On the General Galactic Flow Toward a Location "At the Edge" of the Visible Universe

by

Roger Ellman

Abstract

In March 2008 anomalous behavior in spacecraft flybys of Earth was reported in Physical Review Letters in an article titled *Anomalous Orbital-Energy Changes Observed during Spacecraft Flybys of Earth* [1].

That report was subsequently analyzed and explained in the paper *Analysis of The Anomalous Orbital-Energy Changes Observed in Spacecraft Flybys of Earth* [4], which showed that the Flybys Anomaly shared a common cause with the Pioneer Anomaly and with the behavior of galactic rotation curves both of which demonstrate an unaccounted-for centrally directed acceleration.

In September 2008 a previously unknown large scale flow of galaxy clusters all directed toward "the edge" of the observable universe ["dark flow"] was reported in Astrophysical Journal Letters in a paper titled *A Measurement of Large-Scale Peculiar Velocities of Clusters of Galaxies: Results and Cosmological Implications.* [2,3]

The present paper shows that the "dark flow" shares the same common cause as the Flyby Anomaly et. al. Therefore a universal cause is needed for the otherwise unaccounted-for small but uniform centrally directed accelerations occurring everywhere:

- from the Earth-dominated orbital mechanics of Earth flybys,
- through the solar-dominated mechanics of the Pioneer anomaly,
- further through the behavior of every rotating galaxy and galaxy cluster in the universe,
- to the mechanics of the overall cosmic scale "dark flow" toward the observable edge of the universe.

That universal cause is the Universal Exponential Decay as presented in *Analysis of The Anomalous Orbital-Energy Changes Observed in Spacecraft Flybys of Earth* [4] and further in references [5, 6].

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The universe began with the "Big Bang", an immense explosion radially outward in all directions, largely spherically symmetrically, from an original source "singularity".

We, residing on planet Earth, of star Sol, in one of several branches of spiral galaxy Milky Way, are located off some significant distance in "our general direction" from and relative to the location of the original singularity.

We can "see" or detect a large number of neighbor galaxies, distant and near, whose components similarly proceeded outward from that "Big Bang" in directions slightly or significantly other than our particular direction.

But, there is a further mass of stellar bodies that proceeded outward from the "Big Bang" in directions away from us. What we can detect is only well less than half the total product of the "Big Bang".

Of those that traveled relatively away from us, those that traveled outward relatively slowly may nevertheless be detectable by us because their light traverses distance more rapidly than their distance from us increases. But those that traveled away from us at higher speeds remain undetected and probably undetectable.

Now, the original location of the singularity, the origin, lies essentially at the center of the largely spherical volume of the source's product, the expanding universe. And the universe that we "see" lies largely to one side of that origin's location, but includes that origin's location and a small part of the universe on the other side of it. [See Figure 1, further below.]

In the paper, at http://www.arXiv.org, arXiv:physics/9809029 [pdf], *Analysis of The Anomalous Orbital-Energy Changes Observed in Spacecraft Flybys of Earth* [4] it is shown that the common cause of several relatively recently discovered, but unexplained, effects:

- Galactic Rotation Curves indication of unknown gravitation-like attraction,

- The Pioneer Anomaly,

- The Flyby Anomaly,

is a small centrally directed acceleration that is not accounted for and is of magnitude equal to about $(8.74 \pm 0.94) \times 10^{-8}$ $cm/s2$.

In the paper cited above the following is presented.

> "What could produce such a phenomenon ? What would cause there to be a universe-wide occurrence of small centrally directed same accelerations ? A systematic contraction, a gradual reduction in the length component of every physical quantity in the universe would produce such a phenomenon as follows.
>
> [1] The anomalous acceleration is a gravitation - related phenomenon caused by the general overall exponential decay of the universe with a time constant of $3.57532 \cdot 10^{17}$ sec, about $11.3373 \cdot 10^{9}$ $years$, a natural behavior just as that same form of exponential decay appears throughout the various natural processes of physics.

