Particles and interactions in a quantum polar wave space

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INTRODUCTION

BOHR MODEL OF THE ATOM

First we quantise angular momentum for $n = 1, 2, 3, ...$ as such,

$$L = n\hbar = n\frac{h}{2\pi}, \tag{1}$$

where h is Planck's constant and so de Broglie relation is found,

$$L = pr = \frac{nh}{2\pi}, \tag{2}$$

since $\lambda = h/p$,

$$2\pi r = \frac{nh}{p} = n\lambda \tag{3}$$

Electron's motion is proposed to be modelled by circular motion caused by electrostatic charge,

$$\frac{mv^2}{r} = \frac{q^2}{4\pi\epsilon_0 r^2}, \tag{4}$$

$$r = \frac{\epsilon_0 h^2}{\pi m_e e^2} = a_0, \tag{5}$$

$$r = \frac{\epsilon_0 h^2}{\pi m_e e^2} = a_0, \tag{6}$$

BOHR RADIUS

Requires circular wave motion instead of circular motion. Bohr modelled the atomic radius through circular motion. This is accurate until quantum physics where the wave properties of electrons are more noticeable and more relevant affecting other quantum systems in the way a spherical wave (polar wave) would instead of a sphere.

In order to obtain polar wave equation we apply a sinusoidal function to the radius of the Bohr equation as follows,

$$r\Psi = \frac{\epsilon_0 h^2}{\pi m_e e^2}\Psi = a_0\Psi, \tag{7}$$

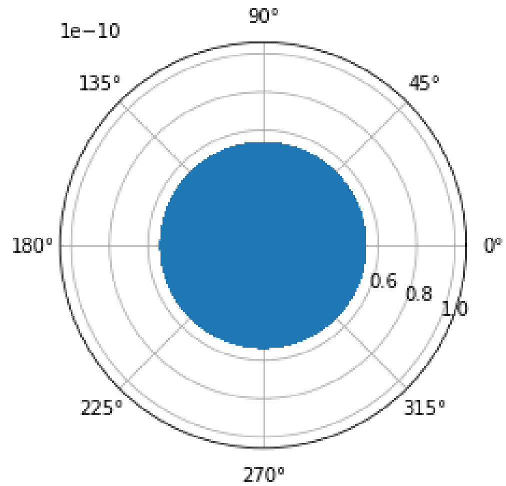

FIG. 1. Bohr's radius computed using the electron wave function in polar coordinates, $\lambda = 2\pi a_0$.

For example where $\Psi(\theta, t) = cos(\frac{2\pi}{\lambda}\theta - wt)$,

$$rcos(\frac{2\pi}{\lambda}\theta - wt) = \frac{\epsilon_0 h^2}{\pi m_e e^2}cos(\frac{2\pi}{\lambda}\theta - wt) = a_0 cos(\frac{2\pi}{\lambda}\theta - wt), \tag{8}$$

where for Cartesian coordinates,

$$x = rcos(\theta), \tag{9}$$

$$y = rsin(\theta). \tag{10}$$

For physical properties p = electron momentum and E = electron energy,

$$\frac{2\pi}{\lambda} = \frac{2\pi p}{h} = k, \tag{11}$$

$$w = \frac{\hbar w}{h} = \frac{E}{h}. \tag{12}$$

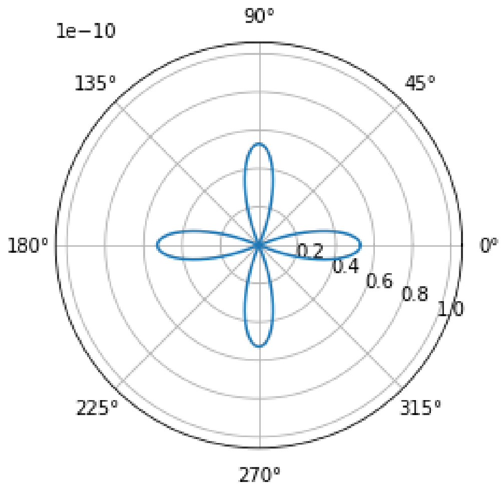

FIG. 2. Bohr's radius computed using the wave function in polar coordinates where $\lambda = \pi/4$.

ELEMENTARY PARTICLES

There are six known quarks: up, down, charm, strange, top and bottom. Six leptons also exist known as: electron, muon, tau and their corresponding neutrinos. There are four known Gauge Bosons called: Gluon, Photon, Z boson and W boson. Higgs boson is a scalar boson.

A quark and an antiquark form mesons such as Pion and Kaon while three quarks form baryons like proton and neutron.

Electron wave function

The example in equation is the electron wave function. The Bohr radius corresponds to the boundary of the electron orbital as electrons are the outer particles that define an atom.

Quark wave function

The quarks propagate through space close to the speed of light. Hence according to relativistic theories, space-time is perceived different for each quark.

Protons and neutrons are made up of three quarks. The strong nuclear force binds these elementary particles together. By following a similar derivation to the Bohr wave function radius but for the strong force we start with,

$$F_G = G\frac{m_1 m_2}{r^2}, \tag{13}$$

where m_1 and m_2 are classical masses and F_G is the gravitational force. The relativistic gravitational constant Grel is 10^{38} times stronger than gravitational force. So we find that,

$$F_S = G_{rel}\frac{m_1 m_2}{r^2}, \tag{14}$$

where m_1 and m_2 are the quark masses and F_S is the strong force.

For quarks assume relatively they orbit each other with circular wave motion. Hence this is saying that quarks within baryons and mesons are quantum entangled in spherical wave motion. Note that relative to our perceived observations this may appear as zigzag or Brownian motion (Quarks would perceive any classical motion as close to zero motion due to the relative slowness.) and so first we must assess the quarks relative perspective frames to each other, then we must assess our own relative perspective frame to the perspective frame of the quantum system. Here we assess the quantum systems inside mesons and baryons.

Let's begin from the perspective of the quarks. We now equate the strong force with the relative motion of two quarks in mesons,

$$\frac{m_1 v_1^2}{r}\Psi = G_{rel}\frac{m_1 m_2}{r^2}\Psi, \tag{15}$$

$$r\Psi = G_{rel}\frac{m_2}{v_1^2}\Psi, \tag{16}$$

where $v = c$,

$$r\Psi = G_{rel}\frac{m_2}{c^2}\Psi, \tag{17}$$

PROTON WAVE FUNCTION

Protons are made up of two up quarks and a down quark.

NEUTRON WAVE FUNCTION

Neutrons are made up of one up quark and two down quarks.

HYDROGEN ATOM WAVE FUNCTION

ATOMIC QUANTUM SPHERICAL HARMONICS

CONCLUSION