The Horst-Eckardt Extensions
of ECE Theory - Achievements since 2019

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Abstract

During the last several years, ECE theory has made progress in solving fundamental problems of physics. Since its inception in 2003, ECE theory has unified electrodynamics, gravitation, dynamics, fluid dynamics, and even quantum mechanics, and has thus achieved fundamental unification of all subject areas of physics. Starting in 2019, the year that Myron Evans passed away, Horst Eckardt has been working on selected principal questions of physics and natural philosophy (in addition to further developing ECE theory). These questions include the aether concept, the intrinsic nature of force fields (gravitation and electrodynamic fields) and the origin of charges and masses, and the answers are called the Horst-Eckardt Extensions (HEE) to ECE theory. Because unification through ECE theory includes quantum mechanics, it can properly be called a Theory of Everything. In addition, even higher dimensions, as described by Burkhard Heim, can be considered in the context of Cartan geometry.

Keywords: Unified field theory; gravitation; dynamics; electromagnetism; nature of force fields, charges and masses.

1 Introduction

ECE (Einstein Cartan Evans) theory has been under development, refinement and extension from 2003 to the present (2023). This process has been presented in about 450 technical articles, which relate to three basic areas: the specification of the relationship of ECE theory to Cartan geometry, the derivation of all foundational areas of physics from this geometry, and the application of this theory to technical questions (which leads to new practical applications). These results are summarized in the ECE textbook to give specialists a single

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and compact source from which to familiarize themselves with this theory. ECE theory is also described in popular scientific presentations and videos.

The focus of ECE theory is an objective description of physics, and it uses generally recognized scientific methods such as logic and mathematics. In recent years, the perspective of ECE theory has expanded. The very general form of geometry that is the basis of ECE theory allowed us to expand the range of scientific questions that could be addressed. We were able to offer explanations in areas that were previously inaccessible to science. Questions, such as "what is a field?" and "how can space curvature and torsion be explained in a clear way?", could now be answered. These topics have been discussed in the UFT series, primarily from Paper 441 onwards, and have led to significant advances regarding fundamental questions of physics and natural philosophy. These results, which are reported in this review article, are not purely philosophical, but are also based on the geometry that was developed by Riemann and Cartan.

2 ECE development 2003-2019

Einstein was the first to recognize the importance of geometry, and considered the curvature of space to be the cause of gravity. By developing the general theory of relativity, he brought about a paradigm shift in physics. This shift was soon followed by a fork in the path of physics that was caused by quantum mechanics. The resulting approaches to thinking about physics were dominant for a hundred years.

This situation persisted until around the year 2000, when Myron Evans realized that the Riemann geometry that Einstein had used was incomplete. A curvature is always associated with a spatial torsion, as Cartan had discovered in the 1920s. Cartan corresponded with Einstein, but Einstein did not see the importance of Cartan's torsion and set the torsion to zero by definition. Einstein only considered curvature in his field equation. However, the curvatures that come out as solutions of Einstein's field equation always also produce torsion, which indicates a fundamental contradiction in the assumptions. This defect remained hidden for about 80 years, until Myron Evans finally discovered it. The AIAS published an entire book in which this problem is described using almost all known solutions to Einstein's field equations. ECE theory, on the other hand, is based on the complete geometry of Riemann and Cartan, and is therefore free of this contradiction.

Evans found that the basic equation of Cartan geometry, the Bianchi identity, (after multiplying constant factors containing the physical units) gives the field equations for both gravitation and electrodynamics. These are formally identical to Maxwell's equations, but apply in a space with curvature and torsion. In this way, electrodynamics is included in general relativity, leading to a unified field theory. In addition to Newton's well-known law of gravitation, three other previously unknown laws of mechanics follow from this, and some of these laws have been proven experimentally through analysis of satellite data. The additional laws are mostly detectable only in cosmic dimensions, which is why we have only known about Newton's limited laws of mechanics.

Evans continued with this unification research, and ultimately succeeded in including quantum mechanics. This was previously thought to be practically impossible, since many people had tried unsuccessfully to achieve this unifica-

tion, by incorporating very complicated mathematical methods into quantum physics. Evans, however, took a completely different path. He also derived quantum physics from the basic equations of geometry, in his case, from the general wave equation, from which all known wave equations of physics follow. Evans just had to "quantize" the geometry, i.e., adapt it to the symmetry resulting from quantum physics. Since Cartan geometry is not limited to a four-dimensional base space, it was possible to do so directly and without any difficulties. Once this was accomplished, the spin of elementary particles was then obtained from quantum symmetry. In principle, the Dirac equation (for half-integer spin) follows from the wave equation, but in a slightly different form with respect to the components of the wave functions, the "spinors". This approach allowed Evans to avoid the concept of negative energy, which had given rise to various interpretations and speculations in Dirac's development.

