dont know so dont ask me to comment, other than to say it wouldnt be my favourite mechanism for RF bioeffects. I mention heat flux here mainly because it is relevant to acoustic transformation theory. As mentioned earlier, my favourite candidate mechanism for RF bioeffects is the RF surface currents on membranes that must in theory accompany the RF reflection caused by a plane of impedance discontinuity. Unfortunately I do not feel confident in the discipline of Physics to elaborate any more than that.

B) ACOUSTIC PROPAGATION FROM EXPOSURE TO MODULATED RF WAVES AT LOW POWER

Now let us consider the more complex model of a slow full sine modulated RF signal, nominally at 10 Hz modulation. The rate of deposition of heat must now also vary sinusoidally at 10 Hz from zero to maximum. However at the minimum of the modulation signal, as the rate of heating in the bulk media dQ_b/dt approaches zero, a temperature difference (at equilibrium) between the lipid and aqueous phase remains, so local heat transfer tends to continue, as if from a heatsink. In fact the modeling would require two heatsinks of differing physical properties to be considered, namely the aqueous phase and the lipid phase. Modeling to include fluctuation of SAR beyond this zero SAR instant might require a numerical computational method beyond my skills. At a slow frequency like 10 Hz, there might be some variation in the rate of heat flux, but in a graph plot it would look like a flattened offset distorted sine shape. Also the timing of the slowest rate of heat transfer would not co-incide with the instant of zero SAR in the bulk media, which means that the two graphed plots are out of time phase. We dont need to have a fully functional model here to understand the take-home message that interfacial heat flux will vary in AM exposure and also in HRIFE exposure.

The thermoelastic model states that pressure variation occurs at the rate of acceleration of heating or the second differential d^2Q/dt^2. In the above scenario, any regular variation of heat flux would cause a regular acoustic emission, albeit of very small amplitude. But in the case of an offset shape, the acoustic amplitude must be somewhat reduced, because only the varying part of the signal can contribute to acceleration. In this scenario the offset amplitude might be say 90% of the peak amplitude of the varying heat flux, leaving only 10% amplitude of varying signal to drive thermoeleastic expansion. However recall that we modeled the interface heat flux as being probably much higher than RF absorption, simply because the interface volume is very much smaller than the bulk volume of the aqueous media. In this example, there is some uneven trace line for the interface heat flux under AM conditions that could be considered a membrane focusing effect. The uneven shape would be some Fourier sum of sine functions plus an offset. Looking at the second differential that determines acoustic propagation, any significantly magnified values for dQ/dt would imply magnified amplitudes for d^2Q/dt^2 . At faster modulation frequencies, curves for heat flux variation would appear shallower or flatter than our 10 Hz example, but the impact on acoustic propagation is not necessarily diminished because it is the only gradient of dQ/dt , rather than its actual amplitude, that determines amplitudes in d^2Q/dt^2.

We can model acoustic emission as the superimposition of acoustic emission at 10 Hz from bulk media, plus another emission of 10 Hz at the interface, which is not in phase with the first signal. Assuming large heatsink behaviors, the conservative modeling predicts that the latter is of lower amplitude. If we wind the modulation right down to 4 Hz, as might be desirable for slime-busting, perhaps the latter would be of similar or even greater amplitude. In either case, with very low frequency modulation, we can simplistically write the superimposition of heat flows as – A.cos wt - [B. g (wt + phi)], where phi is the phase gap, and the function g is either a pure sine wave or a distorted waveform.

The actual acoustic emission must in fact derive from the differential of the local heat variation rate. If we additively superimpose these heating functions on a graph, and then plot the differential roughly by eye, the resulting differential form (local acoustic propagation) begins to approximately look like a harmonic series superimposition. If so, this may in theory have desirable properties in regards to efficient or effective energy coupling into resonant systems.

