From Brownian Motion via the Hubble Number to Gravity

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Abstract

Thesis 1 assumes that in an adiabatic considered Brownian Motion system the temperature would rise by a tiny heat excess.
Thesis 2 postulates that the tiny heat excess in the rough range of $P \approx 10^{-10}$ Watt/kg is solely produced by the gravitational interaction of the masses, because in the adiabatic case gravity is left over as the only effective cause.
Although not yet verified, the heat excess of the earth, of the big gas planets and eventually of some far away asteroids and molecular clouds may uncover some extra unexplained heat excesses.
Thesis 3 assumes the Hubble number to be an indication of the heat excess, considered as a decay constant of $H = \Lambda_0 = 2.27 \cdot 10^{-18}\ s^{-1}$ (corresponding to the tailored value of 70 km/(s·Mpc) in cosmology).
By multiplying with c^2 any mass would exhibit a specific energy release of p/m = 0.204 Watt/kg or $\dot{m}/m = 2.27 \cdot 10^{-18}$ kg/(kg·s). This is postulated as an emission of a yet unknown quantum flow with the velocity of light c resulting in a specific scalar repulsive or recoil force $|f| = \dot{m}/m\ c = 6{,}8 \cdot 10^{-10}$ N/kg on the emitting mass.
Thesis 4 identifies this as the self-gravitation of any mass and energy in the universe and it is supposed that Λ_0 (former H) is the cause of gravity. A consequential stationary background scalar field $|a| = \Lambda_0 \cdot c$ in the universe creates gravitational redshift which is equivalent to the apparent accelerated expansion.
Thesis 5 tries to reduce the scalar from the sphere to an unidirectional vector by dividing by π^2 which then appears as the gravitational constant G. By the more precise value of G now Λ_0 (former H) can be corrected to $2{,}20 \cdot 10^{-18}\ s^{-1}$·corresponding to 67,89 km/(s·Mpc), the lower Planck- and WMAP-satellite value of the contemporary Hubble number discussion.
Final remarks contain historical and modern ideas about the minimum mass of a hypothetical graviton. The prerequisites of an experiment are described which eventually can verify the postulated tiny heat excess.

Keywords: Brownian Motion, heat excess, Hubble number, decay constant, scalar forces, scalar acceleration, gravitation, gravitational constant, graviton

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1. Motivation of considering the Brownian Motion as adiabatic
Results Theses 1 and 2

The phenomena of Brownian Motion, thought in a Gedankenexperiment as adiabatic, are still worrying. Although much was written and calculated about it and among others A.Einstein had published his famous paper about the derivation of the movement from the molecular-kinetic theory of heat 1905 [1], it is still not yet clarified thoroughly what is really going on. How is it that the motion involving friction and the non-perfect elastic collisions within a viscous liquid can exist "eternally" ? [2, 3, see citations].
Einstein derived the basic equation

$$\frac{\Delta^2}{t} = k_B T \frac{1}{3\pi\eta r} \qquad \sqrt{m^2}/s \qquad (1)$$

with	Δ^2	square of displacement	m^2
	t	time	s
	k_B	Boltzmann constant	1,38 e-23 J/K
	T	absolute temperature,	K
	η	viskosity oft the liquid	Pa s
	r	radius of the suspended particles	m

from which the known correlation is shown that the mean velocity of the suspended particles (within certain limits) is approximately proportional to the temperature and invers proportional to the viscosity.

The "eternal" vibration is thinkable only by an assumption of a perfect elasticity of the collisions between the molecules of the solvent and the suspended particles. But this idealized assumption seems to be not justified.
By performing the Gedankenexperiment which makes the volume of a liquid adiabatic, i.e. which realizes a perfect heat insulation (actually is not possible in reality) where any heat convection, heat conduction and heat radiation is thought to be zero the question can be rised: What will happen to the liquid volume and the suspended particles in this experiment?

