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The direction of time

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Abstract
An explanation of the direction of time from the past into the future has not yet been possible. With this publication an explanation is given. In general a connection between time and entropy is assumed. Like time, entropy should have only one direction, it should increase. For this purpose the development of space is described with the classical methods of thermodynamics. Furthermore, a closed and thermally insulated container with different temperature ranges is considered: Even if there is no transport of mass or energy across the system boundaries, there is a temperature equalization. This is interpreted as entropy growth. Furthermore, the concentration equalization in a closed and heat-insulated container with areas of different concentrations is investigated in a similar way.

After these three investigations the explanation for the direction of time can be given. Furthermore, an explanation for the heat flow from "hot" to "cold" as well as for the diffusion flow during concentration equalization is given.

Keywords: Time, Time direction, Entropy, Mass decay, Space expansion

Introduction

The direction of time is one of the greatest mysteries of physics. In physics, processes that run from the future into the past do not occur. There is no physical explanation for this. The laws of physics would allow such processes in principle. There must be a law for space, which prescribes the direction of time. This law is presented in the form of equation (14).

1. Entropy in adiabatically expanding space

Space is a closed and thermally insulated system. Since it expands at the speed of light, neither energy nor matter can cross its system boundaries. The quotient of the space radius and its age always gives exactly the speed of light at any given time. If it is assumed that space today is larger than its visible size, we come to different conclusions. These assumptions, however, contradict equations (13) and (14), which explain unexplained phenomena and allow observable predictions of the mass and temperature development of space.

It shall be shown that the entropy of space can remain constant in accordance with the known laws of thermodynamics.

The well-known differential entropy formula has the following form:

$$dS = \frac{\delta Q}{\mathcal{T}} \qquad (01)$$

The first law of thermodynamics is in differential notation:

$$dU = \delta Q + \delta W \qquad (02)$$

Consequently, you can write with equation (01):

$$dS = \frac{dU - \delta W}{\mathcal{T}} \qquad (03)$$

For the differential internal energy dU and the differential work δW the known relationships apply:

$$dU = mc_v d\mathcal{T} \quad (04) \qquad \text{and} \qquad \delta W = -pdV \quad (05)$$

The relations (04) and (05) are used in equation (03):

$$dS = \frac{mc_v d\mathcal{T} + pdV}{\mathcal{T}} \quad (06)$$

In the adiabatic system space an expansion from state 1 to state 2 takes place.

Equation (06) is therefore integrated between the boundaries 1 and 2. From this follows:

$$S_2 - S_1 = \int_1^2 \frac{mc_v d\mathcal{T}}{\mathcal{T}} + \int_1^2 \frac{pdV}{\mathcal{T}} \quad (07)$$

The general gas law is given in equation (08):

$$pV = mR\mathcal{T} \quad (08)$$

This is used in equation (07) in preparation for integration:

$$S_2 - S_1 = \int_1^2 \frac{mc_v d\mathcal{T}}{\mathcal{T}} + \int_1^2 \frac{mRdV}{V} \quad (09)$$

The terms mc_v and mR can be brought before the integral, since they are constant in each case. Equation (09) can now be fully integrated between the two states:

$$S_2 - S_1 = mc_v ln\mathcal{T}|_{\mathcal{T}_1}^{\mathcal{T}_2} + mRlnV|_{V_1}^{V_2} \quad (10)$$

The generally valid result of the integration is:

$$S_2 - S_1 = mc_v ln\frac{\mathcal{T}_2}{\mathcal{T}_1} + mRln\frac{V_2}{V_1} = mR\left(\frac{c_v}{R} ln\frac{\mathcal{T}_2}{\mathcal{T}_1} + ln\frac{V_2}{V_1}\right) \quad (11)$$

With the definitions $R = c_p - c_v$ and $\kappa = c_p/c_v$ follows $c_v/R = 1/(\kappa - 1)$. It results in a generally valid form:

$$S_2 - S_1 = mR\left(\frac{1}{\kappa-1} ln\frac{\mathcal{T}_2}{\mathcal{T}_1} + ln\frac{V_2}{V_1}\right) = \frac{pV}{\mathcal{T}}\left(\frac{1}{\kappa-1} ln\frac{\mathcal{T}_2}{\mathcal{T}_1} + ln\frac{V_2}{V_1}\right) \quad (12)$$

In equation (12) the pre-factor $mR = pV/\mathcal{T}$ is constant.

In space, mass decays permanently [1.]. In the same measure the gas constant R and the heat capacity increase at constant volume c_v of the ether.

With the known expansion of space the volume increases and the temperature decreases. This leads to the fact that the first summand in equation [12] is negative and the second is positive.

The following applies to space: $\mathcal{T}^3 V = const$. This means that the temperature falls in the third power with the increase in volume. For which κ would the entropy change be zero? For this the factor $1/(\kappa - 1) = 3$ would have to be. From this follows an isentropic exponent for space (of ether) of $\kappa = 4/3$.

