The Neutron Enigma II

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Abstract

We had already dealt with the neutron enigma in an earlier paper[5] and calculated values that were in excellent agreement with the decay times determined experimentally for the two measurement methods solely on the basis of the underlying masses or mass differences. However, this approach was formal, as no knowledge of the decay mechanisms was available and consequently the individual calculation steps could not be justified.

The solution approach presented here was based on the neutron decay mechanism described in a recent publication[1] for calculating the decay curve. In combination with the specific structure of the two competing measurement methods, it was possible to predict that, in contrast to the bottle method, energy is continuously extracted from the system in the beam method, which leads to an increase in the lifetime of the neutrons, since energy and decay time are indirectly proportional, as already explained in the paper[5] cited at the beginning.
The energy loss during the beam experiment could be quantified on the basis of a simple calculation model. From the resulting residual energy, it was possible to calculate the decay time, which corresponds to that measured by Greene3 within the standard deviation.

From the knowledge of the overall mechanism outlined above, some experimental modifications for the beam method can be proposed, which should lead to an approximation of the decay times for both methods:

- A reduction in diameter for the beam tube
- An increase in the suction voltage to remove the proton
- A reduction in the particle density in the beam tube

If these experimental changes lead in the direction we predicted, we can consider the neutron enigma solved.

A Introduction

The confusing fact that different results far beyond the standard deviation were obtained when determining the decay time of the neutron using two different measurement methods, the bottle method and the beam method, appeared in popular science publications (see e.g. Ref 4) as the neutron enigma. For a more detailed description of the two methods, please refer to Ref 4 and 5.

In an earlier paper (Ref 5) we had calculated the decay times essentially from the rest mass of the proton divided by the rest mass difference of neutron and proton.

Bottle method

$$T_{N1} = \left(\frac{h}{(m_N - m_P)c^2} t_{pix} - 1 \right) \left(\frac{1}{\sqrt{1-\left(\frac{1}{4}\right)^2}} \right)^6 = 879,24[s]$$

Beam method

$$T_{N2} = \left(\frac{h}{\left(m_N - m_P - \frac{m_e}{\sqrt{k_{P\,e}}}\right)c^2} t_{pix} - 1 \right) \left(\frac{1}{\sqrt{1-\left(\frac{1}{4}\right)^2}} \right)^6 = 887,43[s]$$

2Bottle method: TN1 = 878.5 ±0.8 s
3Beam method: TN2 = 887.7 ±2.2 s

This model was not based on any knowledge of the internal processes involved in the decay of the neutron. Thus, although the mass loss of $m_e/k_{Pe}^{1/2}$ assumed quite arbitrarily in the second equation leads to an excellent result for the beam method, it could not be derived from any model. Nor were we able to justify the occurrence of the dimension factor f_{D4} to the 6th power.
What was ultimately impressive about these calculations was the excellent agreement with the measured values of Greene[3] and Serebrov[2].

B Calculation of the potential energy in the beam experiment

In this paper we want to tackle the neutron enigma once again on the basis of our newly gained knowledge of the internal structure of the neutron.(Ref 1) The decisive difference between the bottle and beam methods is that in the bottle experiment the decay products are in a thermodynamic equilibrium until the particles are counted, whereas in the beam method the decay products electron and proton are continuously removed from equilibrium, with the proton being extracted and counted at the outer wall of the beam tube, which is connected as a cathode (see Fig. 1)

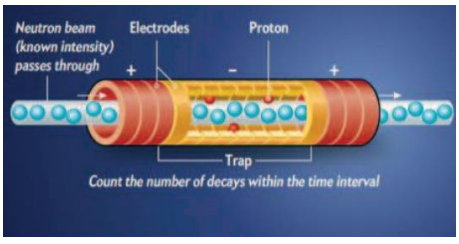

Fig. 1 (Ref. 4)

This has energetic consequences from the perspective of the oscillation model we developed in Ref. 1. According to this model, the decay of the neutron is based on the jumps of the electron from the potential space to the outer surface of the neutron. Due to the changing energy and mass at constant elementary particle density, the jump produces a periodic change in size, which is represented as a harmonic oscillation of the neutron surface. The electron is ejected from the neutron by the outwardly

directed counter-amplitude. Since the oscillation energy is a directed energy of the same magnitude in all spatial directions, only 1/6 of the total energy is transferred to the object in the case of a targeted acceleration in one spatial direction.

