Star Stuff

THE FORD AMATEUR ASTRONOMY CLUB NEWSLETTER

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ASTRONOMERS, USING NEW METHOD, FIND EVIDENCE FOR MISSING MATTER

From: Johns Hopkins University, Office of News and Information
Contact: Emil Venere (Emil@jhu.edu)

For years, scientists have been unable to account for all of the material they believe would have been needed to form the cosmos billions of years ago. But now two Johns Hopkins astrophysicists may have found much of the "missing matter" by using a new method to study the early universe. Their new analytical method is detailed in a scientific paper to be published on April 20 in the Astrophysical Journal. The paper was written by astrophysicists Arthur F. Davidsen and HongGuang Bi.

"I have been very excited about this recent work," said David Schramm, a University of Chicago astrophysicist involved in similar research. "A long-standing problem in cosmology is, 'Where is all the normal matter?' Stars and galaxies do not add up to as much normal matter as we feel must be there from our analyses of nuclear processes that took place in the early universe. Davidsen and Bi appear to have found the normal matter out between the galaxies. Furthermore, the amount they find is completely consistent with the amount we expected to be there from our nuclear physics arguments, so the whole picture holds together remarkably well."

The dark-matter problem can be summarized like this: the universe is made of visible matter and so-called dark matter. Visible matter is seen in the form of stars and galaxies, which emit light and other forms of radiation. Dark matter has not been seen directly, but it is inferred to exist from the gravitational effects it appears to exert on the visible matter.

Dark matter itself appears to come in at least two varieties. One component is made of ordinary "baryonic" matter, the same stuff that makes up all the visible matter in the universe. Baryons are ordinary matter particles like protons and neutrons. But astronomers have not been able to account for all the baryonic matter that is thought to exist, based on their studies of the nuclear reactions that occurred during the Big Bang. The visible stars and galaxies contain only a small fraction of the total amount of such ordinary baryonic matter believed to exist. The other component of the dark matter is widely believed to be some sort of exotic particle that does not emit or absorb light.

The analysis reported in the Hopkins paper suggests that the missing baryonic matter has been found. It was spread throughout intergalactic space in the form of a very diffuse gas of hydrogen and helium atoms whose presence is detected through its effects on light passing through it. These findings don't address the nature and amount of the exotic type of dark matter, which scientists believe makes up a majority of all matter in the universe.

Astronomers had thought that the primordial medium of gases that existed in the early universe was contained in individual "clouds," with nearly empty space in between. But the Johns Hopkins astronomers have found evidence that the gases were not arranged that way. Using their method, Davidsen and Bi propose that the early universe contained a "continuous medium" of hydrogen and helium gases, with regions of higher and lower density blending together smoothly.

Although other scientists are using powerful supercomputers to make similar calculations about the evolution of the universe, the Johns Hopkins scientist have devised a method that requires only "fairly simple analytical equations," Davidsen said. They used their analytical method to explain data from observations made by other astronomers over the past 20 years.

Astronomers have detected the primordial hydrogen gas by using spectrographs to analyze light emitted by very distant objects called quasars. Astronomers find places in the sky where there are no galaxies, to get a clear line of sight to a quasar. As the light from the quasar shines through space, it also shines through the gas, like a headlight through fog. The quasar is so far away that the light now reaching earth is from a time when the universe was roughly one-quarter its present age, about 10 billion years ago.

But intense radiation from quasars and early galaxies has ionized much of the gas, stripping away electrons from the atoms and making the gas largely invisible to detection by spectroscopy. So astronomers are only detecting a small portion of the gas.

> *Astronomers believe that concentrations of the exotic form of dark matter formed gravity "wells" that attracted the gases, beginning the process of star and galaxy formation*

"The gas is so highly ionized that we are seeing only the tail of the dog," Davidsen said. "It's a big dog but we are only seeing the tail. If we had a theory that told us exactly what dog it is, based on what the tail looks like, then we could say something. That's what we have now — a theory that connects the tail to the dog. We now believe we can say how much intergalactic gas, baryonic material, there must have been."

Astronomers believe that the simplest elements, hydrogen, helium and deuterium, were created in the Big Bang. Those simple elements formed stars, in which the more complex elements were manufactured. Exploding stars later released those more complex elements.

But how did the hydrogen and helium come together to form stars in the first place? Astronomers believe that concentrations of the exotic form of dark matter formed gravity "wells" that attracted the gases, beginning the process of star and galaxy formation. The Johns Hopkins astronomers have used their method to see that process going on in the universe about 10 billion years ago, Davidsen said.

"Although a small fraction of baryons had by then managed to condense into stars, galaxies, and quasars, it now appears that most of them were still spread throughout intergalactic space, in the form of very diffuse hydrogen and helium gas that was ionized by the ultraviolet radiation of the quasars," Davidsen said.

The method was inspired by previous findings with the Hopkins Ultraviolet Telescope, which was operated from the cargo bay of a space shuttle in 1995. HUT observations of the primordial helium yielded data that contradicted the theory that the primordial gases were contained only in discrete clouds.

"The missing baryons used to be one of the so-called `dark matter problems,' but this matter is no longer dark, thanks to the work of Davidsen and Bi," Schramm said. ☆

COSMIC CENSORSHIP

News from PRINCETON UNIVERSITY, Communications and Publications

Princeton, N.J. — Princeton Mathematician Demetrios Christodoulou says that British physicist Stephen Hawking shouldn't have conceded his bet on the cosmic censorship conjecture. In a paper to be published in the Annals of Mathematics, Christodoulou marshals what may be the strongest support to date for cosmic censorship.

At issue is the question of whether naked singularities exist or not. Hawking bet two Caltech physicists (John Preskil and Kip Thorne) that they do not. Hawking's concession was reported in a Feb. 12 New York Times front-page article. Hawking was persuaded to pay up on the strength of findings originating in a 1993 paper "Universality and Scaling in Gravitational Collapse of a Massless Scalar Field" by Matthew Choptuik of the University of Texas at Austin.

A singularity occurs when the quantities in a theory "blow up" or become infinite and therefore is a sign that the theory doesn't work. The theory relevant to cosmic censorship is Einstein's theory of general relativity and its insight into gravity in terms of the dynamic relationship between mass and spacetime. According to relativity theory, the denser an object, the more it curves the surrounding space. But when a star at least 1.6 times the mass of the sun dies, it collapses, and its density increases to the point that space becomes so curved that tidal forces (i.e., gravity) affecting particles become infinite. To understand whatever is going on at that point of singularity, more than the theory of general relativity is required. But if the singularity is always hidden rather than being "naked" and therefore observable, then what's going on at the singularity need not be accommodated by general relativity theory. It is the challenge to that theory posed by the possibility of naked singularities that interests general relativity theorists such as Hawking and Christodoulou.

Some 20 years ago the British mathematician Roger Penrose made the cosmic censorship conjecture, which states that in the universe black holes enshroud singularities so that no information about singularities can reach an outside observer. The tremendous gravitational forces of collapsing stars confine even light particles within black holes so that there is no way for anyone outside a black hole to learn from observation anything about what's going on inside. The alternative to cosmic censorship is a naked singularity.

