Department of

Fall 2021

PHYSICS *Newsletter*

Physics department growth

Since starting as Department Chair in 2017, I have worked to increase faculty hiring not only in current research areas but also expanding into new fields that would allow us to build on our strengths. The idea was to grow in such a way that we could take advantage of the many interdisciplinary opportunities presented by the overall growth at Northeastern, while also strengthening disciplinary research, which provides a grounding in experimental and theoretical physical methods that can be applied to a wide variety of fields. Developing in depth departmental research in multiple areas provides a rich array of choices for undergraduate and graduate students seeking educational research opportunities.

We have expanded our high energy physics theory group by adding new faculty who use machine learning to probe the string landscape (Fabian Ruehle, started fall 2021) and quantum information (Ning Bao, starting fall 2022). Work by Jim Halverson and Brent Nelson placed Northeastern in the spotlight at the interface of machine learning and high energy theory, resulting in the award of a $20M institute, the NSF AI Institute for Artificial Intelligence and Fundamental Interactions, that Northeastern helps lead. Adding to our accelerator-based particle physics experimental group, we hired Louise Skinnari, in spring 2019, working on tests of our fundamental understanding of the Universe at the energy frontier of particle interactions, the Large Hadron Collider at CERN.

To work towards developing a new astrophysics group, an important branch of physics that is very popular among students, we hired Tsuguo Aramaki (spring 2021), who develops detection methods to probe dark matter and study other astrophysical processes, working at the intersection of experimental particle physics and astrophysics. We also hired astrophysicist Jonathan Blazek (fall 2020), who works in observational and theoretical cosmology, and who studies the large-scale of structure of the Universe using astronomical surveys that cover large areas of the sky. Finally, Jacqueline McCleary (starting fall 2022) is an observational astrophysicist who studies dark matter in galaxy clusters by analyzing their weak gravitational lensing signal. She also applies similar statistical techniques to characterize galactic dust at cosmological scales.

We also invested in the expansion of our biophysics research, bringing in theoretical biological physicist Herbie Levine (spring 2019), who studies important biological processes including cancer cell migration, and who is Northeastern's first member of the US National Academy of Sciences. This has allowed us to continue to build on our theoretical biophysics group, with our recent hire of Michele Di Pierro (spring 2020), who works on modeling the dynamic structure of large genomic complexes. Together with Paul Whitford, these three faculty members developed a satellite location for a $13M NSF Physics Frontier Center, the Center for Theoretical Biological Physics, based at Rice University, and funded in 2020. Max Bi, who works on the related problem of modeling the

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Photos: 3D printed network in the lab of Albert-László Barabási (left) by Adam Glanzman, Portrait image of Albert-László Barabási (right) by Ruby Wallau from News@Northeastern article, "Sculpture meets science when Albert-László Barabási makes art from network patterns https://cos.northeastern.edu/news/sculpture-meets-science-when-physicist-albert-laszlo-barabasi-makes-art-from-network-patterns/

Northeastern University
Physics

Notes from the Chair

It has been wonderful to see how faculty, staff, and students have embraced in person learning for everyone in fall 2021. I am proud of how last year we met the challenges presented by the ever-changing landscape due to the COVID pandemic, implemented NUFlex instruction, and rotated students through in-person attendance to allow for safe social distancing. Faculty modified their courses to teach effectively using hybrid remote and in person methods, and we even set up our lab courses so that students could attend in person or remotely, with the remote person working with a partner who was doing the experiments in the lab. This involved tremendous effort by faculty and staff, and this was clearly appreciated by the students, allowing for a successful academic year despite the unprecedented circumstances. However, we also found that there is no replacement for in person learning, especially for laboratory courses, and we are delighted at the way the department members have adopted our new protocols for vaccination, testing, and mask wearing, allowing students to safely learn in person.

Since January 2021, we have welcomed 5 new full time faculty members, with four more starting this spring or next fall. Please see the separate article entitled "Physics department growth" for details on these exciting new faculty members and the impressive growth the department has experienced over the past few years.

