The Impossibility for the Universe to (not) Exist

by Anton Biermans
www.quantumgravity.nl

'Concepts that have proven useful in ordering things easily achieve such authority over us that we forget their earthly origins and accept them as unalterable givens.' A Einstein[1]

It's impossible for the universe *not* to exist since then there's no time to not exist in. Assuming that the laws of physics are valid anywhere, anytime, a universe can create itself without any outside help out of nothing only if the grand total of everything inside of it, including spacetime itself, remains nil.
This means that the universe cannot exist *as a whole* either, but only as seen from within, by an observer who physically is part of that sum.
Again there's no time outside of it to exist *in*: as it cannot be in any particular state and evolve as a whole, things inside of it can only evolve with respect to each other, so we see galaxies in all evolutionary phases at all times, evolving at different paces.
We don't see a distant galaxy as it was in *the* past, but as it is at it is at present *to us*: *the* past refers to a clock outside the universe, as if the galaxy has an objective, physical reality even outside of it, as if its state doesn't depend on anything.

The universe could only evolve as a whole if time would pass even outside of it, if there's an outside clock the pace of which doesn't depend on what happens inside of it and so doesn't belong to the universe itself.

By thinking about the universe as an object which can be inspected from the outside, we look at it like we imagine its creator to do, and, in doing so, we unwittingly but implicitly assert that it has, indeed, passively been created by some outside intervention.
Only in that case laws of physics wouldn't matter and only then the universe could exist, have properties and evolve as a whole, *with respect to its creator*: only then there would be time outside of it to evolve and exist in –or to not exist in.

As it doesn't exist as a whole, it obviously cannot have any particular property as a whole, no unique minimum distance –not to mention that to measure it, we'd need a rule the graduations of which are separated by even smaller distances.

This is not to say that distances between particles cannot be quantized, though if there's no limit to their energy, then there's no limit to the size of their minimum distance, so the universe would be both digital *and* analog.
The question whether *the* universe is analog or digital suggests that it contains a finite number of distinguishable positions[2], as if spacetime has the same graininess, the same pixel size everywhere, which, as will be argued, it has not.

One of nature's tricks to keep the sum of everything inside the universe nil, is to design energy as a quantity which is neither positive nor negative, but is both, as something which is greater as its rate of change is greater, the frequency its sign alternates at. Interference experiments indeed show that when two photons annihilate, there's no energy liberated nor has their source lost any energy by emitting them, so a photon, or *any* fundamental particle for that matter, is its own antiparticle, its energy as positive in one phase as it is negative in the next.[3]

If the energy of a particle equals its rate of change, a rate which varies within every cycle, then the indefiniteness in the rest energy of a particle *dE* doesn't refer to an uncertainty in its energy, but is a *measure* of its energy: the greater its variation is in every cycle, the shorter its period is, the higher its energy is, so the uncertainty principle is equivalent to Planck's law $E = h.v$, defining energy in terms of time and vice versa.
Only by alternating its sign, by alternating an increase with a decrease, can it keep its rate of change changing: an increase with respect to a preceding state makes the earlier state smaller, a fate befalling every subsequent state –as we then look back in time indeed.
We can then say that the energy sign of the particle alternates, or, alternatively, that the particle alternates its time direction.

The uncertainty only exists in our measurement as we cannot predict in what phase the probing particle and the particle to be measured meet as they interact: this is why we cannot predict the results of a single interaction, but find (an can predict) a probability distribution in the results if we repeat the experiment many times.

If (with the appropriate choice of units) we may substitute *dx* for *dt* in the uncertainty principle in the form $dE.dt = 1$, so we may write $dE = 1/dx$, or, as *dE* is a measure of the energy of a particle, $E = m = 1/dx$, then the uncertainty principle defines the rest energy of a particle as higher as its position is less indefinite, as it is confined to a smaller space.
As the indefiniteness in the position *dx* of a particle also varies in every cycle, the probability to find it within a smaller area increases as its energy is higher –as reversely, its energy is higher as it is confined to a smaller area.

Since $E = dE/dt = d^2E/dt^2 = d^3E/dt^3 = ...$ except for a phase shift, the rate of change (of the rate of change) varies in every cycle, energy is a truly fractal quantity: if energy and time define each other, then so is time.
This means that a particle with a high rest energy in every cycle repeats all different rates of change, all lower energy states, as if it is created over and over again.
A muon, a heavy electron, for example, for a short time in every cycle actually has the energy, the rate of change of the electron, *is* an electron: this is why a muon can decay into an electron, why particles can appear to have a mixed identity.
If in every cycle the energy of a particle, its rate of change for a short time is zero, its clock stopped, its position completely indefinite, then it can reappear to start its next cycle at a distance from its last position equal to the time its energy is zero and the speed of light –which is why it can 'tunnel'.

