cosmology.[3] Although several have suggested energy-conserving tired-light mechanisms in which the "lost" energy remains in the physical universe in degraded form, nonconservative mechanisms also predicting a permanent loss of energy from the objective physical universe also offer a plausible alternative.[4,5] Even Maxwell considered the possibility of nonconservative photon behavior. His original electromagnetic wave equation contained the energy-damping term $\sigma_0 \mu_0 \; \partial\phi/\partial t$, where σ_0 represented the electrical conductivity of background space.[6] The next section summarizes an approach that predicts nonconservative photon energy behavior, even though the *subquantum* reactions it hypothesizes as the basis of objective physical phenomena are themselves conservative.

2. A NONCONSERVATIVE FIELD THEORY

Subquantum kinetics, a nonlinear unified field theory, predicts that photons should behave in a nonconservative manner in most regions of space, redshifting in intergalactic space and blueshifting in the vicinity of galaxies, the sign and magnitude of a photon's rate of energy change depending on the magnitude of the ambient gravitational potential, ϕ_g, relative to a particular critical value ϕ_{gc}.[5,7] This is the first theory of its kind to apply an open system reaction-kinetics methodology to microphysics. It allows us to describe microphysical phenomena with conceptual and mathematical tools similar to those used in chemistry and the life sciences (e.g., biology, sociology, ecology, and economics), thus making possible a unified approach to systems phenomena. The basic subquantum kinetics equations spawn subatomic particlelike structures that surround themselves with fields (concentration gradients) that accurately portray electrostatic and gravitational energy potential fields. A few advantages of this physics are: it resolves the wave-particle dualism, field-particle dualism, the particle dispersion conundrum, and infinite energy absurdity. In oscillatory motion their fields produce radiant energy waves.

The nonconservative wave equation for radiant energy in subquantum kinetics is derived below. Those who are not familiar with the reaction kinetics methodology, more commonly utilized in chemistry and nuclear engineering, may wish to consult the main papers on subquantum kinetics, which more fully explain the approach.[5] The five kinetic equations given below together specify one possible subquantum kinetics reaction-diffusion system model. This Brusselator-like system is called Model G:

$$\begin{gathered} A \xrightarrow{k_1} G, \quad G \xrightarrow{k_2} X, \\ 2X + Y \xrightarrow{k_3} 3X, \quad B + X \xrightarrow{k_4} Y + Z, \quad X \xrightarrow{k_5} \Omega. \end{gathered} \tag{1}$$

These represent a set of inherently unobservable nonequilibrium reaction processes hypothesized to take place throughout all of space among various types of subquantum units – "etherons." The letters denote spatial concentration magnitudes of these ether media: A and B are the initial reactants; G, X, and Y are the reaction intermediates; and Z and Ω are the final products. Parameters k_1 through k_5 specify the reaction rate constants for these reactions. Model G (1) is expressed in time-dependent form by the following set of nonlinear partial differential equations:

$$\begin{aligned} \partial G/\partial t &= k_1 A - k_2 G + D_g \; \partial^2 G/\partial r^2, \\ \partial X/\partial t &= k_2 G + k_3 X^2 Y - k_4 BX - k_5 X + D_x \; \partial^2 X/\partial r^2 \\ \partial Y/\partial t &= k_4 BX - k_3 X^2 Y + D_y \; \partial^2 Y/\partial r^2 . \end{aligned} \tag{2}$$

where D_i are the diffusion coefficients for each variable specie.

Energy potential is identified with the deviation of a specie concentration above or below its *steady-state* concentration value. Thus if G_0, X_0, and Y_0 are the steady-state values for variables $G(r)$, $X(r)$, and $Y(r)$, then gravity potential is measured as $\phi_g(r) = G(r) - G_0$, and electrostatic potential is measured by $\phi_x(r) = X(r) - X_0$ and $\phi_y(r) = Y(r) - Y_0$, X and Y being complementary reactants that exhibit an interdependent reciprocal relationship.

The reaction system is *subcritical* when $G > G_c$ and *supercritical* when $G < G_c$, where G_c the critical value that brings the system to its threshold of marginal stability. Specifying the critical gravitational potential value as $\phi_{gc} = G_c - G_0$ (where $G_c < G_0$), the system is subcritical when $\phi_g > \phi_{gc}$ and supercritical when $\phi_g < \phi_{gc}$. Under supercritical conditions the reaction processes amplify energy fluctuations (concentration fluctuations) that arise spontaneously in the subquantum medium, and these eventually give rise to localized energy densities, subatomic particles that possess both "charge" and "mass" characteristics, and that generate radially disposed $\phi_g(r)$, $\phi_x(r)$, and $\phi_y(r)$ potential fields consistent with the laws of classical electrostatics and gravitation. Motion of a ϕ_x and ϕ_y electrostatic potential field can induce forces equivalent to the magnetic forces of Ampère.

An oscillating ϕ_x and ϕ_y field produces propagating reaction-diffusion waves, representing waves of radiant energy. A general expression for the propagation of a reaction-diffusion wave in a single r dimension is given as[8]

$$\phi_x(r, t) = \exp[i(k_R r - \omega t)] \exp(-k_i r), \tag{3}$$

or

$$\mathcal{A}(r) = \mathcal{A}_0 \exp(-k_i r), \tag{4}$$

where $\mathcal{A}_0$ is the wave's initial amplitude, $\mathcal{A}(r)$ is its amplitude at distance r, and k_R and k_i are the real and imaginary parts of the wave number $k = 2\pi/\lambda$. For $k_i = 0$, the wave amplitude stays constant; for $k_i < 0$, supercritical conditions prevail and wave amplitude gradually increases; and for $k_i > 0$, subcritical conditions prevail and wave amplitude gradually decreases.

In a similar fashion, for Model G wave energy may be written as

$$E(t) = E_0 \exp[\alpha(\phi_{gc} - \phi_g)t], \tag{5}$$

where $E(t)$ is the energy of the wave at time t, and α is a constant of proportionality. The reaction system generates energy-conserving time-invariant waves only for regions of space where the subquantum reaction system is operating at the critical threshold; that is, where $\phi_g = \phi_{gc}$. In all other regions of space the wave's energy would be nonconservative. In the vicinity of galaxies, where gravitational potential is particularly negative, supercritical conditions would prevail ($\phi_g < \phi_{gc}$), causing wave energy to progressively increase with time and photons to blueshift; see Fig. 1. In intergalactic regions of space, where gravitational potential is much less negative, subcritical conditions would prevail ($\phi_g > \phi_{gc}$) causing wave energy to progressively decrease with time and photons to redshift. Again, it should be emphasized that the nonconservative wave behavior portrayed by this equation emerges as a *prediction* of subquantum kinetics.

Care should be taken not to confuse this photon redshifting and blueshifting effect with the gravitational redshift, which is another effect derivable from subquantum kinetics. The gravitational redshift (or blueshift) only occurs in response to a change in the ambient gravitational potential,