Myron Evans and Horst Eckardt then collaborated to develop a generally relativistic fluid dynamics, which later became the basis for a model that includes the concept of "aether". The next milestone was the addition of "m-theory", which is a simple and elegant way to introduce Einstein-style generally relativistic metrics of spacetime into mechanics and quantum physics. For central symmetries, for example in atomic nuclei, there is an additional force that roughly corresponds to the strong nuclear force. This means that electrons can be absorbed into the nucleus, resulting in a "transmutation" of elements, as is the case, for example, in LENR (Low Energy Nuclear Reaction).

3   ECE development since 2019: the Horst-Eckardt Extensions

By 2019, ECE theory was fully developed; Myron Evans had been able to complete his life's work prior to his unexpected death in that year. Following this great loss, AIAS Director Horst Eckardt continued their research, both through ongoing projects, e.g., those involving m-theory, and also by pursuing further advances in natural philosophy. These continuing research topics, collectively known as Horst-Eckardt Extensions (HEE), are explained below.

3.1   Aether

Myron Evans had always considered the aether model to be very sustainable. When Einstein abolished the aether with his special theory of relativity, this position had appeared reasonable because of the results of the experiment by Michelson and Morley. However, that there was no medium available through which electromagnetic waves could propagate was still an unsatisfactory situation. One had to assume propagation over the (empty) vacuum. After Einstein developed his general theory of relativity, the solutions to his field equations revealed the possibility of a constant background field, the "cosmological constant". He himself said that this could be interpreted as a reintroduction of the aether. The aether would then be a gravitational field in the background.

As we know from the equivalence principle, free masses move in a straight line in the gravitational field, as long as you only look at the immediate surroundings and have no way of receiving information "from afar". A curved orbit, such as that of the Earth around the Sun, can only be seen if you look at the system

from the outside, i.e., at a sufficiently large distance. This principle corresponds to the movement of a small floating piece of wood in a water stream. It always moves with the flow and cannot detect any flow locally, even if the flow is crooked or an eddy. We apply this analogy to the structure of spacetime. Solid matter floats in the aether. It is coupled with the aether, as we shall see in the discussion of gravitation. Therefore, Einstein's space curvature and Cartan's space torsion can be interpreted as describing the flow properties of an aether. From astronomical measurements, we know that galaxies move against each other and that stars in galaxies also follow dynamic paths (e.g., on the galaxy arms). Thus, we see that the aether flows take place on very different size scales.

If the aether is a material substance and very mobile, i.e, a "thin liquid" medium, it must have a mass density, as well as a local flow velocity and pressure. ECE theory offers the possibility of calculating these quantities. In the electromagnetic case, the aether flow velocity corresponds to a vector potential and the aether pressure corresponds to a scalar potential. According to Maxwell, electromagnetic fields are calculated from both types of potentials. Aether vortices create a magnetic force field and pressure differences create an electric force field. The Newtonian gravitational field corresponds to an aether pressure difference. A gravitational vortex field is created by masses that either rotate about themselves or move in a rotational structure. This is called the "gravitomagnetic field".

Another argument for the existence of an aether comes from quantum mechanics. We know from particle experiments that pairs of elementary particles, for example, an electron-positron pair, can form spontaneously out of the "vacuum". Thus, the vacuum cannot be empty, but must have a very high energy density, otherwise such processes would not be possible at all. It has been calculated, from quantum mechanics, that this energy density must be about a hundred powers of ten greater than that resulting from Einstein's cosmological constant. This is the largest discrepancy between physical theories that has ever occurred. In quantum physics, one speaks of a "quantum vacuum" which is subject to certain fluctuations. In ECE theory, we identify this quantum vacuum with the pressure and flow of the aether, and with the geometric allocation of the aether to the geometry of space. This aether is then a quantity of the general theory of relativity and is identified with spacetime itself.

