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Record - 1

DIALOG(R)

Findings on Mysterious Haze at Galaxy's Center

DENNIS OVERBYE,
New York Times (NY), The New York Times on the Web ed,
Saturday, October 31, 2009

TEXT:

In the latest episode of their continuing efforts to embrace and understand the dark side of creation, astronomers sifting data from a new satellite say they have discerned the existence of a mysterious haze of high-energy particles surrounding the center of the Milky Way galaxy.

Nobody knows where the particles came from, and the five astronomers who posted their results online on Monday did not offer a formal opinion. But one tantalizing prospect, they admit, is that the particles are the decayed remains of the long-sought dark matter that constitutes 25 percent of the universe.

"Obviously we wouldn't be doing this if we didn't think it could be dark matter," said one of the authors, Douglas Finkbeiner of the Harvard-Smithsonian Center for Astrophysics.

If true, it would mean that astronomy has finally entered the realm of seeing the unseeable.

The identity of this dark matter, presumably exotic elementary particles left over from the Big Bang, is one of the biggest mysteries in physics.

Other experts, however, say it is far too soon to draw such far-reaching conclusions based on signals from the confused and energetic environs of the galactic center.

"In my opinion, they are skating on very thin ice," said Elliott Bloom of Stanford, a member of the team running NASA's Fermi Gamma-Ray Space Telescope, which recorded the signals.

And indeed, promising signals of dark matter from an alphabet soup of cosmic observing satellites and balloons have popped up in recent months and then disappeared.

Nevertheless, the new paper -- by Gregory Dobler of the Kavli Institute for Theoretical Physics in Santa Barbara, Calif., and four other physicists from Harvard and New York University -- has created a buzz among astrophysicists and is sure to be discussed next week at a conference in Washington on results from the Fermi Gamma-Ray Space Telescope. At issue is the origin of a haze of gamma rays surrounding the center of our galaxy, which does not appear connected to any normal astrophysical cause but matches up with a puzzling cloud of radio waves, a "microwave haze," discovered previously by NASA's WMAP satellite around the center. Both the gamma rays and the microwaves, Dr. Dobler and his colleagues argue, could be caused by the same thing: a cloud of energetic electrons.

The electrons could, in turn, be the result of decaying dark matter, but that, they said, is an argument they will make in a future paper.

In an e-mail message, one of the authors, Neal Weiner of N.Y.U., explained, "It seemed it was important to have a less controversial first paper," just establishing the electron cloud.

Gordon Kane, a particle physicist at the University of Michigan, called the present paper a solid result, adding, "They have demonstrated they know how to use the Fermi data."

But Dr. Bloom said the authors were going too fast. "The galactic center is the Hells Kitchen of astrophysical forces," he said, borrowing a phrase from a recent talk by his French colleague Johann Coehn-Tanugi of Laboratoire de Physique Theorique et Astrophysique, and the University Montpellier 2.

Separating the potential dark matter signal from the astronomical background sources could take years, Dr. Bloom said, especially as the new Fermi satellite adds to the list.

The center of the galaxy, being the center of the local cosmos, is filled with all kinds of high-energy objects, like a giant black hole millions of

times more massive than the Sun, the whirly-gig beams of pulsars, exploding stars and their remains. Cosmological calculations indicate that it should also be full of dark matter particles, whose clumps form the gravitational scaffolding for the thin film of visible matter in the universe. According to many models of dark matter, such particles, when they meet, can annihilate one another in a flash of energy, which would add to the cacophony from the center.

So astronomers have had their antennae out looking for suspicious signals from the sky. One of them was the microwave haze discovered earlier by the WMAP satellite. Dr. Finkbeiner and his colleagues had argued that the haze could be produced by energetic electrons and positrons -- their antimatter opposites -- whirling around in the Milky Way's magnetic field.

If such electrons existed, they should also produce gamma rays when starlight bounced off them and, thus, show up in the Fermi data. As they approached the data, Dr. Finkbeiner said, "we had some trepidation." Indeed, when all the known sources of gamma rays were erased from Fermi observations of the Milky Way center, they were left with a blob of radiation, about 12,000 light-years across, matching the microwave haze exactly.

