**Next Meeting**

When: Sat. Dec. 10, 2011  
Time: 7:30 pm  
Where: UM Observatory  
Speaker: Justin Finke, NRL

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**Directions to Dinner/Meeting**

Members and guests are invited to join us for dinner at the Garden Restaurant located in the UMUC Inn & Conference Center, 3501 University Blvd E. The meeting is held at the UM Astronomy Observatory on Metzerott Rd about halfway between Adelphi Rd and University Blvd.

**Need a Ride?**

Please contact Jay Miller, 240-401-8693, if you need a ride from the metro to dinner or to the meeting at the observatory. Please try to let him know in advance by e-mail at rigel1@starpower.net.

**Observing after the Meeting**

Following the meeting, members and guests are welcome to tour through the Observatory. Weather-permitting, several of the telescopes will also be set up for viewing.

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**Star Dust**

**December 2011: Dr. Justin Finke**  
**Naval Research Laboratory**

**Gamma Rays from Supermassive Black Holes**

**Abstract:** Supermassive black holes accelerate jets to relativistic speeds, which stretch for hundreds of kiloparsecs from the galaxies which host them. These jets are seen in the radio, and they terminate in giant radio lobes. When these objects have their jet pointed towards the Earth, their emission, throughout the electromagnetic spectrum from radio to gamma rays, is strongly Doppler shifted, and they are known as blazars.

Blazars have long been known to be gamma-ray emitters. However, astronomers are discovering that off-axis jets can also emit gamma-rays which are detected by the Fermi Large Area Telescope. I will discuss recent gamma-ray observations of blazars and radio galaxies and their implications.

**Biography:** Justin Finke has been an astrophysicist at the Space Science Division of the Naval Research Laboratory for over a year. Before that, he was a postdoctoral research associate at the same place. His primary research interests are the theory of high-energy emission from active galactic nuclei and supernova remnants, and the interaction of gamma rays with the optical through infrared extragalactic background light. He is currently one of two coordinators for the active galactic nuclei science group of the Fermi Gamma-Ray Space Telescope Collaboration. Justin received his Ph.D. from Ohio University in 2007, where his thesis work was primarily on simulating radiation transport in the accretion disks of X-ray binaries.

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**Brooks Telescope Recoating**

**Michael Chesnes**

On Friday November 18 Jim Edwards from the TriState Astronomers in Hagerstown, MD visited the NCA telescope making class to test and recoat the 12.5 inch f 9.3 primary mirror for TSA’s recently acquired Brooks Telescope, which dates to the 1930s. As you can see from the first photo (courtesy TSA) it’s quite an imposing telescope when fully assembled, and wouldn’t be easy to bring into our class. However, Jim did bring the telescope’s primary mirror in its cell to our class, as well as its secondary mirror. Dirt and oxidation are clearly visible on the primary’s optical surface before recoating, although the rear of the mirror is still pristine, and bears a label advertising Clausung’s Beryl coating. One unusual feature of this mirror is an irregular surface texture reminiscent of spaghetti wrapped around parts of its edge. The texture is barely visible in the lower right hand corner of the middle photo on page 3. Also notice the shaft which extends through a hole in the center of the mirror cell to facilitate removing and returning the primary mirror. (Remaining photos courtesy Guy Brandenburg)

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Thank you!

**Reminder**

After the meeting, everyone is invited to join us at Plato's Diner in College Park. Plato's is located at 7150 Baltimore Ave. (US Rt. 1 at Calvert Rd.), just south of the university’s campus. What if it’s clear and you want to stick around and observe? No problem -- just come over when you're through. This is very informal, and we fully expect people to wander in and out.
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Recent Astronomy: Supermassive Black Holes

December 2011

Nancy Grace Roman

(continued from October 2011)

A giant black hole in the constellation Draco bit off more than it could chew. On 25 March, NASA's Swift satellite detected an x-ray flare when a black hole 3.9 billion light-years from Earth tore a passing star to shreds. The x-ray data as well as radio observations indicate the fireworks caused a narrow jet of material to shoot away from the black hole's outskirts. Similar jets emerge from other black holes, but this is the first time that astronomers have witnessed the birth of one. This discovery means just one wayward star can spark a spectacle. The flow of hot gas toward a black hole has been clearly imaged for the first time in x-rays. The observations from NASA's Chandra X-ray Observatory will help tackle two of the most fundamental problems in modern astrophysics: understanding how black holes grow and how matter behaves in their intense gravity.

