NE:Hydrogen

By Robert J Distinti B.S. EE
46 Rutland Ave.
Fairfield Ct 06825.
(203) 331-9696

Ethereal Mechanics: Hydrogen atom

In the New Electromagnetism series of papers we demonstrate a hypothetical application of the New Electromagnetic models to derive the mass of an electron based on the classical electron radius (see ne.pdf). In this paper we push the hypothetical application one step farther to explore protons and hydrogen atoms.

The simple, purely electromagnetic, approximation for hydrogen mass developed in this paper arrives at 1.0034 grams/mole for the molar mass of hydrogen; whereas, the correct value is 1.0000 grams/mole. This approximation shows that the mass of a hydrogen atom is effectively the mass of a proton minus 7 electron masses.

The derivations shown in this paper are concerned only with the mass of the particles/atoms in question. These derivations do not account for magnetic moment and other particle properties. The complete accounting for all particle properties is included in the Ethereal Mechanics series of papers which are slated for future release.

This paper is designed to demonstrate the simple relationship between mass/inertia and charge in a manner suitable for a high school curriculum.

A more transcendental point of this paper is to demonstrate that inertia should be decoupled from mass in much the same manner that weight has been decoupled from mass.

Hydrogen

1 Prerequisites

This paper continues the binary mass particle (BMP) concepts first demonstrated in section 3.4 of the paper ne.pdf and carried through ng.pdf. The reader is highly encouraged to read these items first.

NOTE: All papers (in pdf form) can be found at www.distinti.com/docs.

1.1 Scientifically accepted constants

The following is a list of scientifically accepted constants found in most text books.

Elementary charge	$e = 1.602177e-19$ Coulombs
Classical Electron Radius	$r_e = 2.81794092e-15$ meters
Mass of Proton	$m_p = 1.6726231e-27$ Kg

2 Proton Radius

In the New Electromagnetism paper ne.pdf, the mass of a "Hypothetical" electron is derived from the BMP model using the classical electron radius. Since there is no accurately published proton radius, we us the BMP mass derivation in reverse to determine the radius of a proton assuming that a "Hypothetical" proton is a BMP with positive charges.

Starting with the effective mass model found in section 3.4.1 of ne.pdf

$$M = \frac{K_M Q^2}{r_P}$$

And solving for r_P yields

$$r_P = \frac{K_M Q^2}{M}$$

Substituting the elementary charge and mass of a proton yields

$$r_P = \frac{(1e-7)(1.60217733e-19)^2}{(1.6726231e-27)} = 1.53469852e-18 \text{ meters}$$

We seem to have a conundrum on our hands. The "hypothetical" proton radius is in the 10^{-18} range while the "hypothetical" electron radius is in the 10^{-15} range. This means that the "hypothetical" proton is of the order of 1000 times smaller than the "hypothetical" electron.

In fact, we will show compelling evidence (some based on accepted physical measurements of protons and electrons) that this might in fact be true. We will also show that the combination of these two hypothetical particles enable us to accurately approximate the mass of a hydrogen atom.

In any event, the results of this section are consistent with the predictions of New Electromagnetism; that is, that the inertial force between two charged particles is inversely proportional to the distance between them. Likewise, the inductive coupling between two wires is inversely proportional to the distance between them.

3 Hydrogen

According to classical theory, a "bare bones" (non-isotope) hydrogen atom is composed of a proton and an electron. Standard text books depict this system as a very small single particle (representing an electron) which orbits a much larger particle which represents a proton.

The hypothetical New Electromagnetism derivations seem to contradict this view of the world since the radius of the electron ($r_e = 2.81794092e-15$ meters) comes out to be about 1836 times larger than the proton radius ($r_P = 1.53469852e-18$ see previous section).

So how do we resolve this dilemma? A simple solution co-locates the orbital centers of the proton and electron; effectively, allowing the electron to orbit the proton. The following diagram depicts this solution.

