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Radio Astronomy Utilizes Airwaves for Outreach

While most radio astronomers around the world are busy scanning the heavens—interpreting the cacophony of radio signals broadcast by the universe—four Radio Astronomers at UW–Madison are busy crafting their own signal for broadcast. And this one is meant for a much more terrestrial transmission.

You see, most Tuesday afternoons in Madison, a handful of chipper astronomy Ph.D. students gather together within the graffiti-decorated building which houses the local radio station, WORT-FM. Here, they huddle around a few microphones—bantering enthusiastically over the latest popular astronomical news.

Each week, the rotating group of four astronomy grads—Jenna Ryon, Arthur Eigenbrot, Anna Williams, and Jacqueline Goldstein—take a break from their rigorous academic work to produce a radio segment aptly named *Radio Astronomy*.

According to Eigenbrot, this current group of radio grads is loosely the fourth generation of *Radio Astronomy*, as the show dates back to 2008.

Every week, the group decides on a topic, drafts a script, records the show, and sends it to the volunteer-run Madison radio station, WORT-FM. After the audio is uploaded and cut, it is ready for air on Tuesdays around 6:50 p.m., during the program *In Our Backyard*.

There is no doubt that *Radio Astronomy* is unique. The segment does not follow the typical scientific outreach tactic of simply trying to teach the public something. Instead the show is able to bring astronomical topics to the public by working it into a real conversation between two people.

As Williams describes it, the group “will often focus on things that our friends and family ask us about.”

For instance, some of the most popular shows tend to revolve around NASA missions or local astronomical events. In one episode, the group discussed the remarkably true story of an Apollo astronaut who forgot to file his taxes before an extended trip to the moon—perfect conversational fodder for a dinner party.

The casual and relaxed nature of *Radio Astronomy* is no surprise. To make the show more accessible, the group typically chooses light and straightforward topics. After all, quick, interesting, and easy-to-follow stories are what the public wants to hear.

Public outreach for graduate students is commonplace in most astronomy departments around the country; however, *Radio Astronomy* is something very special. According to Eigenbrot, “being able to reach the public

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Letter from the Chair



To paraphrase Charles Dickens, it is both the best of times and the worst of times for Badger Astronomy.

On the bad side of things, in mid-November we lost our Department Administrator, Gary Van Ryzin, to illness. Gary was an exceptionally talented polymath, whom we were all fortunate to work with over the past seven years. We will miss him deeply.

On the good side of things, there is much more news than I have space for. Professor Sebastian Heinz continued his groundbreaking analysis of the remarkable x-ray source, Circinus X-1. He has not only shown that it is the youngest known example of a binary system containing both a neutron star and a normal star, but also derived the first reliable distance to this object by pioneering a new way to measure astronomical distances using x-ray light echoes.

Additionally, Professor Amy Barger was honored with a Guggenheim Foundation Fellowship for her spectacular work on the evolution of galaxies and the formation of supermassive black holes.

Furthermore, Badger alumni continue to make huge impacts in the astronomy world. Ken Sembach (Ph.D. 1992) was chosen as Director of NASA's Space Telescope Science Institute, while Ali Bramson (B.S. 2011), who is now a graduate student at the University of Arizona, co-discovered the immense ice sheet found on Mars. As a UW senior, Ali received the Lowell Doherty Award—the highest honor our department bestows on an undergraduate.

The Doherty Award is one of four student awards made possible through generous gifts from our private donors. We have also just selected graduate student, Chris Bard, for the Stebbins Award, while Claire Murray and Jenna Ryon are sharing the Jansky Award. Chris, who works with Professor Rich Townsend, was selected for his outstanding work studying the stellar winds flowing from magnetized stars. Claire, who works with Professor Snezana Stanimirovic, was chosen for her work on interstellar hydrogen. And Jenna, who works with Professor Jay Gallagher, was chosen for her work studying star clusters in distant galaxies.