The black hole is at the center of a large galaxy known as NGC 3115, which is located about 32 million light years from Earth. A large amount of previous data has shown material falling toward and onto black holes, but none with this clear a signature of hot gas. By imaging the hot gas at different distances from this supermassive black hole, astronomers have observed a critical threshold where the motion of gas first becomes dominated by the black hole's gravity and falls inward. This distance from the black hole is known as the "Bondi radius."

As gas flows toward a black hole, it becomes squeezed, making it hotter and brighter, a signature now confirmed by the X-ray observations. The researchers found the rise in gas temperature begins about 700 light years from the black hole, giving the location of the Bondi radius. This suggests the black hole in the center of NGC 3115 has a mass about two billion times that of the sun, making it the closest black hole of that size to Earth.

The Chandra data also show the gas close to the black hole in the center of the galaxy is denser than gas further out, as predicted. Using the observed properties of the gas and theoretical assumptions, the observing team estimated that each year gas weighing about 2 percent the mass of the Sun is being pulled across the Bondi radius toward the black hole.

Astronomers using NASA's Chandra X-ray Observatory discovered the first pair of supermassive black holes in a spiral galaxy similar to the Milky Way. Approximately 160 million light years from Earth, the pair is the nearest known such phenomenon. The black holes are located near the center of the spiral galaxy NGC 3393. Separated by only 490 light years, the black holes are likely the remnant of a merger of two galaxies of unequal mass a billion or more years ago. Since this galaxy was right under our noses by cosmic standards, it makes us wonder how many of these black hole pairs we've been missing.

Previous observations in X-rays and at other wavelengths indicated that a single supermassive black hole existed in the center of NGC 3393. However, a long look by Chandra allowed the researchers to detect and separate the dual black holes. Both black holes are actively growing and emitting X-rays as gas falls towards them and becomes hotter.

When two equal-sized spiral galaxies merge, astronomers think it should result in the formation of a black hole pair and a galaxy with a disrupted appearance and intense star formation. A well-known example is the pair of supermassive black holes in NGC 6240, which is located about 330 million light years from Earth.

However, NGC 3393 is a well-organized spiral galaxy, and its central bulge is dominated by old stars. These are unusual properties for a galaxy containing a pair of black holes. Instead, NGC 3393 may be the first known instance where the merger of a large galaxy and a much smaller one, dubbed a "minor merger" by scientists, has resulted in the formation of a pair of supermassive black holes. In fact, some theories say that minor mergers should be the most common way for black hole pairs to form, but good candidates have been difficult to find because the merged galaxy is expected to look so typical.

The NGC 3393 discovery has some similarities to a possible pair of supermassive black holes found recently also using Chandra data. Two X-ray sources, which may be due to supermassive black holes in a galaxy about two billion light years from Earth, are separated by about 6,500 light years. As in NGC 3393, the host galaxy shows no signs of disturbance or extreme amounts of star formation. However, no structure of any sort, including spiral features, is seen in the galaxy. Also, one of the sources could be explained by a jet, implying only one supermassive black hole is located in the galaxy.

1. This article is based on NASA press releases.
Mid-Atlantic Occultations and Expeditions

David Dunham

Asteroidal Occultations

<table>
<thead>
<tr>
<th>Date</th>
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<td>2UC43086905</td>
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<td>18:04</td>
<td>TYC24120877</td>
<td>11.8</td>
<td>Burydyke</td>
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<td>TYC13140683</td>
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<td>7 VA, NC, SC</td>
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<td>Dec 26</td>
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Jan 8     | Sun  | 22:13| SAO 59363   | 8.3  | Burydyke  | 4.8  | 5 | 2 NC, SC |
Jan 9     | Mon  | 23:24| TYC13110868 | 10.1 | Solvejg   | 5.3  | 2 | 5 NJ, DE, MD, VA, NC |
Jan 11    | Wed  | 23:18| TYC18870067 | 9.9  | Sodankyla | 5.1  | 3 | 4 NJ, DE, MD, VA |
Jan 13    | Fri  | 4:18 | 2UC3786700  | 11.4 | Geldiona  | 3.5  | 3 | 7 NY, PA |

Under Location, if two numbers are given, the first is the distance of the northern (for cusp angles, or CA, with N) or southern (for CA with S) limit (the graze line) from Greenbelt, MD and the second number is the bearing (azimuth) of that distance in deg. Throughout, latitudes and longitudes are N and E, respectively, for geographical locations.

