# MATTER 'N MOTION

Physics Department | Missouri University of Science and Technology
Spring 2023

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# ENDOWMENTS: GIFTS THAT CONTINUE TO GIVE

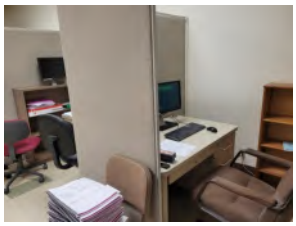
We are grateful for the generosity of the donors who funded the endowed scholarships and prizes that helped so many students this academic year. Our warm thanks go to the families and estates of

**Dr. Richard Anderson**
**Dr. Harold Q Fuller**
**John L. & Betty L. McDaniels**
**Dr. Oran Allan Pringle**
**Dr. Laird D. Schearer**
**Leon E. Woodman**
**Gerrie Fletcher**
**Dr. Richard W. Hannum**
**Burke H. Miller**
**Dr. John R. and Patty Rogers**
**Ed and Mary Sue Sickafus**

# CREATING COLLABORATIVE WORKING AND LEARNING SPACES

Our physics building is 60 years old and in need of some updates. We received funds to renovate two of the shared graduate student offices and are excited to see how the new spaces offer a more productive work environment and invite collaboration among our students. We would like to improve the other student offices as well and would appreciate your help funding the necessary renovations. Please consider donating to the fund at

give.mst.edu



## Note from the Editor:

As you see, we have given the newsletter a facelift. Tell us how you like it, and what you'd like to read about in the next edition. Some content has moved to the website—if you are looking for the list of colloquium talks or the Dean's List, please visit us online at **physics.mst.edu**

**Front cover:** Serotonergic fibers in a mouse brain. Credit: Skrimantas Janusonis. See article on pg. 12.

# DEAR ALUMNI AND FRIENDS,

The past year brought many changes to the physics department. We are deeply saddened by the passing of our long-time colleague Curators' Professor Don Madison who had retired in 2019. We remember him as an excellent researcher and teacher and a kind colleague and friend.
In May, we celebrated the retirement of Dr. Greg Story, winner of a record-holding 27 Teaching Awards, who has inspired thousands of students. At the end of the year, long-serving staff members Pam Crabtree and Jan Gargus retired.
Changes also happened at the university level: the colleges were reorganized, and the physics department is now part of the College of Arts, Science, and Education (CASE) under Dean Dr. Boroujerdi.

2022 was another outstanding year for faculty achievements. Drs. Marco Cavaglia, Daniel Fischer, Shun Saito, and Agnes Vojta received awards from college and university. Dr. Julia Medvedeva was invited to a special NSF workshop to discuss materials research labs for the future. Dr. Ulrich Jentschura is the author of a new textbook on Quantum Electrodynamics. Dr. Alexey Yamilov authored two publications in prestigious journals, and Dr. Julia Medvedeva authored a chapter in a book on amorphous semiconductors. Dr. Fischer was awarded a major National Science Foundation grant, and several other faculty received additional funding for their awards. Five faculty members and several emeriti were listed in a database featuring the top 2% researchers in their fields.

We continue to attract strong students and have currently 82 undergraduates and 27 graduate students. Two-thirds of our undergraduate students engage in research, with excellent results. Our students won prizes at the S&T Undergraduate Research Conference and Student Research Symposium, and the department's Fuller and Schearer Competitions saw many strong contributions. Our thirteen 2022 graduates are authors on six papers in peer-reviewed publications. We also awarded one MS and two PhDs in 2022.
On the following pages, you can read more about the accomplishments of our faculty and students. None of this would be possible without your ongoing support, and I want to express our sincere gratitude.

Warm Regards,

Thomas Vojta
Chair

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# HANGING UP THE CHALK: GREG STORY RETIRES

All good things come to an end. After 28 years of teaching, Dr. **Greg Story** decided it is time to hang up the chalk and retire. As an experimentalist, his research focused on the interaction of lasers with atoms. He taught a variety of courses, at the undergraduate and graduate level, lectures and labs, and inspired thousands of students. Greg received XX Outstanding Teaching Awards, and our graduating seniors often said their favorite classes had been "anything taught by Dr. Story."

Greg says: "Being a professor was a great job, for both research and teaching, and I have always felt privileged to have been given the opportunity to make that my career. There was nothing I would have rather done. "

To celebrate his retirement, Greg, an accomplished musician, gave a concert at the historic Lyric Live Theater in Newburg. He played in front of a full house, with many of his students in the audience.

Greg is looking forward to having more time to pursue his wide interests. He is not only the president of the board of the Lyric Live Theater, but also playwright, director, and actor. He plays music at venues throughout the area and is often joined on stage by his wife Lisa. For Greg, retirement means no more homework grading and the freedom to jump into his kayak whenever the water levels are right. We will miss him in the department and wish him all the best for his new adventures.

## BIG CHANGES IN THE OFFICE: PAM CRABTREE AND JAN GARGUS RETIRE

After a combined forty years in the physics department, **Pam Crabtree** and **Jan Gargus** have retired. We thank them for their hard work over all these years and wish them the very best for the future. The department will not be the same without them!

# DON MADISON PASSED AWAY


We are deeply saddened by the passing of Emeritus Curators' Professor **Don Madison** at the age of age 77 on May 14, 2022.

