JOHNS HOPKINS UNIVERSITY

2018 Year in Review

Physics & Astronomy

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Physics and Astronomy is an annual publication of the Johns Hopkins University Zanvyl Krieger School of Arts and Sciences Department of Physics and Astronomy. Send correspondence to: jon.schroeder@jhu.edu.

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Front cover: An artist's rendition of a black hole in space. A number of the department's faculty members whose research focuses on black holes contributed to the article on page 4: "Black Holes: Riddles of the Cosmos."
Image by Vadim Sadovski

Letter from the Chair

Dear alumni, colleagues, and friends,

I am pleased to bring you this newsletter that reports on all the exciting developments that have happened in our department over the past year. In this letter I just want to give some of the especially noteworthy highlights.

First, I am very happy indeed that three new faculty members joined our department during 2018. Assistant Prof. **Brian Camley** arrived last January. He does numerical simulations of the physics of living systems and is a joint appointment with the Department of Biophysics. He is also a member of the JHU-wide Institute for Data Intensive Engineering and Science (IDIES), which is led by our department. Prof. **Emanuele Berti** joined us in July. He is a theorist working broadly in the areas of General Relativity and Gravitational Waves and works across the boundaries of physics and astronomy. Professor **David Sing** also joined us last July as a Bloomberg Distinguished Professor, a position held jointly with the Department of Earth and Planetary Science. He uses a combination of models and spectroscopic observations to understand the atmospheres of extra-solar planets. All three new arrivals are not only outstanding additions in their own right, but also strengthen us in areas of critical strategic importance. With additional searches underway or planned, we are in the midst of positioning our department for continued success for years to come.

I am also pleased to say that **Jared Kaplan** received tenure and promotion to the rank of Associate Professor, and that **Tyrel M. McQueen** was promoted to the rank of Full Professor. In addition, **Rosemary Wyse** was named an Alumni Centennial Professor in recognition to her many achievements in research.

Our faculty, scientists, students, and alumni continue to be honored with major awards. You will learn more about these throughout the newsletter. Here are a few highlights:

- Among our faculty, **Chia-Ling Chen** was elected Academician of the Academia Sinica, I was awarded the Catherine Wolfe Bruce Gold Medal of the Astronomical Society of the Pacific, **Yi Li** was awarded an Alfred P. Sloan Fellowship, **David Kaplan** received the Gemant Award from American Institute of Physics, and **Joe Silk** received the Henry Norris Russell Lectureship from the American Astronomical Society.
- Among our students, **Cristina Mantilla Suarez** was selected as the LHC Physics Center's Graduate Scholar, **Shu Zhang** earned a Graduate Fellowship at the Kavli Institute for Theoretical Physics, **Wesley T. Fuhrman** was recognized by the Schmidt Science Fellows Program, **Wenzer Qin** was a recipient of a Barry Goldwater Scholarship, and **Hsiang-Chih Hwang** was named the William Gardner Fellow.
- Among our alumni, **Yichen Shen** was named one of Forbes Magazines "30 under 30" for his work in energy technology, **Jennifer Lotz** was named Director of the International Gemini Observatories, **Nhan Tran** received the Primakoff Award for Early-Career Particle Physics by the American Physical Society, and **Yacine Ali-Haimoud**, was the recipient of the Helen B. Warner Prize of the American Astronomical Society.

Next, I'd like to update you on some of the most exciting research activities in the department.

- Our **Institute for Quantum Matter (IQM)** was selected to become an Energy Frontier Research Center, at a funding level of $10.25M over four years. These new funds will enable IQM to expand its ground-breaking work on the realization and understanding of new states of quantum matter.
- Postdoctoral fellow **Vivian Poulin**, along with graduate student **Tanvi Karwa**, and Professsor **Marc Kamionkowski**, published a paper that offers a resolution to one of cosmology's biggest crises: the disagreement between local and global measurements of the Hubble Constant, which specifies the expansion rate of the universe. The team of theorists point to a new exotic form of energy in the early universe as a possible solution.
- Assistant Professor **Kevin Schlaufman** recently discovered what may be one of the oldest stars in the universe. At 13.5 billion years old, it could be one of the first generation of stars to form after the Big Bang.
- NASA prominently featured research by Prof. **Julian Krolik** that focuses on a computer simulation of two supermassive black holes spiraling toward collision. It fully incorporates the physical effects of Einstein's general theory of relativity and shows that gas in such systems will glow predominantly in ultraviolet and X-ray light.
- A team led by Associate Research Professor **Natalia Drichko** reported the first detection of a long-theorized property of quantum matter. They found that a particular quantum material can demonstrate electrical dipole fluctuations—irregular oscillations of tiny charged poles on the material—even in extremely cold conditions, in the neighborhood of minus 450 degrees Fahrenheit.
- Prof. **David Kaplan**'s work surrounding the idea of a "bouncing universe" was featured in a new article that appears in Quanta Magazine titled, "How the Universe Got Its Bounce Back."

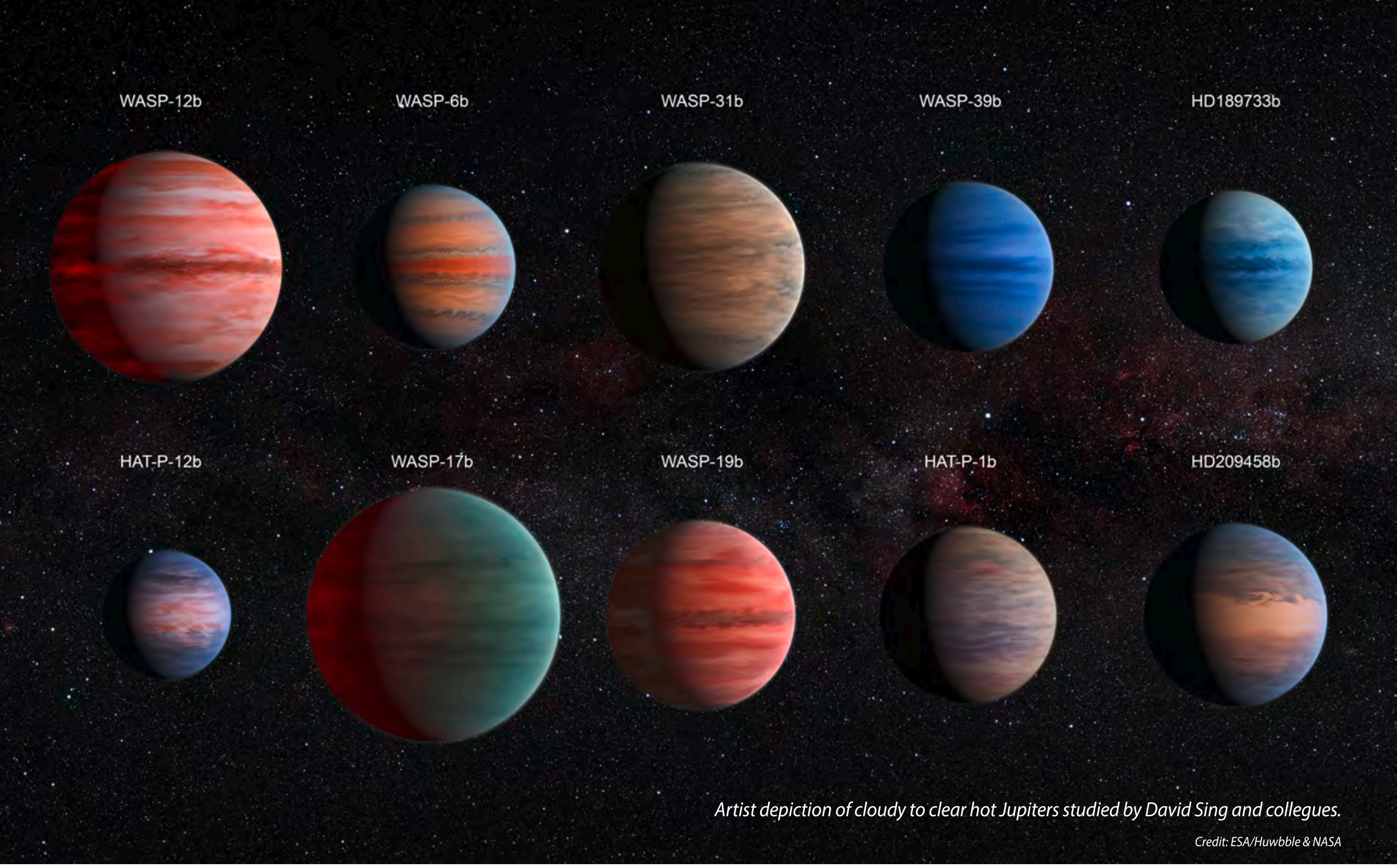
We have also had some sad news this year, as two distinguished members of our faculty passed away. Emeritus Professor **Aihud Pevsner** was for decades a leader in the field of experimental particle physics, both in our department and in the world-wide community. Homewood Professor and Nobel laureate **Riccardo Giacconi**, was one of the great visionaries in modern physics and astronomy, responsible for the invention of X-ray astronomy, and for the development of several of the greatest astronomical observatories of our time, including the Hubble Space Telescope. We will sorely miss Aihud and Riccardo.