A problem with the concept of rest energy is that it treats a particle as a classical object, as something which can be ascribed a definite position at all times.
However, as the indefiniteness in its position varies within every cycle, the term 'rest' refers to something the position of which periodically is far too indefinite to determine the velocity of, so 'rest' doesn't seem to be a very useful concept for quantum objects.
As its energy is expressed stronger as mass, as gravity as its position is less indefinite, we shouldn't worry about whether or not it is at rest inside the area corresponding to that indefiniteness.

The advantage of energy as something the sign of which alternates, is that it allows particles to create one another by alternately borrowing and lending each other the energy to exist: the higher the frequency of the exchange, the higher their energy is.
Particles only exist to each other as far as they exchange energy, so by doing so they preserve and express their mass as a force between them, urging each other to reappear again and again after every disappearance.
If they are to repeat the next cycle with the same period, then they have to reappear at the same distance from each other, so by exchanging energy, they power each other's inertia, their opposition to a change in their distance and exchange frequency.

If their properties are as much the source as the product of their exchange, then so is the force between them, meaning that a force cannot be either attractive or repulsive. Particles then don't resist our pulling them apart or compress them because they have an intrinsic inclination to either attract or repulse, but because we disturb their equilibrium, the frequency they exchange energy at, the mass they have according to each other: by opposing the force they try to conserve their energy, so we feel their inertia at work.
If particles express and preserve their mass by exchanging energy, if by doing so they anchor each other to positions to act from, then any attraction between them obviously cannot exceed their opposition to it, the force which keeps them at those positions.
The greater their mass is, their 'attraction', the greater also their opposition to it is, their inertia, their 'repulsion': a force never can be stronger or weaker than the counter force it can evoke.

If energy is an ambivalent quantity, then so is mass, so the force between masses cannot be either attractive or repulsive, so we can distinguish two kinds of gravity.
The first kind is as attractive as it is repulsive, and is powered by the energy exchange by means of which particles preserve and express their mass.
This force is known as 'electromagnetism', a theory in which particles are supposed to have a constant charge, either positive or negative, so they either attract or repulse each other, any equilibrium the result of opposite forces balancing each other.
As particles are considered to be only the source of their properties, the theory has to assign particles a constant charge sign.
However, being as much the product as the source of their interactions, the charge sign of particles just refers to the energy sign, so their 'charge' sign alternates at a frequency equal to their energy.
By interpreting the equivalence principle[4] to mean that we can call any force that brings to expression the inertia of particles 'gravity', we unify electromagnetism with gravity.
The weak force we call 'gravity', associated with the contraction of masses and the expansion of spacetime between them, is powered by the ongoing creation process: if things find ways to create each other without any stuff or help from the outside, then they can hardly stop doing so.

The smaller the distance between two particles is, the less indefinite it is, the higher the frequency of their exchange is, the greater the mass one particle has according to the other, whereas the farther apart they are, the weaker the force between them, the less energy is involved with a distance change, the less definite their distance is, the longer, the less definite the wavelength they exchange energy at.
If a particle exchanges energy with all other particles within its interaction horizon, at many different frequencies, then the energy *we* measure it to have is the sum of these exchanges, the superposition of all associated frequencies.
If particles can only exchange energy if they are in counter phase[5], then their optimum distance is a half-integer times the wavelength of the exchange, so to express and preserve their energy, the minimum distance where they can be at rest with respect to each other is half that wavelength.

Though the minimum distance between particles then is discrete, smaller as their energy is higher, a distance is less discrete, less definite as its borders are vaguer.
As their energy varies in every cycle, its rate of change, so does the definiteness in their position, in their distance, so their distance only is periodically more or less discreet, the vagueness of its borders varying periodically: the higher the frequency of their exchange, the smaller and less indefinite their distance is, the more discreet it is.
As the force between them changes less per unit distance as they're farther apart and/or have a lower energy so there's less energy involved with a change, then their distance is less definite as it is larger and/or their rest energy is smaller.

If the distance between particles is less indefinite as it is smaller and/or their energy is higher, then spacetime is more defined near masses, as the gravitational field is stronger, so the pixel size is smallest at the center of particles, stars, neutron stars and black-hole like objects –as measured outside the field since a ruler shrinks in the field itself.
As it matters less energetically where a particle exactly is in empty space, far from masses so its position isn't well-defined in a weak gravitational field, distances are less definite in empty spacetime, so here the pixels would be much larger and vaguer.

