A PHOTON-NONPHOTON UNIVERSE
(Technical Brief)

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A simple model of the universe is emerging from a series of studies conducted over a period of some fifty-plus years. Late 1940's studies of a possible photon-like inner structure of electrons, protons and neutrons and the particle-interaction studies of fission chain-reacting systems during the following three decades merged with those on black body radiation to suggest a "photon-nonphoton" model. Like other recently proposed models, the concept sketched here is not offered as "a theory of everything". However, it does suggest simple explanations of what constitutes dark energy, what appears to be dark matter and what causes gravitational forces.

A detailed report on the history and status of the model's construction is given in the 19 November 2002 document entitled "A Photon-Nonphoton Universe"(1). The following represents a technical brief on the main ideas detailed in the 134-page Reference 1 document. The two-vector formalism used to define properties of photons and nonphotons, the two basic pointlike particles of the modeled universe, is defined as is the fission-fusion postulate underlying their symbiotic coexistence in such a universe. How the equilibrium densities of such particles are derived and their relative magnitudes in a 2.73 Kelvin universe are then noted. Redshift in the static universe model is explained in terms of special features of the above postulate. How Newtonian-level gravitational forces may be understood in terms of elastic impacts of nonphotons on the photon-like constituents of matter is then sketched. The features of the emerging photon-nonphoton universe model are summarized. These include estimated values of the properties of the model's point-like constituents and of photonic-ring models of electrons and nucleons. Estimated values of probability-related quantities for various interactions between pairs of the model's point-like constituents are summarized. Special features of the model's nonphotons, such as their abilities to mimic the existence of dark matter and of repulsive gravitational forces, and their potential to fuel a nonphoton fission reactor are noted. This technical brief concludes with notes on possible future theoretical and experimental efforts to determine the true potentialities of the photon-nonphoton universe concept.

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The model here sketched assumes the universe is infinite in both its extent and age. Accordingly, it predicts that, as we become able to look farther and farther, we will continue to find galaxies in the same stages of development that have been previously observed for the nearby galaxies. On the largest cosmological scale, the model assumes that a uniform distribution of the various entities making up the universe exists at all times. On lesser scales, patches of the universe may experience "mini big bang" events that produce the observed mix of light nuclei as these hot spots cool toward the 2.73 Kelvin level of the infinite universe. As later explained, there exists an ample "dark" energy density in the model's ethereal non-photons for the not-so-ethereal photons to cause such mini big bang events.

PHOTONS AND NONPHOTONS

The model assumes all things consist of point-like particles whose properties conform with special relativity and whose interactions conform with the conservation of mass-energy and momentum. The properties of such a particle are expressed in terms of two vectors, $\underline{E}$ and $\underline{B}$, whose lengths are denoted by E and B. Features of this two-vector formalism are:

(i) $\underline{E}$ is perpendicular to $\underline{B}$.

(*ii*) In units of the speed of light, c, the speed of a particle is given by

$$\beta = \frac{2EB}{E^2+B^2}$$

which falls in the range: $0 \leq \beta \leq 1$. For photonic particles, $E=B$ and $\beta=1$. If $E \neq B$, we refer to the particle as a "nonphoton" which moves at a speed in the range $0 \leq \beta < 1$. "Photonics" and "Nonphotons" are the two basic particle species assumed to make up a photon-nonphoton universe.

(iii) In units of ε/c^2, where ε is a tiny unit of energy, a particle's inertial mass, m, is given by

$$m = E^2 + B^2.$$

(iv) In units of ε/c, the magnitude of a particle's momentum, p, is

given by

$$p = 2EB.$$

A particle's momentum is perpendicular to the plane of its formalism vectors, $\underline{E}$ and $\underline{B}$ in the direction of $\underline{E} \times \underline{B}$.

PARTICLE FUSION AND FISSION

Underlying the construction of a photon-nonphoton universe model is the postulate that a particle with vectors $\underline{E}$ and $\underline{B}$ may fuse with a particle with vectors $\underline{e}$ and $\underline{b}$ to form a particle with vectors $\underline{\mathcal{E}}$ and $\underline{\mathcal{B}}$ (and the converse fission of the latter into the former pair may occur) if

$$\underline{E} + \underline{e} = \underline{\mathcal{E}}$$
$$\text{and} \quad \underline{B} + \underline{b} = \underline{\mathcal{B}}$$

as such events would be viewed in a preferred inertial frame. In that frame, an observer would see the microwave background photons to move isotropically. As explained in detail in Sections II and III of Reference 1, the above, together with the mass-energy and momentum conservation laws, leads to a universe model where photons and nonphotons exist symbiotically. That is, a pair of photons may fuse to form a nonphoton which may later fission to return the same two photons to the universe.