Although student awards are undoubtedly important, they are just one way in which we benefit from philanthropy. Recently, UW made its debut as a Sloan Digital Sky Survey (SDSS) con-

sortium member and a major architect of the SDSS MaNGA project. Thanks to generous private support, we are also planning a MaNGA workshop to be held at UW next summer—with additional topical conferences to be held triennially with support from the same donor.

Such conferences establish leadership for UW Astronomy and introduce our students to the broader community. However, networking of another kind is made possible by our ability to fund long-term scientific visitors—who often establish collaborations with our students, postdocs, and faculty that endure for many years. Elsewhere in this issue you'll read about Bautz fellowships for student professional travel and the private funds that support our "Universe in the Park" public outreach program.

Just as a good garden needs good soil, many of our most visible accomplishments rest on the nearly invisible day-to-day work of building a community known for scientific engagement in a supportive environment. And so I'd like to close by thanking the donors on all scales, who have done so much to improve our quality of scientific life, and all the department members who live up to it

Ellen Zweibel
Department Chair

Radio Astronomy *continued from page 1*

through their cars or homes is truly unique to the Madison area."

And despite the fact that these Ph.D. students are devoting their valuable time to ensuring the Madison community gets their weekly dose of astronomy, the group still never seems to view their work as obligatory.

When asked why they do *Radio Astronomy*, the grads did not say that outreach was a requirement, or that it would look better on their CVs. But instead, they simply explained that using the radio to reach the public is one of the coolest ways they could think of to do outreach.

This group of radio astronomers has the mentality that doing outreach is simply a given. They have a passion for what they do, and they also want to share that passion with others.

But then again, where else but UW–Madison could an astronomy Ph.D. student have the pizza guy recognize their voice from the radio?

Contributions

Your support creates opportunities for students, staff, and faculty. The stories you've read about today happened because of gifts from readers like you.

You can contribute online at <http://www.astro.wisc.edu/friends-alumni/help-us-grow/> or by mail to: UW Foundation, US Bank Lockbox 78807, Milwaukee, WI 53278-0807

Questions about how your gifts may be used? Ask: Ellen Zweibel, zweibel@astro.wisc.edu, 608-262-7921 or UW Foundation Director of Development Chris Glueck, chris.glueck@supportuw.org, 608-265-9952

Thank you for supporting Badger Astronomers!



News Notes



Arrivals

Welcome, Graduate Students!

Julie Davis: B.A. astronomy and physics, University of Colorado at Boulder. Julie will be working with Eric Wilcots on the COSMOS HI Large Extragalactic Survey (CHILES), which will observe the halo environments around nearby galaxies.

Dhanesh Krishnarao: B.S. physics and mathematics, American University, Washington, DC. Dhanesh will be working with Matt Haffner, studying the structure and kinematics of ionized gas in galaxies.

Max Pollack: B.S. astrophysics, The College of New Jersey. Max will be working with Bob Mathieu on the formation processes of Blue Straggler stars in binary star systems.

Ben Rosenwasser: B.S. astronomy and astrophysics, Pennsylvania State University. Ben will be working with Amy Barger on a wide-area survey of distant galaxies, where they expect to identify some of the youngest known galaxies.

Departures

Congratulations, Graduates!

Nick Hill has been awarded a Ph.D. in Astronomy for his work utilizing graphical processing units for modeling stellar systems. During his time at UW, Hill has also contributed to modeling the x-ray emissions of the highly magnetized magnetospheres surrounding massive stars.

Corey Wood has been awarded a Ph.D. in Astronomy for both his instrumental and observational work related to integral field spectroscopy. In addition to helping design and build the HexPak and GradPak integral field units, Wood has also performed observations measuring the amount of gas flowing out of starburst galaxies.

DooSoo Yoon has been awarded a Ph.D. in Astronomy for his theoretical and numerical work analyzing the dynamics between the outflowing jets of microquasars and the surrounding medium. Additionally, he has studied how these jets interact with the stellar winds emanating from microquasars. Yoon will be moving to Shanghai, China for a postdoctoral position at Shanghai Observatory.