Both Choptuik's paper and a published paper by Christodoulou himself, "Examples of Naked Singularity Formation in the Gravitational Collapse of a Scalar Field," show that naked singularities are a possibility. But what Christodoulou shows in his forthcoming paper is that the possibility is mathematical only and that the probability of an actual naked singularity forming is zero. "So," says Christodoulou, "that means that naked singularities cannot really — in a physical sense — form." And it means too that Christodoulou's work supports the cosmic censorship conjecture and that Hawking shouldn't have paid up. "Suppose you have a hill and a ball," says Christodoulou, "and roll the ball up the hill. If you send the ball up with a small velocity, then the ball will climb and at some point begin to roll back down. If you send it up with lots of velocity, the ball will go up and over the top of the hill. But if you send the ball with exactly the correct velocity, it is going to take an infinite time to rise to the top of the hill, and at any point in time other than infinity it will still be rising, and somehow at infinity in time it will just get to the top of the hill.

"So the ball doesn't really get to the top if it gets to the top in an infinity of time. And this situation only happens for a very precise value of the velocity, but in physics what's interesting is never such a hairline case because you can never have a precise value of velocity." (That last statement is an allusion to Heisenberg's uncertainty principle which says that an observer can know the position of a particle or its momentum, but not both at the same time.) "The fact that there is a certain exceptional set of parameters which mathematically would give rise to these singularities is definitely interesting," says Christodoulou, "because if there were no such parameters, the whole mathematical treatment would have been a much easier problem. You have to take that set of parameters into account and prove that it is of zero probability."

"Proof" is the key word that differentiates Choptuik's and Christodoulou's work on naked singularities. And it's Christodoulou who has the proof. "Only a general mathematical theorem can enable you to say that in all situations of collapsing matter singularities either will not form or will form preceded by black holes. Everything else is of zero probability. This is essentially what my theorem says."

Christodoulou's analysis turned up another kind of singularity which is a mathematical possibility. He calls it a collapsed light cone and reported it in his paper. Like the naked singularity the probability of it really existing is zero. ☆

STAR STUFF
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Star Stuff Newsletter
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1997 CLUB OFFICERS

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GENERAL MEETINGS

The Ford Amateur Astronomy Club holds regular general meetings open to the public on the fourth Thursday of the month at 5:00 PM. Meetings are held in conference room 100 in the Ford Worldwide Web & Internet Applications (WWW&IA) building, at 555 Republic Drive in the Fairlane Business Park in Dearborn.

OBSERVING SITE

The Ford Amateur Astronomy Club has an established observing site, by permit, at the Spring Mill Pond area of the Island Lake Recreational Area in Brighton, Michigan located near the intersections of I-96 and US-23. Members are responsible for opening and closing the gate after the parks 10:00pm closing time. The combination for the lock should be available on our hotline number. Always close the gate behind you after 10:00pm whether entering or leaving the park.

OBSERVING HOTLINE NUMBER - (313) 39-05456

On Friday and Saturday nights, or nights before holidays, you can call the hotline number up to 2 hours before sunset to find out if we will be observing that night. Assume that any clear Friday or Saturday night is a candidate observing night unless something else is going on or none of the club officers are able to make it.

WWW PAGE

Computers inside the Ford network or on the Internet can access the F.A.A.C. web page at one of the following addresses:

Ford Intranet:	http://pt0106.pto.ford.com/faac/
Internet:	http://kode.net/~dougbock/faac/

MEMBERSHIP AND DUES

Membership to the Ford Amateur Astronomy Club is open to both Ford and Non-Ford Motor Company employees. The general public is also welcome to join. The dues structure is as follows:

Annual Individual/Family	$20.00
Lifetime Membership	$100.00

Membership benefits include a subscription to the Star Stuff newsletter, discounts on subscriptions to Astronomy and/or Sky & Telescope magazine(s), after hour use of the observing site at Island Lake, and discounts at selected area astronomical equipment retailers.

NEWSLETTER STAFF

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NEWSLETTER SUBSCRIPTION

A yearly subscription at a rate of $12.00 is available to those who are not members of the Ford Amateur Astronomy Club. Subscriptions are free to other astronomy clubs wishing to participate in a newsletter exchange.

MAY 1997

SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22 FAAC Meeting	23	24
25	26	27	28	29	30	31

May 04 Moon Occults Saturn
May 05 Moon Occults Mercury
May 05 Eta Aquarids Meteor Shower Peak
May 06 New Moon (4:49 pm)
May 06 Comet Hale-Bopp Crosses the Ecliptic Plane
May 06 Comet Wild 2 Perihelion (1.57 AU)
May 14 First Quarter Moon (6:57 am)
May 21 Asteroid 2554 Skiff Occults Jupiter
May 22 Full Moon (5:16 am)
May 22 Mercury At Its Greatest Western Elongation (25 Degrees)
May 23 Comet Encke Perihelion (0.331 AU)
May 25 Pluto at Opposition
May 28 Comet Hartley 1 Perihelion (1.819 AU)
May 29 Last Quarter Moon (3:53 am)
May 30 Comet C/1996 R3 Perihelion (1.770 AU) ☆

MEETING ANNOUNCEMENT

The Ford Amateur Astronomy Club (FAAC) holds regular general meetings on the fourth Thursday of each month, except November and December. Our next meeting will be **Thursday, May 22, at 5:00 pm.**

The FAAC meets in conference room 100 in the Ford WorldWide Web & Internet Applications (WWW&IA) building, at 555 Republic Drive in the Fairlane Business Park in Dearborn. The find the building take the Southfield Freeway to Rotunda Drive. Go east on Rotunda and take the first right into the Fairlane Business Park (there is a sign). The WWW&IA building is the first building on the left. Park on the south or east side of the building and come to the south door (there is a big "425" over the door). The WWW&IA building is secured with a card entry system. If no one is at the door to let you in, then dial 18388 on the lobby phone and we will send someone. When you enter the building, turn left and follow along the windows to the conference room. ☆

3/27/97 FAAC MEETING MINUTES

by Harry Kindt , Sec'y F.A.A.C.

The general membership meeting of the Ford Amateur Astronomy Club was called to order at 5:05 PM by our president Bob MacFarland. There were 26 members and guests present. The treasurers report was read and accepted.

Most of tonight's meeting involved discussions on upcoming events that our club members are involved with. These include: A Hale-Bopp star party sponsored by the University of Michigan-Dearborn Campus on March 29th, 1997 -already concluded by the time you read this- (Some of our club members attended this event, but due to unfavorable weather, no actual viewing took place, the sponsors decided to re-schedule the event for Saturday, April the 5th at the Dearborn Campus). The next event scheduled is our own clubs outing on April 4th and 5th at the Lake Erie Metro Park at the Cove Point Picnic Area. On April 12th our club is sponsoring a Astronomy Day program at Somerset Mall. Following this is the big SouthEastern Michigan Astronomy Clubs Comet Hale-Bopp/Star Party at Kensington Metro Park on April 25th and 26th. After which is the Third Annual Huron County Star Party at Duggin's Family Campground in Michigan's thumb area, scheduled for May 1st, 2nd, & 3rd, 1997. The last event we discussed was the 14th Annual Summer Solstice Star Party at Doug Bock's Northern Cross Observatory on June 6-8, 1997. Doug Bock reported that there will be no more meetings on the Remote Observing Site until the Fall.

New officers were elected at the F.E.R.A.. meeting as reported by our president, Bob MacFarland. Bob also mentioned that F.E.R.A.. was celebrating its 50th anniversary this year. As part of our club's commitment to the F.E.R.A. organization, we will, again this year, be asked to assist in the sale of tickets for this summers Renascence Festival. George Korody described the requirements and the expense involved in setting up a remote observing site. Most of the cost of setting up such a site would be in the acquisition of the proper mount for the telescope. George also reported on the progress being made in organizing a star party in cooperation with the Lenauwee Astronomy Club at their dark site at Lake Hudson. Target dates now being discussed are Late July or early August. We will keep you posted as the plans are developed.