Total Lunar Occultations

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<td>53B</td>
<td>K1</td>
<td>ZC1482, db1</td>
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<td>71B</td>
<td>P2</td>
<td>Az. 98 ZC1587, db1</td>
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<td>75B</td>
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<td>db1</td>
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<td>35N</td>
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2012
Jan 1     | Sun  | 22:00| D ZC 163  | 7.3  | 58-36 | 68N | F2 | db1                     |
| Jan 2      | Wed  | 1:47 | D 40 Arietis | 5.8 | 76+14 | 39B | K9 | Az.282 ZC 415, db1     |
| Jan 5      | Sat  | 17:25| D 11 Tauri | 5.6  | 88-36 | 78B | P0 | Sun -5 ZC631, db1       |
| Jan 5      | Thu  | 18:08| D 56 Tauri | 5.3  | 89+44 | 74N | A0 | ZC 634                  |
| Jan 6      | Fri  | 19:20| D 108 Tauri | 6.3  | 95+48 | 72N | A2 | ZC 784                  |
| Jan 6      | Fri  | 21:51| D 109 Tauri | 5.0  | 95+52 | 51B | GB | ZC 792                  |
| Jan 7      | Sat  | 2:56 | D 114 Tauri | 4.9  | 96+31 | 70B | B2 | ZC 817                  |
| Jan 8      | Sun  | 5:40 | D 16 Gem  | 6.2  | 99+10 | 46B | A2 | Az.288 ZC 991, Tmd 9   |
| Jan 13     | Fri  | 5:55 | R Zc 1582 | 6.4  | 81-40 | 50N | A3 | db1                     |
| Jan 14     | Sat  | 5:58 | SAO 138378 | 7.5  | 71-41 | 15B | F4 | db1                     |
| Jan 15     | Sun  | 0:12 | R Zc 1788 | 6.8  | 6-28S | 28S | A0 | AZ.108                  |
| Jan 15     | Sun  | 3:47 | R 21 Vir  | 5.5  | 61-38 | 42B | A0 | ZC1800                  |

Explanations & more information is at http://iota.jhuapl.edu/exped.htm. David Dunham, dunham@starpower.net, phone 301-526-5590. Timing equipment and even telescopes can be loaned for most expeditions that we actually undertake; we are always shortest of observers who can fit these events into their schedules, so we hope that you might be able to. Information on timing occultations is at: http://iota.jhuapl.edu/timing920.htm.
Supermassive Black Holes and Precision Cosmology with Megamasers

Date: Wednesday, December 14, 2011
Speaker: Jim Braatz, National Radio Astronomy Observatory, Charlottesville, VA
Topic: Supermassive Black Holes and Precision Cosmology with Megamasers
Time and Location: 1:00 PM, with Q&A to follow; in a 1st floor conference room at the American Center for Physics, 1 Physics Ellipse, College Park, MD-- off River Rd., between Kenilworth Ave. and Paint Branch Parkway.

Abstract: In the gaseous and dusty accretion disks that surround supermassive black holes in the nuclei of nearby galaxies, water molecules emit maser radiation at a wavelength of 1.3 cm. Applying the technique of Very Long Baseline Interferometry, we can map the distribution of individual maser clouds in these disks and determine their positions with an accuracy better than 0.01 milli-arcseconds, and their line-of-sight velocities with an accuracy better than 1 km/s. The masers thus provide a powerful tool for tracing the dynamics of the disk. We use these data to measure precise masses of the central black holes, a measurement which has important implications in understanding how galaxies evolve. In some cases we can also use them to measure direct, geometric distances to the host galaxies, and thereby get a geometric measurement of the expansion rate of the universe. Complementing other observations, these measurements will help to place significant constraints on models of dark energy.

Biography: Jim Braatz is an astronomer at the National Radio Astronomy Observatory (NRAO) in Charlottesville, VA. A native Marylander, Jim received a B.A. in Physics from the Johns Hopkins University and a Ph.D. in Astronomy from the University of Maryland. Subsequently he was a postdoc at Harvard and then a Jansky Fellow with NRAO in Green Bank, WV. Jim has worked on development of the Green Bank Telescope and is also a member of the North American ALMA Science Center, helping the astronomical community use the new Atacama Large Millimeter/Submillimeter Array (ALMA). Jim's research is centered on observations of radio emission from active galaxies. He is the PI of the Megamaser Cosmology Project.
December 9, 2011: Terrible Teddy

In this timeless tale, Santa has made a Teddy Bear too big to fit in the sleigh. But Teddy doesn’t want to be in a department store. Come learn how Teddy uses the stars to find his way back to Santa! A tour of the current night sky follows the presentation. Special: bring a teddy bear to donate to Toys for Tots, and receive $1 off your admission fee!
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Dr. Justin Finke

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