A History of Dark Matter ?

Christiaan Huygens (1678) "Treatise on Light"

Huygens[1] developed equations that predict diffraction patterns [2] based on the following assumptions:
A medium for light transfer is present in vacuum. It is made up of touching material particles. Energy is passed from particle to particle. The particles are extremely fine and easily pass through the spaces between the atoms of materials. Huygens suggested the energy is transferred much like the transfer of energy from sphere to sphere in a series of suspended balls. All the energy on one ball is transferred to an adjacent ball. The velocity of transfer depends on the properties of the balls.

"And it must be known that although the particles of the ether are not ranged thus in straight lines, as in our row of spheres, but confusedly, so that one of them touches several others. This does not hinder them from transmitting their movement and spreading it always forward"

"And this last point is demonstrated even more clearly by the celebrated experiment of Torricelli, in which the tube of glass from which the quicksilver[3] has withdrawn itself, the remaining void of air, transmits light just the same as when air was in it. For this proves that a matter different from air exists in this tube[4]. And that this matter must have penetrated the glass or the quicksilver, either one or the other, though they are both impenetrable to the air. And when, in the same experiment, one makes the vacuum after putting a little water above the quicksilver, one concludes equally that said matter passes through glass or water, or through both."

Torricelli was a contemporary of Galileo and a fellow resident of Pisa.

James Clerk Maxwell (1891)
A Treatise on Electricity and Magnetism Volume 2

Maxwell[5] developed equations that predict various properties of electromagnetic radiation[6] using the following assumptions: A medium for light transfer is present in vacuum. It is made up of touching material particles. It has specific magnetic[7] and dielectric properties[8].

"In several parts of this treatise an attempt has been made to explain electromagnetic phenomena by means of mechanical action transmitted from one body to another by means of a medium occupying the space between them. The undulatory theory of light also assumes the existence of a medium."

"According to the theory of undulation, there is a material medium which fills the space between the two bodies and it is by the action of contiguous parts of this medium that the energy is passed on, from one portion to the next, til it reaches the illuminated body."

"Let us determine the conditions of the propagation of an electromagnetic disturbance through a uniform medium, which we shall suppose to be at rest, that is, to have no motion except that which may be involved in electromagnetic disturbances. Let C be the specific conductivity[9] of the medium, K its specific capacity[10] and u its magnetic 'permeability'[7]

C. A. Skinner (1905), J.J. Thomson (1914) and G. Winchester (1914)

Clarence Skinner performed electrical discharge[11] experiments in low-pressure helium. He reported hydrogen gas was produced at the cathode and the initial rate of production followed Faraday's laws of electrolysis[12]. He obtained thousands of times more hydrogen from a silver cathode than it could have originally contained and stated, "It shows no sign of having its supply of hydrogen reduced in the least". He reported that most cathodes tarnish during electrical discharge in pure helium. The following is the introduction to his excellent article.

"While making an experimental study of the cathode fall[13] of various metals in helium it was observed that no matter how carefully the gas was purified the hydrogen radiation, tested spectroscopically[14] persistently appeared in the cathode glow. Simultaneously with this appearance there was also a continuous increase in the gas pressure with time of discharge. This change in gas pressure was remarkable because of its being much greater than that which had been observed under the same conditions with either nitrogen, oxygen or hydrogen. Now the variation in the cathode fall with current density and with gas pressure in helium was found to be so like that obtained earlier with hydrogen that it appeared necessary to maintain the helium free of the latter in order to make sure that the hydrogen present was not the factor causing this similarity in the results. Futile endeavors to attain this condition led to the present investigation, which locates the source of hydrogen in the cathode, shows that the quantity of hydrogen evolved by a fresh cathode obeys Faraday's law for electrolysis, and that a fresh anode absorbs hydrogen according to the same law."

"Altogether about two cubic centimeters of gas[15] have been given off by this silver disk, which is 15 mm. in diameter and

about one mm. thick. It shows no sign of having its supply of hydrogen reduced in the least."

In experiments leading to the development of the mass spectrograph, Sir J.J. Thomson[16] was unable get his discharge tubes free of hydrogen.

"I would like to direct attention to the analogy between the effect just described and an everyday experience with discharge tubes. I mean the difficulty of getting these tubes free from hydrogen when the test is made by a sensitive method like that of positive rays[17]. Though you may heat the glass tube to the melting point, may dry the gases by liquid air or cooled charcoal and free gases you let into the tube as carefully as you will from hydrogen, you will get hydrogen lines by the positive ray method, even when the bulb has been running several hours a day for nearly a year."

Since the gases tested by Thomson were subjected to electrical discharge prior to test, he may have produced hydrogen by the same mechanism as Skinner. If the medium proposed by Maxwell is a matrix of protons and unpaired electrons, atomic hydrogen might be produced from the medium by electrolysis. If so, atomic hydrogen would be produced at a fresh cathode at the rate predicted by Faraday's Laws. Atomic hydrogen is extremely reactive and would be expected to tarnish metal cathodes as noted by Skinner.

