The Nature of Dark Matter – A Suggested Composition and Mechanism

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A. Summary

It is proposed that dark matter may be neutrons produced in stars and ejected into space as clouds. Dark matter has been calculated to represent at least five times the mass of visible matter in the Universe according to the electromagnetic radiation received. Neutron clouds and associated particles emit no radiation in the conditions under which they are emitted from stars, but they retain their gravitational attraction. A recent paper suggests that the neutron is an extranuclear particle composed of an electron in close orbit around a proton. In the laboratory neutrons decompose into protons and electrons with a half life of about 10 minutes, but in the low temperature and pressure of space it is suggested that they can last indefinitely or at least until they strike an atomic nucleus, so that they form persistent clouds. Neutron clouds are therefore an integral part of the processes of regeneration and redistribution in the Universe.

B. Background

Measurements over the past few decades have shown that stars on the periphery of spiral galaxies such as the Milky Way are moving at orbital velocities which are much greater than ought to be sustainable according to current theory. The maximum velocity at which a star can orbit depends on the force of gravitational attraction between the star and the galaxy of which it is a part. This force is a function of the product of the mass of the star and the mass of the galaxy, and it decreases with the square of the distance between their centres of gravity. This is Newton's Law of Universal Gravitation.

There is a possibility that this law may need modification for astronomical distances in view of the above anomaly, though there is understandable reluctance to change any of Newton's fundamental laws. One suggestion is that his Universal Constant of Gravitation may need to change to accommodate galactic conditions, which is the MOND proposal.

Another is that the inverse-square law may give way to an exponential function beyond a distance that depends on the size of the two masses. This would allow the force to remain above the inverse-square law level in outer space, and result in an inverse-square law zone around each mass (1). This is the corollary of an analysis derived from two hypotheses: that the inverse-square law is the product of an underlying collision mechanism in the medium of space; and that changes of gravitational force which result from changes of location of a mass must have a velocity of transmission to all other masses, as the equations require.

The idea of a transition from an inverse-square law zone to a different function is consistent with the observation that a great number of objects have accumulated in orbit on the edge of the Solar System. This may be because the Sun's inverse-square law zone extends this distance into space, at least in the plane of the Solar System. Moreover, the Voyager spacecraft appear to be slowing down as they reach the boundary of the Solar System, suggesting that they may be entering a new gravitational regime.

However, calculations suggest that modifying the laws of gravitational attraction in whatever form is unlikely to produce a complete answer to the riddle of anomalously high stellar velocities, because the discrepancies are so large. For instance, using the commonly accepted equations, the latest estimates show that the matter visible to astronomers by the electromagnetic radiation which reaches us accounts for no more than 4% of the total mass which must be present. The largest proportion by far (74%) is ascribed to a phenomenon called "dark energy", dark because there is no idea what it is. "Dark energy" has been invented to support the theory of an expanding Universe, and it depends on the interchangeability of mass and energy embodied in the Theory of Relativity. I reject both the model of the expanding Universe and the Theory of Relativity, especially the equivalence of mass and energy, but these are separate arguments which I have pursued elsewhere.

It is the third component of the total mass according to the above estimate which concerns this paper. This is called "dark matter", again dark because we cannot see it. However, the phenomenon is not a purely theoretical concept, because it is based on actual measurement of the "excessive" velocity of stars at the periphery of spiral galaxies. The only known force which could account for this is gravitational attraction which keeps the planets orbiting the Sun, the Moon orbiting the Earth etc. But the only source of gravitational attraction is mass; in fact this is the original definition of mass i.e. what exerts the force of gravitational attraction. If we accept that modification of the Law of Universal Gravitation alone is insufficient to account for the anomalies, as seems likely, then additional mass must be involved, except that we cannot see it. It is this mass that is called "dark matter". What is surprising is that according to this analysis, dark matter accounts for 23% of the Universe.

The corollary is that the Universe contains about five times as much matter which is dark as matter which is visible to us through the electromagnetic radiation that it emits. Whatever scepticism one brings to estimates which relate to the entire Universe, a factor of five cannot be dismissed, certainly not in view of the sophistication of the techniques and the wide range of instruments and measurements now available.

There is currently no idea what this dark matter could be, though the name conjures up an air of something exotic, if that is possible in the context of the Universe. However, its characteristics can be listed:

- It emits no electromagnetic radiation, or at least none that we can see in the present state of the art.