There are 3 possibilities:

Effect	a.) BM slower	b.) BM unchanged	c.) BM faster
Consequence	$dT/dt < 0$ $dS/dt > 0$	$dT/dt = 0$ $dS/dt = 0$	$dT/dt > 0$ $dS/dt < 0$
Paradox	not possible within 1 st law of thermodynamics (1. LoT)	1. LoT satisfied, but in conflict with 2. LoT, which means, the dissipative process of the macroscopic particles (friction, inelast. collision) would be recovered by 100% into movement	1. LoT satisfied only by assumption of an internal heat source, feeded from mass $E = mc^2$

Thesis 1: My assumption ist c.
All bodies carry an inner heat source, even though an extremely small one.
This would mean that any matter related gravitational and inertial mass would emit a certain background excess heat flux, even though an extremely small one and practically not detectable

As known, gravity cannot be insulated at all. Therefore here it is the singly remaining effect in the adiabatic case c.). So it is suspected and supposed that gravity is the cause of thesis 1. This directly leads to the extended thesis 2:

Thesis 2: The outer and inner effect of gravity on any gravitational and inertial mass creates a stationary extremely small excess heat flow.

2. Possible real and theoretical indications of self heating

2.1 Terrestrial bodies, planets, asteroids

As far as known on earth a heat excess of masses, even though an extremely small one of e.g. $P_{se} \approx 1{\cdot}10^{-10}$ W/kg , is not yet registrated in nature, technical applications or physical experiments. The self heating of coal stocks, large hay bundles, pressurized gas or of chemical/radioactive substances is excluded here because these phenomena are related to thermodynamics or chemical/biochemical reaction heat or instable isotopes and which are much larger.

Not yet fully clarified are the excess heats of the planet earth and particularly of the big gas planets

Planet	Excess	Mass	Spec. Excess Power	Lit.
Earth	2,00e13 W	6,4e24 kg	3,3e-12 W/kg	[4]
Jupiter	3,35e17 W	1,9e27 kg	1,8e-10 W/kg	[5]
Saturn	3,69e17 W	5,7e26 kg	6,5e-9 W/kg	[5]
Uranus	0 (?)	8,7e25 kg	0 (?)-	[5]
Neptune	7,74e15 W	1,0e26 kg	7,7e-11 W/kg	[5]

as well as some asteroids which however must be in an orbit beyond the Pluto so that because of her low mass a heat excess as low as $P_{se} = 1{\cdot}10^{-10}$ W/kg could emerge against the sun's heat radiation. But real temperatures practically are not available

The table below is calculated with Stefan-Boltzmann law $P = \varepsilon\, \sigma\, A\, T^4$, $\varepsilon = 1$
P_{su} = absorbed heat radiation from the sun
P_{se} = hypothetical heat excess in the range of p = $1{\cdot}10^{-10}$ W/kg
T_{su+se} = resulting Temperature from sun radiation and internal excess heat
T_{lit} = value from literature (here data from Wikipedia [5])

Name	Sun Distance.	Diameter	Mass	P_{su}	P_{se}	T_{su+se}	T_{lit}	Lit.
	m	m	kg	W	W	K	K	
Haumea	6,48e12	2,0e6	4,0e21	2,3e12	4,0e11	44	44	[5]
Makemake	6,82e12	1,4e6	4,4e21	1,1e12	4,4e11	45	30	[5]
Eris	1,01e13	2,3e6	1,7e22	1,3e12	1,7e12	42	42	[5]
Sedna	7,18e13	9,9e5	9,8e20	4,6e 9	9,9e10	28	30	[5]

Here no real hints of a self heating effect, though only a tiny one, are recognizable, but also cannot be excluded. Further hints can be given by the primary temperatures of big, sunless molecular clouds the massive cores of them show temperatures as high as 10…30 K at radii of 0.1…1 pc and masses of 100…1,000 sun masses [6].