Finally, I want to extend my gratitude to two our alumni for their dedication and hard work in service to the department. **Homaira Akbari** has served for many years as the Chair of our departmental Advisory Council, building and strengthening this important body. She has now "passed the torch" to **David Kupperman**, who is enthusiastically working to continue to strengthen the council.

Homaira and David are not alone. Indeed, I want thank all of you for your continuing interest in, and support of, our mission of pushing back the frontiers in research and of educating and training leaders of tomorrow in science and technology. I am looking forward to working with you in the coming year.

Best,

Timothy



Artist depiction of cloudy to clear hot Jupiters studied by David Sing and collegues.

Credit: ESA/Huwbble & NASA

EXOPLANETS: WORLDS BEYOND OUR OWN

BY MONIKA BORKOVIC

One hundred fifty-nine light years away from Earth, exoplanet HD 209458 b revolves around a main-sequence star, very similar to our own sun. . Its name derives from the sun it orbits—HD 209458 and its classification as a planet—b. Although, sometimes it is more colloquially referred to as "Osiris."

Bloomberg Distinguished Professor, David Sing, however, doesn't have to remember the exoplanet by the "Osiris" nickname. He lists off the numbers in HD 209458 b's name with ease. After all, he has been studying this exoplanet and others like it for over a decade.

Both he and Assistant Professor Kevin Schlaufman are leaders in the field of exoplanet research. Put simply, exoplanets are planets of stars beyond our sun. Their work ranges from studying exoplanet formation, migration, to the composition of the exoplanets themselves. And both have been in the field long enough to see how it has changed.

Thirty years ago, studying exoplanets seemed far out of reach. Exoplanets had only been speculated about, but technological constraints prevented further study. It wasn't until 1995 that the first exoplanet, 51 Pegasi b, was detected and confirmed, making exoplanetary science a new field. Though not the newest field, Schlaufman points out, "it's not the absolute youngest. We can now point to gravitational wave astronomy as something that is even younger." Still, it's not old either, and it has exploded in the span of only a couple decades.

Part of that growth is thanks to technological developments. Better telescopes, like the Hubble, Keplar, and most recently TESS, yielding better data. Technology has played a key role in expanding the capabilities of exoplanet research, allowing scientists to discover more exoplanets and go beyond detection of these distant planets to ask more specific questions.

"Discovery excites me a lot," Sing says, of the field. "These are brand new planets. People have never seen them before, so they're pretty hard to predict because the planets are so diverse and unique."

More than 3,700 exoplanets have been identified since 1995, ranging from gas giants, like Jupiter, to terrestrial Earth-like planets. It is estimated that there are trillions more peppering the universe.

The method of detection varies based on the instrument. 51 Pegasi b was discovered by the radial velocity method, which measures the Doppler shift in the star as it 'wobbles' from the gravitational force of the exoplanet.

HD 209458 b was discovered using the transit method, which involves measuring dips in light observed when the exoplanet crosses between the star and the observer.

Many of the exoplanets discovered have been similar to Jupiter because they have been historically easier to detect. The relative size of these Jupiter-esque planets to their host stars make a more measurable difference when transiting.

What was peculiar about the Jupiter-like exoplanets that were being discovered was their proximity to their host stars. "[When] we were looking for things like the solar system we expected to find big planets like Jupiter, far from their host star," Schalfuman explains. "But what we found were planets like HD 209458 b and 51 Pegasi b, which were nearly as massive as Jupiter, but were closer to their host star than Mercury is to the Sun.

"This has been an ongoing problem: how is it that a planet as big as Jupiter can get right next to its host star…the model that we have for how giant planets form strongly suggests that they preferentially form several times that distance."

Since the discovery of 51 Pegasi b, several theories have emerged to explain how these Jupiters got so close to their stars, the most popular of which, is migration theory. This theory supposes that the early stages of the planet's formation happens further away from the star but gravitational interactions with the planet's protoplanetary disk (a rotating circumstellar disk of dense gas and dust surrounding a newly formed planet) eventually propel it closer, finding more stable orbit.

This has served as the basis for another project conducted by Schlaufman to determine the upper bounds of a planet's size as somewhere between 4 and 10 times the mass of Jupiter—determining where exoplanets end and brown dwarf stars begin. The answer lies in the planet's formation. Exoplanets, even large ones, seem to form a core first and then grow through accretion onto the core, whereas brown dwarfs from directly from a massive gas cloud collapsing under its own weight.

He is also concerned with planet formation more generally. Models of planet formation were initially based on our own solar system, and they may not be applicable to other planetary systems. The hope is to develop a working model for all planet formation by studying empirical data.

Sing researches another aspect of exoplants: their compositions, temperatures, and atmospheric structures—characteristics like cloud effects and formation.

Sing has a joint appointment with the Earth and Planetary Science Department, which he says is important for this kind of research. "The detection of exoplanets was an astronomy problem…but once you get a planetary spectrum then you're really into planetary science."

A lot of his early research focused on the composition of HD 209458 b. "There were only a couple of planets that one could even work with {at the start]." Analysis of spectra was time consuming but yielded some of the earliest glimpses into the distant worlds of exoplanets.

"[Exoplanets] are related to this question of how it is that we got here, how it is that life arose on our planet?"

—Assistant Professor Kevin Schlaufman

It wasn't until the last five years or so that more planets were beginning to be discovered at a rapidly increased rate.

Data on these exoplanets are collected via transmission spectroscopy, a method that takes advantage of exoplanets in transit. On top of using transit to detect exoplanets, the light from the star will filter through the exoplanet's atmosphere, and leave a spectral imprint that provides important chemical markers of the make-up of exoplanets.

He has done extensive work with spectral data received form the Hubble to produce his 2015 comparative study of "hot Jupiters" and is now continuing the work at Hopkins, where he is heading the largest exoplanet research programs using the Hubble.

He and Schlaufman hope that the recent launch of the Transiting Exoplanet Survey Satellite (TESS) and the upcoming James Webb Space Telescope (JWST) will yield even better results.

The addition of these powerful instruments will enable researchers to go beyond detection, and study exoplanets' vast differences more closely.

Less is known about terrestrial exoplanets, those more like Earth than Jupiter, particularly those which orbit larger stars. Many stars found by Keplar were too distant and dim to perform the spectral analysis necessary to study the compositions of exoplanets. TESS serves as a welcome companion that will probe the sky for the brightest stars and the exoplanets that orbit them. Information gathered from TESS will propel decades of in-depth research into exoplanetary research.

Learning about exoplanets is ultimately learning about our own planet.

As Schlaufman says, "It's related to this question of how is it that we got here, how is it that life arose on our planet?" The work that he and David Sing do put us on a path to answering that question.

An artitist's rendition of 51 Pegasi b

Credit:ESO/M. Kornmesser/Nick Risinger (skysurvey.org)

BLACK HOLES: RIDDLES OF THE COSMOS

BY EMILY MULLIN

Black holes are volumes, or regions in space so densely packed with matter that nothing—not even light—can escape.

Stellar black holes, many of which exist in the Milky Way, are believed to form when stars collapse. There are also supermassive black holes, the much larger black holes found at the centers of large galaxies. Scientists still aren't sure about how these colossal objects come to be.

The notion of black holes has been around for nearly a century, and excitement over black holes has been renewed after the measurement of gravitational waves by the Laser Interferometer Gravitational-Wave Observatory (LIGO) that recorded two black holes colliding in 2016.

Even after this discovery, many mysteries about them remain, such as how they form, what's inside them and the role they play in shaping galaxies. The faculty members of Johns Hopkins University's department of physics and astronomy are at the forefront of trying to answer these fundamental questions. Across the department, experts are studying the black holes themselves, their effect on other stellar bodies in the universe, and how we can use black hole data to better understand current theories.

Nadia Zakamska, who joined the faculty in 2010, has been studying supermassive black holes for the past several years. In 2013, her group was the first to discover and characterize galactic winds (streams of high-speed charged particles often observed blowing out of galaxies) driven by supermassive black hole activity. Numerous publications have come out on this phenomenon since. Now that Zakamska and others have been able to map these winds, she says she's moving on to another mystery about black holes.

"There is a giant gap between the mass of the stellar mass black holes known in our galaxy and the supermassive black holes known in the centers of other galaxies," she says. "I have always been really excited about the concept of these intermediate mass black holes. We now know about the existence of about 60 black holes with the mass of our sun and a million supermassive black holes with solar masses up to a billion times that of our sun, but the region in between is terra incognita."

"Looking at the behavior of black holes when they merge hopefully can give us hints on how we could possibly modify gravity and make it compatible with quantum mechanics."

—Professor Emanuele Berti

To explore this question, Zakamska is using multi-wavelength observations to take images of galaxies where active black holes reside.

Julian Krolik, another astrophysicist at Johns Hopkins, was recently awarded the Simons Fellowship in Theoretical Physics to examine how pairs of supermassive black holes interact with the galaxy hosting them.

Along with collaborators at NASA, Krolik published a paper in October describing a new simulation to help understand the kinds of light signals that are produced when two supermassive black holes collide. For the first time, their findings show that gas outside of colliding black holes will glow mostly in ultraviolet and X-Ray.