Over our usual pizza and pop, members had an opportunity too introduce themselves and too briefly describe their viewing experiences since our last meeting. Lots of photographs of the comet Hale-Bopp, taken by our members, were passed around for everyone's enjoyment. Greg Burnett showed us some photographs of the recent Lunar eclipse that he had taken, which he also developed and printed at his darkroom at home. It was agreed that the club would purchase a smaller banner displaying our club's logo for use at our table set-ups at the various start party events. Patti Forton agreed to create individual placards that would identify us as members of the Ford club. The placards are to be attached to our individual telescopes while they are in use star parties.

Our featured speaker was Doug Bock. Doug presented a slide show on comet Hale-Bopp. All of the slides were taken by Doug from his Northern Cross Observatory- Thanks Doug-. The meeting was adjourned at 6:30 PM. ☆

4/24/97 FAAC MEETING MINUTES

by Don Klaser

The meeting was called to order by club president Bob MacFarland at 5:05 pm. There were 25 members and guests in attendance. We started off with pop and pizza as we waited for people to find the new location (our meetings will now be held in conference room 100 of the Ford Worldwide Web & Internet Applications building - see next month's meeting announcement).

Bob MacFarland spoke about several of the upcoming events and distributed some handouts. The treasurers report was then read by Ray Fowler. Don Klaser gave a brief talk on the past Lake Erie Comet Party, Astronomy Day celebration, and upcoming comet/star party at Kensington Metropark (April 25-26). George Korody then spoke about the Hudson Lake State Park dark sky reserve. There will be stargazing and a potluck picnic at this site on July 5.

Bob MacFarland then spoke on the subject of our club establishing a scholarship fund for science majors. Don Klaser, Sue Fowler, George and Pat Korody, and Bob MacFarland will head up a committee to research the scholarship process. A proposal was made, and passed by those in attendance, to ask for a donations at the meetings for the food. This money will help offset some of the expense so we can save for the scholarship. Chris Lee also volunteered to help with providing the pizza for the meetings.

Brief introductions were made by all in attendance. George Korody then gave a presentation on the winter star party in the Florida Keys. ☆

MAY SPACE HISTORY

The following May events come from the 02/25/97 edition of "Space Calendar." This calendar is compiled and maintained by Ron Baalke (baalke@kelvin.jpl.nasa.gov).

May 04 30th Anniversary (1967), Lunar Orbiter 4 Launch
May 07 5th Anniversary (1992), STS-49 Launch, 1st Flight of Endeavour
May 08 35th Anniversary (1962), 1st Atlas Centaur Launch
May 15 10th Anniversary (1987), 1st Energiya Launch (USSR)
May 24 35th Anniversary (1962), Aurora 7 Launch (Scott Carpenter) ☆

MAY 1997 SPACE EVENTS

The following May 1997 events come from the 02/25/97 edition of "Space Calendar." This calendar is compiled and maintained by Ron Baalke (baalke@kelvin.jpl.nasa.gov). Note that launch dates are subject to change.

May 01 SNOE Pegasus XL Launch
May 06 Galileo, Callisto Observations (Orbit 8)
May 07 Galileo, 4th Ganymede Flyby (Orbit 8)
May 15 STS-84 Launch, Atlantis, 6th Shuttle-Mir Mission, SPACEHAB
May 23 Seastar Pegasus XL Launch
May 30 GFO-1 Launch ☆

THE MYSTERY OF THE MISSING MASS

From: David Brand (dbrand@u.washington.edu), University of Washington

The Mystery Of The Missing Mass: The elusive neutrino may not be disappearing at all, but simply changing its "flavor"

Like the Cheshire cat, the elusive neutrino particle can appear and disappear, seemingly at will. And like the smile on the face of the Cheshire cat, the neutrino may be a mere wisp, or have actual substance. But evidence is growing that this ghostly subatomic particle actually has a corpus. If that is so, the particle may not have been disappearing at all, but simply cloaking itself with another form.

"There are still many puzzles," says University of Washington physics professor Kenneth Young. "But experiments are giving us something much stronger than hints that neutrinos have mass." Young is reporting on the international quest to unravel the nature of the neutrino at the spring meeting of the American Physical Society and the American Association of Physics Teachers in Washington, D.C. Young and his colleagues are preparing to release the first year's results from a gargantuan Japanese laboratory designed to probe the mysteries of the neutrino. It is called Super-Kamiokande, and it detects the particles in a massive tank, containing 50,000 metric tons of water, buried more than a half-mile deep in a mine outside Kamioka in the Japanese Alps. The University of Washington is one of nine institutions supporting the $100 million laboratory, which began its research last April.

Based on the first 100 days of research in Japan, Young says there are tantalizing hints that not only does the neutrino have mass and can change its form (or what researchers call "flavor"), but it may also be more abundant at night than during the day, and more plentiful during certain times of the year. The importance of the neutrino is far more than an intellectual exercise. A puzzle of astrophysics is that much of the universe — perhaps 90 percent — is seemingly hidden from view. Researchers postulate that much of this so-called dark matter is actually composed of neutrinos, which are clearly abundant in nature. If the neutrino has mass, then it could be part of "the omnipresent dark matter," says Young. To date, the results from Japan are largely "the inference of statistics," he notes. It will take another two years to provide evidence that the particle may have mass. Along the way, researchers also hope to solve the myth-like question of how a subatomic particle can suddenly disappear, then reappear.

Super-Kam (as physicists have dubbed the laboratory) tracks neutrinos from two sources, the sun and the Earth's atmosphere, where they are created from the reaction of proton bombardment. Every day, says Young, the laboratory registers about one million particle reactions in the water. Most of these reactions are the result of background radiation, such as that produced by rocks surrounding the water tank. Only 30 reactions are separated out as solar neutrinos, and just 10 are identified as atmospheric neutrinos. Because the neutrinos are so shadowy they cannot be tracked directly, but are registered through their collisions with atoms in the ultra-pure water, which is constantly filtered to remove dust and debris.

Although Super-Kam's measurement of solar neutrinos striking the Earth confirms previous experiments, the central mystery still remains: theoretical predictions of the sun's emission of neutrinos calls for twice as many solar neutrinos as are being recorded. The suggestion that previous experiments have simply had a low efficiency in measuring solar neutrinos is discounted by researchers. They have proved their case by firing electrons into the water, and accurately counting their numbers. So where are the missing neutrinos? The answer, says Young, could be that the neutrinos are there all along, but are changing flavor. Specifically, the laboratory tracks just one type of neutrino, called the electron neutrino. But there are also two other types: the muon neutrino (muons are massive electrons) and the tau neutrino (tau particles are very heavy). Each of these is called a different flavor of neutrino.

Says Young: "The question is, do these neutrinos stay with a particular flavor all their lives, or do they change? If they do indeed have mass, it is possible they can change so that the electron neutrino becomes the muon or the tau neutrino? In the case of the solar neutrino we would not be able to see it anymore, because this experiment is at an energy level that can only see the electron neutrino." This changing form from one type of neutrino to another is called oscillation, and it could partially explain why so many solar neutrinos appear to be missing. But there may also be other explanations, says Young. One is "the suspicion" that there may be a detectable drop in electron neutrino population during the day, and an increase at night. During the day, the neutrinos have only to pass through the Earth's atmosphere and the mine rock face to reach Super-Kam. But at night the neutrinos pass completely through the Earth, because the sun is below the horizon. "Oscillation may be far greater if the electron neutrinos have to go through the Earth's core," Young theorizes. In fact, this effect could be so great that just another year of results from Super-Kam "could be enough to make a definitive statement." The electron neutrino population, he says, may also be greater at certain times of the year. That is because of the Earth's elliptical orbit, which changes its distance from the sun by 5 percent during the year.