If we model the membrane as a large plane, and ignoring pores, then it would propagate an acoustic plane wave or a complex of plane waves into the bulk media, and the resulting wave would not dissipate significantly with distance like a point source would. In practice real cell environments are not all bulk media, but rather there are many reflective and refractive interfaces, so it strictly only applies to microdomains. Nevertheless the theory of this particular proposed mode of acoustic propagation from HRIFE exposure and its planar nature are offered for readers consideration.

The above model assumed a full Amplitude Modulated RF carrier. A roughly similar modulation would occur in HRIFE (heterodyned) applications.

C) ACOUSTIC PROPAGATION FROM MEMBRANES DOMINATES IN HIGH PEAK-POWER EXPOSURE TO MODULATED RF

In the proposed therapeutic applications, we may wish to apply HRIFE energy at an average of 10 W/kg or more, with pulsed schemes that allow the peak power to run up to 100 W/kg or more. In these scenarios, the instantaneous heating input tends to swamp the system such that the assumption of large heat sink would become very much less significant. This would in turn reduce the ratio of offset to varying signal in membrane acoustic propagation to far below the 90% ratio that we modeled for 1 W/kg. Modulated RF exposure at fairly high peak power would allow membrane acoustic propagation to dominate over the aqueous acoustic propagation component. Accordingly, the summed acoustic outcome would be much closer to pure sine than in the low-power model. It would also allow effective modulation frequencies to be much higher than the nominal 10 Hz (for the same acoustic effect) if desired. Overall, the amplitude of any of the thermoelastic effects will increase in proportion with increased RF total peak power. It would also be higher as parent RF frequencies increase due to improved SAR efficiency. Thus devices using say the ISM 434 MHz band might be preferred to 27 MHz in some applications. At high peak power, the equilibrium condition we modeled earlier would perhaps never be achieved within any given pulse cycle, and thus might be tricky to model, but nevertheless, the phenomena

of interface heat flux would still be predicted to occur, along with acoustic propagation.

There would probably be some practical limit to how high the modulation frequency could go, even at the nominal 100 W/kg peak SAR in this scenario, before the problem of heatsink behavior begins to weaken the acoustic power outcome. Protocols that attempt to exploit this particular thermoelastic acoustic outcome could get around this practical limit by employing subharmonics of known native resonances as the applied F3, or as an iterated beat frequency in tri-head and quad-head devices, and of course both these ideas can be deployed, e.g. by having one F3 value at an appropriate subharmonic, and the calibrating the lower beat frequency at some subharmonic of F3.

IN VITRO EXPOSURE CHAMBER DESIGNS FOR CULTURED MICRO-ORGANISMS

Microcuvettes are described adapted from the types used for electroporation work, perhaps with thin film polyurethane insulation on the electrodes, suitable for exposure of 100 microliter volumes such as bacterial suspensions.

“Nanocuvettes” are described adapted from the Nanodrop fold-down top plate design, capable of exposing virus suspensions with volumes as low as 1 or 2 microliters with no gasket, or optionally higher volumes of say 20 microliters with a gasket. E-fields can be generated from opposed flat plates (vertical) or by parallel wires embedded in the gasket (horizontal). The same fold-down concept might be adapted for spectroscopy rigs.

An in situ microscopy rig is proposed using twin Indium Tin Oxide coated glass microscope slides which are conductive but optically transparent, e.g. to observe morphology or for optical spectroscopy. A prototype was kindly provided by the Griffith University School of Physics in Brisbane in 1996 when I was an undergraduate student there.

ADVANCED TECHNICAL MANIFESTATIONS FOR HRIFE APPLICATIONS

Multiple heterodyning protocols of the HRIFE technology might deploy multiple nearby low frequency F3 values which iteratively heterodyne to produce inductive forces right down into in the ultra-low frequency bandwidths, suitable for putative responsive biological targets such as branching points on filamentous polysaccharides (slime-busting). It may be appropriate to scan across a window of these lower frequencies to vary the geometry of strain forces to maximize modes of damage.