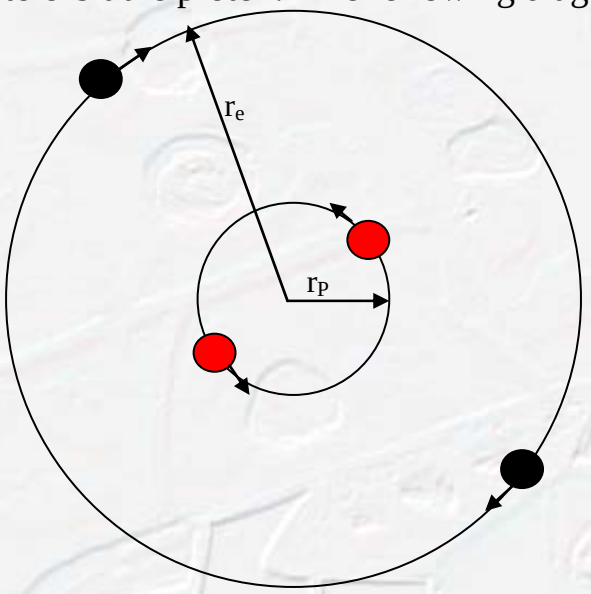


Figure 3-1: Hypothetical Hydrogen atom (Not To Scale)

Remember!! The positive (red) and negative (black) charges which comprise the above model are massless.

The molar mass of a hydrogen atom (non isotope) is 1.0000 grams/mole. For those who glance at a periodic table will see typically 1.00794 grams/mole listed as the molar mass; this occurs because the periodic tables typically account for the distribution of isotopes in actual real world samples. Since we are not modeling an isotope of hydrogen, the real value

of our result should be 1.00000 (at least to as many significant digits as the worst case fundamental constant we are using).

The effective (or inertial) mass of a system of massless charged particles is derived in the paper ng.pdf and is more generally stated here. The inertial mass is the sum of the inertial effects between all charges involved

$$M_{(inertia)} = K_M \sum_{i=1}^{N} \sum_{j=1}^{N} \frac{Q_i Q_j}{d_{ij}} \quad for\ i \neq j$$

Where d is the distance between Qi and Qj.

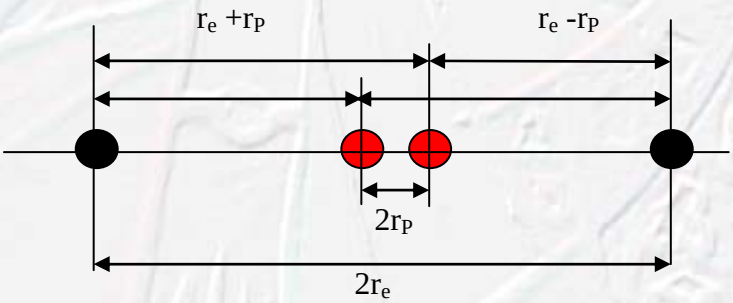
For a four charge system (N=4), like our hypothetical hydrogen atom, there are 12 total interactions that need to be calculated.

The above can be simplified by realizing that each pairing of charges contributes twice to the total mass (see derivation of mass in ne.pdf section 3.4.1 for clarification); therefore, the above can be re-expressed as follows:

$$M_{(inertia)} = 2K_M \sum_{n=1}^{P} \frac{Q_s Q_t}{d_n}$$ P=number of pairs and d is distance between particles.

The above is the sum of the contributions from each unique paring of charges.

If the model is viewed sideways (at a given instant in time), the unique pairs of interactions can be represented as follows:



The above figure shows 6 separate arrows which represent 6 pairs of interactions for a total of 12.

We can simplify the calculation by realizing that r_p is about 2000 times smaller than r_e; therefore, the diagram can be drawn as follows