Until Super-Kam can provide statistical evidence for these theories over the next year or two, the greatest frustration of neutrino hunting may lie with the researchers themselves. Says Young: "They can invent theories faster than they can improve their measurements." ☆

EVIDENCE OF A NEARBY SUPERNOVA

From: Royal Astronomical Society Press Notices, Ref. PN 97/27
Contact: Dr Martin Barstow, University of Leicester, Leicester, UK.

A team of astronomers led by Dr Martin Barstow of the University of Leicester has used a group of white dwarf stars to probe the structure of interstellar space in the vicinity of the Sun. Measurements made with the Extreme Ultraviolet Explorer (EUVE) Satellite have revealed that the local gas appears to be highly ionized in all directions. This can only have happened as the result of a nearby supernova explosion and the relative amounts of ionized gas indicate that it occurred about 4 million years ago.

The formation of the Solar System about 4500 million years ago, would have been profoundly affected by the conditions existing in the cloud of dust and gas from which it originated. Although this original nebula will have been largely dissipated by intense radiation from the young Sun and has probably been left behind by the motion of the Solar System through interstellar space, more recent encounters with interstellar material may have affected us directly and at the very least influenced our astronomical observations.

Our present picture of the local interstellar medium (the gas between stars out to distances of about 300 light years), is that the Sun is embedded in and near the edge of a wispy diffuse cloud, known as the Local Cloud. This cloud, which is only 20-30 light years across, is itself in a larger much less dense region called the Local Bubble. Interstellar gas near the Sun can only be studied directly by observing its effect on the extreme ultraviolet (EUV) radiation from other stars. The ROSAT EUV all- sky survey was able to map out the dimensions of the Local Bubble but could not tell us anything about the state of the gas inside.

The current state of the gas in both the Local Cloud and the Local Bubble is expected to bear the imprint of recent nearby events, such as supernova explosions, and radiation from hot young stars. As a result the interstellar gas should be ionized, with the electrons stripped from the constituent (mainly hydrogen and helium) atoms. The ionized material can only be detected in extreme ultraviolet spectra, recorded using NASA's Extreme Ultraviolet Explorer (EUVE). A critical question is whether the interstellar gas is in equilibrium, with atoms being ionized at the same rate as the ions recombine with the electrons, or not. At the observed level of ionization, the radiation from nearby stars is not enough to maintain an equilibrium but the shortfall could be made up of photons emitted by decaying dark matter.

A team of astronomers led by Dr Martin Barstow and including Paul Dobbie (University of Leicester), Jay Holberg (University of Arizona), Ivan Hubeny (Goddard Space Flight Centre) and Thierry Lanz (University of Utrecht), have used the EUVE spectrometers to carry out detailed observations of 13 nearby white dwarfs, using the shadowing effect of the interstellar medium on the white dwarf spectra to measure the density and level of ionization.

Remarkably, while the gas density varies in different directions, the fraction of material ionized is highly uniform. This can be best explained by a non-equilibrium scenario in which the Local Cloud was ionized by the shock wave from a nearby supernova explosion, since when the ions and electrons have been slowly recombining. The observed fractions of ionized hydrogen (27%) and helium (35%) indicate that the explosion occurred around 4 million years ago. This might be the same supernova which is believed to have swept out the cavity we now identify with the Local Bubble. These results confirm that a source of decaying dark matter is not needed to explain the appearance of the local interstellar medium.

Dr Barstow presented these results at an International Astronomical Union Colloquium on "The Local Bubble and Beyond", held in Garching, Germany, from April 21st to 25th. A paper on the topic was also published in the 21 March issue of the Monthly Notices of the Royal Astronomical Society. ☆

SUPERNOVA 1987A 10-YEAR REVIEW

From: Royal Astronomical Society Press Notices, Ref. PN 97/23 (NAM)
Contact: Dr Peter Meikle, Dept. of Physics, Imperial College, London

Supernova 1987A is, by far, the most extensively studied supernova explosion in history. It has provided an astonishing wealth of discoveries about the physical processes which take place before, during and after a core-collapse-induced supernova.

We now believe that SN 1987A arose from the merger of a massive binary star system. The most dramatic evidence for this is the bright circumstellar ring, beautifully imaged by the Hubble Space Telescope (HST). Material that flowed out during the red supergiant phase was subsequently compressed by the blue supergiant wind to form the ring. This, together with the fainter outer loops, was then "lit-up" (ionized) by the ultraviolet flash as the shock of the explosion reached the surface of the star. While the progenitor of SN 1987A may have been unusual, it was not unique. A rather similar system has been recently discovered in our own Galaxy.

That there was a core-collapse in the star was firmly, and uniquely established by the detection of 19 neutrinos on 23 February 1987. It seems likely that the collapse resulted initially in a neutron star at the centre. However, there is still no convincing evidence for a pulsar at the centre. Indeed, the possibility that the core subsequently collapsed to form a black hole is still being considered. Understanding is growing as to how the core-collapse ultimately leads to the powerful ejection of most of the star. The key lies in the neutrinos, which emerge from the neutron star following the core-collapse. These particles can deposit a large amount of energy in the material just above the neutron star, producing instabilities and coupling the released gravitational energy to the star's outer layers. Observational evidence supporting this scenario has come from infrared spectra of SN1987A. However, it is still not understood what determines the fraction of neutrino energy that is actually deposited.

As the shock travelled through the star, explosive nucleosynthesis took place, creating new chemical elements. In particular, about 0.1 solar masses of nickel-56, which is radioactive, was formed. Several pieces of new evidence for this came from SN1987A. Of particular note was the demonstration, using infrared spectroscopy, of the presence of the decay product cobalt-56 and its decay, in turn, to iron-56. It is the decay of these and other radioactive elements which are responsible for maintaining the emission from the supernova. It is now generally accepted that the explosion and nucleosynthesis was not nicely spherically symmetric. What appears to have happened is that the nickel-56 was created in, perhaps 100, dense, localised pockets, or possibly even finger-like structures pointing radially outward. As the 56Ni decayed first to cobalt-56 and then to iron-56, these regions expanded relative to the rest of the ejecta. Extensive large-scale mixing occurred. Again, much of this is based on spectroscopic studies, especially at near- and far-IR wavelengths. (Asymmetric explosions could easily account for the high velocities many pulsars are observed to have.)

As the ejecta expanded, we saw not just atoms, but also the formation of substantial quantities of molecules and dust. Indeed, carbon monoxide played an important role in cooling large parts of the ejecta. The dust formed in dense, opaque fingers, which seem to be still opaque even after 10 years. As the supernova aged beyond about two years, two important nebular effects took place. These are known as the 'infrared-catastrophe' and the 'freeze-out', and were seen for the first time in SN1987A. The recognition of these processes is vital to our understanding of the way the light curves and spectra of supernovae develop long after the initial explosion.

At the moment, the emission from the ejecta of SN1987A is considerably fainter than from the circumstellar material which dominates the appearance of the SN 1987A system. Nevertheless, the HST has recently shown clearly that the ejecta have "split" into two blobs moving in opposite directions, confirming both the early indications and also the more indirect evidence for an asymmetric explosion. A particularly intriguing fact is that the line joining the two blobs lies exactly along the line to the unexplained and much-disputed Mystery Spot seen briefly a couple of months after the explosion in 1987.

