The Washburn Observer

DEPARTMENT OF
ASTRONOMY
UNIVERSITY OF WISCONSIN-MADISON

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Inside this Issue:

An HD Odyssey: When Art Meets Science

Are science and art confined to left and right brain? Or can they join, creating an immersive experience capturing all of our senses, to transform how we see the world? The Madison Symphony set out to answer that question on the last weekend of September, filling the Madison Overture Center for three straight days as they opened their concert season with a dazzling mashup of art and science.

With generous support from The Friends of UW-Madison Astronomy, the Madison Symphony brought "The Planets: An HD Odyssey" to Wisconsin for the first time. During the event, the orchestra played Gustav Holst's masterpiece "The Planets" in tandem with a spectacular high definition film showcasing beautiful images of each of the eight planets — excluding the dwarf planet Pluto, which had not been discovered by the time Holst wrote the piece.

As the lights dimmed after intermission on Friday, Sept. 23, the orchestra perfected their posture in preparation for the first movement of Holst's 100-year old orchestral suite. "Mars: Bringer of War" appeared on the massive HD screen behind them.

Moments after the text faded out, the opening image of a barren, rusted planet leapt onto the screen as the orchestra bounded into the first measure, which marched forward forcefully to the drumbeat of war. Bold images—both real and computer generated—streamed across the screen synchronized to the music, transfixing the audience in a hypnotic flow of pictures and sound.

At one point, an animated video showed a Mars rover descending through the atmosphere in preparation for a landing. When the rover ignited its armadillo-style shell of airbags and bounced across the Martian surface, some in the audience cupped their hands over their mouths, others audibly gasped.

Though the initial ode to Mars was packed with intensity, the next score—"Venus: Bringer of Peace"—relaxed the audience. By the time the orchestra shifted from the fluttering of

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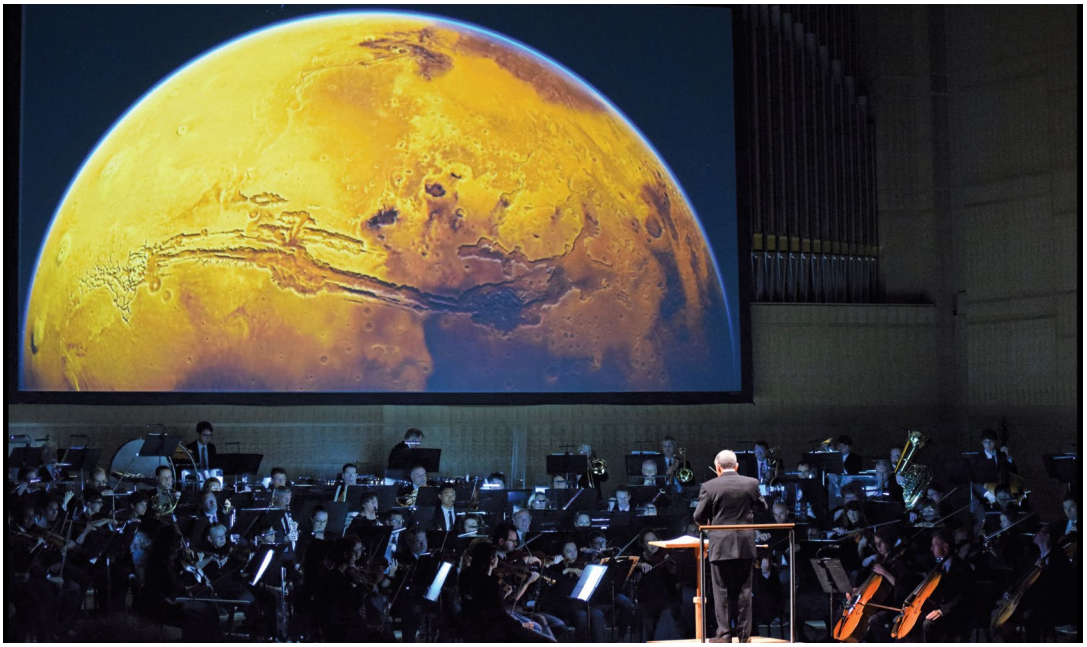

"The Planets: an HD Odyssey": The Madison Symphony Orchestra performs Gustav Holst's "The Planets", synchronized with NASA's high-resolution imagery from missions that traveled the solar system; Photo credit: **Peter Rodgers**

The Washburn Observer is the newsletter of the Department of Astronomy at the University of Wisconsin-Madison

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Letter from the Chair

Becoming a new department chair is like being a Freshman in college in many ways: New challenges and experiences await you every day, deadlines rush at you, and you make fresh acquaintances and friends among your new peer group.

