

A zero-point energy inclusive principle of conservation of energy consistent with zero net energy in the universe

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Summary

The common statement of the principle of conservation of energy fails to take into account the energy of the vacuum, the zero-point energy. What happens for example when a body of matter displaces the local vacuum and reduces the local zero-point energy? In a prior paper the author determined that the mass-energy of electron and proton is equivalent to the zero-point energy they displace.¹ This opens up the intriguing possibility that the principle of conservation of energy should be restated, the total amount of energy including zero-point energy is constant. This paper will include investigations of how different forms of energy can be seen as a displacement of zero-point energy thus confirming the modified principle of conservation of energy. This principle of conservation of energy can also be stated as; the net energy of space is always zero after the baseline zero-point energy is subtracted. In terms of classical forms of energy, there is no net energy in the universe. That leads to the interesting observation that there is no energy beyond the ever-present zero-point energy and thus no problem with regard to the origin of energy.

Background

The principle of conservation of energy is one of physics' most basic assumptions and is important to all areas of physics. One common way to state the principle is that the amount of energy in an isolated system does not change. Another way to state it is that energy is neither created nor destroyed. Energy, however, can be converted from one type to another such as, electrical to mechanical, chemical to electrical, and mass-energy to energy. Then if we consider how energy is measured from different frames of reference we must add the caveat that the energy of the isolated system must be measured from a fixed frame of reference relative to the system.

Zero-point energy has historically not been included in the principle of conservation of energy. In the early years physicists were, of course, ignorant of zero-point energy, then after Planck first hypothesized it many physicists still chose to ignore it or worse deny its existence. If zero-point energy appeared in an equation it was often normalized or subtracted out, so the term no longer appeared. The underlying supposition of the zero-point energy deniers was that zero-point energy did not need to be considered. This has led to serious deficiencies in many popular theories to this day.

Mass-Energy

The discovery that the mass-energy of electrons and protons is equivalent to the zero-point energy they displace was an important clue to an all-encompassing principle of conservation of energy. The author found in a prior paper, *Proton and electron mass derived as the vacuum energy displaced by a Casimir cavity*, that the mass-energy of those

particles is equivalent to the vacuum energy displaced by a Casimir cavity the size of the particles' respective charge radii. It is trivial to show that the same calculation can be applied to the neutron, which has a scattering radius nearly identical to that of a proton.

This means that, at least with respect to the permanently stable particles, the total energy in a volume of space containing those particles and zero-point energy is independent of the number and type of particles present.

It is expected that likewise the mass of all particles is equal to the zero-point energy they displace. A discourse on that subject is, however, beyond the scope of this paper. This leads to the statement that the total energy in a volume of space is independent of the particles present. This can be restated that the net energy of space due to particles after subtraction of the baseline zero-point energy is always zero

Electromagnetic Energy

It is far simpler to see how electromagnetic energy does not affect the total energy in space. We can see that by considering electromagnetic fields, which as a property of the vacuum can only be comprised of vacuum fluctuations, given that nothing else is present. If we consider a wire with a current, it generates a magnetic field. In physical terms this magnetic field is a small degree of rotation of vacuum fluctuation dipoles. If the current is cut, the magnetic field collapses and induces a reverse current in the wire, which indicates that the zero-point energy stored in the field of the vacuum opposes the energy in the current in the wire.

The amount of zero-point energy in an electromagnetic field is equal but opposite to the electromagnetic energy in the circuit. The total energy in a volume of space enclosing an electromagnetic circuit and fields is independent of the electromagnetic energy present. Since the fields propagate to infinity it is necessary to choose a volume that encompasses however many significant digits worth of zero-point energy are desired in a given calculation. It is important to note that this applies to all forms of electromagnetic energy including electro-chemical energy.

Photon Energy

The photon is an important specific case because it is the principle means for transporting packets of energy through a distance. We can see that the standard way of looking at a photon description is incomplete, as it does not explain how a photon produces time varying electric and magnetic fields. Those fields can only be explained if a photon is made up of a series of rotating dipoles, with each rotating in the opposite direction from the one before it.

It turns out that these dipoles have exactly the correct energy and wavelength to be vacuum fluctuations, which is what they are. They can be thought of as electron-positron pairs, but in principle could be any existing charged particle pair. Photon energy is not a separate form of energy from zero-point energy. Photon energy is zero-

point energy. The existence of a photon does not affect the total energy in a volume of space.

