Photo by Carter Fox

A Letter from the Chair

Dear Friends of Michigan Astronomy,

As we prepare to close out the year 2019, I recognize that there is a lot to look back on and celebrate as a department and community of Astronomers. Some of the astronomical highlights of the year were the first image of the silhouette of a black hole and the awarding of the Nobel Prize for the detection of planets, exoplanets, around other stars. There are many amazing aspects of the black hole image but let's simply call out the fact that astronomical science took an image of an object that contains the mass of 4 million suns, is dark, and lies 53 million light-years or 318 quintillion miles away. Oh, and this was done using multiple telescopes linked together, but separated, in some cases, by more than ½ the diameter of the Earth. Let that sink in.

For exoplanets, according to NASA's exoplanet archive there are 4093 exoplanets detected as of Nov. 18, 2019 and, on average, there is at least one planet per star. New detections are coming in almost daily and the potential for new discovery is astounding.

Both of these science areas represent a major focus and future for Michigan Astronomy as our faculty are world leaders in these areas. One of the ways we will do this is by doing science with the European Southern Observatory's Extremely Large Telescope. This telescope will be the biggest on the planet that operates at visible light wavelengths and U-M Astronomy is in advance stages of negotiation to partner with instrument developers for this massive (39m in size) telescope. First light is several years away, but in coming years you will hear more and more about this new opportunity that will break open discovery space within the Universe, including black holes and exoplanets.


Prof. Ted Bergin, Department Chair

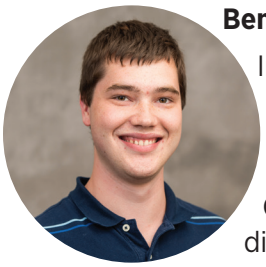
Additionally, Over the past year, the Department of Astronomy said farewell to 6 graduate students as they successfully completed their doctoral studies and have moved on to exciting careers across the country. While it is bittersweet to see them go, our department has also had the pleasure of welcoming 5 new graduate students to the program, and we look forward to watching them grow.

To close, I would like to send a big thank you to everyone who has supported Michigan Astronomy over the years – alumni, former faculty, and even members of the Astronomy community. Your continued support means so much to our department and especially to all of our young scientists who are just embarking on their careers. As we approach the end of 2019 and look to start a new year, I want to encourage you to keep in contact as our department continues to grow and advance in science.

Department News

The latest from our faculty, students, research scientists, and postdocs

STUDENT AWARDS



Benjamin Setterholm

In July of 2019, Benjamin Setterholm was awarded with a Future Investigators in NASA Earth and Space Science and Technology (FINESST) grant. This grant is awarded to highly-qualified individuals working in disciplines related to NASA's scientific goals. Benjamin is using his FINESST grant to support his work using the new MIRC-X and MYSTIC instruments on the CHARA array to observe near-infrared emisson on sub-au scales around nearby young stellar disks.

Jenny Calahan

Jenny Calahan was also awarded a FINESST grant in July 2019. Jenny is using her FINESST grant to support her ALMA observations and simulations of a diverse group of protoplanetary disks. Additionally, this year Jenny was awarded the highly-competitive NSF Graduate Research Fellowship, which recognizes and supports graduate students pursuing degrees in NSF-supported disciplines.

Juan Remolina

Juan Remolina was honored with a Chambliss Award for his poster presentation at the 223rd American Astronomical Society (AAS) meeting in Seattle Washington in January 2019. This student award is given to recognize exemplary research performed by students who present at the poster sessions at the annual AAS meeting.

U-M ASTRONOMY TO HOST 51 PEGASI B FELLOWSHIP

Now is a great time to study exoplanets at the University of Michigan! In 2019, the Department of Astronomy was approved as a host institution for the 51 Peg b Fellowship Program, sponsored by the Heising-Simons Foundation. The 51 Pegasi b Fellowship is an exceptional postdoctoral program that provides recent PhD graduates with the opportunity to conduct theoretical, observational, and experimental research in planetary astronomy.

The U-M Department of Astronomy is home to several research groups focused on planet formation, exoplanet science, and solar system exploration, and this fellowship will provide postdoctoral researchers with the opportunity to work alongside our celebrated faculty hosts, including Fred Adams, Ted Bergin, Nuria Calvet, Lia Corrales, Elena Gallo, Lee Hartmann, Michael Meyer, John Monnier, Emily Rauscher, and many more!

Our department is excited to welcome its first fellows starting next year!

