DARK MATTER AND SUBTLE ENERGY PHYSICS

RESEARCH BY PROFESSOR HAGELIN'S PHYSICS TEAM

Emerald Gate Charitable Trust is supporting John Hagelin and his team of physicists in a groundbreaking new approach to galactic dark matter. The team has discovered new insights into the nature of dark matter, *including* its potential significance to human life.

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Not pictured: Ashley Deans, Ralph Hearn, Robin Ticciati, and Fred Travis

For nearly a century, astrophysicists have noted that the speed at which stars rotate around a galaxy does not seem to obey the established gravitational laws of Newton and Einstein. If we look at our solar system, we find that Mercury, the planet closest to the Sun, is orbiting the Sun at over 100,000 mph. Whereas the Earth, which is farther from the Sun, is orbiting at around 67,000 mph; and Jupiter, which is even farther from the Sun, is orbiting at around 29,000 mph. We see that the farther from the Sun a planet is, the slower its speed—just as Newtonian gravity predicts. (This follows from the fact that, in Newtonian gravity, the strength of the Sun's gravitational pull drops off with the square of the distance from the Sun.)

However, when scientists look at stars orbiting the core of a galaxy, they find that the speed of stars does not drop off with distance from the center, in apparent contradiction to the laws of gravity (see Figure 1). This and other anomalous observations have led astrophysicists to propose that galaxies must have a halo of "missing mass" or "dark matter" that we cannot see (Figure 2). Moreover, this discrepancy is by no means small—this missing mass represents more than 85% of the total mass of our Universe.

But what is the nature of this dark matter? This is the urgent question occupying everyone in astrophysics today. Elena Aprile, the director of the Xenon dark matter collaboration in Italy, summarized the current state of dark matter research: "It's been a saga, and we are all very desperate!"

Initially considered a possibility for the missing dark matter was Massive Compact Halo Objects (MACHOS)—comprised of an unexpected abundance of black holes, brown dwarfs, Jupiter-sized planets, and other such objects that are too dim to observe with our telescopes. However, careful astronomical observations plus other theoretical considerations have ruled out MACHOS as the source of the missing matter. Hence, in 2000, the *New York Times* published a conference report entitled, "In the Dark Matter Wars, WIMPs Beat MACHOS!" And a cartoonist encapsulated the dilemma with the pithy caption, "MACHOS are dead. Desperately seeking WIMPs."