In other than the preferred frame, the above postulated "law" for fusion or fission is expressible in terms of the observable velocity of such a frame relative to the preferred frame. A possible experiment to determine a frame's relative velocity is described in Appendix A and the transformed fusion-fission postulate is examined in Appendix B of Reference 1. Since the preferred frame offers the simplest examination of the fusion-fission processes, the following considers these processes in that particular frame.

PHOTONS AND NONPHOTONS IN EQUILIBRIUM

To establish the densities of photons and nonphotons that symbiotically come to equilibrium, we follow the approach used by Bose to replicate Planck's black body photon spectrum*. The energy of a particle, as seen in the preferred frame, is taken to equal an integer times ε, now a tiny quantum of energy that is much smaller than the energy of an average microwave

**See Section IV of Reference 1*

background photon. On this basis, the densities of photons and nonphotons in an equilibrium mix are determined. As shown in Figure 1, Planck's photon curve is extended into a surface that represents inertial mass-energy densities of nonphotons as well as photons in an equilibrium particle mix. Figure 2 displays these densities as functions of particle inertial mass energy and speed as seen in the preferred frame. In those figures, the usual symbols, k and h, represent Boltzmann's and Planck's constants.

Special features of the particles in a modeled 2.73 Kelvin universe are displayed in Table 1. The average energies of both particle species are seen to be comparable—about a thousandth of an eV (electron volt). In the preferred frame, the speed of the average nonphoton is found to be ~81% of the photon speed. However, the total densities of the two particle species differ widely. Nonphoton densities dwarf those of photons by a factor of order kT/ε. For the T = 2.73 Kelvin universe and a value of ε compatable with the nonphoton gravity concept later discussed, a value of kT/ε of about 1.21×10^{77} has been estimated.

According to Reference 2, apparently various computations compatible with quantum mechanics yield numbers in the range 10^{55} to 10^{120} for the ratio of vacuum energy density to that of matter and radiation. Table 1 information, together with the above-cited kT/ε value, yields an inertial mass-energy density of nonphotons of about 2×10^{77} eV/cm^3. And, $c^2 \times (10^{-30}$ grams/cm^3), or 850 eV/cm^3 represents the average energy density of matter and radiation in the universe. Hence, the emerging photon-nonphoton universe model implies a "dark energy" density of ethereal nonphotons of about 2×10^{74} times that of observable matter and radiation, a number in the wide range compatible with quantum mechanics. A divergent chain reaction, where photons induce the fission of nonphotons into photon pairs, offers an explanation of mini big bangs in portions of an infinite photon-nonphoton universe. The matter and radiation in a 10-billion light-year radius sphere, for example, has an inertial mass-energy equal to that of the photons born from the fission of all the nonphotons in a 32-meter radius sphere.

PHOTON REDSHIFT IN A STATIC UNIVERSE

The observed redshift of light that has traveled cosmological-scale distances is generally attributed to special relativistic Doppler effects. Being based on special relativistic point-like particle dynamics, the photon-

nonphoton universe model, of course, also recognizes this type of redshift. However, we do not require that the observable universe be expanding to explain redshift as does a "big bang"scenario. In Section V of Reference 1, we detail how redshift would occur in a photon-nonphoton universe that is not only infinite but also static when viewed on the largest cosmological scale.

Basically, as a photon emitted from a source travels to a detector, the tiny ε-quanta of the source photon are progressively lost via fusion with the quanta of microwave background photons. Half of the mass-energy of the nonphoton debris equals that lost by the redshifted source photon. For small source-to-detector distances, this type of redshift is roughly proportional to distance. At large distances, the redshift tends to increase exponentially with distance. Thus, a dark night sky is assured in an infinite static universe that is uniformly populated by photon sources. It is noted that if the near-exponential increase of redshift at large distances is used to compute a speed via the Doppler equation, the results might be interpreted as an acceleration of the rate of expansion of an expanding universe.

NONPHOTON GRAVITY

The photon-nonphoton universe model assumes the bodies in solar-type systems present very thin targets to the ethereal nonphotons of 2.73 Kelvin space. On this basis, it may be demonstrated that the Newtonian gravitational force between bodies can be understood in terms of elastic collisions of nonphotons with the basic photon-like constituents (photonics) making up such bodies of weighable (ponderable) matter. To accomplish the demonstation, the ethereal nonphotons and the photonics making up ponderable matter are represented by the average of each species. Section VI of Reference 1 details the demonstration task which required the specification of three quantities: λ, (kT/ε) and γ.

A nonphoton must travel through an average of λ grams/cm^2 of weighable matter to experience its first elastic collision with a photonic constituent of such matter. Nonphoton Newtonian gravity is a first collision concept. The effects of second collisions are assumed to cause the uncertainty in the measured values of G, Newton's gravitational constant. That uncertainty is taken to be about one part in 10^5. The probability for a second collision in the sun would be about 10^{-5} if $\lambda = 10^{16}$ grams/cm^2, the value of λ taken here. And, of course, such a large λ-value satisfies a basic