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RESEARCH ARTICLE

Unidentified Aerial Phenomena (UAP)
A New Hypothesis toward Their Explanation

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Abstract—For six decades now luminous and other unidentified aerial phenomena (UAP) have been sighted worldwide in large numbers. Extensive scientific unidentified aerial phenomena observations have been made over the last 26 years in Hessdalen, Norway. The optical properties of luminous UAPs have been described in detail, but all efforts to explain them by terrestrial causes have failed. Earlier scientific attempts to explain UAPs by extraterrestrial visitation (ETV) have failed as well. A new ETV hypothesis is proposed which aims at causally explaining all luminous UAP sightings in Hessdalen and most elsewhere. To this end a galactic neighborhood scenario and model is defined. It explains why a stealth ETV probe equipped with artificial intelligence (AI) has been built by an exo-civilization and sent in a historical past into our solar system. It states that this extraterrestrial visitation probe (ETVP), now orbiting the earth, occasionally sends a stealth electromagnetic beam (SEMB) down into the atmosphere. It explains in detail how such an SEMB produces luminous UAPs by means of a nonlinear photonic mechanism which, as such, has been known and investigated since 1995 as a branch of current femtosecond physics. This photon mechanism is further developed into a UAP-A and a UAP-B model. Together the two models explain all optical Hessdalen observations.

Keywords: UAP—UFO—extraterrestrial probe—femtosecond—laser filamentation

Introduction

Unidentified aerial phenomena, UAPs, are one of a few subjects that have not been elucidated for more than 60 years. This was still the case in 2012 despite tens of thousands of reliable UAP sightings and observations compiled around 2005 into several, governmentally supported, comprehensive reports (Defence Intelligence Analysis Staff 2000, COMETA 2003). The objective of this article is to explain all luminous UAP sightings in a scientific–technical way, analogous to explaining polar lights in the ionosphere or stern waves behind a moving ship. In what follows, major known properties of luminous UAP are listed. A 25-year-long program of reliable UAP observations in Hessdalen, Norway, is used as a database (Hauge 2010). Existing hypotheses to explain UAP sightings are reviewed and found unconvincing.

A new local SETI (search for extraterrestrial intelligence) hypothesis is presented. It postulates a stealth extraterrestrial visitation probe (ETVP), located in a high earth orbit. Such a probe presupposes the existence of a space-faring exo-civilization. This leads to investigating an exo-civilization scenario that includes a novel process of identifying the earth as a suitable destination for sending an ETVP. A galactic neighborhood model is set up to estimate the likely lifetime of an extraterrestrial civilization that could have sent an ETVP. Existing ETVP hypotheses and searches to detect various objects in near-earth space are reviewed. It is concluded that the presence of a stealth ETVP is a plausible premise for a hypothesis to explain UAPs.

A characterization of the ETVP is attempted and its required properties evaluated. It orbits the earth without public knowledge. An SEMB, defined as a stealth electromagnetic beam emitted by the ETVP, is further postulated. It is explained how the SEMB produces UAPs by means of a nonlinear photonic mechanism. This mechanism has been known and investigated in detail since 1995 in the context of femtosecond physics (Braun, Korn, Liu, Du, Squier, & Mourou 1995). It appears capable, after some extensions, of providing a causal explanation for all optical properties of all kinds of luminous UAPs as observed in Hessdalen and elsewhere.

Major Known Properties of Luminous UAP

Several large compilations of UAP sightings have been published over the last few decades (Defence Intelligence Analysis Staff 2000, COMETA 2003). Alternative terms in use are: UFO for unidentified flying objects, UER for uncorrelated event reports, and OVNI for objets volants non identifiés. Some 25 different UAP properties observed in Hessdalen (Teodorani 2004) and/or elsewhere are summarized in List 1. The list is not yet complete; it should be worked out in more detail and also be extended to include electromagnetic and chemical properties of UAPs.

List 1: Known Properties of UAPs

Shape Properties

A1 Diameter approximately 0.3 to 30 m
A2 Single dots or balls; disk, triangular, rectangular, airship shapes
A3 Clustered dots in grape, chain, detached formation
A4 Worm, rod, hook, spiral, irregular shapes

Surface Properties

B1 Estimated 0.1 to 100 KW light output if isotropic light emitted
B2 Color mostly white, occasionally blue, amber, or red
B3 Small white or colored lights superimposed on a larger dark UAP

Dynamic Properties

C1 Sudden appearance and disappearance
C2 Visible for typically 0.01 to 1 hour
C3 Diffuse overhead flashes, localized UAP
C4 Steady lights, semi-regular intensity changes at a few Hertz
C5 Immobile, moving at various speeds in both lateral and axial directions
C6 Moving on a smooth curve, taking sharp turns, accelerating suddenly
C7 Tracked by radar at speeds of up to approximately 10 km/sec

Reaction Properties

D1 Reacting to a laser beam with a doubling of blinking frequency
D2 Carrying out avoidance maneuvers with respect to airplanes
D3 Changing flight path in reaction to radar beams

Acoustic Properties

E1 Mostly silent when moving at a sub- or super-sonic speed
E2 Rarely emitting a hissing noise

Sighting Properties

F1 In many places, on all continents, at all latitudes to above 60°
F2 Over all months, year after year
F3 From ground, ships, airplanes, and spacecraft
F4 Everywhere low or high up in the sky, and just above ground
F5 Under blue sky, clouds, with land as background
F6 Under high air humidity conditions, in dry air

Existing Hypotheses Concerning UAP Sightings

The deluded viewer hypothesis has always been and is still invoked in the context of UAP sightings (Defence Intelligence Analysis Staff 2000, COMETA 2003). Deluded viewers are said to have in reality seen balloons, flares, satellites, lenticular clouds, birds, the planet Venus, etc. There is a consensus that 60% to 80% of all alleged UAP sightings reported worldwide belong to this category. The remaining 20% to 40% of sightings reported are accepted as genuine UAPs. They justify the search for a scientific explanation. During the period 1950 to 2000 approximately, genuine UAP sightings were mostly interpreted as unidentified flying objects (UFOs).

They were thought of as solid crafts with an inertial mass and a volume that causes the displacement of air (Hill 1995).

UAPs are capable of extraordinary flight performances, controlled maneuvers, and various kinds of interactions with aircraft (Weinstein 2010). This has led to the hypothesis that UAPs are piloted, extraterrestrial vehicles, visiting the earth. However, such an extraterrestrial visitation (ETV) hypothesis faced several unsolvable problems. A first question concerned the extreme flight performances and lack of downwind of the supposedly massive UFOs. The only answer was to postulate the use of an as-yet-unknown force field (anti-gravitation), which does not exist within the realms of generally accepted physics (Hill 1995). A second problem concerned the energy source that could provide the power necessary to hover and repeatedly accelerate massive UFOs. Further questions such as: "How could an antigravity UFO function? Would it have an inertial mass or not? Would Newton's mechanical reaction principle remain valid?" remained without answers. A third problem concerned the silence with which UFOs move at both sub- and supersonic speeds. It is incompatible with a turbulent airflow and a conical pressure wave built up around a moving, air-displacing body. A fourth problem has been, until recently, the lack of any scientific basis to assign a non-zero probability to the existence of advanced exo-civilizations, capable of interstellar travel (Forgan 2009). Because of these four major and several other problems, notably the sudden appearance and disappearance of UAPs, no ETV hypothesis could be developed that would explain a majority of all UAP observations in a scientifically acceptable way.

Systematic observations by scientists in Hessdalen, Norway, starting in 1985 (Hauge 2010) showed that nearly all of their UAP sightings were genuine. The deluded viewer hypothesis that, elsewhere, had always been evoked as an explanation for a majority of all UFO or UAP sightings, could thus be eliminated. Moreover, all UAPs that were visually and instrumentally observed in Hessdalen could be interpreted as thermal plasma balls (Teodorani 2004) rather than as massive UFO crafts. The interpretation of UAPs as balls of ionized air with a density comparable to that of the surrounding atmosphere solved the problem of their hovering without creating any downwind and aerodynamic noise. It also avoided the problem of having to introduce a highly hypothetical antigravity lift force. However, the thermal plasma ball interpretation neither explained the erratic flight movements of UAPs nor their sudden appearance and disappearance. It also did not explain where the energy came from that heated them up to a plasma temperature of several thousand degrees.

Trying to explain the Hessdalen plasma balls by ETV thus remained nearly as problematic as trying to explain solid UFOs by ETV. Interpreting erratically moving plasma balls in the earth's atmosphere as intelligent ET visitors contradicted the common sense of most scientists, whether they worked in physics, exobiology, or space technology. To interpret the Hessdalen plasma balls other than by means of an ETV hypothesis seemed, therefore, the only possible way to go. Several terrestrial hypotheses were proposed with a view to elucidate the plasma ball enigma. A successful hypothesis would have to explain how such balls can suddenly form near the ground or up in the atmosphere, how they can hold still, move about, emit light, and disappear. It would have to explain the functioning of UAPs with an estimated light output of 20 KW and a diameter of 10 m (Teodorani 2009a).

The ball lightning and the earth light hypotheses appeared to be the most promising. Ball lightning must always be associated with strong atmospheric electricity as caused by thunderstorms. It can explain only slowly moving plasma balls of perhaps 20 to 50 cm in diameter, with a lifetime of a few seconds. However, most Hessdalen observations were made under quiet atmospheric conditions and could not be explained by ball lightning. Such observations were called earthlights to express the hypothesis that they appear for ground-related reasons. An entire range of partly sequential and partly simultaneous interactions of mechanical, electrical, thermal, chemical, optical, and/or biochemical forces in rocks, soil, or vegetation and in aerosols were combined in an attempt to formulate a credible earthlight hypothesis (Teodorani 2004). It conjectures that large-scale piezoelectric voltages are built up in compressed underground rocks and that they transform the soil into a powder with internally stored chemical energy. The powder is then supposed to rise up from the ground as an invisible aerosol ball or cluster without deforming into a plume. Once up in the air, it is supposed to start releasing its stored chemical energy into one or several, non-expanding balls of white light with a nearly flat radial luminosity distribution that may last for up to 30 min.

