The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Volume 32 Number 09 September 2006

Calendar of Events
KU STADIUM OBSERVING
Sunday
September 24, 2006
8:30 PM—10:00PM

Fall Meeting Schedule
Friday, Sept. 22
1001 Malott—7:30 PM
Dr. Barbara Anthony-Twarog
Interpreting Stellar Bar Codes

President:
Hannah Swift
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Observing Clubs
Doug Fay

INSIDE THIS ISSUE

Report From the Officers on the August Meeting:

Once again, we didn't have a meeting in August, but are beginning to return to normal operation again with the start of the semester. A few items of business in terms of club operations. Our past club president, Hannah Swift has graduated and is now beginning her first semester as a graduate student in Physics and Astrophysics at Berkeley. She hopes to eventually become involved in the Supernova Project under Saul Perlmutter. Best of luck to Hannah in her future endeavors in graduate school and many thanks for her willingness to contribute to the club over the last three

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The Fight for Pluto Rages On

by the Editors of *Sky & Telescope*

It's not over yet.

In the past week a small but growing group of scientists made their first formal attack against the International Astronomical Union's August 24th resolution that left the solar system with eight planets and downgraded Pluto to a new class of objects known as "dwarf planets." On Thursday two heavy hitters in the planetary-science community — Mark Sykes, director of the Planetary Science Institute, and S. Alan Stern, an executive director of the Southwest Research Institute and leader of the Pluto-bound New Horizons mission — unveiled a petition formally disputing the new definition. The petition, signed by more than 300 of the world's leading space scientists, states, "We, as planetary scientists and astronomers, do not agree with the IAU's definition of a planet, nor will we use it."

The signatories call for a "better definition" of a planet and ask that the method to determine that definition includes more input from the global astronomical community. According to the petitioners, only about 4% of the IAU's nearly 10,000 members were present in Prague to vote on the resolution. In a prepared statement Sykes wrote, "A more open process, involving a broader cross section of the community engaged in planetary studies of our own solar system and others, should be undertaken." Says Stern, "From the number of signatories that the petition received in a few days, it's clear that there is significant unhappiness among scientists with the IAU's planet definition and that it will not be universally adopted by scientists and textbook

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From the Officers, continued

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years. Filling her shoes for this year will be **Luis Vargas**, an Astronomy, Math, and Physics major at KU and the winner of a Goldwater scholarship. Luis will be available for advice, comments, and suggestions via email at lvargas@ku.edu and he also has a mailbox in 1082 Malott. You will be hearing from him on a regular basis in upcoming newsletters.

Reminders on upcoming events:

With the start of the Fall semester, we return to our regular schedule of meetings. The first meeting in September is **Friday the 22nd** at 7:30 PM in 1001 Malott and will be include a presentation by **Dr. Anthony-Twarog** of KU on the technique of high-dispersion spectroscopy, the basis for much of our understanding of the chemical abundances in the Universe and the foundation for the discovery of over 200 extrasolar planets over the last ten years. Future talks by Drs. Steve Shawl and Keith Ashman have been scheduled.

The first open observing session of the semester at the stadium for August was rained out, so we will try again with the last Sunday in September—the 24th. If you plan to come or would like to help out, let us know. The time period for the observing is set for 8:30—10 PM. If this changes and/or we have an update on the schedule for the remainder of the semester, we will inform you via the newsletter, at minimum, via email, and through the web site. If you are unsure and would like to come by on the 24th, weather permitting, please check the web site or call the observatory number (864-3166), as usual for a recorded message.