Prof. Michael Meyer (left) and Dr. Juliette Becker (right)

FACULTY AWARDS

Keren Sharon

Professor Keren Sharon was recognized this year as a recipient of the Class of 1923 Memorial Teaching Award. Recipients of this award are chosen by the College Executive Committee from among those that have been recommended for promotion from assistant professor to associate professor with tenure. Keren received this award in recognition for her outstanding teaching during her first years as a faculty member with the Department of Astronomy.

Emily Rauscher

Back in February, Professor Emily Rauscher was named one of 2019's Cottrell Scholars. Each year, Research Corporation for Science Advancement announces 24 Cottrell Scholar recipients who are identified as leaders in integrating science education and research at top U.S. research institutions. The program, which awards recipients with $100,000, is designed to foster synergy among faculty.

John Monnier

Earlier this year, Professor John Monnier was awarded the 2019 American Astronomical Society (AAS) Joseph Weber Award for Astronomical Instrumentation. The Joseph Weber Award for Astronomical Instrumentation is given each year to an individual who has contributed a significant improvement to instrumentation in the field of Astronomy. John received this award in recognition of his work in long baseline optical interferometry.

Jon Miller

Also early this year, Professor Jon Miller was appointed as a co-chair for NASA's Athena Study Team. The purpose of the Athena Study Team is to oversee U.S. scientific community inputs into the European Space Agency's Athena Mission, a large X-ray telescope that is planned to launch in 2028.

Ted Bergin

In January of 2019, the Department of Astronomy was excited to congratulate Professor Ted Bergin for being awarded the 2019 Dannie Heineman Prize for Astrophysics. The Heineman Prize is a very significant award presented by the Heineman Foundation, American Institute of Physics (AIP) and American Astronomical Society (AAS) that recognizes mid-career scientists for the contributions they have made to their field. Ted received his award for his work in astrochemistry and his contributions to our understanding of the physics and chemistry of star and planet formation, as well as for his efforts to improve diversity and inclusion in astronomy.

DEPARTMENT FAST FACTS

People

- 24 Tenure-Track Faculty (6 jointly-appointed)
- 7 Professor Faculty
- 4 Emeritus Faculty
- 20 Research Scientists & Postdocs
- 30 Graduate Students
- 73 Undergraduate Majors & Minors
- 10 Administrative & Technical Staff

Computing

- University-wide Great Lakes Slurm HPC Cluster

Observatories

- Magellan Telescopes: 2 x 6.5-m telescopes at the Las Campanas Observatory, Chile
- MDM Observatory: 1.3 and 2.4-m telescope on Kitt Peak, Arizona
- Curtis-Schmidt Telescope: Cerro Tololo Inter-American Observatory, Chile
- CHARA: Optical/infrared interferometer on Mont Wilson, California
- NOEMA: Northern Extended Millimeter Array Interferometer, French Alps
- Angell Hall student telescopes & Detroit Observatory Fitz Telescope, University of Michigan, Ann Arbor, MI

Unraveling Mysteries of a Supermassive Black Hole at the Heart of the Milky Way

By: Lia Corrales, LSA Collegiate Postdoctoral Fellow

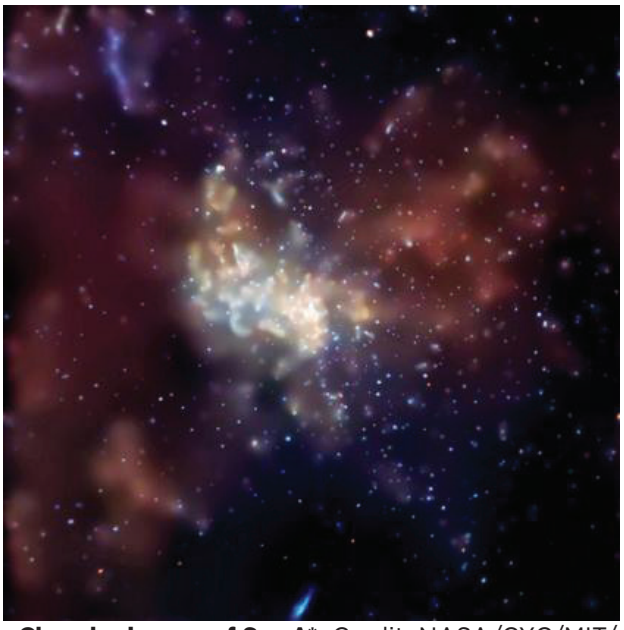
Dr. Lia Corrales

At the heart of every galaxy in the Universe lies a supermassive black hole (SMBH). I recently had the privilege to lead a team of researchers working to unravel the mysteries of Sgr A* - the SMBH at the center of our Galaxy, the Milky Way. Utilizing the Chandra X-ray Observatory for high resolution spectroscopy, my team and I delicately extracted an X-ray spectrum of Sgr A* from the crowded and extended X-ray emission that dominates the Chandra image of our Galactic Center. This is one of the keystone goals of the Chandra Galactic Center X-ray Visionary Project (sgra-star.com), which dedicated approximately one month of telescope time to observing Sgr A*.