The existence of this new gamma ray haze, they say in their paper, settles the question of the origin of the microwave haze, although others like Dr. Bloom disagree. And the question of whether and how these clouds are connected to dark matter is yet to be fought out.

In a model of dark matter recently proposed by Dr. Weiner and others, there is a "dark force" as well as a dark particle; when the dark particles crash into one another, they first produce the carriers of this force, which then decay after thousands or millions of years into the electrons and positrons creating these observed clouds.

But Dr. Kane favors a simpler view -- namely that dark matter particles decay directly into gamma rays.

Dr. Finkbeiner said Dr. Kane's predictions also fit the gamma ray cloud very well. "Kane's prediction is freakishly similar to what we are seeing." But, he admitted, a simple adjustment in models of what kinds of electrons are produced by pulsars could also change the results. Dr. Bloom said that with all the confusion and uncertainty, it was easy to be misled. "Depending on what the part of the elephant you're feeling," he said, "you can have very different models that fit part of what you're looking at."

"We need more data and time to make this work," he said about Fermi and

the quest for dark matter. "It is not something that will come easily."

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Record - 2

DIALOG(R)

7.3 Billion Light-Years Later, Einstein's Theory Prevails

DENNIS OVERBYE,

New York Times (NY), Late Edition - Final ed, p19,

Thursday, October 29, 2009

TEXT:

Astronomers said Wednesday that a race halfway across the universe had ended in a virtual tie. And so the champion is still Albert Einstein -- for now.

The race was between gamma rays of differing energies and wavelengths spit in a burst from an exploding star when the universe was half its present age. After a journey of 7.3 billion light-years, they all arrived within nine-tenths of a second of one another in a detector on NASA's Fermi Gamma-Ray Space Telescope, at 8:22 p.m., Eastern time, on May 9.

Astronomers said the gamma-ray race was one of the most stringent tests yet of a bedrock principle of modern physics: Einstein's proclamation in his 1905 theory of relativity that the speed of light is constant and independent of its color, or energy; its direction; or how you yourself are moving.

"I take it as a confirmation that Einstein is still right," Peter F. Michelson of Stanford, principal investigator for Fermi's Large Area Telescope and one of 206 authors of a paper published online Wednesday in the journal Nature, said in an interview.

There is no evidence so far that the energy or wavelength of light affects its speed through space. That is important because of what it could say about the structure of space-time. Some theorists have suggested that space on very small scales has a granular structure that would speed some light waves faster than others -- in short, that relativity could break down on the smallest scales.

Dr. Michelson and others emphasize that while the new Fermi results do not yet eliminate the prospect, further observations with more gamma-ray bursts

could eventually verify or refute the hypothesis. That would have a major effect on physicists' efforts to unify the Einsteinian gravity that governs outer space with the weird quantum laws that govern the inner space of the atom.

Mario Livio, an astronomer at the Space Telescope Science Institute in Baltimore, called the Fermi results an interesting effect but not revolutionary by any stretch. "The beauty of the experiment is not as much in what it achieves," Dr. Livio said, "as in the fact that you can use astronomical observations to place some interesting limits on very fundamental physics."

Quantum theory, as Einstein discovered to his chagrin, reduces life on subatomic scales to a game of chance in which elementary particles can be here or there but not in between. One consequence is that space-time itself should become discontinuous and chaotic when viewed at very close distances, the way an ocean that looks smooth from an airplane appears choppy and foamy up close.

This, the story goes, could have an effect on the propagation of light -- or photons, as they are called in quantum-speak -- slowing light with short wavelengths relative to light with longer wavelengths. The higher the energy of a photon, the shorter is its wavelength. One way to think about it is to envision the photons as boats on this choppy sea. The small ones, like tugboats, have to climb up and down the waves to get anywhere, while the bigger ones can slice through the waves and bumps like ocean liners, and thus go a little faster.

Until now such quantum gravity theories have been untestable. Ordinarily you would have to see details as small as 10^{-33} centimeters -- the so-called Planck length, which is vastly smaller than an atom -- to test these theories in order to discern the bumpiness of space. Getting that kind of information is far beyond the wildest imaginations of the builders of even the most modern particle accelerators, and that has left quantum gravity theorists with little empirical guidance.