The Astronomical League has many activities to encourage amateur astronomy including Observing Clubs. The Observing Clubs offer certificates of accomplishment for demonstrating observing skills with a variety of instruments and objects. Each Club offers a certificate based upon achieving certain observing goals. These are usually in the form of a specific number of objects of a specific group with a given type of instrument. Occasionally there are multiple levels of accomplishment within the club. There is no time limit for completing the required observing, but good record keeping is required. When you have reached the requisite number of objects, your observing logs are examined by the appropriate authority and you will receive a certificate and pin to proclaim to all that you have reached your goal. Many local astronomical societies even post lists of those who have obtained their certificates. **IF YOU WISH TO BECOME A MEMBER OF ONE OF THE OBSERVING CLUBS AND COMPLETE AN OBSERVING PROJECT, WE NOW HAVE A LOCAL CLUB MEMBER TO EXAMINE AND CERTIFY THAT YOU HAVE MET THE QUALIFICATIONS FOR THE SPECIFIC CLUB**. ***DOUG FAY*** has agreed to take on the job of certifying the observing materials and forwarding the info to the Astronomical League. So, if you have any interest in submitting the log sheets and materials for an observing club, as detailed on the Astronomical League web site, please communicate with Doug; his email address is dfay@ku.edu.

Adding to the extensive list of specialty clubs within the Astronomical League, a new **OUTREACH CLUB** has been created. This recognition is based upon the public outreach activities of a club and contains levels of achievement that that are well within reach of the AAL. The new League Outreach Award will afford individual Astronomy Outreach recognition. Many club/society members already do outreach, but no one organization recognizes the outreach efforts of the many, many individuals. The logical level for our club to work on is the lowest level: a minimum of five 2-hour (minimum each outreach) outreach events with documentation for each event, including date, time (started and ended), location, what you did for the outreach, and an estimate of the number of people attending.

If you have any suggestions for talks, speakers, or public events, please feel free to contact us, particularly Rick Heschmeyer (rcjbm@sbcglobal.net), the events coordinator for the club. Hope to see you later this month at the first meeting on Sept. 22. ALL for now.

About the Astronomy Associates of Lawrence

The club is open to all people interested in sharing their love for astronomy. Monthly meetings are typically on the second Friday of each month and often feature guest speakers, presentations by club members, and a chance to exchange amateur astronomy tips. Approximately the last Sunday of each month we have an open house on Memorial Stadium. Periodic star parties are scheduled as well. For more information, please contact the club officers:Hannah Swift at hkswift@ku.edu, Gary Webber at gwebber@ku.edu, our faculty advisor, Prof. Bruce Twarog at btwarog@ku.edu. or our events coordinator, Rick Heschmeyer at rcjbm@sbcglobal.net. Because of the flexibility of the schedule due to holidays and alternate events, it is always best to check the Web site for the exact Fridays and Sundays when events are scheduled. The information about AAL can be found at

http://www.ku.edu/~aal.

Copies of the *Celestial Mechanic* can also be found on the web at

http://www.ku.edu/~aal/celestialmechanic

Huge Telescope Mirror's Trek Ends in Lab 40 Feet Under UA

Dan Sorenson, The Arizona Daily Star, Tucson

After a meandering five-day, 2,500-mile cross-country wide-load trip, hoist and rigging crews had just three inches to spare as they delicately lowered a 25,000-pound crate containing the mirror blank for a new telescope through a rectangular metal hole in the ground at the University of Arizona on Wednesday.

The 6,700-pound mirror blank, built by Corning Inc. of Corning, N.Y., was delivered for polishing to the College of Optical Sciences' hidden mirror lab, a four-story building under the parking lot behind the college's Meinel Building, just northwest of McKale Center. The college's lab, not to be confused with the UA's famous Steward Observatory Mirror Lab under the east side of Arizona Stadium, generally works on smaller mirrors and private or defense contract jobs and seldom gets any publicity. The mirror is for the Discovery Channel Telescope, a collaboration between the Lowell Observatory and the Discovery Channel, that is to be built at Lowell's Happy Jack site, near Flagstaff.