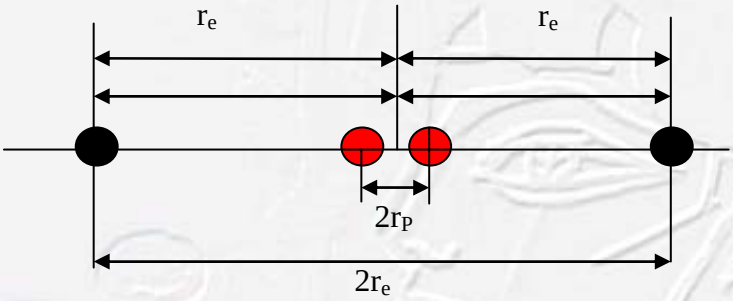


Figure 3-2: simplification which yields excellent approximation

Thus we have the approximate mass for the Hydrogen atom as:

$$M_H = 2K_M\left[\frac{Q_+Q_+}{2r_P} + \frac{Q_-Q_-}{2r_e} + 4\frac{Q_+Q_-}{r_e}\right]$$

Since the third term inside the brackets is a positive charge times a negative charge, its contribution will be negative mass. Also, since all Qs have the same magnitude (the elementary charge) we can reduce the above to the following

$$M_H = 2K_M e^2\left[\frac{1}{2r_P} + \frac{1}{2r_e} - \frac{4}{r_e}\right]$$

Further simplifying

$$M_H = K_M e^2\left[\frac{1}{r_P} - \frac{7}{r_e}\right]$$

Equation 1: Hydrogen Atom Mass (Approximate)

Note: the above basically states that the mass of a hydrogen atom is the mass of a proton minus the mass of seven electrons --- try this out yourself using published values for particle masses, you will get the same answer we are about to obtain.

Now let's plug in the numbers and see what we get (rp is computed from previous section

$$M_H = (1e-7)(1.602177e-19)^2\left[\frac{1}{1.53469852e-18}-\frac{7}{2.81794092e-15}\right]$$

(see Matlab code below)

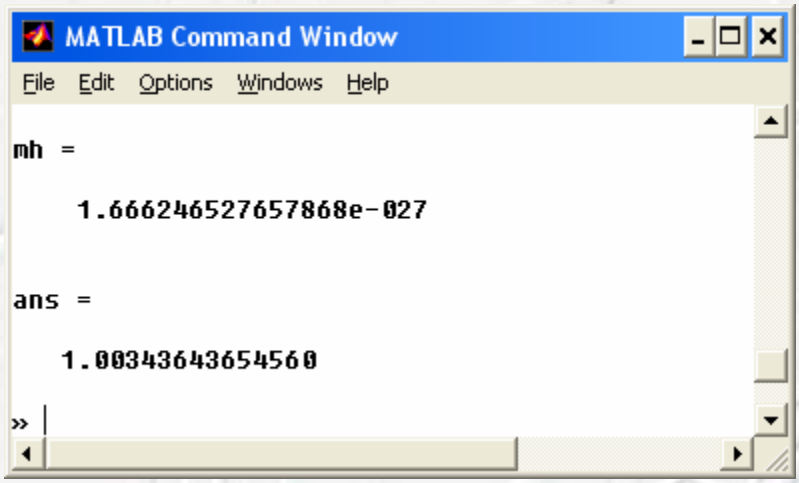
M_H= 1.666246527657868e-027kg/Atom

If we multiply this by 1000(grams/Kg) and Avogadro's number (6.023e23) we get 1.00343643654560 grams per mole.

