

The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Volume 32 Number 01 January 2006

Calendar of Events

January Meeting
 Friday, Jan. 20, 2006
Dr. Frank Wilczek
 Time & Location: TBD

PUBLIC OBSERVING
Sunday Jan. 29, 2006
 8:00PM
 Memorial Stadium

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From the Officers



Report From the Officers on the December Meeting:

Two key items to start this report: (1) on page 9 of the newsletter you will find the **Annual Dues** form; the return envelope should be attached to the newsletter. Please update any necessary info and return the form with your dues by the end of the month, if possible. The dues primarily go to cover the cost of our inclusion in the Astronomical League, the organization that serves as a national voice/conduit for hundreds of amateur astronomy clubs throughout the US. *The Reflector*, published quarterly, is one of the benefits of membership in the AL, not to mention the fact that the national headquarters is based in Kansas City. We will update our membership list with the AL at the end of the month, so if you are new to the club, don't delay in responding. (2) Our monthly meeting for January was scheduled for Friday, Jan. 20, primarily to allow KU to get back in session. Within the last two weeks, however, it was learned that the Department of Physics & Astronomy has arranged for a visit to the university by Dr. Frank Wilczek of MIT, winner of the 2004 Nobel Prize in Physics. Dr. Wilczek will present a colloquium within the Department in the afternoon, with a public lecture scheduled for Friday evening. The arrangements are still being finalized so, at this point, we don't know where and at what time the public lecture will occur. However, given the probable high level of interest in this talk, it seems prudent to make this talk the equivalent event for our January meeting. So, there will be no meeting in Malott Hall for January. Instead, everyone is encouraged to attend



the public talk by Dr. Wilczek. As soon as we know when and where, we will send an update via email and regular mail. There is an article discussing Dr. Wilczek and his prize-winning research on pg. 4; every indication we have, including a personal report from someone who attended another public talk of his, is that he is an excellent speaker and does a fine job of communicating his work within the often bizarre world of quantum mechanics.

Our next public observing session at Memorial Stadium is Sunday Jan. 29 at 8PM. This is the tentative date since we haven't received final approval from the Athletic Department, but we are optimistic that this date will hold up. So, come out on a likely cold January evening and get a



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From the Officers, continued



first telescopic glimpse of the sky for the new year. If you wish to help and/or set up a telescope, let us know—you are always welcome.

For the December meeting, our speaker was Dr. Steve Shawl, who will give a presentation on the Search for Exoplanets—Planets Outside Our Solar System to an enthusiastic group of 15 club members and visitors. The reason why this is the hottest topic in Astronomy was evident (see also this month's issue of *Sky and Telescope* for even more on the properties of the newly discovered planets, especially those that have exhibited transits). The presentation was an updated version of a talk that was part of a lecture series on Clyde Tombaugh and the discovery of planet Pluto offered this semester by the OSHER program at KU and the Astronomy faculty at KU. Following the question and answer session after the talk, we had our annual distribution of door prizes, with enough that virtually everyone

present was able to go home with something, where something ranged from a 2006 calendar in Astronomy, to a copy of *The Neptune Files*, a book about the discovery of Neptune, to posters highlighting some of the recent NASA missions in astronomy. Speaking of Clyde Tombaugh, coming in February is the 100th anniversary of his birth, an event that will be celebrated at KU. Look in your mail during January for an announcement about when and where this will take place. Arrangements are being made to bring Alan Stern, one of the mission leaders of the unmanned mission to Pluto, to KU for a lecture. The mission is scheduled for launch in the latter half of January but potential equipment and weather problems make an exact date impossible to know, so we won't know when he can visit until the mission is underway.