The question that remains to be answered is why no aether wind could be detected in the experiment of Michelson and Morley (and successors). The interpretation of these experiments is still controversial, and a small difference in the speed of light parallel and perpendicular to the Earth's surface could probably be proven using this data. On high mountains the difference is even more pronounced. However, it seems that no massive aether flow is detectable near the Earth. As we will see in Section 3.3, aether movement is strongly disturbed by gravity (or what we think of as gravity). Matter is in constant exchange with the surrounding aether. Therefore, one would have to carry out this experiment in free space to get a meaningful result.

3.2 The true nature of force fields

In addition to unifying quantum theory with general relativity, ECE theory also provides a coherent interpretation of the aether. This has enabled a new perspective on the internal structure of physical fields.

Interaction between physical bodies is mediated either by direct contact or by force fields (which are present throughout space). Electromagnetic and gravitational forces are created by sources, and in classical physics it is assumed that sources interact with other bodies by an "action at a distance". The actual mechanism of how this action works is unknown. It is only known that electromagnetic fields expand at the velocity of light, and the same is assumed for gravitation.

Nobody can tell, however, what a field really "is"; only the *effects* of force fields are described in physical theories. Classical standard physics does not provide internal mechanisms that could produce a force effect. It is only in some quantum theories (for example, quantum electrodynamics) that internal mediators of action are assumed, which are photons in the electromagnetic case and gravitons in the gravitational case. However, the existence of gravitons is hypothetical, and no generally relativistic description of quantum theory exists. The same wave-particle duality that is assumed for photons is also assumed for gravitons. Both are "mediator particles".

Some "out of the box" thinkers like Nicola Tesla and Tom Bearden have tried to explain the intrinsic structure of force fields, but could not integrate their results into the framework of ordinary physics. This is not surprising, because such an approach would require both the integration of the aether idea into regular physics and the inclusion of general relativity into the quantum world.

Using the foundational equations of ECE theory, the force fields of gravitation and electrodynamics are derived from their potentials (scalar and vector), and from the spin connections of spacetime. The latter are missing in the standard theory. In the static case, the force fields are proportional to the vector potentials, multiplied by a spin connection. According to the aether interpretation of potentials, this means that static fields represent an aether flow. This is a result that cannot be obtained from standard physics.

The energy of a field is proportional to the frequency of the spin connection, in analogy to photons, where the energy is proportional to the frequency of the electromagnetic radiation. This may be a hint that fields are connected with quantum states, analogously to the quantum energy $\hbar\omega$. The fields may be interpreted as the internal structure of aether compounds that constitute the flows.

3.3 The nature of gravitation

The unification of electromagnetism and gravitation has shown that they both have the same general intrinsic structure, which is based on aether flows. A consequence of this correspondence is that gravitation is a radiation field of the same type as electromagnetism. The only difference is that electric fields start at source charges, while gravitational fields do not. The physical direction of electric current is from negative to positive charges. If aether particles flow away from a negative charge, the aether density is diminished there. Since no "holes" can appear in the aether, that volume must be refilled immediately by aether particles. This means that there must be a flow in the inverse direction in order to fulfill the continuity equation. The flows of electric and gravitational fields are graphed in Fig. 1.

When we consider macroscopic neutral bodies, received opinion says that there is a gravitational attraction, but no electrical interaction. So far, this is
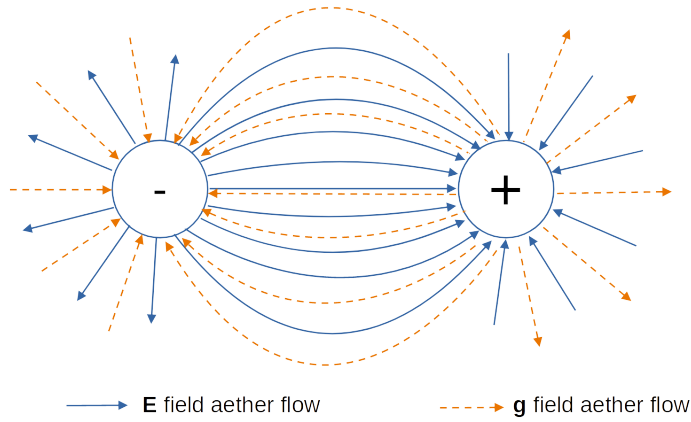
Figure 1: Aether fields of an electric dipole.

in accordance with classical gravitational theory. However, it is known that the surface of the Earth has an excess of negative charges, and that there is an electric field of about 130 V/m perpendicular to the Earth's surface. According to Tesla, the surface charges are an effect of incoming aether flows, so no violation of atomic neutrality takes place. In any case, the counterpart of this electric field is a gravitational back-flux.

