Observational Search for Negative Matter in Intergalactic Voids

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Dr. Robert L. Forward

Forward Unlimited
8114 Pebble Court, Clinton, WA 98236
Phone/Fax: 360-579-1340
Email: FUn@whidbey.com

ABSTRACT:

Negative matter is a hypothetical form of matter with negative rest mass, inertial mass and gravitational mass. It is not antimatter. If negative matter could be collected in macroscopic amounts, its negative inertial property could be used to make an continuously operating propulsion system which requires neither energy nor reaction mass, yet still violates no laws of physics. Negative matter has never been observed, but its existence is not forbidden by the laws of physics. We propose that NASA support an extension to an ongoing astrophysical observational effort by da Costa, et al. (1996) which could possibly determine whether or not negative matter exists in the well-documented but little-understood intergalactic voids.

NEGATIVE MATTER:

Negative matter is a hypothetical form of matter with negative rest mass, inertial mass and gravitational mass. It is not antimatter, which has positive rest mass and inertial mass. Negative matter has never been observed, but, as I discussed in great detail in a previous paper (Forward 1990), its existence is not forbidden by any of the known laws of physics. Negative matter gravitationally repels both positive and negative matter. Thus, clouds of uncharged negative matter will not gravitationally clump to form stars and galaxies, but will disperse into empty space. Because of the negative inertial mass of negative matter, negative matter particles of opposite charge repel each other. Thus, a negative matter "electron" will not be pulled into a circular orbit around a negative matter "proton", but will be repelled into a hyperbolic orbit. As a result, clouds of negative matter ions will not even form into standard atoms. In contrast, negative matter particles with the same charge are attracted to each other. Depending upon the types of quantum mechanical restrictions that apply, this could lead to the formation of highly charged "bags" of quarks with exotic properties (Forward·1992).

If negative matter could be collected in macroscopic amounts, its negative inertial property could be used to make an continuously operating propulsion system that requires neither energy nor reaction mass (Forward 1990) and which violates no laws of physics including the Einstein General Theory of Relativity (Bondi 1957).

EVIDENCE FOR EXISTENCE OF NEGATIVE MATTER:

If negative matter is not forbidden by the laws of physics, then where is it? There exist clues that may point to one place where negative matter can be found--in the intergalactic voids. The clues were already strong in 1990 (see Forward 1990, especially pages 35 and 36), while a recent paper by da Costa, et al. (1996) makes the clues even stronger. Detailed discussions of the intergalactic voids can be found in de Lapparent, et al. (1986) showing the "foam-like" structure found in large-scale three-dimensional "maps" of the universe. The "bubbles" or "voids" in this "foam" are 100 million lightyears across (our Milky Way galaxy is a mere 0.06 million lightyears across). The voids are sharply defined by a large number of galaxies (Trimble 1987) that seem to lie on the surface of the bubbles. There are almost no galaxies in the voids, and those galaxies found there are very unusual, characterized by strong, high-excitation emission spectra.

In a previous paper (Forward 1990) I proposed an explanation for this "frothy" structure of the universe. The proposal was that the universe was initially formed out of nothing, with equal amounts of negative matter and positive matter. (This has the nice feature that the net mass of the universe is zero.) The regions of the early universe that started out with a slight excess of negative matter are now the regions containing the voids. The voids are full of negative matter particles trying to keep as far away from each other as possible, meanwhile pushing the positive matter particles to the surface of the voids where they gravitationally attract each other to form galaxies and stars. One way to test this hypothesis is to measure the effects of the gravity force generated by these voids on the visible matter nearby to see if the gravity force is positive, zero, or negative.

"WEIGHING" THE NEARBY UNIVERSE:

A matter density map of the nearby universe (see Figure 1) has recently been published by da Costa et al. (1996). The density map was generated from a three-dimensional map of the "peculiar" velocity of some 1300 individual field galaxies and 500 galaxies in clusters. The distances and peculiar velocities of each galaxy were obtained from a combination of radial Doppler redshift measurements and distance estimates (presumably based on brightness estimated from the galaxy type), adjusted to give a self-consistent velocity flow pattern.