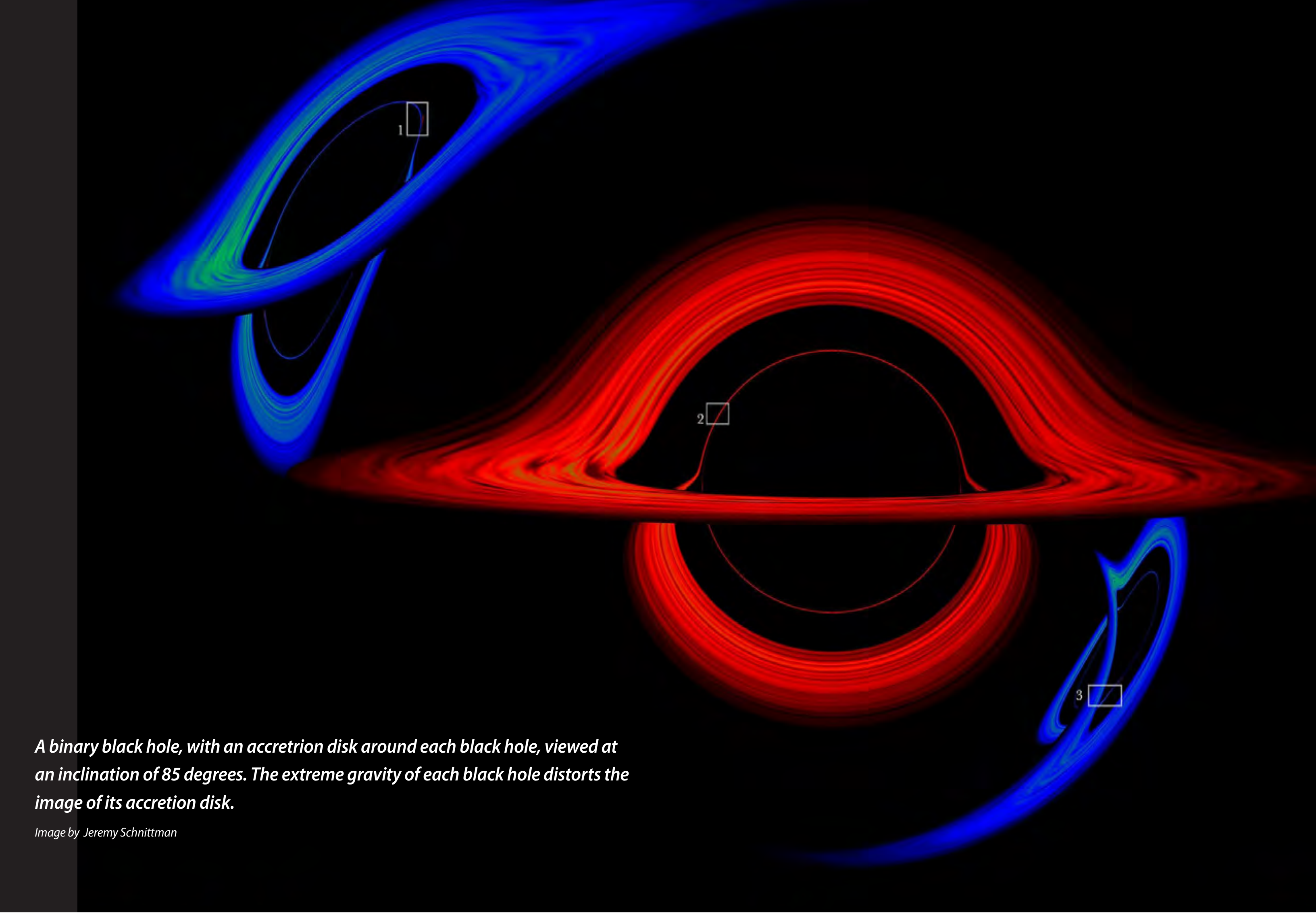
When individual galaxies merge, so do the black holes at their centers. But no one has ever witnessed this event. Though LIGO discovered about half a dozen merging stellar mass black holes in relatively nearby galaxies, it likely won't be able to detect a pair of supermassive black holes.

"Part of the motivation for thinking about the light they emit is to find them before merger," Krolik says.

A new observatory, called the Laser Interferometer Space Antenna, or LISA, a European Space Agency mission, could spot these mergers. Slated to be launched in the 2030s, LISA would be the first gravitational wave detector in space. "In a way, we could scoop them before there is a potential detection from LISA. Even better, they could tell LISA where to look," Krolik says.

Emanuele Berti, who joined the physics and astronomy faculty in 2018, is a key member of LISA's scientific team. Berti, who studies these binary black hole systems, was awarded a grant from NASA to develop tools that will lay the foundation for tests of general relativity using LISA data.

LIGO is producing an incredible amount of data that researchers didn't have before



A binary black hole, with an accretrion disk around each black hole, viewed at an inclination of 85 degrees. The extreme gravity of each black hole distorts the image of its accretion disk.

Image by Jeremy Schnittman

that can be used to understand how black holes grow, evolve, and merge. But Berti says better gravitational wave detectors, like LISA, will be needed to study these events.

"Looking at the behavior of black holes when they merge hopefully can give us hints on how we could possibly modify gravity and make it compatible with quantum mechanics," he says. "We're going to learn so much that it's mind-boggling."

Like Berti, theoretical physicists Jared Kaplan and Ibrahima Bah see blackholes as "laboratories" to test prevailing theories and observe physics at high-energy levels that aren't present here on Earth.

"I'm interested in the consequences of what happens when you combine Einstein's theory of gravity and general relativity with quantum mechanics and how there are surprising properties that arise when you combine those things and think about black holes," says Kaplan.

Kaplan, who joined the faculty in 2012, is using theory to study the interior of black holes and the information paradox, the idea that black holes might eventually radiate all their energy away and evaporate, destroying the information that's put into them. The problem with this idea—and the reason it's called a paradox—is because it seems to violate the laws of physics.

"Our current understanding is that black holes don't destroy the information that you put into them, but what we don't really understand is how that fits together with our other descriptions of black holes," Kaplan says.

Ibrahima Bah, a theoretical physicist who joined the department in 2017, is also trying to understand the makeup of black holes and what is happening inside them. Currently, Bah is working on the question of what happens to matter as it falls and turns into a black hole.

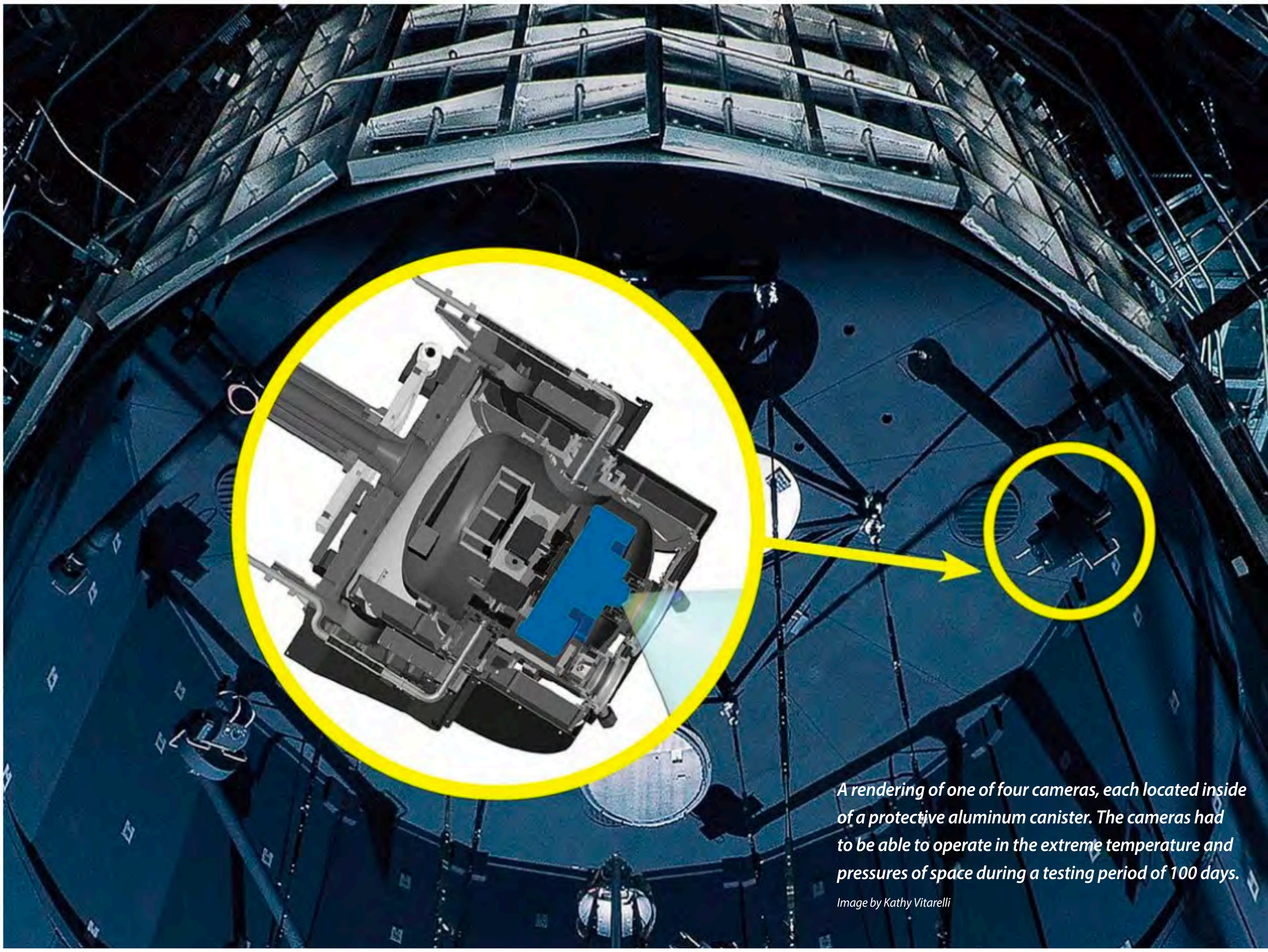
"Black holes give you a window that you can look through to try to understand gravity," Bah says. "Thinking about black holes and understanding the physics inside of the black hole will help us better understand the theory of gravity."