Don joined our department in 1988 as a full professor and retired in 2019. His research area was Theoretical Atomic, Molecular and Optical Physics. He was the Director of the Laboratory for Atomic, Molecular and Optical Research (LAMOR) and a Fellow of the American Physical Society.

An excellent researcher, Don collaborated widely with colleagues in Germany, India, Australia, and the U.S. He published 218 papers in highly regarded peer-reviewed journals, gave 130 invited talks, and made countless other contributions to conferences and seminars at institutions around the world. Don was a patient teacher who mentored 34 undergraduates, 5 MS students, and 15 Ph.D. students, many of whom went on to become successful researchers themselves. He was generous with encouragement and a fantastic role model for younger faculty.

We remember Don as a kind and gentle colleague and friend who loved his wife Lina, his daughters Lisa and Kristina, and his six grandchildren, and who liked to play with model trains.

# ALUMNUS PROFILE: BERNARD FENDLER

It is always a pleasure to welcome our alumni back on campus and find out what happened in their lives. This year's homecoming speaker was Bernard Fendler who earned his BS in 2002 and stayed here to get his MS in 2004. He gave a fascinating talk with the title "A Physicist's Journey into Cancer Research".

Bernard has a longstanding love of the biological sciences. After receiving his PhD in Biophysics at Florida State University, Bernard was awarded a postdoctoral fellowship at Cold Spring Harbor Laboratory focusing on computational research in genomic analyses. After that, Bernard began working in cancer diagnostics, first at the Brigham and Women's Hospital and now at Foundation Medicine as a Computational Biologist. Currently, Bernard specializes in the identification of aberrations in cancer genomes and modeling of Next Generation Sequencing data.
This is just one example for the immense versatility of our alumni's career paths. We'd love to hear about yours!

## Fuller Prize 2022

The Fuller Prize Competition for Undergraduate Research honors the memory of Dr. Harold Q. Fuller, former chair of the physics department

First: **Jordan Stevens** "Dark Energy in Light of Precise Cosmological Observations".

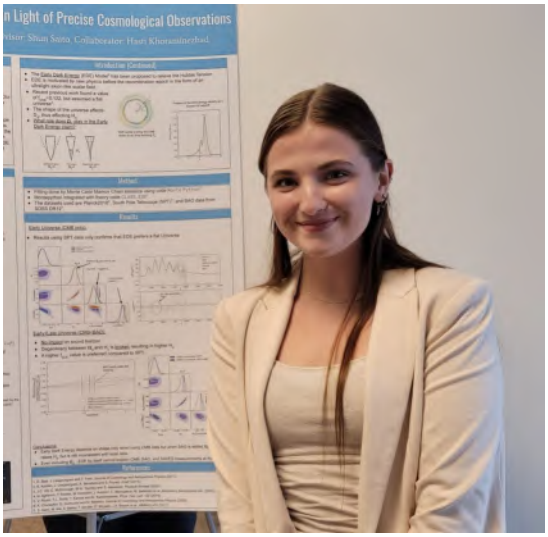
Advisor: Dr. Shun Saito

Second: **Charles Kropp** "Investigation of Time-Delay, Transmission, and Deposition Eigenchannels"

Advisor: Dr. Alexey Yamilov

Third: **Ethan Pham** "Electric Field Exfoliation for Two-Dimensional Nanolayered Materials" Advisor: Dr. Yew San Hor

# STUDENT SPOTLIGHT: Jordan Stevens




Jordan Stevens is a senior from Bonne Terre, Missouri and this year's winner of the Fuller Prize competition. She investigated the effect of a curved universe in the newly proposed Early Dark Energy model which introduces new physics before the time of the Cosmic Microwave Background. "All previous research on the Early Dark Energy model had been done assuming a flat universe. " Jordan says. "We wanted to see if varying the curvature would help shed new light on this model, and we found that a close to flat universe is the most preferred by the datasets we used."

Jordan was one of 36 female students selected to participate in the FUTURE of Physics 2022 conference at Caltech on Sep 12th and 13th. "My trip to the FUTURE 2022 conference at Caltech allowed me to spend time and create friendships with other women in the field of physics. I learned so much about the graduate school application process and it made me excited to continue my physics education."

Jordan graduated in December 2022. We wish her all the best!

"This undergraduate research has been the highlight of my college experience , and I hope every undergraduate student can find a research project they are passionate about."

## S&T Undergraduate Research Conference

First Prize: **Anthony Lonsdale** "Applying Spin Dynamics Methods to Uranium Dioxide" (advisor: Dr. Aleksandr Chernatynskiy)

Second Prize: **Reece Beattie-Hauser** "Scalar Susceptibility of a Diluted Classical XY Model" (advisor: Dr. Thomas Vojta)

Third Prize: **Jordan Stevens** "Early Dark Energy in Precision Cosmology" (advisor: Dr. Shun Saito).

## S&T Student Research Symposium

First Place: **Logan Sowadski** ""Magnetic properties of diluted hexaferrites" (advisor: Dr. Thomas Vojta)

These images were generated with Stable Diffusion 2.1 from StabilityAI

# RESEARCH LABS OF THE FUTURE

Dr. **Julia Medvedeva** took part in a two-day workshop "Materials Research Laboratories of the Future" initiated by the Division of the Materials Research of the National Science Foundation and held at the University of Chicago. This was part of a series of workshops on different classes of materials which have the goal to identify the scientific and technological challenges to be solved in the next ten years.