- It exerts gravitational attraction as a result of having the property of mass.

- It must be particulate in form, like everything else in the Universe i.e. it cannot be some kind of continuous matrix, like the field hypotheses of physics. On the contrary dark matter gives rise to a field, a gravitational field.

- Since it is observable only by the motion of the visible masses which it affects, it is probably associated with mass; it does not exist as randomly distributed regions of dark matter. In fact recent maps of its distribution show it as some sort of gossamer drape around galaxies, strings of galaxies etc. This is not surprising because that is how it is calculated; if you cannot see it, and there is no visible matter nearby which it can affect, there is no way of knowing whether it is there.

- Another interpretation, which is key to the present analysis, is that dark matter and visible matter are associated because both are part of the same dynamic astronomical process, the continuing process of stellar evolution.

In this case the answer may lie much closer to home, because there are already well known particles which fit the requirements, namely neutrons.

C. The fundamental mechanism

A previous paper proposed that neutrons are in fact an extranuclear phenomenon; they do not exist as entities inside the nucleus (2).

In this model neutrons are formed when the high temperature and pressure of stars force electrons into close orbit around protons. Atomic nuclei are then essentially composed of protons grouped together and tending to fly apart because of their like positive charges, but held together by electrons travelling at close to the speed of light and much closer than conventional orbital electrons. As the heavier protons begin to accelerate apart because of their mutual repulsion, these fast moving intranuclear electrons orbit them and pull them back together with their negative charges. Electrons therefore exist in the atom in two forms; intranuclear and extranuclear. They are the same fundamental particles but with different velocities and at different distances from the centre of the atom.

It is a condition of a long term stability of the nucleus that an intranuclear electron should orbit two or more protons, probably because of the tightness and velocity of its orbit. The second proton is needed to prevent the electron flying off into space. Thus intranuclear electrons orbit assemblies of reluctant protons, herding the protons together while avoiding each other as far as possible to keep their negative charges apart, which is the position of stability.

Therefore, according to this model, neutrons do not exist as distinct entities in the nuclei of atoms. However, neutrons certainly exist outside nuclei, because when they are expelled from a nucleus, say by radioactive decay, they act as missiles which can strike other nuclei and cause nuclear fission etc. They are certainly neutral particles, because

they are not deflected by positive or negative poles. The question then is: what are neutrons?

A clue as to their nature is that they are observed to decay with a half life of about 10 minutes into protons and electrons. But electrons are fundamental particles, and so if they are liberated by the decomposition, they must exist as separate particles inside the entity of the neutron. The conclusion drawn in the paper is that, when a proton is ejected from a nucleus, it simply takes an intranuclear electron with it.

The binary system formed in this way is the neutron. The electron is in close orbit around the proton moving at near the speed of light, say in a circle, because there could not be sections of the orbit at which it moved faster. When the neutron strikes another nucleus or meets a similar disturbance, the orbit of the electron is distorted, and if the impact is great enough, it may degenerate into a parabola or even a hyperbola, in which case the electron will part company with the proton altogether. The half life phenomenon results from the stochastic element of the collision process and the nature of the impact.

D. Elements of the Periodic Table

The process of building up the elements of the periodic table according to this model is as follows.

- The high temperatures and pressures in stars cause very rapid movement of electrons and protons and force them into close proximity.

- By chance two of the protons and an electron come together such that the electron enters stable orbit around the two protons, which forms the deuterium nucleus.

- Heavier nuclei are formed by the same random process when a proton and almost always an additional electron are forced by the extreme conditions of temperature and pressure into combination with one of the heavy nuclei. The intranuclear electrons assume new, stable orbits around the assembly of protons to hold the nuclear structure together.

- The probability of particles coming together in this way decreases with increasing mass of the nucleus, because the concentration of heavy nuclei is lower.

- Extranuclear electrons are pulled into orbit around the nuclei to form atoms, which is a much easier process because the mobility of the electrons allows them to adjust their positions with respect both to the nucleus i.e. at a distance, and to each other so as to maximise the distance between negative charges.

- The number of protons in the nucleus is always equal to the number of intranuclear electrons plus the number of extranuclear electrons, so that overall neutrality is maintained.

- Thus the number of “neutrons” in the nucleus is equal to the number of intranuclear electrons.