And like during the first semester in college, it is important to have great mentors. I cannot overstress how thankful I am to the chairs before me, Ellen Zweibel, Jay Gallagher, Bob Mathieu, and Eric Wilcots, for their support and advice.

Now that the first three months as chair are behind me, and I am finding some time to write this letter, a few things come into clear focus.

The *first* is how amazing my colleagues are. Our prior chair, Ellen Zweibel was awarded the 2016 James Clerk Maxwell Prize for a lifetime of brilliant work in plasma physics. Ellen is the first woman ever to win this prize in the 41 years it has been awarded!

Visiting my colleagues Marsha Wolf and Matt Bershady at Washburn Labs is an eye-opening experience in ingenuity. Being department chair gives me a birds-eye view of the department and its people that I did not quite anticipate, but relish all the more.

The *second* is the sense of humility and gratitude I feel when I open a letter to find that someone made a gift to support the Astronomy Department.

Some of the most moving gifts may be small—a twenty dollar check from a recent graduate, a fifty dollar gift from an anonymous donor inspired by a visit to a Washburn Open House. These gifts show us that we affect people's lives in positive ways.

And some gifts are simply overwhelming. Like our two new endowed graduate student fellowships—the Fluno Family Fellowship and the Diermeier Family Foundation Astronomy Fellowship—that will fund two incoming graduate students every year. These two gifts, making use of a generous match by the Nicholas Family's gift to the UW-Madison, fulfill a vision the department formulated almost a decade ago: allowing incoming graduate students to dive into research right away.

Which brings me to my *third* point, the value of long-term planning. When the department went through its strategic planning exercise in 2008, I was a freshly minted Assistant Professor and approached the plan with enthusiasm, but also a sense of doubt. After all, how many strategic plans are placed in a drawer and forgotten almost as soon as the ink is dry? But our strategic plan *did* live up to its promise. We have referred to it over and over when making hiring decisions, setting funding priorities, and structuring our graduate recruitment. And we *have* reached many of our goals.

That is why I am asking the department to craft a new strategic plan. As we approach important milestones like new faculty hires and positioning ourselves in the changing landscape of optical and infrared astronomy, it will be very helpful to have a well-crafted vision we can rely upon. The work we do now will help the department stay the strong, productive, diverse, and welcoming place it is today.

In this issue, you will find stories that describe the beauty of arts and science, the ingenuity of our majors, updates on science and department news, the impact of gifts on department life, and the future of our REU program. Enjoy!

Sebastian Heinz, Department Chair

An HD Odyssey *Continued from page 1*

"Mercury: The Winged Messenger" to the frolicking of "Jupiter: Bringer of Jollity," many leaned forward in their seats, completely absorbed in the swirling belts of Jupiter on the screen.

The concert ended with the ethereal sounds of Neptune sung by a choir hidden behind the stage, filling the audience with the same kind of wonder that, both before the show and during intermission, drove scores of attendees to the information table in the lobby run by the UW-Madison Department of Astronomy. In fact, about 160 of you signed up to receive our newsletter right then and there. We welcome you, new readers!

A week before the performances, the Astronomy Department hosted the Madison Symphony Orchestra at Washburn Observatory for a night of sky viewing. At the historic telescope, the musicians had a chance of their own to connect with the planets. As they took turns gazing at Saturn, they drew upon the fact that, about an hour ago, photons left the sun, touched the surface of Saturn, and traveled back through space to land in their eye.

So while people often think of art and science as two completely different beasts, as seen in The Planets: An HD Odyssey, the two can be much more intertwined. The truth that can be found in science can often fuel art. And in the same vein, an appreciation for art can inspire a sense of wonder, and beautiful science.

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When Opportunity Knocks, Leah Fulmer Answers the Call

When you speak to Leah Fulmer—an ambitious undergraduate astronomy student at UW-Madison—it is clear that she rarely misses out on a new experience. This summer, she was stationed in Santiago, Chile, working with Professor Monica Rubio at the University of Chile.

