# A predicted photon chemistry

Authors: Anthony H. J. Fleming and Elizabeth B. Colorio


**Abstract:** The internal structure of the photon can be described via the electromagnetic self-field model (EMSFT) whereby the ordinary photon consists of two sub-particles of equal mass and opposite charge in dynamic equilibrium with each other. The sub-photonic particles are termed the ephectron and the phroton, corresponding to the electron and proton of the hydrogen atom. As in the application of EMSFT to the hydrogen atom, the mathematical description of the photon has degrees of freedom associated with its electric (E-) and magnetic (H-) fields[i], the electric permittivity, ε, and the magnetic permeability, μ, of a region. Since there are two fields per sub-particle (E- and H-fields), there are six degrees of freedom altogether. EMSFT provides eigensolutions for the simple photon and its compounds. Analogous to the spectroscopy of the hydrogen atom, the simple photon can exist in a range of energy states that depend on the motions of the ephectron and phroton. Analogous to atomic chemistry, the photon exists as compounds wherein the various sub-photonic structures assume distinct entities. These compounds correspond to the bosons and gluons that mediate the weak and strong nuclear forces known to high energy physics. In regions where gluons exist, the equations controlling the fields are a modified version of Maxwell's two curl and two divergence equations. For the strong force there are three curl and three divergence equations, there being a new type of field herein termed the nuclear field that depends upon compounded triplets of the ephectron and phroton. A photonic chemistry may be involved in energy/temperature dependent processes including the layered spherical structure of the ionosphere, the various snowflake structures, and magnetic flips of the sun the earth. A range of biological processes such as the cell cycle may depend on hydration structures found within DNA and other biological protein structures.

## EMSFT, Centre-of-motion E- and H-Fields at the Sub-photonic level

Like quantum mechanics (QM), electromagnetic self-field theory (EMSFT) is both an analytic and a numerical method for solving field equations. Unlike QM, EMSFT solves Maxwell's equations via the fields directly rather than via derived potential functions. The fields within EMSFT are not ubiquitous, but like the interacting particles are discrete and particulate albeit of minute size. This leads to mathematical savings and simplifications not available to QM methods. In EMSFT mass-points are non-singular and non-problematic as they never reside at their origins. Uncertainty is seen as a numerical accuracy due to QM rather than a limitation on reality. EMSFT is applied to situations where dynamic balances hold between interacting particles. It yields deterministic analytic equations for the motions and energy states of the hydrogen atom

[i] Although the sub-photonic fields are referred to as E- and H-fields, they are not the electric and magnetic fields of everyday usage. Where referred to, the ordinary photonic fields are written as $\mathcal{E}$- and $\mathcal{H}$- fields to distinguish them from E- and H-fields acting on the sub-photonic particles. Sub-photonic fields presuppose that there exist particles analogous to the photon that act like fields at the sub-photonic level.

[Fleming 2002]; it is an analytic and a numerical method for investigating and simulating fusion reactions, e.g. triton and deuteron to form helium-4.

Recently EMSFT was used to examine a possible internal structure of the photon [Fleming and Colorio 2003]. EMSFT suggests that the internal structure of the ordinary photon consists of two sub-photonic particles termed the ephectron and the phroton, having equal mass and opposite charge. The relativistic sub-photonic electric (E-) and magnetic (H-) fields for these two interacting particles are calculated unconventionally, like the self-fields of the hydrogen atom. The self-fields in this case do not radiate into free-space but are like a rotating standing wave. Figure1 shows the two sub-particles for a stationary photon; their motions are circular in this case. The fields are measured via vacant points in space, the centres-of-motion. In conventional EM field theory, fields are calculated directly between charge points. Where dynamic balances occur, the motions are periodic, returning to a starting point. In practice, circles and ellipses are common EMSFT solutions matching the motions of systems such as photons, atoms, solar systems and galaxies. Using modified fields the central regions of these systems such as nuclei, suns, and galactic black holes, can also be analyzed. The discrete or particulate fields of these field-particle systems can perform half-integer spirals reminiscent of quantum spin.