UAPs have also been observed in Hessdalen in wintertime when the ground is wet or frozen. It is difficult to imagine under these circumstances how a piezoelectric voltage could build up, how a fine powder could be formed without hydrating and agglutinating, and how such a powder could raise up in the air to suddenly form a luminous UAP aerosol ball. As a matter of fact, no UAP earthlight hypothesis has yet been formulated that would provide a parametric model description that yields acceptable estimates for the generation and sustentation of bright, large, long-lived, and also often erratically moving plasma balls such as observed in Hessdalen and elsewhere. Some hypothetical astronomical influences on UAP sightings have been investigated as well. They were checked by screening a large number of UAP sightings for possible, statistically significant daily variations as caused by an object in the daily rotating stellar background and/or by a slowly varying solar radiation influx. Neither investigation showed any significant correlation (Teodorani 2009b).

To sum up the present situation: Over the last 60 years there have been tens of thousands of genuine UAP sightings, and over the last 25 years hundreds of instrumentally recorded UAP observations. However, up to now, no hypothesis has been formulated that would explain a majority or all UAP sightings and observations. Not one based on atmospheric electricity, or one based on earthlights, or one related to astronomical influences has offered a scientifically satisfactory explanation. This situation leads to considering local SETI (search for extra-terrestrial intelligence) as the only path toward an understanding of UAP sightings (Teodorani 2006).

Stating the New Local SETI Hypothesis

The new local SETI hypothesis, first part, states that a stealth, automated extra-terrestrial visitation probe (ETVP) has been sent by an advanced civilization in the galactic neighborhood. This ETVP has been residing in our solar system for at least as long (decades or centuries) as UAPs have been sighted. It is deduced from UAP observations that the ETVP must orbit the earth, albeit still undetected. The hypothesis, second part, states that the ETVP occasionally emits an invisible electromagnetic beam (SEMB). It is deduced from photon physics that the SEMB, when interacting with the earth's atmosphere, is capable of creating a luminous UAP. The hypothesis, first and second part together, explains all Hessdalen UAP observations and probably all genuine UAP night-time sightings worldwide. It is surmised that most daytime UAPs could be explained by an extension of the same hypothesis. The new local SETI hypothesis does not apply to allegedly grounded, solid alien aircraft such as described in the Roswell incident in 1947 (Corso 1998).

New ETVP Hypothesis, General Exo-Civilization Scenario

In order to be scientifically acceptable, the new local SETI–ETVP hypothesis, beyond explaining UAPs, must also fit into a general exo-civilization scenario that is credible from an astronomical, exo-biological, and technical point of view.

Exo-Civilizations

A first point concerns the probability that advanced exo-civilizations exist, in parallel to our own, somewhere in other solar systems. Before 1995, exoplanets were essentially speculative objects. Between 1995 (Major & Queloz 1995) and mid-2011 some 550 exo-planets have been discovered and characterized, several of which closely resemble our earth (Schneider 2011). In 2011 the probability that at least one advanced exo-civilization exists in our stellar neighborhood was rated higher than before 1995. Consequently, explaining UAPs by an ETVP hypothesis cannot be rejected anymore on grounds of being too improbable.

Probe Propulsion

A second point concerns the technical feasibility of a propulsion system capable of accelerating and decelerating an interstellar space probe. This question has been addressed in several theoretical engineering publications (Project Daedalus Study Group 1978, Beals, Beaulieu, Dembia, Kerstiens, Kramer, West, & Zito 1989, Long & Obousy 2011). They assume an interstellar cruising speed of about 0.1 c, i.e. 0.74 astronomical units per hour. This speed appears attainable on the basis of emerging power- and space-propulsion concepts. Taking our human civilization as a baseline leads to the following likely sequence of developments: The first ground-based fusion reactors should operate before 2050. The first fusion-powered space probes reaching a speed of 10^{-4} to 10^{-3} c should become operational around 2100. Fusion-powered space lasers that accelerate interstellar probes to a speed of 0.1 c can be thus expected around 2200. An interstellar neighborhood voyage would then take several centuries or millennia, depending on the distance between the exo- and our earth-based civilization.

Interstellar Voyage

A third point concerns the type of interstellar voyage that is the most likely to be chosen by an exo-civilization. Taking again our earth civilization as a baseline, three major scenarios can be envisaged. Scenario S-A entails a voyage with human astronauts, S-B one with cyborg entities, and S-C one with an artificial intelligence (AI) subsystem only. What is needed in all three scenarios is an autonomous, highly flexible, and intelligent sensing, interpretation, guidance, and control capability, active during the exo-earth visitation phase of the probe. Any remote control seems excluded as each signal roundtrip would take many years. Scenario S-A would require an extremely large and complex spaceship, since our astronauts' physiological and psychological well-being and their security during a multigenerational voyage would have to be assured. Scenario S-B would entail a few intelligent, non-reproducing cyborgs. They would hibernate during the long voyage to become active during the exo-earth visitation phase only. They would function with a support system that could be at least an order of magnitude simpler than necessary for human astronauts. Cyborgs would thus fit into a much smaller, less costly spaceship. Developing cyborgs could be cheaper than investing in an extremely large spaceship suitable for a multigenerational astronaut crew. S-C, an automated visiting probe, appears as the most realistic scenario. It represents a direct, although far-out extrapolation from presently operational autonomous spacecraft, which are exploring the various planets of our solar system. It is the only interstellar vehicle scenario that has already been subject to scientific exploration (Tough 1998). The AI capability, necessary to guide and control the spacecraft, would be part of its information processing system. The mass and complexity of such an S-C spacecraft should again be an order of magnitude lower than that required for an S-B spaceship with cyborg entities. Only scenario S-C will be retained here, in accordance with Occam's razor.

Telescopic Prior Knowledge of Earth

A fourth point concerns the probable knowledge acquired by an exo-civilization about our planet, previous to their launching of an ETVP. Taking again our earth civilization as a baseline leads to the following likely development sequence: A Darwin-type space telescope array (Cockell et al. 2009) will be operational around 2020 and produce the first information on the atmospheres of earth-like exoplanets. By 2100, the third or fourth generation of progressively larger synthetic aperture space telescope arrays will lead to a detailed physical and chemical characterization of many interesting exo-earths in our stellar neighborhood. Between 2100 and 2200 these exo-earths will be closely monitored for signatures of an active biosphere. At the same time, numerical models that describe their physical, chemical, and biological evolution will be developed. It is concluded that as soon as an ETVP can be built, i.e. after 2200, the biosphere of any exo-earth considered for a visiting probe will have been characterized in considerable detail. A similar telescopic observation sequence should hold for an exo-civilization that studies our earth biosphere before sending an ETVP.

Prior Detection of Human Civilization on Earth

A fifth point concerns the reason why an exo-civilization could have decided, several centuries or millennia ago, to launch an ETVP that produces UAPs in our earth atmosphere. It makes no sense to display strange UAPs over a planet with a plant/animal biosphere only. It is thus probable that the exo-civilization knew about the existence of our human civilization prior to their equipping and launching an ETVP. UAPs have been sighted at least since 1947 (Bourdais 1997) and probably several centuries earlier (Zeller 2006). At the time prior to launching an ETVP, i.e. still centuries earlier, our civilization had no electric streetlights, no TV, no radio emitters, etc., to reveal its existence. It must have revealed itself by other anomalies in the electromagnetic spectrum of the earth. These anomalies have probably been caused by agricultural activities and perhaps by winter heating of dwellings. Trace gases released from cattle herds, from ore processing, etc., may have been further indicators. It is probable that such early, civilization-revealing changes in our earth's spectrum can been detected over interstellar distances. They are all tied to the development of large-scale human settlements which started about 5000 years ago.

An ETVP, cruising for 5000 years at a speed of 0.1c, bridges a distance of 500 light years. This leads to the estimate that an ETVP-launching exo-civilization is located less than 500 light years away from our solar system. The telescopic study of our earth, which had led them to the decision to send us an ETVP, must have been carried out less than about 5000 years ago. If the exo-civilization is very near, for example only 20 light years away, then their ETVP launching decision could have been made in the 18th century.

Purpose of the Exo-Civilization's Probe Visitation

A sixth point concerns the objectives the exo-civilization wanted/wants to achieve with their ETVP. One obvious objective is to gather information about our human civilization. Another objective must be to inform us about their existence. This is inferred from the probe's persistent production of well-visible, but rather enigmatic UAPs.

Taken together, the answers given to the six points addressed above show that the proposed exo-civilization—and ETVP hypothesis—is internally consistent and credible.

New ETVP Hypothesis, Galactic Neighborhood Model

In order to be scientifically viable, the new ETVP hypothesis, beyond fitting into a general exo-civilization scenario, should also fit into an accepted probabilistic galactic neighborhood model. To clarify this issue, the Drake equation (Drake & Sobel 1992) is evaluated for a neighborhood sphere with a radius of 500 light years around our solar system. This sphere represents some 10^{-5} of the entire galactic volume, contains about one million stars, and allows for visits by ETVPs between neighboring exo-civilizations. The rate of star formation in the galaxy has been estimated to be R = 10 per year (Drake Equation 2011); in the sphere it is about 10^{-4} per year. It is assumed that the probability f_p for a star to possess a planetary system and, if so, to possess n_e earth-like planets is about $f_p \cdot n_e = 1$. The probability for such an earth-like planet to develop life, f_l, and then intelligent life, f_i, which forms an advanced civilization, has been estimated at $f_l \cdot f_i = 10^{-2}$ (Rose & Wright 2004). The product of the three probabilities leads to a rate of formation of new, advanced civilizations within the sphere of 10^{-6} per year. Any two such civilizations in our galactic neighborhood are, therefore, on an evolutionary stage that differs on average by about a million years. It is concluded that our civilization is, with a probability of 99.9%, not a historic contemporary (evolutionary difference of 1000 years or less) of any other galactic neighborhood civilization.

The Drake equation introduces a further probability f_c which expresses the possible inability or unwillingness of an advanced civilization to send out SETI-type radio signals; it has been estimated to 0.01 (Drake Equation 2011). This low probability supposes that an exo-civilization cannot identify in advance any solar system that harbors another civilization. Its SETI signals would thus have to be sent at random to many different stars. They would reveal the exo-civilization to its entire, yet unknown, galactic neighborhood. In the present article, the communication strategy assumed for exo-civilizations is entirely different. It starts with a covert, telescopic search for possible emerging civilizations living on candidate planets in suitably identified solar systems within the stellar neighborhood. Only once such a fledging civilization has been found, is an ETVP assembled and launched. The probe is smart, stealth, and, if required, withholds the identity of the exo-civilization that has sent it. With this newly proposed strategy, an exo-civilization sending an ETVP remains protected. It wastes no effort in launching useless SETI signals or ETVPs. The width of the communication channel established by means of an ETVP is much broader than with SETI (Rose & Wright 2004). Based on these three major advantages, the communication probability is now estimated to be $f_c = 1$.

