

The long history of David Rittenhouse Lab

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enn alums who return to campus often marvel at its transformation. Renovation projects have rejuvenated buildings like Fisher-Bennett Hall, the home of the English department and the Cinema Studies Program and one of the main teaching spaces on campus. The Perelman Center for Political Science and Economics, which opened last year, is a major hub for the social sciences. And the construction of the Carolyn Lynch Laboratory and the Stephen A. Levin Building have advanced the life sciences. Of the 26 buildings that house the people, programs and departments that make up Penn Arts & Sciences, nine are either less than 15 years old or have undergone major renovations in that time.

One place that has remained the same in the midst of all this change is the 65-year-old David Rittenhouse Laboratory (DRL). Since 1954, the Math department, along with Physics and Astronomy, has been housed here, at the southeast corner of 34th and Walnut Streets.

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Built in two phases, DRL takes up 243,002 square feet and stretches for a city block. It contains the offices and labs of 86 standing faculty, as well as grad students and post-doctoral fellows, and it provides 20 classrooms used by departments across the School.

While the building itself might resemble a 1950s high school, the departments in it have a history of groundbreaking contributions to their fields. Math, as a cornerstone of not just science but of a broader liberal arts education, has continuously played a role in the instruction of virtually all of Penn's undergraduates. Eight professors have been invited to speak-and one received a repeat invitation-at the International Congress of Mathematicians, the equivalent of a math hall of fame induction. The Physics and Astronomy department, which has recently seen its number of undergraduate majors triple, counts three Nobel prize winners in its family tree.

But a building with history is also a building that was not designed for today's science. The year that DRL was opened saw the first mass inoculation against polio. Dwight Eisenhower was president, and a gallon of gas cost 26 cents. Since then, humans have gone from walking on the moon to seeing what a black hole looks like. New discoveries in math allow modern encryption and decryption. Nanotechnology lets us manipulate atoms.

DRL is the legacy of an era when government partnered closely with higher education and invested heavily in facilities. World War II had just demonstrated the vital importance of science, and the U.S. had entered the technological race of the Cold War. From Harvard to Stanford, a generation of facilities across the country reflect this boom.

Today, the National Science Foundation, the Department of Defense, foundations, and industry continue to fund individual research studies, and in some cases major scientific equipment. But government support for buildings themselves is now greatly reduced, and universities must find other ways to provide the modern facilities that can attract talented faculty and the graduate students that are the lifeblood of a good science department, to make possible cutting-edge research, and to facilitate excellence in teaching in the sciences.

Building modern science facilities of any sort involves unique challenges and great expense. The size and heavy use of DRL will make the effort to replace or update it particularly daunting. But to ensure a future at Penn for the Physics and Astronomy and Math departments that is as bright as their past, the conversations have begun.

Here, we take a brief look at DRL, the two departments it houses, and their distinguished past.

In 2019... MATH **PHYSICS AND** ASTRONOMY



A BUILDING IN TWO PARTS

1954 building

James R. Edmonds, Jr., AR'12, Architect

"Penn had really built nothing since the Depression set in," says History of Art's David Brownlee, coauthor of Building America's First University. An Historical and Architectural Guide to the University of Pennsylvania. "The DRL showed a reinvestment in West Philadelphia and an engagement with the new scientific mandates of the late 20th century. And it's our first building that really looks like a modern building."

1967 addition

J. Roy Carroll, AR'26, GAR'28, Architect

"It was in the spirit of what was being called the Philadelphia School. It's a building for science that looks picturesque, not rational and regular and repetitive," says Brownlee.

37 majors graduated » 25 advanced degrees granted » 107 courses offered » 7 Lindback teaching awards to date

37 majors graduated » 17 advanced degrees granted » 72 courses offered » 13 Lindback teaching awards to date



2000



1995

Tom Lubensky of Physics and Astronomy coauthors Principles of Condensed Matter Physics, an influential textbook which defines the field of soft condensed matter physics.

1999

atter phy

Math's Richard Kadison receives the Steele Prize of the American Mathematical Society for Lifetime Achievement.



Former Professor of Physics and

Astronomy Alan Heeger shares

the Nobel Prize in Chemistry for

Alan MacDiarmid and fellow

Hideki Shirakawa.

work done at Penn on conductive

polymers with Chemistry Professor

While filming A Beautiful Mind, Russell

We see a

picture of a

black hole.

Everyone

Crowe attends a Math Rademacher

Lecture in DRL. No one notices.

Math's Herbert Wilf receives the Steele Prize of the American Mathematical Society for Lifetime Achievement.

1993

1994

Math's David

conjecture, for

the Cole Prize

In Physics and Astronomy, Raymond

for detecting cosmic neutrinos.

Davis shares the Nobel Prize in Physics

which he shares

from the American

Mathematical Society.