Here is the Matlab code used to compute the above

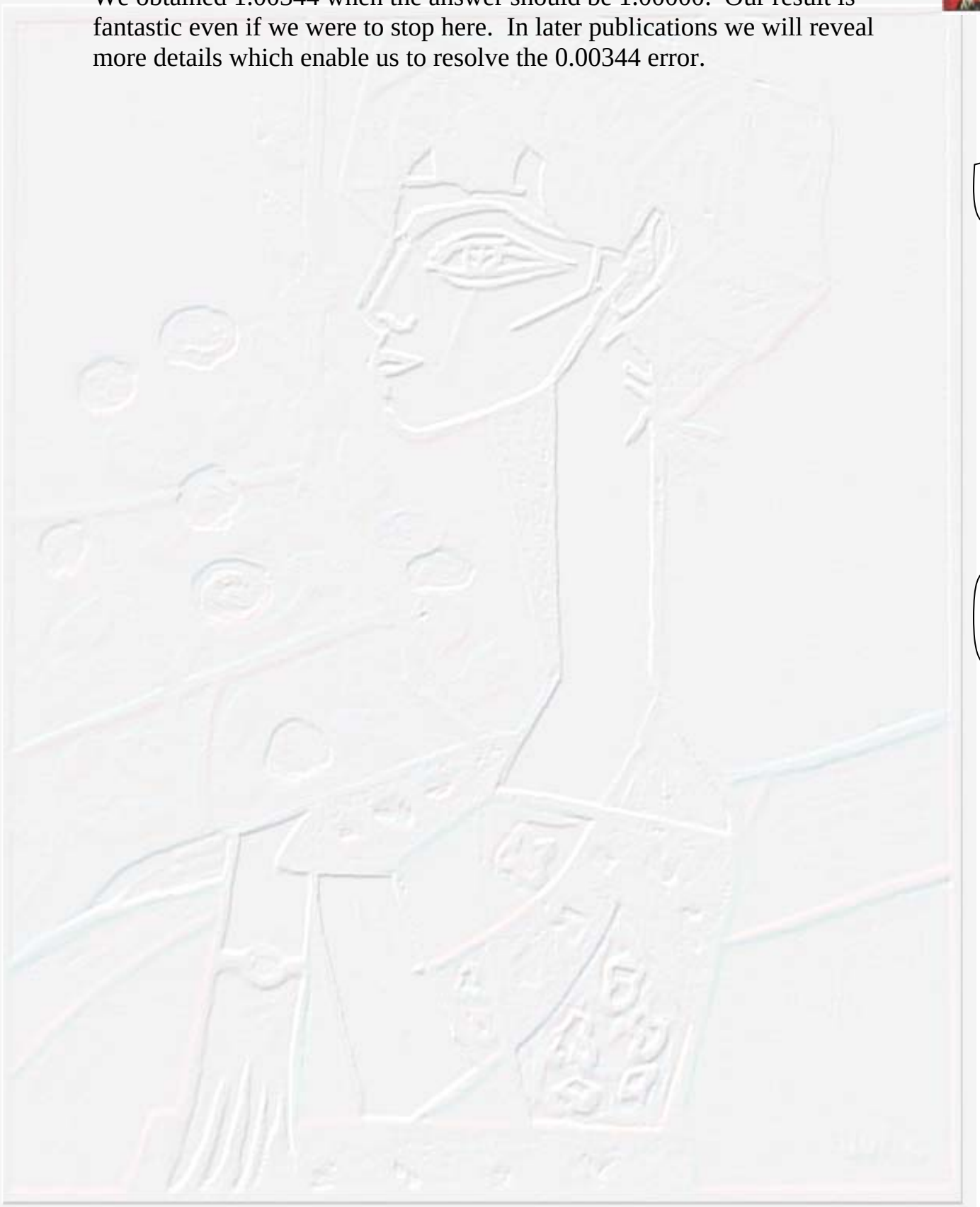
```
format long   % to get full precision  when displaying
% entering all the constants
re=2.81794092e-15;
qe=1.60217733e-19;
km=1e-7;
rp=1.53469852e-18;     % New Electromagnetism calculation
avogadro=6.0221367e23;

mh=km*qe^2*(1/rp-7/re) % mass (kg) per atom of theoretical hydrogen
mh_grams=mh*1000;      % mass in grams
mh_grams*avogadro      % The theoretical molar weight of hydrogen
```

Here are the results



Chemists prefer to express molar mass in terms of grams per mole, that's the reason for the factor of 1000(grams/Kg) above.

We obtained 1.00344 when the answer should be 1.00000. Our result is fantastic even if we were to stop here. In later publications we will reveal more details which enable us to resolve the 0.00344 error.