The decay reaction is summarized as follows according to our model:

I $N^{6/6} \rightarrow \uparrow^{P5/6} + e^{-1/6}$

A neutron with the full vibrational energy (6/6) releases 1/6 of this as kinetic energy to the electron. If the resulting protons are only removed from the equilibrium in the above-mentioned form, there are no differences to the bottle experiment. The fact is, however, that energy can be transferred from another $N^{6/6}$ to this proton by impact contact before it is removed from equilibrium

II $N^{6/6} + P^{5/6} \rightarrow N^{5/6} + \uparrow P^{6/6}$ (f_{u1} = 1; 0.98; 0.96 .....0)

This process continuously removes energy from the system of neutrons. However, as we were able to show in our earlier work (Ref 5), lower energy in the system means a lower decay rate, i.e. a longer mean decay time, which would explain exactly why the decay times in the beam experiment are significantly higher than in the bottle experiment.

In the following, we want to quantify this time change by means of a simple thought experiment.
We assume 100 neutrons that decay continuously, whereby one $N^{6/6}$ is removed from the original system by the decay and another by the energy transfer according to reaction equation II. We are therefore dealing with a two-stage process per cycle. However, the equilibrium of reaction equation II is only initially on the far right-hand side. As the decay time increases, the composition of the reaction mixture and thus the reaction efficiency changes in the direction shown by the reaction arrow above. It is therefore necessary to introduce an efficiency factor (f_{ux}), which very simply goes from 1 at the beginning to 0 at the end of the process. Since the decay process we postulate is a two-stage process, we have to count the factor in steps of two (see equation II or III in brackets).
In addition, we must take into account a back reaction according to equation III, whose factor is of course a mirror image (fu2 = 1-fu1).

III $N^{5/6} + P^{6/6} \rightarrow N^{6/6} + P^{5/6}$ (f_{u2} = 0; 0.02; 0.06 .....1)

There are now two ways to combine the two reactions II and III. Either leave the reaction equations as shown above and multiply the factors f_{u1} and f_{u2} (see orange curve in Fig. 14 a). Or you mirror equation III and thus also the factor f_{u2}, which then becomes f_{u1}, and obtain f_{u1}^2 as the total factor (see orange curve in Fig. 14 b). Although the course of the corresponding curves is very different, the calculations lead to exactly the same result in all cases, i.e. they are just different representations of the same process.

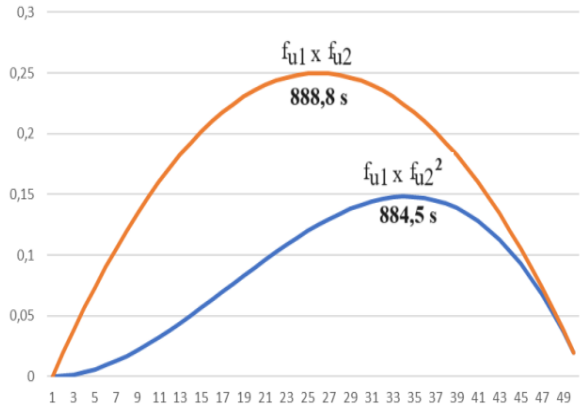

Fig. 14 a

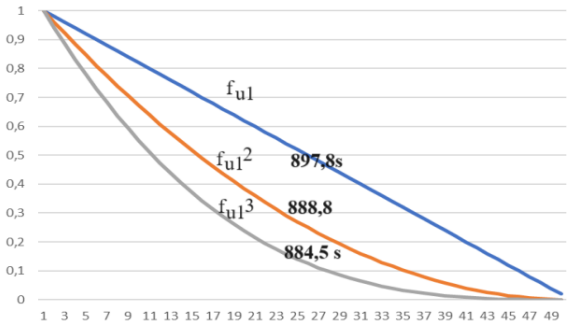

Fig. 14

[2]Bottle method: TN1 = 878.5 ±0.8 s
[3]Beam method: TN2 = 887.7 ±2.2 s

The conversion of energy into time is carried out below, but the time results are already shown in the diagrams above, so they will be discussed briefly here.

The calculations with equally weighted consideration of the back-and-forth reaction (f_{u1} x f_{u2} or f_{u1}^2) lead to a value of 888.8 s, which is only 1.1 s above the result given by Greene et al. (Ref 3) for the beam experiment and thus within the error limit of ±2.2 s given there.
To check our calculation, we also tested how the decay time shifts if we include the back reaction (see Eq. III above) too strongly (f_{u1} x f_{u2}^2 or f_{u1}^3) or not at all (f_{u1}) in the calculation. When overestimating the back reaction, we obtain a value of 884.5 s, as expected, which lies between the results of the bottle and beam experiment, and when ignoring the back reaction, we also obtain a value of 897.8 s, as expected, which is still approx. 10 s above that of the beam experiment, i.e. these calculations always tend to provide the correct results.