According to some alternative researchers, gravitational radiation accelerates negative charges in a direction that is opposite to the direction of propagation of this radiation. As a result, a highly negatively charged body would have a tendency to levitate. If positively charged, the body would increase in weight. In this scenario, the gravitational force does not depend on the mass (as a measure of condensed matter) alone. It will also depend on the charge of a body. It has been reported that such experiments have been performed, but they have not been documented properly. It has also been reported by another source that the weight of a mass changes, if it is irradiated with electromagnetic radiation in the Terahertz range.

For charged elementary particles, this means that their inertial mass would be different from that of a compound of the same elementary particles with a balanced charge. This is a violation of the equivalence principle and has very fundamental consequences for physics. Therefore, this subject should be carefully investigated using scientific methods.

To summarize, we have found that physical fields can be described on three logical levels:

1. Force fields,

2. Potentials,

3. Intrinsic flow quanta.

The third level has been developed in the Horst-Eckardt Extensions (HEE) of ECE theory.

3.4 Reduction of the forces of Nature to only one: the Theory of Everything (TOE)

So far, we have described the unification of electrodynamics, gravitation/dynamics and fluid dynamics. Quantum mechanics is included by using the wave equation of ECE theory.

In particle physics, the strong and weak nuclear forces are handled as separate force fields of Nature so that we have, along with electrodynamics and gravitation, four force fields in total. The nuclear forces have been derived from particle physics experiments, using a phenomenological model of microscopic physics. ECE theory has shown, however, that these forces, if they should be considered in this way at all, can be derived from the wave equation. The wave equation has to be adapted to a representation reflecting the symmetry group that is usually used to describe these forces. Such symmetry groups are necessary to describe particle spin, for example. The laws of quantum mechanics follow from the standard quantization procedure, in which classical functions like momentum and energy are transformed into operators. In ECE theory, the weak nuclear force is of electromagnetic type, while the strong nuclear force can be derived from a metric of general relativity (a variation of the centrally symmetric metric). Thus, the unification with quantum mechanics already contains both nuclear forces. ECE theory accomplishes this unification on the basis of general relativity, so it goes beyond standard theory, which is based only on special relativity.

All unifications that have been achieved by ECE theory are listed below, where the formulas are written in the most abstract form, so that the reader may more easily see their mathematical structure. The variable and operator definitions are included below the formulas.

Field Equations of

Geometry:

$$\boxed{D \wedge T = R \wedge q}$$

Electrodynamics:

$$\boxed{D \wedge F = R \wedge A}$$

Gravitation/dynamics:

$$\boxed{D \wedge G = R \wedge Q}$$

Fluid dynamics (aether):

$$\boxed{D \wedge F_{\mathrm{fd}} = R \wedge v}$$

Quantum mechanics (wave equation):

$$\boxed{(\Box + R)\psi = 0}$$

Meaning of symbols:

D: derivative operator
$\wedge$: antisymmetric multiplication operator (wedge)
T: torsion
R: curvature
q: tetrad
F: electromagnetic field
A: electromagnetic potential
G: gravitational or acceleration field
Q: gravitational or dynamics potential
F_{fd}: fluid dynamics field
v: fluid velocity
$\Box$: Laplace operator
ψ: wave function

3.5   The origin of charges and masses

The basic quantity of general relativity is the line element, which defines a metric from which all tensors of this theory can be derived. Einstein tried to obtain the metric function for a given problem as a solution of his field equations, however, these have turned out to be flawed. Thus, we are left with the question of how we can find properties of curved and twisted spacetime by a similar, but correct, principle.

In Cartan geometry, the basic quantity is the tetrad. All fields, like curvature, torsion and force, can be derived from a given tetrad, as has been shown during the development of ECE theory. Suppose that we want to study the metric of free space (a Minkowski space) in a geometry that is spherically symmetric. Then, the line element, and with it the metric, is known by the basic principles of general relativity. However, in Cartan geometry, we do not have this line element a priori and must construct a tetrad that delivers exactly this line element. This procedure is not always uniquely defined, but for free space it is. Consequently, we have the same starting point for further computations that we have in general relativity.