George Winchester performed electrical discharge experiments at pressures as low as one millionth of a millimeter[18]. He employed aluminum electrodes, with a minimum gap and about 100,000 volts. His paper includes graphs showing the rate of pressure increase under various conditions. He obtained hydrogen, helium and neon. Eventually the production of helium and neon ceased.

"The case of hydrogen is different; I have sparked tubes until the electrodes were entirely wasted away and this gas can be obtained as long as any metal remains."

Preliminary Conclusions

1. **The medium for light transfer has definite magnetic and dielectric properties. Dielectric properties suggest that the medium contains positive and negative particles. Magnetic properties suggest that the negative particles might be electrons.**
2. **Hydrogen gas appears to be formed by electrolysis of the medium. This suggests that the positive particles may be protons.**

Linus Pauling (1945) "Nature of the Chemical Bond"

"The most stable orbit in every atom is the 1s orbit of the K shell. In the normal hydrogen atom this is occupied by one electron, the spin magnetic moment of which makes monatomic hydrogen gas paramagnetic."

"It is customary to refer to electrons with opposed spins as paired, whether they occupy the same orbit in one atom or are involved in the formation of a bond."

Second Conclusions

1. **The magnetic properties of vacuum suggest that vacuum contains unpaired electrons and is, therefore, paramagnetic. This leads to a simple explanation for the forces between two separated permanent magnets.**
2. **The medium may be a matrix of protons and unpaired electrons, much as in molten common salt, where no**

sodium ion touches another sodium ion and no chloride touches another chloride ion.

Weidner and Sells (1969)
Elementary Modern Physics

"We shall see that, apart from the tremendous difference in their relative sizes, 10^{-10} m. [19] for atoms but less than 10^{-14} m. for nuclei, nuclear structure is different from atomic structure in several significant respects."   (Note the factor of 10,000).

Every nucleus includes at least one proton. The size of the proton must be less than 10^{-14} m. The classical radius of the electron is about 10^{-15} m.   The space between nuclei of materials is a wide-open gate to a matrix of touching protons and electrons, as proposed by Huygens.   Glass transmits light. Likely, it contains the medium for light transmission. The medium may permeate all materials. Whether a material transfers light depends on its dielectric and magnetic properties, at the frequency concerned. (Maxwell)

Bose-Einstein Condensation (BEC)

Silvera and Walreven (1982)

The following quotes are from an article in the January, 1982 issue of Scientific American:

"The statistical theory that describes atoms was first studied by the Indian physicist S.N. Bose and is called Bose-Einstein statistics. The phenomenon predicted by Einstein is a mathematical consequence of Bose Statistics, but it was so contrary to the intuition of physicists in the 1920's that it was regarded as a mathematical oddity that would never be found in a real system. It is now thought the phenomenon is

observable in the laboratory. It is called Bose-Einstein condensation."

"The critical temperature for the condensate is proportional to the density raised to the 2/3 power"
Based on the masses and sizes of protons and electrons Bose-Einstein condensed hydrogen would be stable at extremely high temperatures.

"Liquid helium 4 at or below 2.18 degrees[20] is therefore called a superfluid. If it is set flowing in a tube closed on itself, the liquid continues to flow without friction, never coming to a stop as a normal fluid would. It flows into the smallest passages of its containing vessel and has the remarkable ability to flow through a densely packed powder as if the barrier was not present. A vessel with microscopic holes that would be impenetrable to a normal fluid can be a leaky sieve to a superfluid. Such a vessel is said to have a superleak."

Daniel Kleppner[21] and Thomas Greytak

The following quote is from the December, 2000 issue of Scientific American:

"When his former students were making their spectacular condensates of rubidium, sodium and lithium (alkali metals)[22], Kleppner was battling his career-long atom of choice; hydrogen. He has been studying hydrogen since he was a graduate student and postdoc at Harvard University in the late 1950s."

Their experiments toward producing Bose-Einstein condensed hydrogen appeared to be unsuccessful until they employed spin-polarized hydrogen[23]. Perhaps, they had produced Bose-Einstein condensed hydrogen earlier, but couldn't detect it. It

is difficult to detect water you have produced in a summer lake. Ice is much easier to detect.

Lene Vestegaard Hau

The July 2001 issue of Scientific American includes an article by Lene Vestegaard Hau. It describes experiments her group performed at the Rowland Institute In Cambridge, MA. They passed laser beams into Bose-Einstein condensed sodium and found that it transferred light at a much lower speed than vacuum. They were able to stop light transmission and, then restart it, at will, using appropriate laser beams.
If Bose-Einstein condensed sodium transfers light, one might expect Bose-Einstein condensed hydrogen to transfer light at a much greater velocity[24].

Final Conclusions:

Assuming knowable space is permeated with a concentrated matrix of protons and electrons (possibly Bose-Einstein condensed hydrogen) permits simple explanations for many observed phenomena including:

1. **The stability of galaxies[25].**
2. **The formation of hydrogen in low-pressure gasses.**
3. **The values of dielectric constant and permeability of vacuum required by Maxwell's equations.**
4. **The forces between separated permanent magnets**
5. **The formation of hydrogen in space and**
6. **If trans mission of light is less than 100.0000000…% efficient, the "red shift" might be caused by the lost energy. (E = Planck's constant X frequency[26]).**

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