According to the known thermodynamics, the following applies to the entire space:

$$S_2 - S_1 = \frac{pV}{\mathcal{T}}\left(3ln\frac{\mathcal{T}_2}{\mathcal{T}_1} + ln\frac{V_2}{V_1}\right) = 0 \quad (13)$$

The entropy formula (14) found by the author confirms the constant entropy when time is taken into account. While the age of space t increases, its mass m decreases [2.].

$$S = \frac{k}{\hbar} m\, t\, c^2 \quad (14)$$

With mass decay, time is constantly formed: From the potential future arises the current and real past [1.].

Because of the mass decay with permanent time formation, entropy remains constant in space as a whole. It should be noted that in information theory entropy can be understood as potential information. This would have to be preserved in space, if no energy and mass transport and thus no information transport across the system boundaries can take place.

It is also interesting that entropy remains constant during the gravitational process. The author was able to prove for a two-mass system that $m\,t = const.$ applies to every mass. The product of mass and a certain period of time that passes on it remain constant. To prove this, the behavior of two masses that are brought together by gravity from rest and a certain distance was investigated [3.]. While both masses become larger with increasing speed, the time on them passes more slowly.

2. Temperature equalization in an adiabatic container

If one half of an adiabatic container contains hot matter and the other half contains cool matter, temperature equalization takes place. This temperature equalization takes place from the hot to the cold side. In mass decay, the available internal energy must be distributed to less mass and it drives the thermal conduction current. A higher temperature means higher internal energy where it exists. Since the internal energy of the container is preserved during mass decay, the internal energy related to mass increases more on the hot side than on the cold side over time. Since the source strength of the released internal energy is higher on the hot side, the heat conduction current flows towards the cold side. The compensating heat conduction current in a space direction x according to the known equation (15) must flow from the high to the low potential, i.e. from "hot" to "cold". In principle one could define a heat conduction current from "hot" to "cold" and one from "cold" to "hot". The heat flow from "cold" to "hot" would be equivalent to an ordering process and is therefore not possible. If the internal energy is maintained, the cooler particles would have to become even cooler and the warmer particles even warmer. Every mass formation has a structure. During decay, structure is lost, from which the ordered time is formed. This time has an information equivalent due to its order [1.]. The process of structure decay during time formation is therefore a process of information preservation. Future information, which is in the mass, turns into current information in the form of the past time. A further process of order besides the formation of time can therefore not take place.

$$\partial Q/\partial t = -\lambda A\ \partial \mathcal{T}/\partial x \qquad (15)$$

Here Q is the heat, λ the heat conduction coefficient, A the heat flow area and $\mathcal{T}$ the temperature.

The loss of structure, which occurs due to the lost mass in the container, is expressed in the temperature equalization. Because the mass decay occurs universally in the entire space, the direction of the heat flow is not limited to the adiabatic container but is generally valid.

3. Concentration equalization during diffusion in an adiabatic container

Diffusion obeys the same laws as heat conduction. There should be two different concentrations with the same temperature of a solution in each half of an adiabatic container. The diffusion flow is directed from high to low concentration. In mass decay, the available internal energy must be distributed to less mass and it drives the diffusion flow. A higher concentration means that there is more mass of the highly concentrated substance in this area. In the area where there is more mass of this substance, more of its mass must also decay. Since the internal energy of the container is preserved during mass decay, the internal energy related to its mass increases more over time in the area with the higher concentration than in the area with the lower concentration. Since the source strength of the released internal energy is higher in the area with the higher concentration, the diffusion current flows in the direction of the low concentration. The diffusion current from "low concentrated" to "high concentrated" would be equivalent to an ordering process and is therefore not possible. The low concentrated area would be concentrated even lower and the high concentrated area even higher. As with heat conduction, the following applies: The process of structure decay during time formation is a process of information preservation. A further order process besides time formation can therefore not take place.

This causes a compensating diffusion current to flow from high to low concentration according to the well-known equation (16). It is thus the same cause in the form of mass decay as in heat conduction.

$$\partial n/\partial t = -DA\ \partial c/\partial x \qquad (16)$$

Where $n$the number of particles is, D is the diffusion coefficient, A is the passage area and c is the concentration.

The loss of structure caused by the lost mass in the vessel is expressed in concentration equalization. The following also applies to concentration equalization: Because mass decay occurs universally throughout space, the direction of the diffusion flow is not limited to the adiabatic container but is generally valid.

4. The direction of time

How can we explain the direction of time? With validity of equation (14) the explanation is simple. As already explained, the space mass falls with increasing space age. A higher age means more elapsed time, i.e. a longer time. If time were to move not into the future but into the past, the space age (the past time) would become smaller. However, this would be in contradiction to a decreasing mass according to equation (14).

5. Summary

The direction of time as well as the heat and diffusion flow is determined by the mass decay in space. These are phenomena of inner energy conservation and information conservation. As the age of space increases, all masses must become smaller.

The product of mass and space age must remain constant, because the potential information of space (entropy) cannot change. Age only increases when time passes from the past into the future.

In the adiabatic closed container there is no change in volume dV of the gas. Although the volume of the container must grow slightly with the mass decay, the particles grow to the same extent [1.]. Their space of movement therefore remains the same. Consequently, the following applies to heat conduction and concentration equalization in the adiabatic closed vessel: The internal energy, heat, work and entropy remain constant $dU = \delta Q = \delta W = dS = 0$. The equalization currents are an expression of the structural loss of the decaying mass.

6. References

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[3.] See Source [1.], p.53-54.