For Marc Kamionkowski, a theoretical physicist who's been at Hopkins since 2011, a central question about black holes is whether the ones identified by LIGO make up the dark matter in the universe. Kamionkowski, along with Hopkins colleagues, wrote a paper shortly after the LIGO announcement in 2016 suggesting this very thing. "At the time it could not be shown that it was not the dark matter," Kamionkowski says. "We've since discussed a variety of tests that could be pursued to determine whether it is the dark matter."

Those tests could include gravitational microlensing of fast radio bursts, the flashes of radiofrequency and radiation that comes from the sky. The Canadian Hydrogen Intensity Mapping Experiment, or CHIME, has started to see quite a few of these and could potentially see several thousand over the coming years. Kamionkowski says that if a reasonable fraction of these bursts are followed by echoes a few milliseconds later, that sequence could provide evidence that black holes are the dark matter.

It's possible that only some of the dark matter is made up of black holes, but that prospect is less exciting to him. "I'd like to find out what most of the dark matter is. That's a big problem in cosmology," Kamionkowski says.

Clearly, the faculty members of Johns Hopkins University's department of Physics and Astronomy are poised to tackle many of the big problems surrounding black holes.



A rendering of one of four cameras, each located inside of a protective aluminum canister. The cameras had to be able to operate in the extreme temperature and pressures of space during a testing period of 100 days.

Image by Kathy Vitarelli

GETTING IT JUST RIGHT:

JHU'S INSTRUMENT DEVELOPMENT GROUP

Originally Published in the Johns Hopkisn University Arts and Sciences Magazine, Spring 2018 Issue

BY JOE SUGARMAN

The Krieger School's Instrument Development Group (IDG), within the Department of Physics and Astronomy routinely develops precision instruments for scientific research at Johns Hopkins in the fields of astronomy, condensed matter physics, high energy physics, and biomedical research.

But there's much more than that -- the IDG is called on by other universities, industry, and government labs across the country as a unique resource that can take specifications and turn them into instrument designs, and then functioning hardware. The IDG is a national treasure.

One high-profile example is when NASA called on the IDG to help make sure the $8.8 billion James Webb Space Telescope (JWST) have the right shape when cooled. The space agency does not want a repeat of the errors that plagued Hubble, when astronomers discovered a flaw in the telescope's primary mirror array, only after it was in orbit.

JWST will be used to observe some of the most distant objects and events in the universe, such as the formation of the first galaxies. JWST will be operated out of the Space Telescope Science Institute on the Johns Hopkins Homewood campus. Launch will be no earlier than March 2021.

For NASA's new telescope, the IDG was tasked with developing a system of four cameras to be suspended high above JWST on 21-foot-long, rotating booms to record thermal contraction and expansion of the telescope's structure during its 100-day cryogenic test.

These cameras aren't your normal point-and-shoot variety, of course, but $200,000 toaster-sized digital picture-taking machines, traditionally employed in the field of "photogrammetry," the science of using photography to measure distances. In the pitch-black test chamber, the four cameras would each fire a flash every 20 seconds, illuminating small retro-reflective targets placed throughout the chamber and along the surfaces of the telescope. Researchers could then use the data as a precise tape measure to determine how the equipment shifted in response to changes in temperature and pressure. (In space, any shift of the telescope's mirror or other mechanisms could throw its measurements way off.) The cameras could detect any movement down to 100 microns, or the thickness of a sheet of paper.

Last summer in Test Chamber A of the Johnson Space Center in Houston, Texas, the telescope was cooled inside a helium shroud. Over the course of a week, NASA engineers pumped all the air out of the nine-story-tall, 55-foot-wide metal cylinder, creating a vacuum.

Months earlier, Randy Hammond, Stephen Smee, Steve Hope, and Joe Orndorff—all of the Krieger School of Arts and Sciences—were standing on scaffolding 40 feet up, wearing white clean suits, headlamps, and oxygen monitors, as they worked to install several high-tech cameras to be used in a series of tests on the telescope.

The challenge for the IDG team involved working out the delicate balance of keeping the cameras warm enough to function but cold enough so that any heat generated by the camera equipment wouldn't interfere with the infrared detecting systems of the telescope. What's more, the large booms had to be able to rotate 360-degrees on command, and the cameras needed to tilt and pan. "Mechanically, electrically, it's a challenge," says Hammond, senior mechanical engineer. "At minus -400 F, materials do funny things. They can become electrically conductive, properties change. You can't use traditional lubricants in a vacuum. If you just greased things up, the grease "would probably flake off and land on the $9 billion telescope, which is not a good thing."

Working in the basement of the Bloomberg Center on the Homewood campus, they developed four protective cylindrical aluminum canisters the size of microwave ovens to house four cameras. Then they blanketed the canisters with thermal insulation, surrounded that with shielding, and implemented a network of plumbing for thermal control: Through one set flowed relatively warm nitrogen gas to keep the camera comfortable. Another set carried chilled gaseous helium to keep the canister shielding as cold as the test chamber and invisible to the telescope. The nitrogen gas conditioning system—a fairly complex system in its own right—involved using a motorcycle intercooler purchased off eBay and a modified diaphragm pump traditionally used for sewage aeration to purge the lines.

> *"Mechanically, electrically, it's a challenge. At minus 400 degrees, materials do funny things…If you just greased things up, [the grease] would probably flake off and land on the $9 billion telescope…"*
>
> —Randy Hammond, Mechanical Engineer

The cameras' flash units, which NASA specified had to be capable of exceeding 200,000 bursts, were originally fashioned from old Nikon strobes, and after failing prematurely, were redesigned from scratch, implementing custom-made quartz flash tubes and tiny internal cooling fans. "For a task that seems simple on the surface—design a pan/tilt head for a camera—it took a tremendous amount of ingenuity to pull off all these subsystems," says Smee, a mechanical engineer by training and the IDG Director. "You bundle all that stuff together and you've got yourself a very fancy, NASA-approved system. No duct tape was used."

As part of the tests, the team also developed a canister to protect a laser-based measuring device, which was used to gauge changes to the telescope's primary mirror's center of curvature. While the tests were happening, Orndorff stayed in Houston to operate the team's camera systems, at one point, having to abandon his hotel room due to rising waters from Hurricane Harvey.

The Johns Hopkins team was unique in that almost all of the groups participating in the JWST tests were from major aerospace subcontractors, not academic institutions. The IDG's photogrammetry system performed without flaw. "We were receiving progress reports every day, and you just didn't want to see your equipment show up [as problematic]," says Hammond.

On the contrary, NASA was more than happy with IDG's work. "This was possibly the most complicated optical test NASA had ever done, and the photogrammetry system worked great," says Lee Feinberg, JWST's optical element manager at NASA's Goddard Space Flight Center. "We were extremely pleased with its performance."

The significance of their contribution is not lost on the IDG engineers. "It was definitely a thrill to be so close to this telescope," says Smee. "It's the next piece of history comparable to Hubble."

Beyond this one example with JWST, the IDG has worked on dozens of projects and has a superior reputation for success. That this is accomplished with such a small team highlights their expertise.

Members of the Instrument Development Group who worked with JWST (l-r): Al Harding, Randy Hammond, Stephen Smee, Steve Hope, and Joseph Orndorff.

NEWS BRIEFS

David Sing Named Bloomberg Distinguished Professor

David Sing, who heads the largest Hubble research program on exoplanets, now holds appointments in the physics & astronomy department and the Earth & planentary sciences department.

Sing is the university's 35th Bloomberg Distinguished Professor, taking his place among an interdisciplinary group of scholars who are working to address global challenges and teach the next generation. The program is backed by a $350 million gift from Johns Hopkins alum, philanthropist, and three-term New York City Mayor Michael R. Bloomberg.

"Dr. Sing has established himself as a leader of the vanguard in exoplanet research," says Beverly Wendland, dean of the Krieger School. "We expect the new directions his discoveries will take at Johns Hopkins will add a great deal to the local and global community of scholars."

