An alternative Concept of Space and Matter - the Net Charged Universe (NCU)

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Abstract
An alternative cosmological concept of space and matter (Net Charged Universe – NCU) is presented. The concept aims to give an alternative explanation of the phenomena that have forced scientists to assume Dark Energy (DE) and Dark Matter (DM). This means that the DM and DE concepts should be avoided.
The basic idea of the NCU is the existence of electrical charge asymmetry in the entire universe bringing about the effects that are currently attributed to DE and DM respectively.
Some calculations show the plausibility of the NCU. The calculations were used to estimate the rates of electrical charge asymmetry required by the NCU concept in galactic systems ($X_{np\_S}(r)$) as well as extragalactic regions (X_{np_U}). These calculations have revealed that the required net charge rates ($X_{np\_S}(r)$ and X_{np_U}) are both of a very small magnitude. This means that the current physical observations do not appear to be able to prove or to disprove the NCU theory explained here.
For this reason, the NCU concept can be regarded as possible and plausible – until it can be verified by observations that could possibly rule it out. This is very similar to the current situation regarding the concepts of DM and DE.

1. Introduction

This article has been submitted by a non-professional in the fields of cosmology and particle physics but by a person with deep interest in these topics. And as a chemist, I am familiar with scientific thoughts and methods.

From my point of view, I see severe problems with the concepts of Dark Energy (DE - assumed to explain the accelerated expansion of the universe) and Dark Matter (DM - assumed to explain the anomalous radial distribution of stars' orbital velocities in galaxies).

In my opinion, both concepts suffer from a lack of experimental verifiability and of plausible ideas on the physical nature of both "dark" substances. Furthermore, I have a hard time accepting the idea that the well-known visible matter only has a share of 4% of all the matter in our universe.

For these reasons, I am going to propose a scenario without DE and DM which nevertheless seems to be able to explain the phenomena that have led to the assumption of both dark substances.

2. An Alternative Concept of Space and Matter – Qualitative Description

The basic idea of this concept is that our universe contains only matter of the well-known kind, but the electrical charge is not completely symmetrical. This means that the universe as a whole is electrically charged to a very small but crucial amount (Net-Charged Universe – NCU). Such a charge has not been found yet, so its amount must be small enough to not have been detected during current physical observations.

As the calculations below will show, the present amount of charge asymmetry in galaxies does not need to exceed a value of around 10^{-15} to cause the phenomena that have forced scientists to postulate the existence of DM. On the other hand, to replace the idea of DE, the charge asymmetry in extragalactic regions does not need to exceed a value of about 10^{-18}. The reason for this lies in the very strong Coulomb force compared to gravity. Therefore it is plausible for a possibly existing electrical asymmetry to have not yet been observed.

In the following considerations a) and b), the phenomena that have led to DE and DM concepts are explained by the NCU concept in a more detailed qualitative way:

a) *The Accelerated Expansion of the Universe:*

If matter has an average charge, all components repel each other. In the case of stronger electrostatic repulsion compared to gravity, all components move away from each other in an accelerated fashion.

This suggests that new space is formed (or space is expanding) between those expanding particles - a scenario similar to common Big Bang scenarios.

Furthermore, the concept of electrostatically repelling particles could possibly help to solve the so-called Horizon Problem, which was the reason for introducing the Inflation theory. This is because the repulsion of charged matter would make the particles distribute in a very homogeneous way. Especially if we assume a higher degree of charging at the beginning of the universe, this effect could be very strong. Such a higher electrical charge asymmetry seems to me to at least be possible, since the process of how electrons and protons initially came into being within the universe is basically unknown.

b) *The Anomalous Radial Distribution of Stars' Orbital Velocities in Galaxies:*
Seemingly, stars at the edge of galaxies experience a higher gravitational attraction than the visible matter of the respective galaxy could bring about. This was concluded from rotational velocities of stars that had been measured. To explain the higher attraction needed, one today assumes a halo of gravitational DM that shows no further interaction with visible matter.
However, presuming an omnipresent electrostatic charge of the whole universe, one has to conclude that the magnetic fields of the rotating galaxies can track charged particles towards the respective galactic center. Thus, electrical excess charge is concentrated in galaxies and the stars there become more charged than the empty regions outside the galaxies. So the stars' orbital movement relative to the galactic magnetic field should induce a Lorentz force directed towards the galactic center (see Fig. 1).