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. This month we feature the details on the **Universe Sampler Club**. The Universe Sampler observing program is a unique observing program designed specifically for the beginning observer. It is designed to expose the beginner to a sample of the many different types of objects that the Universe has to offer for our observing enjoyment. It is designed to help the new observer learn his or her way around the sky and to teach some of the basics of astronomy. It offers an alternate naked-eye list of deep sky objects for those who are interested in astronomy but shy away because they do not have a telescope or binoculars. The Universe Sampler will take you on an exciting journey through the heavens. You will meet many of the brightest stars, learn their names and the constellations in which they are found. You will visit our moon and some of the planets that share our solar system. You will greet at least one of the comets that leave the outer reaches of the solar system to visit the neighborhood of the sun. You will become acquainted with double stars, variable stars, star clusters, nebulae and galaxies. For more details, visit <http://www.astroleague.org/al/obsclubs/univsamp/univsamp.html>

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 talk by Dr. Wilczek. 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 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>

ASTRONOMERS USE HUBBLE TO 'WEIGH' DOG STAR'S COMPANION

HST/STScI Press Release (12/13/05)

For astronomers, it has always been a source of frustration that the nearest white-dwarf star is buried in the glow of the brightest star in the nighttime sky. This burned-out stellar remnant is a faint companion of the brilliant blue-white Dog Star, Sirius, located in the winter constellation Canis Major. Now, an international team of astronomers has used the keen eye of NASA's Hubble Space Telescope to isolate the light from the white dwarf, called Sirius B.

The new results allow them to measure precisely the white dwarf's mass based on how its intense gravitational field alters the wavelengths of light emitted by the star. Such spectroscopic measurements of Sirius B taken with a telescope looking through the Earth's atmosphere have been severely contaminated by scattered light from the very bright Sirius. "Studying Sirius B has challenged astronomers for more than 140 years," said Martin Barstow of the University of Leicester, U.K., who is the leader of the observing team. "Only with Hubble have we at last been able to obtain the observations we need, uncontaminated by the light from Sirius, in order to measure its change in wavelengths."

Accurately determining the masses of white dwarfs is fundamentally important to understanding stellar evolution. The sun will eventually become a white dwarf. White dwarfs are also the source of Type Ia supernova explosions that are used because of their brightness to measure distances to distant galaxies and the expansion rate of the universe. Measurements based on Type Ia supernovae are fundamental to understanding 'dark energy,' a dominant repulsive force stretching the universe apart. Also, the method used to determine the white dwarf's mass relies on one of the key predictions of Einstein's theory of General Relativity; that light loses energy when it attempts to escape the gravity of a compact star.

Sirius B has a diameter of 7,500 miles, less than the size of Earth, but is much more dense. Its powerful gravitational field is 350,000 times greater than Earth's, meaning that a 150-pound person would weigh 50 million pounds standing on its surface. Light from the surface of the hot white dwarf has to climb out of this gravitational field and is stretched to longer, redder wavelengths of light in the process. This effect, predicted by Einstein's theory of General Relativity in 1916, is called gravitational redshift, and is most easily seen in dense, massive, and hence compact objects whose intense gravitational fields warp space near their surfaces.

Based on the Hubble measurements of the redshift, made with the Space Telescope Imaging Spectrograph in February 2004, the team found that Sirius B has a mass that is 98 percent that of the sun. Sirius itself has a mass of two times that of the sun and a diameter of 1.5 million miles. The Hubble observations have also refined the measurement of Sirius B's surface temperature to be 44,900 degrees Fahrenheit. Sirius itself has a surface temperature of 18,000 degrees Fahrenheit.

At 8.6 light-years away, Sirius is one of the nearest known stars to Earth. Stargazers have watched Sirius since antiquity. Its diminutive companion, however, was not discovered until 1862, when it was first glimpsed by astronomers examining Sirius through one of the

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MIT's Wilczek wins 2004 Nobel Prize in physics



CAMBRIDGE, Mass.--Professor Frank Wilczek, MIT's Herman Feshbach Professor of Physics, has won the 2004 Nobel Prize in physics for a "colorful" discovery in the world of quarks, the building blocks of the atomic nucleus. The work, which involves the dominant, or "color," force between quarks, is key to several major problems in particle physics and beyond. Wilczek, 53, shares the prize of about \$1.3 million with David J. Gross of the University of California at Santa Barbara, and H. David Politzer of the California Institute of Technology.

Wilczek was in the shower when the call from Sweden came at 5:30 a.m. Tuesday morning. "It was this person with a beautiful accent, and it was so early, so I was immediately hopeful," said Wilczek's wife, Betsy Devine. "Frank came in, dripped all over the floor, and talked to half the Swedish Academy."