Britt Lundgren has completed her postdoctoral fellowship with the astronomy department. During her time at UW, Lundgren used both the Hubble Space Telescope and ground-based surveys to investigate a wide range of topics in extragalactic astrophysics. She is now working at AAAS as a Science and Technology Policy Fellow in Big Data Analytics.

Bob Lindner has completed his postdoctoral fellowship with the astronomy department. During his time at UW, Lindner worked with Professor Snezana Stanimirovic taking radio observations of interstellar clouds, while also working to improve the automation of data analysis for massive data sets. He is now working in Madison at Earthling Interactive as a Data Scientist.

Tova Yoast-Hull has been awarded a Ph.D. in Physics for her work utilizing high-energy particle physics and radiative transfer to analyze cosmic ray interactions in starbursting galaxies. Her graduate research was also recognized by the Department of Astronomy through the Whitford Award. Tova is currently working on the IceCUBE team as a postdoctoral fellow at WIPAC.

Congratulations, Undergraduates!

Summer 2014

Robert Masse

Fall 2014

Maxwell Hansen

Tyler Sinotte

Clayton Suplinski

Spring 2015

Adam Birenbaum

Adam Blonsky

Nicholas Derr

Joshua Hanneman

Xinyang Lu

Julia Mayeshiba

Spring 2015

Kevin Meaney

Cailean Rosseter

Aaron Stemo

Mitch Ziesemer

Summer 2015

Sou Thee Her

In Memoriam

The Department of Astronomy lost a number of dear friends in little more than a year's time. **Laura "Pat" Bautz** received her doctorate in astronomy from UW-Madison in 1967, while **Gary Van Ryzin** served as our department administrator for the past seven years. Professor Emeritus **Robert "Bob" Bless** was a world leader in establishing space astronomy during his time with the department, ably shepherding our grants and our new building, while **Richard "Doc" Greiner**, Professor Emeritus of Electrical and Computer Engineering at UW, was a close friend of the department and a member of our Board of Visitors.

Departmental Awards and Honors

Badger Astronomy History

Twenty photodiode tubes from the early 1900s—purchased by pioneer of photometry and former UW Professor, Joel Stebbins—were added to the phototechnology collection at the Smithsonian.

The UW Astronomy machine shop created accurate **replicas of gold and silver medals** awarded to Professor Stebbins in recognition of his contributions to modern astronomy—both before and during his time as director of Washburn Observatory. The replicas will be on display in the Astronomy Department's lobby, while the originals will be stored in the UW–Madison collection.

Please Keep in Touch

We'd like to hear from you. Please send any news that we can include in future newsletters or any changes in your contact information to:
newsletter@astro.wisc.edu or
UW–Madison Department of Astronomy, 475 N. Charter St.,
Madison, WI 53706
Attn: Jake Parks

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Vilas Distinguished Achievement
Professor **Amy Barger** was awarded the prestigious **Guggenheim Fellowship**. Barger will use the award—given to support remarkable mid-career scholars and artists—to observe the most extreme star-forming galaxies in the universe.

Senior Scientist **Jeff Percival** was recognized by the University of Wisconsin as a **Distinguished Senior Scientist**. Percival received this honor for his invention of the Star Tracker 5000, a device used across the astronomy world for positioning astronomical equipment.

Professor **Sebastian Heinz** was presented with the **Vilas Associates Award**—established to honor faculty conducting research of the highest quality and significance. Heinz will use the award to help fund his work utilizing light echoes to more accurately measure distances in space.

Professors **Snezana Stanimirovic** and **Sebastian Heinz** were promoted to **Full Professor** by the UW Department of Astronomy.

Research Scientist **Brian Babler** was awarded the **L&S mid-career academic staff award** for his work over the past 25 years advancing astronomical research through the creation and analysis of giant astronomical survey data sets. The award recognizes those who demonstrate outstanding performance, leadership and service, and substantial professional competency and promise.

Graduate student **Stephen Pardy** was presented with the **2014 Stebbins Award**—given in recognition of research, publications, and presentations to peers. Pardy received the award for his achievements at the International School on Gravitation Dynamics, held at the University of Toronto.

