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Alignment Energy Role in Hydrogen Spillover

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Abstract: *Hydrogen atom decomposition energy coincides with the energy barrier in Hydrogen spillover.*

Keywords: *Hydrogen alignment energy, Hydrogen spillover barrier*

1. Introduction

The part must internalize the whole to which that part belongs to. Actually, the whole has to measure out the whole part. For this purpose, the part goes towards the whole by offering enough energy that nothing is left uncounted. The alignment energy is thus the energy of part enabling the counting of part by the whole without remainder. And the part is counted by the part per se without energy.

2. Counting on the Surface

On the elliptic surface we count the number of elliptic units u in one elliptic unit 1:

$$u = \frac{u}{1}. \tag{1}$$

On the double surface [1] we count the number of double surface units $s(n)$ in one double surface unit $s(1)$:

$$u = \frac{s\,(n)}{s(1)}. \tag{2}$$

But in both cases the number of counted units u remains the same as follows:

$$u = \frac{u}{1} = \frac{s(n)}{s(1)}. \tag{3}$$

The elliptic unit 1 is thus defined as:

$$1 = \frac{u.\,s(1)}{s(n)}. \tag{4}$$

Where holds:

$$s(n) = n\left(2 - \frac{1}{\sqrt{1 + \frac{\pi^2}{n}}}\right). \tag{5}$$

And to the elliptic unit value $n = 1$ belongs the double surface unit value:

$$s(1) = 1.696685529 \ldots \tag{6}$$

Factor $s(n) = u.\,s(1)$ is defined as aligned if n is a natural number ($n \in \mathbb{N}$). And contrarily $s(n)$ is unaligned if n is not a natural number ($n \notin \mathbb{N}$).

We can see from relations (4) and (5) that u and n are related by the irrational factor π so they cannot be natural numbers at the same time, exceptionally in the case when holds $u = n = 1$. The alignment $s(n \in \mathbb{N})$ is therefore hidden from sight since it is manifested by the irrational number of counted units u:

$$u = \frac{s(n \in \mathbb{N})}{s(1)} \notin \mathbb{N}. \quad (7)$$

Figure1. *It is only with the heart that one can see rightly; what is essential is invisible to the eye*

3. Counted Units

In physicochemical world the number of counted units u is given by dividing Compton wavelength of the part λ_{part} by that of the whole λ_{whole}. Or more convenient by dividing the mass of the whole m_{whole} by that of the part m_{part} since:

$$u = \frac{\lambda_{part}}{\lambda_{whole}} = \frac{m_{whole}}{m_{part}}. \quad (8)$$

4. The non-natural Number $n \notin \mathbb{N}$ and Unaligned Ratio $s(n \notin \mathbb{N})$

Factor $s(n)$ is also called as ratio R:

$$s(n) = u.s(1) = \frac{m_{whole}}{m_{part}} s(1) = R. \quad (9)$$

Ratio $R = s(n)$ is in general (except for $m_{whole} = m_{part}$) unaligned:

$$s(n \notin \mathbb{N}) = m.s(1) = \frac{m_{whole}}{m_{part}} s(1) = R_{unaligned}. \quad (10)$$

5. The Natural Number $n \in \mathbb{N}$ and the Aligned Ratio $s(n \in \mathbb{N})$

The natural number $n \in \mathbb{N}$ is found as the highest natural number which is smaller than with the help of equation (10) calculated non-natural number $n \notin \mathbb{N}$:

$$n \in \mathbb{N} < n \notin \mathbb{N}\ (10). \quad (11)$$

Inserting $n \in \mathbb{N}$ (11) in the equation (5) the aligned ratio $R_{aligned} = s(n \in \mathbb{N})$ is given:

$$s(n \in \mathbb{N}) = n\left(2 - \frac{1}{\sqrt{1 + \frac{\pi^2}{n}}}\right) = R_{aligned}. \quad (12)$$