As early as 1990, radio observations began to show the impact of the ejecta with the circumstellar material. The radio emission is steadily brightening, and the effects of the interaction have now also been detected in X-rays and the far-infrared. By about 2006, the ejecta will collide with the ring, with dramatic results. We should see the luminosity increase by a factor of 100 to 1000. This event will provide a beautiful "experiment" for a real-time study of shock interaction and particle acceleration. ☆

THE STAR THAT BLEW UP AS SN1987A

From: Royal Astronomical Society Press Notices, Ref. PN 97/22 (NAM)
Contact: Dr Philipp Podsiadlowski, University of Oxford, Keble Road, Oxford

Ten years after Supernova 1987A in the Large Magellanic Cloud became the first naked-eye supernova in our skies since 1604, Oxford astronomer Philipp Podsiadlowski says that the mystery about the nature of the star that produced this extremely unusual supernova is probably solved. The star that exploded used to be a member of a close binary pair, but it merged with its partner in an act of stellar cannibalism in the relatively recent past — perhaps some 30,000 years ago. Dr Podsiadlowski will explain how this scenario can account for all SN1987A's oddities when he speaks on Thursday 10th April at the UK's National Astronomy Meeting taking place at the University of Southampton.

One of the main puzzles of SN1987A, recognized soon after the explosion, is the fact that the star that exploded was a BLUE supergiant (with a radius of about 40 times the Sun), whereas theory had predicted that massive stars end their lives as RED supergiants (more than 1000 times larger than the Sun). One early idea was that this behaviour was somehow connected with the fact that the Large Magellanic Cloud, a satellite galaxy of the Milky Way, has a somewhat lower concentration of heavier chemical elements than the Milky Way, and that the star used to be a red supergiant but turned into a blue supergiant just 30,000 years ago. But the most recent calculations have shown that this idea just cannot be made to work. Even if it did work, it still would not explain the two other main puzzles of the supernova: the fact that a significant fraction of the material from the core of the star seems to have been thoroughly mixed with its outer layers, and the complex nebula surrounding the supernova remnant.

The nebula around the supernova remnant was first discovered with the European Southern Observatory's New Technology Telescope, but is most clearly seen in images taken with the Hubble Space Telescope. The main nebula consists of three rings that appear to float in space. What is left of the supernova is at the centre of the inner ring (with a radius of 0.7 light years), while the two other rings are parallel to the inner ring, but displaced from it by about 1.5 light years above and below. In the north, the nebula is bounded by a structure that has the appearance of Napoleon's hat.

The whole of this nebula was created before the supernova went off and consists of matter that was ejected by the progenitor star (or stars) within the last 30,000 to 60,000 years. It is very noticeable that the nebula is distinctly non-spherical, but nevertheless is symmetrical around an axis. This suggests that the progenitor was a spinning very fast around that axis. The most recent Hubble Space Telescope image of the supernova provides further evidence for this idea, since for the first time it resolves the actual material ejected during the supernova explosion and shows that it is elongated in the direction perpendicular to the inner ring. This is expected if the star that exploded was not spherical but flattened because it was spinning rapidly. But the rules of physics say that no single star, even if it were born with rapid rotation, could still be turning so fast after it has expanded to supergiant dimensions.

However, the conundrum can be resolved if something acted to 'spin up' the progenitor before it exploded. It turns out that a binary companion is capable of doing just that. Indeed, the type of binary system required is quite typical — most stars are members of binary or multiple systems. The only important requirement is that the merger of the two stars takes place after the progenitor has consumed all the helium in its core.

During the merger, which itself takes only a few years or decades to complete, the companion star is completely destroyed and its material is mixed with the envelope and part of the core of the progenitor. This produces a rapidly rotating star with thoroughly mixed outer layers — thereby explaining that observed peculiarity. This star subsequently wants to shrink to become a blue supergiant. However, the merged system is rotating too rapidly to make a blue supergiant and needs to slow down. This it achieves by spinning off matter in a disc around its equator. Once the star has become a blue supergiant, it develops a powerful stellar wind that sweeps the disc outwards. This process forms the observed inner ring. The outer rings may be 'swept-up' parts of a shock region in the shape of a double cone, produced by the interaction of stellar winds from each of the two stars before they merged.

It now seems that a double-star merger scenario is the only way in which all the various anomalies of this very unusual supernova can be understood. This theory predicts particular chemical anomalies, which would have been produced during the merger itself. If these are detected, it would be virtually conclusive evidence that the theory is correct. ☆

DATA RESOLVES "AGE PROBLEM"

Contact: Robert Tindol (tindol@caltech.edu)

PASADENA — A California Institute of Technology astronomer has obtained data that could resolve the "age problem" of the universe, in which certain stars appear to be older than the universe itself.

Dr. Neill Reid, using information collected by the European Space Agency's Hipparcos satellite, has determined that a key distance measure used to compute the age of certain Milky Way stars is off by 10-15 percent. The new data leads to the conclusion that the oldest stars are 11-13 billion years old, rather than 16-18 billion, as had been thought.

The new results will be of great interest to cosmologists, Reid says, because estimates of the age of the universe, based on tracking back the current rate of expansion, suggest that the Big Bang occurred no more than about 13 billion years ago. Therefore, astronomers will no longer be confronted with the nettling discrepancy between the ages of stars and the age of the universe. "This gives us an alternate way of estimating the age of the universe," says Reid. "The ideal situation would be to have the same answer, independently given by stellar modeling and cosmology."

Reid's method focuses on a type of star (known as subdwarfs) found in globular clusters, which are spherical accumulations of hundreds of thousands of individual stars. These have long been known to be among the earliest objects to form in the universe, since the stars are composed mainly of the primordial elements hydrogen and helium, and because the clusters themselves are distributed throughout a sphere 100,000 light-years in diameter, rather than confined, like the sun, within the flattened pancake of the galactic disk. Astronomers can determine quantitative ages for the clusters by measuring the luminosity of the brightest sunlike stars in each cluster. Those measurements require that the distances to the clusters be known accurately.

Reid looked at some 30 stars within about 200 light-years of Earth. Using the Hipparcos satellite, he was able to obtain very accurate distances to these stars by the parallax method. Parallax is a common method for determining relatively nearby objects. Just as a tree 10 feet away will seem to shift its position against the distant background when an observer closes one eye and then the other, a nearby star will shift its position slightly if the observer waits six months for Earth to reach the opposite side of its orbit. And if the distance between the two observing sites (the baseline) is known very accurately, the observer can then compute the distance to the object by treating the object and the two observing sites as a giant triangle.

Reid chose the 30 stars for special study (out of the 100,000 for which Hipparcos obtained parallax data) because they, like the globular cluster stars, are composed primarily of hydrogen and helium. Thus, these stars also can be assumed to be very old, and may indeed themselves once have been members of globulars that were torn apart as they orbited the galaxy. Once distances have been measured, these nearby stars act as standard candles whose brightness can be compared to similar stars in the globular clusters. While this is a well-known technique, older investigations were only able to use lower-accuracy, pre-Hipparcos parallaxes for 10 of the 30 stars.

Reid's conclusion is that the clusters are about 10-15 percent farther from Earth than previously thought. This, in turn, means that the stars in those clusters are actually about 20 percent brighter than previously thought, because luminosity falls off as distance increases. Brighter stars have shorter lifetimes, so this means that the clusters themselves must be younger than once assumed.