Graduate student **Chris Bard** was presented with the **2015 Stebbins Award** in recognition of his outstanding research. For his research, Bard runs computer simula-

Chancellor's Inclusive Excellence Award in Teaching



Professor **Eric Wilcots** was awarded the **Chancellor's Inclusive Excellence Award in Teaching** for both his work engaging non-science majors in popular astronomy courses and his work developing the concept of Universe in the Park.

tions which model the magnetospheres around both the Earth and stars.

Graduate students **Jenna Ryon** and **Claire Murray** were presented with the **Jansky Award**—given to honor both outstanding research accomplishments and scientific independence, leadership, and creativity.

Graduate students **Claire Murray** and **Ben Tofflemire** were awarded a **Chambliss Medal** for their posters at the American Astronomical Society meeting in Seattle, Washington.

Visiting REU participant **Joseph Putko** was awarded a **Chambliss Medal** for undergraduate presenters for his poster at the AAS meeting in Seattle.

Grainger Postdoctoral Fellow **Aleks Diamond-Stanic** was presented with the **First Wave Outstanding Faculty/Staff Recognition Award** for his mentoring of astrophysics major and spoken word poet, Miona Short. The award was established by the Office of Multicultural Arts Initiatives to honor faculty and staff who support student success both inside and outside of the classroom.



Tiny Instrument Makes Giant Difference



(Pictured from left to right) Brian Tibbetts, Jeff Percival, and Cliff Murphy stand in front of a rocket equipped with the ST 5000. The Suborbital Local Interstellar Cloud Experiment (SLICE) was launched on April 21, 2013 to study how interstellar gas streaming through the Solar System affects the Sun's solar wind, and indirectly the Earth's climate and biology.

Upon first walking into the office of Jeff Percival—Distinguished Senior Scientist in the Department of Astronomy—one will quickly notice a small device, dressed with microchips and circuits, gently resting atop a bed of pink bubble wrap.

This is his latest project, the next generation of the Star Tracker 5000.

ST5000—which Percival helped bring into the world at the turn of the millennium—is a guidance system capable of steering scientifically equipped suborbital rockets with unprecedented accuracy and speed.

When Percival first recognized the broader need for a high-quality suborbital rocket guidance system, he knew it would be possible to build with the help of the talented people within the UW Astronomy Instrumentation Lab.

First, there is Kurt Jaehnig, an invaluable expert in instrument design. Next, there is Sam Gabelt, an electronics technician whose skill borders on artistry. And finally, there is Don Michalski, whose long experience with analog electronics is increasingly rare today.

As Percival said, “The Star Tracker 5000 could literally not have been invented anywhere else, and it’s due to the rich environment and history of instrumentation in this department.”

Unlike earlier suborbital rocket guidance systems—which could take up to a minute to calculate a rocket’s orientation—the ST5000 is able to determine flight information in merely a second.

And while earlier devices were limited to an accuracy of about a hundredth of a degree, the ST5000 is over 10 times as precise.

Because the duration of many suborbital rocket missions is less than ten minutes, the added speed and preci-

sion of the ST5000 makes it a crucial enabling technology for many modern astronomical missions.

Ranging from analyzing the tails of comets to studying the atmosphere of Earth, there are many ways the ST5000 has been employed. For instance, the device has even been used to help guide high-altitude balloon missions.

Yet, with all the attention usually focused on the decade-long, multi-billion dollar, space-based missions, it is easy to forget about the importance of suborbital rocket missions.

According to Percival, one of the most important advantages of suborbital versus orbital missions is the fact that suborbital missions are astonishingly more affordable.

As Percival explained, “they provide a means to cheaply test equipment planned for use in future space-based projects.”

Furthermore—unlike orbital projects—suborbital projects can be proposed, funded, carried out, and analyzed within the time it takes to complete a typical graduate program. This makes them ideal for maintaining a steady pipeline of talented, experienced investigators for future space missions.