The Drake equation finally introduces L, the probable lifetime of an advanced civilization. It has originally been estimated to be 0.01 million years (Drake Equation 2011). As our stellar neighborhood produces a new exo-civilization only about once every million years, it would, for 99% of the time, not harbor any advanced civilization at all. If, however, exo-civilizations had a probable lifetime of 10 million years, then our own civilization could, right from its beginning, have had about 10 much older exo-civilizations in its stellar neighborhood. Should L be evaluated to 0.01 or rather to 10 million years? It is noted that the first figure is an extremely short period in a planet's biosphere evolution. If, on earth, all Lucy-type creatures, 4 million years ago, after practicing biped locomotion for just 0.01 million years, had become extinct, then hominids would have been an evolutionary failure. This did not happen; the combination of a large brain, biped walking, and free hands was an enduring success. By analogy it is predicted that, on earth, the combination of a still larger brain, free hands, and technology-promoting social behavior will again be an enduring success.

At present, there are nearly 10^{10} living humans, a majority using technology products and services. It is probable that even the worst nuclear war or epidemic, etc., imaginable would not lead to a total extinction of the human species. It could ultimately force humanity to go a second time through the last 1000 years of its history of civilization. In this and in all other less dramatic cases it is foreseeable that humans, including their genetically modified descendants, cryogenic bodies, cyborgs, androids, etc., will go on striving for a similarly long period as the great apes have already been striving on earth. Taking this forecast for our earth civilization as a galactic baseline leads to a probable civilization lifetime of $L = 10$ rather than 0.01 million years.

According to the above-given probabilities for the Drake equation, our stellar neighborhood harbors, as an order of magnitude, 10 mature or aging civilizations. Their likely age of for example a million years is vastly different from that of our own civilization. Mature exo-civilizations must have gone through hundreds of historical epochs, each with their societal, technological, environmental, etc., ups and downs. This includes epochs of rapid technology advancement followed by epochs of technology stagnation, periods of population expansion followed by contraction periods resulting from partial self-destructions, epochs of biological and ecological transformations, migrations to other planets, and perhaps retreats back to the home planet, etc. Mainstream exo-civilizations are also likely to have a long history of mutual interstellar observation, communication, and traffic within the wider galaxy. According to the proposed hypothesis, one of these neighboring exo-civilizations has recently, i.e. less than about five thousand years ago, noticed the emergence of our civilization. It has launched a stealth ETVP that has now been residing for a historical period in earth orbit. It is equipped with a communication link that has been down-engineered to correspond to our past and present level of comprehension, both socio-psychologically and technologically. This communication link is identified as a stealth SEMB (structured electromagnetic beam) which produces UAPs, visible in various places on earth.

Previous ETVP Hypotheses and Searches

R. Bracewell in 1960 was the first to describe a hypothetical automated messenger probe (Bracewell 1960). His ETVP would have been launched centuries ago by a superior intelligent community. After arrival and slowdown in our solar system, it would have stayed in a local orbit for a long time. It would have first functioned in a silent, radio signal–receiving mode and then in a delayed radio signal–re-emitting mode and would have finally exchanged time-coded information with human radio engineers. A Bracewell ETVP would have revealed itself only to professionals equipped with a suitable transceiver system. Before Marconi's and Tesla's inventions, such a probe could not have carried out any messenger mission. Following R. Bracewell's publication, some experimental searches to detect an ETVP by its delayed return radio signal were carried out in 1974; the results were negative (Ridpath 1974).

R. A. Freitas described in 1980 a probe according to the J. von Neumann concept (Freitas 1980). Such an ETVP would replicate itself infinitely by using material collected in each of the solar systems visited. It appears to be at least one order of magnitude more complex than a Bracewell probe. The designers of a von Neumann probe would have to make sure that their ETVP does not produce unreasonably large numbers of clones in every solar system in the Galaxy. On earth, bacteria come close to micron-sized von Neumann probes; they fill up every ecological niche in every plant, animal, and soil.

Rose and Wright (2004) have shown that if interstellar messages are long and archival and if their transmission time is of secondary importance, then a probe with inscribed matter is in general a more energy-efficient vector than a SETI type beam of electromagnetic radiation. Their result further supports the present hypothesis of a material ETVP residing in our solar system.

Following the conclusions drawn in the sections "New ETVP Hypothesis, General Exo-Civilization Scenario" and "New ETVP Hypothesis, Galactic Neighborhood Model," it is probable that the ETVP, equipped with a communication interface adapted to our civilization, has been and remains located in near-earth space. The discovery of such a messenger ETVP is not assured, however. It requires, firstly, that the ETVP is designed to be detectable by our present-day space observation instrumentation; secondly, that this instrumentation is actually used to search for an ETVP; and thirdly, that a positive search result is published for everyone to know about.

In 1981/1982 a telescopic–photographic search was carried out to detect possible natural or artificial objects in the earth–moon libration points; the result was published and is negative (Valdes & Freitas 1983). In 2001 an automated instrumental optical search for a possible ETVP, resident in a solar or an earth orbit, was proposed, but apparently not implemented (Stride 2001).

In 1998 NASA formally embraced the goal of finding, tracking, and cataloguing by 2008 some 90% of all near-earth objects (NEOs), such as asteroids and comets with a diameter of 1 km or larger which, sometime in the future, may come dangerously close to the earth (Yeomans 1999). Several wide-field telescopes with mirror diameters of up to 2 m were and are still used for this Spaceguard program. A NEO search constitutes, without saying, also a search for a near-earth ETVP. At one AU distance (astronomical unit—distance from earth to sun), the minimum diameter for detecting an NEO or ETVP with an albedo above 0.1 is about 1 km. At lunar distance, i.e. about 1/400 closer, it is a few meters. Some 700 NEOs have been discovered since, but no ETVP seems to be among them. In 2003 a study was carried out to determine the feasibility of a follow-up search for NEOs in solar orbit with a diameter down to 140 m by the year 2028 (Stokes et al. 2003).

Man-made objects in earth orbit are observed by the ground-based US Space Surveillance Network (SSN) and the follow-up Space Fence Network. It comprises some 25 multistatic and conventional radars, optical telescopes, communication links, and data processing facilities (SSN 2011). The ESA is currently configuring a similar network (ESA 2011). Automated optical tracking and laser ranging of small objects in space has also been carried out by the University of Berne (Schildknecht 2010). Nearly ten thousand man-made objects are currently tracked and catalogued in their low, intermediate elliptical, and high geostationary orbits by the Space Fence Network. These active/inactive satellites, spent rockets, and larger space debris constitute a permanent collision hazard. Up to now, neither an earth-orbiting natural object (a second moon) nor an ETVP seems to have been discovered. In 1970 the USA started to deploy a Defense Support Program (DSP), which comprised 23 launches of geostationary satellites (Defense Support Program 2011). They form an infrared imaging platform for intelligence, surveillance, and reconnaissance (ISR) of missile launches. This first-generation platform will, from 2011 on, be progressively replaced by another space-based infrared system (SBIRS) that will be able to observe a variety of thermal objects in near-earth space and on the earth's surface with an improved spatio–temporal resolution and over a wider part of the IR spectrum (SBIRS 2011).

None of the science or engineering teams working in any of the above-mentioned NEO-debris, satellite-debris, space debris, and DSP/SBIRS programs seems to have published any observation concerning an object with features indicative of an ETVP. The presence of an ETVP remains nevertheless a credible hypothesis to explain UAP sightings. Either the ETVP has been designed so as to escape observation by all human-built detection/tracking systems, or else an ETVP has indeed been detected but has never been made the subject of a scientific publication.

New Hypothesis, Characterization of the ETVP

High Earth Orbit

The first unknown property of an ETVP according to the new hypothesis concerns the orbital height. UAPs have been sighted in many places on earth, nearly every month, year after year. An ETVP in a solar orbit is unlikely as it would be located much of the year at a distance of about an AU (earth–sun distance). In order to generate a UAP on earth, the ETVP must emit an SEMB in the NIR (near infrared) range that can be focused down to approximately 1 m. According to the laws of wave optics, the ETVP would require, at one AU distance, an emitting and focusing structure of about 100 km diameter, whereas, in a high earth orbit, a structure of 30 m diameter is sufficient. A 100-km–size structure would require a 10^7 times larger mass which appears an unlikely choice for an ETVP. It is inferred that the ETVP is in an earth orbit, not farther out. According to the hypothesis, the ETVP must have been present for at least as long as UAPs have been sighted. However, none of the ongoing near-earth space observation programs seems to have detected such a probe. This apparent contradiction is solved if it can be shown that a sufficiently stealth ETVP is technically feasible.

Probe Size and Orientation

The second group of unknowns of an ETVP include its size and orbital parameters. An earth-facing, cylindrical reference probe with a diameter of 30 m, orbiting at a distance of 50,000 km, is assumed. A rationale is given in the section "New Hypothesis, Characterization of the SEMB." The reference diameter and distance together allow for an estimate on how stealth the ETVP needs to be. An NEO with an albedo of 0.1 at the indicated distance would remain undetected if it had a diameter of about 0.3 m or less. The reference probe has a diameter which is two orders of magnitude larger. To remain undetected, its albedo across the visible and infrared wavelengths, for which the telescopes employed are sensitive, and also its radar signature, must, therefore, remain below 10^{-5}. It is deduced that the reference ETVP should have a surface with a specular reflectivity in the entire solar spectral range of about 99.999%. All its visible surfaces should be oriented such that any radiation from the sun, the moon, and the earth itself is reflected away from the earth with its NEO telescopes and Space Fence Network. In order to present no thermal signature to the DSP or to future SBIRS satellites, the reference ETVP should furthermore be reflective in the entire thermal infrared domain or else be cryogenically cooled. It should finally be designed so as to radiate its excess heat only into a (double) cone which points into the unobserved direction of the earth's axis. Laser mirrors with a required reflectivity of 99.999% in a limited spectral range are state of the art (Rempe, Thompson, Kimble, & Lalezari 1992). The technology needed to design, build, and position a stealth spacecraft is known as well. A US patent, published in 1994, describes a passive conic mirror shield that renders an earth-orbiting satellite practically invisible both in the optical and radar domains (Eldridge, McKechnie, & Hefley 1994). It is inferred that an ETVP may use a similar, but superior stealth technology. To perform beyond the US patent description, the ETVP could actively nullify any residual return signals from radar or lidar beams sent in its direction. An additional detection risk would arise if the ETVP passed repeatedly between the earth and the sun or the moon. It is inferred that the ETVP may modify its orbit from time to time, so as to avoid occluding passages observable from earth.