While in the Southern Hemisphere, Fulmer took advantage of every opportunity that came her way. In addition to visiting the Atacama Large Millimeter/submillimeter Array, she twice observed at the Atacama Pathfinder Experiment telescope, and also presented her research at the University of Valparaiso in Chile.

Fulmer began her undergraduate career at UW-Madison as a biomedical engineering student. However, it didn't take long before she filled an empty space in her schedule with a class she deemed "more fun"—Astronomy 104, taught by Professor Jay Gallagher.

Within a few weeks, Professor Gallagher picked up on Fulmer's intelligence and ambition, so he invited her to Sterling Hall to discuss her future plans. Fulmer vividly remembers as they walked through Woodman Astronomical Library—our repository of over 15,000 astronomical books, catalogs, and periodicals—she was overcome by emotion.

Shortly thereafter, she dropped biomedical engineering and declared as an astronomy major.

That same year, Professor Gallagher offered Fulmer an undergraduate research position—a very exciting opportunity for a freshman. With Gallagher's help, Fulmer began investigating the inner and outer disks of the isolated galaxy NGC 5523. Since then, she has also calculated the galactic rotation curve of the Milky Way, and investigated the unexpected formation of massive stars in the gas-poor environment of NGC 602.

Although Fulmer is clearly a very motivated student, she is quick to acknowledge that she has received a lot of support in the form of both opportunities and people. Besides attending colloquia, science lunches, and journal clubs, Fulmer also joined Women of Wisconsin Strengthening Astronomy, which is where she met two of her most valued confidants—Miona Short and Sarah Martin.

Leah Fulmer at the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile

"Those things that UW particularly offers really give you a sense of community," Fulmer said, "they make you feel safe enough to, you know, reach out for support…and that means a lot to me as an undergraduate."

Although Fulmer plans to earn her Ph.D. in Astronomy, she is not sure exactly what she will focus on. For that, Fulmer says, she needs to gather more data by embracing every opportunity and taking advantage of the research diversity that UW-Madison has to offer.

Contributions

Your support creates opportunities for students, staff, and faculty. The stories you've read about here happened because of gifts from readers like you. You can contribute online at http://www.astro.wisc.edu/giving or by mail to: UW Foundation, US Bank, Lockbox 78807, Milwaukee, WI 53278-0807.

Questions about how your gifts may be used? Contact: **Sebastian Heinz**, chair@astro.wisc.edu, 608-890-1459, or UW-Foundation Director of Development, **Troy Oleck**, troy.oleck@supportuw.org, 608-308-5526. **Thank you for supporting Badger Astronomers!**

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Department News

Departures

Chris Bard earned a Ph.D. in Astronomy this summer for his work with Professor **Rich Townsend** running complex computer simulations of stellar magnetospheres—which are spherical shells of intense magnetic fields that surround some massive stars. During his time at UW, Bard also worked with **John Dorelli** of the **NASA Goddard Space Flight Center,** where he applied his computer simulations to Earth's own magnetosphere. Bard has accepted a NASA Postdoctoral Program Fellowship at Goddard Space Flight Center, where he plans to push his simulations to the third dimension.

John Chisholm earned a Ph.D. in Astronomy this summer for his work with Professor **Christy Tremonti** investigating the feedback processes that occur in both star-forming galaxies and active galactic nuclei (AGN)—which are the extremely dense and luminous centers of some galaxies. Chisholm has accepted a Postdoctoral Research Fellowship in **Daniel Schaerer's** starburst group at **Geneva Observatory,** where he will work on projects ranging from **ALMA** observations to modeling the UV signatures of galactic winds.

Greg Mosby earned a Ph.D. in Astronomy this summer for his work with Professor **Christy Tremonti** and **Marsha Wolf**, which used both quasars and their host galaxies to test the paradigms of galactic evolution. Mosby has accepted a **NASA Postdoctoral Program Fellowship** at Goddard Space Flight Center, where he will work with **Bernie Rauscher** to develop very low-noise infrared detectors for use in future NASA missions.