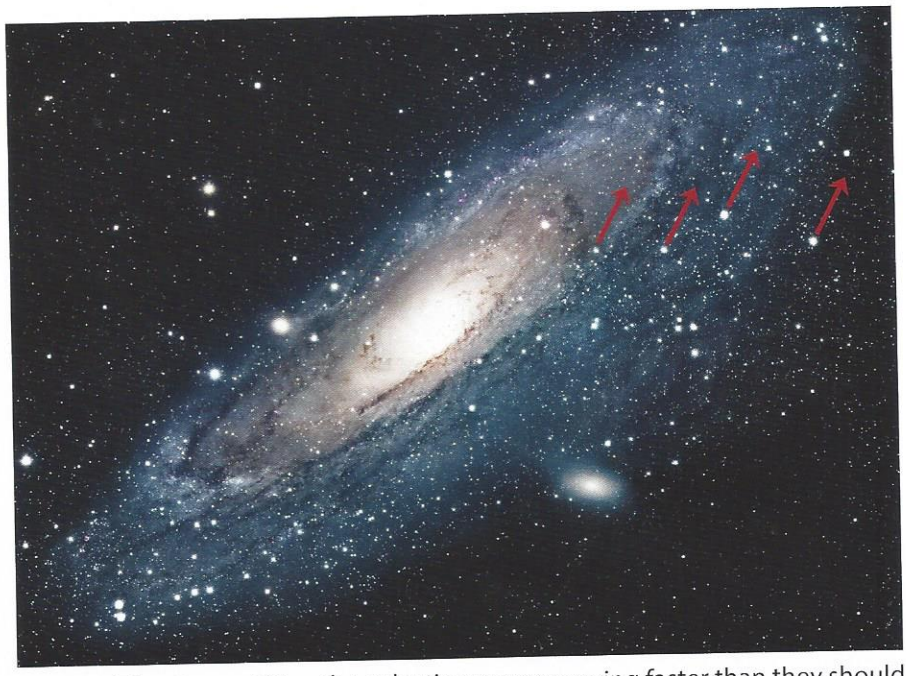

Figure 1. The stars orbiting the galactic core are moving faster than they should be, given the visible distribution of matter. *Credit: 2002 R. Gendler, Photo by R. Gendler, arrows added.*

Figure 2. Galaxy with dark matter halo (shown using computer simulation) causes enhanced gravitational pull and accounts for increased speed of orbits. *Credit: 2002 R. Gendler, Photo by R. Gendler, arrows added.*

So, what are WIMPs? This dark matter candidate consists of Weakly Interacting Massive Particles (WIMPs), which gained great prominence when Hagelin and team showed in their landmark 1984 paper, "*Super-*

