Star Stuff

FERA
Ford Employees Recreation Association

THE FORD AMATEUR ASTRONOMY CLUB NEWSLETTER

Volume 6, Number 6 June 1997

UK ASTRONOMERS HELP TO RECHART THE HEAVENS

From: Royal Astronomical Society Press Notices
Issued by: Dr Jacqueline Mitton, RAS Public Relations Officer

Almost 300 scientists from all over the world gathered in Venice to present startling new evidence which will revolutionise our understanding of the scale of the heavens. The exciting new results include the discovery that many so-called 'local' stars and galaxies are not where we thought they were at all. Some are nearer than previously believed, while others are much further away. Similar evidence was also presented for some of the moons of Jupiter and Saturn. In addition, astronomers provided confirmation that the universe is perhaps 5-10% larger and older than suggested by earlier measurements.

The Venice '97 Symposium took place from 13-16 May. It was called to bring together the results from Europe's unique astrometry mission, Hipparcos, and coincides with the publication of the first accurate censuses of the stars in our Galaxy. The Hipparcos Catalogue contains information on the positions of 118,218 stars while the Tycho Catalogue gives rather less precise information on a further 1,038,332 stars.

New Results : A major surprise involves a catalogue of about 3000 'nearby' stars which were all thought to lie within some 75 light years of the Sun. Hipparcos data indicate that some 20 to 30 percent of these stars are much further away than this limit, putting in doubt some of the other indirect ways currently used to calibrate stellar distances. This result may have serious implications for our understanding of the galactic distance scale.

Andrew Murray, formerly of the RGO, and collaborators made a similar selection of stars thought to be within 250 light years. New results to be presented in Venice indicate that only about half of the original group are actually within this distance. A discussion of the dynamics of these stars will be presented by Dr. Margaret Penston of RGO and Dr. James Binney of Oxford University. In addition, a group led by Dr. Michael Perryman of ESTEC / Leiden Observatory has obtained very significant improvements in our knowledge of the nearby Hyades star cluster. A distance estimate almost 10 times more accurate than that obtained from the ground is now available, and various uncertainties in earlier ground-based determinations can now be eliminated.

Closer to home, Hipparcos also measured the positions of two moons of Jupiter, Europa and Callisto, and Titan, the largest moon of Saturn, as well as some 40 minor planets. The measurements of the moons analyzed by Dr. Leslie Morrison of RGO and others show that small discrepancies between available ephemerides (predicted positions) and observations as made by the Carlsberg Meridian Circle are confirmed by the Hipparcos data. These results will be of crucial importance in the planning of interplanetary space missions. Similar observations by the Carlsberg telescope were used to direct the Galileo spacecraft close to the asteroids Ida and Dactyl en route to Jupiter.

Some of the results have already been presented in preliminary form at an RAS meeting in London last February. Updates on these will be given at the Venice Symposium. They include the first parallax-based calibration of the positions of Cepheid variable stars by Dr. Michael Feast (University of Cape Town) and Dr. Robin Catchpole (Royal Greenwich Observatory), and of Mira variables by Drs. Floor van Leeuwen (RGO), Michael Feast and Patricia Whitelock (SAAO). These studies have already shown that two neighbouring galaxies known as the Magellanic Clouds seem to be some 5 percent further away than was previously thought — 171,000 light years for the Large Magellanic Cloud instead of 163,000. By extrapolation, the data also suggest that the universe is between 10 and 12 billion years old — about 5 percent older (and larger) than previously estimated.

Cepheids and Miras are important stepping stones on the extra-galactic distance scale because there is a direct relationship between the rate of their fluctuation and the brightness of these natural 'candles' — a so-called period-luminosity relationship. The brightness of the stars will obviously diminish with distance. So, once the distances of a few Cepheids are known, the distances of all the others can be accurately calculated.

Further research by Dr. van Leeuwen has produced one of the most unexpected results: the finding that the Pleiades cluster lies some 15 percent closer to the Sun than had been assumed over the past 50 years. This means that stars in this cluster have a relatively low luminosity for their temperature. The reasons behind this phenomenon are still very unclear, and the only explanation currently available, a much increased helium abundance for all stars in this cluster, appears rather unlikely. Measurements from spectra of early type stars in this cluster will be needed to clear up the mystery.

The Hipparcos parallax data also provides the first serious possibility to obtain more detailed calibrations of stellar luminosities. The understanding of how the brightness of stars is affected by chemical composition, stellar rotation and age will no longer have to rely almost entirely on theoretical models. This will help define better boundaries for the models of stellar structure and stellar evolution.