2.2 Theoretical derivation from the Hubble number, interpreted as a decay constant

It is assumed that the tiny excess heat emission results from stationary decay of any mass *m* and from any equivalent energy $E = m{\cdot}c^2$. This can be compared with the known zero-point energy or can be assumed to be the same. It is estimated as the mean density of the universe's vacuum (not zero) of $\rho \approx 5{\cdot}10^{-27}$ kg/m^3, which would be the specific energy equivalent of $e = \rho{\cdot}c^2 \approx 5{\cdot}10^{-10}$ J/m^3 [10]

Since around the 1920s the redshift *z* – distance *r* relation of the spectra of galaxies in the universe was discovered, and first it was detected as a nearly linear function up to $z \approx 0.1$ and still up to today it is interpreted (corresponding to the ART and Einstein's field equations including some arbitrary boundary conditions) as an accelerated expansion of the space's universe as

$$v = H{\cdot}r \qquad \text{m/s} \qquad (2)$$

If the value of the Hubble constant H, which in current cosmological "tailored" scales is between 67 and 73 km/(s Mpc) [7], (here in mean H = 70 km/(s Mpc)), is reduced to its mks-basic units, a numerical value of

$$H = 70.000\ ms^{-1}/3{,}086\cdot 10^{22}m = 2.27\cdot 10^{-18}\ s^{-1} \quad (3)$$

is resulting.
This implicates quite another interpretation and it corresponds now to the well known unit of the decay constants Λ. The range of some isotopes of natural radioactivity are e.g. K40: $\Lambda = 1.73\cdot 10^{-17}$, Rb87: $4.57\cdot 10^{19}$, Bi209: $1.16\cdot 10^{-29}\ s^{-1}$.

Now considering this number H other than in cosmology as a decay constant of any mass or energy, it is possible to "see" this decay from the photons $\Delta e = h\cdot\Delta v$ from distant galaxies, because despite the high velocity of light c the distances are so large that the photons can simultaneously be observed on their long lasting travel of billions of years losing their energy successively and getting redshifted.
By no other method (e.g. archaeology) it is comparably so easy to reveal the decay of energy by any look through a modern telescope.

Here the three phenomena manifest their main properties

a. Gravity of mass, energy	always attracting, never repelling
b. Redshift of energy	always increasing, never decreasing
c. Decay of mass, energy	always $dm/dt < 0$ or $dE/dt<0$

so that it is postulated here that all three phenomena have the same root, whereby it seems that the Hubble number or rather the decay constant H, named in c., fundamentally is the cause of a. and b.

Therefore it is proposed here to rename the former Hubble number H into Λ_0, an ubiquitous decay constant of the universe.

Now taken the decay process seriously Λ_0 can be expressed in specific values too,
e.g the decay of matter becomes

$$\Lambda_0 = 2.27\cdot 10^{-18}\ kg/(kgs) \qquad 1/s \quad (4)$$

or equivalently the decay of energy $\Lambda_0 = 2.27\cdot 10^{-18}\ J/(Js) \quad = W/J = 1/s$

Now there is an equivalence between the redshift Δz

$$\Delta z = \Delta\lambda/\lambda_0 \quad (5)$$

and the standard interpretation of it as an accelerated expansion of the universe expressed by the Hubble relation (for the first linearly and non relativistically valid up to approx. $\Delta z \leq 0.1$)

$$\Delta v = c\cdot\Delta z = \Lambda_0\cdot\Delta R \quad (6)$$

and an energy decay per distance ΔR or per the look-back time (i.e. residence time in space)

$$\Delta t = \Delta R/c \quad (7)$$

Now interpreting Λ_0 as an decay of Energy E (or mass = E/c^2) as a function of time, with eqn. (5) this would similarily result in an observable redshift $\Delta z = \Lambda_0\cdot\Delta t = \Lambda_0\,\Delta R/c$
which is the same as the Hubble eqn. (2) $\Delta v = c\cdot\Delta z = \Lambda_0\cdot\Delta R$ (8)

This means that by observing any radiation from galaxies in cosmological distances it is the same as watching the photon energy $\Delta E = h\cdot\Delta v$ decaying on its long lasting path from the source to the observer.
So, any observer at any place in the universe has the unique possibility to watch simultaneously the photons from various distances (i.e. with various residence times) in the course of their decay, i.e. redshift.