Emanuele Berti Joins Faculty

Emanuele Berti joined the facuty in July 2018. Berti specializes in gravitational physics and astronomy. His research interests include dynamics and formation of black holes and neutron stars, gravitational radiation, relativistic astrophysics and strong-field tests of general relativity. Berti uses gravitational waves to better understand black hole binary astrophysics and cosmology and is part of NASA's Laser Interferometer Space Antenna (LISA) Study Team. In August of 2018, Berti organized the first joint meeting of the NASA LISA Study Team and the European Space Agency Science Study Team on JHU's Homewood campus.

Rosemary Wyse Promoted to Alumni Cenntenial Professor

In July, Professor **Rosemary Wyse** was promoted to Alumni Centennial Professor. Wyse will succeed S. Alexander Szalay, holding one of two Alumni Centennial Professorships; the other position is held by Bloomberg Distinguished Professor Charles Bennett. The positions were established in 1976 at the university's Centennial to honor Johns Hopkins alumni and commemorate "the century of achievement" in the School of Arts and Science. Rosemary Wyse received her BSc from Queen Mary College, University of London, and her PhD at the Institute of Astronomy at the University of Cambridge. Her research focus is in the field of galaxy formation and evolution, with emphases on resolved stellar populations and the nature of dark matter.

Jared Kaplan Promoted to Associate Professor

Congratulations to **Jared Kaplan**, who has been promoted to the rank of Associate Professor with tenure effective on July 1, 2018. Jared joined the faculty as an Assistant Professor in 2012. He works on problems of theoretical physics, with special interests in effective field theory, particle physics, and cosmology, as well as formal aspects of scattering amplitudes, holography, and conformal field theory. Kaplan has received research support from the National Science Foundation and the Alfred P. Sloan Foundation. He is also a referee for two peer-reviewed journals: *Journal of High Energy Physics* and *Physical Review.*

Tim Heckman Receives the 2018 Catherine Wolfe Bruce Gold Medal

Tim Heckman, Department Chair and Dr. A. Herman Pfund Professor, has received the Catherine Wolfe Bruce Gold Medal from the Astronomical Society of the Pacific. The Catherine Wolfe Bruce Gold Medal has been awarded since 1898 for "a lifetime of outstanding research in astronomy." Professor Heckman joins a long list of some of the greatest astronomers of the past century with his acceptance of this honor. Heckman's research focuses on the formation and evolution of galaxies and supermassive black holes.

Marc Kamionkowski and Team Awarded 2018 JHU Discovery Award

A departmental team led by Prof. **Marc Kamionkowski** has been chosen to receive a 2018 Johns Hopkins Discovery Award for their proposal, "In Search of the Cosmic Dark Sector." The award provides grants to cross-divisional teams, which comprise of faculty and non-faculty members from at least two schools of the university, who are "poised to arrive at important discoveries or creative works." Their proposal was one of 30 selected from nearly 200 considered by faculty from across the university.

Joseph Silk recipient of the 2018 Henry Norris Russell Lectureship

Joseph Silk, Homewood Professor of Physics and Astronomy, has been honored by the American Astronomical Society. He is the recipient of the 2018 Henry Norris Russell Lectureship, which is intended to recognize a lifetime of eminence in astronomical research. Silk is honored "for his lifetime contributions to our understanding of the early universe and galaxy formation."

Julian Krolik Honored with Simons Fellowship

Professor **Julian Krolik** has been awarded a Simons Fellowship in Physics, which provides scholars with the opportunity to spend a year away from classroom and administrative duties in order to pursue research interests.

Krolik is among 12 theoretical physicists to receive this highly competitive, honorific fellowship in 2018.

"This award greatly helped me make the most of my sabbatical. With its support, I was able to make long visits to each of three different sets of collaborators, all distant from Baltimore. Despite all the wonders of video-conferencing, nothing beats the focus and intensity of face-to-face discussions," said Krolik. He plans to spend substantial time at the Hebrew University in Jerusalem, Israel studying what happens when the tidal gravity of supermassive black holes disrupts stars that venture too close, as well as at the Institut d'Astrophysique in Paris, France to begin a project on how pairs of supermassive black holes interact with the galaxy hosting them. In visits to the Rochester Institute of Technology, he will expand a long-standing effort to predict what kind of light is made by gas around supermassive binary black holes as they approach merger.

Simons Fellows are chosen based on research accomplishment in the five years prior to application and the potential scientific impact of the fellowship. The New York City-based Simons Foundation is a private foundation whose mission is to advance the frontiers of research in mathematics and the basic sciences. It funds a variety of grants, fellowships, and projects.

"Professor Krolik is one of the world's experts on the processes that occur under the extreme conditions near supermassive black holes, one of the most important issues in astrophysics. Understanding these processes is essential to understanding how these objects grow and how they unleash enormous amounts of energy. They are also great laboratories for probing the predictions of Einstein's General Theory of Relativity." says Timothy Heckman, chair of the Henry A. Rowland Department of Physics and Astronomy. "We are delighted that through the Simons Foundation, Dr. Krolik will have the opportunity to expand his research program by developing and extending his collaborations with other scientists around the world."

Julian Krolik giving a presentation.
Credit: University of Cambridge

NEWS BRIEFS

Yi Li Selected for an Alfred P. Sloan Fellowship

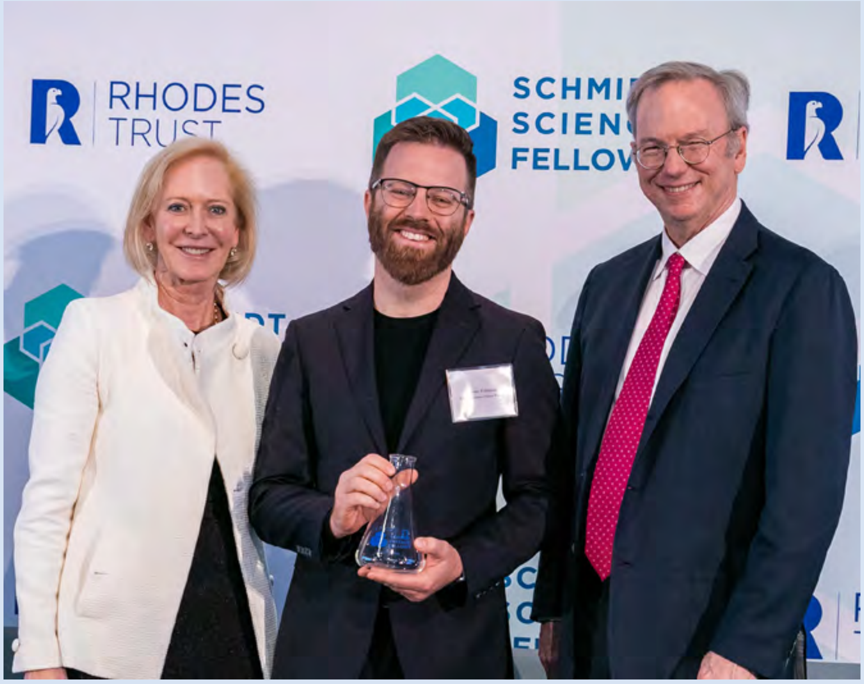
Assistant Professor **Yi Li** was selected for an Alfred P. Sloan Fellowship for her outstanding research in condensed matter physics theory. Alfred P. Sloan Fellowships are awarded to "early-career scholars who represent the most promising scientific researchers working today. Their achievements and potential place them among the next generation of scientific leaders in the U.S. and Canada."

David Kaplan Receives 2018 Gemant Award from the American Institute of Physics

The American Institute of Physics announced today that particle physicist and movie producer **David Kaplan** has won the 2018 Andrew Gemant Award, an annual prize recognizing contributions to the cultural, artistic and humanistic dimension of physics.

Chia-Ling Chien Elected Academician of Academia Sinica

Chia-Ling Chien, the department's Jacob K. Hain Professor of Physics, has been elected Academician of Academia Sinica, one of only five new members in the Division of Mathematics and Physical Sciences. Academia Sinica honored Chein for his outstanding achievements in condensed matter physics, nanostructures, and spintronics.



Wesley T. Fuhrman Recognized by the Schmidt Science Fellows Program

Recent Institute for Quantum Matter Ph. D. graduate **Wesley T. Fuhrman** has been selected as an inaugural Schmidt Science Fellow for his research into topological insulators.

Endowed by Eric Schmidt, the former CEO of Google, and his wife, philanthropist Wendy Schmidt (pictured on either side of Fuhrman above), the fellowship program seeks to support the next generation of scientific leaders, giving them the tools and opportunities they need to drive world-changing innovations. Winners receive a $100,000 award.

Tyrel M. McQueen & Jonah Erlebacher and Awarded 2018 JHU Discovery Award

A departmental team led by **Tyrel M. McQueen** and Jonah Erlebacher (WSE) has been chosen to receive a 2018 Johns Hopkins Discovery Award for their proposal, "Exotic Superconductors by Design."

The award provides grants to cross-divisional teams, which comprise of faculty and non-faculty members from at least two schools of the university, who are "poised to arrive at important discoveries or creative works."

Their proposal was one of 30 selected from nearly 200 considered by faculty from across the university.