We are delighted to have begun holding in-person department events, including weekly meetings of the Society of Physics Students undergraduate group and the Introduction to Research course for incoming PhD students. I am happy to see continued leadership from our SPS students, which includes a student-organized peer mentoring program that connects new students with more experienced undergraduate students in our majors. Finally, our active seminar series are still being held virtually and attendance and discussion at these seminars is strong, allowing us to maintain a lively intellectual climate.

-Mark Williams, Chair

Using this billion-dollar laser, physicists hope to probe the quantum world for new discoveries

Say you're an aspiring physicist, probing the quantum world to gain insight into the fundamental nature of reality.

There are two ways to go about your scientific odyssey, but both involve very expensive machinery. One way is to smash a bunch of atoms together, revealing their subatomic guts; another is to toss them under a ray of light, illuminating a nanoscopic trajectory across space.

A group of theoretical physicists at Northeastern are setting out to do the latter, with millions in new funding. They are part of a multi-institutional team that received a $2.7 million grant from the Department of Energy for a project aimed at developing a set of machine-learning tools and associated software that will help researchers better interpret quantum images produced by one of the world's largest and most powerful particle accelerators, the billion-dollar Stanford Linear Accelerator.

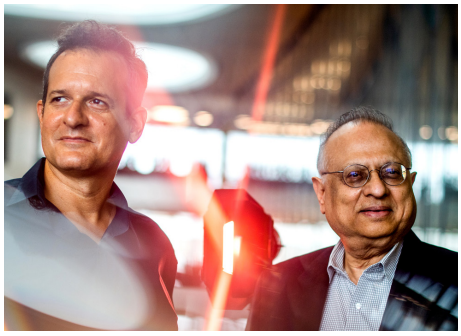


Image by Matthew Modoono

The funding for the project will be split more or less equally between Northeastern University, Howard University—the lead institution involved—and the Stanford Linear Accelerator Center (SLAC).

Particle accelerators are large, complicated machines, but do exactly what the name suggests: They accelerate charged particles, such as the protons and electrons that comprise atoms, to incredibly high speeds, often crashing them against other particles in magnificent acts of quantum destruction.

But the Stanford particle accelerator, also called the Linac Coherent Light Source (LCLS), along with its upgrade, the LCLS-II, isn't designed to pulverize atoms. Researchers involved in the project plan to use the LCLS to shoot high-energy X-rays at a range of different materials to observe how the light scatters when interacting with matter that has been merely "disturbed," not smashed to bits, says Arun Bansil, university distinguished professor in the Department of Physics at Northeastern.

The LCLS machines can take "X-ray snapshots of atoms and molecules at work" at "ultrafast timescales," according to SLAC's website. The Stanford laser can deliver 120 X-ray pulses per second, with each lasting just "quadrillionths of a second," or femtoseconds. At such an incomprehensibly fast timescale, researchers will also be developing a set of technological tools to model and interpret the data.

"Those are snapshots of material in its excited state," Bansil says. "It's kind of like what happens when you throw a stone in water."

It's the resulting splash, to complete the quantum metaphor, that researchers are looking to capture at precise moments in time, and in sequence, Bansil says.

Here's another way to look at it: If you've ever been inside a sporting arena when the "Mexican wave" is going around, you might not be paying attention to the people—their facial expressions, what they're wearing, and other such characteristics—who make up the wave, only that they are part of a larger process.

Here, the fans would represent groups of electrons in their "excited state."

"It's much easier to describe the Mexican wave to someone than the behavior of 19,000 individual people," says Adrian Feiguin, associate professor in the College of Science, who is also part of the research team.

But what's so complicated about this delicate molecular film is that it is not observed in so-called real space, or through direct means, Bansil says.

Quantum world continues on page 3

Physics Department Growth continued from page 1

mechanics of cellular networks, started in spring 2017, rounding out a theoretical biological physics team that models living systems over a wide range of length scales and complexities. We also added to our experimental biophysics group with Vivek Venkatachalam, who started in fall 2017, working on the relationship between whole brain activity and behavior through development. More recently, we hired Paul Stevenson, who started in spring 2021, and who works on experimental development of quantum sensing, applying this to both materials and biological applications.

