7. ABIOTIC CONDITIONS ARE PROBABLE

Mechanics creates a deterministic worldview. This makes the world in principle predictable as a calculable process from the Big Bang onwards. The mechanics of Newton seemed to be a complete whole until Einstein put them into a relativistic, but also deterministic perspective.[a]

Half a century before Einstein, a more statistical approach in physics had already proven to be necessary. It worked reasonably well to bring both approaches into line with each other on different levels of scale.[b] With the rise of quantum physics, however, this again became a problem on an even smaller scale.
This chapter describes some examples of these different ways of thinking.

§ 29 MECHANICS RELATIVATES SPACE AND TIME

E=MC^2 IS THE LIMIT OF E=MV^2 DUE TO THE MAXIMUM SPEED OF MASSES C

In short, classical mechanics since Newton[c] reads (without differentials):
Speed v is a traveled distance s divided by the required time t: **v=s/t.**
Acceleration a is v, again divided by the time t, in order to reach that speed: **a=s/t^2.**
Force F is the acceleration a, times the accelerated mass m: **F=ma.**
Energy[d] E is a force F exerted on a mass m over a distance s squared: **E=mv^2.**

Masses, however, appear to have a maximum mutual speed c ≈ 300 000km/sec (the speed of light).[e] At that maximum speed more added energy cannot end up in a higher speed v (being at its maximum c). So, it must result in mass m, according to: **E=mc^2.**[f]

a Einstein(1905)Zur Elektrodynamik bewegter Körper(Annalen der Physik)17 p 891-921 en (Annalen der Physik)18, p 639–641, 1905.http://onlinelibrary.wiley.com/doi/10.1002/andp.19053221004/epdf.

b See for example Young(1964)Fundamentals of Mechanics and Heat(New York)McGraw-Hill

c Newton(1687)Philosophiae naturalis principia Mathematica(London) https://openlibrary.org/books/OL25646536M/Philosophiae_naturalis_principia_mathematica

d If you add up all rising partial velocities dv from 0 to the final velocity v_e, and multiply that with the m of *one* moved mass: $\int_0^{v_e} mv \cdot dv = \frac{1}{2} m{v_e}^2$, then you have calculated the kinetic energy e of that mass m with speed v_e. However, if you push a car to that speed, then your ground surface also undergoes the same force in the opposite direction (action = reaction). This must bring about an immeasurably small movement of another, very large mass (the earth) 'at rest'. It is part of your work. That 'reaction mass' then receives the same kinetic energy in opposite direction, in total twice ½ mv^2. Until here Newton(1687), but further applies Einstein(1905)

e The Dutchman Beeckman(1634)Journal tenu par Isaac Beeckman de 1604 à 1634 Tome III already came up with a method to calculate c (http://adcs.home.xs4all.nl/beeckman/III/1634.html#lumen), but Rømer (1676) "A Demonstration concerning the Motion of Light". Philosophical Transactions of the Royal Society 12 (136): 893–4. 1677 really calculated c from astronomical observations. On the 15th Conférence Générale des Poids et Mesures (CGPM) in 1975, the speed of light c was finally set at 299 792 458 m/s. The Dutchman Lorentz(1895)Versuch einer Theorie der electrischen und optischen Erscheinungen in bewegten Körpern(Leiden)Brill proved that a moving mass m is larger by a factor λ, so that $m_{moving}=\lambda m_{in\ rest}$, where $\lambda = (1-(v/c)^2)^{-½}$. That 'Lorentz factor' and therefore your moving mass, would become infinite if you would approach the speed of light c. Close to c you then have to use an infinite amount of energy to speed up. Thus c is a maximum speed for masses.

f Acceleration beyond light speed is imaginary, because it requires more than infinite energy. As a thought experiment, however, it is a simple shortcut into the complicated mathematics of the special relativity theory of Einstein(1905).