A known phenomenon that is in keeping with this model of building a nucleus is electron capture, in which an electron is pulled into the nucleus to form a new, stable entity. This occurs with isotopes of certain elements such as copper. The conventional view is that the electron is annihilated by a proton in the nucleus which promptly turns into a neutron. However, according to the model proposed in this paper the electron enters the nucleus and joins the intranuclear electrons in their close orbit around the assembly of protons to form a new nuclear structure. In both cases the charge on the nucleus decreases, and so the number of extranuclear electrons which it can support for neutrality is reduced by one electron. This change in the extranuclear electronic structure, which is responsible for chemical bonding, transmutes the atom from the element copper to the element nickel.

E. The astronomical effect

This model potentially provides an explanation of the phenomenon of dark matter. The proposition is that a proportion of protons is ejected into space together with close orbiting electrons. This orbital system, forged in the heat and pressure of the star, remains intact and constitutes a neutron. Neutrons captured in the laboratory decay in a few minutes because, according to the theory set out above, they collide with other nuclei. Neutrons which collide with other nuclei in the conditions of the star, and probably up to the boundary of the hypothetical inverse square zone, suffer the same fate and return to separate protons and electrons. Outside the zone the particles travel fast and parallel, so that there are no collisions and no reason why they should decompose. In effect they form a very diffuse cloud of moving gas, which is cold because there is no interaction between particles; there are no “extranuclear” electrons to transmit orbital vibrations, that is the measure of temperature. The corollary is that there is no reason why neutrons should not last indefinitely under these conditions.

If a neutron does in fact eventually decompose, the proton and the electron of which it is composed will go their separate ways, and form their own clouds of particles, probably moving in the same direct as the neutrons. The overall result is a single cloud of neutrons suffused with protons and electrons. If an electron and a proton happen to coincide under suitable conditions, they may form a hydrogen atom to add to the cloud. Similarly, if two hydrogen atoms come together with sufficient energy, they form a hydrogen molecule, but there is no obvious source of “ignition”, unless it comes from outside. One thing is certain: the protons and electrons in the cloud can never again come together to form neutrons, because the temperature is too low and the pressure is very nearly complete vacuum.

These particles have been ejected from the star, but they all have mass, and so they are all subject to the gravitational attraction of the star (and of course vice versa). After being expelled they are continually being pulled back by the force of gravity, and so they are decelerating. At some distance depending on its initial velocity each particle is brought to a halt, and it begins to fall back down again. The result is to set up a slow countercurrent

stream of particles. The flow is not completely reversible because the returning particles run the risk of collision, not least when they re-enter the inverse square zone.

There is an additional consideration: it may not be justified to treat the entire cloud as having a centre of gravity with a force of gravitational attraction which diminishes with distance according to the inverse-square law. If the theory is correct that gravitational force is subject to disruption by collisions, the cloud outside the collision zone may have greater gravitational effect than the inverse-square law predicts, because the particles are far apart. Thus their effective mass as measured by their gravitational pull could be quite significant compared with the mass of the star. All this adds up to a significant additional gravitational force.

F. Electromagnetic radiation

The thesis of a previous paper is that electromagnetic radiation is generated by the acceleration of particles through the medium of space (3). It does not occur when particles decelerate. In the process described in the previous section all acceleration occurs at the star when the neutrons are ejected. At this stage any electromagnetic radiation is part of the light emitted by the star. After that point all particles are decelerating because of the gravitational attraction of the star, and so no electromagnetic radiation is generated. Thus to take it component by component, the neutrons are slowing down and so they generate no light. If they decompose into protons and electrons, these too slow down, the proton because it is most of the mass of the neutron, and the electron because it is leaving the fast orbit around the proton for a separate existence. Nor does there seem to be any reason for any atomic or molecular hydrogen to emit radiation, because there is nothing to provide the stimulation of disturbance required, or to transmit it from particle to particle if it were generated, which may be construed as lack of heat. Any electromagnetic radiation generated therefore would be of an extremely low intensity because of the nature of the cloud of particles. The overall picture would be of intense cold and near perfect vacuum.

There is the possibility that radiation could be produced when the countercurrent meets the rising cloud of neutrons and other particles, but it would be very low intensity and probably of very long wavelength, because any transitions would involve only small changes of energy level.

The net result is that both star and galaxy, which is the assemblage of stars, would have significantly greater mass than are visible, which is practically a definition of dark matter.