6. The Aligned Ratio $s(n \in \mathbb{N})$ and the Corresponding Alignment Energy

Ratio $R = s(n)$ is aligned only if the part offers the alignment energy $W_{alignment}$:

$$s(n \in \mathbb{N}) = m.s(1) = \frac{m_{whole}}{m_{part} + \frac{W_{alignment}}{c^2}} s(1) = R_{aligned}. \quad (13)$$

7. The Alignment Energy

Knowing the unaligned ratio $R_{unaligned}$ (10) and aligned ratio $R_{aligned}$ (12) the aligned energy can be calculated as follows:

$$W_{alignment} = \left(\frac{R_{unaligned}}{R_{aligned}} - 1\right) m_{part} c^2. \quad (14)$$

If the part is the whole to itself ($\frac{R_{unaligned}}{R_{aligned}} = 1$) of course no alignment energy is needed.

8. The Alignment and Decomposition Characteristics of Hydrogen Atom and Electron

The alignment and decomposition characteristics of the Hydrogen atom (H) as a whole and electron as its part are presented in Table1. The data for mass of H and electron are taken from reference [2] and [3], respectively.

$Partic$	$Mass\ (Da)$	$R_{unaligned} = \frac{m_{particle}}{m_{electron}} s(1)$	$n \in \mathbb{N}$	$R_{aligned} = s(n) = n\left(2 - \frac{1}{\sqrt{1+\frac{\pi^2}{n^2}}}\right)$	$W_{alignment} = \left(\frac{R_{unaligned}}{R_{aligned}} - 1\right) m_{electron}c^2$	W_{atom}
H	1,0078250 31898	3117,07031	31 17	3117,00158	11,2671 eV	$-13,6057$
elect ron	0,0005485 7990907	s(1)=1,69668…	1	s(1)	0 eV	0 eV

The electron as a part of H possesses the alignment energy $W_{alignment} = 11{,}2671\ eV$ but the electron outside the atom is as a part of itself without the alignment energy.

The electron as a part of H possesses the atom energy $W_{atom} = -13{,}6057\ eV$ but the free electron outside the atom is without atom energy.

9. The Composition and Decomposition of Hydrogen Atom

At the composition or decomposition of H both energies (alignment and atom) should be taken into account:

a) Composition

$$W_{composition} = W_{alignment} + W_{atom} = 11{,}2671\text{ eV} + (-13{,}6057\ eV) = -2{,}3386\ eV. \qquad (15a)$$

At the H composition reaction the alignment energy $W_{alignment} = 11{,}2671\ eV$ plays a role of activation energy. The composition energy signed negative $W_{composition} = -2{,}3386\ eV$ means that at the H composition that energy is released.

b) Decomposition

$$W_{decomposition} = W_{ionisation} - W_{alignment} = 13{,}6057\ eV - 11{,}2671\ eV = 2{,}3386\ eV. \qquad (15b)$$

At the H decomposition the ionisation energy $W_{ionisation} = -W_{atom} = 13{,}6057\ eV$ plays a role of activation energy. The decomposition energy signed positive $W_{decomposition} = 2{,}3386\ eV$ means that at the H decomposition that energy is invested.

10. The Hydrogen Spillover

Hydrogen (H) spillover [4] refers to the diffusion of activated hydrogen atoms from a hydrogen-rich activator such as transition metal catalysts to support materials with no ability to dissociate hydrogen molecules by themselves. It should not be simply considered as a migration of an “invariable” chemical species. Rather, it is suggested that the possibility of dynamic equilibrium between the ionic H+ /e- pair and the radical H· should be considered, where their relative ratio depends on the electronic properties of the supports. Following our idea presented in previous chapters we can add that the concerned equilibrium could be provided under energy barrier determined by the hydrogen atom decomposition energy:

$$W_{barrier} = W_{decomposition} = 2.34\ eV. \qquad (16)$$

11. Conclusion

Interestingly, such barrier is found in the reference [4].

DEDICATION

To the Holy Three Kings and Antoine de Saint-Exupery

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