This mass building-up already starts from 0m/sec onwards by any acceleration, but at low v compared to c (v/c) the mass increase is immeasurably small (***Fig. 162***)[a]

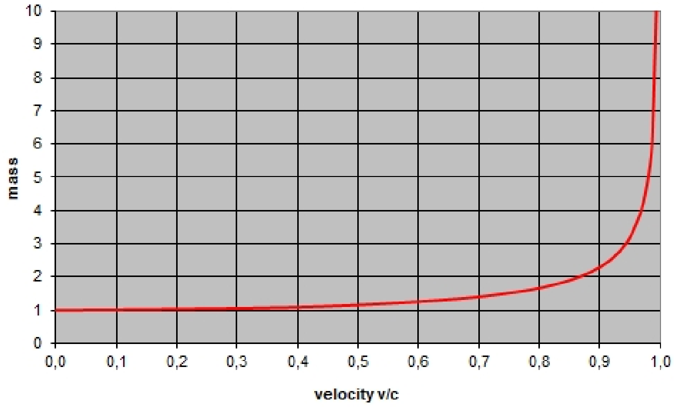
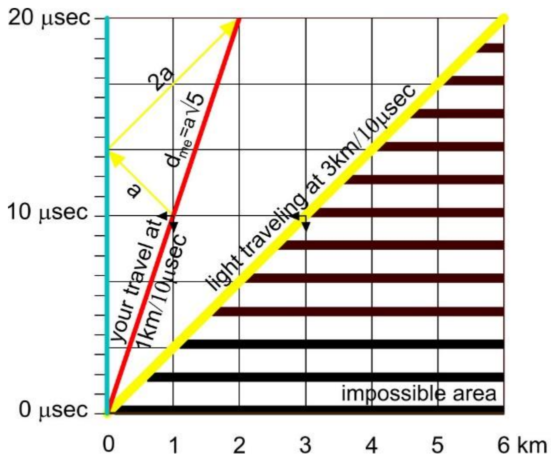


Fig. 162 Lorentz' mass increase through velocity

MASS INCREASES, BUT TIME AND DISTANCE SHRINK THROUGH MUTUAL VELOCITY

Imagine you move away from me with ⅓c≈100 000km/sec (1km/10µsec[b]).
Your travel is shown as a red line in ***Fig. 163***. We both start at the origin (0, 0).
I don’t move (blue vertical axis). I travel in time only, not in space (horizontal axis).
In ***Fig. 164***, however, you (now ‘in rest’) see me disappearing behind you. At 10µsec, you send me a light signal (yellow arrow)[c], which I mirror 90° back to you. The light reaches you over the same distance (3∗a), but your grid has shrunk √4.5/√5≈95%.



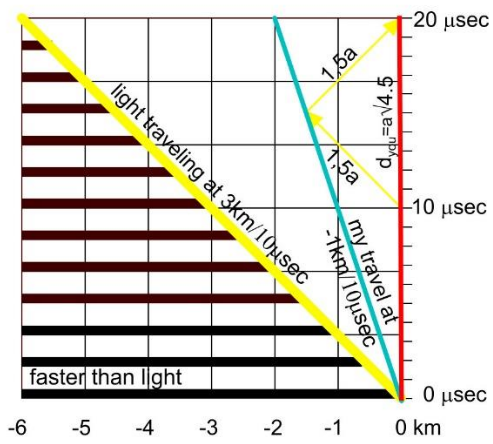


Fig. 163 Your travel in my world   ***Fig. 164 My travel in your world***

Because c is a constant, 1**µ**sec equals 0.3km, so 3⅓**µ**sec=1km.
As a result, the axes in each graph become geometrically equivalent as 'space-time'.[d]
So, I could draw a km∗km grid in both cases.

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a Lorentz(1895)Versuch einer Theorie der electrischen und optischen Erscheinungen in bewegten Körpern(Leiden)Brill https://de.wikisource.org/wiki/Versuch_einer_Theorie_der_electrischen_und_optischen_Erscheinungen_in_bewegten_K%C3%B6rpern

b A µsec is a second/million.