The mirror blank -- an unpolished concave glass disc, 14 feet wide and 4 inches thick, which one lab manager called "a giant contact lens" -- will be polished smooth over the next three years. The first six months will be spent modifying the lab's polishing equipment and attaching the mirror blank to a frame so it can be polished to near perfection, said Marty Valente, director of the Optical Fabrication and Engineering Facility.

To explain just how smooth the surface will be, lab scientists say that if the mirror were the size of the United States, the largest variation in the surface would be an inch high. The blank is made of a special Ultra Low Expansion glass that minimizes changes in the surface caused by temperature changes, Valente said.

A large crane removed the lab's metal hatch cover and pulled out several pieces of equipment from 40 feet below to make room for the mirror crate. Valente said he was relieved to find that they had even three inches of space on the wide sides of the crate; before it was delivered he said the measurements he'd been given provided only an inch and a half on the widest dimension. The crated mirror came in on a special 22-wheel air-cushioned flatbed tractor-trailer rig. Driver Chris Babyak, a heavy- and wide-load expert, said the escorted haul took 5 1/2 days from Pittsburgh because he had to make many detours to avoid road construction and other restrictions.

The UA will get $3 million and some TV fame for polishing the 4.3-meter mirror of the $40 million telescope, expected to be completed in 2009. A Discovery Channel video crew was on hand to record every moment of the delicate delivery and uncrating for a documentary being made about the building of the DCT.

Lowell Observatory officials have said the telescope will be ideal for deep surveys of the outer solar system, the region referred to as the Kuiper Belt, where the newly reclassified dwarf planet Pluto orbits. It is also expected to be used for expanding the search for asteroids that have a chance to collide with Earth, imaging studies of major comets and searching for planets in other solar systems.

Deadly Planets

By Patrick L. Barry and Dr. Tony Phillips

About 900 light years from here, there's a rocky planet not much bigger than Earth. It goes around its star once every hundred days, a trifle fast, but not too different from a standard Earth-year. At least two and possibly three other planets circle the same star, forming a complete solar system.

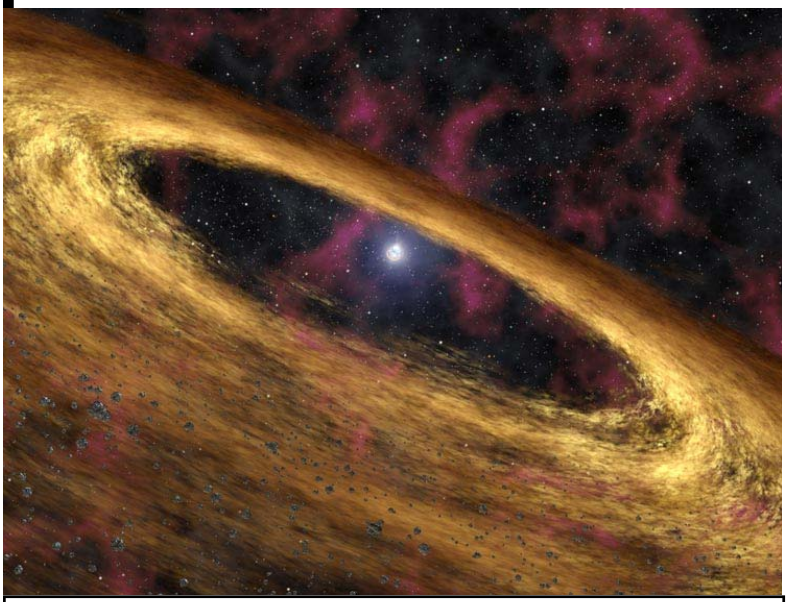
Interested? Don't be. Going there would be the last thing you ever do. The star is a pulsar, PSR 1257+12, the seething-hot core of a supernova that exploded millions of years ago. Its planets are bathed not in gentle, life-giving sunshine but instead a blistering torrent of X-rays and high-energy particles.

"It would be like trying to live next to Chernobyl," says Charles Beichman, a scientist at JPL and director of the Michelson Science Center at Caltech.