[2] That decay involves the fundamental constants (c, q, G, h, etc.) and decay of any of those must be dimensionally consistent with the decay of the others. The dimension that is decaying is length, the $[L]$ dimension in the dimensions of, e.g.: h, $[M \cdot L^2/T]$; c, $[L/T]$; and G, $[L^3/M \cdot T^2]$."

To the above list of three effects caused by the systematic contraction of the universe, the Universal Exponential Decay, can now be added the newly discovered "dark flow" as reported below in an article from *Science News, Magazine of the Society for Science & The Public* [3]. and in *A Measurement of Large-Scale Peculiar Velocities of Clusters of Galaxies: Results and Cosmological Implications* [2].

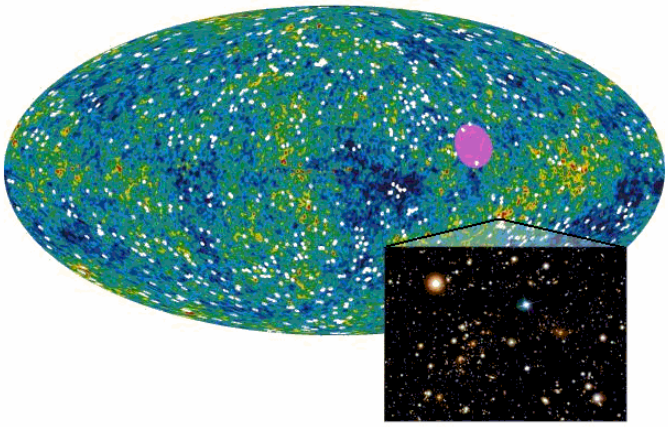
That is, the contraction caused by the Universal Exponential Decay naturally accelerates all the matter of the universe gradually back toward the location of its origin even while that matter also is affected by its role in the expansion of the universe because of that matter's original outward velocity and its gradual slowing due to gravitation.

[See, at http://www.arXiv.org, arXiv:physics/0004053 [pdf] Title: *Analysis of the "Big Bang" and the Resulting Outward Cosmic Expansion: Hubble - Einstein Cosmology vs. The Universal Exponential Decay* [7].

A "map" of the universe that we "see" would look somewhat as Figure 1,below, where the shaded-in circular region toward the right in the map [purple if in color] corresponds to the location and region of the original source singularity, toward which the contraction caused by the Universal Exponential Decay is directed.

From *Science News, Magazine of the Society for Science & The Public:* [3]

Scientists detect a mysterious flow of galactic clusters



Galaxy clusters across the sky (white spots, shown here on an all-sky survey of the cosmic microwave background) appear to move, on average, in one direction toward the southern sky (purple patch).

Figure 1

A Map of That Part of the Universe Observable to Us

A newly discovered "dark flow" appears to carry clusters of galaxies toward a point in the southern sky, a new study suggests.

As if dark matter and dark energy weren't confusing enough, researchers detected what they have dubbed dark flow while surveying 700 galaxy clusters — each containing hundreds to thousands of galaxies — within a radius of approximately 1 billion light-years. On average, the clusters appeared to move in a uniform direction at about 1,000 kilometers per second.

While no one knows the cause of the motion, the scientists suggest that whatever it is may no longer lie within the visible universe. The work appears online in two separate papers, one to appear in the Oct. 20 *Astrophysical Journal Letters* and the other in an upcoming *Astrophysical Journal*.

"We expected to find something completely different," says Alexander Kashlinsky, an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Md. "It's basically a slope across the universe," in a direction somewhere between the constellations of Centaurus and Vela.

The result flies in the face of one of cosmologists' most cherished assumptions — backed by a vast wealth of data — that the universe is uniform. That is, its structure and the density of matter in it are about the same in all regions of the sky.

But the findings further complicate the picture of cosmology, comments cosmologist Glenn Starkman of Case Western Reserve University in Cleveland. The new results add to anomalies discovered in recent years in the cosmic microwave background, or CMB, the ubiquitous bath of cold radiation left over from the Big Bang. "It's yet another piece of evidence that, on the largest scales, either we're misunderstanding something or discovering something about the universe," Starkman says.

Harald Ebeling, an astronomer at the University of Hawaii's Institute for Astronomy in Honolulu and a coauthor of the studies, says he and his team checked and rechecked their results for more than a year before publishing them. "We didn't believe it for the longest time," he says.