Kinetic Energy

Kinetic energy is another area where the vacuum fluctuation deniers failed us, for without vacuum fluctuations there is no physical mechanism to explain inertia and principles of conservation of momentum and kinetic energy. Once we acknowledge the existence of vacuum fluctuations, we can only conclude that there must be some interaction between moving matter and the vacuum fluctuations. Once again there is nothing else present for matter to interact with. It turns out that this interaction is mathematically equivalent to electromagnetic field theory.²

As with electromagnetic interactions the zero-point energy induced by kinetic interactions is of an opposite but equal magnitude. The net energy of space due to kinetic energy is zero. Note that kinetic energy encompasses all large-scale forms of motion and relates to temperature and pressure related conservation of energy principles.

Casimir Force

As with anything related to the study of zero-point energy the Casimir force provides an excellent example of how all force interactions can be seen to operate. The Casimir force comes about when vacuum fluctuations are displaced from a region of space when two objects are close together, thus leading to a force differential that pushes the bodies together. This can be seen as a pressure differential where the vacuum pressure pushing the bodies together is greater than the pressure pushing them apart leading to what looks like an "attractive" force.

With Casimir energy it is easy to see that there is a direct correlation between the zero-point energy and the energy between the affected bodies. The Casimir energy is equal to the displaced zero-point energy. The appearance of a Casimir force does not change the total energy or net energy in that region of space.

Here it is interesting to note that electromagnetic forces can be thought to act in a manner consistent with the Casimir force. The existence of electric and magnetic fields changes the local zero-point energy in space, and it is this change in local vacuum pressure that leads to motion.

Nuclear Force

As with the origin of mass problem nuclear energy is another area where the mainstream, non-vacuum fluctuation based model gives us no clue how nuclear energy and vacuum energy interrelate. That problem is easily solved when the Casimir force between two proton or neutron sized spheres is computed and compared to the nuclear force, for then it is easily shown that the strong nuclear force is simply a Casimir force.

The nucleons are pushed together when vacuum fluctuation wavelengths between them are excluded. This nuclear Casimir force is strong enough to overcome Coulomb repulsion and account for the nuclear force.³ As with the general case of the Casimir force the nuclear force does not change the total energy or net energy in a region of space.

Weak Interactions

Weak interactions such as beta decay have been difficult to characterize ever since they were identified. Neutron decay is perhaps the simplest example. A neutron decays into a proton and electron, also known as a beta particle. A neutron is also produced when an electron of sufficient energy combines with a proton. Based on conservation of energy principles it was thought that the beta particle should have a fixed energy, but it does not. The sampling of neutron decay beta particle energies yields a curve that starts as low as 25 keV, reaches a maximum occurrence around 220 keV, and a maximum energy of over 800 keV.⁴

The evidence appears to show that energy is not conserved with respect to neutron decay as the beta energy varies a great deal. The same is true of similar weak interactions. Physicists refused to accept that the principle of conservation of energy fails here. Whether through denial or theoretical bias they failed to consider a vacuum fluctuation based solution. That led them with one other possible solution. They had to invent a new particle to account for the missing energy, a particle that was unseen and cannot be observed directly, the neutrino. The neutrino solution still fails to account for two more fundamental problems; what is the underlying process producing the range of energies, and what type of interaction yields the probability function.

There is a far more elegant vacuum energy based solution based on the Hawking mechanism.⁵ Hawking radiation is theoretically due to a vacuum fluctuation, a particle pair, where one particle of the pair crosses the event horizon of a black hole while the other escapes the black hole's gravity field as a photon. In this way zero-point energy is converted to photon energy and the black hole loses an equivalent amount of energy thus conserving energy.

Neutron decay is similar. A vacuum fluctuation, an electron-positron pair, occurs close to a neutron. The positron annihilates the electron-like component of the neutron leaving behind a proton and a free electron some distance away. The vacuum fluctuation donates its energy and the remaining neutron decay energy is transferred to the electron.

The energy distribution is explained by the normally random energies of the vacuum fluctuations. The interaction probability between the neutron and the vacuum fluctuations yields the probability function. As with Hawking radiation, the vacuum provides the initial energy, and thus we have another example of zero-point energy interacting directly with non-zero-point energy. The zero-point energy, mass-energy and kinetic energy are conserved such that the total and net energy do not change.

Gravity

Again we have a commonly accepted force theory that does not take zero-point energy into account. Even worse, if zero point energy were added into the equations the model would fail catastrophically, which is a principle reason why physicists are avoiding integrating zero-point energy into all force models. Still worse, given that mass-energy due to particle does not change the local net energy of space, there is no net energy to plug into the gravitational equations thus leading to zero gravitation force everywhere. The existence of zero-point energy disproves the current gravitational model.