Shu Zhang Earns graduate Fellowship at Kavli Institute for Theoretical Physics

Graduate student **Shu "Suzy" Zhang** has earned a graduate fellowship at the Kavli Institute for Theoretical Physics. The purpose of the Graduate Fellowship Program is to offer a unique opportunity for a select group of physics doctoral students to spend a minimum period of 5 months at the KITP, participate in KITP research programs, and broaden their pursuit of theoretical physics in areas of current research. Previous KITP graduate fellows include Assistant Professor **Yi Li** and former graduate student Yuan Wan (who is now Associate Professor at the Institute of Physics in Beijing).

Hsiang-Chih Hwang Named 2018 Gardner Fellow

Graduate student **Hsiang-Chih Hwang** has been named the 2018 Gardner Fellow. The Gardner fellowship and award will allow Hwang to focus on his research with Prof. **Nadia Zakamska** on variability of young starts in the Milky Way and with Prof. **Tim Heckman** on chemical evolution of galaxies. Hwang is the tenth Gardner Fellow. The fellowship was founded by William Gardner (Ph.D., '68), who received his Ph.D. in physics under Prof. **Warren Moos** and had a successful career in fiber optics and telecommunications at Bell Laboratories. Gardner now generously provides support for one of the department's highest priorities-enabling graduate students to dive into research from the start.

Undergraduate Wenzer Qin a Recipient of a Barry Goldwater Scholarship

Wenzer Qin, an undergraduate junior in the department, has been selected as a recipient of a Barry Goldwater Scholarship. The Goldwater Scholarship Program seeks to identify and support college sophomores and juniors who show exceptional promise of becoming the next generation of research leaders in the natural sciences, engineering, and mathematics. Qin will receive an award of up to $7,500 a year to help cover costs associated with tuition, mandatory fees, books, room and board.

PAGS Outreach Event at Enoch Pratt Library

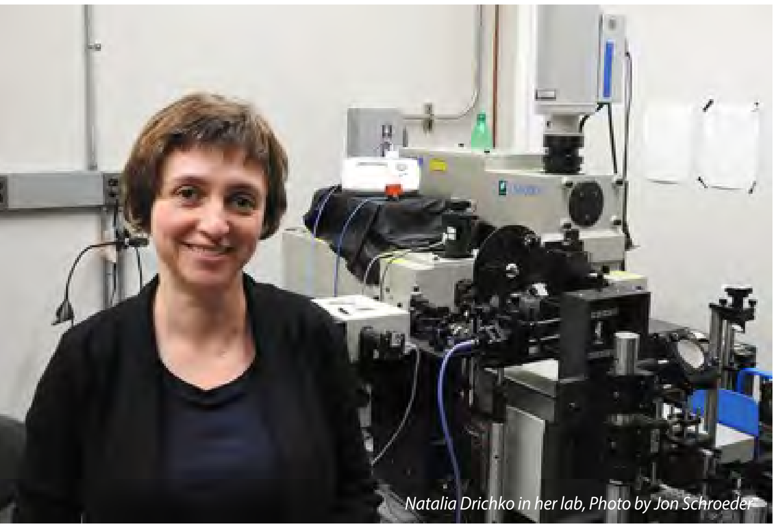
Physics and Astronomy Graduate Student (PAGS) Outreach hosted an event at the Canton Branch of the Enoch Pratt Free Library for 35 local 2nd and 3rd graders. These elementary school students got to learn more about the universe through a show in PAGS Outreach's new inflatable planetarium and other fun physics demos. PAGS Outreach was founded in 2012, and continues its mission of improving science literacy in Baltimore City schools through demonstrations, shows and talks.

Collin Broholm Participates in "Subatomic Smackdown"

Prof. **Collin Broholm** has entered the ring as part of a fun competition that pits four subatomic particles – neutron, proton, photon and electron – against one another, each one putting forward an argument about why it is THE BEST subatomic particle in the universe. Broholm joins a team of scientists and science writers for this event sponsored by the National High Magnetic Field Laboratory. The smackdown culminates in the March 30th Twitter #SubatomicSmackdown that will take place throughout that day and culminate in an online vote. Keep an eye on the National High Magnetic Field Laboratory's Fields Magazine to follow how the smackdown unfolds.

NEWS BRIEFS

Natalia Drichko's Laboratory Publishes Evidence for a New State of Quantum Matter



Natalia Drichko in her lab, Photo by Jon Schroeder

A theorized but never-before detected state of quantum matter has now been spotted in the lab, a team led by a Johns Hopkins scientist reports.

The study findings, published in the journal *Science*, show that a particular quantum material first synthesized 20 years ago, behaves like a metal but is not. The material can demonstrate electrical dipole fluctuations—irregular oscillations of tiny charged poles on the material—even in extremely cold conditions, in the neighborhood of 5.4 Kelvin (minus 450 degrees Fahrenheit).

"What we found with this particular quantum material is that, even at super-cold temperatures, electrical dipoles are still present and fluctuate according to the laws of quantum mechanics," said **Natalia Drichko**, associate research professor in physics at Johns Hopkins University and the study's senior author. "Usually we think of quantum mechanics as a theory of small things, like atoms, but here we observe that the whole crystal is behaving quantum-mechanically."

Classical physics describes most of the behavior of physical objects we see and experience in everyday life. In classical physics, objects freeze at extremely low temperatures, Drichko said. In quantum physics—science that primarily describes the behavior of matter and energy at the atomic level and smaller—there is motion even at those frigid temperatures, Drichko said.

"That's one of the major differences between classical and quantum physics that condensed matter physicists are exploring," she said.

An electrical dipole is a pair of equal but oppositely charged poles separated by some distance. Such dipoles can, for instance, allow a hair to "stick" to a comb through the exchange of static electricity: Tiny dipoles form on the edge of the comb and the edge of the hair.

Drichko's research team observed the new extreme-low-temperature electrical state of the quantum matter in Drichko's Raman spectroscopy lab, where the key work was done by graduate student Nora Hassan. Team members focused light on a small crystal of the material. Employing techniques from other disciplines, including chemistry and biology, they found evidence of the dipole fluctuations.

The study was possible because of the team's home-built, custom-engineered spectrometer, which increased the sensitivity of the measurements 100 times.

The unique quantum effect the team found could potentially be used in quantum computing, a type of computing in which information is captured and stored in ways that take advantage of the quantum states of matter.

Read the entire paper here:
Science 08 Jun 2018:
Vol. 360, Issue 6393, pp. 1101-1104
DOI: 10.1126/science.aan6286

Evidence Points to Cooling Property of Dark Matter as JHU Researchers Predicted

A new measurement reported in Nature provides evidence for a new cooling property of dark matter posited by a collection of professors, postdoctoral fellows, and students from our department. The initial paper exploring the possibility of heat exchange between hydrogen and dark matter was authored in 2013 by **Marc Kamionkowski**, and two of his collaborators. Two subsequent papers elaborated further this heat exchange and proposed to seek evidence for it in precisely the type of measurements reported in Nature. One of these papers was authored by **Joseph Silk**, a JHU research professor, and his collaborators; the other paper was written by JHU postdocs **Yacine Ali-Haïmoud** and **Ely Kovetz** and a graduate student, **Julián Munoz**.

The Institute for Quantum Matter Now an Energy Frontier Research Center

The Institute for Quantum Matter (IQM) was designated as an Energy Frontier Research Center (EFRC) by the Department of Energy Office of Science in 2018. IQM joins a list of 42 EFRCs that were announced in 2018. IQM was selected at a funding level of $10.25M (total) over four years. IQM focuses on the realization and understanding of new states of quantum matter: (1) Quantum Spin Liquids (2) Magnetic Weyl Semi-metals (3) Monopole Superconductors (4) Axion Insulators.

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

NEWS BRIEFS

Cristina Mantilla Suarez Selected as LHC Physics Center's Graduate Scholar

Graduate student **Cristina Mantilla Suarez** has been selected as one of the two LHC Physics Center's Graduate Scholars for 2019. This program is aimed to support exceptional Graduate Students from the US institutions working on the CMS experiment at CERN, by allowing them to spend a year at Fermilab to pursue thesis research opportunities at the LHC Physics Center under the mentorship of resident scientists. Cristina's primary adviser is Prof. **Petar Maksimovic**.

Cristina will continue her work with Dr. Nhan Tran, a former student of our department (see more about Nhan on page 16), on the search for new light resonances reconstructed in highly boosted jets, as well as on the upgrade of the CMS's Pixel Detector for the upcoming High Luminosity LHC .

Rapper, producer Consensus brings his particle physics flow to Johns Hopkins

As a songwriter, emcee, rapper, and producer, Antoine Gittens-Jackson, known professionally as Consensus, draws from the hip-hop, grime, and trap genres of music.

As a scientist from South London with a degree in aeronautical engineering, for his latest project, he draws inspiration from particle physics, dark matter, and the Large Hadron Collider.

Consensus—who has performed and spoken about the intersection of art and science throughout Europe, Canada, and the U.S.—brought his tour to the Johns Hopkins Department of Physics & Astronomy .

The 90-minute performance, titled ConCERNed: Using Hip-Hop to Engage New Audiences in Particle Physics, breaks down the particle physics research that happens at the world's largest and most powerful particle accelerator: the Large Hadron Collider at the CERN lab, in Geneva, Switzerland.

