

The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Volume 31 Number 06 JUNE 2005

Calendar of Events

FRIDAY JUNE 17

1001 Malott
7:30 PM

EXTRATERRESTRIALS: Part 1

NGS Video Presentation

FIRST SUMMER BAND OBSERVING: WED. June 15

9:30 PM

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From the Officers

Report From the Officers on the MAY Meeting:



For May, we had an exciting and entertaining talk by one of our own members, Rex Powell. Rex has become an amateur expert in a field of space/earth science that has become somewhat unfashionable over the last few decades but may still have a few secrets left to divulge, the origin of tektites. Using his own extensive collection of tektites from around the world, Rex demonstrated the various classes of objects and

the interpretation of their origins, in particular, how and why the ideas surrounding these products of collisions with space debris have changed over the years. Of special interest to Rex is a fall of tektites that occurred in China and the South Pacific thousands of years ago and may have triggered an evolutionary burst in the production of tools among the inhabitants of the region.

For the first two meetings of the summer, we will have a 2-part video presentation of a series produced by the National Geographic Society on the nature of potential life on planets beyond our solar system. The discovery of extrasolar planets (over 160 are now known) has heightened the interest in the conditions under which life can originate, survive, and evolve. Among the major projects planned over the next decade for space-based astronomy are a number of telescopes heavily devoted to uncovering evidence for life outside of the solar system, including a mission called the Terrestrial Planet Finder (for potentially bad news about these planned missions, see the story on pg. 3). The graphics on this series are quite spectacular, so join us for a large screen view and hopefully some discussion of what you think may happen!

Returning to the issue of observing on the local front, we did have an open house at Memorial Stadium in May! There was some haze but, for the most part, the weather cooperated and the members of the public who attended, along with club members

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Wednesday Night Summer Band Concerts

June 1, 2005 to July 27, 2005
<http://www.lawrencecityband.com/lcb/>

Times: 8:00 p.m. **Admission Charge:** no
Location: South Park gazebo
11th & Massachusetts
Lawrence, KS

TENTATIVE OBSERVING NIGHTS:
WEDNESDAY— JUNE 15, JUNE 29

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From the Officers, continued

who helped, got in some respectable viewing of a wide variety of objects. There is still nothing more spectacular than seeing the moon through a good-size telescope on a clear night. While this will be the only stadium session until the end of August, we are also planning on expanding our program of public observing after the band concerts downtown. The one time we did this, it was very successful at drawing people, particularly families with children, to look at the sky, even with the lights downtown. Based on discussions at the meeting, we decided to schedule downtown observing every two weeks after the band concert. The schedule of concerts has just appeared on the web site and will run, as noted in the box on page 1, from June 1 through July 27. Our planned schedule for June is to have telescopes set up in the park on the west side of Massachusetts St. on WED. JUNE 15 and WED. JUNE 29 starting at 9:30 PM. We can reevaluate this plan depending on how things go and schedule the July sessions for July 13 and 27 if everyone is agreeable. If you haven't contacted Bruce Twarog (btwarog@ku.edu) about helping, please think about this option if you have a portable scope and are willing to volunteer for an evening once we have schedule set. We should only need 2 scopes at each session, so with enough people, there is no need to be concerned about being available every session. Moreover, there is a non-zero probability that we will lose some nights because of weather.