Interpreting Λ_0 *now* as a universal decay constant it can be written in the dimension of gravitational and inertial mass as $\Lambda_{0m} = \Lambda_0\cdot\Delta m/m$ kg/(s·kg) = 1/s (9)
which is $\dot{m}/m = 2{,}27\cdot 10^{-18}$ kg/(s·kg) = 1/s
or $\dot{m}/m = 71.6$ ng/(a·kg) = 1/s (nanogram per year)

This tiny mass-loss is practically out of the range of being measurable by any balance, this even more as the balance will lose mass by itself also.

Equivalently eqn. (7) can be written in the dimension of energy E in the dimension of J = Ws

$\Lambda_{0e} = \Lambda_0 \, \Delta E/E$ Ws/(s·Ws) (10)

which results in the specific power $p = 2{,}27 \cdot 10^{-18}$ W/Ws = 1/s

or multiplied by c^2 $P = \dot{m}\, c^2 = 0.204$ W/kg (11)

Thesis 3: Per kg mass the decay constant Λ_0 (former Hubble constant H) results in an energy flow or power of 0.204 W/kg. As this is not a heat flow (this would be detected immediately) it can be interpreted only as an equivalent specific particle flow of $\dot{m} = 2{,}27 \cdot 10^{-18}$ kg/(s·kg) or multiplied with c^2 as specific radiation power of $p = 0.204$ W/kg.
As a side effect it is suggested that the particle flow emission creates a tiny fraction of friction within the mass of a value in the range of $P_0 = P_p \cdot 10^{-10}$ W.

2.3 Interpreting the decay constant Λ_0 as a particle flow of velocity *c* the recoil force of which is effecting the attracting gravitation

If the specific particle flow of $\dot{m} = 2{,}27 \cdot 10^{-18}$ kg/(s·kg) is considered to be a not yet known particle flow (at least with which leaves any mass spherically in all directions with the speed of light *c* then a spherically scalar **recoil** force in opposite direction is created

$$|f| = (\dot{m}/m)\, c \qquad \text{N/kg} \qquad (12)$$

which with eqn. (9) results in the mass-specific force

$$|f| = (\dot{m}/m) \cdot c = \Lambda_0\, c = 2{,}27 \cdot 10^{-18} \cdot 3.0 \cdot 10^{8}\ \text{m/s} = 6{,}8 \cdot 10^{-10}\ \text{kg·m/(s s kg)} = \text{N/kg} \qquad (13)$$

Identically this specific scalar force is resulting in units of an acceleration

$$|a| = \Lambda_0 \cdot c \cdot = 6.8 \cdot 10^{-10} \quad \text{kg m/(s s kg)} = \text{m/s}^2 \qquad (14)$$

Thesis 4 Now finally it is assumed and proposed that the well known gravitation constant $G = 6.674 \cdot 10^{-11}$ m³/(kg·s²) might result in the unidirectional application of the scalar force $|f|$ (12) or scalar acceleration $|a|$ (14).
This is because *G* is always measured in a vector, one dimensional distance between the attracting bodies.
To convert the one dimensional counteracting force vector into a two dimensional plane, *G* must be rotated by 180° and multiplied by π per 1 m vector length in the unit circle and then this circle plane is again rotated 180° by multiplying π per 1 m vector length to get the scalar 3-sphere, as sketched below in Fig. 1.