Jenna Ryon earned a Ph.D. in Astronomy this summer for her work with Professor **Jay Gallagher** studying the properties of young, massive star clusters in nearby galaxies using data from the Hubble Space Telescope. Additionally, Ryon has worked to characterize the luminosity, mass, age, and size distributions of individual stars within nearby clusters. Ryon has accepted a position at the **Space Telescope Science Institute** as a Senior Research and Instrument Analyst, where she will work on the Advanced Camera for Surveys team.

Katelyn Milliman earned a Ph.D. in Astronomy this summer for her work with Professor **Bob Mathieu** investigating why oddball stars in some open clusters do not evolve following theoretically predicted paths. In her research, Milliman found that many of these strange stars were actually previously unknown binary star systems. Milliman has accepted a position as a STEM instructor at a local elementary school in Beaverton, Oregon, where she will help educate the next generation of scientists.

Arthur Eigenbrot earned a Ph.D. in Astronomy this summer for his work with Professor **Matt Bershady** studying how multi-mode fiber optics can affect the collection of astronomical data. Additionally, Eigenbrot worked to model the distribution of material in edge-on spiral galaxies. Eigenbrot is planning to work in the private sector after taking some well-deserved time to travel the US.

Danielle Nielsen earned her Master's in Astronomy this fall for her work with Professor **Eric Wilcots**.

Elijah Bernstein-Cooper earned his Master's in Astronomy this fall for his work with Professor **Snezana Stanimirovic** on the nature of interstellar clouds through the study of Carbon Monoxide and Hydrogen in emission and absorption.

Please Stay 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, Astronomy Department, 475 N. Charter St., Madison, WI 53706, attention: Newsletter

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A New Cohort of Postdocs

Josh Wiener rejoined the UW-Madison Department of Astronomy this fall as a postdoctoral researcher after earning his Ph.D. from the **University of California, Santa Barbara**. At UW, Wiener will work with Professor **Ellen Zweibel** on computer simulations that model how cosmic ray physics can influence mass and energy transfer in and around galaxies. Josh also spent a semester in Madison as a student.

Shravan Shetty joined the astronomy department this fall as a postdoctoral researcher after earning his Ph.D. from **Oxford University**. At UW, Shravan will work with Professor **Matt Bershady** studying the dynamical properties of spiral galaxies in hopes of better understanding galactic evolution, stellar populations, and scaling relations. Shravan will work on MaNGA data from the SDSS IV project

Lia Corrales joined the Astronomy Department this fall as an **Einstein Fellow** after completing a postdoctoral position at the **MIT KAVLI Institute for Astrophysics and Space Research**. At UW, Corrales aims to use bright X-ray binaries to measure interstellar dust grain size distributions—which will ultimately help her investigate the Milky Way's galactic structure. She will work with Professor **Sebastian Heinz**.

Department News

Arrivals: Welcome, Graduate Students!

Logan Jones: B.S. in Physics, **University of Arkansas**. Logan is working with Professor **Amy Barger** studying extremely distant, high redshift galaxies. Since the light from these distant galaxies was emitted billions of years ago, their study is vital to our understanding of early star and galaxy formation.

Camilo Machuca: B.S. in Astronomy, **Georgia State University**. Camilo is working with Professors **Matt Bershady** and **Eric Wilcots** investigating the dynamics and evolution of galaxies using spatially-resolved spectroscopic data from MaNGA. In addition to furthering our understanding of how galaxies change over time, the research will also shed light on the distribution of dark matter in the galactic disk.

Kendall Hall: B.S. in Physics, **California State University-Fresno**. 2016 **Fluno Fellow** Hall is working with Professor **Snezana Stanimirovic** analyzing the chemical composition of the Perseus cloud by comparing observations to simulations of analogous clouds. The goal of their work is to better understand how smaller clouds can coalesce into giant molecular clouds.

Erika Carlson: B.S. in Physics and Astronomy, **Pomona College**. 2016 **Fluno Fellow** Carlson is working with Professor **Robert Mathieu** studying triple star systems within open clusters of the Milky Way. By investigating these systems, she will gain insight into the motions and dynamics of stars within open clusters over time.

Departmental Awards and Honors

2016 Hilldale Lecture: We were honored to welcome Professor **Frank Shu** to Madison in October for the 2016 **Hilldale Lecture** on "Stopping Global Warming Economically." Frank is a decorated astrophysicist well known for his work in Galactic structure and planet formation and has dedicated himself to finding solutions to the global warming challenge.