As noted in past newsletters, we are members of the Astronomical League. Among their many activities to encourage amateur astronomy are the Observing Clubs. The Observing Clubs offer encouragement and 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. This month we feature the details on the **Constellation Hunter Club**. The Constellation Hunter Club has two certifications and pins: The Northern Skies and the Southern Skies. The purpose of these programs is to provide an orientation to the sky for novice astronomers. They require no special equipment (other than a planisphere and a reference for the brighter star names), and no prior knowledge. The objective is to provide a forum for the novice observer to become more familiar with the constellations and brighter stars, to begin to learn to navigate among the stars, and to provide a solid foundation for moving on to other observation programs such as the Messier Club. To qualify for the AL's Constellation Hunter Certificates and pins, you need only be a member of the Astronomical League, either through an affiliated club or as a Member-at-Large, and observe and sketch all of the constellations on the specific checklist that you are pursuing (Northern Checklists are available at <http://www.astroleague.org/al/obsclubs/consthunt/const3.html>.) No equipment is required other than a planisphere and reference information of the names of major stars and constellation boundaries. Binoculars, while not required, will give you a deeper look into the star fields that you sketch. You should not include these additional stars and objects on your sketches, but the view will give you an appreciation for all of the things that await you in the other Astronomical League Certification Programs. You should proceed constellation by constellation. For each constellation, you need to provide this data: (1) Local date and time, (2) Latitude and Longitude of observation, (3) Constellation name, (4) Sky conditions: transparency, and seeing, (5) A sketch of all stars that were visible to the unaided eye, out to the limits of the constellation's boundary. Named stars should be identified on the sketch. The sketch should include other objects that are visible within the boundaries of the constellation, including but not limited to: galaxies, open clusters, globular clusters, and nebulas. For more info, visit the web site <http://www.astroleague.com>.

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. ALL for now. Hope to see you all in 2 weeks, either at the meeting or the observing in the park..

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 hksswift@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>

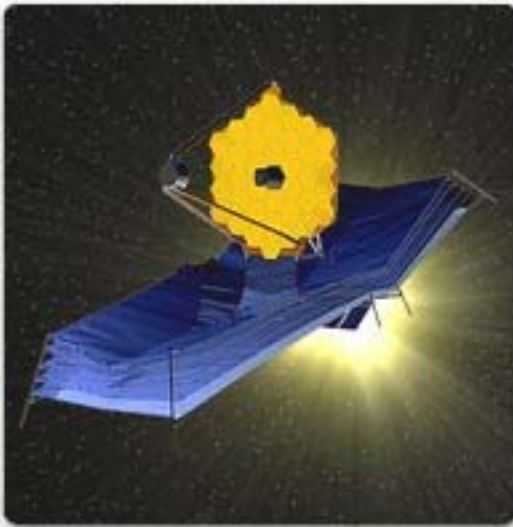
NASA Budget Crisis Threatens Space Telescopes

By Richard Tresch Fienberg, skypub.com

Astronomers are riding an emotional roller coaster. Last month they were elated when NASA's new administrator, Michael D. Griffin, restarted work on a possible shuttle mission to extend the life of the Hubble Space Telescope. This month they're in despair over news that future space-astronomy missions may be downsized, delayed, or cancelled because of a financial crisis within the agency.

In a recent letter to Congress, Griffin noted that NASA's budget for the current year falls about \$2 billion short of what's needed to keep all current programs on track. Reasons for the imbalance include cost overruns in the shuttle return-to-flight effort and in several space-science missions, congressionally mandated expenditures ("earmarks," otherwise known as "pork"), and the resumption of preparations for servicing Hubble. Testifying before a Senate subcommittee on May 12th, Griffin admitted that "identifying offsets needed to fund these items has created some difficult choices."

Among the projects whose timelines will be stretched out are the Space Interferometry Mission and Terrestrial Planet Finder, advanced space telescopes designed to explore planets around other stars beginning in 2011 (SIM) and sometime between 2012 and 2015 (TPF). Griffin says he doesn't yet know the extent of these delays. NASA's Mars Science Lab, a long-duration rover now slated for launch in 2009, may slip to 2011.