Probe Power Capacity

The third unknown about an ETVP is its power capacity. In Hessdalen, the maximum visible light power of a UAP, evaluated as an isotropic (4π) emitter has been estimated to be 35 to 100 KW. It will be shown in the sections "New UAP Hypothesis, Discussion of UAP-A and UAP-B" and "Comparing the New Hypothesis with UAP Observations" that a UAP, according to the proposed model, emits into a solid angle of approximately $\pi\ (0.15)^2 = 0.07$ (or less) and that the relevant NIR to visible light up-conversion efficiency is approximately 30%. The proposed ETVP model thus requires a SEMP-emitting system with a maximum, time-averaged NIR output of about 2 KW.

Probe's Sensors and Reactions

The fourth unknown about an ETVP concerns its sensor and AI subsystem. In Hessdalen, a blinking UAP has been observed to react to a returned small laser beam with a doubling of its blinking frequency (Strand 2000). A number of following and avoidance maneuvers of UAPs with airplanes have been reported (for example Associated Press 1986). UAPs have changed their flight path in reaction to radar beams (see for example Documenting Reality 2000). UAPs also seem to control their distance from the ground, from cars, pedestrians, etc. All these observations lead to the conclusion that UAPs are intelligently steered with a reaction time of probably less than a second. It is inferred that the ETVP must be instrumented to detect various objects on earth in the optical and radar domains, perhaps by using the UAP as a relay device. It is also inferred that the ETVP must process this earth observation data, interpret it, and then steer the SEMB so as to move a UAP purposefully inside the atmosphere, all in near real time. It is finally inferred that the ETVP must be located at a distance of less than about a light-second from the UAP which is a further indication that the ETVP is located in an earth orbit.

Probe's Orbit and Angle to Earth

The fifth unknown about an ETVP concerns its orbital parameters. UAP sightings have been reported from all continents around the earth (Ballester-Olmos 2009). This excludes the locking of a single ETVP into the earth rotation period. It is deduced that the time of revolution of the ETVP must be different from a stellar day and thus its distance different from a geostationary satellite (36,000 km). UAPs have been observed up to the latitude of Hessdalen (63° north), both in midsummer and in midwinter (Teodorani & Nobili 2002). This requires the ETVP to rise high enough above a northern horizon, and thus indicates an orbit that is strongly inclined with respect to the earth's equator. According to a statistical analysis carried out in 1975, UAPs remain visible for approximately 0.01 to 1 hour; they have been observed in 43 out of 508 sightings for at least 1 hour (Poher & Vallée 1975). Most UAPs have been sighted only locally but some have been observed by successive observers over a flight path of more than 1000 km (for example Sparks 1998). The proposed hypothesis requires that for all sighting locations, durations, and along all flight paths observed, the orbiting ETVP remains above the local horizon by an angle of perhaps 0.2 radian or more. Taken together, these observations lead to the conclusion that its earth revolution must last at least about 6 hours and that the corresponding orbit lies above 10,000 km.

Summing up, it can be stated that the ETVP must orbit the earth at a distance between 10,000 and 100,000 km, that its time of revolution is different from 24 hours, and that its orbital plane is strongly inclined to the equatorial plane. Its actual orbital parameters and size and shape remain unknown. For our further discussion, a reference ETVP in a circular 1.5-day polar orbit, which corresponds to a distance of 50,000 km above the earth surface, is assumed. It situates the ETVP considerably above all human-built geostationary and lower orbit satellites. This fits all observational data and allows for a UAP reaction time of 0.33 sec. The reference ETVP with its 30 m diameter and power capacity in the low KW range remains stealth in the optical, IR, and microwave domains with an albedo as low as 10^{-5}. The physics necessary to build such a space probe is understood today. The hypothesis of a large, yet undetectable ETVP in a high earth orbit is thus legitimate. Its capacity to emit an SEMB which produces UAPs is investigated below.

New Hypothesis, Characterization of the SEMB

The proposed hypothesis, second part, states that the earth-orbiting ETVP sends from time to time an SEMB into the earth's atmosphere where it creates, through a nonlinear photonic interaction with air, a luminous UAP. No publication has been found that formulates this or a similar concept. Also no visual, photographic, or video observation seems to have been published showing an SEMB arriving from space and ending up in a UAP.

It is necessary, therefore, first to investigate how an SEMB crossing the atmosphere could remain invisible to observers located nearby. An SEMB in the visible domain must obviously be excluded; this leaves UV and near infrared (NIR) ranges as major options. According to Raleigh's law, all light waves with a wavelength λ are scattered on the statistical density variations of air molecules with a $1/\lambda^4$ power dependence. An SEMB in the NIR range is more difficult to detect because it scatters nearly 100 times less than one in the UV range. To escape detection, its wavelength λ_S must lie beyond the sensitivity range of all instruments used up to now by UAP observers. It is inferred that the shortest SEMB wavelength that satisfies this conditions lies around $\lambda_S = 1.1$ μm.

In Hessdalen, UAPs have often been sighted near ground and under high air humidity conditions (Teodorani 2004). It is thus required that the SEMB is able to traverse the entire atmosphere with its strong CO_2 and H_2O molecular absorption bands in the NIR range. One explanation is that λ_S lies in between these vibration bands, i.e. in an atmospheric window at 1.0–1.08, 1.2–1.3, 1.5–1.75 μm, etc. Another explanation is that the SEMB is repetitively pulsed with a peak power sufficient to saturate an interacting H_2O or CO_2 absorption band within a few ps (picosecond, i.e. 10^{-12} s). A third explanation is that the SEMB is pulsed even faster, in the fs (femtosecond, i.e. 10^{-15} s) domain, i.e. too rapidly to couple with any molecular vibration modes. It is known that a repetitively pulsed, absorption saturating, or else an ultra fast–pulsed wave-train can traverse fog nearly loss-free at a near IR wavelength (Méjean, Kasparian, Yu, Salmon, Frey, & Wolf 2005).

The model ETVP at 50,000 km distance with an emitting structure of 30-m diameter produces an SEMB at $\lambda_S = 1.1$ μm which, according to scalar wave optics, can be focused within the atmosphere to an Airy disk of approximately 1 m diameter with a 50% intensity roll-off. An invisible SEMB, which can be focused under a wide range of atmospheric conditions to any chosen point in the atmosphere to create a visible UAP, appears now as a physically realistic concept. An observer located anywhere on the ground, in an airplane, or up in a spacecraft nearby sees only a UAP appearing in midair and nothing else.

A major observational fact that has baffled scientists in Hessdalen, and elsewhere many other persons, concerns the dynamic behavior and shapes of UAPs. UAPs appear out of nothing, remain immobile in the sky, move slowly, accelerate suddenly, take sharp turns, move at a high speed, and disappear instantly. Balls, chains, or clusters of dots, spiral-shaped, and irregularly shaped UAPs have been seen and photographically recorded in Hessdalen (Strand 2011) and elsewhere. Most of the observed UAP movements and shapes are incompatible with any known hypothesis based on natural, earth-related causes.

The new hypothesis, second part, explains the entire static and dynamic behavior of UAPs in a straightforward way. Their appearance is controlled by the ETVP which turns the SEMB on, steers it at various angular speeds in two lateral directions, and then turns it off again (the steering of UAPs in the third, axial direction will be discussed later). It is hypothesized that the ETVP possesses a fast, possibly solid-state, SEMB-generating, modulating, and deflecting system, which operates in the NIR domain. Human-built equivalents exist in the microwave domain. These are phased-array radar systems used to detect and track missiles and airplanes.

A remarkable film recording from Hessdalen shows a moving constellation of partly flaring UAPs in midair (Google Videos 2009). Other UAPs have been photographed sitting quietly on the ground (bubbles). It is estimated that, in order to appear immobile, a UAP should drift sideways by no more than about 0.3 m. It is surmised that the orbiting ETVP possesses a sensor subsystem that tracks a UAP with respect to the local topography (or to some airplane flying nearby) in real time. For the reference ETVP, considering the speed of light, the delay in the control loop of 2 times 50,000 km is 0.33 seconds. An estimate shows that the reference ETVP needs to control the UAP with respect to the earth surface down to lateral speed errors of about 1 m/sec. This amounts to an SEMB angular speed control of 20 nano-radian/sec, allowing for lateral excursions of about 7 nano-radian. To compare: The Hubble space telescope has a pointing accuracy of about 30 nano-radian.

UAPs are not always immobile or slowly moving. In Hessdalen, a bright UAP has been tracked by radar at a speed of 8.5 km/sec (Strand 2000). Similar hypersonic velocities of UAPs have baffled radar operators worldwide and worried air force officers from many countries. The proposed hypothesis readily explains high speed UAPs by a correspondingly high angular scan velocity of the SEMB. From the Hessdalen UAP observation, it is inferred that the reference ETVP would have to steer the SEMB at an angular velocity of 170 μ radian/sec. It is also possible to estimate the required dynamic range of the angular steering system in the ETVP: It must cover speeds from 0 up to about 10 km/sec with a resolution of 1 m/sec. This includes tracking speeds from 0 to 0.46 km/sec, necessary to produce immobile UAPs on the rotating earth, anywhere between the poles and the equator.

New UAP Hypothesis, Understanding Luminous UAP

In Hessdalen and elsewhere UAPs have mostly been observed in the form of luminous white balls or clusters of balls. Such UAPs light up in different positions and sometimes exhibit a jerky motion. A detailed analysis by Teodorani and Nobili (2002) of several Hessdalen UAPs has led to the following conclusions: Their visible spectrum appears broad band without any clearly discernible absorption or emission lines; it resembles a blackbody radiator approaching 6000 °K. Their luminance is nearly flat top, and their total luminosity is proportional to their surface, i.e. to the ball surface multiplied by the number of composing balls. It is noted that the luminance of a UAP is about six orders of magnitude below that of a 6000 °K blackbody. A Hessdalen UAP with an indicative radius of 10 m has been estimated to emit isotropically 35 to 100 KW of light over its luminous surface of about 1260 m^2 (Teodorani & Nobili 2002). A 6000 °K blackbody source, continuously emitting the same luminous power as this UAP, would require a luminous surface of only 5 to 14 cm^2. If the Hessdalen UAPs were indeed 6000 °K blackbody radiators, then they would have to repetitively flash up only during a fraction $\eta\ 0.4 - 1.1 \cdot 10^{-6}$ of the observation time in order to produce their estimated light output.