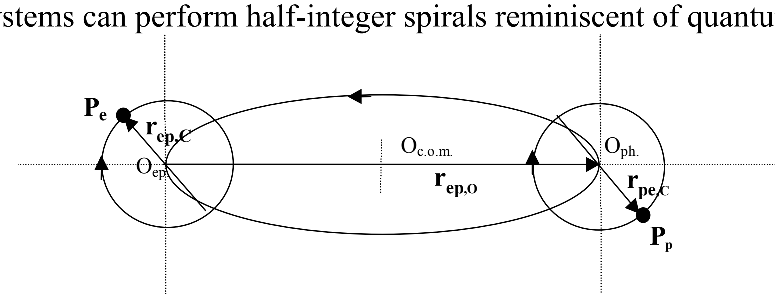



**Figure 1.** Geometry to determine E- and H-fields via the centres-of-motion at the sub-photonic level. The ephectron and the phroton have equal mass but opposite charge. There is an orbital and a cyclotron separation between the particles measured via their centres of motion and a stationary centre of mass. Each particle is shifted in phase 180° from the other in both rotational directions.

The mutual positions of the two sub-photonic particles, the ephectron and phroton define their mutual E-fields; their positions and velocities define their mutual H-fields. These motions also define their centres of motion (Figure 1). The E-field force acting on the ephectron $\vec{F}_{E,e}$ and the phroton $\vec{F}_{E,p}$ by the orbital rotations of the particles may be written

$$\vec{F}_{E,e} = \frac{q_p q_e}{4\pi\varepsilon_0}\frac{\hat{r}_{ep,o}}{\left|r^2_{ep,o}\right|} = -\vec{F}_{E,p} = \frac{-q_p q_e}{4\pi\varepsilon_0}\frac{\hat{r}_{pe,o}}{\left|r^2_{pe,o}\right|} \qquad (1)$$

where $q_e$ and $q_p$ are the elementary charges of the ephectron and the phroton, $\vec{r}_{ep,o}$ the orbital separation vector, $\hat{r}_{ep,o}$ the unit orbital separation vector. The force acting on the ephectron due to the H-field $\vec{F}_{H,e}$ acting between the two rotating particles is written

$$\vec{F}_{H,p} = \frac{-q_p q_e}{4\pi\varepsilon_0}\frac{\hat{r}_{ep,c}}{\left|r^2_{ep,c}\right|} = -\vec{F}_{H,e} = \frac{q_e q_p}{4\pi\varepsilon_0}\frac{\hat{r}_{pe,c}}{\left|r^2_{pe,c}\right|} \qquad (2)$$

where $\vec{r}_{ep,c}$ is the radial cyclotron separation vector , and $\hat{r}_{ep,c}$ the unit radial cyclotron separation vector between the charges. While at first sight these forms may look like Coulomb fields, they are not; they are calculated between centres of motion. The H-field may also look like a Coulomb field but it can be recast in terms of a magnetic field form ($\boldsymbol{q}\ \boldsymbol{v}_c \times \boldsymbol{B}$). These E- and H-field forms are also consistent within Maxwell's equations. Due to the dynamic balance which is a periodic motion, the orbital and cyclotron radial separation vectors are written in terms of unit orbital and cyclotron spinors. Vectors that rotate periodically in time are *physical* spinors, distinct from the usual *mathematical* definitions of spinors as *unit entities* for defining tensors etc.

$$\hat{\boldsymbol{r}}_{pe,o} = \hat{\boldsymbol{r}}_o \boldsymbol{e}^{j\omega_o t} \qquad (3a)$$

and $$\hat{\boldsymbol{r}}_{pe,c} = \hat{\boldsymbol{r}}_c \boldsymbol{e}^{j\omega_c t} \qquad (3b)$$

where $\hat{\boldsymbol{r}}_o$ and $\hat{\boldsymbol{r}}_c$ are unit radial vectors.

As for standing waves in closed regions, systems of periodically rotating fields can have mixed field forms, a positive exponent with the orbital spinor of the E-field

$$\sigma_o(r_o, \omega_o) = \hat{\boldsymbol{r}}_o \boldsymbol{e}^{j\phi_o} \qquad (4a)$$

and a negative exponent with the cyclotron spinor of the H-field

$$\sigma_c(r_c, \omega_c) = \hat{\boldsymbol{r}}_c \boldsymbol{e}^{j\phi_c} \qquad (4b)$$

Thus the photon's self-fields are non-radiating standing waves. Further, these fields are fundamentally different to the classical fields because they are discrete particles in their own right. Hence, the field is like a collection of coherent dust particles and do not occupy the entire regions of free-space as in Coulomb's law or the Biot-Savart law.