British astronomers Michael Feast and Robin Catchpole recently arrived at very similar conclusions, also based on new data from Hipparcos, but using a different, and less direct, line of argument. They used new measurements of a type of variable known as Cepheids to determine a revised distance to the Large Magellanic Cloud, a galaxy orbiting the Milky Way. Feast and Catchpole used another type of variable star, the RR Lyrae variables, to bridge between the LMC and globular clusters. The fact that these two independent methods give the same answer makes that answer more believable, says Reid.

"Most people previously believed that 14 billion years was the youngest age you could have for these stars," Reid says. "I think it's now accurate to say that the oldest you could make them is 14 billion years. No longer are we faced with the paradox of a universe younger than its stellar constituents."

The work is set to appear in July in the Astrophysical Journal. ☆

ANTIMATTER CLOUDS IN MILKY WAY

From: NASANews@hq.nasa.gov, Release: 97-83

Scientists using data from an instrument on NASAUs Compton Gamma Ray Observatory (CGRO) have discovered two unexpected clouds of antimatter in the Milky Way Galaxy which scientists call Rantimatter annihilation radiation.S

Scientists from Northwestern University, Evanston, IL, the Naval Research Laboratory (NRL), Washington, DC, and other institutions used CGROUs Oriented Scintillation Spectrometer Experiment (OSSE) to make the discovery, which points to the existence of a hot fountain of gas filled with antimatter electrons rising from a region that surrounds the center of the Milky Way galaxy. The nature of the furious activity producing the hot antimatter-filled fountain is unclear, but could be related to massive star formation taking place near the large black hole at the center of the galaxy. Other possibilities include winds from giant stars or black hole antimatter factories.

The researchers used maps of gamma ray sources from CGRO which they expected to show a large cloud of antimatter near the galactic center and along the plane of the galaxy. The maps, surprisingly, also show a second cloud of antimatter well off the galactic plane. The second cloud may be caused by the explosions of young massive stars. "The origin of this new and unexpected source of antimatter is a mystery," said William R. Purcell, research scientist and assistant professor of physics and astronomy at Northwestern University. The antimatter cloud could have been formed by multiple star bursts occurring in the central region of the galaxy, jets of material from a black hole near the galactic center, the merger of two neutron stars, or it could have been produced by an entirely different source," said James D. Kurfess, head of the Gamma and Cosmic Ray Astrophysics Branch at the Naval Research Laboratory.

The researchers presented their findings today at the fourth Compton Symposium in Williamsburg, VA. The results have been submitted for publication in the Astrophysical Journal. A second paper presented at the conference, titled "The Annihilation Fountain in the Galactic Center Region," examines theoretical models for one possible source of the antimatter — star bursts in the central region. The second paper is authored by Dr. Charles Dermer and Dr. Jeffrey Skibo of NRL. They note that the gamma-ray observations permit us to see clearly, for the first time, a new part of our galaxy made of a hot column of gas filled with antimatter electrons (also called positrons by scientists), and they argue that the antimatter electrons come from newly created elements produced by exploding stars formed near the center of our galaxy.

"It is like finding a new roorn in the house we have lived in since childhood," comments Dr. Dermer. "And the room is not empty — it has some engine or boiler making hot gas filled with annihilating antimatter. No one is certain whether the antimatter comes from exploding stars, black holes or something entirely different, and that is what makes this discovery so exciting."

Evidence points to the existence of a black hole with the mass of a million Suns at the very center of our galaxy. Unlike in other galaxies which harbor huge black holes, very little light comes from this source. Huge dense clouds of gas also surround the galactic center. Prolific star formation, powerful stellar winds from massive stars, and supernovae are all found here. Another theory, based on observation of radio emissions showing some black holes produce X-rays and jets, is that such outflowing jets could be made of antimatter.

The Compton Gamma Ray Observatory, launched from the Space Shuttle in 1991, views the universe in a search for gamma rays and their source. Gamma rays are extremely energetic light photons produced by high-energy particles, by the decay of excited nuclei, and when matter and antimatter annihilate each other. Antimatter cannot be found in large quantities on Earth because it would instantly vaporize anything it came into contact with. All evidence points to the universe being composed almost entirely of normal matter, though opinions differ on this.

Using the OSSE experiment, the OSSE team found antimatter positrons to be annihilating with normal matter electrons at an astonishing rate. Scientists are speculating on the origin of this antimatter, with a "black-hole lobby" favoring antimatter production in the jets of black holes.

Other scientists favor freshly synthesized radioactive material in stellar explosions being ejected up above our galaxy in an annihilating fountain of gas. Drs. Dermer and Skibo favor the latter scenario, because exploding stars will eject large quantities of hot gas made up of normal matter. This hot gas provides a target with which the antimatter electrons can annihilate. ☆

STATISTICALLY SPEAKING

Location (Dearborn, MI): 42°19'12" N, 83°10'48" W, 180 meters elevation
Local Time = Universal Time - 4 hours (Eastern Daylight Savings Time)

Abbreviations used in reports:
FM Full Moon FQ First Qtr Moon LQ Last Qtr Moon NM New Moon
MR Moon Rise MS Moon Set SR Sun Rise SS Sun Set

Calendar Report for May 1997

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	Lunar Events May 06 NM: 16:49 May 14 FQ: 6:57 May 22 FM: 5:16 May 29 LQ: 3:52			1 SR: 6:28 SS: 20:32 MR: 3:26 MS: 14:41	2 SR: 6:27 SS: 20:34 MR: 4:04 MS: 15:52	3 SR: 6:25 SS: 20:35 MR: 4:39 MS: 17:03
4 SR: 6:24 SS: 20:36 MR: 5:15 MS: 18:13	5 SR: 6:23 SS: 20:37 MR: 5:51 MS: 19:24	6 SR: 6:21 SS: 20:38 MR: 6:29 MS: 20:32	7 SR: 6:20 SS: 20:39 MR: 7:11 MS: 21:37	8 SR: 6:19 SS: 20:40 MR: 7:55 MS: 22:38	9 SR: 6:18 SS: 20:41 MR: 8:44 MS: 23:34	10 SR: 6:17 SS: 20:42 MR: 9:36 MS: None
11 SR: 6:16 SS: 20:43 MR: 10:30 MS: 0:23	12 SR: 6:14 SS: 20:44 MR: 11:26 MS: 1:06	13 SR: 6:13 SS: 20:45 MR: 12:22 MS: 1:44	14 SR: 6:12 SS: 20:46 MR: 13:19 MS: 2:18	15 SR: 6:11 SS: 20:47 MR: 14:15 MS: 2:49	16 SR: 6:10 SS: 20:49 MR: 15:12 MS: 3:19	17 SR: 6:09 SS: 20:50 MR: 16:10 MS: 3:47
18 SR: 6:08 SS: 20:51 MR: 17:09 MS: 4:16	19 SR: 6:07 SS: 20:52 MR: 18:09 MS: 4:46	20 SR: 6:07 SS: 20:52 MR: 19:10 MS: 5:18	21 SR: 6:06 SS: 20:53 MR: 20:12 MS: 5:54	22 SR: 6:05 SS: 20:54 MR: 21:14 MS: 6:35	23 SR: 6:04 SS: 20:55 MR: 22:14 MS: 7:21	24 SR: 6:03 SS: 20:56 MR: 23:10 MS: 8:14
25 SR: 6:03 SS: 20:57 MR: None MS: 9:13	26 SR: 6:02 SS: 20:58 MR: 0:01 MS: 10:17	27 SR: 6:01 SS: 20:59 MR: 0:47 MS: 11:24	28 SR: 6:01 SS: 21:00 MR: 1:28 MS: 12:32	29 SR: 6:00 SS: 21:01 MR: 2:06 MS: 13:42	30 SR: 6:00 SS: 21:01 MR: 2:41 MS: 14:51	31 SR: 5:59 SS: 21:02 MR: 3:16 MS: 16:00