Fortunately one of Newton's contemporaries Nicolas Fatio de Duillier established the framework for a physical model that explains gravity.⁶ This model was later popularized by La Sage and often bears his name. It is also sometimes called the push theory or shadow theory of gravity as Fatio thought that space was filled with corpuscles and that these corpuscles pushed against bodies. Or, alternatively two bodies shadow each other from the force coming from the direction of the opposing body leading to a net "attractive" force.

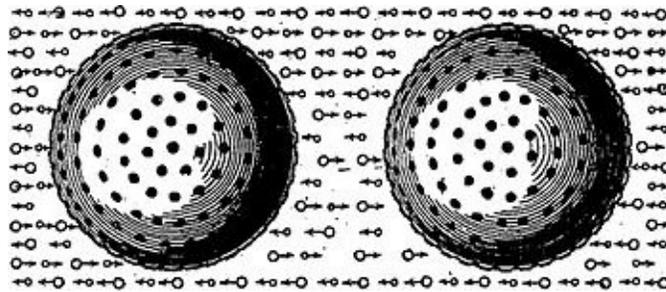


Figure 1. An illustration of the push theory of gravity by Le Sage.

Kinetic interpretations of this theory were used to quickly discredit it, but Fatio's corpuscles turn out to be vacuum fluctuations rather than particles following normal kinetic laws. Of course, the physicists of the time knew nothing of vacuum fluctuations other than a vague notion of æther, and physicists of the last century simply chose to deny or ignore the existence of vacuum fluctuations.

What we end up with is a gravitational model that shares some similarities with the Casimir force as it is due to vacuum pressure differentials, only in this case it is due to a shadowing effect rather than exclusion of vacuum fluctuations related to the distance between the bodies. Note that both effects need to be accounted for in the general two-body case, but the Casimir effect can be ignored at large distances.

The source of this $1/r^2$ varying pressure force is a type of long-range London-van der Waals force, the derivation of which is beyond the scope of this paper. This is the same $1/r^2$ varying pressure force observed in electromagnetic forces as the two are related.

Again we have a force that gets its energy by excluding a portion of the zero-point energy. The presence of gravitational forces does not change the total energy of space, and the net energy of space due to gravity is zero.

Relativity

There still needs to be a discussion about the frame of reference from which the system is being viewed. When there is a larger relative velocity between the observer's frame of reference and the bodies being observed, those bodies appear to have more energy. Because of that the principle of conservation of energy still only holds if the observer's frame of reference is fixed relative to the system being measured.

Another important point comes about because the baseline zero-point energy is not frame independent. The zero-point field has a rest frame and the baseline zero-point energy minimum is observed from the rest frame. Note that the zero-point field rest frame has been identified through observations of cosmic background radiation.

Conclusion

It is clear that the effect of zero-point energy within the scope of most mainstream energy and force theories has not been clearly established. Zero-point energy's role in principles of conservation of energy has been generally ignored. It becomes necessary then to first adopt zero-point energy compatible force models before being able to consider a principle of conservation that properly takes it into account. Once done it is clear that the long held supposition that classical forms of energy do not affect the baseline zero-point energy is not true. Zero-point energy cannot simply be normalized out of an equation because in each case the classical form of energy is displacing zero-point energy.

Once zero-point is included the principle of conservation of energy can be stated, the total amount of energy in a region of space is constant and equal to the baseline zero-point energy. This requires that the energy be measured from a fixed frame of reference. It can also be stated that the net energy in a region of space, with the baseline zero-point energy subtracted, is always zero.

This leads to the interesting consequence that no energy has been or can be added to the universe. There is no need to explain an origin of energy problem, as there is no such problem. The natural zero-point energy is sufficient and is the source of all the energy in the universe.

¹ Fleming, R., "Proton and electron mass derived as the vacuum energy displaced by a Casimir cavity," <http://vixra.org/pdf/1203.0033v1.pdf>

² Fleming, R. "The Matter Force," 19th Natural Philosophy Alliance Proceedings, Ed. Volk, Vol. 9, pg 162

³ Fleming, R., "The Nuclear Force," <http://vixra.org/pdf/1403.0006v1.pdf>

⁴ J. Reich et al., "A measurement of the beta asymmetry in neutron decay with PERKEO II," Nuclear Instruments and Methods in Physics Research A 440 (2000) 535-538

⁵ Fleming, R., "Beta decay as a virtual particle interaction analogous to Hawking radiation," <http://vixra.org/pdf/1204.0050v1.pdf>

⁶ N Fatio de Dullier, "De le Cause de la Pesanteur" (ca 1690), Edited version published by K. Bopp, Drei Untersuchungen zur Geschichte der Mathematik, Walter de Gruyter & Co. pg 19-26 1929.