## Electromagnetic Fields: Photons, Atoms and Solar Systems

The EM fields controlling the motions of the sub-photonic charged particles satisfy the Maxwell-Lorentz equations, (5). The region near and inside the photon is assumed isotropic and homogeneous. Where discrete point-mass particles carrying units of elementary charge $\boldsymbol{q}_{ph}$ are studied, the Maxwell-Lorentz equations[ii] can be written

$$\nabla \bullet \vec{E} = \frac{4\pi}{v_q}\ q \qquad (5a)$$

$$\nabla \bullet \vec{H} = 0 \qquad (5b)$$

$$\nabla \times \vec{E} + \mu_{ph}\ \frac{\partial\ \vec{H}}{dt} = 0 \qquad (5c)$$

$$\nabla \times \vec{H} - \varepsilon_{ph}\ \frac{\partial\ \vec{E}}{dt} = \frac{\pi}{s_q}\ q\ \vec{v} \qquad (5d)$$

where the Lorentz equation for the forces acting on the particles is written

$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B} \qquad (5e)$$

[ii] Where a current density is used in 5c, the factor 4π comes about applying Green's theorem, a surface over the volume enclosed by charge density. For discrete charges, π represents an area enclosed by the charge.

and the constitutive equations $\vec{B} = \mu_{ph}\vec{H}$ , $\vec{D} = \varepsilon_{ph}\vec{E}$ where $\varepsilon_{ph}$ and $\mu_{ph}$ are invariant scalars, the photon's constitutive parameters analogous to those of free space, $\varepsilon_0$ and $\mu_0$ .

The field forms, (4), are substituted into the Maxwell-Lorentz equations, (5), yielding analytic solutions for the energy states of the photon modeled as two point-masses. This EMSFT solution closely mirrors the solution obtained by EMSFT for the spectroscopy agreeing with the quantum theory of the hydrogen atom. That centre-of-motion fields provide a simple theory consistent with known data for the hydrogen atom is proof of its accuracy and simplicity at the atomic level. These atomic solutions are in stark comparison to the infinite terms associated with point-to-point classical fields used in quantum theory. The photon's complete solution will be detailed in a separate report. The basics of the solutions are as follows. There are two fields per particle causing two motions per particle. Each spinor, (4), has two variables hence there are four unknowns per particle. There are eight equations in the total system to define the complete motions of the photon's sub-particles. As both particles have equal mass, there are two equivalent sets of four equations. Maxwell's curl equations provide three equations per particle and a form of the virial theorem provides a fourth equation per particle; the div equations are incorporated into the fields. There are four equations per particle. The remaining unknowns after these equations are solved analytically are the mass and charge of phroton and ephectron, and constitutive parameters $\varepsilon_{ph}$ and $\mu_{ph}$ that define the energy density around the stationary photon in terms of its two fields. The spectral lines given by these parametric modal equations may then be matched to experiment for best fit.

## Strong Nuclear Fields: Nuclei, Suns, Galactic Black Holes, Supercluster Centres

The strong nuclear fields controlling the motions of charged particles satisfy the following adaptation of the Maxwell-Lorentz equations, (6). In general, the region is assumed isotropic and homogeneous and $\varepsilon_n$ and $\mu_n$ are invariant scalars. Where nuclear sub-particles, quarks, carrying units of elementary charge $q_q$ are studied, the modified Maxwell-Lorentz equations can be written

$$\nabla \bullet \vec{E} = \frac{4\pi}{v_q} \; q_q \tag{6a}$$

$$\nabla \bullet \vec{H} = 0 \tag{6b}$$

$$\nabla \bullet \vec{N} = 0 \tag{6c}$$

$$\nabla \times \vec{E} + \mu_n \frac{\partial \vec{H}}{dt} = 0 \tag{6d}$$

$$\nabla \times \vec{H} - \varepsilon_0 \frac{\partial \vec{E}}{dt} = \frac{\pi}{s_q} \; q_q \, \vec{v} \tag{6e}$$

$$\nabla \times \vec{N} + v_n \frac{\partial \vec{E}}{dt} = 0 \tag{6f}$$

where the modified Lorentz equation for the field-forces acting on the particles is written

$$\vec{F} = q_q\vec{E} + q_q\vec{v} \times \vec{B} + q_q\vec{v} \times \vec{M} \tag{6g}$$

and the constitutive equations $\vec{B} = \mu_n \vec{H}$ , $\vec{D} = \varepsilon_n \vec{E}$ and $\vec{M} = \nu_n \vec{N}$ where $\varepsilon_n$ $\mu_n$ and $\nu_n$ are invariant scalars, the nuclear constitutive parameters similar to those of free space, $\varepsilon_0$ and $\mu_0$ , except the energy density within the nucleus now depends upon the three gluon fields. These modified equations provide three orthogonal motions per quark, simple rotations for a stationary quark. There are now six unknowns per particle, eighteen in the complete nuclear system. The curl equations, (6d-f), provide four scalar equations, and there are now two virial equations to give six equations in six unknowns. Like the photon, the resulting analytic parametric solutions may be compared to the experimental results given by particle physics.