The uncertainty principle is often thought to imply that spacetime is filled to the brim with virtual particles, their energy higher as we look at smaller scales: though this should have gravitational effects, none are observed.
If the energy of particles isn't only the source, but also the product of their interactions, then their energy evidently only is as great as is expressed as gravity, the ambivalent force by means of which they anchor each other to their positions.
So instead of saying that for energy to be a source of gravity it must have a position to be able to act from, we can as well say that for a particle *to have energy*, it must have a well-defined position.
If the position of particles is less indefinite near masses, in a stronger field, then the energy of virtual particles, like the price of real-estate, depends on the location, where they pop up: they are, in fact, part of the gravitational field, of the mass of its 'source'.

If particles only exist to each other as far as they exchange energy[6], then they create one another as they near each other from infinity: as the force between them, the frequency of their exchange increases as they near each other, their distance becomes less indefinite –though this happens only *if* their energy increases.
This circular reasoning reflects the fact that if particles are to create one another, they must create a space so that their energy *does* increase as they near one another.
If we define spacetime as being greater as it contains more *physically* different positions, then the particles create spacetime as they contract, as their energy increases.
So mass, a gravitational field then is an area of contracted spacetime: the heavier the object, the stronger the field, the more physically different positions it contains within a smaller volume, as measured with a rule outside the field, whereas spacetime is expanded where it is less defined, far from masses where positions differ less energetically.[7]

It is a misconception, then, that we find more violent physics at smaller scales: it is the energy density somewhere which determines the degree of 'violence', the extent to which spacetime is detailed, defined.[8]
Spacetime, then, is more defined as it takes more energy to enter[9]: the stronger the gravitational field, the more energy it takes for a test particle to penetrate the field, the slower it is observed to move as seen from outside the field, the more viscous spacetime seems, the more the field acts like a solid object.

As a particle cannot express its mass far from masses, exchange energy at the frequency corresponding to its rest energy, it preserves its mass by slowing down its clock, by moving at a relativistic velocity, so according to its own slowed down clock, the frequency it oscillates at remains unchanged, its mass preserved.
As particles cannot be at rest in empty space, far from masses, where their position is ill-defined, they cannot contract at random places, so empty space remains empty.: since they only can contract at rest where the forces are equal from all directions, mass is created preferably at such places, producing a uniform mass distribution in the universe.

According to Zeno's paradox[10], an arrow can never reach its target as each subsequent halving of their distance takes a finite time.
Though the paradox is thought to be solved if there is a discrete, minimum distance which cannot be halved, two points are only separated in space and time as far as they differ *physically*, a difference which depends on the arrow as well as on the target.
If to the arrow positions are less definite as it moves faster and/or its mass is smaller, then its path shrinks in space and time as it moves faster or has a smaller rest energy.
With a zero mass all positions would be perfectly equal to the arrow so its path in space and time then would shrink to zero length, so its flight would take no time at all.

The question whether *the* universe is built out of discrete minimum volumes reflects a deep ignorance about the nature of spacetime.
The problem is that we cannot let go of the idea of particles as small versions of macroscopic objects, as tiny or even infinitesimal pellets containing energy.
By assuming particles only to be the source of their properties, as if they are the private, mortgage-free owners of their energy, we isolate them from their environment, as if they have a surface protecting, separating some content from the vacuum of empty space.
By doing so, we treat them as classical objects, ascribing them an autonomous existence, as things which though they undeniably do interact, have a reality beyond interactions, an existence independent of anything, as if they've passively been created by some creator.

As a consequence, we regard space as an unavoidable inconvenience as they obviously need someplace to be in, confusing it with a *mathematical* space, a homogenous quantity which, though curved by mass, has other properties unrelated to mass, thereby degrading particles to tenants, to *fremdkörper* in a sterile environment.
A particle, however, isn't some kind of pellet which shows wave-like behavior: it actually is the other way around, a wave phenomenon showing particle-like behavior.
It is an area where the definiteness of positions in a wave-like manner varies in space and time, so we cannot exactly distinguish where the particle ends and space begins.
If it has no center to act as the cause of whatever emanations, then the distance between particles never can become infinitesimal, so interaction energies never become infinite: their energy determines their distance and vice versa.
Its particle-like properties consist of the area having a more or less definite position as it differs physically from the adjacent space, the ability to move and rotate, its gravitational field by offering resistance to penetration giving it tangibility, whereas its energy exchange anchors it to some position, providing it with inertia.