Our own sun emits small amounts of pulsar-like X-rays and high energy particles, but the amount of such radiation coming from a pulsar is "orders of magnitude more," he says. Even for a planet orbiting as far out as the Earth, this radiation could blow away the planet's atmosphere, and even vaporize sand right off the planet's surface.

Astronomer Alex Wolszczan discovered planets around PSR 1257+12 in the 1990s using Puerto Rico's giant Arecibo radio telescope. At first, no one believed worlds could form around pulsars—it was too bizarre. Supernovas were supposed to destroy planets, not create them. Where did these worlds come from?

NASA's Spitzer Space Telescope may have found the solution. Last year, a group of astronomers led by Deepto Chakrabarty of MIT pointed the infrared telescope toward pulsar 4U 0142+61. Data revealed a disk of gas and dust surrounding the central star, probably wreckage from the supernova. It was just the sort of disk that could coalesce to form planets!



Artist's concept of a pulsar and surrounding disk of rubble called a "fallback" disk, out of which new planets could form.

As deadly as pulsar planets are, they might also be hauntingly beautiful. The vaporized matter rising from the planets' surfaces could be ionized by the incoming radiation, creating colorful auroras across the sky. And though the pulsar would only appear as a tiny dot in the sky (the pulsar itself is only 20-40 km across), it would be enshrouded in a hazy glow of light emitted by radiation particles as they curve in the pulsar's strong magnetic field.

Wasted beauty? Maybe. Beichman points out the positive: "It's an awful place to try and form planets, but if you can do it there, you can do it anywhere."

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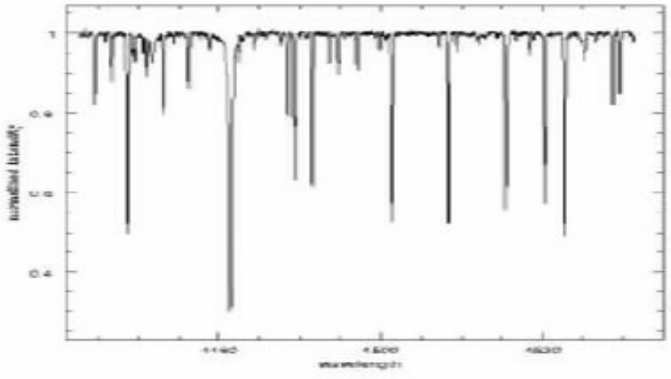
The Astronomy Associates of Lawrence present

Dr. Barbara Anthony-Twarog

Department of Physics & Astronomy
University of Kansas

INTERPRETING STELLAR BAR CODES



FRIDAY, September 22, 2006
7:30 PM, 1001 Malott Hall
University of Kansas

Missing Gas Found in Milky Way

By Robin Lloyd, Special to SPACE.com

The true abundance in the Milky Way of a heavy, primordial form of hydrogen has eluded scientists for decades, but it turns out that huge quantities of it have been hidden in the dust that is scattered between stars. The new finding relied on satellite measurements of a type of hydrogen called deuterium and found that its distribution in our galaxy is patchy rather than uniform. It will force big changes in theories about star and galaxy formation, astronomers say. "Since the 1970s we have been unable to explain why deuterium levels vary all over the place," said Jeffrey Linsky, an astrophysicist at the University of Colorado at Boulder. "The answer we found is as unsettling as it is exciting."

Heavy hydrogen

Deuterium is a type, or isotope, of hydrogen that is a bit heavier than regular hydrogen. Deuterium has one proton and one neutron while regular hydrogen has no neutrons and one proton. Scientists think deuterium is burned and destroyed during a star's lifetime, which theoretically means the amount of deuterium present in the universe can be used as a measure of star creation and galaxy building over billions of years. Still, previous deuterium measurements varied so much that some scientists thought the measurements were wrong or that there was something wrong with their instruments. The instruments were fine. The results were right. It was the explanation of the results that was lacking.