| Field Symbol | Field Definition |
|---|---|
| $\vec{\mathcal{E}}$ | **Photonic (ordinary) electric field** |
| $\vec{\mathcal{H}}$ | **Photonic (ordinary) magnetic field** |
| $\vec{E}$ | **Sub-photonic electric field** |
| $\vec{H}$ | **Sub-photonic magnetic field** |
| $\vec{D}$ | **Sub-photonic electric displacement** |
| $\vec{B}$ | **Sub-photonic magnetic flux density** |
| $\vec{N}$ | **Nuclear field** |
| $\vec{M}$ | **Nuclear flux density** |

**Table 1:** Nomenclature.

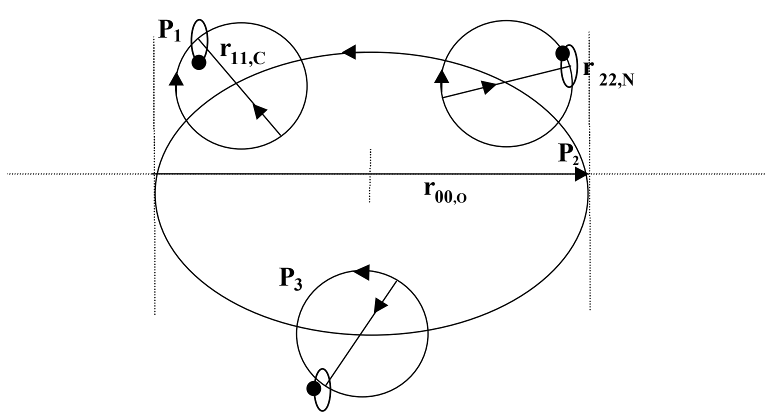



**Figure 2.** Centre-of-motion E- H-, and N- (gluon) fields at the sub-nuclear level. The three quarks shown have equal mass and charge for simplicity of the diagram. There is an orbital, a cyclotron, and a third kind of orthogonal separation between the particles measured via their centres of motion and the centre of mass. The three quarks are shifted in phase 120° from each other in each rotation. In the diagram, the various distances of separation for each rotation are equal for all quarks.

## Weak Fields

Bosons mediate the weak forces found near nuclei. According to the Salam-Weinberg theory, the three massive vector bosons ($W^+$, $W^-$ and $Z^0$) along with the photon (γ) carry the weak force. They also exhibit what is termed spontaneous symmetry breaking by which at high energy levels the four particles behave identically. At lower energy levels, the four behave like completely different particles. These field particles are due to certain dipolar compounds of photons that do no require the nuclear field as in the strong forces. These compounds can be due to pairings of either two phrotons ($W^+$), two ephectrons ($W^-$), or a quadrupole compound consisting of both two phrotons and two ephectrons. At higher energy levels the sub-photonic particles disassociate to form a single compound. As does the photon, bosons use the Maxwell-Lorentz equations, (5).

## Radiating Photons and Phonons

The energy radiated out from a nuclear reaction involves the types of field particles involved with the motion of the quark as in Figure 2 (field particles not shown). This means that when a nuclear emission occurs, there are three possible components of the emitted field. In the non-nuclear environment outside an atom for instance, these field components separate into acoustic and EM forms of near fields and far-fields. The EM wave is long-range, while the acoustic wave is relatively short-range. In distinction from the 'stationary' photon discussed above, the radiated photon moves with the speed of light while the acoustic wave, sometimes called the longitudinal wave, moves much slower. The preceding nuclear reactions release other forms of energy in addition to the field energy, by the scattering of the original quarks.