Notes :

1. THE HIPPARCOS MISSION : Hipparcos is unlike any other space mission in two main respects. Firstly, all of the objects to be studied were decided upon before launch, with all programme stars in the 'Input Catalogue' being observed at regular intervals through the mission. Secondly, the entire, complex data stream was reduced independently by two separate consortia of scientists.

The mission started badly with the failure of the Apogee Boost Motor which placed the satellite in the wrong orbit. This was a highly elliptical path, requiring much greater input from ground control, additional ground stations and adaptations of some of the data reduction software. The data return was significantly better than expected due to the efforts of the operation teams at ESOC and ESTEC and to the data reduction consortia. Hipparcos was built by the European Space Agency. It was launched in August 1989 and remained operational until March 1993. The aim of the mission was to accurately measure the positions of more than 100,000 stars and some solar system objects.

2. ASTROMETRY: PARALLAX AND PROPER MOTION : One of the key methods was to measure the apparent shift in location of each star against the celestial background as seen from the Earth (and Hipparcos) at different times of year. Just as a finger held in front of one's face seems to shift position as first one eye and then the other is opened and closed, so stars also seem to shift position when seen from different viewpoints. This is known as parallax. If we know the distance between both eyes and the angle from each eye to the finger, we can calculate the finger's position by triangulation. Similarly, since we know the distance between the Earth and the Sun (93 million miles or 150 million km) and the parallax angles for each star, we can work out the distances to the stars.

Another important yardstick can also be determined from Hipparcos data — the proper motions of the stars. The proper motion is the real movement of the star across the sky and is a partial reflection of its motion through space relative to the Sun. Usually, the further the star, the smaller its proper motion. Astrometric measures are of fundamental importance in many areas of astronomical study. For example, they allow astronomers to learn about the structure of our Milky Way galaxy, and to calculate the distance scale of the universe.

(continued on page 2)

(continued from page 1)

3. IMPORTANCE OF ASTROMETRY FROM SPACE : Astrometric measurements are usually very hard to make since their accuracy is severely limited by the Earth's atmosphere. Another problem is that stellar parallaxes are very small since the stars are so far away. From the ground the most accurate measurements have been to a precision of about 8 milliarcseconds. These problems were overcome when Hipparcos went into orbit. The satellite succeeded in fixing stellar positions to within 1 - 2 milliarcseconds (equivalent to measuring the height of a child standing on the moon). As a result, the number of stars for which a direct measurement of distance is known has dramatically increased. ☆

NEW INSIGHTS FROM GALILEO

From: NASANews@hq.nasa.gov (RELEASE: 97-110)

Jupiter's icy moon Europa has a metallic core and layered internal structure similar to the Earth's, while the heavily cratered moon Callisto is a mixture of metallic rock and ice with no identifiable central core, according to new results from NASA's Galileo mission. In addition, recent plasma wave observations from Galileo show no evidence of a magnetic field or magnetosphere around Callisto, but do hint at the prospect of a tenuous atmosphere. These peer-reviewed findings, reported in Science magazine and Nature magazine, are based on data gathered during Galileo's Nov. 4, 1996, flyby of Callisto and its Europa encounters on Dec. 19, 1996, and Feb. 20, 1997.

"Before Galileo, we could only make educated guesses about the structure of the Jovian moons," said Dr. John Anderson, a planetary scientist at NASA's Jet Propulsion Laboratory (JPL). "Now, with the help of the spacecraft, we can measure the gravitational fields of the satellites and determine their interior structure and density. We can determine how the matter is distributed inside."

While scientists use seismic waves to study Earth's interior, Galileo performs remote studies of Jupiter's moons by measuring small changes in the spacecraft's trajectory as it passes each body. "These new results from the gravity data are very consistent with the idea of subsurface oceans on Europa," Anderson said. "We know that Europa has a very deep layer of water in some form, but we don't yet know whether that water is liquid or frozen."

In an article appearing in the May 23 edition of Science, Dr. Margaret Kivelson, principal investigator for Galileo's magnetometer, reports that during its December 1996 pass by Europa, the magnetometer detected what she described as "a substantial magnetic signature," and also found that Europa's north magnetic pole is pointed in an odd direction. Based on these observations, Kivelson, a professor at the University of California at Los Angeles, said Europa may have a magnetic field about one-quarter the strength of Ganymede's magnetic field. Although the magnetometer was malfunctioning during Galileo's Europa flyby in February 1997, Kivelson said the problem is corrected and the device is expected to return valuable data during its upcoming Europa flybys. The next Europa encounter is scheduled for November, with a series of flybys planned during a two-year Galileo extended mission.