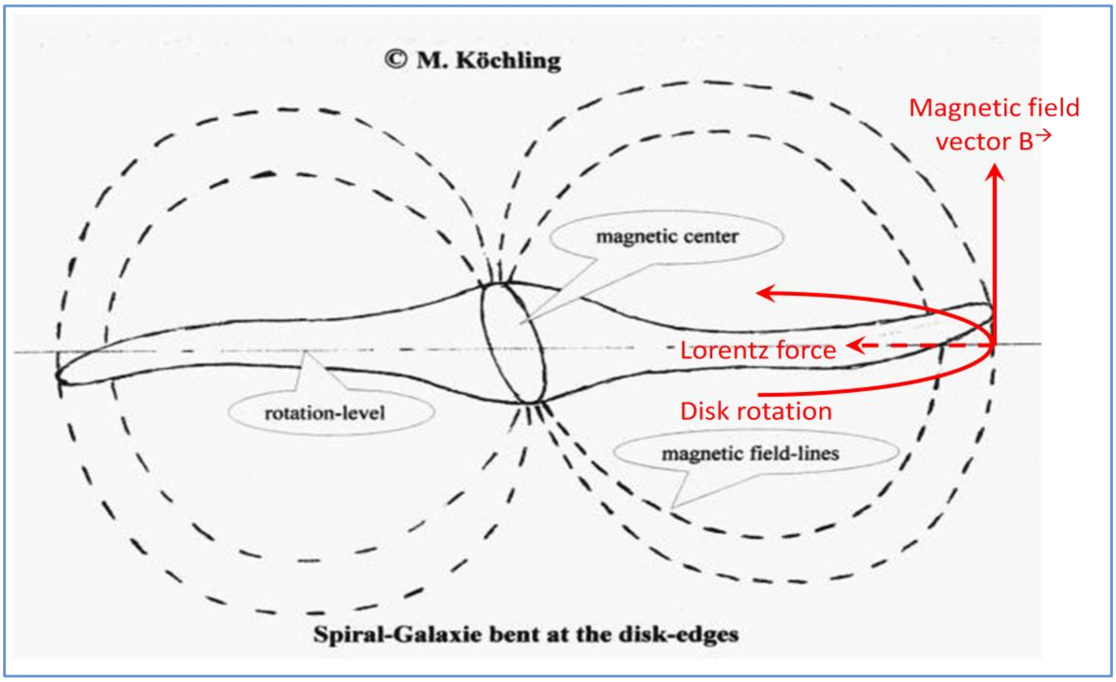

Fig. 1: Radial Cross Section through a Rotating Galaxy, source here (additions in red by the author)

As a result of this, stars are tracked towards the galactic center, producing a higher centripetal force than by gravity alone. The corresponding higher centrifugal force, required to create a stationary star orbit, is then brought about by increased orbital velocities of stars. As it seems to me, the historical formation process of galaxies lead to a dynamic equilibrium between gravity, the charged empty universe, the charged stars, and the galactic magnetic fields.

Before starting some calculations, we should consider that there are two possibilities to bring about an electric net charge of universe matter:

a) There is an excess of protons in the whole universe (positive net charge).
b) There is an excess of electrons in the whole universe (negative net charge).

The following calculations are based on the assumption that the whole universe is charged positive (case a)). Case b) would, however, yield similar results.

