International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 9 (2017) pp. 1883-1884

Hydrogen Subatoms in a Multiply Charged Ion Field

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Abstract

It is shown that hydrogen subatoms possess high dielectric strength in a field of multiply charged ions. On the example of titanium ions, it is demonstrated that the distribution of protons in the electron shell of the subatom to the nuclei is equivalent to the energy of the incident proton ~ 3.2 *keV* and should significantly increase the probability of nuclear reactions.

Keywords: hydrogen subatoms, multiply charged ions, binding energy, hydrogen.

INTRODUCTION

Unlike with classical atoms, the intrinsic energy of electron motion mc^2 [1] is of great significance in hydrogen subatoms. This leads to the formation of a more compact quantum system, having a characteristic radius of 0.75 *a,* where *a* is the Bohr radius, contributing to a lower polarisability of the subatoms. The ionisation energy of the subatoms is 4/9 of the ionisation energy of the hydrogen atom, which equals $\varepsilon_0 = 6.02\, eV$. This energy corresponds to the binding energy of an electron in a hydrogen-like ion with a charge of *Z*= 2 in the excited state with a principal quantum number of *n*= 3. The energy diagram of an electron in a subatom has an unusual form as shown in Fig. 1:

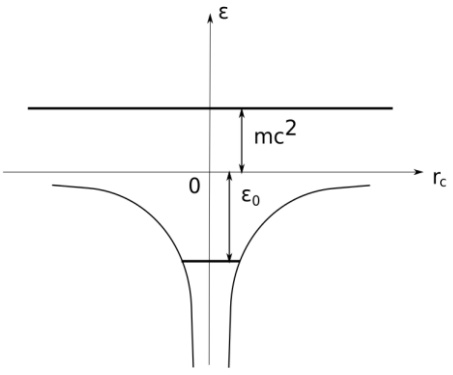

Figure 1. Energy diagram of hydrogen subatom

It can be adduced that a free electron with energy mc^2 "captures" a proton to form a bound state with energy of ε_0. Subatoms of hydrogen can approach the nuclei of other elements as neutral particles at sufficiently close distances, since the proton is shielded by an electron shell with a large intrinsic energy. Let us now examine this situation in more detail.

CALCULATION

The motion equation of the hydrogen subatom in the field of the nucleus is written using the *Z* - number in the periodic table in accordance with Fig. 2.

$$-\frac{\hbar^2}{2m}\Delta\,\Psi(\vec{r},\vec{r}_0)-\frac{e^2\Psi_1}{\vec{r}}+\frac{e^2Z\Psi}{r_0}-\frac{e^2Z\Psi}{\left|\vec{r}+\vec{r}_0\right|}=(E-\varepsilon)\Psi(\vec{r},\vec{r}_0) \tag{1}$$

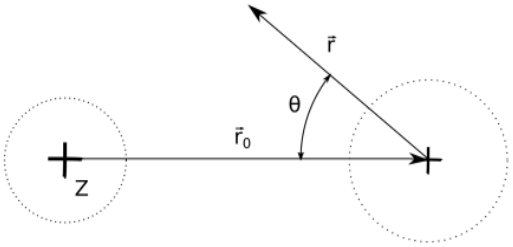

Figure 2. Coordinates of the hydrogen subatom

Here r_0 is the distance from the centre of the multiply charged ion to the probabilistic centre of the subatom, $E = mc^2$. We will assume that $\vec{r}_0$ is the parameter of the problem and reformat equation (1) to the form:

$$-\frac{\hbar^2}{2m}\Delta\,\Psi(\vec{r},\vec{r}_0)-\frac{e^2\Psi}{\vec{r}}-\frac{e^2Z\Psi}{\left|\vec{r}+\vec{r}_0\right|}=(E_1-\frac{e^2Z}{r_0}-\varepsilon(r_0))\Psi(\vec{r},\vec{r}_0) \tag{2}$$

In the case of $r_0 >> r$ we obtain from (2) an equation for describing the energy spectrum of subatoms of hydrogen [1].

$$-\frac{\hbar^2}{2m}\Delta\ \Psi\ (\vec{r}\ )-\frac{e^2\Psi}{\vec{r}}=(E\ -\varepsilon)\Psi\ (\vec{r}\ ) \tag{3}$$

The solution to equation (3) gives:

$$\varepsilon\ = m\ c^2+\frac{2e^2}{9a} \tag{4}$$

Here the Bohr radius is $a=\hbar^2/m\ e^2$, $\varepsilon_0=\frac{2e^2}{9a}$

Let us consider the case of $r_0<<r$. Then

$$\frac{1}{|\vec{r}+\vec{r}_0|}=\frac{1}{\sqrt{r^2+r_0{}^2-2rr_0\cos\Theta}}\approx\frac{1}{r} \tag{5}$$

Here it is considered that in subatoms of hydrogen $\Theta\sim\pi/2$ [1]. Taking into account the relation (5), we rewrite equation (2):

$$-\frac{\hbar^2}{2m}\Delta\ \Psi\ (\vec{r}\ ,\vec{r}_0)-\frac{e^2(1+Z)\Psi}{\vec{r}}=(E_1-\frac{e^2Z}{r_0}-\varepsilon(r_0))\Psi\ (\vec{r}\ ,\vec{r}_0) \tag{6}$$

Equation (6) can be reduced to the form of equation (3), redefining the parameters of the problem to at once write the solution:

$$\varepsilon_p=mc^2+\frac{2}{9}(1+Z)^2\frac{e^2}{a}-\frac{e^2Z}{r_0} \tag{7}$$

From the formula (7) it can be seen that the Coulomb component of the subatom's binding energy increases significantly by a factor of $(1+Z)^2$. For example, for titanium nuclei with Z = 22, the Coulomb component of hydrogen subatoms is 3.2 *keV*. The limiting radius of approach of the subatom with the nucleus is r_{0i}, after which it is ionised in an external electric field:

$$r_{0i}=\frac{9Za}{2(1+Z)^2} \tag{8}$$

CONCLUSION

In the case of titanium $r_{0i}=a/5{,}34$. In this situation, the polarisability of the subatoms will be two orders of magnitude smaller than the standard value for hydrogen atoms.

The distribution of a proton in the electron shell of the subatom to the nuclei is equivalent to the energy of the incident proton ~ 3.2 *keV* and should significantly increase the probability of nuclear reactions. In the case of nickel with Z = 28, we have $\varepsilon_0=5\,keV$, $r_{0i}=a/6.67$.

Thus, the existence of hydrogen subatoms in the system under consideration – for example, porous titanium + hydrogen – can be inferred from indirect evidence: the appearance of new elements and ultraviolet radiation with photon energy of 6.02 *eV*, which can occur upon heating and exposure of the system in time. The results of the first of such experiments are described in review [2]. The latest experimental works in this direction can be found in review [3].

The research was conducted with the financial support from the Federal Targeted Program for 2014-2020 of the Ministry of Education and Science of the Russian Federation, agreement#14.578.21.0113 dated October 27,2015, unique ID RFMEF157815X0113.

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