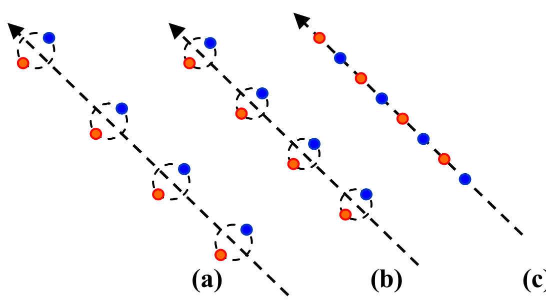



**Figure 3**. Velocity of photon varies to zero when string appears (a) c, (b) c/2, (c) $c \approx 0$. At $c \approx 0$, it is possible for 2D or 3D lattices of photons to form (Bose-Einstein condensates).

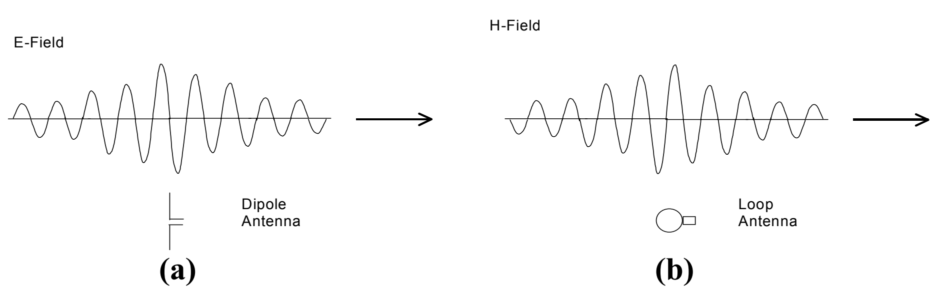



**Figure 4.** EM wave packet, of a single radiating photon as shown in Figure 3. The E-field shown in (a) is shifted in phase by 90º from the H-field shown in (b).