In general relativity, we can compute the Christoffel symbols for the free-space geometry, but nothing more. The curvature tensors are zero. With Cartan geometry, we obtain non-vanishing spin connections, and some non-vanishing torsion tensor elements and force fields. The electric (or gravitational) field is zero, because there is no central charge (or mass) of attraction. However, a rotational magnetic (or gravitomagnetic) field appears, although no rotation of space is assumed, only a static structure with rotational symmetry. We arrive at the astonishing conclusion that rotational structures can be evoked by space-time itself. This becomes more plausible when we consider our identification of spacetime with an aether flux. A rotational symmetry defines an aether flux or rotational potential. According to the ECE field equations, this produces a rotational force field. An example is shown in Fig. 2.

In the next step, we use a metric that has a non-homogeneous aether density. In vortex structures, like a tornado, it is known that the pressure in the central "eye" is lower than in the outer region. Therefore, we can apply a metric in which the aether density is lower close to the center and approaches zero at the
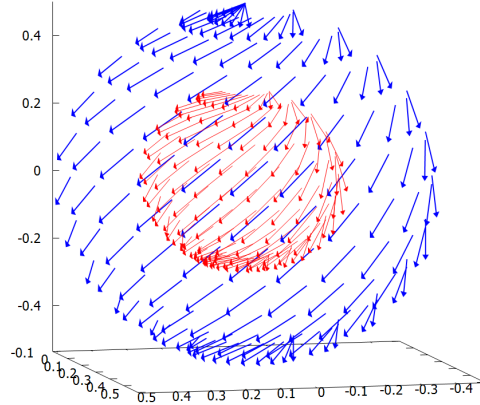
Figure 2: Graphical representation of a magnetic field produced by spacetime itself.

central point. This kind of metric structure has been developed under the name "m theory". In this geometry, a central electric (gravitational) field appears, whose divergence is different from zero. This means that there is a central charge or mass distribution. This is a result of our calculation; it was not assumed a priori. In other words, charges (masses) are created by the structure of geometry itself. In contrast to this, in classical physics, as well as in Einsteinian relativity, charges and masses must exist independently as sources of fields, otherwise no central force fields can exist. This fact is the reason why Einsteinian relativity has problems with energy conservation. In ECE theory, this problem does not exist because no external charges and masses appear in this theory. Charges and masses are condensed structures of aether flows and therefore fields by definition. ECE is a pure field theory.

Besides the charges or masses that are created by geometry itself, there is a magnetic dipole in the center, which is the source of a magnetic dipole field. This is comparable with the magnetic field of the Earth. The origin of charges and masses, an ultimate mystery of physics, is now being shown to be an effect of rotational spacetime, or the aether, itself.

In a refinement of the model, we can add rotational motion to the tetrad and, therefore, to the metric. This leads to additional components in the central electric (gravitational) field and in the rotational magnetic (gravitomagnetic) field. Besides its divergence, the electric field now has a rotational component as well. In total, we find six basic vortex structures, which could be compared with the six basic quarks of the Standard Model of particle physics. A single spherically symmetric spacetime cannot be split into fragments. This corresponds to the fact that single quarks cannot be observed separately. In contrast to the Standard Model, our result follows from semi-classical considerations, without any need for highly specialized quantum effects.

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3.6 Higher dimensions

ECE theory explains all types of physical fields on a common basis, namely geometry. This then allows all areas of physics to be explained on a common geometric basis, which facilitates an enormous increase in insights into physics and natural philosophy. As previously described, the unified model encompasses gravitation, electrodynamics, fluid mechanics, quantum mechanics and elementary particle theory.

ECE theory was developed in four dimensions (one time and three space dimensions), as was the case in Einstein's theory. The reason was that in standard physics and the natural philosophy based on it, it is not necessary to cross this limit. Natural sciences are based on the principle of objectivity, that all insights and knowledge must be verifiable through experiment in a repeatable and reproducible form. In "direct" science, there is no room for spiritual or even philosophical elements, both of which are subjective elements of the human mind. In medicine, however, mental effects play a role, for example, processes in the human brain, up to and including psychology, which is built entirely on a non-material basis. Some fields, such as brain research, deal with both objective science and mental elements, as they investigate, for example, the extent to which the human mind is tied to processes in the brain.

These fields that bridge the mental and the physical motivated us to investigate how ECE theory could function as a basis for describing the relationship between purely mental (and even spiritual) processes, and material processes. The formal way to do this is to extend the theory beyond four dimensions. Fortunately, there was a German physicist, Burkhard Heim (1925-2001), who devoted his life to developing a theory of higher dimensions. He took Einstein's work and expanded space-time by at least 8 dimensions, which are spiritual and non-material in nature.