Because of this, Percival strongly believes that astronomy departments with instrument development programs offer valuable opportunities to graduate students that departments with fewer possible specializations do not.

UW’s Department of Astronomy—in harmony with the Wisconsin Institute for Discovery theme which resonates throughout the Madison campus—focuses on exposing graduate students to a variety of different disciplines to help broaden their knowledge base and ultimately produce unexpected results.

As Percival said, “the strength of an instrumentation program, like UW Astronomy has had for many decades, is that it is, in a sense, greater than the sum of the parts.”

Research Highlights

Revising the Density of Our Local Universe

Can revising the density of matter in our galactic neighborhood explain away the need for dark energy? A recent paper co-authored by Vilas Distinguished Achievement Professor, **Amy Barger**, shows that it might.

Based on the publication, Barger and her colleagues present evidence showing that our little corner of the Universe may be filled with far less matter than astronomers previously thought.

Although this may seem like a rather mundane finding, if true, the implications could be very far-reaching.

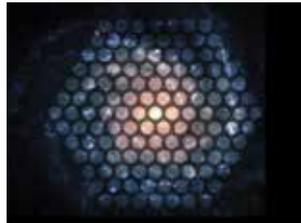
With her research, Barger and her colleagues have shown that the magnitude of the under-density may be enough to eliminate the need for the commonly accepted—yet utterly baffling—component of our universe dubbed dark energy.

MaNGA Prototype Proves Worth

In preparation for the latest incarnation of the Sloan Digital Sky Survey (SDSS-IV), UW Astronomy professors **Matthew Bershadsky** and **Christy Tremonti** recently co-authored a promising analysis of preliminary data collected using a prototype of the Mapping Nearby Galaxies at Apache Point Observatory (P-MaNGA) instrument.

The MaNGA survey—which will be the first massive spectroscopic survey to collect unique spectra from multiple areas of individual galaxies—is one of the most highly anticipated arms of the upcoming SDSS-IV project.

Although the P-MaNGA project was primarily launched to fine-tune the instrument and perform some technical



experiments, the project team has since released the fully-calibrated, spatially-resolved spectra for nearly 1,400 of the 10,000 planned target galaxies.

Detecting X-Ray Ripples in a Cosmic Pond

In a recent paper featured in the *Astrophysical Journal*, Professor **Sebastian Heinz** and an international team of scientists have used an extremely bright light echo in the form of rings to determine the distance to the oddball neutron star binary system Circinus X-1.

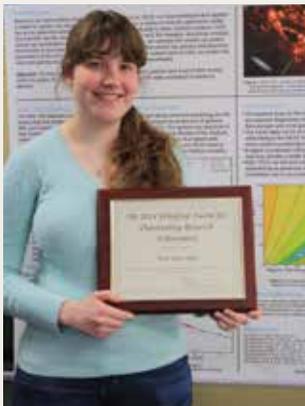
The echo is created when x-rays from the neutron star scatter off interstellar dust clouds between Earth and the neutron star—much like the sound waves of a yodeler bounce through surrounding mountains.

Following the example of bats using echolocation to measure distances to their prey, Heinz and colleagues used simple geometry to determine a distance to Circinus X-1 of 30,600 lightyears. This is both the first time such an echolocation distance measurement was possible and the first reliable distance measurement to Circinus X-1.

Circinus X-1 is not only a benchmark neutron star, but it is also the youngest known x-ray binary star—at only a few thousand years old. Furthermore, it has an anomalously low magnetic field, which suggests that neutron star birth is a more diverse process than previously thought.



Recent Ph.D. Thesis by Tova Yoast-Hull



For her recent Ph.D. thesis in physics, **Tova Yoast-Hull** applied her knowledge of high energy physics to modeling how cosmic rays interact with matter and magnetic fields in vigorously star-forming galaxies.

In particular, Yoast-Hull studied the two separate cores of Arp 220—which is an active and ultraluminous starburst galaxy.