According to the new hypothesis, second part, the light emitted by a UAP results from an optical filamentation and air breakdown process discovered in 1995 by A. Braun et al. (Braun, Korn, Liu, Du, Squier, & Mourou 1995). This photonic process is obtained by means of an NIR laser which launches collimated fs pulses of sufficiently high power density into a transparent dielectric, for example air. The pulses self-focus, after an initial dark path, into one or several sub-millimetre-size NIR bullets, which are stable electromagnetic wave packets of high-energy density. In air, dark path lengths of up to 350 m have been experimentally produced (Béjot, Bonacina, Extermann, Moret, & Wolf 2007). The gradual self-focusing of pulses, i.e. their radial compression along a dark path, is known to result from a non-linear Kerr effect that locally augments the index of refraction of air. However, self-focusing also augments the electric field inside the pulses up to a point where free electrons are created by multi-photon absorption. Free electrons add a negative contribution to the refractive index which eventually balances the Kerr focusing effect. For typical 100 fs pulses in air the radially compressed NIR bullets reach an equilibrium diameter of about 100 μm for a length of 30 μm. Once formed, they fly over a path length that again depends on the initial properties of the pulses. Eventually the bullets' flights end; they fade out once the beam energy content has been exhausted. Along their flight path the nearly monochromatic NIR bullets emit a narrow forward cone of super-continuum light (SCL). A powerful pulsed NIR laser, emitting for example at $\lambda_S = 0.8$ or 1.05 µm, produces a bundle comprising N_B invisible bullets at λ_S, each of which produces a cone of visible SCL. The angle of the SCL cones depends on the wavelength considered. Blue-violet light is emitted in a semi-cone of about 4 mrad, red light in a semi-cone of 2 mrad (Maioli, Salamé, Lascoux, Salmon, Béjot, Kasparian, & Wolf 2009).

According to the proposed hypothesis, the SEMB produces bundles of NIR bullets in the atmosphere and these in turn create bundles of SCL cones equivalent to those obtained with laboratory lasers. The SEMB consists of sequential NIR pulses at λ_S, probably near 1.1 µm, which follow each other at a suitably high frequency f_S. On their way through space they keep their initial time-amplitude structure. Upon penetrating the stratosphere and part of the troposphere, they are progressively compressed in time and self-focus from their geometric diameter of about 1 m down to a beam waist in the dm range. There each pulse decays into a bundle of sub-millimeter size NIR bullets that each produce a visible SCL cone flashing in the forward direction.

The successive bundles of SCL light flashes aim downward to a fixed point on earth. An observer, positioned within the SCL cones, perceives their light and interprets it as a UAP. An observer close to the cone's axis receives a high fraction of red light and sees an amber-colored UAP. When positioned 2 to 3 mrads off-axis, the UAP appears white. When positioned 3 to 4 mrads off-axis the UAP appears blue. When positioned still further sideways, nothing is visible. This UAP description is valid for an SEMB that aims steadily at a fixed point on the ground. However, the ETVP may rapidly scan the SEMB inside an angular cone of a few milli-radians around a fixed point on the ground. An observer situated within the superimposed SCL and scanning cones then perceives a nearly white UAP, independent from his (small) off-axis position. At the same time the UAP appears to him as a small luminous disk, rather than as a point light source. This description, which is based uniquely on the hypothesis, second part, closely matches the optical properties of many UAPs as observed in Hessdalen and elsewhere.

The energy conversion efficiency from an NIR laser pulse to a bundle of visible SCL flashes has been investigated; it is approximately inverse to the laser pulse length. For very short 30 fs pulses, it reaches 30% (Petit et al. 2011). The forward distance travelled by the SCL is determined only by atmospheric conditions. In a Lidar experiment, single SCL flashes have been sent upward, 20 km into the stratosphere, from where a small fraction was backscattered and detected on the ground after a roundtrip of 40 km (Béjot, Bonacina, Extermann, Moret, & Wolf 2007). This indicates that, for a downward-directed SEMB, a small time-averaged optical power should already be sufficient to create a UAP which is well-visible to observers situated within the SCL cones.

Each NIR bullet in a round receives the same minimum amount of NIR energy from the SEMB. Provided that the loss mechanisms are the same for all bullets, they fly over the same path length before extinguishing. This path length defines the axial extension of a UAP. There are two major known energy loss mechanisms along the flight path of a bullet: Firstly, the bullet produces a visible SCL cone in forward direction which consumes a minor part of its energy. Secondly, it produces a filament of hot, weakly ionized air that it leaves behind. This heating process absorbs a major part of the initial bullet energy. The air, being inertially confined, has the same molecular density before and after the passage of a bullet. The total time-integrated length of a filament is the same as that of the corresponding bullet path. The ionized part of a filament, however, is much shorter. The initial degree of ionization is about $1 \cdot 10^{-3}$. It decays within the deionization time on the order of 100 ps (Tzortzakis, Prade, Franco, & Mysyrowicz 2000), which corresponds to a instantaneous ionized trail behind the bullet of about 30 mm. The ions emit, upon recombination, an isotropic afterglow. It contains a number of narrow molecular nitrogen and oxygen lines that span over the UV and visible part of the spectrum (Xu, Azarm, Bernhardt, Kamali, & Chin 2009). Farther behind the bullet the filament continues to exist for a few hundred ns in the form of an inertially confined tube of deionized hot air. Still later the filament starts to expand laterally and to cool down further. As a rough approximation it can be assumed that the luminous power emitted by the SCL cones is the same as that emitted by the filament afterglow. However, the SCL is emitted into a cone of approximately 10^{-5} rad^2 whereas the afterglow is emitted into a sphere of approximately 10 rad^2. A bundle of NIR bullets, when viewed from the side, thus shines approximately 10^6 times less strongly than when viewed against its propagation direction. It is concluded that a UAP, according to the above description, remains practically invisible to observers located outside the SCL cones.

The proposed hypothesis explains how UAPs can appear out of nothing in midair or near the ground, such as is often observed. It is necessary therefore that the invisible SEMB produces NIR bullets and herewith visible SCL cones only after a long dark path across the earth's atmosphere. The equation that describes the dark path length of self-focusing NIR laser pulses in the air, until bullet formation, is known (Chin 2006). It is proportional to the square of the entry-beam diameter and depends furthermore on optical parameters such as pulse power density, focusing state, and chirp. The atmospheric dark path length of an SEMB, until formation of a visible UAP, should obey the same equation. With an experimental laser beam of 8.2 cm diameter, the dark path length in air could be adjusted up to 350 m (Petit et al. 2011). The SEMB according to the hypothesis has a nominal atmospheric entry beam diameter of 100 cm. It should, therefore, travel over a dark path length that is $(12.2)^2$ times longer than the 8.2 cm beam, i.e. up to 52 km. Such a dark path length is sufficient, even for an obliquely incident SEMB, to traverse the entire earth's atmosphere and to generate a luminous UAP near the ground. The actual optical length of the SEMB dark path depends on its angle of incidence and on the air density integral along its trajectory. An ETVP that tunes the optical parameters of its SEMB in real time should thus be able to control the position of a UAP created along the beam axis. It is concluded that the new hypothesis is capable of explaining UAP sightings at any height above ground, in Hessdalen and elsewhere. It also explains how UAPs can rise from (near) the ground and accelerate unbelievably fast upward, to disappear at a high altitude within seconds.

The hypothesis is also capable of explaining how UAPs can be generated within a wide luminosity range. To this end a few further facts concerning the properties of NIR bullets in air need to be taken from photon physics. A single bullet of light is created as soon as the power density of a time-compressed (chirped) and Kerr-focused NIR pulse becomes high enough to produce a small, i.e. mm size, region of multi-photon ionization. A bundle of N_B bullets is created as soon as the total pulse power is large enough to produce a wider region of multi-filamentation (Petit et al. 2011). The bullets then form and fly with a lateral spacing of 3–10 mm and N_B becomes approximately proportional to the cross-section of the multi-filamentation region (Couairon & Mysyrowicz 2007a). The bullets extinguish as soon as the power density of the NIR pulse again falls below the critical value for beam self-focusing. The bullet flight path length from the point of creation to the point of extinction depends on the distance over which the critical power density is sustained against all dispersing and absorptive effects. This distance depends on the initial pulse power reservoir, on the pulse focusing state, on the mechanisms of bullet power loss, and on bullet mergers which in turn are influenced by optical turbulence (Couairon & Mysyrowicz 2007b). Bullet-path lengths between 6 m and 100 m have been produced by means of one experimental setup (Hao et al. 2009). Other experiments have been carried out to obtain bullet-path lengths spanning from a few cm to 2 km. It is concluded that the luminosity of a UAP is proportional firstly to the number of NIR bullets, i.e. to the number of SCL cones created in a bullet bundle. This means that the luminosity of a UAP is proportional to the cross-section of the multi-filamentation region formed within the focused SEMB. The luminosity of a UAP is, secondly, proportional to the bullet-flight path length, as this corresponds to the time each SCL cone emits. The luminosity of a UAP is, thirdly, proportional to the pulse frequency f_S, which corresponds to the rate at which bullet bundles, i.e. bundles of SCL cones, are created. If the ETVP is capable of generating an SEMB where each of these three factors can be tuned over a range of 1 to 10, then the luminous intensity of the resulting UAP can be varied across a range of 1 to 1000. An SEMB capable of creating a similarly wide range of luminous intensities appears necessary and sufficient to explain nearly all UAP sightings.

The proposed hypothesis, as described up to here, explains the formation of cylinder-shaped UAPs that are visible only in a narrow forward cone along their axis. Their diameter corresponds to the multi-filamentation region of the SEMB which is estimated to be in the dm range. Such small UAP diameters result from an SEMB with a nominal ETVP launching diameter of 30 m which has been focused first geometrically and then by Kerr effect. The UAP cylinder length corresponds to the bullet flight path length. The resulting UAP, if created at a pulse frequency f_S above the flicker fusion frequency, looks like a white, star-like object in the sky that can be visually observed and instrumentally recorded. Such a UAP can light up, shine steadily or else with variable intensity, and shut down in any time sequence.