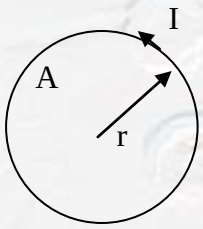
4 Interesting discussions

4.1 Classical Evidence that an electron is larger than a proton

In published tables of particle properties, the following magnetic moments of the electron and proton are found:

System	μ_m Magnetic moment (J/T)
Proton	1.41060761e-26
Electron	9.2847701e-24

The most basic definition of a magnetic moment is the current around a circular ring times the area of the ring (IA)



Equation 2: components of magnetic moment

From the New Electromagnetism identity I*L=Q*v we solve for I

$$I = \frac{Qv}{L} = \frac{Qv}{2\pi r} = \frac{Qv}{2\pi r}$$

Since area is pi*radius^2 we continue

$$\mu_m = IA = \frac{Qv}{2\pi r}\pi r^2 = \frac{Q}{2}vr$$

Since the charge of both an electron and proton are the same we end up with

$$\mu_m = \frac{evr}{2}$$

The first and most important observation that can be made is that the magnetic moment of a particle is proportional to its radius.

If we solve the above for r and set v to the speed of light (I will explain why this was chosen in a moment) we can derive what radii are needed to obtain the given magnetic moments.

System	Radius based on Published Magnetic moment (meters)
Proton	$r_P = \frac{2\mu_{mP}}{cQ} = \frac{2*1.41060761e-26}{1.60217733e-19*3e8} = 5.8736e-016$
Electron	$r_e = \frac{2\mu_{me}}{cQ} = \frac{2*9.2847701e-24}{1.60217733e-19*3e8} = 3.8661e-013$

Taking the ratio of the results indicates that the electron must be 660 times the radius of the proton in order to obtain its desired magnetic moment.

An important observation is that these radii are way off from published classical values. The only way to reduce the radii of the electron predicted by the above is to increase the charge and/or charge velocity. Considering that we can not change the charge (otherwise there would be too much charge for an electron) and since the velocity (speed of light) is supposedly the maximum that could be used, then other possibilities must be considered. One such possibility is that the method used to measure the published magnetic moment is in error. New Electromagnetism shows that when a BMP is exposed to a magnetic field, the radius of the particle will expand; thereby, giving the impression of a much larger magnetic moment.

In spite of the possible error introduced by measurement process, the mere fact that the measured magnetic moment of an electron is larger than a proton suggests that an electron must be larger than a proton.

5 Conclusion

Although this work is labeled "Hypothetical," the more advanced (by no means final) techniques that have been developed for the Ethereal Mechanics papers (which resolve the 0.3% error) are not too much different than what is revealed here.

It is clear that the concept of mass which has always been analogous to inertia needs to be redefined for clarity. This is analogous to the manner in which weight has been decoupled to mass. For the sake of discussion we will use the term "Inertial Mass" ($M_{inertial}$) to describe the Electromagnetic manifestation of the effects of inertia.

The New Electromagnetism mass model clearly demonstrates that the "Inertial Mass" of a system of particles is inversely proportional to its radius. This is counterintuitive to ingrained thinking where inertia is directly proportional to mass which is directly proportional to size. A critical point to remember is that Inertial Mass is an electromagnetic phenomenon of a system of massless charged particles that include "anti-matter" effects which manifest as interactions between oppositely charged particles. This is clearly demonstrated by the fact that a hydrogen atom is the sum of the Proton Inertial Mass and the Electron Inertial Mass MINUS 8 Electron Inertial Masses which are the result of interactions between dislike charges.

This counterintuitive process is substantially limited to the atomic level according to our best understanding at this time. This is due to the fact that the distances between atoms in a quantity of hydrogen is much much greater than the subatomic distances that the inertial effects of one atom do not affect the inertial of another. This may not be true for atoms bonded together to form a molecule (such as H_2) where the distances between the two systems may be small enough to affect the total Inertial Mass – we are studying molecular bonding at this time.

The most exciting aspect of this paper is that New Electromagnetism has reduced the task of calculating the mass of a hydrogen atom to simple algebra for which any average high school student can follow. I'm not sure if any of the classical sciences, in the hands of an expert, could determine the mass of a particle.