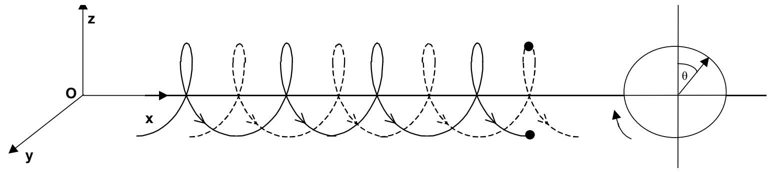



**Figure 5. A** phonon is shown with its field pointing along the direction of propagation.

## Possible Photon States in Nature

### (a) Layers within the Ionosphere

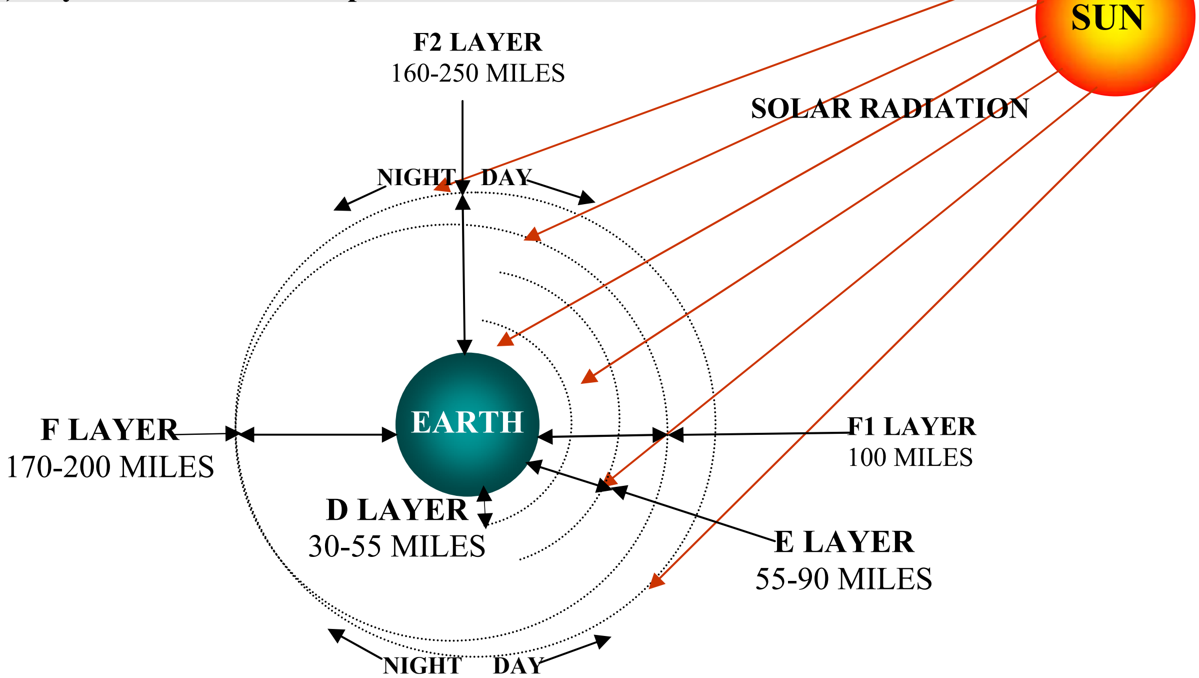



**Figure 6.** Earth's ionospheric layers. A lack of layers on the night side show the layered structure is related to the sun-earth photons. As the energy density rises near the earth, the photon energy states change that may alter the chemical structure of hydration bonds.

One possible occurrence of photonic states are the ionospheric layers known to exist in the earth's atmosphere. These layers are the cause of the Schumman resonances. In terms of EMSFT, the photons from the sun are increasing their energy as they approach earth. As they pass a particular energy state level, the E-field changes. This causes the stratification into clouds etc, and the anomalous radiofrequency effects when these layers can act like giant spherically annular waveguides. The chemistry of the ionosphere is complex and there is a temperature inversion linked to the environmentally important ozone layer that serves to protect the earth's surface and biological life including DNA from the excessive temperatures at the upper reaches of the atmosphere.

There appears to be a synergy between the way the weather cycle and the cell cycle both depend on periodic temperature variations. The presence of life forms may well depend on regions where there are substantial changes in temperature leading to a differential in photon states. In other words life may form along surfaces between regions where large differences in energy density occur. Two examples are on the earth's surface, where light, heat, and water exist in plenitude, and near submarinal volcanic regions where similar conditions apply. The submarinal light may initially be nuclear, but it leads to biological 'light' forms, biophotons.

## (b) Snow Flake Structure

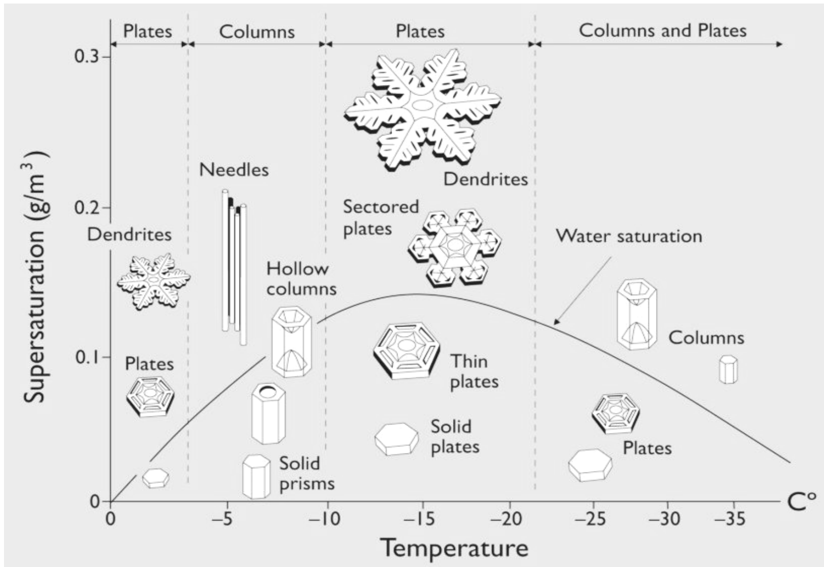



**Image:** Kenneth G. Libbrecht, Caltech

**Figure 7**. The structure of a snow flake is related to temperature and may be controlled by the photonic state inside the hydration bonding. According to EMSFT, the EM field itself has energy levels at which it changes structure. At different temperatures, the charge distribution changes and this can have a profound effect upon the bonding. Another example of this effect is the way avalanches occur.