The researchers discussed how to:

- build integrated infrastructure and instrumentation that align with the Materials Genome Initiative (**MGI**).
- bridge the length and time scales in modeling and measurements.
- embed Artificial Intelligence and Machine Learning in closed-loop Make-Measure-Model cycles.
- train the next-generation workforce with the interdisciplinary skills to address the challenges and take advantage of the opportunities afforded by transformative and generational changes in automation, artificial intelligence, scale-bridging modeling, and instrument development
- enable equitable and inclusive access to instrumentation and infrastructure.

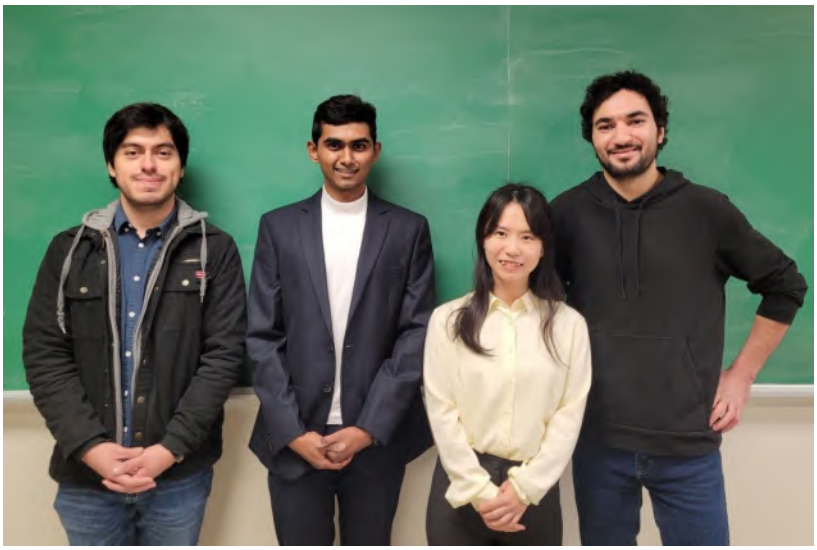
The outcomes of the workshops will be gathered and analyzed by participating NSF program directors to guide future funding opportunities.

The **Materials Genome Initiative** is a federal multi-agency initiative for discovering, manufacturing, and deploying advanced materials twice as fast and at a fraction of the cost compared to traditional methods. The initiative addresses urgent societal needs, accelerates technological innovation, and enhances US manufacturing competitiveness.

**Fun fact:**
If you google images for "Science Research Laboratory of the Future", 83% of the labs will have people in them!

Dr. **Julia Medvedeva is** a professor of physics and senior investigator of the Materials Research Center at S&T. She recently contributed a chapter to the book **Amorphous Oxide Semiconductors: IGZO and Related Materials for Display and Memory** (Wiley Series in Display Technology), edited by Hideo Hosono and Hideya Kumomi .

# SCHEARER PRIZE 2022



Jose Nicasio, Gaurav Khairnar, Yanyan Zheng, and Ali Sarikhani

The Schearer Prize Competition for graduate research is held in memory of Laird D. Schearer, the department's first Curators' Professor of Physics, and rewards graduate students for outstanding research performed during the course of their graduate study.

**First prize: Gaurav Khairnar**
"Phases and Phase Transitions of the Disordered q-state Quantum Clock model" (advisor: Dr. Thomas Vojta)

**Second prize:**
**Ali Sarikhani**
"Transparency and room temperature ferromagnetism in diluted magnetic polycrystalline Zn1−xCrxTe non-oxide II-VI semiconductor compounds" (advisor Dr. Yew San Hor)

and

**Yanyan Zheng**
"An Optically Targeted Search for Gravitational Waves emitted by Core-Collapse Supernovae during the Third Observing Run of Advanced LIGO and Advanced Virgo" (advisor Dr. Marco Cavaglia)

**Third prize: Jose Nicasio**
"Dispersion of Ultra-Relativistic Tardyonic and Tachyonic Wave Packets on Cosmic Scales" (advisor: Dr. Ulrich Jentschura)

## From the winner Gaurav Khrainar

I consider being the winner of the Schearer Prize a great honor. I would like to take this opportunity to express my sincerest gratitude to Dr. Thomas Vojta who has continually guided me in my academic pursuits. I would like to thank fellow students for providing encouragement and inspiration. I would also like to acknowledge Vishnu PK and Dr. Rajesh Narayanan from IIT Madras, with whom we have collaborated on this research. Finally, I want to thank this year's Schearer Prize Committee for giving me the opportunity to present this work.

The work I presented for the competition was based on a project looking into the critical behavior of disordered quantum clock models in one dimension. Clock models can be thought of as a generalization of Ising model, where spins can take one of equally spaced orientations on a unit circle. Ferromagnetic exchange interactions between the spins, result in interesting phases in presence of disorder. Using large-scale Monte Carlo simulations, we identified phases and phase transitions. We found that for weak disorder strengths, critical behavior belongs to the same universality class as the clean case. Beyond a particular disorder strength, we found a disorder dependent critical behavior. We also show the evidence of infinite randomness critical behavior at sufficiently strong disorder.