New data

New data from NASA's Far Ultraviolet Spectroscopic Explorer (FUSE) satellite, launched in 1991 to study the origin and evolution of hydrogen and deuterium in the universe, allowed Linsky and his colleagues to confirm previous patchy deuterium findings and take it big step further. The deuterium shows up in patches because it tends to clump with solid dust grains and therefore becomes invisible. This explains why along certain sight lines, satellites detect a lot of deuterium in interstellar gas but very little in other directions, Linsky said. The patchy distribution of deuterium especially made sense to Princeton University's Bruce Draine, one of Linsky's co-authors on a research paper on the new deuterium findings. Three years ago, he proposed that the patchiness has to do with the chemistry of dust grains found in the space between stars, the interstellar medium. These regions of space consist mostly of gas but there is a small fraction of material in the form of very small particles, usually less than 1 micron in size (one particle of flour is about 60 microns wide).

Strong bond

The basic idea is that the chemical bond between carbon atoms and deuterium atoms in the interstellar medium is slightly stronger, due to that extra neutron, than the chemical bond between carbon and hydrogen atoms. Over time then, deuterium atoms replace hydrogen atoms in dust grains made primarily of carbon. This process occurs when dust grains are very cold and undisturbed, which is typical in the interstellar medium. However the shock wave of a nearby supernova shock or hot star can suddenly zap the solid-phase, deuterium-carbon bond in dust grains and send the deuterium back into the gas phase. The FUSE spacecraft only measures deuterium in the gas phase so it finds low quantities of deuterium when no supernova or star is or was recently nearby and high quantities when a nearby hot star or supernova shock wave has evaporated the deuterium back into a detectable phase. FUSE not only found patchy deuterium. It found more deuterium than scientists predicted. Scientists thought at least a third of the deuterium created during the Big Bang would have been destroyed over time as a result of stellar formation, leaving much less than the amount FUSE detected.

What it means

If the peak levels of deuterium are correct, either a lot less material has been converted to elements in stars or more primordial gas rained down onto our galaxy over its lifetime than previously thought.

"My guess is that the second scenario is the more likely answer," Linsky told *SPACE.com*. "We know very little about the rate at which deuterium-rich gas is raining down on the galaxy today and in the past."

The paper by Linsky, Draine and their colleagues was published in the *Astrophysical Journal*.

Mass cut-off between stars and brown dwarfs revealed

David Shiga - NewScientist.com

The faintest stars ever seen in an ancient star cluster have been imaged by the Hubble Space Telescope. The observations provide the most accurate measurement ever made of the mass boundary between lightweight stars and "failed" stars called brown dwarfs – the dividing line is at about 80 times the mass of Jupiter, in line with theoretical predictions. Stars and brown dwarfs are both made of the same materials – mostly hydrogen and helium – but their long-term behaviour is different. Stars – even those with very low mass, called red dwarfs – can burn hydrogen for many billions of years. Brown dwarfs, on the other hand, are not massive enough to sustain hydrogen fusion for long, fizzling out after just 1 billion years or so. Previously, scientists calculated that the minimum mass needed to sustain long-term hydrogen burning is about 75 Jupiters. But observational confirmation has been hard to come by because young brown dwarfs and young low mass stars look very similar.

Ancient clusters

One way to distinguish the two is to look for the faintest stars in very old star clusters. Stars in clusters are thought to share approximately the same age, so old clusters should contain no observable brown dwarfs – the failed stars would have already cooled and faded from view. Any faint objects seen in such clusters would be red dwarfs or white dwarfs, dense cores of mostly carbon and oxygen that are the cooling embers of stars like the Sun. "Globular" star clusters – so named because of their round shape – are ideal for studying these faint stars because they are more than 10 billion years old, and contain hundreds of thousands or millions of stars. Now, astronomers led by Harvey Richer of the University of British Columbia in Vancouver, Canada, have used Hubble to find the faintest red dwarfs ever seen in a globular cluster. They looked at a relatively nearby cluster called NGC 6397, which is 8500 light years from Earth.