"What's really lacking," Dr. Michelson explained, "is a laboratory experiment that tells us anything. So we have to use cosmology: we use the universe as the lab."

The photons from GRB 090510, detected on May 9, ranged from 10,000 electron volts -- the energy unit of choice in physics -- to 31 billion electron volts, a factor of more than a million, in seven brief bursts over about two seconds.

The spread in travel time of 0.9 second between the highest- and

lowest-energy gamma rays, if attributed to quantum effects rather than the dynamics of the explosion itself, suggested that any quantum effects in which the slowing of light is proportional to its energy do not show up until you get down to sizes about eight-tenths of the Planck length, according to the Nature paper, whose lead author was Sylvain Guiriec of the University of Alabama.

But Dr. Livio emphasized that this was only one of many classes of models. "It would be amazing that in effect we don't need a quantum theory of gravity," he said. "This only tells us where there are the dead ends."

Indeed, other physicists said that even this model would not be ruled out until the size limit had been set much below the Planck size.

The good news, astronomers said, is that more data expected from Fermi could decide the question. As Lee Smolin, a quantum gravity theorist from the Perimeter Institute for Theoretical Physics in Waterloo, Ontario, said, "So a genuine experimental test of a hypothesized quantum gravity effect is in progress."

In the meantime, the last word belongs to Einstein, Robert P. Kirshner of the Harvard-Smithsonian Center for Astrophysics wrote in an e-mail message paraphrasing a 1919 headline in The New York Times about observations that confirmed Einstein's general relativity. "But the Nature story," Dr. Kirshner wrote, "is 'Einstein found right again. Heavens not askew! Savants not agog!'"

CHART: A Sprint Across Bumpy Space-Time: Quantum theory says that up very close, space-time appears discontinuous and chaotic, characteristics that would have an effect on the propagation of light. A NASA experiment found no evidence of such an effect.(Source: Nature)

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Record - 3

DIALOG(R)

Cottage Grove lands all-star exhibit.

Randi Bjornstad, The Register-Guard,
The Register-Guard (Eugene, OR), pE31,
Sunday, October 25, 2009

TEXT:

For the next several weeks, the Cottage Grove Public Library will bask in

the glory of being one of just 40 public libraries in the United States to host "Visions of the Universe: Four Centuries of Discovery," a traveling exhibit that ranges from the astronomical observations of the 17th century Italian astronomer Galileo Galilei to the most recent photographs from the Hubble Space Telescope.

Aimed at sparking interest in astronomy and mathematics among today's students, the exhibit illustrates not only the characteristics of planets, stars, nebulae and galaxies but also the scale - both in size and time - of the universe.

The "Visions of the Universe" presentation includes a dozen large, brilliantly colored panels on topics such as storms on the sun, the rings of Saturn, star birth and stellar explosions. Each panel can be viewed at <http://amazing-space.stsci.edu/visions>, and downloaded as a full-size poster - at 19 inches by 34 inches, it's best printed at a professional printing center - along with an educational booklet on the topic.

Cottage Grove's presentation adds even more activities to interest students and their families.

Among the activities is a celestial-themed "By the Light of the Moon" costume dance Oct. 30. The dance follows the city's pre-Halloween "Night Light Parade of Surprises." In addition, there is an after-school space-oriented film festival on Friday afternoons through Nov. 20 and a series of early evening lectures on the universe on Tuesdays through Nov. 10.

The American Library Association developed the project in conjunction with the Smithsonian Astrophysical Observatory and the Space Telescope Science Institute, which specializes in designing planetarium shows, museum exhibits and Web sites including hubblesite.org and amazing-space.stsci.edu to further public interest in space and astronomy.

While the East Coast organizations put together the basic exhibit, Cottage Grove library assistant Colleen Shaw said the local library has added a great deal to it. "We painted a mural to go with the exhibit, and we put up a lot of stars and planets," Shaw said. "We also have a lot of other information about astronauts and other space topics. As the only library in Oregon to be chosen to have this exhibit, we think this is a really big deal."

VISIONS OF THE UNIVERSE

Where: Cottage Grove Public Library at 700 E. Gibbs Ave.