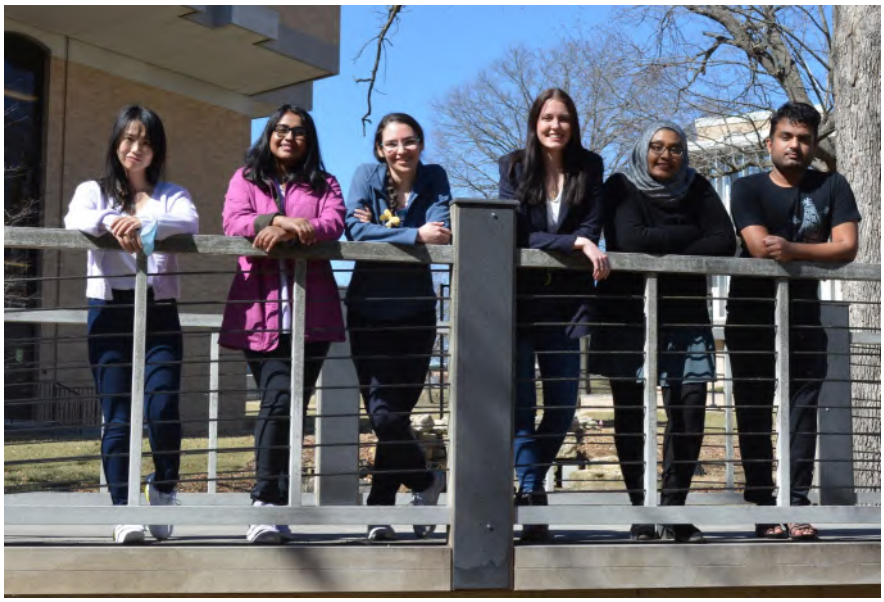
On behalf of all students, special thanks to Schearer family for inspiring us and for providing this amazing platform for showcasing our research.

# BLACK HOLES ARE COMING TO TOWN

On September 14, 2015, a new arrow was added to the quiver of astronomy. The first direct detection of gravitational waves from a pair of coalescing black holes revealed a new messenger to explore the sky and uncover the universe's deepest mysteries. The many LIGO and Virgo detections that have followed since that first, historic observation have allowed scientists to confirm the origin of gamma-ray bursts, measure the speed of gravitational waves and the expansion of the universe, investigate the behavior of matter at high densities and low temperatures, and test alternative theories of gravity. LIGO, Virgo, and KAGRA data have enabled the production of thousands of papers on these and other topics at the frontier of high-energy astrophysics and cosmology.

The LIGO, Virgo, and KAGRA detectors are expected to bring a bounty of new gravitational-wave observations starting next spring, when they will again become operational after a three year hiatus. In the next observing run, we could see more than one black hole collision per day. A black hole storm is coming!

These observations will revolutionize our understanding of black holes and the dark universe. Missouri S&T will be part of this "cosmic revolution." In the next few years, our students and senior researchers will work with their LIGO, Virgo, and KAGRA colleagues to run the detectors, improve the quality of the data, find and interpret new gravitational-wave signals from space, and perhaps even discover the "unexpected" that may be lurking in the deep recesses of the universe, where "no one has gone before."



Prof. **Marco Cavaglia** is the recipient of the 2022 **Faculty Excellence Award**. He is the head of the S&T LIGO group.

