

# **APPENDIX B**

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### THE HYDROGEN ATOM

The Hydrogen atom with its naturally fixed orbits has served as a testing ground for many theories. There is no doubt that standard quantum theory, based on Planck's constant  $h$  as a constant of angular momentum together with Einstein's relativistic velocity theory, has improved the accuracy in determining the position of atomic orbits but they still do not give exact results. Two reasons were given in Chapter 6 section 6.3 namely that Planck's constant is not compatible with momentum since it is an energy constant and that Einstein's relativity theory falls short in dealing with velocities created by loss of potential energy such as experienced by electrons in atomic orbits. The simple laws of the Deadbeat Universe, however, provide the right energy-velocity relationship for electrons in atoms, and as will be shown, it puts the orbits in their right places to a precision limited only by the accuracy of the physical constants involved in the calculations.

#### The Hydrogen Atom

Atoms have been thought of as miniature solar systems ever since the beginning of the 20th century. It was Ernest Rutherford (1911) who proved this point of view to be true through scattering experiments but it remained a mystery why the atomic orbits could only exist in certain well defined radii from the central nucleus. A student of Rutherford's, Niels Bohr, discovered that the well defined orbits seemed to appear in certain steps of the angular momentum  $h = m_e v r$  where  $h$  is Planck's constant,  $m_e$  the electron's mass,  $v$  the orbital velocity and  $r$  the radius of the orbit. Soon thereafter, a remarkable discovery was made by Lois de Broglie, which would revolutionize not only atomic physics but particle physics as well. Lois de Broglie showed that moving particles, such as electrons have wave properties similar to that of light rays and that their wavelengths, just like light, could be determined by Planck's constant and from the particles momentum or  $\lambda = h/(mv)$ . de Broglie

also showed that orbits can only exist at atomic radii where the orbital circumference  $2\pi r$  equals the electron's particle wavelength in wave lengths of  $\frac{1}{2}\lambda, 1\lambda, 1\frac{1}{2}\lambda, 2\lambda, 2\frac{1}{2}\lambda, 3\lambda$  etc. This motivated the Austrian physicist Erwin Schrödinger and others to formulate orbital equations based on wave properties and statistics which is about as far as atomic physics has progressed today. Even if atomic physics has advanced significantly since Rutherford, Bohr and de Broglie together with Einstein's relativity theory, the equations do not fit measurements too well. The problem is twofold. First, Planck's constant is an energy constant and not compatible with momentum so de Broglie's momentum equation  $\lambda = h/(mv)$  has to be replaced by the energy relation  $\lambda = hv/E$ . This becomes clear if we compare

$$\lambda_{energy} = \frac{v}{\nu} = \frac{hv}{E} \neq \lambda_{momentum} = \frac{\frac{1}{2}hv}{\frac{1}{2}mv^2} = \frac{h}{mv}. \quad (1) \quad (143)$$

were  $\nu = E/h$  is the frequency of the particle associated with its energy. We know that Newton's energy relation  $\frac{1}{2}mv^2$ , from which the momentum is deduced, is not accurate at high relativistic velocities and therefore, any quantum theory based on particle momentum is doomed and cannot yield correct answers. The second problem is that we can not use Einstein's relativistic velocity equations because orbits in atoms are created by loss of potential energy whereas Einstein's relativity is only accurate for velocities generated by gain in potential energy as explained in Chapter 6 section 6.3. The purpose of this appendix is to show that by applying relativistic velocities generated by loss of energy, together with de Broglie's wave theory based on energy rather than momentum (see the atomic orbit Equation (73) in Chapter 6 section 6.3), one is able to obtain accurate energies for the different orbits and wave lengths of  $n$  in the Hydrogen atom

$$E_{orbit} = E_0 \left[ 1 - \sqrt{1 - \left( \frac{Zq^2}{n4\epsilon_0 hc} \right)^2} \right] \times \frac{m_n}{(m_n + m_e)}, \quad (144)$$

Orbital energies using Equation (144) are listed in Table 3 and also shown in the energy diagram of Fig. 26.

Orbit	$n$ =Wave length	Energy Joules
1	$\frac{1}{2}$	$2.178709658 \times 10^{-18}$
2	1	$5.446719526 \times 10^{-19}$
3	$1\frac{1}{2}$	$2.420759869 \times 10^{-19}$
4	2	$1.361676403 \times 10^{-19}$
5	$2\frac{1}{2}$	$8.714731931 \times 10^{-20}$
6	3	$6.051891492 \times 10^{-20}$
7	$3\frac{1}{2}$	$4.446290966 \times 10^{-20}$
8	4	$3.404188964 \times 10^{-20}$

Table 3. The first eight orbits in Hydrogen and their energies.