Galileo's findings on the Jovian moon Callisto revealed a much different structure than Europa. Scientists believe that because Callisto is the Galilean moon located farthest from Jupiter, it was never subjected to the same gravitational pull as the inner moons and, therefore, never experienced enough heating to form different layers. "Callisto had a much more sedate, predictable and peaceful history than the other Galilean moons," Anderson explained, "and, therefore, it is a more typical solar system object." The findings indicate Callisto has no core, but instead has a homogeneous structure, with 60 percent of its ingredients being rock, including iron and iron sulfide, and 40 percent made of compressed ice.

Dr. Donald Gurnett, principal investigator for the Galileo spacecraft's plasma wave instrument, said the instrument displayed a very minor response from Callisto and, consequently, showed no evidence of a magnetic field or magnetosphere. The latest issue of Nature magazine contains these findings, as well as supportive data from magnetometer studies of Callisto, as reported by Dr. Krishan Khurana of UCLA. However, Gurnett added, "There is some evidence of a plasma source on Callisto, which might indicate a very tenuous atmosphere." Gurnett is a professor at the University of Iowa at Iowa City.

The Galileo spacecraft was launched in October 1989 and entered orbit around Jupiter on Dec. 7, 1995. The Galileo mission is managed by JPL for NASA's Office of Space Science, Washington, DC. Images and other data from Galileo are posted on the Galileo mission home page on the World Wide Web at URL: http://www.jpl.nasa.gov/galileo. ☆

STAR STUFF
Monthly Publication of the Ford Amateur Astronomy Club

Star Stuff Newsletter
P.O. Box 7527
Dearborn, Michigan 48121-7527

1997 CLUB OFFICERS

President:	Bob MacFarland	313-33-79754
Vice President:	George Korody	248-349-1930
Secretary:	Harry Kindt	313-835-1831
Treasurer:	Ray Fowler	313-8292182 (pager)

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

Editor:	Paul Mrozek (313-33-73619)
Inter-company Mail:	MD 57, POEE.
E-mail:	pmrozek; pmrozek@pt0106.pto.ford.com pmrozek@ford.com (outside of Ford)

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.

JUNE 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	23	24	25	26 FAAC Meeting	27	28
29	30					

June 01 Moon Occults Saturn
June 03 Asteroid 354 Eleonora at Opposition (10.5 Magnitude)
June 05 New Moon (3:06 am)
June 13 Moon Occults Mars
June 13 First Quarter Moon (12:53 am)
June 15 Comet Hale-Bopp is 3.5 degrees from Comet Encke
June 15 Comet Mrkos, Closest Approach to Earth (1.7968 AU)
June 15 Venus at Perihelion
June 17 Asteroid 15 Eunomia at Opposition (9.2 Magnitude)
June 18 Jupiter Occults PPM 239210 (10.0 Magnitude Star)
June 19 Asteroid 1992 LR Near-Earth Flyby (0.2426 AU)
June 19 Comet 1997 A1 Perihelion (3.159 AU)
June 20 Full Moon (3:12 pm)
June 21 Summer Solstice
June 27 Last Quarter Moon (8:44 am)
June 28 Moon Occults Saturn
June 29 Asteroid 6524 Baalke at Opposition (15.5 Magnitude) ☆

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, June 26, at 5:00 pm.** The agenda is usually announced a couple of days before the meeting.

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. ☆

5/22/97 FAAC MEETING MINUTES

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

The meeting was called to order at 5:05 PM by our president Bob MacFarland. There were 23 members and guests present.

Bob MacFarland announced that The Nature Company of Macomb Mall was holding a mini-star party on the top deck of the parking structure at the mall. The event was scheduled for Saturday, May 24 and members were encouraged to bring their telescopes. In addition, Bob mentioned the upcoming Summer Solstice star party at Doug Bock's Northern Cross Observatory in Fenton Mi. scheduled for the weekend of June 6-8. Bob also said that Doug was still looking for the loan of a flat-bed truck and some help in dis-mantling and moving an observatory to his site in Fenton.

The treasurers report was read and accepted.

Bob MacFarland noted that a list of ticket prices for various events was available from the FERA organization. Club members are encouraged to get involved in the sale of these tickets in order to maintain a good relationship with the FERA folks.

Don Klaser had nothing new to report on the activities of the Public Relations/ Education committee. He did, however, mention that we should begin to think about our Fifth Annual Star Party which is scheduled for September 6, 1997 at the Island Lake Recreation Area. All members are encouraged to submit ideas and, of course, to volunteer their assistance.

There was no new business to be brought before the membership.