The three won "for the discovery of asymptotic freedom in the theory of the strong interaction," according to the Royal Swedish Academy of Sciences. Asymptotic freedom is a phenomenon whereby quarks behave as free particles when they are close together, but become more strongly attracted to each other as the distance between them increases. This theory forms the key to the interpretation of almost all experimental studies involving modern particle accelerators.

"Thanks to their discovery, David Gross, David Politzer and Frank Wilczek have brought physics one step closer to fulfilling a grand dream, to formulate a unified theory comprising gravity as well -- a theory for everything," the Academy said in announcing the prize.

"What this year's laureates discovered was something that, at first sight, seemed completely contradictory. The interpretation of their mathematical result was that the closer the quarks are to each other, the weaker is the 'colour charge.' When the quarks are really close to each other, the force is so weak that they behave almost as free particles.

"The converse is true when the quarks move apart: the force becomes stronger when the distance increases. This property may be compared to a rubber band. The more the band is stretched, the stronger the force.

"This discovery was expressed in 1973 in an elegant mathematical framework that led to a completely new theory, Quantum Chromodynamics, QCD. This theory was an important contribution to the Standard Model, the theory that describes all physics connected with the electromagnetic force (which acts between charged particles), the weak force (which is important for the sun's energy production) and the strong force (which acts between quarks). With the aid of QCD physicists can at last explain why quarks only behave as free particles at extremely high energies. In the proton and the neutron they always occur in triplets," said the Academy.

Wilczek's earliest work, done with Gross at Princeton in the 1970s, concerned the change of fundamental couplings with energy. This work led to the discovery of asymptotic freedom, which makes it possible to understand the behavior of matter under extreme conditions, such as occurred in the earliest moments of the Big Bang. Also, it permits the construction of unified models of particle interactions, which have concrete predictive power. Wilczek has been a leading participant in all these developments. One notable result of the cosmological work is a compelling explanation of the

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A Short-Lived Spiral?

By Joshua Roth, skypub.com

How long could spacefaring voyagers remain away from their home galaxy before they couldn't recognize it upon returning home? If that galaxy is 8th-magnitude M77 (NGC 1068 in Cetus), the answer is just 100 million years — a cosmological eyeblink. So say Michael R. Merrifield (University of Nottingham, England) and Richard J. Rand and Sharon E. Meidt (University of New Mexico) in a paper that recently was published electronically by *Monthly Notices of the Royal Astronomical Society*.



Most astronomers believe that spiral arms are waves that course through a galaxy's disk, containing different stars and gas clouds at different times. But no one knows how long those waves can sustain spiral structure. Kitt Peak Advanced Observing Program participants François and Shelley Pelletier joined Adam Block to make this color-composite image of Cetus's M77. NOAO / AURA / NSF

M77's subtle inner spiral can shed much light on the longevity of simple but bold spirals seen in prominently barred galaxies like NGC 1300 and in closely interacting ones like M51.

Merrifield and his colleagues derived new formulas and applied them to measurements of M77's carbon-monoxide-laced gas clouds (carbon monoxide molecules emit finely tuned radio waves, allowing astronomers to precisely measure the positions and line-of-sight velocities of interstellar matter). Spiral-shaped wave patterns that are just 3,000 light-years (20 arcseconds) from the galaxy's center whirl around the core three times as often as those 6,000 light-years out, says the team — all but guaranteeing that the galaxy's bright inner pinwheel is destined to wind itself up into an amorphous disk. "If this result turns out to apply commonly to other galaxies," the scientists write, "then intergalactic travelers would be well advised not to use the morphology of spiral structure to identify their homes."

But some experts are reserving judgment. Bruce G. Elmegreen (IBM Thomas J. Watson Research Center) cautions that the composition of M77's interstellar clouds may differ from place to place, possibly fooling Merrifield and his collaborators into thinking that the innermost parts of the galaxy's spiral pattern will outrace the outer parts after a few laps around the track. And while M77's inferred identity as a quick-change artist doesn't surprise John Kormendy (University of Texas, Austin), he doubts that



Many of the galaxies with bold, high-contrast arms have an "engine" of some kind that seems to sustain their spiral patterns, either a bar (as in the case of NGC 1300 in Eridanus, *left*) or a companion galaxy orbiting at close range (as in the case of M51 and its satellite galaxy NGC 5195, *right*). Hubble Heritage Program / STScI / NASA / ESA

Light Echoes Reveal Exploded Stars

Space.com

Using recently discovered faint light echoes, astronomers have divined when three known supernovas occurred.