Table 3 shows the entire calculation for the resulting energy term using f_{u1}^2 as an example.
The sum of all energy contributions of the $N^{6/6}$ (column V) and the $N^{5/6}$ (column VI) is divided by the sum of all neutrons included in this calculation, i.e. by the sum of all contributions from columns III and IV. This gives the average potential energy for a neutron after a complete decay process.

I	II	III	IV	V	VI
0	1	100	0	78233,3	0
1	0,9604	98,0396	0,9604	76699,6144	626,127018
2	0,9216	96,1568	1,8432	75226,6378	1201,66318
3	0,8836	94,3492	2,6508	73812,4927	1728,17316
4	0,8464	92,6144	3,3856	72455,3014	2207,22161
5	0,81	90,95	4,05	71153,1864	2640,3732
6	0,7744	89,3536	4,6464	69904,2699	3029,1926
7	0,7396	87,8228	5,1772	68706,6746	3375,24448
8	0,7056	86,3552	5,6448	67558,5227	3680,09349
9	0,6724	84,9484	6,0516	66457,9366	3945,30431
10	0,64	83,6	6,4	65403,0388	4172,4416
11	0,6084	82,3076	6,6924	64391,9516	4363,07003
12	0,5776	81,0688	6,9312	63422,7975	4518,75425
13	0,5476	79,8812	7,1188	62493,6988	4641,05895
14	0,5184	78,7424	7,2576	61602,778	4731,54877
15	0,49	77,65	7,35	60748,1575	4791,7884
16	0,4624	76,6016	7,3984	59927,9595	4823,34249
17	0,4356	75,5948	7,4052	59140,3067	4827,77571
18	0,4096	74,6272	7,3728	58383,3213	4806,65272
19	0,3844	73,6964	7,3036	57655,1257	4761,5382
20	0,36	72,8	7,2	56953,8424	4693,9968
21	0,3364	71,9356	7,0644	56277,5938	4605,59319
22	0,3136	71,1008	6,8992	55624,5022	4497,89204
23	0,2916	70,2932	6,7068	54992,69	4372,45802
24	0,2704	69,5104	6,4896	54380,2798	4230,85578
25	0,25	68,75	6,25	53785,3938	4074,65
26	0,2304	68,0096	5,9904	53206,1544	3905,40534
27	0,2116	67,2868	5,7132	52640,6841	3724,68646
28	0,1936	66,5792	5,4208	52087,1053	3534,05804
29	0,1764	65,8844	5,1156	51543,5403	3335,08473
30	0,16	65,2	4,8	51008,1116	3129,3312
31	0,1444	64,5236	4,4764	50478,9416	2918,36212
32	0,1296	63,8528	4,1472	49954,1526	2703,74216
33	0,1156	63,1852	3,8148	49431,8671	2487,03597
34	0,1024	62,5184	3,4816	48910,2074	2269,80823
35	0,09	61,85	3,15	48387,2961	2053,6236
36	0,0784	61,1776	2,8224	47861,2553	1840,04675
37	0,0676	60,4988	2,5012	47330,2077	1630,64233
38	0,0576	59,8112	2,1888	46792,2755	1426,97503
39	0,0484	59,1124	1,8876	46245,5812	1230,60949
40	0,04	58,4	1,6	45688,2472	1043,1104
41	0,0324	57,6716	1,3284	45118,3958	866,04241
42	0,0256	56,9248	1,0752	44534,1496	700,970189
43	0,0196	56,1572	0,8428	43933,6307	549,458403
44	0,0144	55,3664	0,6336	43314,9618	413,071718
45	0,01	54,55	0,45	42676,2652	293,3748
46	0,0064	53,7056	0,2944	42015,6632	191,932314
47	0,0036	52,8308	0,1692	41331,2783	110,308925
48	0,0016	51,9232	0,0768	40621,2328	50,0692992
49	0,0004	50,9804	0,0196	39883,6493	12,7781024

Tab. 3 Calculation of the average potential energy

I Number of protons

II f_{u1}^2

III: 100 – I – IV

IV: f_{u1}^2x I

V: III x $E_{pot\ max}$ (782,33 keV)

VI: IV x $E_{pot\ max}$ x 5/6 (651,944 keV)

(V+VI)/(III+IV) = E_{potx} /N =2926153,57/3775 = **775, 414 keV/Neutron**

C The conversion of energy into time

The conversion of energy into time is also carried out over a length using the equation shown in the legend under D below. However, the energies calculated above must be subjected to a correction before they can be included in the calculation of time.