George Korody had nothing new to report on the Lake Hudson dark sky observing party. We are still awaiting word from the Lenawee club on obtaining a 36" yard scope for use at the event. No definite date has been set, but it looks like it will take place in late July or early August.

Greg Burnett reported on the new format that is now in effect for the Hot-Line. Members are being asked to leave a message on the Hot-Line if they have plans too go out to Island Lake for an observing session. The Hot-Line will be updated indicating that members will be out at the site. Remember that the gate is now secured with a combination lock after 10:00 PM. Members are to secure the gate upon entering or leaving the park after that time. The combination to the lock will be available over the Hot-Line.

Over our usual pizza and pop, those present had the opportunity to introduce themselves and to describe some of their viewing experiences since our last meeting. Most of the discussion was about the very successful Hale-Bopp comet party held at Kensington Metro Park on April 25-26.

Our featured speaker for the evening was Greg Burnett who gave an excellent and comprehensive talk on Astro-Photography. Thank you Greg.

Bob Justin also attended our meeting and assisted George Korody in making some minor repairs to George's recently acquired LX-200 scope. Thank you Bob.

The meeting adjurned around 6:45 pm. ☆

JUNE SPACE HISTORY

The following June events come from the 03/19/97 edition of "Space Calendar." This calendar is compiled and maintained by Ron Baalke (baalke@kelvin.jpl.nasa.gov).

June 07 5th Anniversary (1992), EUVE Launch
June 12 30th Anniversary (1967), Venera 4 Launch (Soviet Venus Lander)
June 14 30th Anniversary (1967), Mariner 5 Launch (Venus Flyby)
June 24 15th Anniversary (1982), Soyuz T-6 Launch (USSR)
June 25 5th Anniversary (1992), STS-50 Launch, US Microgravity Lab
June 27 15th Anniversary (1982), STS-4 Launch, 1st Shuttle DOD Mission
June 27 15th Anniversary (1982), STS-4 Launch, Last Test Flight ☆

JUNE 1997 SPACE EVENTS

The following June 1997 events come from the 03/19/97 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.

June ?? Astra-1G Proton Launch
June ?? UHF-F8 Atlas 2 Launch
June ?? Intelsat 802 Ariane 4 Launch
June 02 Galileo, Orbital Trim Maneuver #28 (OTM-28)
June 15 Clark LMLV-1 Launch
June 20 NEAR, Trajectory Correction Maneuver #6 (TCM-6)
June 22 Galileo, Orbital Trim Maneuver #29 (OTM-29)
June 24 Mars Pathfinder, Trajectory Correction Maneuver #4 (TCM-4)
June 24 Soyuz TM-26 Launch (Russia)
June 25 Galileo, 2nd Caliisto Flyby (Orbit 9)
June 26 Galileo, Ganymede Observations (Orbit 9)
June 27 NEAR, Asteroid Mathilde Flyby ☆

HIPPARCOS IMPACTS EVOLUTION

ESA Press Release (esapress@esoc.esa.de): Nr 14-97 - Paris 12 May 1997

The impact of Hipparcos star-fixing extends to life's evolution

To find anything to rival the new results on star positions and motions from the Hipparcos satellite, the European Space Agency's director of science has to look back 400 years. Commenting on the Hipparcos Symposium which commences in Venice on 13 May, Roger Bonnet compares it to astronomy in Denmark at the end of the 16th Century.

"ESA's Hipparcos brings the greatest step forward in star measurements since Tycho Brahe," Bonnet says. "When the Danish astronomer died in 1601, the German astronomer Johannes Kepler inherited his careful observations. Kepler used them to discover the laws of the motions of planets, and paved the way for Isaac Newton's gravitational theory. Now we have another multinational success story from European astronomy".

"Hipparcos began as an imaginative French concept to chart the stars by satellite," Bonnet continues. "ESA adopted the idea and many astronomers in our member states collaborated in the mission. A hundred-fold improvement in the accuracy of star positions may already alter the size of the Universe and the ages of stars. So don't be surprised if the results from Hipparcos are as revolutionary as Tycho Brahe's, in their impact on our knowledge of the cosmos."

The study of the Earth itself will benefit from the new star data. Wobbles of the Earth and variations in its rate of rotation can now be measured far more accurately. The ozone layer will be monitored by ESA's Envisat environmental mission, by looking for chemical alterations in the light from 1000 Hipparcos stars, when seen on lines of sight slanting through the atmosphere.