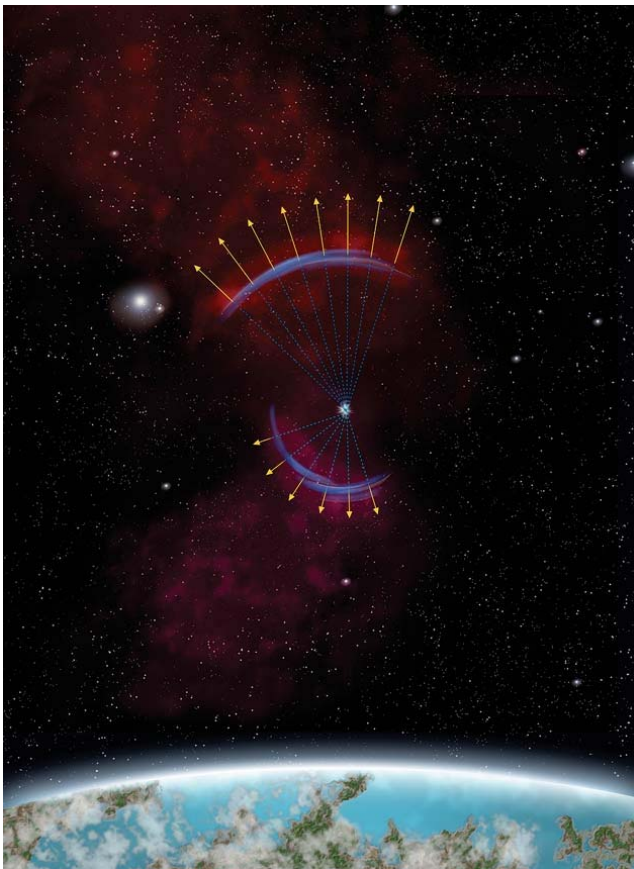
The visible echoes are described as being much like sound echoes. They're created when light from the explosion expands outward and reflects off dust and travels toward Earth.

The explosions occurred centuries ago, the astronomers said, with the oldest having erupted about 600 years ago in Earth-time. All three occurred in the Large Magellanic Cloud (LMC), a satellite galaxy to our Milky Way.

The LMC is about 160,000 light-years away.

The discoveries were not intended. Astronomers were surveying the region for signs of dark matter, a mysterious something that pervades the universe but which has never been seen.

In images taken years apart, researchers found concentric, circular-shaped arcs best explained as light moving outward over time and being scattered as it encounters dense pockets of interstellar dust, the researchers report in the Dec. 22 issue of the journal *Nature*. With each set of arcs, some geometric figuring shows they point back to supernova remnants that had been found previously by the orbiting Chandra X-ray Observatory, which spotted more recently emitted light from nearer to the objects.



Artist's concept of a light echo from a supernova that exploded in the nearby galaxy called the Large Magellanic Cloud (LMC), as seen from Earth more than two centuries after the original explosion. The echo is only part of a ring, because to be seen it must intersect with existing clouds of interstellar dust far from the explosion, which are not spaced equally within the large volume that the supernova light continues to expand into. P. Marenfeld and NOAO/AURA/NSF

"Without the geometry of the light echo, we had no way of knowing just how old these supernovae were," said lead researcher Armin Rest of the National Optical Astronomy Observatory (NOAO).

"Some relatively simple mathematics can help us answer one of the most vexing problems that astronomers can ask—exactly how old is this object that we are looking at?"

It is not the first light echo ever seen. Astronomers have seen one around a well known dead star called Cassiopeia A and, in a remarkable animation, around another object that's not well understood.

But spotting three at once without even trying was unusual. The technique could be applied to study other, more famous supernovae.