We significantly added to our condensed matter and materials physics field by hiring quantum materials theorist Greg Fiete from University of Texas-Austin, who started in spring 2019. Greg's work focuses on topological properties of materials, unconventional magnetism and superconductivity, and optical responses of laser-driven materials. Yizhi You, a theorist who studies the emergence of fractionalized states in quantum matter and quantum information sciences, will join us in fall 2022, rounding out our efforts in the theory of quantum materials. Paul Stevenson's addition as an experimentalist, given his overlap in studies of quantum systems, gives us an excellent starting point to develop a highly competitive quantum materials program.

Concurrent with our faculty expansion with pioneering research labs, we experienced an increase in our undergraduate and graduate student cohort, requiring new faculty who specialize in teaching physics. In 2019, Baris Altunkaynak, who manages our introductory physics lab courses, joined us as Assistant Teaching Professor. Anne Van De Ven Moloney started a position as Assistant (now Associate) Teaching Professor as well, having previously played a lead role in development of our graduate level Nanomedicine Certificate Program. Henry Smith also became a teaching faculty member, having been with us as a teaching staff member for many years. We are also happy to welcome three new teaching faculty this year. Needa Brown joined us in September 2021 as Assistant Teaching Professor, and in addition to teaching she is serving as Director of the Nanomedicine Certificate Program. Haridas Kumarakuru also joins us as Assistant Teaching Professor, and is transitioning from working as a part-time lecturer, where he contributed significantly to our advanced physics laboratory and electronics courses. Finally, Camille Gomez-Laberge joins us in spring 2022 as Associate Teaching Professor, following successful work as Preceptor in Physics at Harvard University. We are excited to have these new faculty to join our current teaching faculty, bringing innovative physics education methods to the Department.

I am proud to have been a part of this historic growth in Physics tenured, tenure-track, and teaching faculty. Their combined skills as educators will provide opportunities for student learning in the classroom through modern, evidence-based teaching, while also providing critical opportunities to obtain research experience for all students. I want to thank the many faculty leaders who are responsible for developing and conducting the many successful faculty searches!

-Mark Williams, Chair

The state of physics co-ops

Image by Steve Savistsky

As with every facet of our daily lives the pandemic changed the way we live, work, and think about the world and the future. The co-op program also encountered this, with many employers having to shift to fully remote work for much of the past 18 months.

A few Physics and related co-ops pivoted to a hybrid approach. For example, some of the roles with more research and data analysis components to them were in fact remote for much of the time, such as the University of Milan co-ops. But some of the positions such as the ones many of our students pursue at E-Ink and MKS Instruments, respectively, continue as mostly in-person experiences. Given the hands-on nature of labs and the equipment that companies such as these use on a daily basis for their operations, there will probably be a return to more in-person experiences for Physics students. There is also the possibility (as seen in some of the mostly in-person roles) to adapt towards a hybrid environment whenever there are meetings, research, and data analysis projects that are completed within a co-op.

Companies are re-evaluating how their employees interact, utilize, and make the most of their space. In doing so employers and university (on and off campus) research labs alike engage in a more thoughtful and intentional approach to making the most of students' experiences and time. They clearly delineate which projects need the most hands-on support and attention, while providing a flexible and supportive environment for remote work.

Employers and candidates alike are placing a greater significance on diversity, equity, and inclusion within their searches. Whether through an emphasis on anti-racist hiring and retention initiatives or students seeking out organizations with more professional development and affinity groups, the landscape for co-ops being more equitable is moving forward. Employers now are more receptive to revising job descriptions to broaden the acceptable qualifications and to understanding the needs and added challenges that international students face when pursuing co-op.

Physics co-ops are growing with more research opportunities particularly in the off-campus positions as Northeastern's reach and reputation grows. Within industry I see a continued growth in the engineering overlap in interest and experience that our students have and an even more pronounced growth in biomedical physics and imaging type roles.

-Steve Savitsky, Assistant Co-op Coordinator

Quantum world continued, from page 2

The "image" produced by the laser is rather a set of data points from which researchers use to infer the behavior of electrons and other small particles in the materials. The software platforms will give them the opportunity to interpret data from the LCLS in real-time, Bansil says.

"So, in this sense, the machines, which are really computers, are used to look at large amounts of data to gain physical insights into the data and help develop new theoretical models," Bansil says.

The focus of the overall project is to better understand the properties and states of certain magnetic materials, Bansil says.