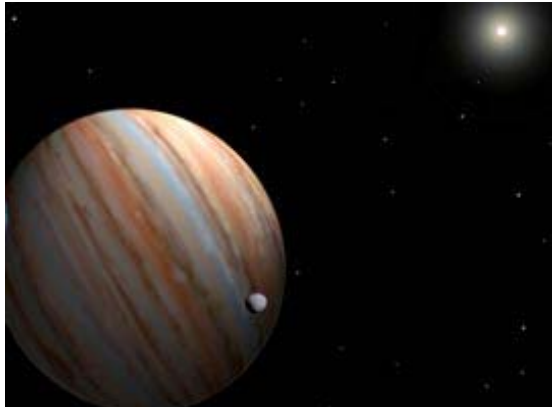
Artist's rendition of the Webb Space Telescope

By far the worst problem for astronomers concerns the James Webb Space Telescope (JWST), a 6.5-meter (256-inch) infrared observatory sometimes called Hubble's successor. It's a joint project of NASA, the European Space Agency, and the Canadian Space Agency. Various hurdles seem destined to delay its launch by at least a year, to no earlier than 2012, and threaten to increase the mission's cost by as much as \$1 billion, to more than \$3 billion. In response, NASA has asked the project to consider whether a 4-meter telescope with fewer scientific instruments could be flown instead. According to one astronomer on the Webb team, who asked to remain anonymous, "such an observatory would not be worth continuing with" because it wouldn't be able to compete scientifically with the next generation of giant ground-based telescopes except in a narrow range of infrared wavelengths. "None of us believe it'd save the required amount of money anyway."

At this point it's anybody's guess what will happen to Webb. If NASA can't scrounge enough extra money to continue the project in its current form, perhaps by taking it from another mission, outright cancellation is a very real possibility. "I don't know the technical and budget path we'll find," says senior project scientist John Mather (NASA/Goddard Space Flight Center), "but the JWST project management and science team are extremely determined to find a solution in working with our international partners and NASA Headquarters."

Amateurs Help Discover Exoplanet

By Robert Naeye, skypub.com

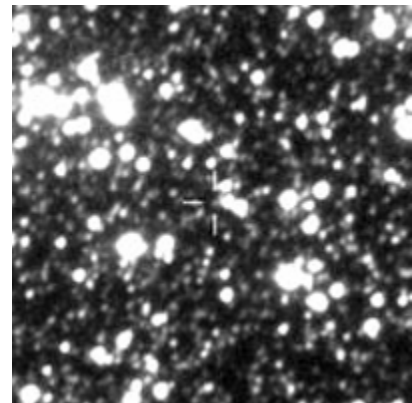


Artist David A. Aguilar depicts the exoplanet that professional and amateur astronomers discovered recently by gravitational microlensing. The planet is about 3 times as massive as Jupiter, and it orbits its host star (upper right) at about 3 astronomical units. The moon is hypothetical. Courtesy David A. Aguilar (CfA).

In a milestone event, amateur astronomers have participated directly in the discovery of an extrasolar planet last month. The amateurs, who hail from New Zealand, made crucial observations that helped several international collaborations of professional astronomers nail down the existence of the planet. Amateur astronomers have previously detected the presence of exoplanets, but only after professionals made the initial findings.

The newly discovered planet is just the second one found by gravitational microlensing, an effect predicted by Einstein's general theory of relativity. According to relativity, if a massive object such as a star moves directly between Earth and a background star, the intervening star's gravity acts like a lens. It temporarily magnifies the background star, causing a characteristic brightening pattern that astronomers can distinguish from normal variable stars. If a planet orbiting the lensing star comes near the light path, it will either increase or decrease the brightening depending on the geometry of the alignment.

While the theory of microlensing is well understood, catching actual events is fiendishly difficult. Several international collaborations monitor millions of faint stars around the clock to catch these rare events. A collaboration known as the Optical Gravitational Lensing Experiment (OGLE), headed by Andrzej Udalski (Warsaw University, Poland), first detected the microlensing event earlier this year. On April 18th, as the event was still in progress, Andrew Gould (Ohio State University) noticed something unusual going on that might involve a planet. He quickly alerted several other groups to monitor the star, including members of the Microlensing Follow-Up Network, or MicroFUN, for short.