**Top 5 things people should know about black holes**
(according to the author, in no particular order)

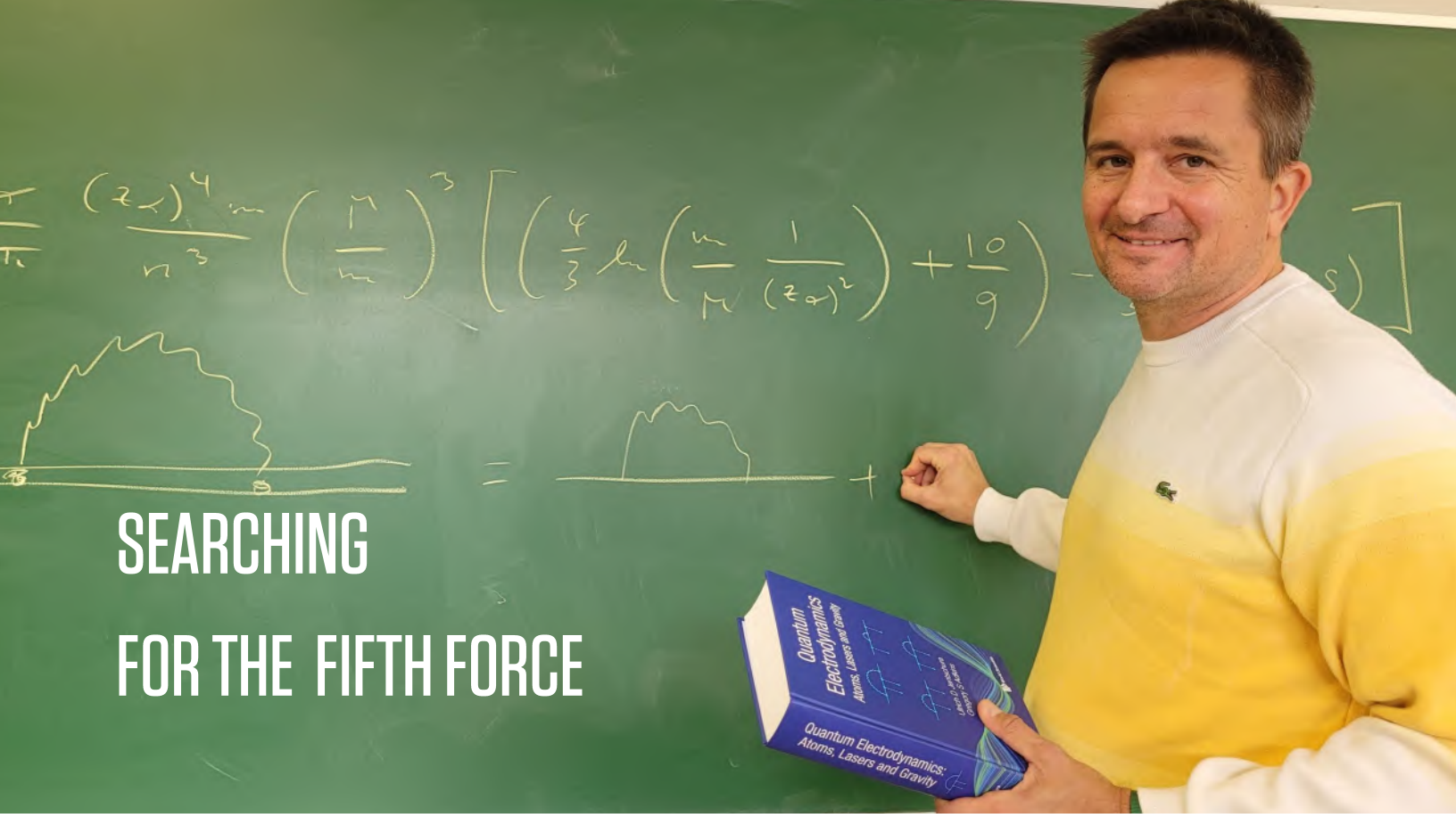
**#1: Black holes come in all sizes.** We only observed black holes with masses ranging from a few to several tens of billions of times the mass of the Sun. However, Einstein's General Relativity tells us that black holes can be created with essentially any mass – from subatomic values to the mass of the whole universe.

**#2: Black holes have no "hair".** No matter how black holes are formed, the only physical quantities that determine their properties are their mass, spin rate, and charge. Like bald heads of the same size, complexion and age look all the same, so do black holes.

**#3: Black holes are not really black.** Due to the quantum nature of particles, black holes can evaporate by emitting radiation. In other words, they shine (in many shades of) "gray" rather than being pitch black.

**#4: Black holes can merge, but cannot split.** If you collide two black holes, you can form a bigger one. Astronomers have observed this process tens of times. However, the laws of black hole thermodynamics forbid the reverse process. (Or so we think…)

**#5: Black holes can ring.** Like a glass partially filled with water can vibrate at a specific frequency, so can a black hole with a given mass. The universe uses a "black hole" harp to play its symphony in gravitational waves.




# SEARCHING FOR THE FIFTH FORCE

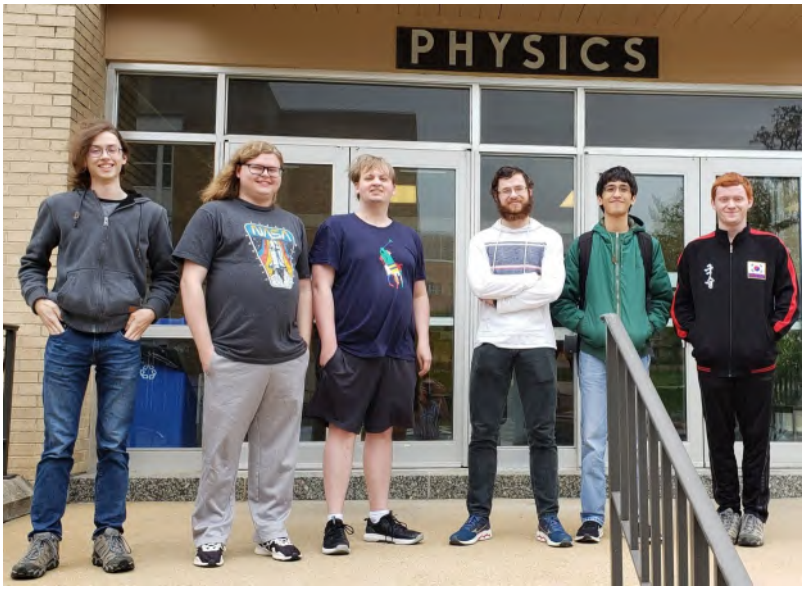
Quantum electrodynamics (QED) is a relativistic field theory that describes the interactions of charged particles with the electric field. It governs the interactions between light, including strong lasers, and matter, and thus the behavior of atoms and molecules. A main idea of QED is that charged particles interact by emitting and absorbing "virtual" photons, the particles that transmit electromagnetic forces.