"The materials we will be focusing on are indeed magnetic materials," Bansil says. "Magnetism is getting more and more attention because of the business it offers."

-Tanner Stening, News@Northeastern, Sept 13, 2021

Department Nota Bene

Honors

Professor Paul Champion received the Lifetime Achievement Award at the 2021 International Conference on Time Resolved Vibrational Spectroscopy.

Assistant Professor Louise Skinnari received a Department of Energy early career award (2020) and a Compact Muon Solenoid Young Researcher Prize (2020).

Assistant Professor Max Bi (2021) received a National Science Foundation CAREER award.

The Italian government has bestowed upon Sternberg Family Distinguished University Professor Alessandro Vespignani the honor of the Knight of the Order of the Star of Italy. That honor is given to Italians abroad or foreigners who have advanced cooperation between Italy and other countries.

Professor Alesandro Vespignani received the 2020 Euler Award from the Network Science Society for his foundational role in the field of network epidemiology, and his discovery of the impact of heterogenous structured populations on disease dynamics.

Greg Fiete received the Bessel Award from Alexander von Humboldt Foundation

Tim Hussey retired as a reserch technician from Northeastern in September after working in the department for 38 years.

Professor Don Heiman retired in June. He joined the Physics Department faculty in 1997.

Grad student Joha Joshi was awarded the 2021 Outstanding Teachers of First Year Engineering Students Award for Physics.

The National Science Foundation awarded Graduate Research Fellowships to undergraduate students Jennifer Garland and Isabel Kain.

Ishaan Lohia was awarded a Huntington100 award.

Lawrence Awards

The 2021 Lawrence Awards were presented online on May 4 via YouTube.com. Congratulations to this year's winners.

Excellence in Teaching

First Year TA

Nathaniel Avish	Nolan Flannery
Alexander Bellas	Ryan McCarthy
John (JP) Dervan	Nicole Voce

Second Year TA

Nathaniel Beaver	Jiancheng (JC) Zeng
Nicholas Van Alfen	

Advanced TA

Joha Joshi	Sudip Timilsina
Liam Price	

Journal Club Speaker Award
Luhang Yang

Morelli Graduate Research Fellowship
Rakshanasreepriya Kankanala

Graduate Academic Excellence

First Year	Arpit Raj
Second Year	Sayantani Kayal

Lawrence Research Fellowship

Nikhil Deliwala	Jakob Stepanyants

Undergraduate Co-op Fellowship
Bryce Parazin

Undergraduate Research Award for Women in Physics

Allison Cross	Anika Padin

Altshuler Alumni Research Award

Cy Elliott	Asher Solnit

Alumni Co-op Award
Jared Rogers

Undergraduate Academic Excellence

First Year

Daniel Abadjiev	Ian Morton
David Abrahamyan	Henry Noyes
Aaron Angress	Nishi Patel
Joshua Ayaviri	Christopher Pocchia
Kianna Cabral	Maris Podgurski
Anja Castro-Diephouse	Ali Rana
Jared Cohen	Brian Reicher
Sean Coursey	Stephanie Rongone
Briana Daniels	Olivia Sato
Joseph Desroches	Kyle Sawicki
Michael Gadhia	Kayshihant Shankar
Noah Haggerty	Anwar Sirage
Carter Hughes	Rocco Tropea
Tyler Krasnigor	Thomas Weatherbee
Evan Lentz	Joshua Weissert
Heather Morrell	

Second Year

William Cutler	Samuel Koblensky
Kyle Ednie	Vedant Rautela
Nicholas Hurley	Alex Storrer