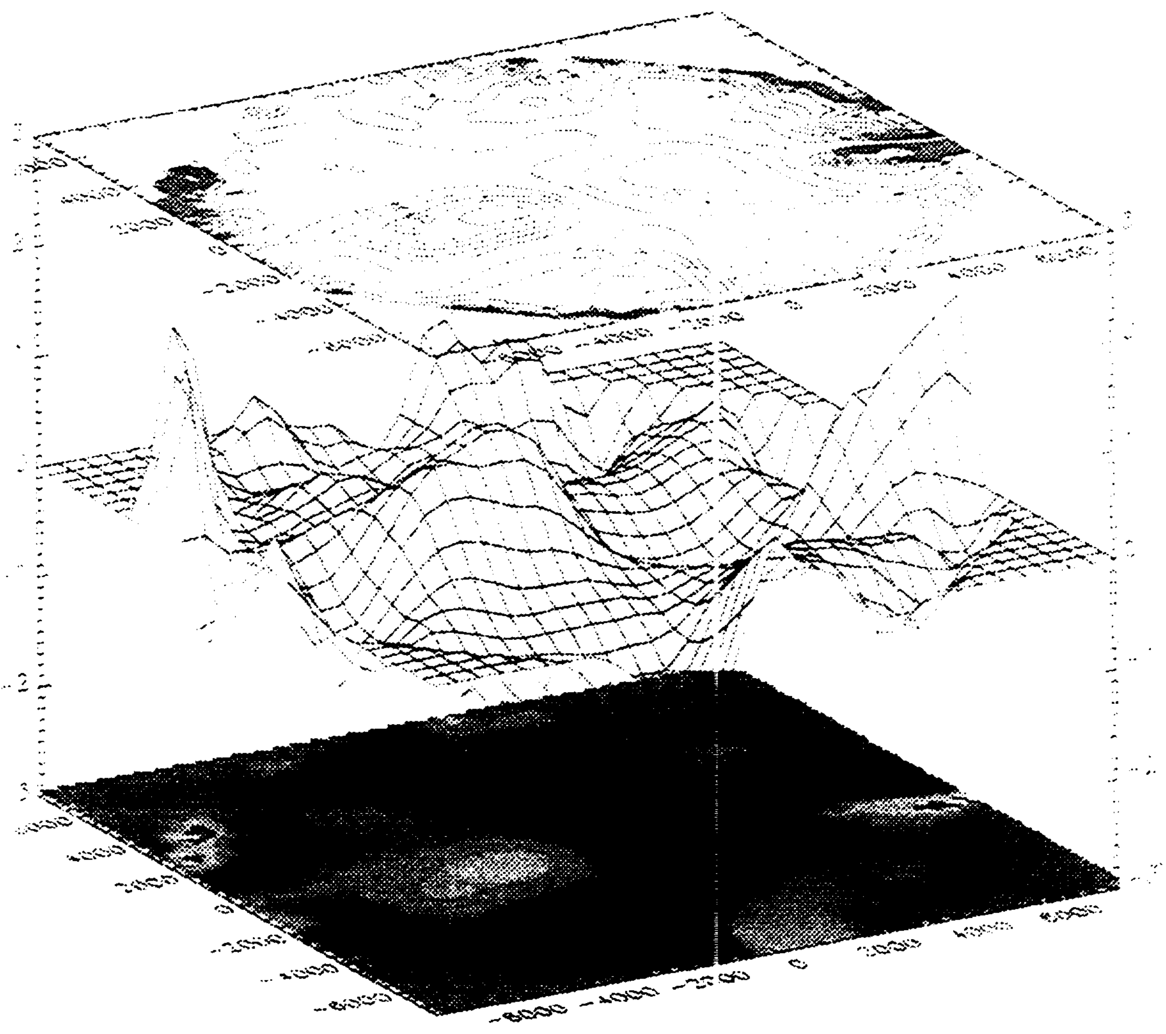

Fig. 1 - Matter density in the supergalactic plane with density contour intervals of $\delta=0.2$. Surface density map with height proportional to δ showing compact positive overdensity regions and spheroidal negative underdensity regions.

The matter density map includes the density contributions of both the visible matter (the galaxies) and any unseen dark matter. The gravity forces due to the candidate matter density distribution are calculated. The gravity forces are then used to generate estimates for the velocities of the visible matter galaxies subjected to those gravity forces. The matter density map is then readjusted until a self-consistent solution is achieved. The resultant matter density map shows some interesting features: (a) The matter density map is characterized by positive matter overdensities which are compact and negative matter underdensities which are large in volume, have a roughly spherical shape, and have a high negative underdensity contrast. (b) The spheroidal voids have non-trivial negative density contrasts reaching $\delta = -0.6$, which are comparable in magnitude to the more compact positive density contrasts which reach $\delta = +1.2$. (c) Comparison with redshift maps suggests that the visible galaxies delineate real (very low matter density) voids in the matter distribution, rather than merely less luminous regions with normal matter density. These voids are separated by moderately low-density structures which correspond to the filamentary and wall-like structures observed in the galaxy distribution (da Costa, et al. 1996).

Although the matter density variations of the voids have been assigned negative values in Fig. 1, that does not mean the voids contain negative matter. The velocity field predictions would be the same if the matter density map had a constant value of matter density added to each point. This background matter density would only be observable in the velocity flow pattern of a much larger sample of the universe.

PROPOSED OBSERVATIONAL SEARCH FOR NEGATIVE MATTER:

It is proposed that NASA support an extension of the present program of da Costa, et al. (1996) to produce a larger, coarser, matter density map which includes near its center the region covered by Figure 1. This coarse matter density map should give an value for the total mass of a region containing one or more voids. Once this "background" matter density of the region is known, then using the more detailed distribution of Fig. 1, it should be possible to estimate the "absolute" matter density in the voids by subtracting the $\delta = -0.6$ value of the voids from the coarse estimate of the positive background matter density. It is fully expected that the value finally obtained will be positive, although close to zero. If, however, a void is determined to have a significant negative matter density, then either there is negative matter in the voids, or there is a large underlying positive uniform matter density to the universe that is unobservable using peculiar velocity flow field maps. Either result is scientifically significant.

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