G. Stars and galaxies

All the processes described above are in effect self-contained stellar systems, but in that case each galaxy, indeed each star, would in effect be its own Universe for ever separated from every other. This is clearly not so, not least because it offends against the requirement of entropy that everything should mix with everything else in the course of

time, especially infinite time, so that every possible combination occurs at some time. There must be further mechanisms in operation. These include the following:

- At some point in the process of thermonuclear reaction, explosions occur and matter is ejected into space. Some travels far, and comes eventually under the influence of other stars and galaxies, which is a form of mixing. We are made of stardust!

- Electromagnetic radiation is emitted which travels anywhere in the Universe, until it is absorbed by a mass. This is transmission of energy from one mass to another, which is a form of mixing..

- The result is cooling at the points of origin and heating at the receptor, in effect a trend to equalisation of temperatures. This has been construed as an inevitable descent into a Universe of cold desolation, because the temperature at which such equalisation occurs is much lower than that of the source.

- However, this considers only the extranuclear electrons, those which are responsible for transmitting sensible heat, and whose transitions generate electromagnetic radiation. In fact there is in addition the motion and gravitational attraction of each mass which eventually brings it into collision with another mass. Ultimately such collisions lead to the conditions of extreme temperature and pressure in masses in which thermonuclear reactions can begin again. Thus the cycle is complete.

There is no change of entropy overall, because what is apparently lost in one location is recovered in another. It does imply, however, that different regions are in different conditions at any time, which may influence the generation and distribution of the neutron clouds proposed here as dark matter. Neutron clouds are part of a dynamic system in which neutrons are continually being generated in stars but continually decomposing by impact with atomic nuclei.

For instance there is the phenomenon of stars reaching the end of their thermonuclear activity, which undergo gravitational collapse with the result that they are very small and extremely dense. The atomic structure of such stars is completely crushed, and so the star is thought to be composed entirely of neutrons or, according to the model proposed here, of protons around which all electrons are in close orbits. It is difficult to envisage how this could occur unless the orbits of the electrons are synchronised in some way, which produces in effect a giant nucleus. Measurements show that such stars appear to rotate at extremely high speeds, some even significant with respect to the speed of light, which is also difficult to accept, simply on mechanical grounds. They also possess enormous magnetic fields. There are suggestions that “superfluid neutrons” may be involved.

It is not clear why neutrons as such should produce magnetic fields. It seems much more likely that it is a surface layer of electrons which moves so fast. Electrons could certainly produce magnetic fields if they moved in streams i.e. with a direction, which would

effectively be a giant electric current. Their systematic impingement could produce regular emissions, just as conflicting magnetic fields are observed to produce eruptions of electromagnetic radiation on the Sun.

However that may be, it is not clear whether neutrons would be emitted by such bodies. If the star is really a mass of neutrons, there may not be enough protons to escape from the interior, but if they did, they would have plenty of electrons to take with them in close orbit. There may of course be independent, mobile neutrons both in the star and near the surface. If neutrons did manage to escape, they might well survive a long time undetected, and add to the dark matter of the galaxy.

H. Conclusions

In view of these arguments it seems to be quite possible that unseen neutrons and associated particles could account for the gravitational effects ascribed to dark matter, especially if the modified model of the origin and transmission of gravitational attraction are included. Careful measurement would be required to detect neutrons in space, if the analysis is correct, because the process of detection would itself cause decomposition into protons and electrons. Cloud chambers in space could be a problem! Perhaps the simplest way is to detect the effect of neutrons as missiles on material structures, which goes back to the first experiments that showed their existence. Measurement would have to be carried out in space to avoid interference on Earth.

There seems to be evidence already available in the form of the Van Allen belts. The upper belt, which is 25,000 to 36,000 km from Earth seems to contain mainly electrons from the solar wind, but relatively few energetic particles. By contrast the lower belt about 5,000 km above the equator contains both protons and electrons, either from the solar wind or from collisions of cosmic rays with atoms. An explanation could be that the particles largely originate from neutrons. These would not necessarily be detected in the upper belt, especially if they were not being looked for, but if some began to decompose into electrons and protons by the collision mechanisms suggested above, the electrons might very well be left behind trapped in the upper belt while protons carried on towards Earth because of their greater mass and momentum. They would be accompanied by the neutrons which reached and decomposed in the lower belt.

Finally there is the consideration that large quantities of unseen and fairly unpredictably distributed masses of particles might well affect the mass-luminosity relationship in addition to the exceptions which are already known, such as white dwarfs, which are degenerate, and red giants which have extended atmospheres.

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