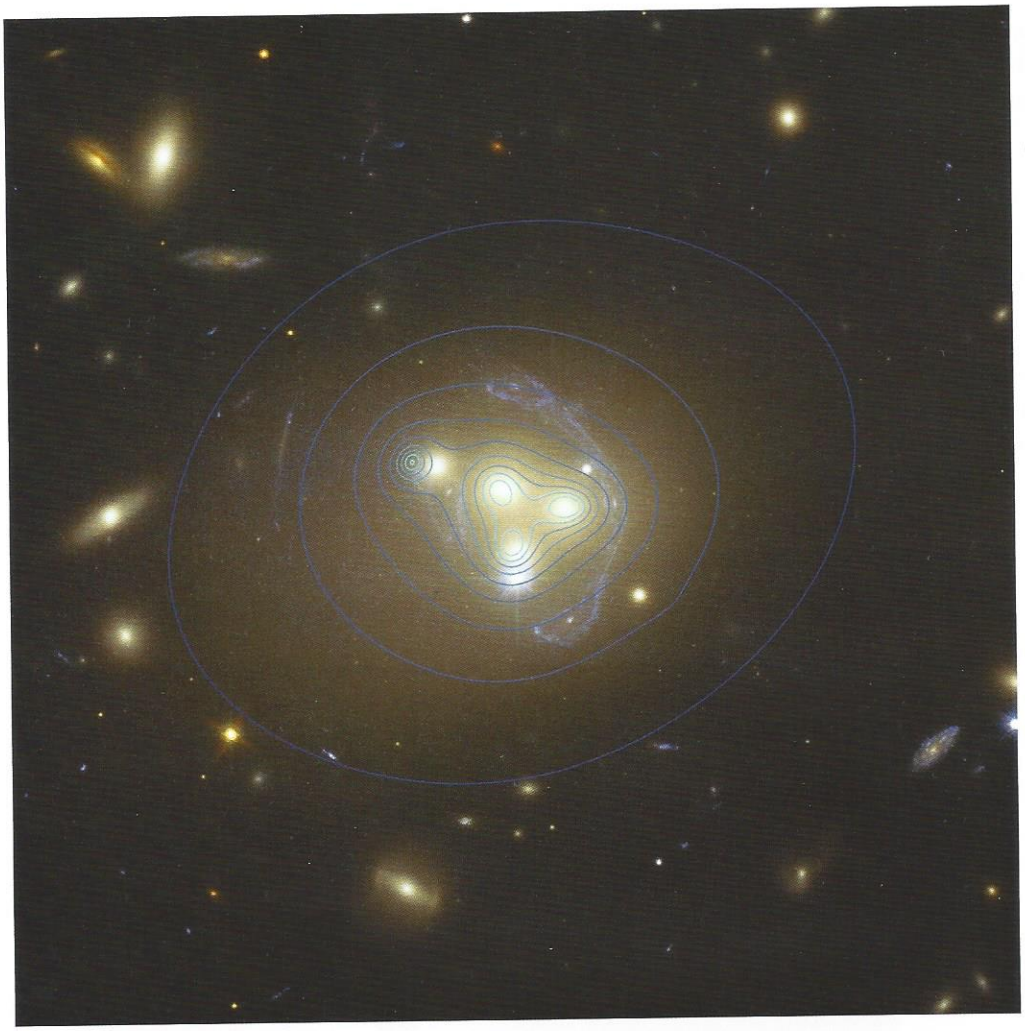

Figure 3. This image from Hubble shows the galaxy cluster Abell 3827. The pale blue blotches and contour lines surrounding the four central galaxies are dark-matter concentrations (as determined by the gravitational lensing of a far-distant galaxy located behind the cluster). The pale blue dark-matter clump at the left is significantly displaced from the position of the galaxy just to the right of it, implying that dark matter can clump to itself. In other words, some unknown form of DM-DM interaction is occurring.
Credit: ESO/R. Massey

symmetric Relics from the Big Bang," that WIMPs arise inevitably in supersymmetric theories—the most popular extension of the standard Electroweak theory of particle physics. WIMP particles interact with each other, both gravitationally (a long-range force) and via the weak force (a very short-range force). But because dark-matter particles are so dilute (spread out), and because the weak force is: a) weak, and especially b) so short-range, the weak force is totally inconsequential for such widely dispersed dark matter particles. Effectually, therefore, WIMPs interact with each other—and with us, for that matter—***only*** through their gravitational influence. And gravity is also a very weak force. It therefore takes huge, vast quantities of dark matter to collectively have any influence on us, or on the galaxy. Hence, as individual particles, WIMPs are invisible—to us, and to each other. A WIMP particle will fly straight through the Earth, making no contact at all.

Because WIMPs don't interact with each other, except *en masse* via gravity, they don't stick together and form dark matter clumps (like lumps in your Cream of Wheat). Instead, they forever whiz past one another in huge, diffuse clouds like our giant spherical galactic halo (Figure 2). Gravity alone prevents WIMPs from flying away altogether.

And yet... some recent, breakthrough observations of dark-matter distribution in large galaxy clusters (see Figure 3) have found that dark matter ***does*** appear to cluster on smaller scales (like lumps in Cream of Wheat) much more than would be expected through gravity alone—i.e., much more than can be explained on the basis of WIMPs alone. Evidently, at least some dark matter has a greater capacity for self-interaction (and self-clumping) than WIMPs would allow. A stronger force than the weak force *must* be involved—most likely electromagnetism. (Electromagnetism is at the basis of most of the physics, chemistry, and biology we are familiar with in ordinary life.) And, if dark matter interacts with *itself* electromagnetically, then it will also interact electromagnetically with ordinary charged matter—including the matter in the Earth, and in us humans.

As it happens, Professor Hagelin's ongoing work in unified field theories based on the superstring predicts the existence of a *Hidden Sector*, in which

Figure 4. Dark Matter clumping around planetary objects (computer simulation).
Credits: NASA Blue Marble image and heic1710d ESA/Hubble, Palomar Observatory/California Institute of Technology. Composited images and simulation of dark matter halo

reside as yet undiscovered particles beyond the normal *visible sector* particles that comprise the known Universe. "These Hidden Sector particles could be all around us," Professor Hagelin explains, "though difficult to see and as yet undetected—mainly because science has not known what to look for."