Planet View Info Report for May 1997

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
Mercury							
5/ 6/1997	5:49	19:05	1h53m07s	9°50'01"	15°50'01"	0.097	0.59663
5/13/1997	5:30	18:39	1h56m27s	8°47'15"	22°17'47"	0.216	0.67083
5/20/1997	5:15	18:33	2h12m15s	9°39'18"	25°06'46"	0.340	0.77161
5/27/1997	5:05	18:43	2h38m36s	11°59'54"	24°55'44"	0.466	0.88960
Venus							
5/ 6/1997	6:50	21:22	3h27m34s	18°34'03"	8°41'06"	0.989	1.70229
5/13/1997	6:48	21:39	4h03m00s	20°44'30"	10°31'36"	0.983	1.68984
5/20/1997	6:49	21:56	4h39m17s	22°27'10"	12°23'04"	0.977	1.67457
5/27/1997	6:53	22:10	5h16m16s	23°38'48"	14°15'04"	0.969	1.65653
Mars							
5/ 6/1997	15:22	4:19	11h15m32s	6°43'37"	121°36'42"	0.924	0.84566
5/13/1997	15:00	3:52	11h18m36s	6°06'34"	115°47'45"	0.913	0.89399
5/20/1997	14:41	3:27	11h23m31s	5°19'04"	110°29'23"	0.904	0.94429
5/27/1997	14:23	3:02	11h30m00s	4°22'33"	105°37'27"	0.896	0.99579
Jupiter							
5/ 6/1997	3:02	13:11	21h30m58s	-15°21'28"	85°23'02"	0.990	5.06922
5/13/1997	2:36	12:47	21h33m37s	-15°10'14"	91°29'16"	0.990	4.95850
5/20/1997	2:10	12:22	21h35m44s	-15°01'36"	97°42'14"	0.990	4.84821
5/27/1997	1:44	11:56	21h37m17s	-14°55'43"	104°02'35"	0.991	4.73959
Saturn							
5/ 6/1997	5:16	17:46	0h56m00s	3°34'09"	31°18'58"	0.999	10.29680
5/13/1997	4:50	17:23	0h58m53s	3°51'14"	37°17'43"	0.999	10.23132
5/20/1997	4:24	16:59	1h01m39s	4°07'16"	43°17'30"	0.999	10.15620
5/27/1997	3:58	16:35	1h04m16s	4°22'07"	49°18'49"	0.998	10.07226
Uranus							
5/ 6/1997	2:29	12:11	20h45m01s	-18°41'00"	96°51'36"	0.999	19.66908
5/13/1997	2:02	11:44	20h45m06s	-18°40'54"	103°36'30"	0.999	19.55373
5/20/1997	1:34	11:16	20h45m02s	-18°41'27"	110°22'23"	0.999	19.44173
5/27/1997	1:07	10:48	20h44m48s	-18°42'36"	117°09'26"	0.999	19.33464
Neptune							
5/ 6/1997	1:57	11:30	20h08m11s	-19°44'34"	105°33'29"	1.000	29.86582
5/13/1997	1:30	11:02	20h08m04s	-19°44'54"	112°21'23"	1.000	29.75305
5/20/1997	1:02	10:34	20h07m50s	-19°45'34"	119°09'23"	1.000	29.64573
5/27/1997	0:34	10:07	20h07m31s	-19°46'33"	125°57'38"	1.000	29.54532
Pluto							
5/ 6/1997	21:21	8:28	16h20m38s	-8°19'47"	156°57'11"	1.000	29.04378
5/13/1997	20:53	8:00	16h19m56s	-8°17'38"	162°13'19"	1.000	29.01246
5/20/1997	20:24	7:32	16h19m11s	-8°15'47"	166°00'05"	1.000	28.99495
5/27/1997	19:56	7:04	16h18m27s	-8°14'16"	166°57'19"	1.000	28.99139

Planet Conjunction/Opposition Report for May 1997

5/ 9/1997 Mercury @ Aphelion Distance from Sun: 0.47 AU
5/25/1997 Pluto @ Opposition Hour: 6

Moon Apsides Report for May 1997

Date	Hour	Apsis	Distance (km)	Diameter
5/ 3/1997	7	Perigee	366637	0.5432°
5/15/1997	6	Apogee	404217	0.4927°
5/29/1997	3	Perigee	369793	0.5386°

Meteor Showers Report for May 1997

Date	Meteor Shower	ZHR	RA	DEC	Illum. Frac.	Longitude
5/ 4/1997	eta-Aquarids	35	22h20m	-1°	0.05	45°
5/12/1997	alpha-Scorpiids	5	16h04m	-24°	0.35	52°

Twilight Report for May 1997

Date	Sun Rise	Sun Set	Astronomical Begin	Astronomical End	Nautical Begin	Nautical End	Civil Begin	Civil End
5/ 6/1997	6:21	20:38	4:25	22:35	5:07	21:52	5:45	21:14
5/13/1997	6:13	20:45	4:12	22:47	4:57	22:02	5:36	21:22
5/20/1997	6:07	20:52	4:01	22:59	4:48	22:11	5:29	21:30
5/27/1997	6:01	20:59	3:51	23:09	4:40	22:20	5:23	21:37

SKY & TELESCOPE NEWS BULLETINS

from the editors of Sky & Telescope magazine

PIONEER 10

On March 31 NASA ended its support for occasional tracking of Pioneers 6, 7, and 8, which orbit the Sun between Venus and Mars. Also shut down were the particle detectors on Pioneer 10, now nearly 10 billion km from the Sun. Pioneer 10's transmissions will continue to be used for training tracking-station operators, but no more scientific data will be returned.

NEW LOCAL GALAXY

Galaxies keep turning up where astronomers thought there was only blank sky, and a new one object has just been added to the 30 members of what's called the Local Group. Alan Whiting and George Hau (University of Cambridge) detected a large, extremely dim glow in the constellation Antlia. This newly discovered "Antlia Dwarf" is about 3.3 million light-years away, half again as far as the Andromeda Galaxy, and it contains only about a million stars — enough to make a dim, 16th-magnitude glow. The Antlia galaxy is centered at RA 10h 0.41m, DEC -27° 20'. It's only the second dwarf elliptical found to lie outside the gravitational dominance of a larger galaxy in the Local Group.

GAMMA-RAY BURSTERS: FAR OR NEAR?

On February 28, a gamma-ray detector aboard the Italian-Dutch spacecraft BeppoSAX was triggered, and the satellite's X-ray cameras saw a simultaneous flash in the constellation Orion. That alone was reason for interest, however, the news that followed has sent observatories worldwide into a flurry of activity. In a March IAU Circular, Paul J. Groot (University of Amsterdam) and his colleagues announced that they observed the X-ray hotspot with telescopes on La Palma and found a faint light source that faded from view between March 1 and 8. Observations from other observatories confirmed the likely existence of a distant galaxy. This encourages scientists who think gamma-ray bursts originate billions of light-years away. However, in another IAU Circular Patricia Caraveo (Institute of Cosmic Physics, Milan) and her colleagues report that a pointlike object seen by the Hubble Space Telescope in the same spot is moving a half-arcsecond per year. This could mean that the bursting gamma-ray source may be a relatively nearby object within our own Milky Way.