An international pro-am collaboration discovered a planet by observing this faint star in Sagittarius (marked by crosshairs). The star brightened as the exoplanet's host star crossed in front and magnified its light in a process known as gravitational microlensing. Courtesy Optical Gravitational Lensing Experiment.

Two New Zealand amateur astronomers in this group, Grant W. Christie of Auckland and Jennie McCormick of Pakuranga, caught the microlensing event (designated OGLE-2005-BLG-071) in progress with their 14- and 10-inch telescopes. Their data, combined with those of the professional groups, confirmed a half-magnitude dimming of the background star caused by the gravity of a planetary-mass object. "The amateur data was essential to understanding what was going on," says team member B. Scott Gaudi (Harvard-Smithsonian Center for Astrophysics), whose calculations showed that the deviation was due to a planet.

The planet acted like an astigmatism in a lens. Its gravity caused the slight dimming because it took a little bit of light that the lensing star

(Continued on page 6)



The Astronomy Associates of Lawrence
present

Fraction of those planets
 on which life develops.

$$N = R_* f_p n_e f_l f_i f_c L$$

**AN NGS VIDEO
 PRESENTATION**

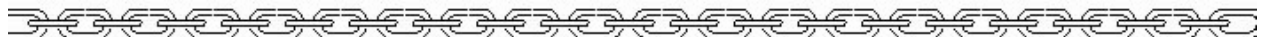
EXTRATERRESTRIAL
 Part I

FRIDAY, JUNE 17, 2005

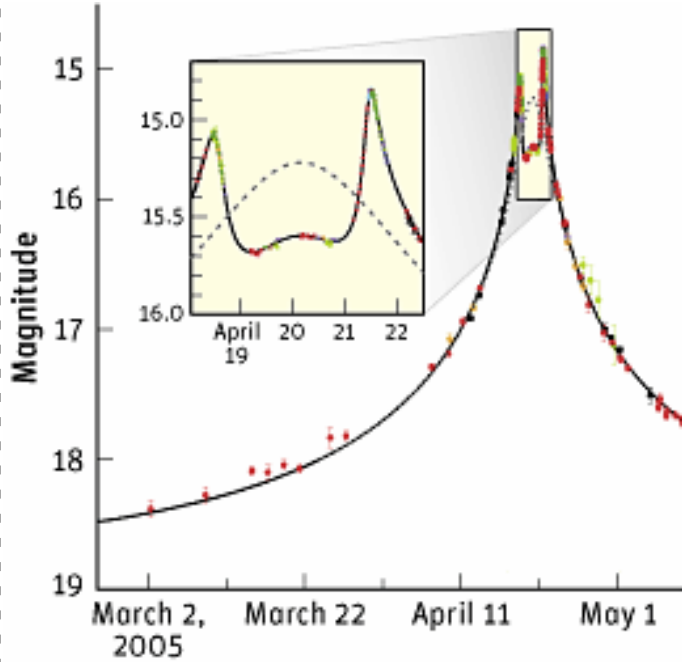
7:30 PM, 1001 Malott Hall

University of Kansas

FREE & OPEN TO THE PUBLIC



(Continued from page 4)



This light curve, whose data come from five groups, shows how the brightness of the faint background star rose and fell over several months. The sharp rise and fall in mid and late April is due to a planet. If the planet had not been there, the light curve would have followed the rounded dotted line. Click on the image to see a larger version. The observations from Farm Cove and Auckland were made by amateur astronomers. Source: B. Scott Gaudi (CfA) and Subo Dong (Ohio State University)

was trying to direct toward Earth and deflected it out of our line of sight.