The central 100 light years around Sgr A* is suffused with million degree gas, a supernova remnant, and a dense population of neutron stars, black holes, and massive stars. Within 10 light years of Sgr A*, a population of evolved, massive stars produce winds that fill the area, serving as food for the black hole. The process of matter falling into a black hole – accretion – is one of the fundamental fields of astrophysics because it tests our understanding of gravity, thermal processes, and electromagnetism.

Sgr A* has become a mysterious black hole because it is 100,000 times less luminous than expected, given the amount of material provided by the stars in its environment. Thus, it is one of the most important cases for testing accretion models in extreme environments. And because it is so dim, extracting information about Sgr A* can be difficult because objects within a few light years of the black hole are brighter.

Through careful filtering and building of background treatments, I was able to successfully extract a spectrum for Sgr A* in order to measure the X-ray emission lines from hot plasma flowing into the black hole. This particular measurement provides the highest spectral resolution possible, showing hints of a multi-temperature, stratified, and Doppler shifted gas. While research into more advanced models are ongoing, this dataset is set to be released publicly, and is part of the Chandra legacy. Now 20 years old, Chandra has the imaging resolution necessary to observe Sgr A*, and this capability will not be replaced for decades.



Chandra image of Sgr A*. Credit: NASA/CXC/MIT/F.K.Baganoff et al

More Satellites than Stars?

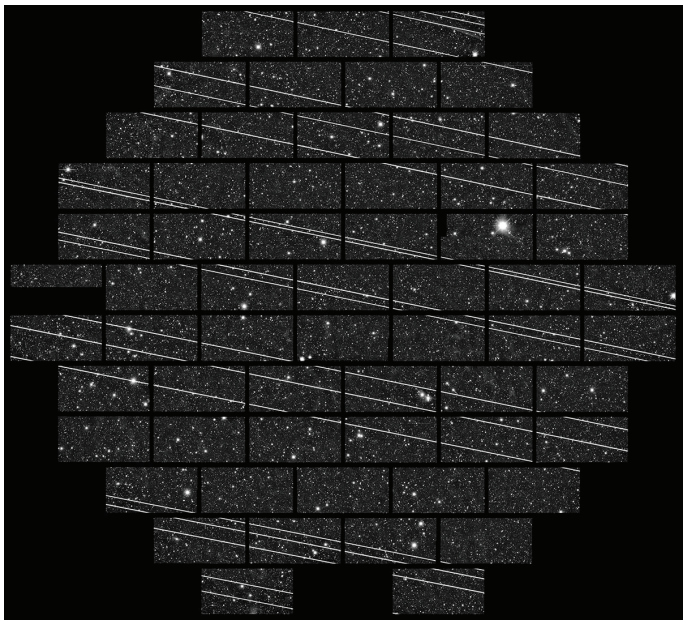
By: Patrick Seitzer, Research Professor (Emeritus)

If you go out after sunset or before sunrise, you will see bright satellites like the International Space Station, the Hubble Space Telescope, and others. Perhaps up to a dozen at once will be visible to the eye.

This situation is changing rapidly now with the proposed launch of thousands of bright satellites into Low Earth Orbit (LEO). Called mega-constellations, these systems are designed to bring Internet access to any point on Earth with very low signal delay. Plans have been filed by several companies to launch up to 42,000 or more satellites into LEO during the next decade. So when you go out and view the night sky after sunset or before sunrise you might see over a hundred such satellites instead of just a few. The night sky will not be the same.

Prof. Patrick Seitzer

On May 24, 2019, SpaceX launched 60 Starlink satellites, followed by another 60 on November 11, 2019. By the end of 2020 this first mega-constellation will have a total of 1584 new satellites in LEO, visible to the eye from a dark sky site.



Starlink Satellites Imaged from CTIO by the DELVE Survey. Credit: NSF's National Optical-Infrared Astronomy Research Laboratory/NSF/AURA/CTIO/DELVE

And telescopes will see these and fainter ones, presenting a challenge to astronomers. Recently 19 Starlinks from the second launch were caught totally by accident in an exposure taken with the Dark Energy Camera on the 4.0-m Blanco telescope at Cerro Tololo Inter-American Observatory in Chile (also home to the Department's Curtis-Schmidt telescope). This shows the challenge astronomers are starting to face.