Atomic theorist Dr. **Ulrich Jentschura** and his coauthor Dr. Gregory Adkins from Franklin & Marshall College wrote a new book. "Quantum Electrodynamics: Atoms, Lasers and Gravity" that was published by World Scientific, Singapore, in 2022. This book is a much-needed modernization of the classic text by Bethe and Salpeter. It introduces readers to a variety of topics surrounding quantum field theory, notably its role in bound states, laser physics, and the gravitational coupling of Dirac particles. It discusses sophisticated concepts based on detailed derivations which cannot be found elsewhere in the literature. The photograph shows Jentschura writing the formula and corresponding Feynman diagram for the bound-state self energy shift, which was the first quantum-field theoretical effect ever detected in an experiment.

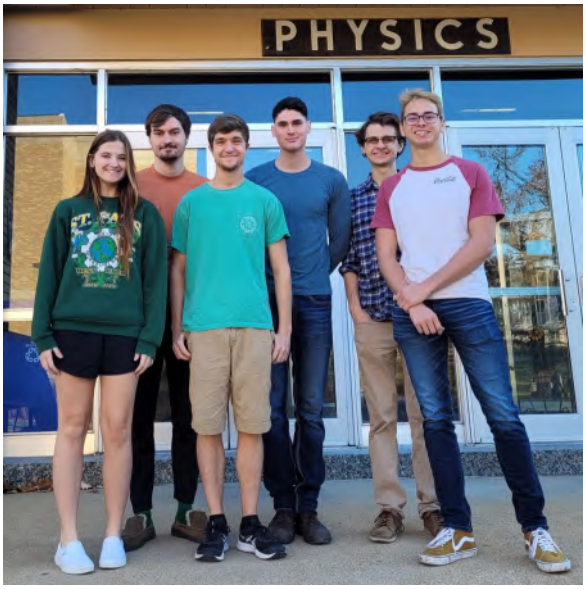
As a guest editor, Jentschura recently curated two Special Issues of MDPI journals: *Atoms* on precision atomic physics and *Symmetry* on tachyons and fundamental symmetries. In his research, Jentschura applies his theoretical framework to the several intriguing puzzles. Nuclear decay experiments at the ATOMKI Laboratory in Hungary hint at the existence of a 17 MeV particle which couples weakly to neutrons. This particle, only 34 times heavier than the electron, could be the force carrier for a possible fifth force and connected to the elusive dark matter. Dr. Jentschura's analysis suggests that precision spectroscopy experiments examining the hyperfine structure of muonic bound systems – such as muonic hydrogen – could hold the key to unraveling this mystery. This discovery could have far-reaching consequences and overthrow the Standard Model of particle physics.

# CONGRATULATIONS TO OUR GRADUATES

## Bachelor of Science in Physics:




Spring 2022: Nicholas Theodorou, Cole Rischbieter, Sean Anderson, Zachary Miller, Andrew Niiro, Andrew Janes, Jose Padron (not pictured).




Fall 2022: Jordan Stevens, Anthony Lonsdale, Jacob Mizeur, Ian Smith, Charles Kropp, Jacob Kinate.

## PhD in Physics:

Sujan Bastola, Xuecheng Ye

## MS in Physics:

Zenon Klok

Dr. Alexey Yamilov is the author of two papers in the prestigious journals Nature Physics and Proceeding of the National Academy of Sciences .

"Depth-Targeted Energy Deposition Deep Inside Scattering Media," N. Bender, A. Yamilov, A. Goetschy, H. Yilmaz, C. W. Hsu, H. Cao, Nat. Phys. 18, 309-315 (2022)

"Coherent enhancement of optical remission in diffusive media," N. Bender, A. Goetschy, C. W. Hsu, H. Yilmaz, P. Jara Palacios, A. Yamilov, H. Cao, PNAS 119, 2207089119 (2022)

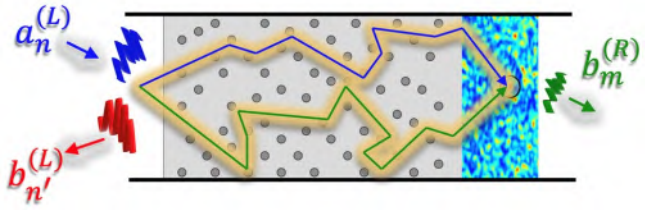
# WHEN RANDOM WALK IS NOT SO RANDOM:

## Coherent control of wave propagation in opaque materials

The concept of diffusion is widely used to describe propagation of light through multiple scattering media such as clouds, interstellar gas, colloids, paint, biological tissue, etc. Such media are often called random. This terminology is, however, misleading. Notwithstanding its complexity, the process of wave propagation is entirely deterministic – uniquely defined by the exact positions of scattering centers and the shape of the incident wavefront. Technological advances over the last decades made it possible to synthesize arbitrary wavefields opening new frontier in light control inside strongly scattering media.

Dr. **Alexey Yamilov**'s theoretical work on the NSF grant "Wave transport via eigenchannels of complex media" has resulted in two high-profile publications. The papers, which also included corroborating experiments, were the result of a joint effort by groups from the US, France and Turkey. The researchers were able to answer such scientifically and technologically important questions as "How can one systematically find the incident wavefront that optimally deposits energy into a target?" and "What is the ultimate limit on the energy enhancement in a region?"

Predictable energy delivery opens the door to numerous applications, e.g., optogenetic control of cells, photothermal therapy, as well as probing and manipulating photoelectrochemical processes deep inside nominally opaque media.