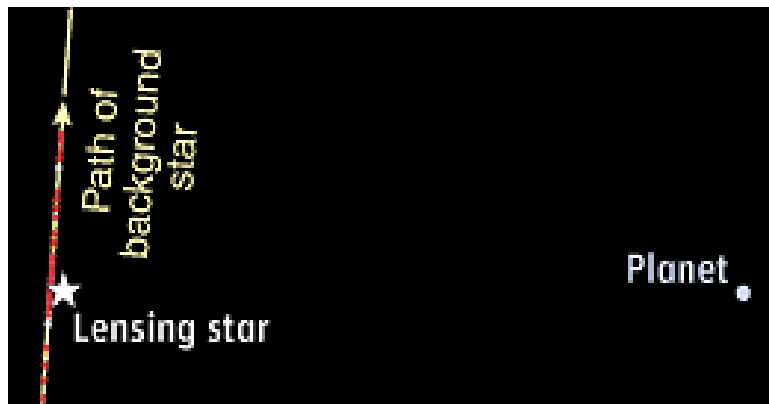
The downside of the microlensing technique is that it yields very little information about the exoplanet or its host star, and no opportunity for follow-up studies of the planet itself. All the discoverers can say about the planet is that it's roughly three times the mass of Jupiter and orbits its unnamed host star at approximately three times the average Earth-Sun distance. The planet and star lie about 15,000 light-years away in the direction of the galactic center.

But microlensing has a huge potential upside: it can detect the presence of Earth-mass planets using ground-based telescopes and current technology. "This discovery is the tip of the iceberg for microlensing searches. With improving technologies and techniques, the first Earth-size planet may be found by microlensing," says Gaudi.

"If an Earth-mass planet were in the same position [as the exoplanet we found], we would have been able to detect it," adds Gould.

Amateurs will participate in future discoveries as well. "These amateur astronomers work all day, then go home and observe all night," says Gaudi. "Their contribution is a testament to how far amateurs have come. It speaks highly of their dedication to the field. If we can get others involved, that would be fantastic."

Christie's and McCormick's names appear on the discovery paper, which has been submitted to the prestigious *Astrophysical Journal Letters*. The MOA, PLANET, and RoboNET collaborations also participated in the planet's discovery.



This diagram shows the geometry on the plane of the sky of the foreground lensing host star and planet and the background star, which is the source of the light monitored by the various collaborations. Source: B. Scott Gaudi and Subo Dong.

'Fairy Tale' Might Explain Moon Craters and Planet Orbits

By Michael Schirber, Space.com

A recently devised "fairy tale" may explain our outer solar system, as well as some of the craters on the Moon. Most planet theories assume that these bodies formed in circular orbits, all lined up in the same plane around the Sun. Although that basically describes our solar system, there are slight discrepancies: non-circular (deemed eccentric) orbits that are tilted (or inclined) with respect to each other.

Jupiter, Saturn and Uranus have eccentricities of 6, 9 and 8 percent, respectively. The inclinations of the outer planets are as much as 2 degrees from the main plane of the solar system. These small perturbations are difficult to account for, since gas and debris leftover from planet formation would tend to drag the planets into neat, circular orbits.

Shock to the system

Now researchers show in computer simulations that a dramatic shock to the early solar system could reproduce the orbits – including the eccentricities and inclinations – of the giant planets. In addition, the shock provides an origin for Trojan asteroids, rocks that orbit the Sun in front of or behind Jupiter while gravitationally bound to that planet. The shock also explains a spike in the number lunar impacts – called the late heavy bombardment – which occurred nearly four billion years ago and is revealed in studies of craters on the Moon.

Hal Levison of the Southwest Research Institute presented the new model at a symposium earlier this month at the Space Telescope Science Institute (STScI). It will be formally unveiled in the May 26 issue of the journal *Nature*.

"I call it a fairy tale because it's a nice compact story," Levison told SPACE.com during the STScI meeting. "I hope it will inspire continued discussion."

Whether it's true remains to be seen.

"I like the fairy tale because it solves a number of things," said Mario Livio, an STScI theorist. "But there are certain inputs – like the initial orbit of the giants and the make-up of the disk – that may need more explaining."