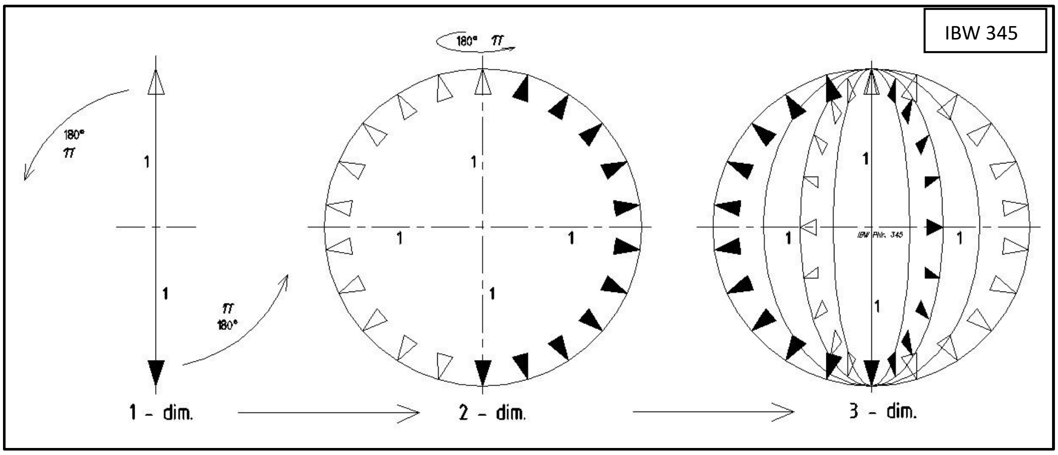

Fig. 1 From an one dimensional vector to a three dimensional scalar by multiplying π^2

So, from the former Hubble constant, identical with the new decay constant Λ_0, the unidirectional G can be transformed into the mass-specific scalar acceleration $|a|$ *by*

$|a| = G \cdot \pi^2$ m^3/(kg·s^2) · kg/m^2 = 6.674·10^{-11}·9.87 kg m/(s^2 kg) = 6.59·10^{-10} m/s^2 (15)

Now, as G is measured approx. 2 decades more precisely than the former H, a corrected new H resp. Λ_0 can be determined by forming the ratio of (15) to (13)

resulting in Λ_0 = (6,59/6,80)·2.27·10^{-18} s^{-1} = 2,20·10^{-18} s^{-1} (16)

Multiplied with 1 Mpc and divided by 1 km this would give a corrected "old" Hubble

number of H = 2,20·10^{-18} s^{-1}·3,086·10^{19} m/m = 67,89 km/(s·Mpc) (17)

This value would be similar to the lower one of the two today suggested values, namely to H = 67 +/- 1 km/(s·Mpc) determined from ΛCDM measurements of the WMAP- and Planck-satellites. [7]

Here the scalar acceleration $|a|$ is derived from the Hubble constant H, interpreted as a decay constant Λ_0. This is compatible to a background gravitational scalar field $|a| = \Lambda_0 \cdot c$ in the universe, which was already suggested long time ago [8, 9] but which today is not taken into account in the Standard Model of Cosmology. This stationary scalar field $|a| = \Lambda_0 \cdot c$ creates the gravitational redshift and is equivalent to the acceleration field of an apparently expanding universe.

<u>Thesis 5</u> Theses 1 – 4 now can result in an new definition of the gravity constant G by using the new decay constant Λ_0 (former H)

$$G = \frac{\Lambda_0 \cdot c}{\pi^2} = 6.674 \cdot 10^{-11} \quad \text{m}^3/(\text{kg s}^2) \tag{18}$$