More advanced manifestations of the technology might be devised to impart circular polarization to the output, and the rate of its spin might be calibrated to have the golden ratio phi between acoustic propagation distance per period versus the F3 acoustic wavelength, to optimise resonant coupling in biological systems that are structured on phi geometry. Alternatively in a system where native resonance is known to exist via spectroscopy research, the rate of spin might be synchronised. In a similar vein, the two carriers might be spun left-clockwise (East) versus left-clockwise (West) to give proper wave “opposition” and perhaps to maximise any vortex effects.

SPECTROSCOPY APPLICATIONS

There may be much of the above theoretical speculation that may be disputed. However let us hypothesise a black box “mechanism X” whereby appropriate heterodyning of RF waves can deposit acoustic energy into a biological system, or otherwise excite resonance in macromolecular systems or in virus walls, e.g. by electromagnetic coupling. The best kind of science is where we can measure things rather than merely theorise. Spectroscopy analysis offers the hope that putative virus capsid resonant frequencies could be detected.

Many people believe that Rife chose to observe the visual effects of many different frequency exposures on the morphological appearance of micro-organisms using his special fluorescence microscope. However it might be more efficient to consider devising spectroscopy approaches to searching for native resonant frequencies in samples of bacteria suspension or virus infected cell cultures or perhaps purified virus suspension. (Virus could be suspended in a micelle-enhanced media to simulate the presence of plasma membranes to which virus might typically attach).

In the 20th century, various types of low-frequency spectroscopy such as impedance spectroscopy have been utilised by biophysicists. Some of these could perhaps be adapted for HRIFE exposure experiments.

The first approach is by standing wave ratio (SWR) spectroscopy, where RF reflection of the parent carriers are analysed as F3 is scanned. The idea here is that we might expect that if F1 is fixed and F2 is scanned slowly, the reflection of F2 back up the coaxial feed cable to the F1 output might vary slightly in the resonant condition, compared to neighboring frequencies when F3 is not coupling into resonance. The practical limits of such an approach might be issues with poor signal to noise ratio. Use of high-density virus suspension in a Nanocuvette might improve SNR.

Conventional low frequency impedance spectroscopy (LFIS) uses a reference current and then measures phase lag in reflected or refracted signal. It may be that this type of rig could be synchronised in phase with HRIFE. Variants of this approach might use a regular reference current and compare the status during the on and off phases of gated HRIFE. Recently an extremely high resolution microscopy technology has been developed using LFIS. Interestingly, it is used to examine artificial membranes to build up images of biofouling / biofilm.

As a second idea, it may be that Rife used an interferometry method to detect resonance, based on the theory that light interference patterns or perhaps Aerie ring patterns could alter under the influence of physical vibration in the resonant condition. This approach could look at a discrete object less than 0.3 micron such as a dilute virus particle under ultra-high "empty magnification". The disc spacing of an Aerie disc would be predicted to become somewhat unstable if the particle begins to vibrate under resonant conditions. In real conditions, Brownian motion could cause problems, so a gel fixative might be employed that does not damp the vibration as strongly as a solid or resin fixative.

A related interferometric approach uses an extremely fine needle beam that performs an optical scan of the small object to build a data set that can predict the object size and shape. If the object goes into vibrational resonance, qualitative differences in the data would be detected. (See also Scanning Interferometric Apertureless Microscopy research performed by IBM Corporation).

The fourth spectroscopy approach is also an optical method suited to the Rife microscope design that analyses the power spectrum (intensity of various

color bands) of excited fluorescent light emission of monochromatically illuminated microscopic samples during a frequency scan from the HRIFE apparatus. The fluorescent image light is collimated into a parallel beam and then assayed after reflection off a diffraction grating, or after passing through simple prisms to cause separate light frequencies to fan out. This is a novel method which I have named “Rife Spectroscopy”(*20). This could have been achieved by Rife easily enough using "slow motion" film technology, in which he had expertise, provided that each photographic exposure was long enough to get a decent black and white image of the rainbow fan. The idea is that as the scan slowly takes the low frequency component past a match to some native resonance, the ratio of lux power in the main emission frequency window might differ slightly from other present spectra or from background.