 $rk(G/p(G)) \leq s + 2g$

Harbater coauthors a

proof of Abhyankar's

Magic: The Gathering, the first tradingcard game, debuts and sells out. It's created by Math's Richard Garfield, C'85, GR'93, a student of Herbert Wilf,



2004

Physics and Astronomy's

Philip Nelson publishes his

textbook Biological Physics,

curricula worldwide.

Physics and

Astronomy's

Charles Kane and

Eugene Mele receive

now a resource for biophysics

HYSIC



2005 Ron Donagi of Math coauthors a breakthrough paper on producing a Heterotic Standard Model.

The Math department

2008 creates the Applied Math-

ematics and Computational Science Program.

1985 Math's Peter Freyd and

Math's Eugenio Calabi is inducted his student David Yetter into the National Academy of are co-discoverers of Sciences for accomplishments the HOMFLY polynomial, a knot invariant in the mathematical field of knot theory.



2009

including the development of the Calabi conjecture, which led to Calabi-Yau manifolds. Physics and Astronomy's **Paul**

1982

Steinhardt and his student Andreas Albrecht formulate the first viable inflationary theory of the universe.

Richard Feynma proposes quantum computing.

1980

2010

Using modern techniques, Math's Philip Gressman and Robert Strain solve the 140-year-old Boltzmann equation. <

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\frac{\partial F}{\partial t} + v \cdot \nabla_x F = \mathcal{Q}(F, F)
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NASA confirms the presence of large quantities of water ice on the north pole of the Moon.

2016

Math's Charles Epstein receives the Bergman Prize of the American Mathematical Society for fundamental contributions including his research on a relative index on the space of embeddable Cauchy-Riemann structures.

 ${}^{0}S: \ker {}^{1}\bar{\partial}_{b} \longrightarrow \ker {}^{0}\bar{\partial}_{b}$

Physics and Astronomy's Eugene Beier and Joshua Klein are part of the SNO collaboration that shares in a Breakthrough Prize for their work on neutrino oscillations.

Hidden Figures hits theaters.

2019 Scientific Americarl covers research led by Physics and Astronomy's Mirjam Cvetic that finds a "quadrillion" string theory solutions.



Six years of observation of distant galaxies world-leading cosmological analyses by and others in Physics and Astronomy.

2002



for the Dark Energy Survey ends, beginning Bhuvnesh Jain, Masao Sako, Gary Bernstein,

the Breakthrough Prize for their work on topological insulators, which conduct electricity only on their surfaces.



Physics and Astronomy's Mark Devlin and his group begin work on an 8,000-pound large aperture telescope receiver destined for the Simons Observatory in the Atacama Desert.



2018 Math's Robert Ghrist begins publishing Calculus BLUE, 25 hours of free animated video lectures for multivariable calculus. He and his team, in partnership with Honeywell Intl., also develop powerful new

methods arising from algebraic topology.

Following the arrival of Mark Trodden and Justin Khoury,

Physics and Astronomy establishes the Center for Particle

Cosmology to address questions about the universe and

fundamental theories of matter and energy.

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FALL/WINTER 2019

The new physics and mathematics

building opens. It's named after

David Rittenhouse, an inventor,

astronomer, professor, and surveyor,

second in awesomeness only to his

friend Ben Franklin. An addition is

completed in 1967 (see box p. 21).

1954

1957





1960

In Physics and Astronomy, Eli Burstein helps lead the creation of Penn's interdisciplinary Laboratory for Research on the Structure of Matter. The center has been continuously funded and is currently led by Arjun Yodh.



Math's Murray Gerstenhaber discovers an algebraic structure that will be named for him.



Star Trek premieres.

1969

Humans land on the moon.





1973

The first publickey cryptosystem is used for secure data transmission.

1972

Physics and Astronomy's **John Robert Schrieffer** shares the Nobel Prize in Physics for developing the first successful quantum theory of superconductivity.

2011

Andrea Liu of Physics and Astronomy identifies defects that mediate flow in solids ranging from crystalline to completely disordered, enabling microscopic understanding of how solids deform and ultimately break if pushed too far.

2012

Voyager Lenters interstellar space.

Math's Antonella Grassi develops a program to study elliptic fibrations with Julius Shaneson. Their findings inspire a completely new formulation of F-theory in physics.



Math's Tony Pantev and Ron Donagi are selected to lead the Simons Collaboration for Homological Mirror Symmetry (HMS), a group exploring HMS and its applications.

2014

In Math, Florian Pop helps to prove the full Oort Conjecture on cyclic covers, while Ted Chinburg and David Harbater advance knowledge on the non-cyclic group.

 $p\iota_{\rho-1} \leq \iota_{\rho} < p\iota_{\rho-1} + p$