Since starburst galaxies are often packed with both new stars and supernovae, they also emit huge amounts of

cosmic rays. In turn, the cosmic rays then interact with surrounding interstellar gas to produce a cascade of high-energy particles, such as gamma-rays and neutrinos.

Yoast-Hull was able to accurately model how these cosmic rays interacted with the interstellar gas in Arp 220. With this model, she then predicted the resulting gamma-ray and neutrino fluxes—which can now be tested and verified through observations.



How Far We Can Go—With Your Help.

For Ben Tofflemire, *it* meant he was able to venture down to Stellenbosch, South Africa to attend the Science with SALT conference. There, Tofflemire met with the people actually responsible for gathering his research data using the Southern African Large Telescope (SALT).

For Anna Williams, *it* meant she was able to work her way through a European circuit of conferences in France, Germany, and Italy. Throughout her trip, Williams exchanged thoughts with numerous internationally renowned experts in her area of extragalactic magnetic fields.

For Zach Pace, *it* meant he was able to attend a vital collaboration meeting in Madrid, Spain for SDSS-IV. While rubbing elbows with his peers, Pace received the unexpected offer to run an official blog for MaNGA, a highly anticipated arm of the latest Sloan Digital Sky Survey (SDSS-IV).

But what is the “it” that enabled all these amazing opportunities for UW–Madison Astronomy graduate students?

“It” is the generosity of people just like you.

“With the help of our generous community, we are able to open up a world of opportunities which would have otherwise been impossible.”

—Professor Sebastian Heinz

This year, Tofflemire, Williams, and Pace, in addition to John Chisholm, were all selected as Bautz Travel Fellows. The fellowship—which is funded through the privately donated Bautz Fund—is an award established to provide outstanding graduate students the opportunity to

attend and present their research at foreign conferences.

Unfortunately, valuable travel experiences for graduate students are not the only expenses for which the UW Department of Astronomy relies on privately donated funds. Although the department has always done quite well earning federal grant support, the money does not pay for everything.

Many of the most publically adored astronomical outreach programs are also funded entirely through private donations. The most far-reaching example of this is the Universe in the Park program (UitP).

UitP—which is funded through the generous donations of Jere and Anne Fluno—is one of the most popular astronomical outreach programs in Madison. And it is based on one simple idea—astronomy is best understood outside, beneath the dark skies.

The UitP program, which has been serving Wisconsin for nearly two decades, equips a UW astronomy student with a telescope and sends them to a different state park every Saturday throughout the summer.

During the event—which is free to attend and open to anyone—the public is often treated to an introductory astronomy presentation before taking their turn observing the majestic night sky.

The Bautz Travel Fellowship program and UitP are only two examples of how private donations have enabled amazing experiences for both students and the public alike. However, with the support of people just like you, there is no end to what UW Astronomy can achieve.

As Professor Sebastian Heinz puts it, with the help of our generous community, “we are able to open up a world of opportunities which would have otherwise been impossible.”

Donation Amount	What will it provide?
\$10	Coffee for departmental meeting
\$50	Poster for undergraduate scientific conference
\$100	New filter for Universe in the Park (UitP) telescopes
\$250	One night of Universe in the Park
\$500	Printing cost for one issue of the Washburn Observer
\$1,000	Cost to attend a domestic scientific conference
\$2,000	Celestron telescope for UitP, with accessories
\$2,500	Cost to attend an international scientific conference
\$5,000	Long-term visitor for department
\$10,000	Graduate student summer research fellowship
\$25,000	Refurbishment of educational facilities on Sterling Hall roof
\$50,000	Funding for undergraduate scholarship
\$100,000	New filter for One Degree Imager (ODI) on WIYN 3.5m telescope
\$500,000	Start-up funding for new faculty member
\$1,000,000	Endows a graduate fellowship for astronomical research
\$2,000,000	Endows a postdoctoral fellowship for astronomical research



Students view sunspots using a solar filter from the newly renovated rooftop on Sterling Hall.



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Pictured from atop Van Hise Hall, Washburn Observatory (bottom left) overlooks Lake Mendota from Observatory Hill.