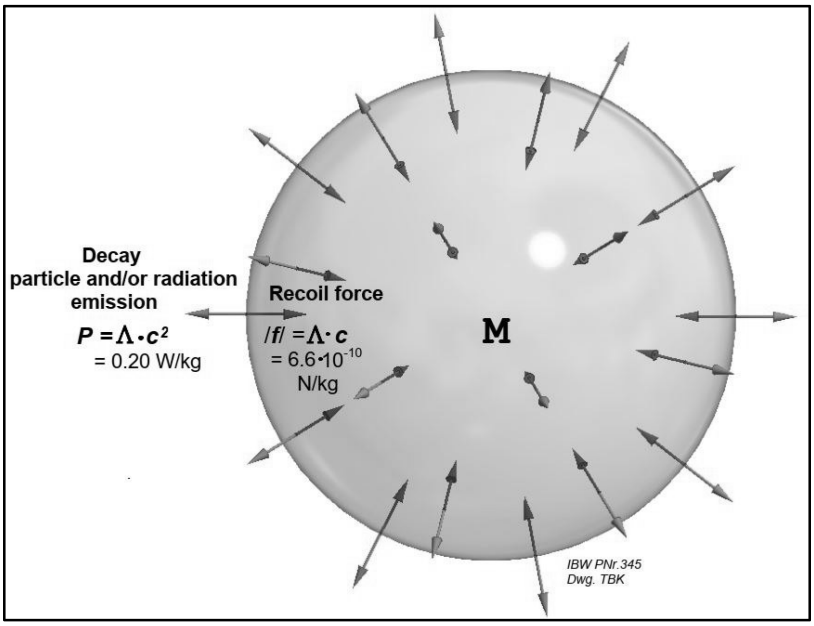

Fig. 2 Sketch of the balance of forces creating gravity by the decay emission (grey arrows) and the the corresponding recoil force (black arrows)

3. Final remarks regarding the understanding of gravity

Already in 1937 W. Nernst [11] expressed the assumption that the Hubble number H, quotation "as a reciprocal of time, i.e. a frequency, apparently has the rank of a constant of nature; $h \cdot H$ therefore has the dimension of an energy quantum 1.2·10^{-64} g (corrected here to $h\,\Lambda_0$ = 8.0·10^{-52} Ws or 8.8·10^{-69} kg, the auth.). The assumption is obvious that in these very tiny quanta not only the light quanta are disappearing but that for this quantum this is also valid for the gravitational work and the kinetic energy." (end of quotation) Transposed to the latest research in the field of gravitational wave detection a mass of the hypothetical graviton was estimated to be $m_g \leq 7.7\times10^{-23}$ eV/c^2 = ≤ $1.37\cdot10^{-58}$ kg .[12], which is still approx. 10 orders of magnitude heavier than the postulated a.m. $m_g = h\,\Lambda_0 = 8.8\cdot10^{-69}$ kg.

The stationary existence of very tiny quanta in a huge number propagating through the universe isotropically with the speed of light *c* would in principle also correspond to the general statement of A. Einstein (1920) [13] about the universe's ether, quotation: "Summarizing we can say: According to the General Theory of Relativity space is equipped with physical properties; in this sense an ether is existing. According to the Gereral Theory of Relativity space without an ether is unthinkable; because in such a way there would not be only no light propagation, but also there would be no possibility of the existence of scales and clocks, i. e. no space-time distances within physics."

4. Proposal for an experimental setup

With todays very sensitive thermocouples and high gain instrumental amplifiers, a possible test arrangement is proposed as shown below (example only)