3. A Calculation on the Expansion of the Universe without Dark Energy

Based upon the idea of an electrostatically-driven expansion of the universe, we can calculate an estimate for the present average charge asymmetry in empty regions (outside galaxies): To calculate the expansion acceleration a_{exp_avgp} for one average proton (and thus the acceleration of the expansion of the universe), the gravitational attraction force (F_{grav_p}) and the electrostatic expansion force (F_{elstat_np}) of the net-charged matter are to be superimposed. Firstly, for one naked (not neutralized) proton, the expansion force (F_{exp_np}) is given with:

$$F_{exp\_np} = F_{elstat\_np} + F_{grav\_p}$$

$$F_{elstat\_np} = \frac{X_{np\_U} * N_p * {e_L}^2}{4\pi * \varepsilon_0 * R_U^2}$$

(X_{np_U} ≡ fraction of excess protons in empty regions of the universe, N_p ≡ number of protons in the universe, e_L ≡ elementary charge, ε_0 ≡ absolute permittivity, R_U ≡ radius of the universe)

Since the probability for a proton to be not neutralized equals X_{np_U}, the electrostatic force experienced by an average proton is:

$$F_{elstat\_avgp} = F_{elstat\_np} * X_{np\_U} = \frac{X_{X_{np\_U}}^2 * N_p * {e_L}^2}{4\pi * \varepsilon_0 * R_U^2}$$

The gravitational attraction (note the negative algebraic sign) for each proton is:

$$F_{grav\_p} = -\frac{N_p * m_p^2 * G}{R_U^2}$$

(m_p ≡ proton mass, G ≡ gravitational constant).

By superposition of both forces, the total expansion force for an average proton amounts to:

$$F_{exp\_avgp} = F_{elstat\_avgp} + F_{grav\_p}$$

Because of $F_{exp\_avgp} = m_p * a_{\mathrm{exp\_avgp}} = m_p * \frac{d^2 R_U}{dt^2}$, (with a_{exp_avgp} being the average acceleration of expansion of the universe), one obtains:

$$\frac{d^2 R_U}{dt^2} = \frac{X_{np\_U}^2 * N_p * {e_L}^2}{4\pi * m_p * R_U^2 * \varepsilon_0} - \frac{N_p * m_p * G}{R_U^2}$$, and with $N_P = \frac{R_U * c^2}{G * m_P}$ (valid for the present universe):

$$\frac{d^2 R_U}{dt^2} = \frac{X_{np\_U}^2 * {e_L}^2 * c^2}{4\pi * R_U * m_p^2 * \varepsilon_0 * G} - \frac{c^2}{R_U}$$

Furthermore, H ≡ current Hubble constant (<u>H ≅ 2,3*10^-18 s^-1</u>):

$\frac{d^2 R_U}{dt^2} = H^2 * R_U$ (due to $\frac{dR_U}{dt} = H * R_U$)

After solving for X_{np_U}, one obtains an estimate of its current value:

$$\mathrm{X_{np\_U}} = \sqrt{[1 + (\frac{H * R_U}{c})^2] * \frac{4\pi * \varepsilon_0 * m_p^2 * G}{{e_L}^2}} \cong 1.3 * 10^{-18}$$

4. A Calculation on the Anomalous Orbital Speed of Stars in Galaxies without Dark Matter

In order to have a basis for the following considerations and calculations, some data is needed on the radial distribution of mass and the orbital speed of stars in a galaxy. Therefore, I am going to calculate using data of our galaxy – the Milky Way.
Searching for so-called rotation curves of the Milky Way, we can find a number of quite different diagrams. See [1…4]. For use in the following calculation I choose reference [4].