Opening act

The story begins with Jupiter, Saturn, Uranus and Neptune in a tight orbital configuration, surrounded by a host of bit players – smaller debris called "planetesimals." Planets and planetesimals occasionally have close encounters, usually resulting in an early stage exit for the little guy, but the planet may migrate as well.

"If a planet throws a planetesimal out of the solar system, the planet moves toward the Sun, just a tiny bit, in compensation," explains Kleomenis Tsiganis. "If, on the other hand, the planet scatters the planetesimal inward, the planet jumps slightly farther from the Sun."

Tsiganis and Alessandro Morbidelli of the Observatoire de la Côte d'Azur, France, along with Levison and Rodney Gomes of the National Observatory of Brazil, developed the simulations to follow this planetary evolution. Over time, these planet-debris interactions likely caused Jupiter to end up closer to the Sun, while the three other planets moved further out.

Resonant behavior

The major turning point in the story, the shock, happened when the main characters – Jupiter and Sat-

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urn – migrated into a gravitational "sweet spot" called a resonance.

This is when one planet's year is an integer multiple of the other's. An integer is a whole number, like 1, 2 or 3, as opposed to a fractional number. This synchronicity of orbits can excite small perturbations – effectively "pumping up" eccentricities and inclinations – as well as knocking other stuff around. The strongest resonance is 1:2, corresponding to one planet making a single orbit for every two orbits of the other. The current ratio for Jupiter and Saturn is approximately 1:2.5 -- no longer a resonance. The scientists suspect that the two gas giants started out much closer and then migrated apart, passing through the 1:2 resonance – thereby unleashing total mayhem in the outer solar system.

"This caused the orbits of Uranus and Neptune to go nuts," Gomes said.

In different runs of the simulation, these ice giants sometimes swap places, and occasionally one of them gets ejected. In general, however, the two planets settle down in large radius orbits, which is where they are found today.

Bonus material

The chaos from the resonance crossing subsides after a few million years, but the simulations show that the four planets retain eccentricities and inclinations that are in line with the observed values. Moreover, the dance of the outer planets throws planetesimals in all directions, which has two interesting consequences.

First, some of this debris winds up at the same radius as Jupiter, but slightly leading or trailing the planet by roughly 60 degrees. This is the position of the so-called Trojan asteroids. These small bodies are separate from the asteroid belt that exists between Jupiter and Mars. Previous theories for Jupiter's Trojans assumed that they formed in the vicinity of the planet, but this cannot explain the observed high inclinations – some asteroids orbiting 40 degrees out of the plane. However, these tilted orbits are not a problem if the Trojans were captured during the planetary shuffle.

A second fortuitous result is that the resonance crossing may coincide with the late heavy bombardment, or LHB. That era, about 700 million years after the Moon formed, saw a sharp increase in lunar cratering. In their simulations, the researchers can track the amount of planetesimals thrown into the inner solar system, and they estimate that the Moon would have been struck by approximately 10 quadrillion tons of material, which is very close to what was laid down during the LHB.

The moral of the story

"Our model explains so many things that we believe it must be basically correct," Morbidelli said. "The structure of the outer solar system shows that the planets probably went through a shake-up well after the planet formation process ended."

In three separate papers in *Nature*, Morbidelli and his co-workers outline their main results. Although the model does offer a compact story, it does have its complications. Douglas Lin of the University of California, Santa Cruz, worried that the inner solar system could be disrupted by the wildly eccentric movements of the giant planets.

"No crime is ever perfect," Lin said. With the resonance, "it's not hard to scramble things up, but to get it to happen when and where you want may be hard to do."

There was also evidence, presented at the same STScI symposium by Renu Malhotra of the University of Arizona, that the crater sizes on the Moon are consistent with the sizes of objects in the asteroid belt.

This would argue against a contribution to the LHB from outer solar system planetesimals as the fairy tale would claim.