## (c) The Sun's Magnetic Flips

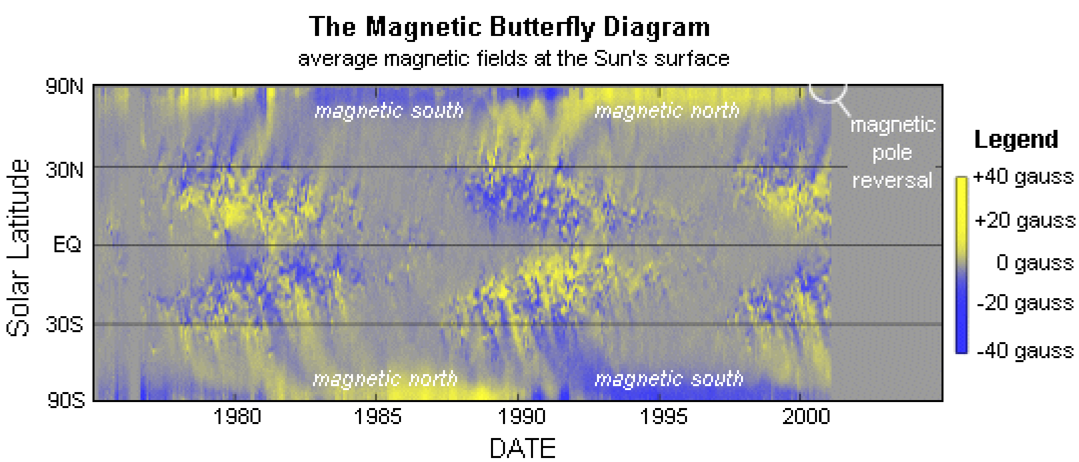


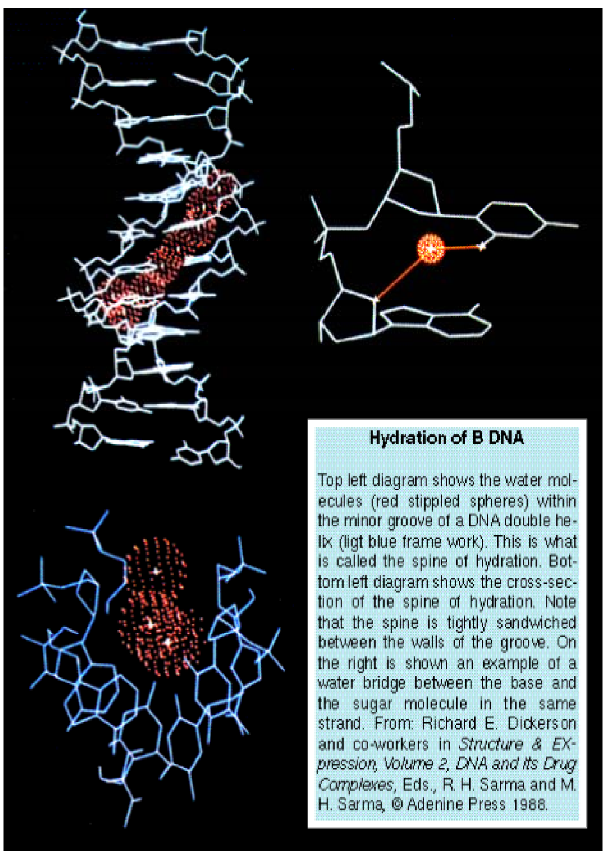

**Image:** NASA/NSSTC/Hathaway

**Figure 8**. In this "magnetic butterfly diagram," yellow regions are occupied by south-pointing magnetic fields; blue denotes north. At mid-latitudes the diagram is dominated by intense magnetic fields above sunspots. During the sunspot cycle, sunspots drift, on average, toward the equator—hence the butterfly wings. The uniform blue and yellow regions near the poles reveal the orientation of the Sun's underlying dipole magnetic field.

The sun's magnetic field flips every eleven years or so and corresponds to the sun's increased sun spot activity and interference to global RF communications.  The earth also undergoes less regular magnetic flips.  These flips could be due to intragalactic or intergalactic energy variations affecting the energy level of our own solar system. Such flips of the earth's magnetic fields may have played a biophysical role within the evolution of life upon earth.

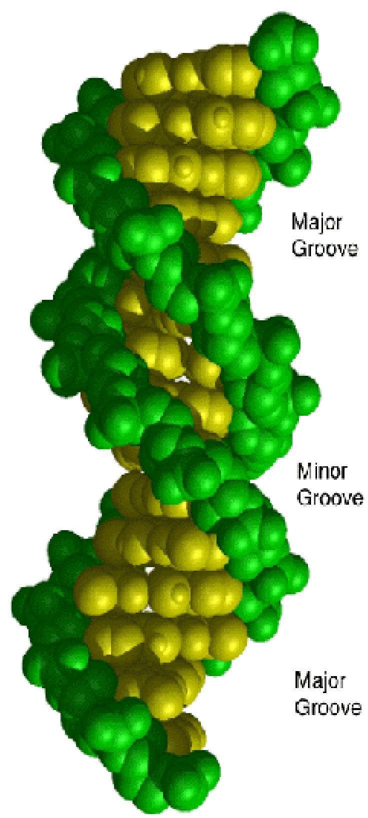
## (d) DNA's Hydration States and the Cell Cycle