This initial UAP description fits many but not all properties of UAPs as observed in Hessdalen and elsewhere.

There are several reports about large, spherical- or disk-shaped UAPs with radii of 10 m and above (Teodorani & Nobili 2002) and also about UAPs with non-spherical, for example triangular, shapes. It is useful, therefore, to extend the initial hypothesis with a view to explaining the production of large, arbitrarily shaped UAPs. The extension is based on an ETVP emitting an SEMB which is recurrently line scanned or scatter scanned, etc., in two lateral directions. The scanning speed necessary to create a large luminous UAP disk of for example 20 m diameter can be estimated as follows: The focus bundle of SCL emitting bullets is 0.2 m across, whereas the diameter of the UAP disk is 100 times larger. To avoid any visual flicker, the entire UAP disk must be scanned at a rate of at least 30 Hz; this yields a scanning speed of $0.2 \text{ m/s} \times 100^2 \times 30 = 60 \text{ km/s}$. To evenly light up the entire visible UAP disk, the SCL pulses must flash every 0.2 m along the scanning path; this yields a pulse frequency $f_S = 300$ KHz. It is noted that this SEMB scanning scheme results automatically in a flat-top luminosity distribution across the UAP disk. Such a UAP luminosity distribution has been measured repeatedly in Hessdalen, but could not be interpreted (Teodorani 2004). The proposed hypothesis furthermore explains those Hessdalen observations where a UAP changes its apparent size while keeping its luminous intensity and its color temperature constant. This is in total contradiction to UAP models based on adiabatically expanding thermal plasma balls (Teodorani & Nobili 2002).

The proposed hypothesis can be further extended to a scanning SEMB which, in addition, is pulse power–modulated at f_S. Such an SEMB creates a UAP in midair in a way similar to a scanning laser projector creating a TV image on a cloud underside. Any stationary or dynamic (morphing) UAP shape can be obtained this way. All observations of UAPs with non-spherical shapes, notably triangular, grape, rod, spiral, polygon, etc., in Hessdalen and elsewhere (Strand 2011), are explained by this extension of the hypothesis. Groupings of point-like UAPs that flare up, pulsate, show jerky movements, split up, and/or fuse have been sighted as well (Google Videos 2007). Such UAPs are explained by the same scanning and pulse power–modulating SEMB hypothesis. Some flickering and/or morphing UAPs could perhaps also be explained by a stationary SEMB that is dynamically deflected by atmospheric turbulence.

UAPs, whether small or large, are known to be silent phenomena (Hill 1995). This intriguing observational fact is impossible to explain on the basis of any hypothesis that presupposes that UAPs are large-size, electrically or thermo-chemically sustained plasma balls. According to the proposed hypothesis, UAPs are generated by angularly scanned bundles of sub-millimeter–sized NIR photon bullets, which are fired at an ultrasonic pulse frequency f_S. Only small air volumes are involved; they heat up within femtoseconds, expand, and then cool on a ps to μs time scale. A photonic UAP, when averaged over its entire volume and lifetime, represents a nearly ambient temperature and atmospheric pressure phenomenon of very low energy density. This explains the silence of UAPs, even at close range.

To close this section, it is noted that the entire filament generation, conical SCL, and recombination light emission process of ultra-fast laser pulses in air has been investigated for more than 17 years by research groups all around the world and has resulted in approximately 1,000 publications (Filamentation 2013). In Europe, a major group has been formed by researchers working in Berlin, Jena, Lyon, Paris, and Geneva. They have introduced for their experimentation a powerful, mobile, femtosecond laser system called Teramobile (Wille, Rodriguez, Kasparian, Modelain, Yu, Mysyrowicz, Sauerbrey, Wolf, & Wöste 2002). However, neither this nor any other laser research group has ever published a paper that would establish a relationship among filamentation, optical air breakdown, and SCL flash emission on one hand and UAP observations on the other. All their work has remained focused on photon physics for atmospheric sensing, for lightning control, etc.

New UAP Hypothesis, Discussion of UAP-A and UAP-B

Luminous UAPs, according to the hypothesis explained in the section "New UAP Hypothesis, Understanding Luminous UAP" above, are generated by an invisible SEMB, consisting of single NIR pulses, which are emitted at an ultrasonic frequency f_S typically below 1 MHz. Arriving at some point in the atmosphere, each pulse creates by self-focusing a bundle of for example $N_B = 300$ laterally distributed bullets that fly in parallel inside a cylinder of for example 200-mm diameter until extinction. Each bullet produces along its flight path a narrow cone of SCL, the axis of which prolongs the SEMB. Each bullet also leaves a weakly ionized filament behind which recombines within approximately 100 ps (Tzortzakis, Prade, Franco, & Mysyrowicz 2000), i.e. some 10^4 times faster than the time interval $1/f_S$ between two successive pulses. Each subsequent bundle of bullets is created, therefore, again in deionized, quiescent air. This means that subsequent bundles of bullets and their SCL cones are not deflected by the filaments left over from previous bullets. A UAP that emits such unaltered bundles of SCL cones is now called a UAP-A. It can be understood by direct extrapolation of experimentally and theoretically established femto-laser processes. A UAP-A becomes visible only when its sequential bundles of SCL cones with their opening angle of 4 to 8 mrad reach an observer who then sees a bright light. The line of sight from the observer to the UAP-A must nearly coincide with the prolongation of the incoming SEMB. An observer located outside the narrow SCL cones sees nothing or else only a weak recombination light that is isotropically emitted by the filaments left behind by the bullets. Two observers, located at a lateral distance corresponding to more than about 8 mrad, cannot both see a UAP-A as long as it remains stationary. They will disagree on what they see. If, however, a UAP-A moves sideways, then it becomes visible first to one and, a moment later, to the other observer. They will agree that they have both seen a UAP. The observers may install two laterally displaced, time-synchronized cameras to determine the distance of a UAP-A by optical triangulation; they will find out that their cameras are unable to determine the distance of a UAP-A.

The proposed hypothesis can now be extended as follows: A UAP-B is produced by rounds comprising each N_R pulse instead of single NIR pulses. The rounds follow each other again at an ultrasonic frequency f_S. Each pulse in a round creates, after self-focusing, a bundle of N_B bullets that are laterally distributed in a semi-regular pattern over a circular bundle cross-section. All pulses in a round together create, after self-focusing, a compact bullet package of $N_B \times N_R$ bullets. Bullet packages with visible SCL cones, generated repeatedly at f_S, produce a seemingly continuous white shining UAP-B. It remains visible to observers who are positioned at large lateral distances from each other.

It is known from theory, numerical simulations, and experiments (Couairon & Mysyrowicz 2007b) that NIR bullets exchange, along their flight path, energy with the surrounding air column which acts as a reservoir for the radially oscillating optical energy. They compress semi-periodically in the space and time domain due to group velocity dispersion. Bullets produce, along their flight path, filaments with diameters varying semi-periodically between about 0.1 and 1 mm. They feature alternating cylindrical and spindle-shaped sections with characteristic lengths in the mm to m region. The free electron density within these sections varies by a factor of 10 to 100 (Couairon & Mysyrowicz 2007b). The air inside a bullet experiences for an instant a high electric field-strength, producing a non-linear Kerr effect that leads to an augmentation of the refractive index. At the same time it becomes partly ionized, which lowers the index. The resulting refractive index inside a bullet remains close to that of ambient air. The air inside a filament just behind a bullet remains partly ionized as well, but experiences no Kerr effect. This leads to an ionization-dependent refractive index in the filament that lies below that of ambient air. It causes subsequent bullets to be deflected. Behind a bullet package the filaments gradually deionize, such that their refractive index reverts back to that of ambient air. Inside a bullet package, but between the bullets and filaments, the refractive index of air remains essentially unaltered.

The first pulse in a round self-focuses into quiescent air. The flight direction of the resulting first bundle of bullets and their SCL cones therefore remains parallel to the UAP-B axis, the same as for a UAP-A. The first bundle of bullets also produces a first bundle of undeflected filaments. The second, third, etc., bundles of bullets and their SCL cones do not form in quiescent air after that. Their points of formation are on average laterally displaced with respect to the filaments already in place. These small displacements are of arbitrary size and azimuthal direction. Second-pulse bullets thus fly along a path that asymmetrically overlaps the ionized filaments from first-pulse bullets. They fly across a refractive index gradient that is nearly perpendicular to their propagation direction. It means, according to ray optics, that these bullets move on a curved path and are deflected into various azimuthal directions. The radius of curvature of their path is inversely proportional to the local refractive index gradient. Second-pulse bullets produce deflected SCL cones and deflected filaments. Third-, fourth-, etc., pulse bullets are not only deflected by straight first-pulse filaments but also by oblique, second-pulse, etc., filaments. Second-, third-, etc., pulse bullets that fly through filament-spindle sections are deflected into a wider angular range than those flying through cylinder sections. Bullets from later pulses up to NB = 100 are thus multiply deflected into progressively larger conical domains. They produce SCL cones and filaments that are more and more oblique with respect to the initial bullet direction. This multiple-deflection process continues until the bullets and their SCL cones leave the initial filament package obliquely and start to propagate in quiescent air. This explains why UAP-Bs are visible within a much wider cone.

A numeric example appears best-suited to further concretize the proposed UAP-B concept. The SEMB shall be structured into rounds that are composed of each $N_R = 100$ pulse. Each pulse forms, after self-focusing, a bundle of $N_B = 300$ bullets. Each round forms a bullet package with $N_R \times N_B = 3.10^4$ bullets. The SEMB shall consist of a 30-sec long sequence of such bullet packages sent at an ultrasonic frequency of $f_S = 300$ KHz. Angular scanning of the SEMB creates a UAP-B which is for example disk-shaped with a diameter of 10 m. Each round is fired within 10 ps at a pulse rate $f_R = 10^{13}$ Hz. A pulse duration $\Delta t_S = 30$ fs is postulated, leaving a time separation of 70 fs between two pulses. It is assumed that this separation is sufficient to decouple the self-focusing process of each pulse from that of its neighbors. The physics of self-focusing a single pulse into a bundle of for example 300 bullets is understood (Couairon & Mysyrowicz 2007a). A short-pulse duration of 30 fs is required firstly to produce an adequately long dark path length of the SEMB across the earth's atmosphere. Only chirped, i.e. time-compressed, pulses allow for combining a long focusing dark path with a high instant power needed for bullet production. A short pulse is required, secondly to obtain the desired bullet path length of $L_B = 10$ m. The high pulse rate of 10^{13} Hz is necessary to build up a high free electron density within the filaments. This is required because only strongly ionized filaments are capable of substantially deflecting bullets. Only deflected bullets produce deflected SCLs, i.e. a UAP-B that is visible within a large angular domain.