Even the erratic evolution of life on Earth may make more sense, as Hipparcos picks out stars that passed close enough to cause trouble here. Reliable identifications of stars heading towards or away from our vicinity were impossible before Hipparcos. The satellite measured shifts in the directions of stars in the sky with such high precision that astronomers can now pick out those few stars that scarcely change their bearings. Such stars are probably moving almost directly towards or away from us. A US-European team, led by Robert Preston at the Jet Propulsion Laboratory, used Hipparcos to search for nearby stars with very small shifts in position. They were, or will be, passers-by.

Gliese 710, an inconspicuous star in the constellation Ophiuchus, is currently 63 light-years away and approaching at about 14 kilometres per second. From the Hipparcos data, it will pass within about one light-year, one million years from now. Joan Garcia-Sanchez, a doctoral student in Preston's team, identifies Gliese 710 in one of the scientific posters that display Hipparcos results in Venice. Garcia-Sanchez has found evidence that Gliese 710 is today moving more slowly towards the Sun than it was several decades ago. That may mean it is orbiting around another star, so far unidentified. If so, the closest distance to which Gliese 710 will approach may be nearer or farther than in the team's initial estimate.

The stars of the Alpha Centauri system, at 4 light-years, are the nearest at present. Several stars investigated by Preston and his colleagues will come within 3 light-years during the next 8,500,000 years. Others have already passed by during a similar time-span and are now travelling away from us.

"A star coming too near could put the Earth at risk," Bob Preston explains. "It might dislodge comets from a swarm that surrounds the Sun in the Oort Cloud, and send them into the inner Solar System. Some comets could then collide with our planet. The fossils tell us of past disasters, in extinctions of many species, and we hope to identify culprits among stars now hurrying away from the scene. The theory isn't new, but only now can we check it, thanks to the amazing precision of Hipparcos."

Uncertainty about the timing of the stellar visits arises from inadequate information about the speed of approach or recession. That is measured from ground-based observatories, by shifts in the wavelengths of light (blueshifts and redshifts). A team led by Dave Latham at the Center for Astrophysics in Cambridge, Massachusetts, is busy making fresh observations to improve the ground-based data on the visitors, past and future.

The Hipparcos Catalogue and the wider Universe

Hipparcos results fill large catalogues due for release to the world's astronomers via the Internet and in CD-ROMs early in June, and in 16 printed volumes soon afterwards. These are results of four years of space observations, 1989-93, and a further three years of intensive computation. The Hipparcos Catalogue echoes the name of Hipparchus, who founded astrometry in ancient Greece. It gives precise data on 118,000 stars. A million stars, logged with lesser but still unprecedented ccuracy, comprise the Tycho Catalogue, named after Tycho Brahe.

The role of Albert Einstein's theory of gravity illustrates the extraordinary accuracy of the Hipparcos Catalogue. General Relativity predicts a deflection of starlight by the Sun's gravity. Hitherto this was confirmed only with objects seen within a degree or two of the edge of the Sun, where the effect is strongest. Hipparcos was sensitive to the bending of light-rays even in directions at right angles to the Sun. If the computations had ignored General Relativity the star-fixing would be less accurate. Conversely, Einstein's predictions are found to be correct to within one part in a thousand.

As well as the positions, distances and motions of many stars, the Hipparcos Catalogue includes unprecedented surveys of double and variable stars. Hipparcos observed 24,000 double stars in the Hipparcos Catalogue, of which 10,000 were not previously known to be double. Frequent observations, over the four years of the space operations, monitored the changes in brightness of 12,000 known variable stars, and discovered 8000 more.

The stars charted by Hipparcos are relatively close, compared with the galaxies. Eleven teams of astronomers have cooperated in linking them to the wider cosmos, defined in the International Celestial Reference Frame. They matched Hipparcos stars to galaxies near the lines of sight, to the major photographic surveys of the sky, and to the sharp observations in long-range astronomy that come from widely spaced radio instruments and the Hubble Space Telescope. Radio astronomers will henceforward be able to correct any mismatch, by comparing nearby radio sources in the Hipparcos Catalogue with the positions of distant quasars.

Jean Kovalevsky of the CJte d'Azur Observatory in Grasse, France, coordinated this work of uniting Hipparcos results with the cosmos in general. He is also the leader of the consortium called FAST (Fundamental Astronomy by Space Techniques) which is one of two multinational teams that worked in parallel to generate the basic Hipparcos Catalogue.

"We have related the stars of Hipparcos to the whole Universe of galaxies and quasars, to better than two tenths of a millionth of a degree," Kovalevsky reports. "We have also got rid of a possible rotation of the system of Hipparcos stars, to more than twice that precision. And the wide Universe gives us a more reliable reference frame for the sky and the stars than our spinning, wobbling and orbiting planet has ever provided."