$E_{cor} = 2\ E_{pot}\ f_{D42}^{2}$ (Table 4 point C)

-2	782530	1467800,062	4,90518E-16	3,86848E-21	877,65	
-1	782430	1467612,491	4,90581E-16	3,86914E-21	877,80	
0	**782330**	**1467424,92**	**4,91E-16**	**3,8698E-21**	**877,95**	**soll**
1	782130	1467049,778	4,90769E-16	3,87112E-21	878,25	
2	**781930**	**1466674,64**	**4,91E-16**	**3,87244E-21**	**878,55**	**878,5 bottl**
3	781730	1466299,494	4,9102E-16	3,87376E-21	878,85	
4	781530	1465924,351	4,91146E-16	3,87508E-21	879,15	
5	781330	1465549,209	4,91272E-16	3,8764E-21	879,45	
18	778730	1460672,361	4,92912E-16	3,89367E-21	883,37	
19	778530	1460297,219	4,93038E-16	3,895E-21	883,67	
20	778330	1459922,077	4,93165E-16	3,89634E-21	883,97	
21	**778130**	**1459546,93**	**4,93E-16**	**3,89767E-21**	**884,28**	**cal fu1^3**
22	777930	1459171,792	4,93419E-16	3,89901E-21	884,58	
23	777730	1458796,65	4,93546E-16	3,90034E-21	884,88	
24	777530	1458421,508	4,93673E-16	3,90168E-21	885,19	
30	776330	1456170,655	4,94436E-16	3,90973E-21	887,01	
31	776130	1455795,513	4,94563E-16	3,91107E-21	887,32	
32	**775930**	**1455420,37**	**4,95E-16**	**3,91241E-21**	**887,62**	**887,7 beam**
33	775730	1455045,228	4,94818E-16	3,91376E-21	887,93	
34	775530	1454670,086	4,94946E-16	3,9151E-21	888,23	
35	775330	1454294,944	4,95073E-16	3,91645E-21	888,54	
36	**775130**	**1453919,8**	**4,95E-16**	**3,9178E-21**	**888,84**	**cal fu1^2**
37	774930	1453544,659	4,95329E-16	3,91915E-21	889,15	
38	774730	1453169,517	4,95457E-16	3,9205E-21	889,46	
63	769730	1443790,963	4,98675E-16	3,95449E-21	897,17	
64	769530	1443415,82	4,98805E-16	3,95586E-21	897,48	
65	**769330**	**1443040,68**	**4,99E-16**	**3,95723E-21**	**897,79**	**fu1**
66	769130	1442665,536	4,99064E-16	3,9586E-21	898,10	
67	768930	1442290,394	4,99194E-16	3,95997E-21	898,41	

Tab. 4 A B C D E F

A consecutive number

B $E_{pot_{cal}}\left[eV\right]$

C $E_{cor} = 2\, f_{D42}{}^{2} E_{pot_{cal}}\left[eV\right]$

D $s_{cal} = \dfrac{e}{8\pi\varepsilon_0 E_t}\left[m\right]$

E $t_{per} = \dfrac{s_{cal}^{\frac{4}{3}}}{f_{time_1}}\left[s\right]$ * $f_{time1} = 1\ m^{4/3}/s$

F $t_{D_N} = t_{per} n_{t\,\max}\left[s\right]$

*The length-time conversion factors $f_{time1,2}$ were discussed in detail in Ref 1, last chapter.

The two factors 2 and f_{d42}^2 are not unknown, as they already played a role in the calculation of the natural constants α, ε_0 and μ_0 (see Ref. 7), but there always in the constellation $2/f_{D42}^2$ or $f_{D42}^2/2$. A more detailed explanation for the occurrence of these factors in this case in multiplicative form cannot yet be given at this point.
The further calculations of columns E and F are discussed in detail in the last section.

The decay times from the calculations in Table 4 have already been discussed above using the curves. Here we will only briefly discuss the value that is actually to be expected, which results from the difference in mass or energy between the neutron on the one side and the proton plus electron on the other (782.33 keV). The calculated value (see Table 4, black line) of 877.95 is only 0.6 s below the value measured by Serebrov[2] and thus within the specified standard deviation of 0.8 s.

Conclusion: The bottle experiment reflects the actual decay time of the neutron very accurately.