Note that while we may be lucky enough to detect macrostructural resonance of some virus capsids by spectroscopy, it is likely that other macromolecular systems (e.g. in bacteria) would be smaller in size and likely to be masked by poor signal to noise ratio. Any hope to detect resonance in bacteria might require direct testing without recourse to spectroscopy, by analysing replication rates post-exposure in a “hit or miss” series of exposures (see Appendix B). (*21)

APPENDIX A (FOLLOWS NEXT PAGE), from Wikipedia

Mathematical principle [edit]

Heterodyning is based on the trigonometric identity:

$$\sin\theta \sin\varphi = \frac{1}{2}\cos(\theta - \varphi) - \frac{1}{2}\cos(\theta + \varphi)$$

The product on the left hand side represents the multiplication ("mixing") of a sine wave with another sine wave. The right hand side shows that the resulting signal is the difference of two sinusoidal terms, one at the sum of the two original frequencies, and one at the difference, which can be considered to be separate signals.

Using this trigonometric identity, the result of multiplying two sine wave signals, $\sin(2\pi f_1 t)$ and $\sin(2\pi f_2 t)$ can be calculated:

$$\sin(2\pi f_1 t)\sin(2\pi f_2 t) = \frac{1}{2}\cos[2\pi(f_1 - f_2)t] - \frac{1}{2}\cos[2\pi(f_1 + f_2)t]$$

The result is the sum of two sinusoidal signals, one at the sum $f_1 + f_2$ and one at the difference $f_1 - f_2$ of the original frequencies

Mixer [edit]

The two signals are combined in a device called a *mixer*. It can be seen from the previous section that an ideal mixer would be a device that multiplies the two signals. Some widely used mixer circuits, such as the Gilbert cell, operate in this way, but they are limited to lower frequencies. However, any *nonlinear* electronic component will also multiply signals applied to it, producing heterodyne frequencies in its output, so a variety of nonlinear components are used as mixers. A nonlinear component is one in which the output current or voltage is a nonlinear function of its input. Most circuit elements in communications circuits are designed to be linear. This means they obey the superposition principle; if $F(v)$ is the output of a linear element with an input of v:

$$F(v_1 + v_2) = F(v_1) + F(v_2)$$

So if two sine wave signals at frequencies f_1 and f_2 are applied to a linear device, the output is simply the sum of the outputs when the two signals are applied separately with no product terms. So the function F must be nonlinear to create heterodynes (mixer products). A perfect multiplier only produces mixer products at the sum and difference frequencies ($f_1 \pm f_2$), but more general nonlinear functions produce higher order mixer products: $n \cdot f_1 + m \cdot f_2$ for integers n and m. Some mixer designs, such as double-balanced mixers, suppress some high order undesired products, while other designs, such as harmonic mixers exploit high order differences.

Examples of nonlinear components that are used as mixers are vacuum tubes and transistors biased near cutoff (class C), and diodes. Ferromagnetic core inductors driven into saturation can also be used at lower frequencies. In nonlinear optics, crystals that have nonlinear characteristics are used to mix laser light beams to create heterodynes at optical frequencies.

Output of a mixer [edit]

To demonstrate mathematically how a nonlinear component can multiply signals and generate heterodyne frequencies, the nonlinear function F can be expanded in a power series (MacLaurin series):

$$F(v) = \alpha_1 v + \alpha_2 v^2 + \alpha_3 v^3 + \ldots$$

To simplify the math, the higher order terms above α_2 will be indicated by an ellipsis ("...") and only the first terms will be shown. Applying the two sine waves at frequencies $\omega_1 = 2\pi f_1$ and $\omega_2 = 2\pi f_2$ to this device:

$$v_{\text{out}} = F(A_1 \sin\omega_1 t + A_2 \sin\omega_2 t)$$
$$v_{\text{out}} = \alpha_1(A_1 \sin\omega_1 t + A_2 \sin\omega_2 t) + \alpha_2(A_1 \sin\omega_1 t + A_2 \sin\omega_2 t)^2 + \ldots$$
$$v_{\text{out}} = \alpha_1(A_1 \sin\omega_1 t + A_2 \sin\omega_2 t) + \alpha_2(A_1^2 \sin^2\omega_1 t + 2A_1A_2 \sin\omega_1 t \sin\omega_2 t + A_2^2 \sin^2\omega_2 t) + \ldots$$