Among the astronomical space missions already adopting Hipparcos data for better aiming is ESA's Infrared Space Observatory ISO. The forthcoming X-ray astronomy missions, NASA's AXAF and ESA's XMM, will rely on Hipparcos when searching the sky Hipparcos stars will also guide deep space probes, including the NASA-ESA Cassini/Huygens mission to Saturn and Titan, and ESA's Rosetta mission to Comet Wirtanen.

The Tycho project progresses from 1,000,000 to 3,000,000 stars

The Tycho Catalogue gives the positions of many more stars, so although its accuracy is about one-tenth as good as the Hipparcos Catalogue's, it is the more generous source of greatly improved data for the world's astronomers. Plotting and characterizing eight times as many stars as the Hipparcos Catalogue, the Tycho Catalogue offers a comprehensive survey of the stars around the Sun. It includes 99.9 per cent of stars down to magnitude 10, which means stars 100 times fainter than the unaided human eye can normally see. Russian and German astronomers are now comparing the Tycho results on a million stars with positions of the same stars observed from the ground during the past 100 years, to measure their motions across the sky.

The Danish astronomer Erik Hog is a worthy heir of Tycho Brahe. He adopted a star mapper, installed in Hipparcos for checking the telescope's aim, as an additional source of astrometric data. From Copenhagen University Observatory he led the multinational Tycho Data Analysis Consortium (TDAC) which produced the Tycho Catalogue.

"A million million bits of data came from our star mapper in Hipparcos," Hog remarks. "We nearly drowned in the torrent when we started. So we limited the Tycho Catalogue to one million stars, in order to keep up with the work on the Hipparcos Catalogue. With more experience and faster computers, and based on the Hipparcos and Tycho Catalogues, we've started work on a Second Tycho Catalogue of three million stars. We hope to have it ready by 1999." ☆

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 June 1997

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 SR: 5:59 SS: 21:03 MR: 3:50 MS: 17:09	2 SR: 5:58 SS: 21:04 MR: 4:26 MS: 18:16	3 SR: 5:58 SS: 21:04 MR: 5:05 MS: 19:22	4 SR: 5:57 SS: 21:05 MR: 5:47 MS: 20:24	5 SR: 5:57 SS: 21:06 MR: 6:34 MS: 21:22	6 SR: 5:57 SS: 21:07 MR: 7:24 MS: 22:15	7 SR: 5:56 SS: 21:07 MR: 8:18 MS: 23:01
8 SR: 5:56 SS: 21:08 MR: 9:13 MS: 23:42	9 SR: 5:56 SS: 21:08 MR: 10:10 MS: None	10 SR: 5:56 SS: 21:09 MR: 11:07 MS: 0:18	11 SR: 5:56 SS: 21:09 MR: 12:04 MS: 0:50	12 SR: 5:55 SS: 21:10 MR: 13:01 MS: 1:20	13 SR: 5:55 SS: 21:10 MR: 13:58 MS: 1:49	14 SR: 5:55 SS: 21:11 MR: 14:55 MS: 2:17
15 SR: 5:55 SS. 21:11 MR: 15:54 MS: 2:46	16 SR: 5:55 SS: 21:12 MR: 16:55 MS: 3:17	17 SR: 5:55 SS: 21:12 MR: 17:56 MS: 3:50	18 SR: 5:56 SS: 21:12 MR: 18:59 MS: 4:29	19 SR: 5:56 SS: 21:13 MR: 20:00 MS: 5:12	20 SR: 5:56 SS: 21:13 MR: 21:00 MS: 6:03	21 SR: 5:56 SS: 21:13 MR: 21:55 MS: 7:00
22 SR: 5:56 SS: 21:13 MR: 22:44 MS: 8:04	23 SR: 5:57 SS: 21:13 MR: 23:28 MS: 9:12	24 SR: 5:57 SS: 21:13 MR: None MS: 10:22	25 SR: 5:57 SS: 21:13 MR: 0:08 MS: 11:33	26 SR: 5:58 SS: 21:14 MR: 0:45 MS: 12:43	27 SR: 5:58 SS: 21:14 MR: 1:19 MS: 13:52	28 SR: 5:58 SS: 21:13 MR: 1:54 MS: 15:00
29 SR: 5:59 SS: 21:13 MR: 2:28 MS: 16:07	30 SR: 5:59 SS: 21:13 MR: 3:05 MS: 17:12			Lunar Events June 05 NM: 3:06 June 13 FQ: 0:53 June 20 FM:15:12 June 27 LQ: 8:44		