Each bundle of 300 bullets shall have an initial diameter of 0.2 m, corresponding to a typical lateral bullet spacing of about 10 mm. An entire round of 100 bundles forms a 3-mm thick, disk-shaped bullet package that flies for 33 ns at 3.10^8 m/s (speed of light) over its 10-m path length before extinguishing. The individual bullets have an average diameter of 200 µm and a thickness of 9 µm, corresponding to their pulse duration of 30 fs. Their thickness is limited by the Fourier transform wavelength spread that corresponds, for a center NIR wavelength $\lambda_S = 1.1$ µm, to about 8 oscillations. Subsequent bullets in a package follow each other at a distance of about 20 μm; their longitudinal spacing is thus 10 times less than their diameter.

While advancing along their path, the bullets produce filaments with an initial average diameter of 200 μm. The filaments deionize within approximately 100 ps, i.e. some 30 mm behind the bullets. During the 10 ps needed to form a bullet package the deionization process remains negligible. After formation of a first-bullet bundle in a round, the filaments created have a free electron density of approximately 3.10^{16} cm^{-3},(e.g., Couairon & Mysyrowicz 2007b). Atmospheric air has a neutral molecular density of 3.10^{-19} cm^{-3} which means that the first filaments are ionized to 0.1%. The second bullet bundle follows 0.1 ps later and flies into the filaments produced by the first bundle. The electron density of the filaments created by the second bundle adds up to that of the first filaments. The electron density then further augments during formation of the remaining nearly 100 bundles to approach 3.10^{18} cm^{-3}. After 10 ps and a 3-mm path length, the package is complete and all its bullets participate in maintaining a high degree of ionization within its 3.10^4 filaments.

The question to address next concerns the way bullets within a package are deflected by the ionized filaments along their flight path. The refractive index of ambient air is approximately 1.0003. The refractive index contribution of ionized air molecules inside a filament depends on the electron density and is given by the electron plasma dispersion relation (Bastian 2005). For an electron density rising up to 3.10^{18} cm^{-3} and for λ_S = 1.1 μm, the refractive index is reduced by 0.0002. The angle of deflection of a bullet by a partly ionized cylindrical filament is determined by its angle of incidence and by the refractive index step across a filament–air interface. The simplest estimate is based on linear ray optics, applied to a bullet flying inside and along a straight, ionized filament with an index of refraction reduced by 0.0002. Applying Snell's law to the limiting angle of total reflection, i.e. to grazing incidence, one obtains a bullet exit angle of 0.02 rad.

Each time a bullet is deflected, it produces a deflected filament. There are 3.10^4 filaments in a bullet package within an initial disk area of 3.10^4 mm^2, leading to a filament density of $1/mm^2$. With an average filament diameter of 0.2 mm, a once-deflected bullet must thus move on average by 5 mm laterally to encounter another filament and to be deflected a second time. A bullet that has been deflected once and moves obliquely at an angle of 0.02 rad is on average deflected a second time after moving forward by 5/0.02 = 250 mm. Such a bullet is on average deflected by an already oblique, either cylinder- or spindle-shaped filament. The resulting second-deflection angle lies within a cone of approximately ±40 mrad, which depends on the direction of inclination and azimuthal orientation of the oblique filament and also on its cylindrical or spindle shape.

As a result, the bullet package advances in its initial direction while the individual bullets, except those from the first pulse, are multiply deflected over small angles by the filaments that have been produced in front of them. As the bullet package flies forward, its oblique filaments become intertwined so as to form a filament felt. While advancing, the multiply deflected bullets within the filament felt drift on average into larger radial distances. The drifting process inside the package lasts over the initial bullet path, i.e. as long as the bullet and filament density remains about $1/\text{mm}^2$.

The bullet drift obeys the square root law of a random walk into progressively augmenting radial distances and deflection angles. As the forward-flying bullets drift radially outward, the bullet package progressively augments its disk-shaped area and the bullet paths open up like a fireworks burst. An average bullet in a package, soon after its formation, is now considered. It shall be located at a radial distance of 71 mm, where half of all bullets are found around the center and half farther out. From there, this average bullet must move nearly 30 mm radially to escape over the initial package radius of 100 mm. Its random walk through the filament felt requires, according to the square root law, approximately $(30/5)^2 = 36$ deflections. After having drifted across the filament felt to the rim, the escaping angle of this average bullet is estimated to be at $36^{0.5} \times 20$ mrad = ±120 mrad.

The average obliqueness of a bullet path during its multiple deflections across the filament felt is estimated to be half the escaping angle, i.e. 60 mrad. For a lateral bullet displacement of 5 mm, a bullet thus advances between two deflections on average by 5/0.06 = 83 mm; hence, after 36 deflections, it advances by approximately 3 m. Over this initial path the bullet package expands its diameter by 2 × 0.06 × 3 m = 0.36 m from 0.2 m to about 0.56 m. This expansion reduces the probability for further bullet deflections by a factor of $(0.56/0.20)^2$, i.e. by about 8. This means that an average bullet escapes from the package after an initial path of approximately 3 m. It then flies nearly without deflections for another 7 m until extinguishing. Overall a bullet package can be described as 3.10^4 bullets moving in a 10-m long forward burst which lasts 33 ns and opens up to approximately ±120 mrad. Each of the bullets emits a forward SCL cone open to about 6 mrad. The 3.10^4 SCL cones together emit a forward flash of incoherent white light, which opens up to approximately 250 mrad.

In our UAP-B example the ETVP produces, during a time span of 30 sec, an angularly scanned SEMB that transports bullet packages at a rate of

300 KHz. These packages create, somewhere in the earth's atmosphere, a single or multiple, immobile or moving, quiescent or intensity-modulated white UAP-B of fixed or morphing size and shape. This UAP-B is visible in midair within a forward cone of approximately 0.25 rad. From the side and from behind, both UAP-A and UAP-B remain faintly visible because of the recombination light emitted by their filaments.

Comparing the New Hypothesis with UAP Observations

The proposed local SETI hypothesis, first part, defines a reference ETVP that orbits the earth in a 1.5-day polar orbit at a distance of 50,000 km. It predicts, in the second part, that the ETVP occasionally emits an invisible SEMB that produces a UAP at some selected earth longitude, latitude, and height above ground, atmospheric conditions permitting. It also predicts that a UAP-A emits a narrow cone and a UAP-B a wide cone of white light in prolongation of the incident SEMB. This light cone intersects the ground over an elliptic or hyperbolic area within which an observer can see the UAP. He then describes his line of sight by an azimuth and elevation of the UAP.

A simple model example helps to interpret UAP sightings made in Hessdalen and elsewhere. An SEMB, incident from the south at an elevation of 0.2 radian, creates a UAP-A at a height of 2 km above horizontal ground. The distance, where the axis of the UAP light cone intersects the ground, then lies 10 km farther north. For a UAP-A with a cone-opening angle of 6 mrad, the elliptic area intersecting the ground and within which it is visible measures about 60 × 300 m. For a UAP-B with a cone-opening angle of 0.25 rad, the corresponding elliptic area on the ground starts 6 km north and ends 27 km north of the UAP; in an east–west direction it spans 2.5 km across. For an observer located at the rim of this elliptic area, the line of sight to the UAP-B differs from that to the invisible SEMB by 125 mrad.

The azimuth and elevation of all UAP observations made in Hessdalen between 1998 and 2001 have been assembled into a sky map (Teodorani 2004). The map also includes 15 positions of the moon which allows for calibrating as follows: It covers an elevation angle spanning from nearly 60° below the astronomic horizon to 65°, i.e. 1.13 radian above it. In the azimuthal direction, the map covers an angle of 180°, i.e. of 3.14 radian, spanning from east over south to west. The map shows approximately 200 UAP events that appear to be distributed at random over all azimuths and elevations above the terrain horizon. These sightings could in principle be all of the UAP-A type. It would mean that the invisible ETVP is located each time nearly behind the UAP and that the SEMB aims nearly in the direction of the observer. If this were the case, then the regular earth orbits of the ETVP may become visible on the sky map as a pattern of preferred UAP sighting directions. As there seems to be no discernible such pattern, it is likely that the ETVP emits the SEMB on average obliquely with respect to the sightline of the observer and that many of the 200 Hessdalen sightings are of the UAP-B type.

The map also shows approximately 20 UAP sightings that are below the terrain horizon. An estimated 13 are located less than 0.1 radian and the other 7 are between 0.1 and 0.4 radian below the horizon. The first 13 sightings can be marginally explained as UAP-B events. The last approximately 7 sightings, which are all located next to the ground, necessitate a separate explanation. A haze layer often covers the Hessdalen Valley. A scanned SEMB, incident from a high elevation angle, shall create a voluminous UAP-B inside the layer. This leads to the condensation of fog droplets that in turn scatter the downward emitted SCL-B light cone over a large solid angle. The UAP then appears as a large white ball of fog (or otherwise-shaped object), sitting on the ground, lit from the inside and visible from everywhere.

An optical EMBLA mission was carried out in Hessdalen from July 29 to August 21, 2001 (Teodorani, Strand, & Hauge 2001). Before its operations started, the Hessdalen Automated Measuring Station (AMS) was upgraded with a pair of coupled video cameras, placed at a lateral distance of 171 m. This computer-controlled camera pair was programmed to measure the distances of UAPs by optical triangulation. Altogether, 20 UAP events have been captured. However, the EMBLA mission report does not state that the two cameras had simultaneously observed the UAPs and that their distance had been determined by triangulation. The UAP distances are reported 16 times as "kilometres" without any explanation and the remaining 4 times as: "5 km", "5 km", "2.5 km", "50–100 m?" with additional estimates as "hundreds of meters", and "presumably 5 to 7 km". It is surmised that in many cases only one camera had recorded any particular UAP event and that the planned triangulations could not be carried out. The UAP-A model of a narrow conical emitter explains why the UAP distances could not be determined. At an estimated maximum sighting distance of 7 km, the 6-mrad wide UAP-A cones illuminated a patch of land of 42 m width. This means that a close group of observers near a first AMS camera could jointly see a UAP-A. However, another group of observers and/or a second AMS camera farther away than about 40 m could either see nothing or else another UAP-A located near the first one at the same or at a different distance.