Appendix A. Particle data resource

Though there is no official declaration as to the size (radius of a proton) an official website www.particleadventure.org (DOE, CERN) has the following chart which lists the latest best estimate for the size of the various particles which comprise an atom:

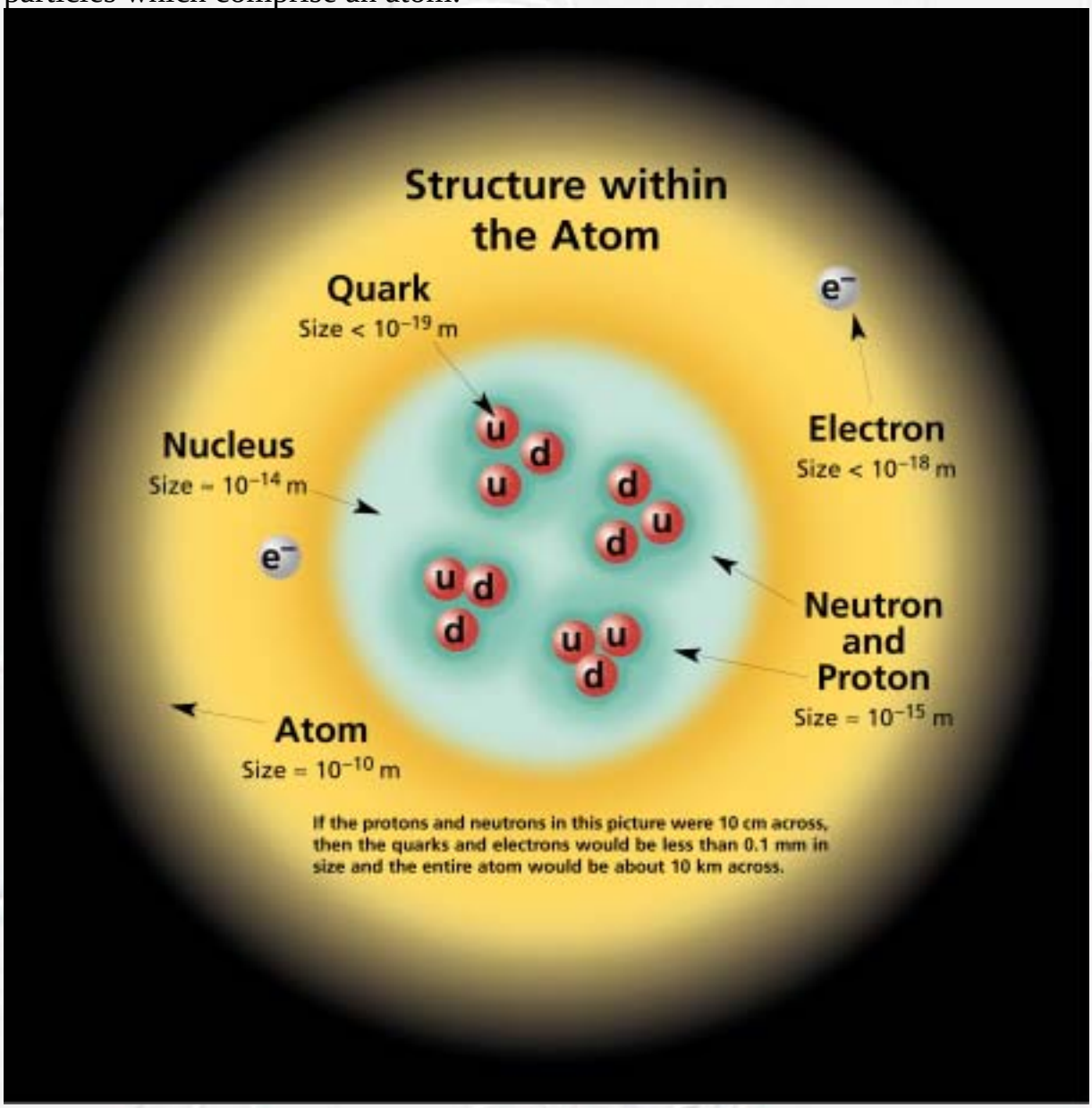


Figure 5-1:From www.particleadventure.org

Comparison of various sources for relative particle size

	According to New Electromagnetism/ Ethereal Mechanics	According to Particle Adventure.org	Value found in many classical physics texts
r_e Electron	10^{-15}	10^{-18}	10^{-15}
r_P Proton	10^{-18}	10^{-15}	???