c The thick yellow diagonals represent the speed of light c (3km/10µsec). Each slope parallel to that yellow line (or back perpendicular to it) equals that speed. It is the same for you and me. Even with a moving light source, c remains the same forwards and backwards, proven by the experiments of Michelson;Morley(1887)On the relative Motion of the Earth and the Luminiferous Ether(American Journal of Science)XXXIV p333-345

d Minkowski(1908)Die Grundgleichungen für die elektromagnetischen Vorgänge in bewegten Körpern(Nachrichten der Gesellschaft der Wissenschaften zu Göttingen)Mathematisch-Physikalische Klasse p53–111

In ***Fig. 163*** the red route you travel during the time that your yellow signal is on the way (with a rectangular detour reflected through me), is the slanted side d_{me} of a right triangle. According to Pythagoras d_{me}^2 equals $a^2+(2a)^2$, so $d_{me}=\sqrt{(a^2+(2a)^2)}=\mathbf{a\sqrt{5}}$.

In ***Fig. 164*** you do not move (the red line is upright), but I take off behind you. Then, your yellow rectangular triangle looks different. In both cases, the light travels the same distance in the same time (a+2a=1.5a+1.5a), but your slanted side d_{you} is $\sqrt{((1,5a)^2+(1,5a)^2)}=\mathbf{a\sqrt{4.5}}$. So d_{you} (10µsec) is 95% smaller than with me (d_{me})! [a]

ACCELERATION DRAWS YOUR SPACE-TIME CROOKED COMPARED TO MINE

In ***Fig. 165*** I project your world (red) as warped in my grid (black). Your second and meter are smaller. The *time* is smaller *for those who move in relation to an observer*.

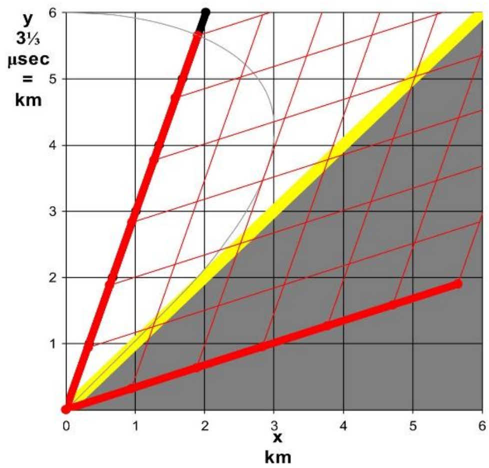

Fig. 165 My projection of your world

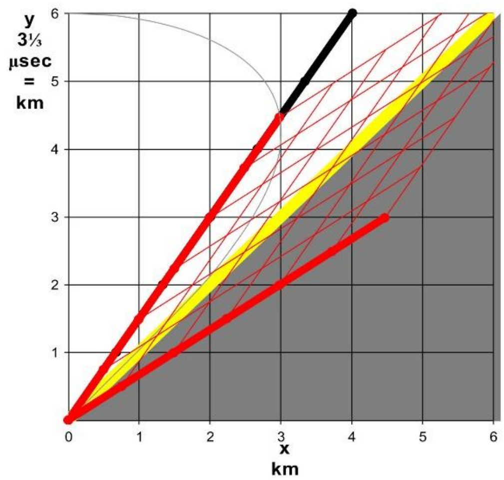

Fig. 166 The same with double speed

In 1905 Einstein had advanced so far with his *Special* Theory of Relativity, thanks to the concept of 'local time' by Lorentz (1895).

How do you understand acceleration now? After ten years Einstein's *General* Theory of Relativity (1916)[b] gave the answer. The accelerations in ***Fig 167*** show curved lines (more and more kilometers are being made per sec). Time and space are curved.

In ***Fig 167*** the acceleration forward is positive, retardation is simply a negative acceleration (***Fig 168***). More masses in a universe then cause waves and swirls in the infinite space-time of accelerations.

a I chose convenient figures. For all speeds and more generally, a derivation applies with other triangles. You now *pass* me at a shortest distance p. Exacly at that moment I send you a light signal. It travels a distance r at speed c in order to reach you while you have traveled a distance q at speed v. According to Pythagoras, $p^2+q^2=r^2$. Now divide everything by r^2: $p^2/r^2+q^2/r^2=1$ or $p^2/r^2=1-q^2/r^2$. The ratio between p and r $p/r=\sqrt{(1-q^2/r^2)}$. In the time r/c that the light is traveling along r, you traveled the distance q=v(your speed)*r/c. Now $p/r=\sqrt{(1-v^2r^2/r^2c^2)}=\sqrt{1v^2/c^2}$, or simply $p/r=\sqrt{(1-(v/c)^2)}$. That is the *shrink* factor 1/γ! In this, γ is the famous Lorenz factor, with which your mass *grows*.