AS THE UNIVERSE TURNS?

Does the universe have something akin to a rotational axis? Two astronomers may have uncovered this surprising finding by studying radio observations of distant galaxies. In an issue of Physical Review Letters, John Ralston of the University of Kansas and Borge Nodland of the University of Rochester report on how the radio signals in the cosmos seem to be polarized preferentially in certain directions, suggesting that there is a universal axis. If confirmed, this could have significant consequences to our understanding of the universe. The researchers explain that the laws of electromagnetism may need revising, that the universe didn't expand as uniformly as now though, or that light in intergalactic space may travel at different speeds for some reason.

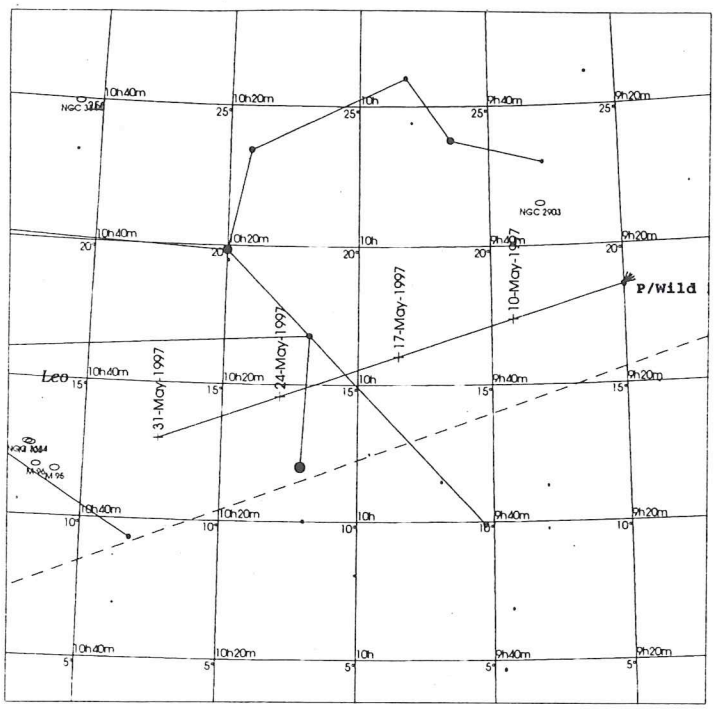
A NEW EXTRASOLAR PLANET

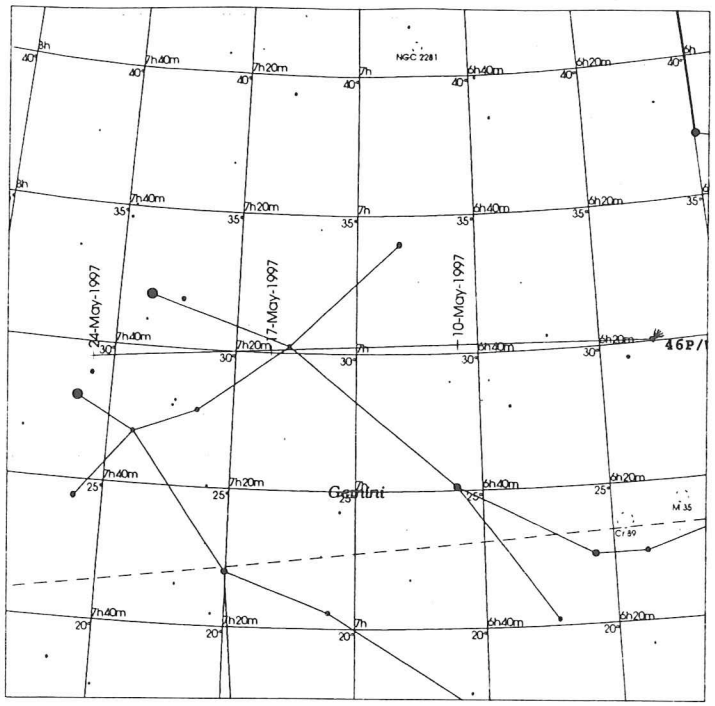
A team of astronomers has found evidence for a planet around Rho Coronae Borealis, a 5th-magntiude star about 78 light-years away. Spectroscopic measurements over 11 months show the star's velocity toward and away from Earth varies by ±67 m/s over a 40-day period. These values argue for a companion at least as massive as Jupiter in an orbit only about 1/4 the Earth-Sun distance. Since Rho Cor Bor is much like our Sun, the suspected planet would have a temperature of about 300° Celsius — making it an unlikely habitat for life. The companion's orbit is roughly circular, implying it formed at roughly that location from gas and dust in the coalescing nebula that created the star.

HALE-BOPP's THIRD TAIL

Comet Hale-Bopp has a tail of sodium atoms that is distinct from its dust and gas tails. This third tail was first seen on April 16 in images filtered to isolate the yellow light emitted by neutral sodium atoms. The sodium tail is nearly 7° long but too faint to be seen in normal photographs. Spectra show the sodium atoms are accelerating along the tail and reach 95 km/s at 11 million km from the nucleus. Apparently this acceleration is linked to the process of sodium's fluorescent glow. Its atoms absorb photons from the Sun but reradiate them in random directions, an imbalance that provides the accelerating force. ☆

FINDING COMET P/WILD2 AND COMET 46P/WIRTANEN





STARS	SOLAR SYSTEM				DEEP SKY	NOTES
<2 • 4.5	☿ Mercury	♅ Uranus	⬭ Galaxy			
2.5 • 5	♀ Venus	♆ Neptune	⊕ Globular Cluster	Created with SkyMap Software by Chris Marriott (www.skymap.com)		
3 • 5.5	♂ Mars	♇ Pluto	∴ Open Cluster			
3.5 >6	♃ Jupiter	☄ Comet	✧ Planetary Nebula			
4	♄ Saturn	⚬ Asteroid	□ Diffuse Nebula			
			○ Other Object			

Local Time: 22:00:00 3-May-1997 | UTC: 21:00:00 3-May-1997 | Sidereal Time: 11:37:06
Location: 53° 27' 0" N 2° 31' 0" W | RA: 10h00m00s Dec: +16° 00' Field: 25.0° | Julian Day: 2450572.3750

STARS	SOLAR SYSTEM				DEEP SKY	NOTES
<2 • 4.5	☿ Mercury	♅ Uranus	⬭ Galaxy			
2.5 • 5	♀ Venus	♆ Neptune	⊕ Globular Cluster	Created with SkyMap Software by Chris Marriott (www.skymap.com)		
3 • 5.5	♂ Mars	♇ Pluto	∴ Open Cluster			
3.5 >6	♃ Jupiter	☄ Comet	✧ Planetary Nebula			
4	♄ Saturn	⚬ Asteroid	□ Diffuse Nebula			
			○ Other Object			

Local Time: 22:00:00 3-May-1997 | UTC: 21:00:00 3-May-1997 | Sidereal Time: 11:37:06
Location: 53° 27' 0" N 2° 31' 0" W | RA: 7h00m00s Dec: +30° 00' Field: 25.0° | Julian Day: 2450572.3750

Ford Amateur Astronomy Club
Star Stuff Newsletter
P.O. Box 7527
Dearborn, MI 48121