Right now there are over 18,000 artificial objects in Earth orbit with published orbits, all launched since 1957. The majority of these are two faint to be seen with the eye. That situation could change dramatically in the next decade, when the majority of satellites will be bright ones!

The author is part of a working group of the American Astronomical Society studying the issue and trying to work with satellite operators to mitigate the challenge.

Musings of a Catholic Astronomer at Michigan

By: Fr. Richard D'Souza,
Astronomer, Vatican Observatory

If one is familiar with the history of astronomy, then it should come as no surprise that a Catholic priest was a postdoctoral research scholar at the Department of Astronomy at the University of Michigan for the last three years. I consider myself as following in the footsteps of George Lemaitre, Angelo Secchi and many others at the Vatican Observatory who made significant contributions to the field of Astronomy. I find no conflict with scientific research and my faith. In fact, I often find that my science strengthens my faith, and my faith allows me to be more open and critical in my scientific research. Studying the mysteries of the heavens allows me to better appreciate the magnificence of God who created it all.

I spent three enjoyable years at the Department of Astronomy, working with Eric Bell. Much of our interaction was spent laughing (often at our own mistakes) and learning together. And it was in having fun that we solved one of the biggest mysteries of the history of our galactic neighbor, the Andromeda galaxy. But we also spent much time talking about bigger 'questions'!

During my tenure at Michigan, I often assisted at St. Mary's Student Parish (Thompson Street) on the weekends. Through this, I was privileged to encounter a wide cross-section of the students and faculty of the University. Their search for meaning constantly challenged me to rethink my own faith and its relevance for our lives today, and also to creatively explore new ways in which my science and my faith could go hand in hand. Through the combination of my experiences in and outside the Department of Astronomy, I learnt that the three

Fr. Richard D'Souza

qualities I need to succeed as a scientist are faith, hope, and love. Allow me to explain this briefly.

So much of science is based on faith. At a fundamental level, one needs to have faith that the world is good and worthy of being studied. Even when the observations/data do not make sense, one needs to preserve and have faith that they do in fact follow certain physical laws, which are at the moment may be hidden from us. All scientific work begins with reasonable assumptions that we accept in faith. Moreover, we have to reasonably believe and engage with the scientific work of our predecessors. We also have faith in our models and in our collaborators. It is faith which allow us to make progress. But it is also this reasonable faith

which allows us to be critical of our assumptions/models as well as previous scientific work, which they do not agree with new data. Understanding the 'component' of faith in the sciences is essential to make progress while at the same time allowing us to be critical.

The sciences are driven by hope. Hope that we will be able to better understand nature; hope that the particular questions and approaches we have chosen will bear fruit. We hope that our intuition will turn out to be correct. We hope that we will be awarded the next NSF/NASA grant to fund the research we want to do. Without hope, science will not be able to move forward. While we don't know how things will turn out in the end, we have hope that we will be able to understand more. Sustaining that hope is essential to be successful long-term in the sciences.

Finally, I have come to realize that love is essential for the flourishing of the sciences. Science is not a mere reporting of facts, but is a conversation around these facts and observations. Through this conversation, scientists try to understand and make sense of physical world around them. Science is not so much about 'stars are made up of mostly of hydrogen and helium' – but it is about "What is a star? How do they work? What are they made up of? How are they born? How do they die?" It is through a back and forth conversation in a community that scientists approach a better understanding of physical reality. Progress in science critically depends on the quality and health of the conversation within the community. Today the scientific community is going through a transformation: we are increasingly realizing that progress in the sciences is directly correlated with its diversity; that breakthroughs in science happens only when the environment is conducive for different voices to be heard, especially voices from the fringes, and which have been traditionally suppressed. In order for science to advance, senior scientists and PIs need to create a safe space where 'all' can flourish and where long-term benefits can be reaped. In many ways, science is undergoing the revolution of love. Due to the inadequacies of the English language, we may never talk about science in these terms, but love is essential for science to flourish!

That's a challenge I set for myself as I encounter students here at my new job at the Vatican Observatory in Rome; instilling in them faith, hope, and love. And I am grateful to Michigan for teaching me this!

Fr. Richard D'Souza (left) and Prof. Eric Bell (right)

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STORY PAGE

DID YOU KNOW?

The Department of Astronomy is on social media! Follow us on Facebook, Twitter, and Instagram to stay up-to-date on the latest from the department.

Photo by Carter Fox