Stark contrast

The cluster is 13.5 billion years old, nearly as old as the universe. "The brown dwarfs have by now faded off into obscurity so there is a very stark contrast between the stars that could burn hydrogen and the ones that couldn't," says team member Jay Anderson of Rice University in Houston, Texas, US. Theory predicts that the mass cut-off for what constitutes a star is different for objects of different metallicity, which refers to the proportion of elements heavier than hydrogen the object contains.

The core of the ancient star cluster NGC 6397, seen in this Hubble image, is an ideal hunting ground for stars only slightly more massive than brown dwarfs (Image: NASA/

For objects with a metallicity similar to that of the Sun, theory suggests that anything with less than 7.5% the mass of the Sun – or about 75 Jupiters – will be a brown dwarf. In the case of NGC 6397, which has a metallicity 100 times lower than that of the Sun, the dividing line is expected to be at 8.3% the mass of the Sun, or about 83 Jupiters. The members of the dim red dwarf population seen in the Hubble images appear to be heavier than this limit, in agreement with theoretical calculations.

Tightest constraint

The new observations are sensitive to stars 10 to 20 times fainter than in previous work on the same cluster, Anderson told **New Scientist**. "This kind of observation is probably the best kind of constraint one can get," says Gibor Basri of the University of California, Berkeley, US. The theoretically predicted hydrogen burning limits "have stood up to what observational tests we have," he told **New Scientist**. "I don't think anyone thinks they're off by a lot." The observations also revealed the telltale signs of very old white dwarfs. Although white dwarfs start out with temperatures of about 100,000° Kelvin, some of those seen in the Hubble images are old enough to have cooled below 4000° K.

That is low enough for hydrogen atoms in their atmospheres to join together to form molecules. This makes the white dwarfs bluer than they would otherwise appear, an effect rarely observed before.

Big bang pushed back two billion years?

Zeeya Merali, NewScientist.com

Our universe may be 15% larger and older than we thought, according to new measurements of the distance to a nearby galaxy. Researchers led by Alceste Bonanos at the Carnegie Institution of Washington, US, used data from telescopes including the 10-metre Keck-II telescope in Hawaii, US, to measure the distance to a pair of stars in the Triangulum Galaxy.

The team used light, velocity, and temperature measurements to calculate the true luminosity of the two stars, which eclipse one another every five days. By comparing this intrinsic luminosity to their observed brightness, the team calculated that the galaxy lies 3.14 million light years away from us. Surprisingly, this is about half a million light years farther than previously thought. Measuring astronomical distances is not simple. Distant, bright objects, for example, can look the same as closer, dim ones. So astronomers have built a ladder-like system that starts by using several independent methods to accurately determine the distance to nearby objects. They then use these measurements to define a more distant cosmic yardstick, and so on.

New observations of the Triangulum Galaxy suggest it is 3 million light years away – 15% farther away than previously thought (Image: Canada-France-Hawaii Telescope/J-C Cuillandre)

“In every step, you accumulate errors,” says team member Krzysztof Stanek at Ohio State University in Columbus, US. “We wanted an independent measure of distance – a single step that will one day help with measuring dark energy and other things.”

Hubble constant

Gauging distances by observing a binary star has cut out those extra steps, says team member Norbert Przybilla at the University of Erlangen-Nuremberg, Germany. "This is the farthest distance that anyone has been able to measure directly," he told **New Scientist**. "It's the cutting edge of what can be done with these telescopes."