Planet View Info Report for June 1997

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
Mercury							
6/ 3/1997	5:00	19:06	3h14m29s	15°17'55"	22°16'35"	0.601	1.01803
6/10/1997	5:03	19:42	4h00m11s	19°00'06"	17°24'52"	0.753	1.14732
6/17/1997	5:18	20:27	4h56m26s	22°21'50"	10°31'32"	0.907	1.25815
6/24/1997	5:46	21:13	6h01m23s	24°21'55"	2°24'10"	0.995	1.32033
Venus							
6/ 3/1997	7:00	22:23	5h53m42s	24°16'55"	16°07'16"	0.960	1.63571
6/10/1997	7:10	22:33	6h31m17s	24°20'09"	17°59'25"	0.950	1.61207
6/17/1997	7:23	22:40	7h08m40s	23°48'21"	19°51'22"	0.939	1.58565
6/24/1997	7:37	22:43	7h45m29s	22°42'37"	21°42'44"	0.926	1.55661
Mars							
6/ 3/1997	14:08	2:39	11h37m52s	3°18'10"	101°08'20"	0.890	1.04795
6/10/1997	13:54	2:16	11h46m56s	2°06'49"	96°59'21"	0.886	1.10027
6/17/1997	13:41	1:54	11h57m03s	0°49'27"	93°08'07"	0.883	1.15226
6/24/1997	13:30	1:32	12h08m05s	-0°33'01"	89°32'04"	0.881	1.20360
Jupiter							
6/ 3/1997	1:17	11:30	21h38m15s	-14°52'45"	110°31'07"	0.991	4.63394
6/10/1997	0:50	11:03	21h38m37s	-14°52'49"	117°08'16"	0.992	4.53270
6/17/1997	0:22	10:35	21h38m21s	-14°55'58"	123°54'01"	0.993	4.43739
6/24/1997	23:50	10:06	21h37m30s	-15°02'05"	130°48'25"	0.994	4.34940
Saturn							
6/ 3/1997	3:32	16:10	1h06m42s	4°35'41"	55°22'21"	0.998	9.98033
6/10/1997	3:06	15:46	1h08m56s	4°47'51"	61°28'31"	0.998	9.88134
6/17/1997	2:40	15:21	1h10m57s	4°58'30"	67°37'31"	0.998	9.77646
6/24/1997	2:14	14:56	1h12m43s	5°07'33"	73°49'50"	0.997	9.66687
Uranus							
6/ 3/1997	0:39	10:20	20h44m24s	-18°44'21"	123°57'59"	1.000	19.23393
6/10/1997	0:11	9:52	20h43m52s	-18°46'38"	130°47'59"	1.000	19.14112
6/17/1997	23:39	9:24	20h43m12s	-18°49'26"	137°39'10"	1.000	19.05765
6/24/1997	23:11	8:55	20h42m24s	-18°52'39"	144°31'32"	1.000	18.98470
Neptune							
6/ 3/1997	0:06	9:38	20h07m05s	-19°47'49"	132°46'28"	1.000	29.45319
6/10/1997	23:34	9:10	20h06m35s	-19°49'21"	139°35'50"	1.000	29.37073
6/17/1997	23:06	8:42	20h06m00s	-19°51'07"	146°25'31"	1.000	29.29917
6/24/1997	22:38	8:14	20h05m21s	-19°53'05"	153°15'32"	1.000	29.23947
Pluto							
6/ 3/1997	19:28	6:36	16h17m41s	-8°13'07"	164°34'17"	1.000	29.00185
6/10/1997	18:59	6:07	16h16m57s	-8°12'23"	160°01'33"	1.000	29.02622
6/17/1997	18:31	5:39	16h16m14s	-8°12'04"	154°27'54"	1.000	29.06409
6/24/1997	18:03	5:11	16h15m34s	-8°12'12"	148°26'03"	1.000	29.11480

Planet Conjunction/Opposition & Apsides Report for June 1997

6/15/1997	Venus @ Perihelion	Distance from Sun: 0.72 AU
6/22/1997	Mercury @ Perihelion	Distance from Sun: 0.31 AU
6/25/1997	Mercury @ Superior Conjunction	Hour: 20

Moon Apsides Report for June 1997

Date	Hour	Apsis	Distance (km)	Diameter
6/12/1997	1	Apogee	404185	0.4927°
6/24/1997	1	Perigee	366492	0.5434°

Meteor Showers Report for June 1997

Date	Meteor Shower	ZHR	RA	DEC	Illum. Frac.	Longitude
6/ 9/1997	Ophiuchids	5	17h56m	-23°	0.20	79°
6/19/1997	Ophiuchids	5	17h20m	-20°	0.99	89°

Twilight Report for June 1997

Date	Sun Rise	Sun Set	Astronomical Begin	Astronomical End	Nautical Begin	Nautical End	Civil Begin	Civil End
6/ 3/1997	5:58	21:04	3:43	23:19	4:35	22:27	5:18	21:44
6/10/1997	5:56	21:09	3:38	23:27	4:32	22:33	5:16	21:49
6/17/1997	5:55	21:12	3:36	23:31	4:31	22:37	5:15	21:52
6/24/1997	5:57	21:13	3:37	23:33	4:32	22:38	5:17	21:53

SKY & TELESCOPE NEWS BULLETINS

from the editors of Sky & Telescope magazine

GEMINGA's PLANET?