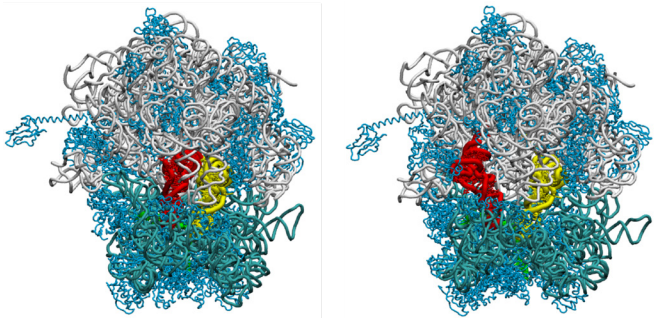
Third Year

Adrian Fedorko	Asher Solnit
Jeremy Paton	

Fourth Year

Joshua Bigman	Thomas Pioch

COS Dean's award for Graduate Excellence in Research
Anindita Maiti



Computer Simulation of Ribosome. ["An in-house computer model uncovered a location on the ribosome that is unique to bacteria. Targeting this location could allow antibiotics to disable bacterial ribosomes without harming human ones."/ Image Credit: Whitford Research Group]
News@Northeastern: The Ribosome: Is it the Key to the Next Generation of Antibiotic Therapies? https://cos.northeastern.edu/news/the-ribosome-is-it-the-key-to-the-next-generation-of-antibiotic-therapies/

Congratulations to our 2020/2021 Physics Degree Recipients

Doctor of Philosophy

Amin Abou Ibrahim
Advisor: Professor Pran Nath
Testing supersymmetry at future high energy colliders, in dark matter and high precision experiments

Asher Ameli
Advisor Alain Karma
Network medicine approaches to diagnostics and therapeutics

Jonathan Carifio
Advisor Professor Brent Nelson
Examining the String Landscape using Data Science and Network Techniques

Chad Freer
Advisor Professor Darien Wood
The Hunt for Physics Beyond the Standard Model: Dark Matter, Invisible Higgs Boson Decays, Large Extra Dimensions and Unparticles in pp Collisions at sqrt(s) = 13 TeV

Alexei Matyushov
Advisors Professor Nian Sun and Adrian Feiguin
NEMS Magnetoelectric Sensors

Liam Timms
Advisor Professor Srinivas Sridhar
Preclinical Applications and Clinical Tranlation of the QUTE-CE MRA Technique

Ivan Voitalov
Advisor Professor Dmitri Krioukov
Theory and Applications of Latent Network Geometry

Chi Zhang
Advisor Professor Armen Stepanyants
Associative Learning in cortical and artificial neural networks

Master of Science

Kengcheng Feng (May 2021)
Guohao Hao (December 2020)
Bharadwaj Harikrishnan (May 2021)
Matthew Matzelle (December 2020)
Sourya Vemuri (May 2021)
Zhuyao Wang (August 2020)
Xinyue Xiong (December 2020)
Hyojun Yu (December 2020)

Bachelor of Science

(Spring 2021 unless otherwise noted)

Nikolas Alexandropoulos
Gweneth Andersen
Carlos Benavides**
William Bonaventura
Tadhg Buma
Kayla Caputo
Haoze Chen*
Arun Chundru
Amalia DeCoursey
Anush Devadhasan*
Benjamin Dreisen
Matthew Ellis
Alastair Fisher
Jennifer Garland
Anthony Gironda
Benjamin Gross*
Brynnydd Hamilton
Ethan Jeffs
Dillon Johnstone
Kyle Kilroy
Sagar Kumar**
Ishaan Lohia
Nicholas Lozoponi
Ethan McCue*
Bradley Mileson
Adam Mirza
Fernando Núñez-Santos
Casey Pancoast
Kevin Parlato
Neil Patel
Gus Pearl
Thedita Pedersen*
Nicholas Pelizzari
Sophia Renauld
Christopher Reusch*
Agustin Romero
Courtney Schreiber
Nabeel Sherazi
Zachary Silva
Christian Skroce
Victoria Spinosa
Ethan Surveski
Jason Suwandi
Joshua Towner
Zhe Wang**

*August 2020 degree conferral
**December 2020 degree conferral

Supporting the Department

The Physics Challenge is an opportunity to make a lasting contribution to the future of the Physics Department and the University.

Your support will provide scholarships to students, develop new physics programs, and contribute to new facilities and equipment.

Your support is essential to furthering our mission to provide our students with education and experiences that will help transform their lives.

For more information on how to give, please go to
https://cos.northeastern.edu/alumni/giving/

or contact:
Kevin Thompson
Associate Dean for Development
College of Science
k.thompson@northeastern.edu

By Check:
Make check payable to
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Boston, MA 02115

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Do you know of an alumnus who is not receiving our newsletter but would like to be on our mailing list?

Contact Us

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