Happy 20th Anniversary, Universe in the Park! Our popular public viewing program turns 20 and is stronger than ever, thanks to generous support from **Anne and Jere Fluno**!

Whitford Lecture: The 2016 Whitford Lecture was given by Badger alumnus **Ken Sembach**, Director of the **Space Telescope Science Institute**. Ken got his Ph.D. in Madison working with **Blair Savage** on absorption line spectroscopy, and he discussed the future of space astronomy and the upcoming missions *JWST* and *WFIRST*.

Bautz Lecture: This year's Bautz Lecture was given by award-winning German Astronomer **Eva Grebel**, from the **University of Heidelberg**, who discussed the topic of Galactic Archeology—the process of learning about the past of Galaxies from the properties of Galaxies in the present.

James Clerk Maxwell Prize: We celebrate **Ellen Zweibel**, winner of the 2016 **Maxwell Prize**, the highest honor in plasma physics. Ellen is the first woman to win the prize in its 41 year history. See page **6** for more.

Donald E. Osterbrock Prize: We congratulate **Jordan Marché** on winning the 2017 **Donald E. Osterbrock Prize** for his contributions to the Bibliographical Encyclopedia of Astronomers, along with his co-authors. "The Historical Astronomy Division awards the Donald E. Osterbrock Book Prize biennially to the authors of a book judged to advance the field of the history of astronomy or to bring history of astronomy to light."

Astronomy graduate student **Dhanesh Krishnarao** was awarded the **2016 Stebbins Award** for his work generating and analyzing maps of the warm ionized gas around the Sagittarius-Carina Arm of the Milky Way—showing that the distinct galactic spiral arm has unique properties and can potentially influence the distant halo of the galaxy. The Stebbins Award is given to a graduate student each year to recognize scientific independence, leadership, and creativity, and the ability to communicate research to a scientific audience. "My advisor, **Matt Haffner**, has been outrageously supportive since my arrival," Krishnarao said. "His guidance, encouragement, and support drive me to try my best."

Dan McCammon, Professor of Physics at UW-Madison and longtime friend and collaborator of the Astronomy Department, was awarded a **2016 NASA Exceptional Public Service Achievement Medal**, which recognizes exceptional contributions to NASA by non-civil servants. The prize was awarded for McCammon's seminal contributions to X-ray astrophysics, particularly his work developing X-ray calorimeter technology and its applications.

Diermeier Family Foundation Astronomy Fellowship

The Department of Astronomy is delighted to announce the creation of the **Diermeier Family Foundation Astronomy Fellowship**, which will provide financial backing to a new astronomy graduate student each year, allowing them to immediately dive into a research project they can help define.

The fellowship will help us recruit the most talented graduates from around the globe, and fulfills our long-term goal of allowing incoming students to be funded independently of research grants.

The Diermeier Family Foundation Astronomy Fellowship is possible thanks to the generous support of **Jeff and Julie Diermeier**. The funds were matched by **Ab & Nancy Nicholas** as part of their generous **Nicholas Match program**.

REU Program Renewed

Let us count the ways in which our Research Experiences for Undergraduates (REU) program is a win-win for everybody involved. Summer after summer, it allows ambitious young scientists to gain visibility and experience, positioning them well for a future in academia and beyond. It provides UW faculty and staff with resources to carry out research projects otherwise impossible to do. It helps us recruit talented students with a bright future in astronomy into our graduate program. And it brings research opportunities in STEM to underrepresented groups.

We are thrilled to announce that, after 15 successful years, our REU program was renewed for another three-year term by the NSF -- thank you, Eric Hooper, Bob Benjamin, Snezana Stanimirovic, and all involved! We are equally thrilled to announce that the program leadership will transition from Professor Snezana Stanimirovic, who has steered the program for the past eight years with great success, to Professor Elena D'Onghia, who will lead us forward with new ideas and initiatives.

Robert Moncada — who spent his summer working with Professor Justin Vandenbroucke on an instrumentation project for the Cherenkov Telescope Array (CTA)—gained a lot from his time in the cheesehead state. "The [REU] project allowed me to get an idea of what instrumentation in astronomy is like," Moncada said, "It makes you an awesome troubleshooter!"

With another successful REU session behind us, the UW-Madison Department of Astronomy is excited to host the next batch of talented undergraduate researchers in 2017. Congratulations, REU team, on another round of success!