Coincidentally, new research by a former collaborator of Hagelin shows that the WIMPs we had come to know and love—the WIMPs that we believe existed abundantly in the early Universe—are actually *unstable*. And by now, 13 billion years into the life of the Universe, many will have decayed into the aforementioned Hidden Sector particles. And these Hidden Sector particles (at least many of them) will have a small *electric charge*. These "micro-charged" particles, which theoretically populate our Universe today, will interact with themselves electromagnetically, which would explain the anomalous dark matter clumping seen in the recent, aforementioned galactic dark matter experiments.

Because of these experiments, and the above theoretical considerations, we can conclude that Hidden Sector micro-charged dark matter (mcDM) particles exist, and that they provide a more plausible dark matter theory than the WIMPs alone. Depending on *how many* primordial WIMPs have already decayed into Hidden Sector mcDM particles by now, this might even explain why conventional WIMP dark matter experimental searches have so far come up empty — there may not be any WIMPs left!

These are some of the early consequences of the Emerald Gate research project which, if borne out, would be groundbreaking, to say the least. *And they may be just the tip of the iceberg!*

Potential Implications for Life on Earth

Professor Hagelin and team have shown that, over the last 4-1/2 billion years, these mcDM particles would be captured within, as well as clustered around, the Earth (see Figure 4). This not only has interesting geophysical repercussions, but it greatly increases the likelihood of their interacting with us—clinging to us electrostatically like Glad Wrap clings to your hand. Potentially, we would all have a micro-charged dark matter halo—an *aura*, if you will—which would extend beyond the boundaries of our physiol-

Figure 5. Hidden sector dark matter is super cold and, like a superfluid, is governed by the laws of quantum physics. *Credit: European Space Agency and Wolfram Freudling (Space Telescope-European Coordinating Facility/European Southern Observatory, Germany)*

ogy. These ethereal clouds could even behave as a sort of "subtle body," supporting our mind and mental functioning,[1] and providing a long-sought physical explanation for the mind/body interaction. Thus, dark matter, previously viewed as an unlikely actor in any type of Earth-related physics, chemistry, or biology, now (because of its electric charge) becomes a plausible participant in geophysical, physiological, and even mental processes.

Such Earth-bound Hidden Sector mcDM, coalescing around biological (and other charged) matter, may also be the raw material underlying the oft-cited "biofield," which is hypothesized by many to promote integrity and healthy functioning of biological organisms. Indeed, it is our working hypothesis that this biofield *is* the "subtle body," composed of the very stuff (mcDM) that holds our galaxy together.

In other words, based on our theoretical calculations plus recent observational evidence, mcDM particles are distributed thinly across our galaxy, but coalesce more densely around stars and planets like the Earth. Because mcDM particles carry such small electric charge—from 1 millionth to 1 billionth of the electron's charge—they are difficult or impossible to see with our earthly eyes. But highly sensitive experimental searches are underway, including an experiment we are about to launch here at MIU.

Moreover, while Hidden Sector mcDM particles only interact electro-

[1] The temperature of these Hidden Sector dark-matter shrouds can be shown to be on the order of 1 to 3 degrees above Absolute Zero (see Figure 5 above), which suggests that they are governed by the laws of quantum mechanics (as opposed to classical mechanics). Quantum systems, such as superfluids and superconductors, are *non-material* entities. They do not behave like classical matter. Shrödinger's famous quantum cat is neither alive nor dead: it is *both* fully alive *and* fully dead. A quantum system is, thus, not an actual physical system; it's a *conceptual* system—technically a vector in an infinite-dimensional Hilbert space. Quantum systems (such as those made of super-cold Hidden Sector dark matter) belong to the realm of mind.

magnetically very weakly with us (due to their small electric charge), they interact very readily among themselves. These Hidden Sector particles could, and most likely will, bind together to form more complex Hidden Sector systems, starting with Hidden Sector atoms and molecules, leading to more complex structures including (hypothetically) subtle bodies. This opens up rich, multifaceted possibilities for dark-matter interaction with ordinary biological matter—including living cells, tissues, organs, and the brain—which can be explored in properly designed experiments, guided by sound theory. Some very exciting, carefully chosen experiments will be incorporated in the next phase of our Emerald Gate partnership.