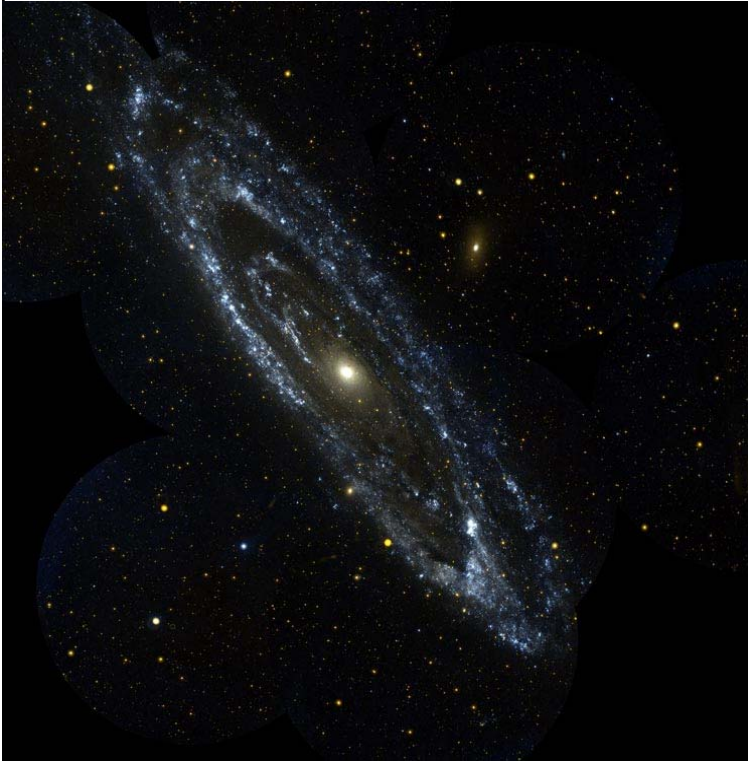
"Imagine seeing light from the same explosion first seen by Johannes Kepler some 400 years ago, or the one recorded by Chinese observers in 1006," said Christopher Stubbs of the Harvard-Smithsonian Center for Astrophysics (CfA). "These light echoes give us that possibility."

Stubbs is the co-author of the paper and principal investigator for the SuperMACHO program from which the images came.

The approach could also shed light, quite literally, on space between stars. Dust and gas between the stars is mostly invisible unless illuminated. The ancient supernova emissions serve as headlight in the fog, lighting up surrounding clouds of matter with its strobe-like flash, the astronomers said.

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vatories of the Carnegie Institution of Washington.



The GALEX telescope took this UV image of the Andromeda galaxy (M31), revealing a surprising shape not apparent in visible light.

Beyond Andromeda lies a whole universe of galaxies—spirals, ellipticals and irregulars, giants and dwarfs, each with its own surprising patterns of star formation. To discover those patterns, GALEX has imaged hundreds of nearby galaxies. Only a few, such as Andromeda, have been analyzed in complete detail. "We still have a lot of work to do," says Boissier, enthusiastically. GALEX has photographed an even greater number of distant galaxies—"some as far away as 10 billion light-years," Boissier adds—to measure how the rate of new star formation has changed over the universe's long history. Contained in those terabytes of data is our universe's "life story." Unraveling it will keep scientists busy for years to come.

For more about GALEX, visit www.galex.caltech.edu. Kids can see how to make a galactic art project at spaceplace.nasa.gov/en/kids/galex/art.shtml.

(Continued from page 4)

asymmetry between matter and antimatter in the present universe. In the past few years, another concept Wilczek discovered and developed, fractional quantum statistics, has been found to characterize the behavior of recently discovered states of matter. It is the focal point of much current activity in condensed matter physics.

Wilczek's many awards include the 2002 Lorentz Medal from the Royal Netherlands Academy of Arts and Sciences, which called him "one of the most influential theoretical physicists of his generation." He is a member of the American National Academy of Sciences, and has received the Dirac Medal (1994) and the Michelson-Morley Prize (2002).