Learning by Teaching

Every department needs some glue to hold it together. Our graduate students are a critical component of that glue. A case in point is Astronomy Graduate Lectures for Undergrads (AstroGLU)—a research lecture series pioneered by our grad students. AstroGLU invites undergrads out of the classroom, beyond their texts, and into the living story of astronomy. While textbooks introduce students to present astronomical knowledge, AstroGLU introduces them to the *future* by exposing them to currently open questions and to the graduate researchers asking those questions.

AstroGLU lecturers talk about the circuitous nature of the research process that is usually hidden beneath the polished results students see in the glossy pages of their textbooks. They reveal the dead-ends and surprising starts that make research what it is. Furthermore, they show how students develop the tools needed to answer questions no one has ever even asked before.

AstroGLU, now in its second year, was initiated and continues to be promoted by graduate students. With two 20-minute lectures offered about three times a semester, AstroGLU often draws an audience of over a hundred undergraduates.

While the lectures serve as a bridge for undergrads between classes and the world of research, graduate students also benefit from the opportunity to present their niche-specific research within the broader context of astronomy.

In bringing undergraduates out of the classroom and graduates out of their offices, AstroGLU breathes life into the Wisconsin idea that education should influence people's lives beyond the confines of a lecture hall. After lecturing on supernovae, Charee Peters said she was "impressed by how many people came up afterwards with intelligent questions given the talks were 15 to 20 minutes. As a graduate student, that was really cool to see."

Ellen Zweibel Maxwell Prize

How does a star form? How do black holes grow? How do you build a fusion reactor? It all comes down to plasma physics, one of the most complex branches of physics. A plasma is a gas composed of different species of charged particles, and the cosmos is full of plasmas. So, if you want to understand space plasmas, stop by Professor Ellen Zweibel's office, because she is one of the worlds premier plasma astrophysicists and a shining example of a teacher and a scientist.

Ellen has worked on the ways in which the cosmos gets magnetized, she has made important contributions to our understanding of the process of accretion, and she has illuminated the theory of how plasmas propagate and evolve in space.

The easiest way to see just what kind of impact Ellen's work has had is to read the dedication of her 2016 James Clerk Mawell Prize in Plasma Physics, the highest honor in plasma physics bestowed by the American Physical Society. Ellen received the award "for seminal research on the energetics, stability, and dynamics of astrophysical plasmas, including those related to stars and galaxies, and for leadership in linking plasma and other astrophysical phenomena."

Among the 41 Maxwell Prize recipients, Ellen stands out not just as a superb plasma astrophysicist, but also as the first woman ever to win this prize. We are immensely proud to have her as our colleague, teacher, and mentor. Congratulations, Ellen, on this wonderful and richly deserved honor!

Research News

An Evolutionary Theory for Yellow Straggler S1237

Emily Leiner, an astronomy graduate student working with Professor Bob Mathieu, presented a paper this summer at the Binary Stars in Cambridge conference in England. At the conference, which she attended thanks to a Bautz Fellowship, Leiner presented her analysis of a peculiar yellow straggler called S1237, located in the open star cluster M67.

Yellow stragglers are a curious group of stars that show up between blue stragglers and red giants on a color-magnitude diagram — which relates the mass of a star to its overall color and brightness. In order to determine how odd a yellow straggler really is, researchers first need to pinpoint exactly how massive it is—and this is where Leiner comes in.

Leiner and her co-authors determined the first ever asteroseismic mass and radius measurements for a yellow straggler. They found that S1237 has a mass nearly three times that of the Sun, while its radius is nearly nine times as big. This implies that S1237 formed through a collision involving at least three stars.

However, Leiner is quick to note that there could be another explanation. "If the asteroseismic mass is somewhat off and the star is closer to 2.5 [times the mass of the sun] or less, then the star is of normal brightness and color, and a merger of two stars could have created it." If this is the case, then Leiner's work is especially important, as it suggests that asteroseismic scaling relations for massive stars may need to be revised.

Kiso 5639: A Tadpole in the Cosmic Pond

Jay Gallagher, W.W. Morgan Professor of Astronomy, co-authored a recent study which used the Hubble Space Telescope to observe a so-called tadpole galaxy known as Kiso 5639. Tadpole galaxies—named for their bright heads and elongated tails—are a particularly interesting subset of galaxies because they are asymmetrical in both shape and composition.