To calculate the orbital speed (v(r)) of objects circling around a very large mass center (with mass M) at a distance of r, the following equation applies:

$$v(r) = \sqrt{\frac{G * M}{r}}$$

In the case of the rotation of stars around the galactic center, each star is attracted by a different galactic mass fraction inside its respective orbit. Thus, M depends on r. I call that mass fraction the effective mass $m_E(r)$. So the orbital velocity of stars is given by:

$$v(r) = \sqrt{\frac{G * m_E(r)}{r}}$$

The value of $m_E(r)$ is given by the sum of the central galactic bulge mass (m_B) and the mass fraction of the galactic disk inside the radius r. Since the calculations here are to be restricted to the disc regions of the galaxy, the whole bulge mass m_B is taken into account in each case.
The bulge mass can be taken from [4] and has a value of approximately $2*10^{40}$ kg.
Furthermore, from [4] we can derive the following equation describing the radial mass density distribution in the galactic disk (with ρ as mass per disk area):

$\rho(r) = \rho_0 * e^{-k*r}$, where $k \triangleq 9*10^{-21}\ m^{-1}$ and $\rho_0 \triangleq 2\ kg/m^2$

From that equation, the radial effective mass distribution $m_E(r)$ can be determined by the following integration:

$$m_E(r) = m_B + 2\pi \int_0^r \rho(r) * rdr = m_B + 2\pi\rho_0 \int_0^r e^{-kr} * rdr$$

After solving this equation, one obtains:

$m_E(r) = m_B + 2\pi\rho_0[\frac{1}{k^2} - \frac{(kr+1)}{k^2} * e^{-kr}]$ (see Fig. 2 – the green line)

From that mass distribution, the expected rotation curve $(v(r)_{calc\_establ})$ according to Newton's law is obtained as follows (see Fig. 2 – the blue line):

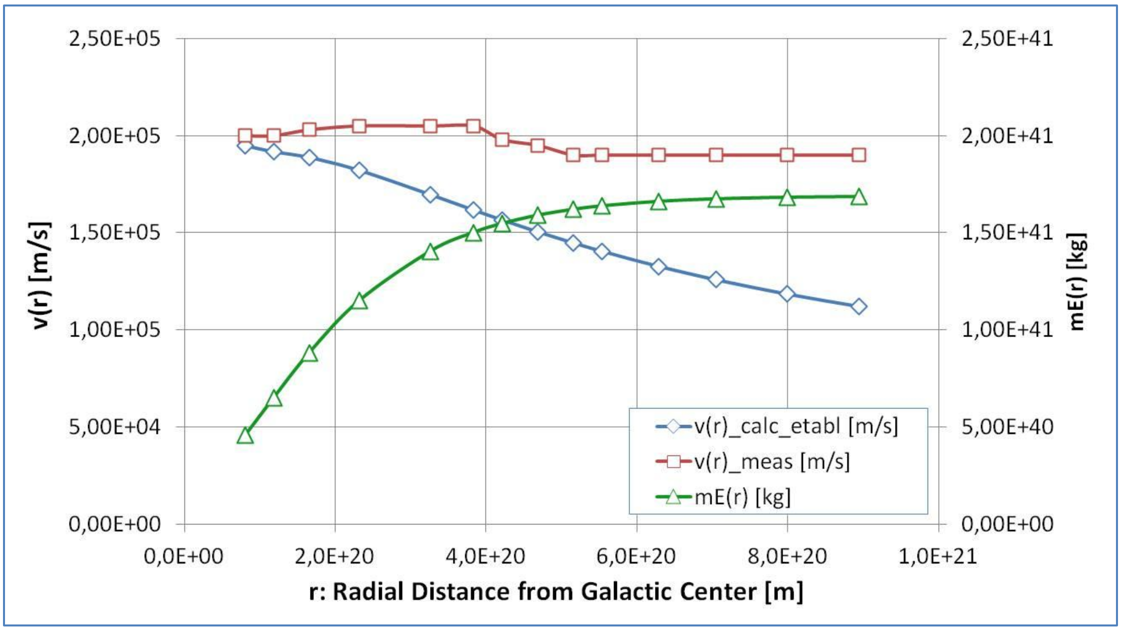

Fig. 2: Radial Distribution of Masses and Stars' Orbital Velocities (Calculated and Measured)

In contrast to these theoretical calculations, the observed radial speed distribution ($v(r)_{\_meas}$ - the brown line in Fig. 2) is nearly flat towards the edge of the galaxy. That means there is an additional centripetal force besides the well-known gravitational attraction. As explained above, this additional force is considered here to be a Lorentz force created by the galactic magnetic field and the net charged stars moving through that field. Thus the assumption of DM should no longer be necessary.