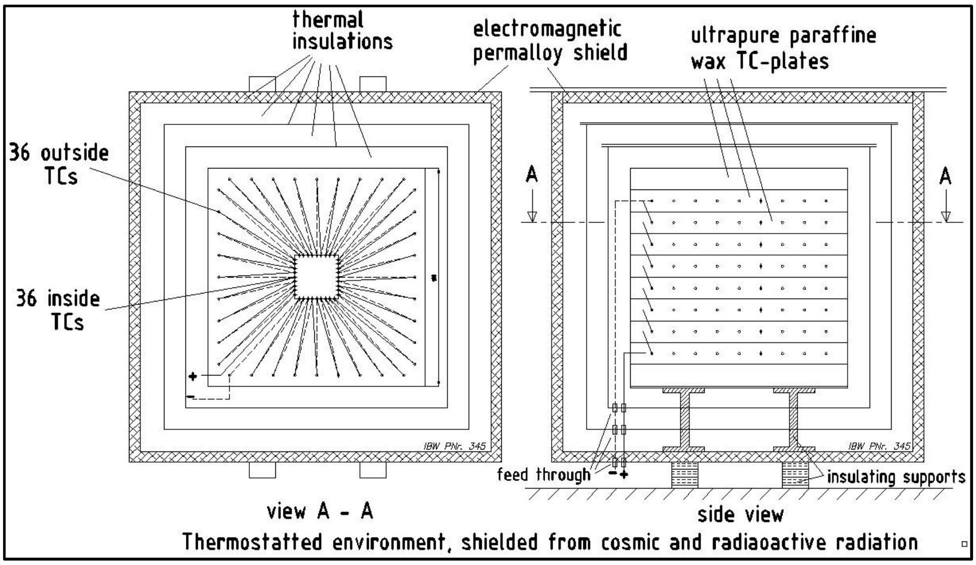

Fig. 1 Sketch of a test arrangement of wax embedded 8 x 72 thermocouples in a compensation circuit

To detect possible tiny amounts of heat release in matter, it is an essential requirement to suppress other sources of heat absorption which are not belonging to this experiment and must be suppressed as far as possible. I.e. the experiments should be performed inside a deep underground cavity with low background radioactivity

A rough calculation illustrates the challenge of this experiment:

The substance paraffin wax seems to be well suited for this experiment because of its high heat capacity c_h ≈ 2.1 kJ/kg, its low heat conductivity λ ≈ 0.25 W/(m·kg) and low electrical conductivity. It can be achieved in a destilled, very clean condition and at the experiments environmental temperature of approx. +10°C it is well solid. But before choosing this material it must be clarified if it is stable enough and does not release any re- or decrystallisation heat.

The experiment should be performed in parallel with 3 different clean materials e.g. paraffin wax, a metal and a mineral for comparison.

With the numbers

M	mass	kg
c_h	heat capacity	J/(kg·K)
P	expected heat release	W

T expected temperature increase ΔT grd
t time s

the expected period of time to detect a temperature increase of $\Delta T = 1\cdot10^{-6}$ grd between inside (core) and outside of the mass stack is estimated:
Here the thermocouples (72 x 8 = 576 pcs connected in series) are expected to deliver $\Delta U \approx$ 0,035 V/grd (conventional TCs e.g. Constantan-NiCrome) or $\Delta U \approx$ 0.21 V/grd (Sb_2Te_3-PbTe).

So a differential voltage between ΔU $3.5\cdot10^{-8}$ … $2.1\cdot10^{-7}$ V have to be detected within a certain time period, which is calculated by $P = M\cdot c_h\cdot \Delta T$, whereby the lowest detectable heat excess P $\geq 1\cdot10^{-10}$ W is assumed.

$$t = M\cdot\Delta T\cdot c_h /P = 0.9 \text{ kg}\cdot1\cdot10^{-6} \text{ grd}\cdot2.100 \text{ Ws}/1\cdot10^{-}10 \text{ W} \approx 3.8\cdot10^{6} \text{ s} \approx 220 \text{ days (7…8 months)} \quad (19)$$

The voltage output ΔU $3.5\cdot10^{-8}$ … $2.1\cdot10^{-7}$ V has to be amplified $3\cdot10^{5}$-…$5\cdot10^{4}$-fold to achieve an useful signal of 1 mV, which is assumed to be incoming stably and with low-noise by the relatively low resistance of 20…100 kΩ of the TCs series and by the help of low-noise differential instrumentation amplifiers.

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from it: Introduction of J. Stachel, p. 40, quotation (transl. Germ.-Engl. the author):
Einstein noticed that the laws of thermodynamics might not be valid in general if the molecular kinetic heat theory can be applied. This is when watching suspended particles in a liquid which are so large that their movement can be observed under a microscope the fluctuations of them are leading to microscopic but observable violations of the second law of thermodynamics
from it: Einstein on Brownian motion, p. 98, quotation (transl. the author):
„Sometime between 1902 and 1905 Einstein read Poincarès book *La science et l' hypothèse*, which shortly mentioned the work of Gouy on the Brownian movement and which gave a hint to Gouy's consideration after which the Brownian motion is violating the second law of thermodynamics. Einstein's second work on Brownian motion [2] which he wrote after Siedentopf had called attention to him to Gouy's work, quotes Gouys observations as qualitative confirmation of his results."

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