The researchers' work built upon a survey of the entire sky in the X-ray spectrum taken by the orbiting telescope ROSAT in the early 1990s. Galaxy clusters are usually suffused in a thin but very hot plasma, which emits X-rays. Back then, Ebeling and others used the ROSAT data to identify hundreds of large galaxy clusters by their X-ray halos, and matched that with optical-telescope data to estimate the clusters' distance from Earth.

In the new study, the researchers estimated the motion of each cluster with respect to the CMB radiation, which is believed to be "the ultimate reference" of movement on a cosmological scale, says Ebeling.

As CMB radiation crosses a galaxy cluster, it gets scattered by electrons in the intergalactic plasma, Ebeling says. The scattering affects the radiation's frequency. The frequency goes up if the cluster is moving toward Earth, and down if it's moving away. This is called the kinetic Sunyaev-Zeldovich effect, analogous to the familiar Doppler shift of sound waves. The Doppler shift explains why the pitch of an ambulance's siren sounds different depending on whether the ambulance is approaching or moving away from the listener.

The researchers looked for the kinetic Sunyaev-Zeldovich effect in CMB data released two years ago by NASA's Wilkinson Microwave Anisotropy Probe mission. The effect was extremely small — comparable to a temperature change of millionths of a kelvin, Ebeling says.

For a single cluster, a variation this small easily drowns in the much larger experimental errors. Moreover, each cluster tends to move in its own direction, tugged by clusters nearby. But on average, the velocities showed a clear trend. "The velocity is not only high," Kashlinsky says, "but it also remains the same velocity as far as you can see."

"People will be inherently skeptical of any such results," Starkman says, since they call into question the standard, homogeneous model of the universe. "Even those who have doubts about the model don't have better alternatives." But, he adds, researchers should still take the results seriously.

Kashlinsky says that random energy fluctuations in the earliest split second of the Big Bang — the epoch of stupendous expansion called inflation — could have created a large imbalance in the distribution of matter. While the denser regions of the universe would now be forever out of sight, the imbalance could have left its mark on the overall structure of spacetime. Like a dining room table tipped so that all the dinner plates slide off in the same direction, the imbalance may have put the local corner of the universe on a slope.

Such a large-scale imbalance is "absolutely possible," says cosmologist Andrei Linde of Stanford University. But it would require some rather contrived tweaks to the still-tentative models of how inflation works. "Inflation typically makes the universe completely uniform," Linde says. "People do not want to go in this direction without a really seriously demonstrated need."

The results are something that people will "scratch their heads over," says Ethan Vishniac of McMaster University in Hamilton in Canada. As the editor in chief of *The Astrophysical Journal*, Vishniac personally reviewed one of the papers. While the team's methods were correct, he says, there are still large margins of error in the data, and only more research will help settle the matter of the lopsided universe.

References

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[5] R. Ellman, *A Comprehensive Resolution of the Pioneer 10 and 11 "Anomalous Acceleration" Problem Presented in the Comprehensive Report "Study of the Anomalous Acceleration of Pioneer 10 and 11" and the Relationship of that Issue to "Dark Matter", "Dark Energy", and the Cosmological Model*, Los Alamos National Laboratory Eprint Archive at http://arxiv.org, physics/9906031. [The value of the error

range of a_P, the Pioneer "anomalous acceleration", was adjusted by the researchers in a later paper, at http://arxiv.org, gr-qc/0409117 , from ± 0.94 to ± 1.33.]

[6] R. Ellman, *The Origin and Its Meaning*, The-Origin Foundation, Inc., http://www.The-Origin.org, 1997. [The book may be downloaded in .pdf files from http://www.The-Origin.org/download.htm]. The Universal Exponential Decay is fully treated in Section 21, *The Probable End.*

[7] R. Ellman, *Analysis of the "Big Bang" and the Resulting Outward Cosmic Expansion: Hubble - Einstein Cosmology vs. The Universal Exponential Decay,* Los Alamos National Laboratory Eprint Archive at http://arxiv.org, physics/0004053.