As mentioned above, different references vary with respect to the ratio of observed centrifugal forces of circling stars to the gravitational centripetal forces. One can find values of around three and in some cases even greater than 100. The reasons for this are not very clear. From [4], the ratio between centrifugal and gravitational centripetal forces at the edge of the galaxy can be found to be approximately 3. The following calculations will be done based upon that value. I am now going to calculate an estimate of the net charge in stars ($X_{np\_S}(r)$) needed for a Lorentz force that is strong enough to play the role of the missing centripetal force component.

$$F_{cf} = \; F_{Lor} \; + F_{grav}$$

(F_{cf} ≡ centrifugal force, F_{grav} ≡ gravitational force, F_{Lor} ≡ Lorentz force)

$$F_{cf} = \frac{m_P * N_{p\_S} \; * v(r)^2}{r}$$

$$F_{Lor} = \; X_{np\_S}(r) * N_{p\_S} \; * e_L * v_{rel}^{\rightarrow}(r) \; x \; B^{\rightarrow}$$

$$F_{grav} = \; \frac{m_P * N_{p\_S} \; * m_E(r) * G}{r^2}$$

($X_{np\_S}(r)$ ≡ fraction of excess protons in star, N_{p_S} ≡ number of protons in star, $v_{rel}^{\rightarrow}(r)$ ≡ vector of orbital velocity relative to magnetic field lines, $B^{\rightarrow}$ ≡ magnetic field vector) Assuming the vectors $v_{rel}^{\rightarrow}(r)$ and $B^{\rightarrow}$ to be orthogonal to each other (see Fig. 1), the vector product of both can be written as the scalar product $v_{rel}(r) * B$, so one obtains from the four force equations above:

$$X_{nP\_S}(\mathrm{r}) = [v(r)^2 - \frac{m_E(r) * G}{r}] * \frac{m_p}{r * e_L * v_{rel}(r) * B}$$

In spite of the uncertainty of F_{cf}/F_{grav} , the magnitude of $X_{nP\_S}(\mathrm{r})$ is about 10^{-15} for all values of F_{cf}/F_{grav} published in the references mentioned above.

Fig. 3 shows (together with F_{cf} and F_{grav}) the required additional centripetal force ($F_{Lor\_required}$) versus r and the net charge in stars ($X_{np\_s}(r)$) necessary to produce it.