Very soon we will know a lot more about these mcDM particles and their behavior, as we complete a comprehensive investigation of all potentially useful constraints imposed by particle physics and astrophysical data and experiments (including the aforementioned galactic dark-matter clumping measured by gravitational lensing experiments; supernova observations; irregularities in the cosmic microwave background radiation; and more). We are still chasing these constraints down, as a vast literature on these topics has emerged in the last few years.

From our Consciousness-Based perspective, as the Universe emerges and evolves, basic archetypal structures of intelligence repeat themselves across vastly different scales and domains. The ancient Vedas and Upanishads say, *Yatha pinde, tatha Brahmande*, translated as: As is the atom, so is the Universe. As is the microcosm, so is the macrocosm.

This is why analogies, including those expressed in the form of mathematical formulae, can be applied across different domains of science, and on vastly different time and distance scales. The operative structuring dynamics, or laws of nature, that are seen expressed across these different scales are rooted in the very nature and structure of intelligence itself. This is why, for example, the "bio-field," which is theorized to play a formative or morphogenic role in biological systems, has gained growing prominence in contemporary theorizing.

We do suspect that the subtle body (or subtle energy or bio-field), while presumably macroscopic, can be understood through the microscopic laws of quantum theory and string theory, for which we have a precise understanding, just as other known macroscopic quantum coherent systems, like superfluids, are understood through the microscopic laws of quantum theory. (It is conceivable, of course, that even quantum mechanics and string theory may not be sufficient to understand some of these consciousness phenomena, since consciousness is primary and, in the final analysis, can only be understood on its own level.)

So, armed with our Consciousness-Based perspective, with the most advanced and successful physical theories, and the most up-to-date experimental constraints drawn from particle physics, astrophysics and cosmology, we expect to soon pin down the dynamics of subtle energy, and subtle-body / normal-body interactions, while we simultaneously unravel the mystery of dark matter clustering, recently discovered through gravitational lensing.

The rather evasive, long-sought mind-brain connection is tantalizingly close to our grasp. And that understanding is an essential step towards unlocking the health-promoting potential that may lie within the bio-field, subtle energy, subtle body realm. And we hope, in the process, to shed new, contemporary physical and biophysical light on the ancient healing arts, such as Ayurveda.

Ayuredic treatment modalities and their underlying principles are extensively expounded in the Ayurvedic texts, but in a logical framework that is foreign to the modern medical mind. Dr. Tony Nadar, working closely with Maharishi Mahesh Yogi over many years, has done much to forge a bridge between the age-old Ayurvedic wisdom and modern medical theory. We hope, and anticipate, that our emerging string-theoretic understanding of subtle energy—and its electromagnetic link to the human body—will further elucidate the underlying principles and practices of Ayurveda, as well as other time-tested healing arts.

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By grounding dark matter research in cutting-edge physics—specifically, in the micro-charged Hidden Sector of superstring theory—Professor Hagelin's team is not only advancing our understanding of galactic dark matter, but is opening the possibility of exciting dark matter discoveries, with potential applications in the fields of geophysics, physical chemistry, biochemistry, neuroscience, and even sociology [e.g., see Hagelin's recent talk on The Physics of Social Coherence.]

Success in this project could spark a breakthrough within the broader scientific community, allowing them to understand and thereby embrace phenomena that formerly lay outside the scientific mainstream—such as the Maharishi Effect, the Sidhis, Ayurveda, and other alternative and indigenous healing modalities.

Hagelin and the physics team are most grateful to the Emerald Gate foundation for providing the inspiration and the financial means for this essential project. As greater resources flow to the University from operations and donations, thereby easing MIU's ever-pressing financial needs, Hagelin and his team will have more time to advance this and other groundbreaking research.