Earlier measurements were based on calculations using the Hubble constant, a measure of the expansion rate and age of the universe. The new observation implies that the value used for the constant is off by 15%, says Przybilla. That suggests the universe is 15% larger, and 15% older than previously thought. Recent estimates have put the age of the universe at 13.7 billion years, and the new research suggests it may actually be 15.8 billion years old. "Our result hints that there may be something interesting happening with the Hubble constant," says Przybilla. But he cautions that the study reports only one distance measurement. "We need to follow this up with more measurements."

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More news and images from Spitzer can be found at http://www.spitzer.caltech.edu/ . In addition, The Space Place Web site features a cartoon talk show episode starring Michelle Thaller, a scientist on Spitzer. Go to http://spaceplace.nasa.gov/en/kids/live/ for a great place to introduce kids to infrared and the joys of astronomy.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Famous Star Hosts Distant World

by Robert Naeye, skypub.com

Astronomers have discovered more than 200 extrasolar planets — and nearly every one orbits an obscure star with a forgettable name. But finally astronomers have found a planet around a bright, familiar star dear to the hearts of amateurs worldwide: Pollux. The 1st magnitude star is one of the brightest stars in the sky and one of the famous "twin" stars in the constellation Gemini.

Astronomers have found an extrasolar planet orbiting Pollux (bright yellow star at left), the 16th brightest star in the night sky. It's the brightest star visible from Earth that is known to host a world outside of our solar system.
Akira Fujii

Two independent groups, led by Sabine Reffert (Heidelberg-KÃ¶nigstuhl State Observatory, Germany) and Artie Hatzes (Thuringia State Observatory, Germany), discovered the planet using the Doppler technique. The planet has a minimum mass of 2.9 Jupiters and orbits Pollux in a 590-day, nearly circular orbit. "What a wonderful gift that anyone, even in the center of a city, can gaze up and see a star that has a planet," says Geoff Marcy (University of California, Berkeley), a member of Reffert's group. Marcy's group has also recently announced the discovery of five new exoplanets.

In other extrasolar-planet news The European group led by Michel Mayor (Geneva Observatory, Switzerland) has found the second four-planet system around another solar-type star. The four planets orbit Mu Arae (HD 160691), a *G*3 star 50 light-years from Earth. Two planets were previously known to orbit this star, but analysis of additional data reveals two new planets and gives a better orbital solution for all four. The planets orbit at distances of 0.09, 0.92, 1.5, and 5.2 astronomical units and have minimum masses of 0.03, 0.5, 1.7, and 1.8 Jupiters, respectively. Previously known four-planet systems exist around the solar-type star 55 Cancri and the pulsar B1257+12. The outer Mu Arae planet, which has an orbital period of about 11½ years, is the closest Jupiter analog yet found outside the solar system.

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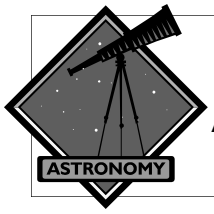
writers." Other battle lines are being drawn as some scientists are questioning the IAU's authority in this matter altogether. The director of the Center for Space Exploration Policy Research, Mark Bullock, released the following statement: "A key public-policy question is who has the social mandate to alter the definition of something as fundamental as a planet. Scientists have in the past vested the IAU with authority to name asteroids and other planetary objects. However, the word 'planet' has cultural, historical, and social meaning and as such requires much broader discussion and consensus than those required for the naming of astronomical bodies."

Meanwhile the chair of the American Astronomical Society's Division for Planetary Sciences, Richard G. French (Wellesley College), urged the group's more than 1,200 members to recognize the authority of the IAU to render their decision and reiterated that refinements to the definition are desired. In a letter to the DPS community, he writes, "There is still work to be done, too, in constructing a definition that is generally applicable to extra-solar planetary systems. These and other changes, radical or moderate, presumably will be addressed at the next IAU General Assembly in Rio de Janeiro in 2009, and the DPS community will continue to be involved in all stages of this process."

You can read the Sykes-Stern petition, including the list of signatories, at http://www.ipetitions.com/petition/planetprotest.

Celestial Mechanic September 2006



AAL

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