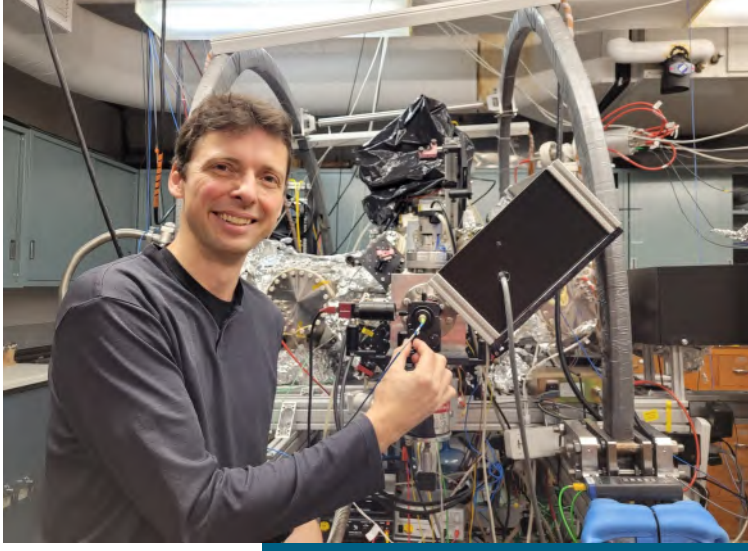



Tailoring the incident wavefront to the scattering medium makes it possible to manipulate how the light propagates through it.

# AGNES VOJTA RECEIVES WOMEN'S ADVOCATE AWARD

Dr. **Agnes Vojta**, teaching professor of physics, was named the 2022 recipient of the Dr. Elizabeth Cummins Women's Advocate Award at Missouri S&T. The Women's Advocate award is given to a Missouri S&T employee who demonstrates commitment to women on campus through mentorship and advocacy and by setting an example through professional achievement.

# TWISTING LIGHT

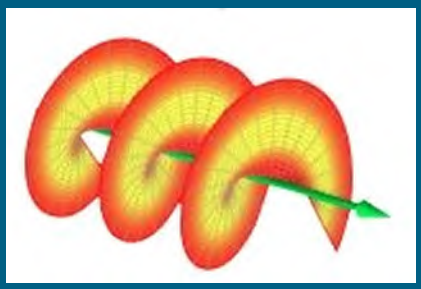


Dr. **Daniel Fischer** received a large grant from the National Science Foundation to investigate novel ways of controlling the electron dynamics in multiphoton processes. He studies one of the simplest atomic systems – a lithium atom with a single active electron. In an all-optical trap, the lithium atoms are held at milli-Kelvin temperatures and subjected to femtosecond laser pulses. The momentum of the emitted photoelectrons and recoiling target ions is analyzed in a high-resolution reaction microscope.

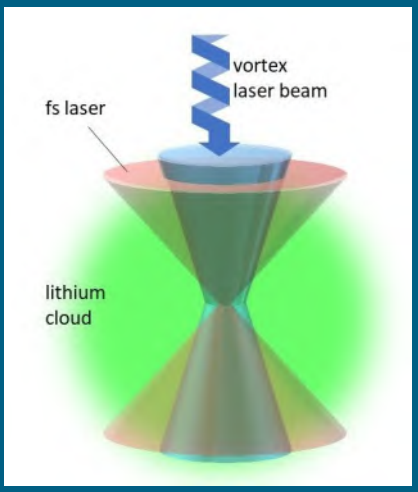
The microscopic properties of the laser source, like polarization, spectral, and temporal structure, can be varied over a broad parameter range. But Fischer plans to shape the macroscopic properties of the laser beam as well. He wants to alter the laser field wavefront to create twisted vortex laser beams that carry angular momentum. The goal is to couple this angular momentum to the electrons, which will open additional ionization pathways that are "forbidden" in conventional photo-absorption processes. These pathways have been theoretically predicted, but not yet observed.

Positioning an atom accurately in the center of a helical laser beam presents a formidable experimental challenge. Fischer is confident that his experiments will present the first evidence of orbital angular momentum transfer in photoionization processes. These findings will have a significant impact not only in AMO physics but in all branches of science and engineering where laser radiation is used.

Dr. Daniel Fischer, associate professor of physics, is a recipient of the 2022 Faculty Research Award.



https://commons.wikimedia.org/wiki/File:Helix_oam.png




# SAITO WINS CASB RESEARCH AWARD

Dr. **Shun Saito**, assistant professor of physics, was awarded a 2022 CASB Research Award for his exceptional work with undergraduate students.

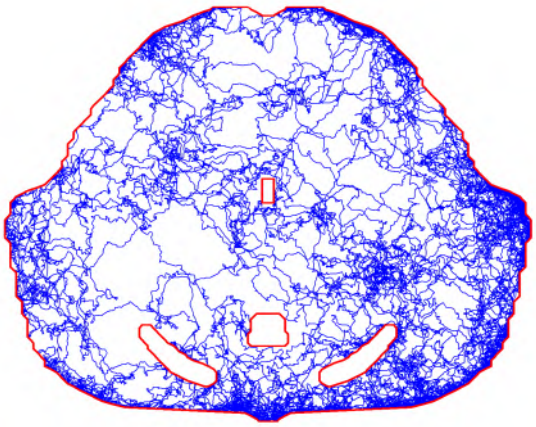
His work with students from Lincoln University and the University of Western Cape is supported by two new grants from the NSF and the University of Missouri South African Education Program.