b Einstein(1916)Die Grundlage der allgemeinen Relativitätstheorie(Annalen der Physik)IV 49 p769-822 http://onlinelibrary.wiley.com/doi/10.1002/andp.19163540702/abstract

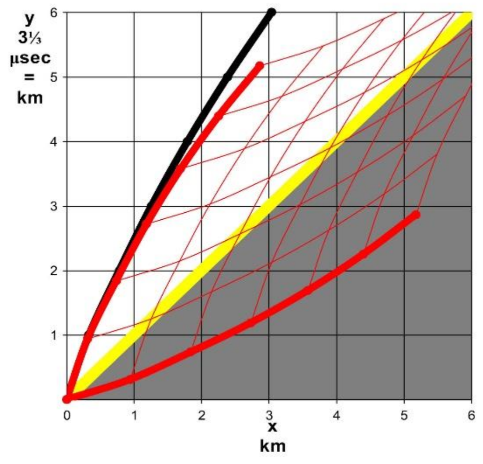

Fig. 167 Acceleration

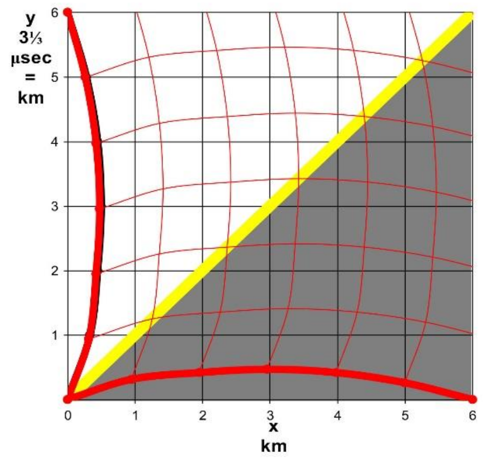

Fig. 168 Retardation

A free floating mass m can only be accelerated or deviated by gravity or electromagnetic force. Gravity is only measurable in the vicinity of a mass. That curvature is therefore the influence of mass. Your coordinates curve in the vicinity of a mass, an accelerative force. In fact, gravity *is* that curvature of space-time!

We have always assumed that light follows a straight line. This is not true for the light beam with accelerative forces in the vicinity. For an observer a beam of light would have to deflect in the vicinity of a mass even more if space itself is curving.

You should be able to see a galaxy behind the sun twice as earlier as expected before it can appear at the edge of the sun according to calculation.
That is exactly what Eddington[a] was able to demonstrate for the first time during the solar eclipse on 29 May 1919.

Lorentz' mass growth γ (***Fig. 162***) makes the gravitational landscape even more complicated, because there are countless masses in the universe moving away from you or coming towards you. If you ever come back, then I have grown old faster than you, but you are not as heavy as you were on the way.

§ 30 QUANTUM MECHANICS SUPPOSES UNCERTAINTY

IF YOU KNOW THE PLACE, THEN YOU CANNOT KNOW THE TIME

At the level of molecules, atoms, their parts (electrons, neutrons and protons) and even smaller particles[b], there are other field forces than gravity[c]. They keep such particles together at a much shorter distance. These forces are not immediately measurable, because the smaller these particles are, the less you can determine their place and speed without disturbing them by your observation (eg with light particles, photons).

a Eddington(1920)Space time and gravitation An outline of the General Relativity Theory(Cambridge)University Press http://www.gutenberg.org/files/29782/29782-pdf.pdf?session_id=a60a38a8e2635a9ee437a880211f4b09acb4dd27
b Quarks (from which protons and neutrons are composed), leptomes (like the electron) and bosons (like the photon).
c Electromagnetic forces (transferred by photons), strong nuclear forces (gluons), weak nuclear forces and other (bosons).