We related this to ECE theory by approaching Heim's universe from below. Since Cartan geometry is not restricted to any specific number of dimensions, we investigated how the fifth and sixth dimensions could open a way to understanding processes in which the human will (formed, according to Heim, in dimensions 5 and 6) interacts with matter (in dimensions 1 to 4) and can even change material structures. We know of no other theory that could describe this interaction on a mathematical and quantitative basis. This is a first attempt, and it could be the beginning of a completely new interdisciplinary research area.

Burkhard Heim, who was a student of Werner Heisenberg, expanded Einstein's ideas to the highest philosophical levels. To do this, he had to leave the world of materially bound physics, and expand Einstein's four spacetime dimensions to 12 dimensions. The first four dimensions (d1-d4) are the same as in relativistic spacetime. Dimensions 5 and 6 (d5-d6) include an energetic control field for processes in d1-d4. The higher dimensions, d7-d12, represent a consciousness space that contains a global information field (d7-d8) and the realm of spirit (d9-d12). The dimensions d5-d6 obey the conservation of energy; in higher dimensions, the concept of energy no longer exists. Formally, it is a 12-dimensional manifold, but dimensions greater than 4 are non-material. It is important to understand that the dimensions d5-d12 have a time-like character in terms of spatial metrics.

Above the fourth dimension, higher dimensions are not affected by lower dimensions, and there is a strict hierarchy of dependencies. This means that fields defined in a specific dimension only depend on fields in higher dimensions. Material processes are controlled by higher dimensions, so there must be a coupling between higher and lower dimensions.

Heim developed a quantization scheme based on structural aspects of the first six dimensions, and he considered this quantization to be essential. A very surprising result is that this scheme can predict the masses and lifetimes of all known elementary particles with high precision. In ECE theory, one can use the wave equation (in quantized or unquantized form) to make such predictions.

If the classical fields are extended to six or more dimensions, the number of ECE field equations increases over-proportionally. This is not a deficit but rather an implicit confirmation of Heim's statement that higher dimensions belong in the realm of thought and spirit, in the sense that a thought cannot be constrained by physical properties, especially by properties of four spacetime dimensions. The coupling to matter is mediated through the fifth and sixth dimensions, where, according to Heim, the conservation of energy still applies.

With six dimensions, the determinant of the metric becomes singular. This means that all locations would be visible to an observer at the same time. An observer in the sixth dimension could thus "time travel" to any point in space and time in the fourth dimension. This is at least a possibility, even though the specific mechanism cannot yet be specified. You can see that the sixth dimension represents a kind of limit, above which the universe somehow works differently.

The transition from spiritual space to matter can be described by the ECE wave equation. The coupling between the fifth and sixth dimensions causes changes in the scalar curvature that interacts with all dimensions, so the lower dimensions are also affected. The influence of higher dimensions can be formalized by an iterative solution process of the wave equation, which provides a way to understand the details of this effect.

We used the wave equation of classical field theory, and not a quantum process, to model this effect. Nevertheless, a quantum process could be introduced by using the quantized form of the wave equation, such as that represented by the fermion equation of ECE theory. Physicists like to use quantum effects as a catch-all for anything that they don't understand. However, we have shown that this interpretation of a transition from what was termed spiritual space to matter does not necessarily require such concepts, and that the combination of the classic field theories of Burkhard Heim and Myron Evans provides a viable explanation. Since the solution is formalized, it could even be possible to develop examples and numerical models of influences of higher dimensions, in the future.

4   Final remarks

Rapid progress has been made in recent years, as the refined nature and true scope of ECE unified field theory have become increasingly visible. In addition, the way forward has become simpler and more direct because we now have the benefit of a higher perspective with a comprehensive view of all paths that have led to this point in science.

Einstein was the first to apply geometry to foundational physics, which brought about the first recent paradigm shift. The second shift occurred when quantum mechanics extended physics to new concepts on the microscopic level. It then took a hundred years for all areas of physics, including quantum mechanics, to be brought together under ECE unified field theory, which avoids the cul-de-sacs present in other models. This third paradigm shift is completely based on geometry, as it was developed by Riemann and Cartan.

As our understanding of ECE theory and its Horst-Eckardt Extensions increases, so do our capabilities to advance physics, and to teach and learn about true natural philosophy.

Acknowledgment