Exhibit hours: 10 a.m. to 8 p.m. Monday and Tuesday; 10 a.m. to 6 p.m. Wednesday through Saturday; closed Sunday.

Astronomy Lecture Series: Tuesdays, 6 p.m. to 8 p.m.

Oct. 27: "Who's Looking at You, Kid?" with Steve Kilston discusses modern techniques to search for extraterrestrial intelligence, the most likely places to search and the chances of finding beings more advanced than ourselves.

Nov. 3: "Tour of the Solar System" with Jerry Oltion looks at the physical properties of the sun and each of the planets and the challenges of trying to live on or near them.

Nov. 10: "Women Astronomers - Reaching for the Stars" with Mabel Armstrong, a Cottage Grove graduate who wrote a book by the same name, detailing the importance of women who studied the stars from ancient to modern times.

After School Film Festival: Fridays, 4 p.m. to 6 p.m. (free movie and free popcorn)

Oct. 30: Red Planet (rated PG-13)

Nov. 6: Star Trek First Contact (rated PG-13)

Nov. 13: ET, the Extraterrestrial (rated PG)

Nov. 20: Battlestar Galactica (rated PG)

Parade and Costume Dance: Oct. 30 - Parade begins 6:15 p.m. at Fifth and Main streets in downtown Cottage Grove, with lighted floats on a space theme; all costumed "space creatures" welcome; dance at the library/community center follows for space creatures and Earthlings alike; families welcome at free event.

Information: 942-3828

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Record - 4

DIALOG(R)

From the castle: mind-meld.

Clough, Wayne

Smithsonian, v40, n7, p23(1)

Thursday, October 1, 2009

TEXT:

GRATEFUL DEAD FANS may remember the lyrics, "Dark star crashes, pouring its light into ashes." Mickey Hart, a drummer for the Dead, is still thinking about the cosmos, and he recently contacted Smithsonian Under Secretary Richard Kurin to arrange a discussion with distinguished astrophysicist Margaret Geller of the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts, science historian David DeVorkin and ethnomusicologist Atesh Sonneborn; I also participated. Our question: How might Hart perceive and record the "music" of the universe? Can lightwaves reaching Earth after traveling hundreds of millions of light-years speak to our creative, as well as our scientific, selves? Geller answered yes, and offered ideas for how Hart might translate what we observe into music. She suggested that a musician she knows--a person who also has superb computer skills--could help Hart convert strings of numbers representing star formation, gamma ray bursts, black hole binaries and other astrophysical phenomena into music. In an e-mail, Hart reacted to his Smithsonian visit: "Exciting. ... As Soupy Sales would say, 'My brains are falling out.'"

Such intersections of science and the arts occur frequently at the Smithsonian. At a recent materials science workshop, Julian Raby, the director of our Freer and Sackler Galleries, described the ongoing collaborative research being conducted on ancient Chinese metalwork and ceramics by the Freer and Sackler with Chicago's Field Museum and China's Shaanxi Research Institute for Archaeology. And at the National Museum of Cambodia in Phnom Penh, Freer and Sackler conservators have created a lab to treat the museum's collection of bronzes; a U.S. exhibition of some of them is being planned. The Freer and Sackler Galleries have also partnered with our Museum Conservation Institute (MCI) to analyze the paint on sixth-century Buddhist sculptures. Currently Freer and Sackler staff are using radiography to study Japanese writing boxes. Used by aristocrats between 1392 and 1868, these intricately decorated lacquer boxes all stored calligraphy tools, but they vary in construction. Is it because of their function or their date? Radiography may help answer the question.

With the National Museum of Natural History, the Conservation Institute is also helping preserve, in their natural settings, Mongolia's deer stones--3,000-year-old plinths carved with elaborate flying "spirit deer." MCI specialists are also capturing pictorial information about these monuments with 3-D laser scanning. And Conservation Institute director Robert Koestler is helping investigate rapidly growing soil mold that threatens one of the world's great treasures--the Paleolithic cave at Lascaux, France, and its nearly 2,000 animal images painted 16,000 years ago. Science and the arts are unusual partners at most places, but not at the Smithsonian.

G. WAYNE CLOUGH is Secretary of the Smithsonian Institution.

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