# PHYSICS MEETS NEUROSCIENCE

The neurotransmitter serotonin plays a crucial role in the central nervous system. It affects mood, behavior, cognition, appetite, and sleep. In the brain, serotonin is transported along special axons that form a complicated random network with an inhomogeneous density.

In collaboration with neuroscientists from UC Santa Barbara, the researchers in Dr. **Thomas Vojta**'s group are modeling the networks of serotonin-carrying fibers. They run simulations on high-performance computer clusters, compare the results with anatomical data provided by the neurobiologists, and fine-tune their model to incorporate biological features. The results will contribute to a fundamental understanding of the role the axon networks play in the brain. This will support the development of new approaches to prevent and treat mood disorders stemming from impaired serotonin pathways.

The project offers research opportunities for undergraduate students Johnathan House and Reece Beattie-Hauser and will constitute the thesis work of graduate students Gaurav Khairnar and Angela Rayle whose presentations at Kummer Day and for the Kummer Board were well received.



# BARBARA HALE HONORED

Professor Emerita Barbara Hale was honored for her work and dedication to Chi Omega by the Syracuse University Alumnae. She was presented with a special gift, a crystal designed for her by award-winning designer Peter Yenawine, President and Chief Designer at Crystal Signatures and alumnus of Syracuse University.

Prof. Hale retired from S&T in 2018 after 46 years of service. She had served as the faculty advisor for Chi Omega since 1979.

**We are grateful for the support of these alumni and friends in 2022:**

**CORPORATE:**

Baker Hughes Foundation

**$1,000 -$2499**

Thomas K. Gaylord
Gary S. Kovener
Kevin Moll
Charles W. Myles
Michael Noble
Don Packwood
Agnes and Thomas Vojta
Gerald Wilemski

**$500-$999**

Charlotte A. Bhasin
Kul Bhasin
Richard H. Burkel
Jon Holdman
Timothy H. Kaiser
Lane A. Martin
Amy Morriss
Casey Morriss
Timothy J. Sommerer
Nancy Stepp
August C. Weisler Jr.
Choon Bee Zahn

**$250-$499**

Harro Ackermann
James P. Canner
Stephen D. Christiansen
Bernard Joseph Fendler
John R. Glaese
Harry E. Hardebeck
Wayne E. Holland
Jared F. Hund
Ulrich D. Jentschura
Thomas M. Jordan
James I. Latham
Christopher William Lloyd
Roger E. May
Thomas J. McMahon
Brian G. Millburn
Mark W. Morris
Daniel Payton III

**$ 250-500 ctd**

Dennis C. Pease
Andrew Richard Prideaux
Donnie W. Priest
Kathy A. Rages
Carl T. Reichert
Frank E. Salter
Richard H. Shields
Bart Smith
James G. Smith
Richard D. Thom
Robert E. Thurman
Millard K. Underwood Jr.
Terrence R. Ward
David J. Wolters

**$100-$250**

Robert E. Caldwell
Ross O. Carnes
Daniel Chitwood
Kevin B. Edwards
Suzanna Edwards
Roger Foehrweiser
Bo He
Carol E. Henderson-Kuhn
George Hessler
Nicholas R. Hugenberg
Steven A. Mezines
Elizabeth A. S. Munson
William F. Munson
Eric J. Norman
John Reagan
Gary S. Sammelmann
Gary K. Woodward

**Under $100**

Bruce C. Anderson
Derek Anderson
Stanley S. Hansen II
William A. Lindgren
Havva Malone
Rex A. Mann
John L. McDaniels
Michael J. Mochel
Paul Parris
Mark A. Peckham
Sawyer A. Scheer
Morgan P. Slusher
Michael X. Strebler
Charles Williams
Gary G. Wooley

# INSPIRING A NEW GENERATION

When the hallways of the physics building ring with excited shrieks and laughter and white clouds rise from the floor, it means that a group of children has come to learn about the wonders of physics. Liquid nitrogen is always a favorite among the hands-on demonstrations our students and faculty use to entertain and educate.

Inspiring a new generation of scientists, recruiting future students, and explaining our research to the public are important parts of our mission and require a team effort of the entire department.

At Open House and Discover Day events, prospective students and their families get to see levitating magnets in Dr. Kim's low-temperature lab and glowing clouds of Lithium atoms in Dr. Fischer's laser lab. Visitors at Tower Grove Park's Astronomy Festival in St. Louis had the opportunity to chat about dark energy and the history of the universe with members of Dr. Saito's cosmology group. At the St. Louis Science Center's Sci Fest, Dr. Cavaglia's LIGO group offered demonstrations of gravitational waves and black holes.

From faculty volunteering for the Missouri Regional Science Olympiad to students hosting an astrophotography event for Opening Week, we constantly look for opportunities to share our passion for physics and encourage future scientists.

(Photo credit: Michael Pierce)

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# Keep in touch!

Drop us an email at **physics@mst.edu,** visit the campus when you are in town, or plan a special trip for Homecoming 2023. We would love to show you what we have accomplished

Tell us what you're doing with your physics degree, and what you've been up to since you left Rolla. We love to hear from our graduates!

You can follow us on facebook at **SandTPhysics** or on LinkedIn at

https://www.linkedin.com/company/missouri-s-t-physics/

Our website is **physics.mst.edu**