It can be seen that the second term above contains a product of the two sine waves. Simplifying with trigonometric identities:

$$v_{\text{out}} = \alpha_1(A_1 \sin\omega_1 t + A_2 \sin\omega_2 t) + \alpha_2\left(\frac{A_1^2}{2}[1 - \cos 2\omega_1 t] + A_1A_2[\cos(\omega_1 t - \omega_2 t) - \cos(\omega_1 t + \omega_2 t)] + \frac{A_2^2}{2}[1 - \cos 2\omega_2 t]\right) + \ldots$$

$$v_{\text{out}} = \alpha_2 A_1 A_2 \cos(\omega_1 - \omega_2)t - \alpha_2 A_1 A_2 \cos(\omega_1 + \omega_2)t + \ldots$$

So the output contains sinusoidal terms with frequencies at the sum $\omega_1 + \omega_2$ and difference $\omega_1 - \omega_2$ of the two original frequencies. It also contains terms at the original frequencies and at multiples of the original frequencies $2\omega_1$, $2\omega_2$, $3\omega_1$, $3\omega_2$, etc.; the latter are called harmonics, as well as more complicated terms at frequencies of $M\omega_1 + N\omega_2$, called intermodulation products. These unwanted frequencies, along with the unwanted heterodyne frequency, must be filtered out of the mixer output by an electronic filter to leave the desired heterodyne.

APPENDIX B

HIGH THROUGHPUT LAB PROTOCOLS

This section outlines a protocol for hit-or-miss exposures without the benefit of any spectroscopy data. It follows from the recommended protocol of 10 windows per decade of frequencies. Mortality is detected by an assay of virus or bacterial replication say 48 hours after exposure, using real-time PCR analysis.

Done in triplicate with 3 sham controls using 3 active and 3 sham microcuvettes on a bench, a single 10 minute scan procedure with a 48 hour incubation rest followed by six lysis extractions, repeated for 10 frequency window scans per decade, would assay for putative resonance through a whole decade e.g. from 3kHz to 30 kHz. A real-time PCR run with 60 tubes could be performed in a few hours (a whole day if you include in-house DNA extractions). Robot dispensers are available that use tubes with pre-coated dry primers for the PCR step. Primer design and tube coating can be cheaply outsourced to allow many species to be investigated. Rotary PCR disk systems are available using 72 or 100 tubes per run. Three decades worth of extractions (180 tubes) could be assayed in two runs in half a day. The lysis step is quick and easy to perform, and the lysate can be stored for automated batch extractions which can also be outsourced. Even PCR assaying from frozen extracts can be outsourced. Allowing 10 minutes for suspension, counting and loading, 10 minutes for exposures, and 10 minutes to re-incubate samples for subsequent culture by assistants, each decade takes 300 minutes or 5 hours to run (at 10 scan windows per decade). Increasing the bench apparatus from 6 to 18 chambers would allow 3 workers to comfortably run 3 decades in a day, allowing batched cultures of one species to be exposed to frequencies from say 1 kHz right through to 1MHz.

The slowest part of research work might be the in-house culture optimisation for new species, especially where feeder cell layers are used to culture virus. Extraction of virus (with or without micelle-enhancement) for exposure and / or spectroscopy would also require labor-intensive optimisation.

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FOOTNOTES

The Footnotes are available in the unabridged version, available for A$ 17.00 at http://hrife.com/buyhrifebook/

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REFERENCES

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