Part of DNA's structure involves hydration between bases across its internal core. The photon's energy states may act as a kind of general-purpose trigger within the cell cycle.  As the energy drops within each cell during the cycle of normal healthy cells within a tissue, the DNA strand begins to stretch out to its full molecular reach.  This may be due to the states of the photon gradually assuming a form more and more akin to a liquid crystal.  Metaphase may be the gradual reaching of an equilibrium state that is subsequently broken in a precipitate fashion as a critical energy level is crossed and the photonic state changes instantaneously.



**Hydration of B DNA**

Top left diagram shows the water molecules (red stippled spheres) within the minor groove of a DNA double helix (ligt blue frame work). This is what is called the spine of hydration. Bottom left diagram shows the cross-section of the spine of hydration. Note that the spine is tightly sandwiched between the walls of the groove. On the right is shown an example of a water bridge between the base and the sugar molecule in the same strand. From: Richard E. Dickerson and co-workers in *Structure & Expression, Volume 2, DNA and its Drug Complexes*, Eds., R. H. Sarma and M. H. Sarma, © Adenine Press 1988.




Hydration found in clouds, snowflakes, and near biological macromolecules, may be dependent on the structure of the field itself that can change depending on the energy state of the photon.  This effect occurs near interfacial surfaces at the terrestrial and the biological level.

## (e) Dielectric Theory (endogenous and exogenous)

Cells are the fundamental building blocks of tissues. There are large numbers of cells in each tissue type, along with a range of other components in each tissue type. For instance, the extra cellular matrix (ECM) can comprise structural or connection fibres between cells. The cells are a community of individual entities sharing their self-energy via cell metabolism and cell-to-cell communication via the motor cortex region or other short-range mechanisms, possibly the ECM. The cells thus communicate and change their individual energy states as the cell cycle proceeds; some cells die others replicate. The 'eigenstates' associated with each tissue type are no longer simple analytic solutions but need to be analyzed using sophisticated modeling techniques. There is no longer one operating frequency but a whole range of eigensolutions that map out how the tissue can remain as a viable entity, or conversely it may fall into disrepair.

The tissue can be analyzed via EMSFT-type mathematics yielding resonant frequencies at which the cells operate. These frequencies are related to the motions of proteins within the cell membrane that can move within the cell surface, and to the way the DNA operates. Biophotons are important elements in this dynamic energy balance and are sent via the DNA to the cell surface and on to other cells or to the controlling 'centre' of the tissue. The dielectric response of cells is a cell polarization process of diffusing proteins within the membrane, and also a periodic rotation of these same proteins. Hence the well-known dielectric response of tissues is predominantly a dipolar response at ELF frequencies when most of the cells are all aligned in a similar direction without too many rotations occurring within cell membrane proteins. As the external frequency of a perturbing field is raised to RF say, the rotations within each cell's membrane increase in frequency and the average polarization across the entire tissue decreases due to the rapid rotational diffusions.

As each cell develops, it has a specific set of five frequencies associated with the bases of the DNA code. As the cell's energy drops, these frequencies also drop except in apoptosis, or cell blebbing, when the cell frequency becomes chaotic. So each cell is in a particular state at any time depending on the tissue's overall integrity. The overall tissue frequency is a weighted average over all cells. This is a macroscopic quantity, whereas, each cell has discrete frequencies. The biophotons associated with these frequencies are measurable. Although the DNA appears to act like an antenna, it emits EM according to solutions associated with photonic spectroscopy. The EMSFT balance across cells acts to increase or decrease the energy level at points within the tissue where an overall state is required by the controlling mechanism(s), for example stem cell growth.

## (e) Degenerative (Aging) Action of Hydration States

In keeping with the frequency-based mechanisms discussed above, extracellular components of tissues operate within certain frequency bands causing hydration binding to become important factors if the frequencies associated with healthy tissues diminish. Such diminution of a tissue's energy can occur via many different mechanisms including the aging process or other degenerative processes. For instance stiffening of joints and limbs may be seen as a lowering of the photonic states within the hydration bonds associated with the ECM.

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