Consensus' goal is to make the complex science relatable with lyrics that connect themes from everyday life to the subatomic world. While he has two EPs and upcoming projects in the works that don't deal with science, he has especially enjoyed performing for scientists and science enthusiasts on the ConCERNed tour.

"Art is such a powerful vehicle for teaching," he says. "There's an overlap between art and science; some people find beauty in mathematical equations that others may find boring or clinical."

Consensus was on tour with a group from Switzerland in 2015 when he was introduced to some CERN employees with an appreciation for hip-hop. It wasn't much later when CERN selected Consensus to be part of its outreach program called art@CMS, the primary goal of which is to engage wider and new audiences in high-energy physics by building synergies between the scientific community and artists across the world. The Compact Muon Solenoid, or CMS, is a 14,000-ton particle detector at CERN, and Consensus focused several of his tracks on the science conducted with the tool. CERN eventually asked Consensus to perform his odes in the shadow of the towering CMS for the detector's 25th anniversary.

In addition to the CMS, Consensus has also performed ConCERNed at Cambridge University, Oxford University, and Fermilab, America's particle physics and accelerator laboratory.

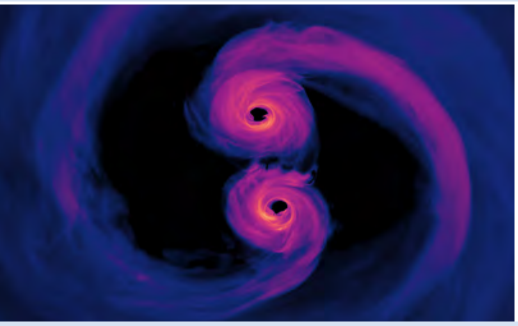
"The performance at JHU was quite interactive," he says. "We had live question and answer sessions between each track, and depending on where the conversation led us, we choose the next track organically."

VIDEOS

What are videos doing in a newsletter? Let us explain, or rather, let the researchers explain their recent publications in their own words. To watch each person explain their research, simply scan the QR code using your phone.

Beyond the Elements: PARADIM Lab

To meet our voracious demand for faster computers, clearer communications, and cheaper energy, Tyrel M. McQueen and his team in the PARADIM Lab are working to create smaller, lighter, tougher stuff.

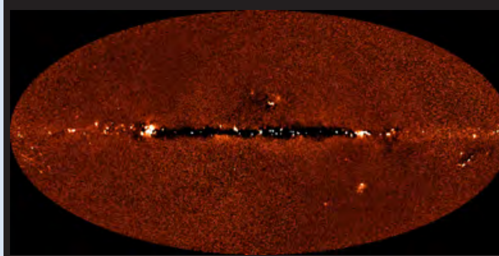


Electromagnetic Emission from Supermassive Binary Black Holes Approaching Merger

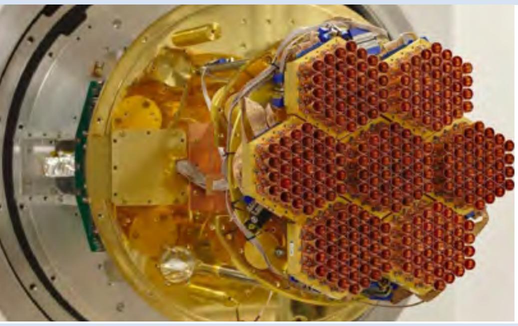
A recent publication by Prof. **Julian Krolik** and co-authors were featured on NASA's webiste. The science focuses on a computer simulation of two supermassive black holes spiraling toward collision. It fully incorporates the physical effects of Einstein's general theory of relativity and shows that gas in such systems will glow predominantly in ultraviolet and X-ray light.

Downsizing of Star Formation Measured from the Clustered Infrared Background Correlated with Quasars

Graduate student **Kirsten Hall** summarizes her recently published paper, which investigates the redshift evolution of physical properties of Dusty Star Forming Galaxies.



Credit: M. Hauser (STScI) and NASA



Design and characterization of the Cosmology Large Angular Scale Surveyor (CLASS) 93 GHz focal plane

Graduate student **Sumit Dahal** shares his recently submitted work on the design of the CLASS telescope, which was designed to detect polarization patterns in the cosmic microwave background (CMB). Its 4 telescopes, operating at different GHz, tease foreground contaminants like dust and synchotron emissions from the CMB.

How Do Growing Supermassive Black Holes Regulate Galaxy Evolution?

Most models predict the existence of more massive galaxies than have been observed. Graduate student **Erini Lambrides** breaks down her recently published paper, which investigates the role of supermassive black holes in regulating the size of galaxies.

Credit: ESA/Hubble, L. Calçada (ESO)

Credit: Matt Petroff

Variable-delay Polarization Modulators for the CLASS Telescope

Recent PhD graduate **Katie Harrington** explains her published thesis paper on a new instrument in the CLASS telescope called Variable-delay polarization modules, which are designed to detect evidence of the inflation and reionization periods of the early universe by measuring changes in the polarization signal patterns across the cosmic microwave background (CMB).

ALUMNI UPDATES

Jennifer Lotz Becomes Director of Gemeni Observatory

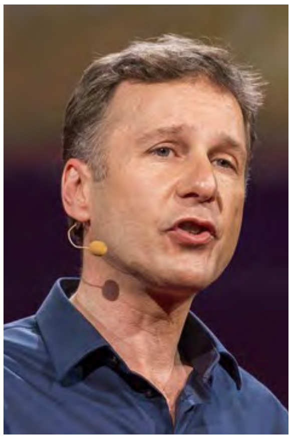
Dr. **Jennifer Lotz**, who earned her Ph. D. in our department in 2003, has been appointed by the Association of Universities for Research in Astronomy (AURA) as the next Director of the Gemini Observatory.

Dr. Lotz, who has held a tenure position as an associate astronomer at the Space Telescope Science Institute (STScI) with a joint appointment as a research scientist at Johns Hopkins University, began her 5-year appointment on October 1, 2018.

Her work specializes in galaxy evolution and morphology, the high-redshift Universe and gravitational lensing. This drew her to the Gemeni Observatory, which is able to "uniquely study time-dependent phenomena ranging from small Solar System bodies to distant gravitational wave sources," she says.

The Gemini Observatory is one of five centers managed by AURA, the others being the Large Synoptic Survey Telescope (LSST), the National Optical Astronomy Observatory (NOAO), the National Solar Observatory (NSO), and the Space Telescope Science Institute (STScI).

Andy Connolly Appointed to the JHU Society of Scholars



Prof. **Andy Connolly** has been appointed to the JHU Society of Scholars. Andy was a postdoctoral fellow and Assistant Research Scientist in our department from 1993 to 1999 .

He is now a Professor in the Department of Astronomy at the University of Washington. Among his other interests, he leads the development of simulations of what the Large Synoptic Survey Telescope (LSST) will soon observe. He is also interested in developing the technologies that are useful in research and education. As part of this, he created "Google Sky."

The Society of Scholars was created on the recommendation of then-university president Milton S. Eisenhower and approved by the board of trustees on May 1, 1967. The society—the first of its kind in the nation—inducts former postdoctoral fellows, postdoctoral degree recipients, house staff, and junior or visiting faculty who have gained marked distinction in their respective fields.

Yacine Ali-Haimoud recipient of the Helen B. Warner Prize

Yacine Ali-Haimoud, who was a postdoc at JHU from 2014–2017 (and joined the faculty of NYU in Fall 2017) was honored by the American Astronomical Society. He is the recipient of the Helen B. Warner Prize, which recognizes outstanding early-career contributions to theoretical or observational astronomy. He is honored for his "extraordinary work on a broad array of cosmological problems."

Nhan Tran awarded 2019 Henry Primakoff Award

Former PhD student **Nhan Tran** has been awarded the 2019 Henry Primakoff Award for Early-Career Particle Physics by the American Physical Society. He is being recognized "For wide-ranging contributions to the Compact Muon Solenoid experiment, including the development of a novel pileup subtraction method at the Large Hadron Collider, and the use of jet substructure for the analysis of high-energy collisions." Tran completed his PhD in 2011, and is currently a Wilson Fellow at Fermi National Accelerator Laboratory.

Yichen Shen Named Forbes' 30 Under 30

Yichen Shen, former JHU Physics major (class of 2011), was named one of Forbes Magazine's "30 under 30" for his contributions to energy technology in 2018. Shen is the founder and CEO of Lightelligence Inc. and the founder of Lux Labs Inc., two companies that leverage advances in nanophotonics he developed in his PhD and postdoctoral research at MIT.