Wilczek was born in Queens, N.Y. He received his B.S. (1970) from the University of Chicago and his M.A. (1971) and Ph.D. (1973) from Princeton University. He later became professor of physics at Princeton and at the University of California at Santa Barbara. He joined the MIT faculty in 2000 with appointments in the Department of Physics and the Center for Theoretical Physics. This year he was named one of five Kavli Scholars through MIT's Center for Space Research, soon to be renamed the Kavli Institute for Astrophysics and Space Research. "We love MIT," Devine said in a telephone interview. "It's been wonderful for Frank and our family."

Wilczek regularly speaks and writes on theoretical physics for a wide audience.

He and his wife live in Cambridge, Mass. They have two daughters, Amity and Mira. Amity, who has a Ph.D. from Harvard, is currently a postdoctoral associate in biology there. Mira, who earned her S.B. from MIT in 2004, works for IBM in Boston.

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This picture is an artist's impression showing how the binary star system of Sirius A and its diminutive blue companion, Sirius B, might appear to an interstellar visitor. The large, bluish-white star Sirius A dominates the scene, while Sirius B is the small but very hot and blue white-dwarf star on the right. The two stars revolve around each other every 50 years. White dwarfs are the leftover remnants of stars similar to our Sun. The Sirius system, only 8.6 light-years from Earth, is the fifth closest stellar system known. Sirius B is faint because of its tiny size. Its diameter is only 7,500 miles, slightly smaller than the size of our Earth. The Sirius system is so close to Earth that most of the familiar constellations would have nearly the same appearance as in our own sky. In this rendition, we see in the background the three bright stars that make up the Summer Triangle: Altair, Deneb, and Vega. Altair is the white dot above Sirius A; Deneb is the dot to the upper right; and Vega lies below Sirius B. But there is one unfamiliar addition to the constellations: our own Sun is the second-magnitude star, shown as a small dot just below and to the right of Sirius A.

most powerful telescopes of that time.

Details of the work were reported in the October 2005 issue of the Monthly Notices of the Royal Astronomical Society. Other participants on the team include Howard Bond of the Space Telescope Science Institute, Baltimore, Md.; Matt Burleigh of the University of Leicester; Jay Holberg and Ivan Hubeny of the University of Arizona, Tucson; and Detlev Koester of the University of Kiel, Germany.



A New View of the Andromeda Galaxy

By Dr. Tony Phillips and Patrick L. Barry

This is a good time of year to see the Andromeda galaxy. When the sun sets and the sky fades to black, Andromeda materializes high in the eastern sky. You can find it with your unaided eye. At first glance, it looks like a very dim, fuzzy comet, wider than the full moon. Upon closer inspection through a backyard telescope—wow! It's a beautiful spiral galaxy. At a distance of "only" 2 million light-years, Andromeda is the nearest big galaxy to the Milky Way, and astronomers know it better than any other. The swirling shape of Andromeda is utterly familiar.

Not anymore. A space telescope named GALEX has captured a new and different view of Andromeda. According to GALEX, Andromeda is not a spiral but a ring. GALEX is the "Galaxy Evolution Explorer," an ultraviolet telescope launched by NASA in 2003. Its mission is to learn how galaxies are born and how they change with age. GALEX's ability to see ultraviolet (UV) light is crucial; UV radiation comes from newborn stars, so UV images of galaxies reveal star birth—the central process of galaxy evolution.

GALEX's sensitivity to UV is why Andromeda looks different. To the human eye (or to an ordinary visible-light telescope), Andromeda remains its usual self: a vast whirlpool of stars, all ages and all sizes. To GALEX, Andromeda is defined by its youngest, hottest stars. They are concentrated in the galaxy's core and scattered around a vast ring some 150,000 light years in diameter. It's utterly *unfamiliar*.

"Looking at familiar galaxies with a new wavelength, UV, allows us to get a better understanding of the processes affecting their evolution," says Samuel Boissier, a member of the GALEX team at the Obser-

(Continued on page 7)

Astronomy Associates of Lawrence

ANNUAL DUES FORM: Please return by **Jan. 31, 2006**

Dues for 1 year: Regular Members/Families= \$12.00

Students= \$6.00

Checks should be made out to: KUEA

REVISIONS ONLY

If the information in your address label on the reverse side of this sheet is incorrect or if you wish to update any of the information, please fill in the appropriate line below with the revised info and return this form with your dues. Thank you.

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Celestial Mechanic January 2006



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