Like we cannot distinguish energy from time beyond some limit[11] as they define each other, we cannot distinguish mass sharply from its gravitational field, where particle ends and where its environment begins as they are two aspects of a single phenomenon.
Particles are as much the product of their environment as they help power spacetime itself by keeping positions physically different from one another: by exchanging energy, objects anchor each other at more or less defined positions, defining and preserving spacetime between them, *powering* it, at the same time powering their own mass.

However, since we've decided that particles only are the source of their properties, a force either is attractive or repulsive, so to explain any equilibrium between particles, we had to invent different kinds of forces, all of which add to their energy, with the result that we don't believe Einstein's credo that mass and space define each other anymore.

If particles are the source *and* product of their interactions and their properties and rest energy could vary continuously, then they obviously couldn't exist: a property requires a backbone, a resistance to any change so that energy can be absorbed, converted into motion instead of resulting in a change of properties, of identity.

To have a discrete energy, to be stable within a certain energy interval seems to require the existence of different kinds of particles, of inter-specie interactions to secure the ratio between their masses.
However, since the energy one particle has according to the other, the frequency of their exchange depends on their distance, spin, speed and direction of motion, we may as well say that it is their different behavior *with respect to each other* which causes different properties, that is, different discrete exchange frequencies, differences which originate in all degrees of freedom space and time allow, are built out of.
So if different kinds of particles exchange energy at different frequencies, and the energy of any particle is a superposition of all frequencies of all its different exchanges, then this is why they can change their identity, transform, split, and fuse to other kinds.
Since some (groups of?) frequencies interfere destructively, the frequencies or frequency intervals which survive are discrete, so if the spin of particles affects the frequency of their exchange, then this might be why spin is quantified. The existence of the different particle generations of the Standard Model indicates that particles evolve, their rest energy depending on the conditions they're forged in.
This begs the question whether virtual particles form a 0^{th} particle generation, having all possible energies up to the level of their real counterparts of the 1^{st} generation?
A higher energy being a less indefinite energy, this suggests that to promote each other to real particles, the ratio between their energies must become more sharply defined, as if to sustain one another, the different members of the generation must assume less indefinite, more discreetly limited frequencies, their mass ratio more precisely adjusted, and assume a discreet spin etc. so they can set up a sustainable, lasting exchange.
This is somewhat like how different strings of piano resonate as a key is pressed, a different set of harmonic overtones for every ground tone: by resonating in restricted frequencies, energy loss in other, destructive frequencies is suppressed, the superposed sound prolonged.
As the energy of virtual particles of the field is higher as they are nearer to the real particles they eventually may become, they even get a kind of education as how to go about it.
Since this requires getting rid of disorder, of destructively interfering frequencies, these are radiated away as they become real particles –a radiation which as it prevents the creation of mass elsewhere, helps keeping empty spacetime empty.

If there are to be three space dimensions, then for an observing particle to be able to distinguish directions, two particles moving in directions perpendicular directions then should be observed to have different properties, so different dimensions require the existence of different kinds of particles, properties and associated conservation laws.

If particles can change their identity, if a quark by emitting or absorbing an electron becomes a different quark, if a composite particle can change its state by absorbing or emitting energy, then there must be a common currency for all these different kinds of changes, a unit energy to pay for this.
However, though energy comes in packets of an integer number of *h*, the Planck constant, that does not mean that there's a minimum energy quantity: since in $A . B = h$, *h* doesn't limit the value of *A* and *B*, *h* must be a conversion factor.

In the uncertainty principle, *h* refers to the impossibility to measure two intrinsically related quantities independently from each other: as energy and time define each other, we cannot distinguish one from the other beyond some limit.
Since by measuring it, we affect the energy of a particle to an unpredictable, but limited degree, we cannot distinguish energy differences smaller than this amount.
The Planck constant in $E = h.v$ then plays the same role in physics as the number 1 in the series of integers, reflecting the fact that two energies only can be distinguished if their difference is larger than corresponds to *h*.

The breadth of this difference then is a function of frequency: at higher energies there are more energy levels per energy interval for particles to occupy, so the difference between subsequent levels decreases, becomes less indefinite at higher energies.[12]

The reason we wonder whether there's a minimum energy quantum is that we regard energy as an unambiguous, absolute quantity, as if we can count the energy content of the universe as a whole, which obviously doesn't make any sense.
This again shows our stubborn insistence that a particle exists even outside interactions, as if its energy is a god-given property the origin of which it is not our business to ask.
Since particles only exist to each other as far as they exchange energy, as energy only exists in its exchange, it's a relative quantity, something a particle has *with respect to* another particle, to some arbitrarily chosen comparison object inside the universe: there's no measurer outside of it to grant inside quantities the absoluteness we so seem to crave.