The detailed explanation given above for the different measured values in the measurement methods mentioned also makes it clear why the standard deviation in the beam experiments is significantly larger than in the bottle experiment, as the former measurement method uses an system of imbalance that reacts very sensitively to the exact performance of the experiment.
We can go even further and specifically change the experimental procedure in the beam experiment so that, ideally, the measurement results of both methods match.

For this purpose, the secondary reaction in β-decay must be eliminated as far as possible in accordance with reaction equation II, i.e. contact of the proton generated by the decay with an initial neutron before reaching the cathode must be prevented. This leads to the physical requirements mentioned below, which can be largely realized by the experimental changes shown on the right.

Physical requirement (proton)	Experimental change
short transit path	Reduction of the tube diameter
short runtime	Increase in suction voltage
large free path	Reduction in particle density

It would of course be of great interest to us if the beam experiments were carried out under the conditions, we have specified in order to verify or falsify our hypothesis presented here.

D Quantization and dequantization

The last step in calculating the decay time of the neutron by means of the time quantum number n_{tmax}, i.e. the conversion of the period time t_{per} with a duration of approx. 10^{-21} s into time periods corresponding to the macroscopically determined decay times (Table 4 column F), must also be explained in more detail.

As repeatedly pointed out in earlier works, minimal sizes are indispensable in a projection. Time and length and their combinations are of course the decisive variables in our system.

$$t_{\min} = 4,4077488 \cdot 10^{-24} \left[s \right]$$
$$s_{\min} = 1,3214098 \cdot 10^{-15} \left[m \right]$$

Consequently, each quantity is "granular" and can only be represented in multiples of the minimum quantities (quantization).

$t_i = n_i \, t_{min}$

$s_i = n_i \, s_{min}$

Of particular importance are the maximum n_i per unit size, which we will refer to below as the time or length quantum number.
These correspond approximately to the pixel numbers in electronic photography, which are known to indicate the number of the smallest, no longer resolved areas (pixels) per sensor chip and thus reflect its resolution and quality.

$$n_{t_{\max}} = \frac{t_E}{t_{\min}} = 2,26873 \cdot 10^{23} \qquad t_E = 1s$$

$$n_{s_{\max}} = \frac{s_E}{s_{\min}} = 7,567674 \cdot 10^{14} \qquad s_E = 1m$$

In addition to the time and length quantum numbers, we have become familiar with the combination of these two as an important quantization variable when calculating the gravitational constant (Ref7).

$$n_{g_{\max}} = \frac{s_E t_E}{s_{\min} t_{\min}} = 1,716903 \cdot 10^{38}$$

$$G = \frac{V_P}{6 m_P {t_{\min}}^2 n_{g_{\max}}} \, f_{D4} = 6,67377 \cdot 10^{-11} \left[\frac{m^3}{kgs^2} \right]$$

In order to make the calculation step described above for the calculation of the decay times (see Table 4, column F) plausible, we refer back to the calculation of the electric field constants in Ref 7.
We had solved the electrostatic force equation according to ε_0 and replaced the respective lengths and times with the corresponding minimum values as the decisive step.

$$* \ \varepsilon_0 = \frac{e^2 t^2}{4\pi s^3 m_e} \Rightarrow \varepsilon_0 = \frac{e^2 {t_{\min}}^2}{4\pi {s_{\min}}^3 m_e} = \frac{e^2 \left(\frac{t_E}{n_{t_{\max}}} \right)^2}{4\pi \left(\frac{s_E}{n_{s_{\max}}} \right)^3 m_e}$$

*In these equations, the factor $f_{D42}^2/2$, which leads to the correct result but is uninteresting in this context, was not taken into account

We also achieve this substitution if we extend the numerator and denominator by the respective unit values and divide each of them by the corresponding quantum numbers (see equation system above

right). The result is identical, but it becomes much clearer that we have quantized the definition equation for ε_0 here.

By multiplying by the length or time quantum number, we can of course reverse the process. We therefore carry out a dequantization.

This is precisely the last step in calculating the decay times from the periodic times in Table 4 F.

$$t_{D_N} = t_{per} n_{t_{\max}} \left[s \right]$$

We must therefore get used to the idea of a lack of quantization of time inside the neutron, which is another surprise when dealing with its inner life. Of course, everyone is free to consider this last step nonsensical and to regard the excellent agreement between the measured and calculated decay times of the neutron as pure coincidence. However, we are convinced that these values are very real and that the quantization of time is suspended inside the neutron. However, this also means that time has an infinite resolution in this area. The fact that the jumps nevertheless occur in the minimum time t_{min}, as postulated at the beginning, is obviously related to the fact that the oscillations induced by this have an external effect on our projection of time and space, which in turn makes quantization indispensable.