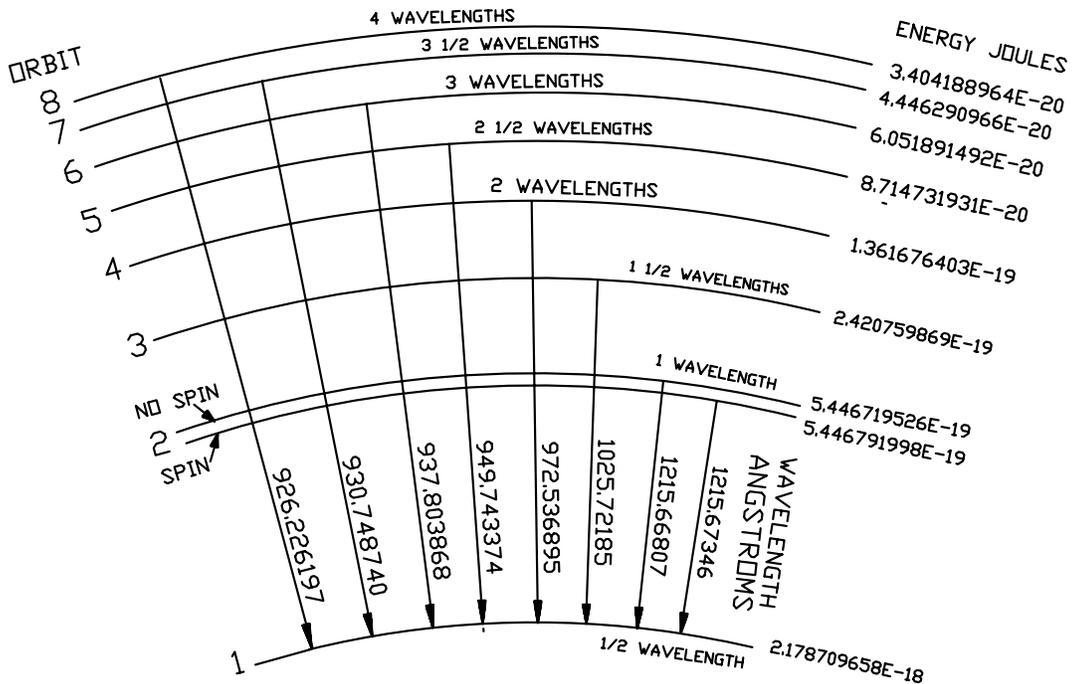


Fig. 26. Energy diagram of the Hydrogen atom as predicted by the “Deadbeat Universe”.

An electron can fall from any orbit down to the ground state orbit, or orbit number 1, as shown by the arrows in Fig. 26. The orbiting

electron can also fall between different orbits which is not shown here. As the electron falls in to a closer orbit, potential energy is lost to radiation. The amount of energy escaped, in the form of radiation equals the energy difference between the orbits. In Fig. 26 the wavelength of the radiation liberated is listed next to each arrow. The spectrum of wavelengths listed is that of the Lyman series.

One interesting phenomenon is the electron's spin or rotation around its own axis. The spin will shift the orbital energies causing each orbit to split up into small fractions. This energy fragmentation can be seen in the emitted wavelengths and is called finestructure splitting. The effect of the electron's spin is shown in Fig. 26 by the double line in orbit number 2 and is caused by tidal forces similar to that of the Earth's tidal influence on the Moon. For example, consider the Moon being captured in its 28 day orbit around the Earth. At first the Moon would not rotate around its own axis and would show the same face relative to the fixed stars but it would appear to rotate once every 28 days relative to Earth. However, tidal forces between Earth and the Moon will soon bring this relative rotation to a stop so that the Moon now will show the same face to the Earth at all times but rotate once every 28 day around its axis relative to the fixed stars. The energy consumed in generating the Moon's rotation or spin around its axis relative to the fixed stars will cause the Moon's orbit to fall slightly closer to the Earth. An electron in orbit around the atomic nucleus will suffer the same fate and will eventually rotate with the same frequency around its axis as around its orbit. The energy ratio between the two rotations will therefore equal the ratio of the orbital radius to that of the electron's radius  $R/r_e$  where  $R$  is the distance between the electron and the nucleus. The maximum loss of energy due to the electron's spin in orbit 2, for example, in Hydrogen is therefore

$$E_{spin} = \frac{nr_e}{R} E = \frac{n8\pi\epsilon_0 E_{orb}^2 r_e}{q^2} \times \left[ \frac{m_n + m_e}{m_n} \right]^2 = 7.2550833 \times 10^{-24} \text{ J}, \quad (145)$$

where  $E_{orb}$  is the electron's energy in orbit 2 and  $n=1$  is the wave number or wave length of orbit 2.  $E$  is the is combined orbital energy of both the electron and nucleus. The electron's electromagnetic radius is  $r_e = q/(4\pi\epsilon_0 m_e c^2)$  and  $q$  is the elementary charge.