Other Hessdalen observations require the UAP-B model for explanation. They concern UAPs in viewing directions that cannot be in line with the SEMB and thus with the ETVP direction. This can be the case, as already discussed, for UAPs seen close below the terrain horizon. It must be the case also for immobile UAPs that remain visible for more than a few minutes, for UAPs that move or jump across the field of view, and for multiple UAPs flying in a wide-open formation.

In Hessdalen, several stationary UAPs have been observed during time spans from a few seconds up to a maximum of 3 min (Teodorani 2004). The reference ETVP orbits the earth within 1.5 days and moves, therefore, at 2.9 mrad per min across the sky. An immobile UAP-A with its 6-mrad emission cone can thus be observed for up to 2.1 min. Most Hessdalen observations of stationary UAPs in the sky are compatible, hence, with the UAP-A model. Elsewhere in the world UAP observation times of an hour and more have been reported (Poher & Vallée 1975). In an hour, the reference ETVP moves 175 mrad with respect to the local sky coordinates and also with respect to an immobile UAP. A stationary UAP-B with a light emission cone of ±125 mrad could thus remain visible for up to 1.7 hours. If the ETVP steered the SEMB such that it aims constantly at one location on the ground, then a slowly moving UAP-A or UAP-B created up in the sky could remain visible to a local observer for an entire night.

In Hessdalen, on December 4, 1999, a video was recorded in which an approximately triangular UAP moves smoothly over 39% of the camera field of view before extinguishing (Strand 1999). The zoom lens setting used has not been indicated. Nevertheless, even with a wide-angle zoom setting, a UAP-B light emission cone of ±150 mrad would be sufficient to explain this recording. If a 20% longer focal distance setting had been used, then a UAP-B emission cone of ±125 mrad would suffice. Most other videos of moving UAPs worldwide should become similarly explainable as well.

On September 20, 2007, again in Hessdalen, a 30-sec exposure photographic image was taken with a 50-mm lens, equipped with a transmission grating. It shows the white trace of an intense, multiply flaring UAP moving in an approximately horizontal, jerky path across 42% of the field of view before extinguishing. It shows, below the white trace, a featureless emission spectrum going from red to indigo. The image also shows dark hills, a clear evening sky with a few small clouds and many stars in the background (Hauge 2009). The luminous trace recorded on the image corresponds to a UAP motion over 300 mrad. A slightly adapted UAP-B model, with an emission cone that is 20% wider than the order-of-magnitude model presented in the section “New UAP Hypothesis, Discussion of UAP-A and UAP-B,” again explains this Hessdalen phenomenon. The multiple, sub-second intensity flares and the jerky path recorded are entirely compatible with a scanned and intensity-modulated SEMB–UAP model.

The nearly featureless white spectrum is what a bundle of SCL emission cones are known to produce. It is evident that this Hessdalen phenomenon is totally incompatible with any previous interpretation, were it based on a chemical combustion process in midair, on an atmospheric electrical phenomenon, or on a hoax, etc.

To summarize: The 1998 to 2001 UAP sky map with its approximately 220 sightings and UAP observations in Hessdalen can be entirely explained by either a UAP-A or UAP-B model in direct observation or else in diffuse reflection from a ground haze layer. UAP-As with their 6-mrad, narrow light cones explain the 20 EMBLA 2001 Hessdalen AMS observations and their unsuccessful triangulations. A UAP-B with a much wider light cone explains the December 4, 1999, Hessdalen video and also the September 20, 2007, photographic image and spectrum of a moving UAP. Both UAP models with their white light emission cones of 6 mrad and 250–300 mrad, taken together appear adequate to explain all observations of stationary, moving, single, and multiple UAPs of various shapes that have been sighted in Hessdalen. To decide definitely for each single Hessdalen observation whether and which of the two proposed UAP models applies, it will be necessary to engage in a direct dialogue with the Hessdalen science team and to access their remaining, yet unpublished, instrumental and observational data.

Conclusions

UAP phenomena have, for nearly three generations of scientists, resisted all efforts to find a rational and coherent explanation. Available compilations of UAPs show that they are complex phenomena with a wide range of visual shapes, luminosity, colors, dynamics, reactions, acoustics, electromagnetic, and other properties. UAPs have been observed all over the world for more than six decades (see the section “Major Known Properties of Luminous UAP”). Previous researchers have considered explanations based on alien crafts using “antigravity,” on ball lightning, earth lights, rock piezoelectricity, hoaxes, etc. Each of these hypotheses offers at best a partial fit for a fraction of all UAP sightings. In view of this unsatisfactory situation, some investigators have tried to exclude all UAP sightings that did not match their explanations. However, even for those sightings that seemed to fit best, the researchers were unable to indicate a physical, chemical, etc., process that would model the relevant UAP observations in an overall coherent and quantitative way (see the section “Existing Hypotheses Concerning UAP Sightings”).

The absence of any scientifically acceptable theory to explain UAPs has spurred the creation of thousands of Internet articles, books, movies, etc., which offer pseudo-scientific or else fantasy explanations. For the general public, observable UAP properties have become indistinguishable from fictional UFO properties, and knowledge about UAPs has become mixed up with irrational beliefs. This is contrary to what an enlightened, democratic, and responsible society should head for.

The present article explains the nature of UAPs by means of an entirely new hypothesis. It combines extensive observational data from UAP research in Hessdalen with experimentally and theoretically well-established facts in physics, notably in photonics, astronomy, palaeontology, history, and future technology (see the section "Stating the New Local SETI Hypothesis). The proposed hypothesis postulates the existence of a technically superior civilization in our galactic neighborhood at a maximum distance of about 500 light years. It has remotely detected our own civilization at its early agricultural level and has, less than about 5000 years ago, launched an extraterrestrial visiting probe, ETVP, which has travelled at approximately 0.1 c (speed of light). To be in line with historical UAP sightings, this ETVP had been placed into earth orbit several centuries ago. This scenario is compatible with recent advances in exoplanet and exobiology research and with technical forecasting for earth-based telescope, spacecraft, and artificial intelligence systems. It forms, therefore, a credible first part of the proposed hypothesis (see the section "New ETVP Hypothesis, General Exo-Civilization Scenario"). A galactic neighborhood model based on the Drake equation has furthermore been evaluated. The proposed scenario fits herein as well, provided the average lifetime of exo-civilizations is on the order of 10 million years, i.e. comparable to the history of hominids on earth (see the section "New ETVP Hypothesis, Galactic Neighborhood Model").

Several high-tech optical and radar space surveillance systems have been in operation for fifty years to track satellites, space debris, missiles, and NEOs. They should be able to detect and track a non-stealth ETVP in earth orbit. An Internet search has shown that no observation indicative of such an ETVP has ever been reported (see the section "Previous ETVP Hypotheses and Searches"). Accounting for this and other facts, the proposed hypothesis postulates a highly stealth reference ETVP, located in a 1.5-day polar orbit. The required degree of invisibility is compatible with near-future terrestrial technology (see the section "New Hypothesis, Characterization of the ETVP").

R. Bracewell, back in 1960, described a hypothetical, radio-emitting ETVP (Bracewell 1960). His article proves that the concept of an interstellar earth-visiting probe was introduced into scientific thinking half a century ago. The postulated presence of an earth-orbiting ETVP is also in line with the main conclusion reached by J. Haqq-Misra and K. Kopparapu in 2012:

"Extraterrestrial technology may exist in the Solar System without our knowledge" (Haqq-Misra & Kopparapu 2012).

The second part of the proposed hypothesis stipulates that the ETVP comprises an advanced sensor-, AI-, and NIR-emitter system that occasionally generates a steered electromagnetic beam (SEMB). This SEMB is directed into the earth's atmosphere where it creates, through a femtosecond (fs) photonic process, a filamentary plasma discharge, which is seen as a UAP (see the section "New Hypothesis, Characterization of the SEMB). Ultrafast lasers, producing single and multiple filamentary plasma discharges, have been studied for 17 years now by several research groups. They produce conical flashes of super continuous light (SCL) in midair, very much like a UAP. However, no scientist seems to have applied these results from laser technology, quantum optics, and aerology to UAP research.

It is shown (see the section "New UAP Hypothesis, Understanding Luminous UAP) how such a photonic process can be used to build a model UAP-A. It explains the entire gamut of properties of (nearly) stationary UAPs seen in the sky, notably their various shapes and sizes, their morphing, their white and/or colored-light output, their sudden appearance and disappearance, their silence, and their invisible energy source. To obtain a match with all remaining UAP observations, an extended femtosecond photonic process is defined and investigated. It leads to a UAP-B model that is capable of explaining single and multiple UAPs that move smoothly or erratically across the sky, which remain visible for up to several hours, and which appear near the horizon line. Together the two proposed UAP models also explain why UAPs can appear anywhere on earth and under widely different atmospheric conditions (see the section "New UAP Hypothesis, Discussion of UAP-A and UAP-B").

There are several additional properties of UAPs that have not yet been discussed in the present paper. They concern electromagnetic disturbances, radar echoes, soil marks, etc., associated with UAP sightings.

It is hoped that the UAP generation hypothesis described in this article will help researchers to build a bridge between femtosecond photonics, theoretical engineering, and scientific UAP observations. To bring these activities closer together, an interdisciplinary workshop should be held. Subsequently, a theoretical research project should be planned to investigate and test the new ETVP–SEMB–UAP hypothesis in more detail. The exo-civilization scenario part is amenable to statistical modeling. The photonics part is amenable to computer modeling and to experimental testing, i.e. to the creation and investigation of artificial UAPs. A further UAP observation project with suitably extended sensing instrumentation could be envisaged at Hessdalen. A positive experimental and/or observational proof of the photonic nature of UAPs would render the existence of a stealth ETVP in a high earth orbit highly likely. This in turn would become a proof for the first part of the hypothesis, i.e. for the existence of a neighboring advanced exo-civilization.

It is hoped that the present article can set a cornerstone, from where scientists will be able to till a new field of research. It will enclose investigation of phenomena that require exo-technology for their explanation, such as UAP observations, crop circles, possibly positive SETI signals, etc.

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