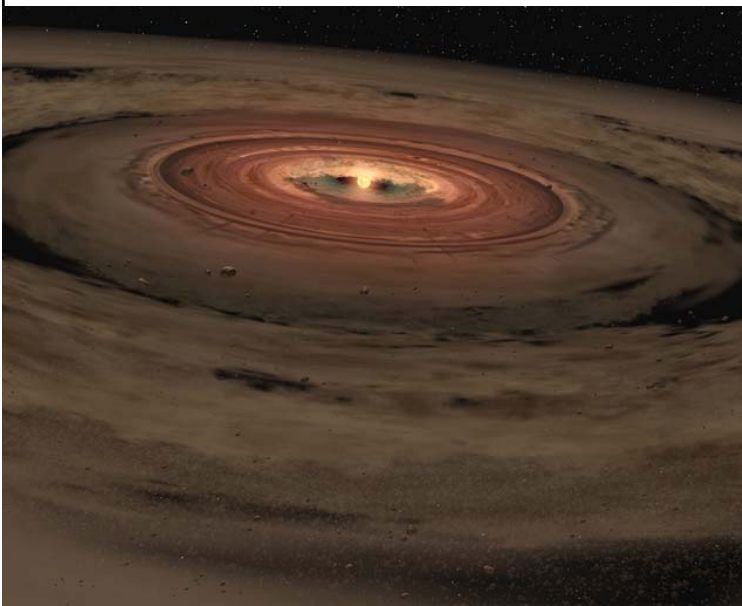


Seeing in the Dark with Spitzer

by Patrick Barry and Tony Phillips

Have you ever gotten up in the middle of the night, walked to the bathroom and, in the darkness, tripped over your dog? A tip from the world of high-tech espionage: next time use night-vision goggles.

Night vision goggles detect heat in the form of infrared radiation—a “color” normally invisible to the human eye. Wearing a pair you can see sleeping dogs, or anything that’s warm, in complete darkness. This same trick works in the darkness of space. Much of the exciting action in the cosmos is too dark for ordinary telescopes to see. For example, stars are born in the heart of dark interstellar clouds.



Artist's rendering of brown dwarf OTS44 with its rotating planetary disk.

While the stars themselves are bright, their birth-clouds are dense, practically impenetrable. The workings of star birth are thus hidden.

That's why NASA launched the Spitzer Space Telescope into orbit in 2003. Like a giant set of infrared goggles, Spitzer allows scientists to peer into the darkness of space and see, for example, stars and planets being born. Dogs or dog *stars*: infrared radiation reveals both.

There is one problem, though, for astronomers. “Infrared telescopes on the ground can't see very well,” explains Michelle Thaller, an astronomer at the California Institute of Technology.

“Earth's atmosphere blocks most infrared light from above. It was important to put Spitzer into space where it can get a clear view of the cosmos.” The clear view provided by Spitzer recently allowed sci-

entists to make a remarkable discovery: They found planets coalescing out of a disk of gas and dust that was circling—not a star—but a “failed star” not much bigger than a planet! Planets orbiting a giant planet? The celestial body at the center of this planetary system, called OTS 44, is only about 15 times the mass of Jupiter. Technically, it's considered a “brown dwarf,” a kind of star that doesn't have enough mass to trigger nuclear fusion and shine. Scientists had seen planetary systems forming around brown dwarfs before, but never around one so small and planet-like. Spitzer promises to continue making extraordinary discoveries like this one. Think of it as being like a Hubble Space Telescope for looking at invisible, infrared light. Like Hubble, Spitzer offers a view of the cosmos that's leaps and bounds beyond anything that came before. Spitzer was designed to operate for at least two and a half years, but probably will last for five years or more.

For more about Spitzer and to see the latest images, go to <http://www.spitzer.caltech.edu/spitzer>. Kids and grown-ups will enjoy browsing common sights in infrared and visible light at the interactive infrared photo album on The Space Place, http://spaceplace.nasa.gov/en/kids/sirtf1/sirtf_action.shtml. This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

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