By studying the distribution of elements within Kiso 5639, Gallagher and his co-authors found that the head of the galactic tadpole is packed with pristine star-forming material (mostly hydrogen and helium). However, the tail—which appears much dimmer and more stretched out—is full of spent fuel like carbon, nitrogen, and oxygen. Based on this, Gallagher and his team determined that Kiso 5639 is plowing through the sparse but significant amount of material that permeates outer space.

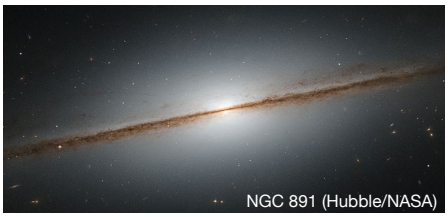

KISO 5639 (Hubble/NASA)

As Gallagher puts it, "The sky rocket appearance of this galaxy reflects how star formation can be energized through interactions with their environment, which is one reason why astronomers no longer view galaxies as separated 'islands' in an otherwise empty universe."

Levitating Gas in NGC 891

Can gas levitate above a galaxy? Erin Boettcher—an astronomy graduate student working with Professors Ellen Zweibel, Jay Gallagher, and Bob Benjamin—recently authored a paper investigating how gas in the galaxy NGC 891 can be stably suspended above and below the mid-plane of that galaxy.

This is not as easy as it may sound because the gravitational pull of the galaxy attracts any gas toward the plane of the galaxy. Like the Earth, disk galaxies have atmospheres, and these atmospheres each have a certain scale height—a height above winch the atmosphere drops off rapidly. The scale height of Earth's atmosphere is about 5 miles, for example. The scale height of a galaxy like NGC 891 is about 5 thousand light years!

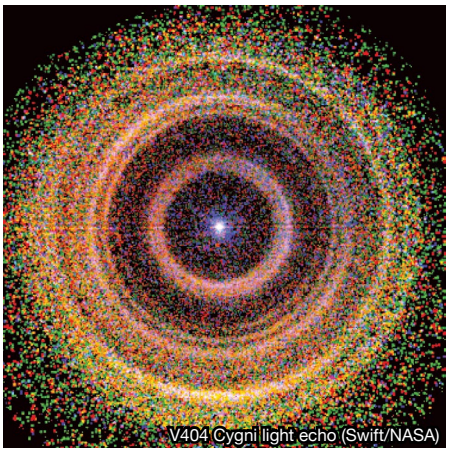

NGC 891 (Hubble/NASA)

To support gas at that height against the force of gravity, a pressure force has to act in the opposite direction. In the Earth's atmosphere, this pressure force is simply due the change in atmospheric pressure with height. But this kind of thermal pressure force is way too small to explain the observed extra-planar gas in NGC891. Either another component of pressure is needed, or the gas must be moving away from the galaxy.

Boettcher's work shows that the combined action of magnetic fields and high-energy particles called cosmic rays can explain the observed gas well above the plane. So it *is* possible to levitate gas above a galaxy after all—problem solved.

X-ray Dust Tomography with V404 Cygni

Mapping out the distribution of dust and gas in our Galaxy is painstaking. But X-rays offer a new, easier way by using light echoes. Maybe you recall from the Fall 2015 Edition of the Washburn Observer how Professor Sebastian Heinz and colleagues used echolocation to measure the distance to neutron star Circinus X-1? Get ready for an encore.


V404 Cygni light echo (Swift/NASA)

A bright light echo from the black hole V404 Cygni has given Heinz and his team of X-ray astronomers—including new Einstein Fellow Lia Corrales—a precision map of dust between Earth and the X-ray source in the constellation Cygnus. Each of the eight rings in the image is caused by the echo of a different interstellar cloud of dust and molecules.

From the size of the rings, we can directly determine the distance to each cloud to within a few percent precision. Distance measurements of such accuracy are rare, let alone for a whole bunch of objects at the same time. So, it's hard to beat eight for the price of one, especially if it comes with a beautiful image! And yes, you can put a ring on that.

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Astronomy Board of Visitors member Bob Terrell delights Wisconsin State Park visitors with his Sun in the Park program, modeled after our 20th-anniversary Universe in the Park!