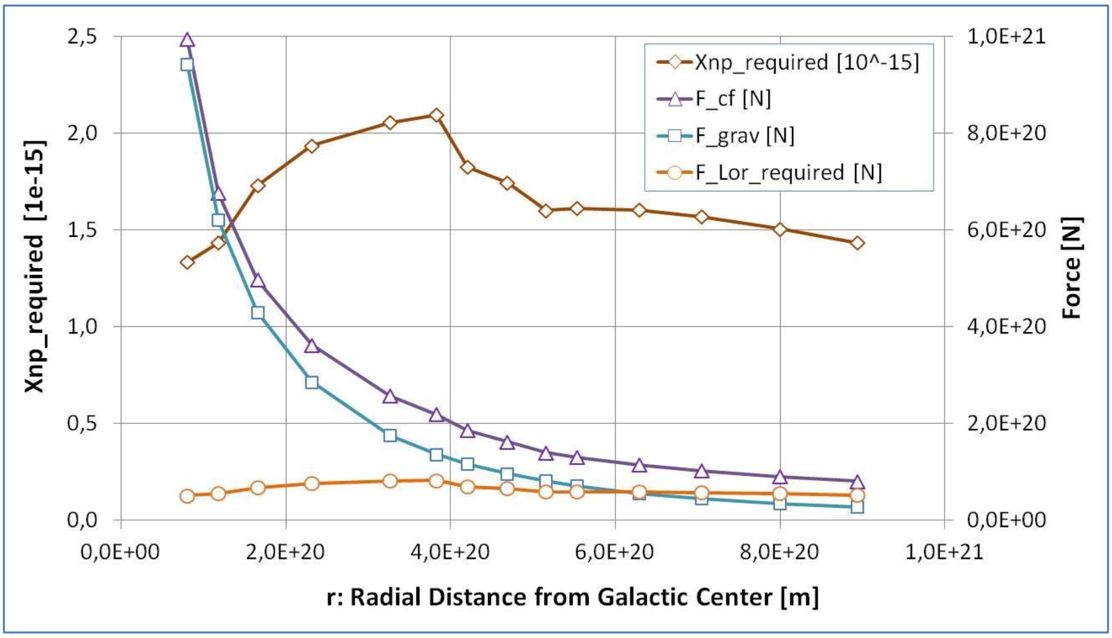

Fig. 3: Radial Curves of Forces Affecting Stars in the Milky Way and X_{np_S} Needed for $F_{\_Lor}$ According to the NCU Concept

The assumptions for this calculation were:

B ≅ 10^{-9} kg/As^2 [5] and $v_{rel}(r) \cong v_{meas}(r)$.

The second assumption might not be fully valid, but since $X_{nP\_S}(\mathrm{r}) \sim 1/v_{rel}(r)$, the influence of $v_{rel}(r)$ on the magnitude of $X_{nP\_S}(\mathrm{r})$ is not very great. Therefore, for an estimate with respect to the orders of magnitude which are calculated here, both assumptions are presumed to be suitable.

5. Conclusion

An alternative cosmological concept of space and matter (Net Charged Universe – NCU) has been presented here. The concept aims to give an alternative explanation of the phenomena that have forced scientists to assume DE and DM. This means that the DM and DE concepts should be avoided.

The basic idea of the NCU is the existence of electrical charge asymmetry in the entire universe bringing about the effects that are currently attributed to DE and DM respectively. Some calculations have been performed to test the plausibility of the NCU. The calculations were used to estimate the rates of electrical charge asymmetry required by the NCU concept in galactic systems ($X_{np\_s}(r)$) as well as extragalactic regions (X_{np_U}). These calculations have revealed that the required net charge rates ($X_{np\_s}(r)$ and X_{np_U}) are both of a very small magnitude. This means that the current physical observations do not appear to be able to prove or to disprove the NCU theory explained here. This situation means that the NCU concept can be regarded as possible and plausible – until it can be verified by observations that could possibly rule it out. This is very similar to the situation regarding the concepts of DM and DE.

However, since DM and DE are complicated concepts and seemingly a bit “spooky”, I think the NCU concept presented here should be preferred for epistemological reasons or, if I may, for reasons of theoretical elegance.

6. An Appeal

Finally, let me appeal to professional scientists in the fields of sophisticated cosmological and physical calculations. I am calling on all physicists and mathematicians who feel they have the skills to calculate the consequences of the NCU concept in a more detailed manner – in order to rule it out or to find further (possibly interesting) consequences of the NCU.

Since I am not able to do it by myself, I hope that some scientists will perform this work – for the sake of soundly founded science. Good luck!

References:

[1] https://en.wikipedia.org/wiki/Milky_Way

[2] http://www.astronomynotes.com/ismnotes/s7.htm

[3] https://www.dpg-physik.de/veroeffentlichung/physik_konkret/pix/Physik_Konkret_16.pdf

[4] http://www.ioa.s.u-tokyo.ac.jp/~sofue/htdocs/2013psss/sofue2013psss.pdf

[5] http://www.ethlife.ethz.ch/archive_articles/080718_Magneticfields_lilly/index_EN