Instead of saying that a particle alternates its energy sign, we can say as well that it alternately moves in opposite time directions, oscillating about some zero-time point, as if it is not energy which is ambivalent, but time.
The result is that if all particles could and would keep their frequency constant, then no time would pass: as in that case everything in the universe would be frozen in time, the passing of time proves that their energy changes, increases.
Instead of saying that the energy of objects changes, that our world continuously changes *in* time, we can as well say that it is this change which powers time, which makes one moment differ from the other, changes we experience as the passing of time.
Time is not waiting for events to happen, as if they're predestined to happen, cooling their heels in the backstage: events by happening power time.

As a gravitational field slows down processes inside of it as observed from the outside, and any random change increasing the rest energy of its source tends to freeze the new state even more in time, an increase of energy is favored above a decrease and thus tends to be conserved: as a disintegration leaves no traces so cannot not be observed, we perceive events to follow one time direction rather than the other.
If particles, to create one another, to increase their energy, have to contract to stars and galaxies, then we cannot accuse particles of preceding galaxies: if the particles are forged in the formation of galaxies, the bricks baked in the building process, then we cannot say that one causally precedes the other, so time anyhow is a two-faced kind of affair.
As the universe as a whole obviously cannot follow any time direction as it doesn't exist *in* time, as there's no clock outside of it to absolutely determine the sequence of inside events, then the speed of light is property of spacetime rather than a velocity.

A universe which according to its own laws cannot exist, have no beginning as a whole, is a proposition which is hard to fathom, let alone accept: however, as it isn't your garden-variety kind of thing, we shouldn't expect it to behave like one.
If the universe as a whole is but an intellectual, a religious construct which has no *physical* reality whatsoever, then we cannot require it to have a beginning.
Though all things inside of it may have a beginning and ending, the whole usually is more than the sum of its parts –or, in this case, less.
Like the fact that the sun moves through the sky doesn't necessarily mean that it revolves about the Earth, that we experience time to pass, our life to have a beginning and end, does not necessarily mean that space or time itself must have endpoints: a beginning presumes it to be preceded by something, waiting for it to begin.

[1] http://en.wikiquote.org/wiki/Albert_Einstein (25 Jan 2011)

[2] –a number which increases as the universe expands –that is, if it expands at all. If the universe doesn't evolve *in* time but powers time, contains all time within, then clocks (are observed to) run slower and run farther behind as they are more distant, so the redshift of galaxies doesn't necessarily indicate a receding motion, an expanding universe, so would need no dark energy to explain observations.

[3] –the difference being that when massive particles annihilate, there *is* energy liberated.

[4] http://en.wikipedia.org/wiki/Equivalence_principle (25 Jan 2011)

[5] That is, to an observing particle sitting on a line connecting the two particles so one particle is half a wavelength farther away than the first, then to this observer they look to be always in the same phase. If the sign of its own energy alternates at the same frequency the observed particles oscillate, then it observes no oscillation at all.

[6] Unlike the net transmission of energy, the energy *exchange* by means of which particles express and preserve their mass is not observable, only its result: their existence.

[7] As no position in the universe is completely indefinite, spacetime does contain energy, mass, so empty space can be thought of as a form of extremely diluted mass. If we define the universe to end where all positions are perfectly equal, and this only happens infinitely far from masses, then it is without ends itself, though then the term 'distance' then looses any significance.
This is not to say that an observer can see all of it: his universe only is as large as his interaction horizon, depending on his mass, every observer sitting at the center of his universe.

[8] Though these 'quantum fluctuations' are supposed to be random, if a higher energy density, a smaller space requires a more precise coordination of their behavior and exchange so they oscillate in concert, then their behavior is less disorderly in areas of high energy density.
This is one reason why neutron stars and black-hole like objects scarcely emit energy, unlike stars where the kinetic energy of particles varies fast, so they keep emitting and absorbing photons.

[9] -ignoring the weak gravity, the force making Newton's proverbial apple fall

[10] http://en.wikipedia.org/wiki/Zeno%27s_paradox (25 Jan 2011) Zeno's paradox

[11] $dE.dt \geq \hbar / 2$

[12] –which is why matter can contract to unlimited densities.
Perhaps as their energy becomes less indefinite, they have to obey laws of physics more exactly – thereby confirming, preserving those laws more forcefully?
After all, particles don't just obey laws imposed on them from 'above': they are the materialisation of those laws, built into, being at the core of their properties.