In May more than 300 scientists met in Williamsburg, Virginia, to announce the latest discoveries from the Compton Gamma Ray Observatory (CGRO). John R. Mattox (Boston University) and his colleagues have been using CGRO to time clocklike blips from Geminga, an enigmatic pulsar some 500 light-years from Earth. Their data reveal a 5.1-year cycle that may be due to a planet with 1.7 times the mass of Earth. Mattox stresses that the pulsar's shifting emissions have been traced reliably for only one cycle; they could simply reflect changes in the pulsar's internal structure. Confirming the planet hypothesis will require further timing data or other evidence, like an eclipse of Geminga. Although there are a few other promising suspects, only one other pulsar, PSR 1257+12 in Virgo, is widely believed to harbor three (and possibly four) planets. Unfortunately for SETI fans, pulsar planets are unlikely homes for life; they are bombarded by showers of energetic particles that vastly dwarf even the most energetic solar flares.

NO LOPSIDED UNIVERSE?

Does the universe as a whole have a preferred direction? Borge Nodland (University of Rochester) and John P. Ralston (University of Kansas) made such a claim last month, based on their observation that radio waves from distant galaxies seemed polarized in a manner that varies from one side of the sky to the other, thus defining a preferred axis. But that would violate a cherished cosmological axiom: the universe should look the same in all directions.

Since then other astronomers have come forward to question the finding. Sean M. Carroll (University of California, Santa Barbara) and George B. Field (Harvard-Smithsonian Center for Astrophysics) have reexamined Nodland and Ralston's data and found their result statistically insignificant. And a group led by John F. C. Wardle (Brandeis University) used the Very Large Array (VLA) radio telescope in New Mexico and the 10-meter Keck telescope in Hawaii to look for the telltale polarization in 26 quasars — but they can't see it. Finally, Stanford astronomers Ronald N. Bracewell and Von R. Eshleman point out that the suspected axis lies within 30 degrees of known hot and cold spots in the cosmic microwave background. Those spots exist because our solar system is in orbit around the center of the Milky Way, which itself is bound to the Virgo Cluster of galaxies. Our motion with respect to the universe at large, they suggest, may explain the controversial findings.

GAMMA-RAY BURST CAPTURED!

The three decade-old mystery of gamma ray bursters — brief flashes of gamma rays that occur in seemingly random points on the sky — is beginning to clear. Only recently have visible-light manifestation of the bursts had been found, thanks to the quick alerts provided by an Italian and Dutch satellite called BeppoSAX. One of these events was caught on February 28th. Another one on May 8th, was imaged with Kitt Peak National Observatory's 36-inch reflector by Howard E. Bond (Space Telescope Science Institute). One day after his first observations, one starlike point had brightened by about 1 magnitude. Observations made around the world have since shown that the variable "star" peaked around May 10th at 20th magnitude. As reported this week in IAU Circular 6655, Caltech astronomers were able to obtain a spectrum before it faded using the Keck II telescope. That spectrum shows the signature of intervening iron and magnesium, but at a distance of several billion light-years. While this appears to confirm that gamma-ray bursters are very distant objects, it also makes their stupendous energy harder than ever to account for. If the gamma rays seen on May 8th indeed originated at that distance, they amounted to per second as much energy as our Sun has emitted in the last five billion years.

JUPITER WATCH

Elsewhere in the solar system, there's interesting atmospheric activity on Jupiter, according to John Rogers of the British Astronomical Association. On May 13th, he announced that a white oval in the planet's South Tropical Zone is impinging on the Great Red Spot. At that time, the oval was beginning to show signs of being disturbed. Rogers is calling for images and observations to monitor what he calls an "unprecedented" event. While you're watching Jupiter's clouds, don't forget to try for the mutual eclipses and occultations of the planet's four largest satellites. For a time table of these so-called mutual events, see page 78 of the June issue of Sky & Telescope.

COMET HALE-BOPP : KENSINGTON STAR PARTY 4/26/97

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