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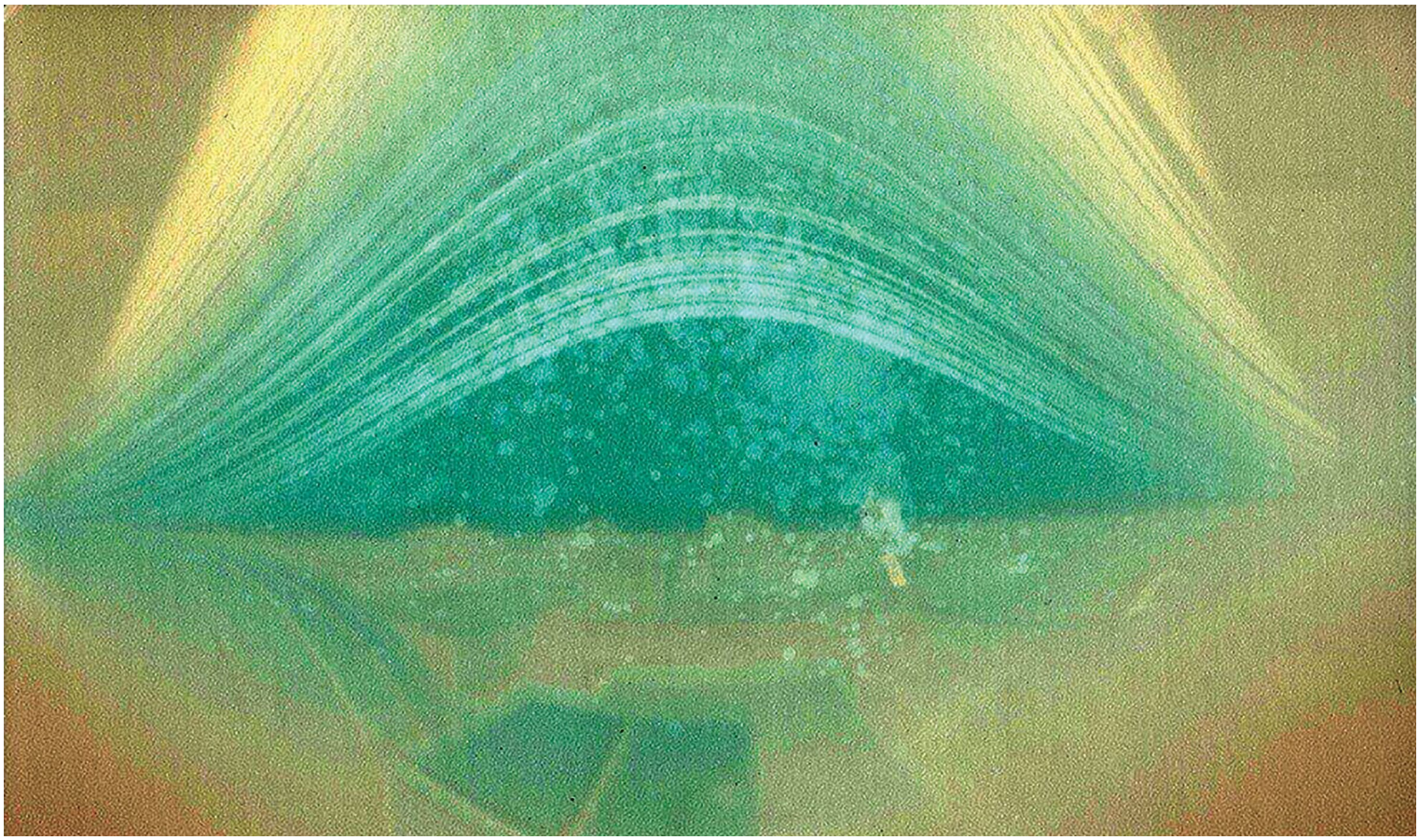

Using a pinhole camera made from an aluminum can, duct tape, and photosensitive paper, undergraduate Garrett Frankson captured this time-lapse image which charts the sun's path across the sky each day for six months from atop Sterling Hall. The image was one of the winners of the UW Cool Science Image contest. The lowest arc shows the sun's trajectory during the winter solstice, while the highest arc shows the sun's path during the summer solstice.