Please keep in touch!
We would love to hear from you.
Please contact Pam Carmen in the Chair's Office at

pcarmen@jhu.edu

IN MEMORIUM

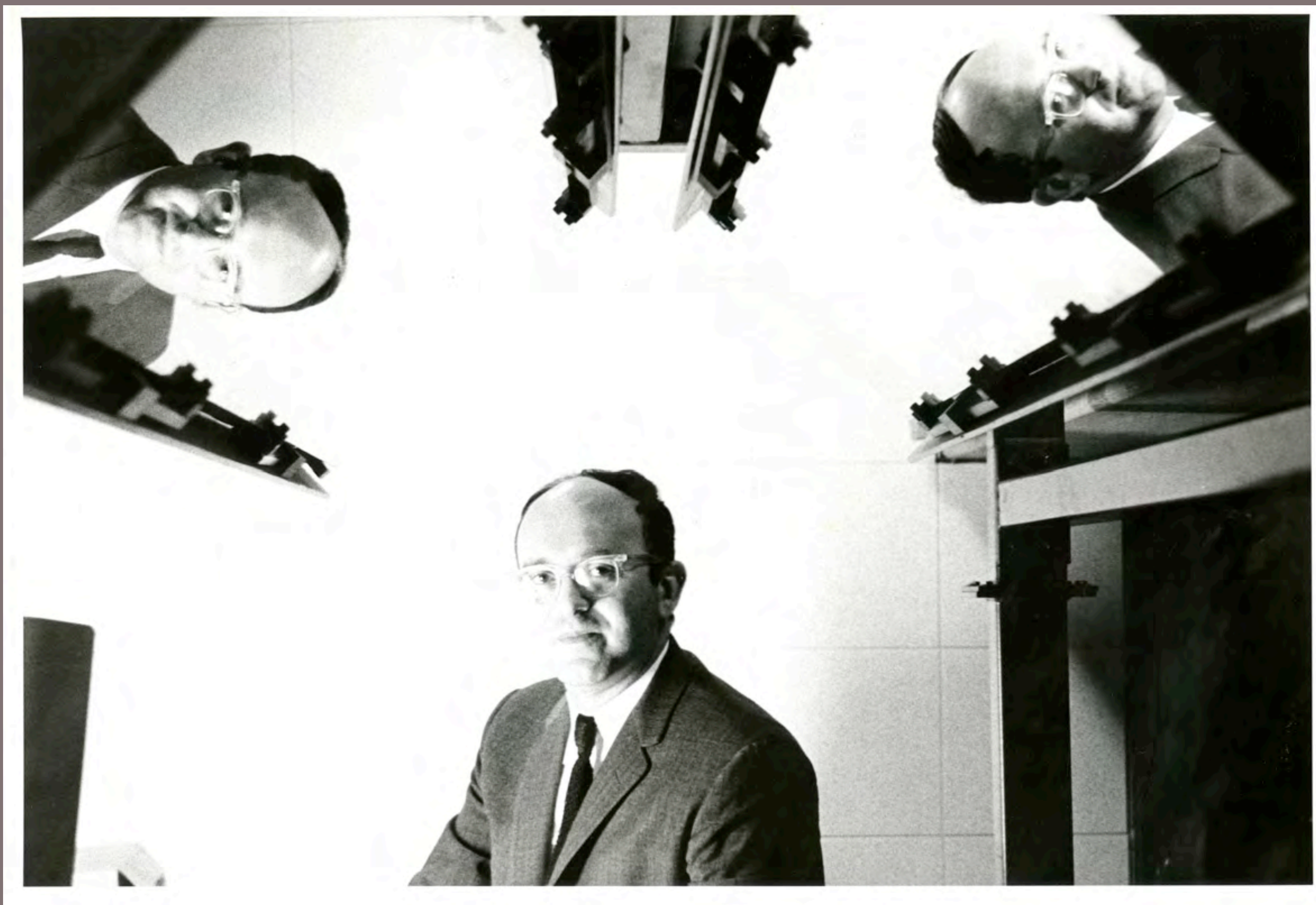


Photo by William C. Hamilton, 1962

Aihud Pevsner, Professor Emeritus in the Department of Physics and Astronomy, died on June 17, 2018 at age 92.

Professor Pevsner came to JHU in 1956 and began a program of research in particle physics using bubble chambers to observe final states containing "strange" particles that we now understand to contain a new flavor of quark. With his collaborators, he showed that all strange mesons had a common mass to within 1% and that with non-strange mesons, they fit into the octet structure predicted by the quark model Gell Mann and Ne'eman. It was his work that completed the first octet with the discovery of the eta meson, which he named after Hopkins by choosing the lower case Greek h as its symbol. During his long career, he conducted research at Brookhaven, Fermilab, SLAC, CERN, and DESY. He understood demographic and technological trends in particle physics research before many in the community and helped to keep the Hopkins group competitive. He is also remembered by many as the chief organizer of a nationwide lobbying effort on behalf of the ill-fated Superconducting Super Collider.

Professor Pevsner was born in Haifa, British Mandate Palestine in 1925. He immigrated with his family to New York City in 1928 where he graduated from Stuyvesant High School and Columbia College before earning his Ph. D. from Columbia University in 1953. He was an instructor at MIT from 1953 until he came to Hopkins in 1956. He served a term as department chair in the l970s. He was a fellow of the American Physical Society, and a Trustee of Associated Universities, Inc. Other honors he received include two fellowships from the John Simon Guggenheim Foundation and a Senior Research Fulbright Fellowship. In 1977, he became the first recipient of the Jacob L. Hain endowed professorship in the Division of Arts and Sciences.

Professor Pevsner is survived by his wife Lucille Pevsner; children Mark Pevsner, Laura Cheshire, and Jonathan Pevsner; and grandchildren Madeline Cheshire, and Ava and Lillian Pevsner.

Our friend and colleague Aihud was a voluble individual who greatly enjoyed story telling and the art of conversation. By his own admission, he was a "contrarian" who liked to challenge the preconceived notions of his conversation partners. The department is a quieter and less colorful place without him.

—Professor Morris Swartz

IN MEMORIUM

Riccardo Giacconi, professor and Nobel Laureate in the Department of Physics and Astronomy, died on December 9, 2018, in California. He was 87.

Considered the "father of X-ray astronomy," Professor Giacconi was the first permanent director of the Space Telescope Science Institute (STScI), where he was instrumental in the vision for, and success of, the Hubble Space Telescope, and built a foundation of insights, approaches, and facilities on which much of the astronomy and astrophysics community continues to base its research. While at Harvard in the 1970s, he and his team designed and built the X-ray detectors that started an entirely new astronomical field; X-ray observations have revealed phenomena including black holes, quasars, and galaxy clusters.

Born in Genoa, Italy, and raised in Milan, Professor Giacconi earned his doctorate in physics at the University of Milan. He came to the U.S. in 1956 on a Fulbright fellowship to study cosmic rays at the University of Indiana, and came to Johns Hopkins and STScI in 1981. He also served as director general of the European Southern Observatory in Garching, Germany, where he built the Very Large Telescope, and as president of Associated Universities, Inc., where he expanded the Very Large Array and initiated construction of the Atacama Large Millimeter/submillimeter Array. Most recently, he served as principal investigator for NASA's Chandra X-ray Observatory.

Professor Giacconi was a co-recipient of the 2002 Nobel Prize in physics for "pioneering contributions to astrophysics, which have led to the discovery of cosmic X-ray sources." In his brief acceptance speech, he said, "At first, upon learning that we have become Nobel Laureates there is a feeling of personal pride which we share with family and friends. Then the realization hits us that the work for which we are honoured is the result of the cooperative effort of many many people over the years. Finally we feel a sense of continuity with the quest, initiated thousands of years ago for an understanding of the cosmos in which we live. While enormous strides have been made in the last decades, one of the most fundamental questions still have no answers, and so the quest goes on."

In addition to the Nobel Prize, Professor Giacconi was the recipient of the Wolf Prize in Physics, the NASA Distinguished Public Service Award, and the President's National Medal of Science.

His legacy to the scientific community will continue to resonate for a long time to come. Kenneth Sembach, current director of STScI, shared these thoughts about Professor Giacconi: "Riccardo was a highly accomplished astrophysicist and the first permanent director of the Space Telescope Science Institute. As such, we owe much to him for the vision and success of the Institute. Each STScI director is a product of their time, but I think it's fair to say that Riccardo was much more than that—he defined the institute and set it in motion. While subsequent directors have each steered their own course, all have stood on his shoulders to see what otherwise may have remained hidden. Those of you who knew Riccardo know what I mean—I offer you my condolences. Those of you who didn't should ask one of us who did—Riccardo left a legacy for all of us."

Professor Giacconi is survived by his wife, Mirella; daughters, Anna and Guia; and grandchildren, Alexandra and Colburn. He was pre-deceased by his son, Mark. The funeral will be private with immediate family only.

We send condolences to Professor Giacconi's family and to his colleagues in the Department of Physics and Astronomy and at STScI.

— Beverly Wendland

James B. Knapp Dean, Zanvyl Krieger School of Arts & Sciences

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New Horizons Visits Ultima Thule

NASA's New Horizons, the spacecraft that made history in 2015 with its fly-by of Pluto, visited its next destination on January 1, 2019: Ultima Thule (pronounced 'thoo-lee'), a Kuiper belt object that formed when the solar system did—unlike many other objects, it was formed in situ in the Kuiper belt. New data on Ultima Thule's composition, size, and orbit can be compared to surrounding bodies, shedding new light on the growth process of small planets and the solar system's early days. **Hal Weaver**, the Project Scientist of New Horizons, is also a Research Professor in the department and earned his Ph. D. from JHU .

Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute