



STEP INSIDE THE PERIMETER

a year in review: 2015/16



STRONG
GRAVITY

COSMOLOGY

MATHEMATICAL
PHYSICS

QUANTUM
INFORMATION

TODAY'S THEORETICAL PHYSICS IS TOMORROW'S TECHNOLOGY

Practically every technology we use today emerged from breakthroughs in fundamental, discovery-driven physics. Maxwell's equations unifying electricity and magnetism led directly to all wireless communications. Quantum mechanics gave us transistors, computers, MRI, smartphones, and more. Without general relativity, there would be no GPS.

At Perimeter Institute for Theoretical Physics, scientists pursue new breakthroughs in our understanding of the universe, from the smallest subatomic particle to the entire cosmos. Their discoveries will create new knowledge and make possible the next wave of transformative technologies to further humanity in ways we have only begun to imagine.

The detection of gravitational waves was the year's biggest news in science. Celebrated around the world, it confirmed key predictions of Einstein's theory of general relativity. More

importantly, it opened a new window on the cosmos that will undoubtedly lead to new discoveries.

At the other end of the spectrum, fundamental exploration of the quantum world is driving new discoveries and powerful nascent technologies, from quantum computers to superconducting materials to ultra-precise quantum sensors.

We are in the most exciting period in decades for fundamental physics. Observations and measurements drawn from the universe on all scales are expanding the frontiers of our knowledge.

Theory is the first link in the innovation chain. With extensive connections spanning theoretical research, experimental labs, technology development, venture capital, and early-stage companies, Perimeter is helping ensure Ontario and Canada are at the forefront of discoveries that will change the world.

"It's extremely important to underline how essential the work being done here is – not just for Canada, but for the entire world."

– Canadian Prime Minister Justin Trudeau

CONDENSED
MATTER

PARTICLE
PHYSICS

QUANTUM FIELDS
AND STRINGS

QUANTUM
GRAVITY

QUANTUM
FOUNDATIONS

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THE MOST PROMISING AREAS FOR DISCOVERY LIE BETWEEN DISCIPLINES

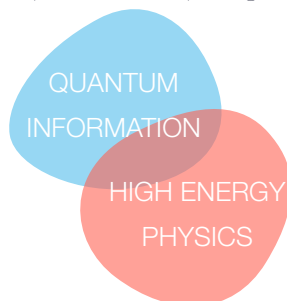
Perimeter's mission is bold: to make breakthroughs. Researchers are actively encouraged to venture into the fertile areas between specializations.

Interfaces often hold the greatest potential for discovery. The intersection of mathematics and condensed matter, for example, created the field of topological matter, which now brims with technological possibilities. It also led to a share of the 2016 Nobel Prize in Physics for Duncan Haldane, a Princeton Professor and Perimeter Distinguished Visiting Research Chair.

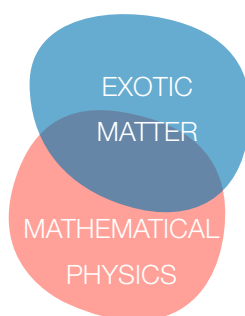
Every day, you can find around 150 researchers at Perimeter, working on chalkboards, collaborating over coffee, sifting through data, and devising experiments to push the boundaries of knowledge.

With interdisciplinary research networks spanning the globe, Perimeter scientists connect with top institutions and experiments worldwide, including the Event Horizon Telescope, LIGO, SNOLAB, and the Large Hadron Collider at CERN. Since its founding, more than 4,000 papers by Perimeter researchers have appeared in 170 journals, attracting well over 150,000 citations.

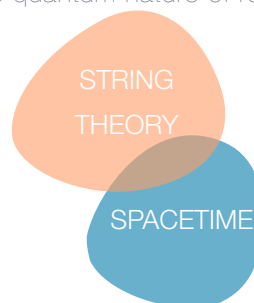
Developing the frameworks
for quantum computing



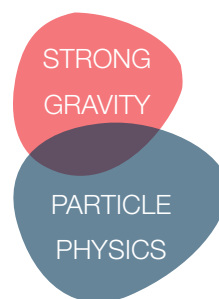
Exploring the extraordinary
promise of quantum matter



Devising theory and
experiments to understand
the quantum nature of reality



Combining theory and
experiment to probe black
holes, gravitational waves,
dark matter, and more



"Perimeter has successfully positioned Canada as a world leader in theoretical physics research, and its influence on Canada's reputation in foundational theoretical physics is significantly higher than just five years ago."

– KPMG evaluation report, June 2016

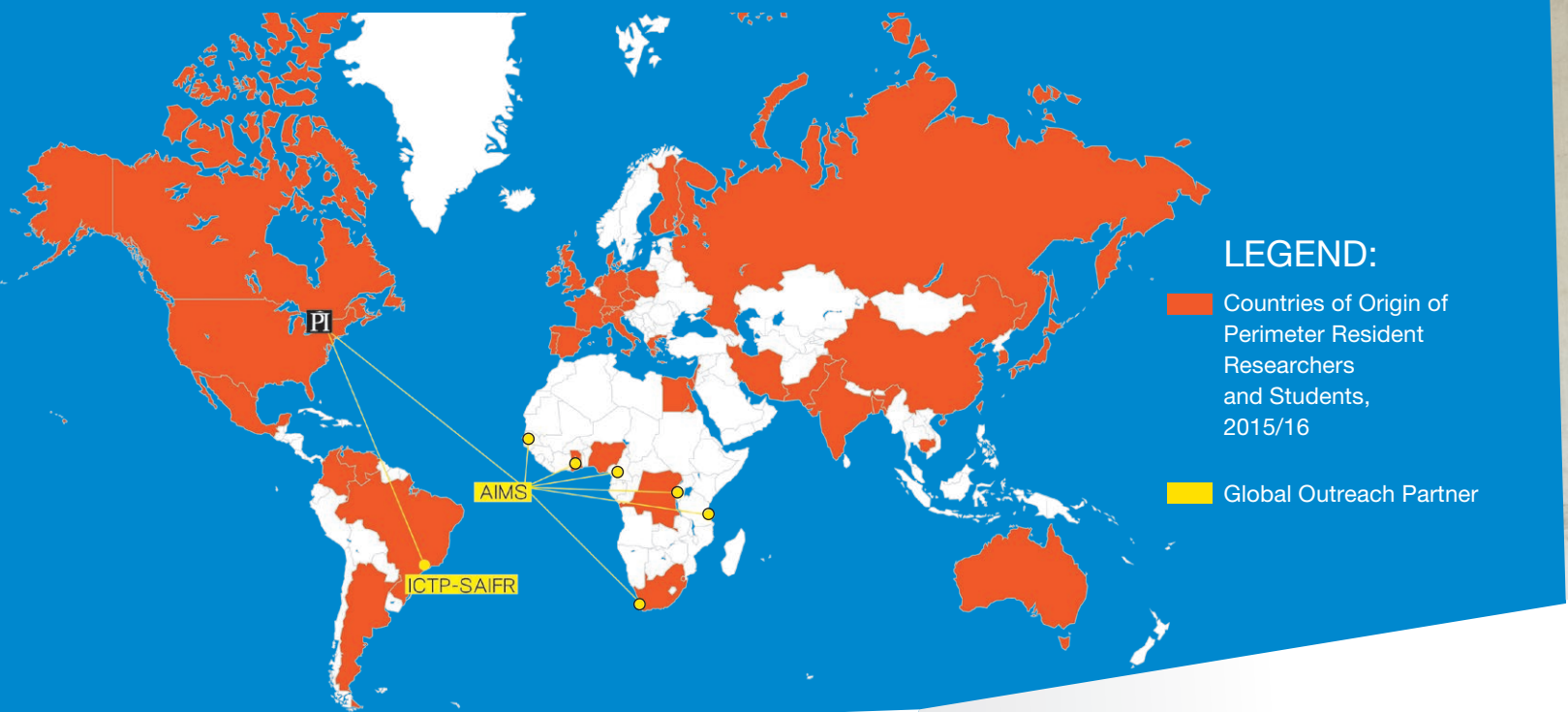
COLLABORATION AND DIVERSITY FUEL DISCOVERIES

The best way to spur breakthroughs is to bring brilliant people together. The brightest minds come to Perimeter from all corners of the world to pursue ambitious research within a vibrant, collaborative environment. As the world's largest independent centre for theoretical physics, we recognize that diversity is one of our greatest strengths.

In 2015/16, the Perimeter community grew to include:

- 22 full-time faculty (1 new)
- 20 associate faculty, jointly appointed with other Canadian institutions (2 new)
- 9 Perimeter Research Chairs (1 new)
- 49 Distinguished Visiting Research Chairs (5 new)
- 5 Emmy Noether Visiting Fellows, part of Perimeter's initiative to recruit, support, and retain more women in physics
- 27 Visiting Fellows (7 new)
- 118 Affiliate members from across Canada (7 new)

GLOBAL RESEARCH COMMUNITY, GLOBAL CONNECTIONS



GLOBAL PARTNERSHIPS PROMOTE ACCESS TO EXCELLENCE

Perimeter reaches out globally to new centres of excellence, seeking to discover and support new voices in global science. The Institute continues to strengthen its ties with the African Institute for Mathematical Sciences (AIMS), a network of centres that aims to substantially increase Africa's scientific capacity. In 2015, Perimeter also forged a new partnership with Brazil's International Centre for Theoretical Physics – South American Institute for Fundamental Research (ICTP-SAIFR) to promote collaboration and training opportunities between North and South America.

RESEARCH CHAIRS SUPPORT WORLD-LEADING SCIENTISTS

Perimeter Research Chairs give outstanding scientists the resources to maximize their productivity and mentor emerging scientists. Among the most prestigious appointments in the world, Perimeter's nine research chairs are held by both established and emerging scientific leaders, and supported by visionary individuals, corporations, and foundations.

In 2015/16, supporters funded two new Perimeter Research Chairs:

- Particle physicist Asimina Arvanitaki as the Stavros Niarchos Foundation Aristarchus Chair
- Cosmologist Paul Steinhardt as the Daniel Family Richard P. Feynman Chair (Visiting)

"I have developed many valued friends and collaborators with whom I continue to explore exciting questions at the forefronts of theoretical physics. I am greatly honoured by the Daniel Family Richard P. Feynman Chair and look forward to taking advantage of the opportunities it provides."

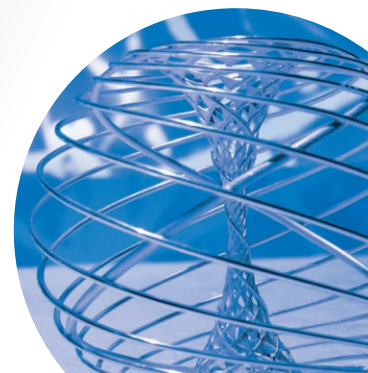
– Paul Steinhardt, The Daniel Family Richard P. Feynman Chair (Visiting)

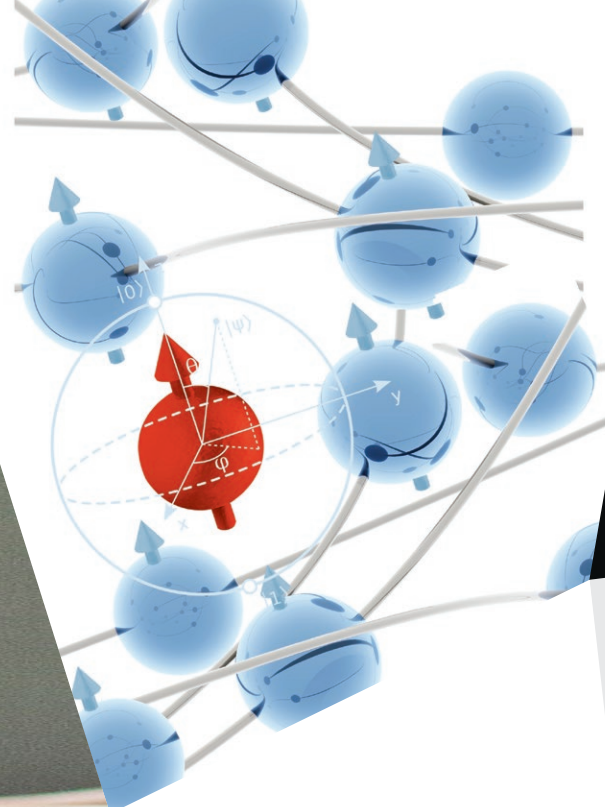


AWARDS RECOGNIZE GROUNDBREAKING SCIENCE

This year, Perimeter faculty and associates won 12 major honours and awards. Some recognized the pioneering work of senior scientists, like Neil Turok's 2016 John Torrence Tate Award for International Leadership in Physics from the American Institute of Physics. Others highlighted rising stars: In late 2016, for example, Asimina Arvanitaki won the 2017 New Horizons Prize from the Breakthrough Foundation, the field's highest honour for young scientists. She is the fifth Perimeter scientist to win the prize in the past five years – more than any other institution in the world.

Perimeter Institute faculty, associates, and postgraduate researchers were awarded \$4.7 million in research grants in 2015/16.





“Perimeter really understands the needs and ways of scientists, and does its best to facilitate both individual research and far-reaching collaborations.”

*– Tudor Dimofte, University of California, Davis
faculty member and former Perimeter postdoctoral fellow*

UNIQUE TRAINING ATTRACTS EXCEPTIONAL TALENT

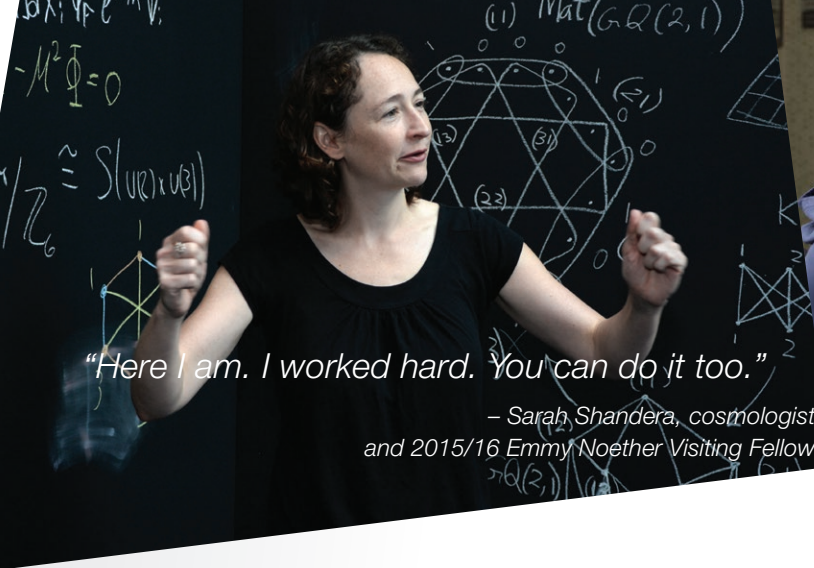
Young minds are the lifeblood of science. Perimeter attracts students from the undergraduate to PhD levels, and is home to the world's largest group of postdoctoral fellows in theoretical physics. They all work alongside, and collaborate with, eminent senior scientists and rising stars.

Known as a place where young scientists thrive, positions at Perimeter are highly coveted: Last year, over 600 vied to become Perimeter postdoctoral fellows; 19 were recruited. Over 500 applied to the Perimeter Scholars International master's program, which is jointly administered with the University of Waterloo; 29 were accepted. It has become perhaps the most competitive master's program in theoretical physics worldwide.

In 2015/16, Perimeter was home to 163 scientists-in-training:

- 58 postdoctoral fellows
- 49 PhD students
- 29 master's students
- 27 Visiting Graduate Fellows





"Here I am. I worked hard. You can do it too."

– Sarah Shandera, cosmologist
and 2015/16 Emmy Noether Visiting Fellow



CURIOSITY DOESN'T HAVE A GENDER

Perimeter is challenging the under-representation of women in physics through its Emmy Noether Initiatives, named after the influential German mathematician whose work underpins much of modern physics. These efforts are backed by the Emmy Noether Circle, who champion women in science. This year, they supported:

- 5 Emmy Noether Visiting Fellows
- 4 master's and PhD students
- 200 female high school students at the annual Inspiring Future Women in Science event

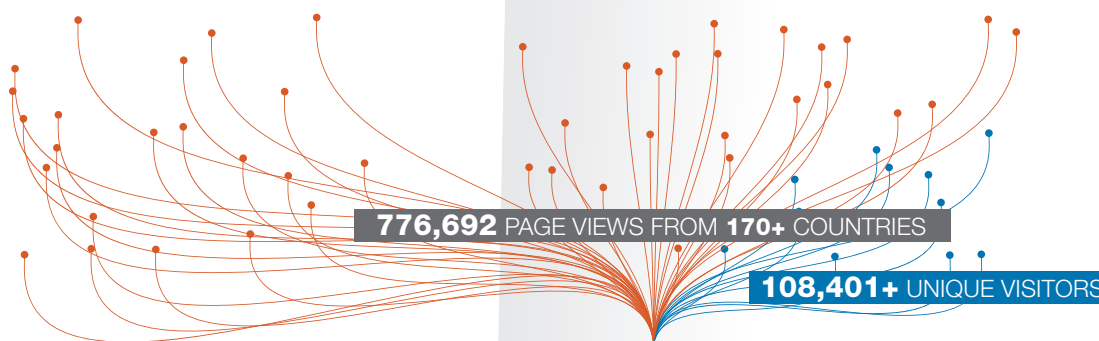
PI Emmy Noether
CIRCLE

PERIMETER ACCELERATES SCIENCE IN PERSON AND ONLINE

Perimeter is a hub for the global physics community. Its renowned conference program is known for top-notch conferences and workshops on exciting, leading-edge topics. Visiting scientists come to collaborate with Perimeter's researchers, give seminars and talks, teach, and pursue their own research away from usual distractions.

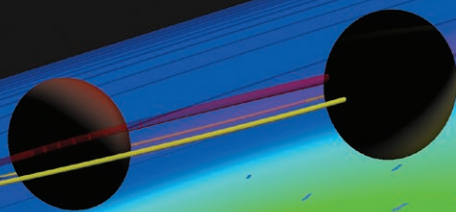
Talks, lectures, and seminars are all made freely available online on the Perimeter Institute Recorded Seminar Archive (PIRSA). Started in 2003, PIRSA has amassed 10,000 videos from seminars, courses, and workshops to date, making it the largest video archive in theoretical physics and a major resource for the entire field.

- 17 conferences and workshops
- Over 1,000 scientists from around the world
- 8 joint workshops at Perimeter, and another 16 off-site
- 322 scientific talks this year, added to the PIRSA archive



SCIENTIFIC TALKS VIEWED ON PIRSA
AND PERIMETERINSTITUTE.CA

The direct detection of gravitational waves was not only the biggest moment in science this year. It was an unbeatable moment for science outreach. Perimeter's stories, explainers, videos, and teaching kits – released on the day of the historic announcement – helped thousands share in the dawn of observational astronomy.



EDUCATIONAL OUTREACH SEEDS TOMORROW'S SCIENCE

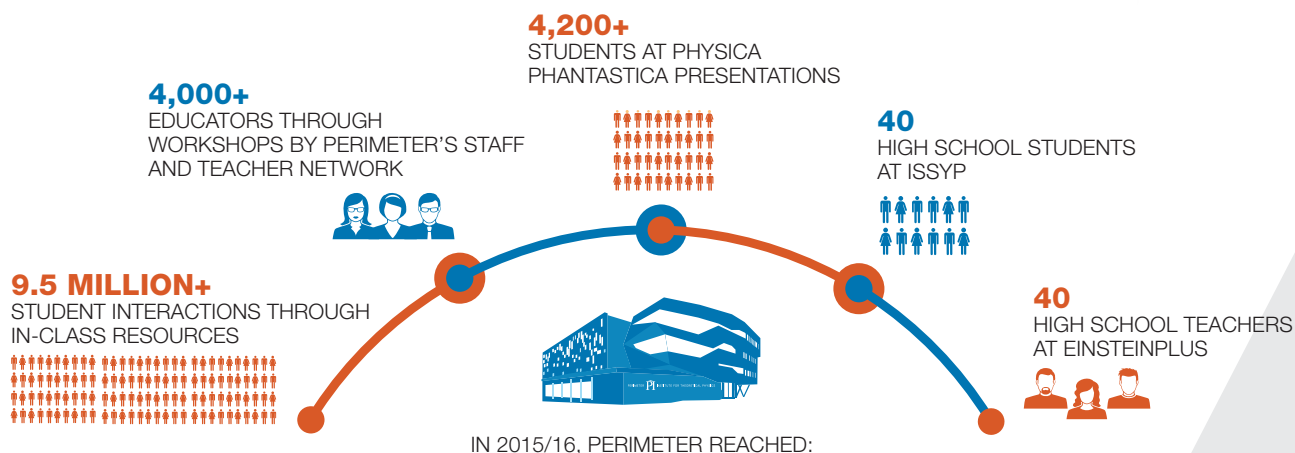
Science is all about “aha!” moments: a great question, a sudden insight, a new discovery. Perimeter's Educational Outreach programs ignite these sparks in children and adults around the world. Through in-class resources, a teacher-training network, annual “deep dive” summer camps, and global consultation on science education, Perimeter helps curious people to actually *do* modern physics. These moments can unlock a world of potential.

This year, Perimeter broadened its educational reach substantially by producing new resources about science, math, and technology for students in grades 5 to 8, and releasing “Contemporary Physics,” a new module exploring neutrino physics, black hole science, and gravitational waves.

Perimeter's excellence in educational outreach has not gone unnoticed. Canadian Heritage selected Perimeter to be the lead partner of Innovation150, a signature initiative of the Canada 150 celebrations taking place throughout 2017.

“I've learned how much I don't know, and I've realized that's not an obstacle. It encourages me to learn more.”

– Lola Hourihane, Ireland (ISSYP 2015)





BIG IDEAS, BIG REACH: PERIMETER INSTITUTE PUBLIC LECTURES

In person and online, large audiences come to Perimeter to be transported to the brink of discovery at the Institute's popular Public Lecture Series. This year's eight lectures were presented to capacity audiences in the Mike Lazaridis Theatre of Ideas, and to expanding audiences online.

Topics ranged from dark matter and atomic clocks to climate change and nuclear medicine, and included a presentation by Nobel-winning physicist and Perimeter Board member Art McDonald on his groundbreaking research into neutrinos.



2015/16 PERIMETER INSTITUTE PUBLIC LECTURE SERIES

PERIMETER GAINS NATIONAL AND INTERNATIONAL COVERAGE



Perimeter's scientific and outreach activities are regularly covered by national and international media, including *Scientific American*, *The Globe and Mail*, *Wired*, *The Guardian*, *The Economist*, *Maclean's*, and more.

Perimeter's popular monthly "Slice of PI" dispatches for science enthusiasts won the 2015 Science in Society Communications Award from the Canadian Science Writers' Association.

FACEBOOK
FOLLOWERS

+58%

TWITTER
FOLLOWERS

+40%

YOUTUBE
VIDEO VIEWS

1.3 MILLION+

MORE THAN ALL PREVIOUS
YEARS COMBINED



Canada  Ontario

BMO  Financial Group

 KREMBIL FOUNDATION

 STAVROS NIARCHOS FOUNDATION

The Riddell Family
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THE LAZARIDIS
FAMILY FOUNDATION

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CARLO FIDANI

The Peter and Shelagh Godsoe
Family Foundation



John
Templeton
Foundation

Gluskin
Sheff

The Daniel Family

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ENERGY

The Ira Gluskin and Maxine Granovsky
Gluskin Charitable Foundation

Quantum Valley
INVESTMENTS



RBC Foundation

 Scotiabank

The Bluma Appel
Community Trust

The Scott Griffin
Foundation

 hamberlain
FAMILY FOUNDATION



Joanne Cuthbertson
and Charlie Fischer

MEMBERS OF PERIMETER LEADERSHIP CIRCLES

Emmy Noether
Circle

Directors
Circle

Accelerators
Circle

Brad and Kathy
Marsland

Larry and Margaret
Marsland



The Kitchener and Waterloo Community Foundation
- Musagetes Fund
- The John A. Pollock Family Fund

Toyota Motor
Manufacturing Canada Inc.

 Maplesoft
Mathematics • Modeling • Simulation
A GLOBAL RISK COMPANY

 Deloitte.

 LINAMAR
Power to Perform

 BURGUNDY
ASSET MANAGEMENT LTD.

OUR PARTNERS SUSTAIN A CRUCIAL STRATEGIC ASSET

Perimeter's vision is to create the world's foremost centre for foundational theoretical physics, uniting public and private partners and the world's best scientific minds in a shared enterprise to achieve breakthroughs that will transform our future.

An innovative public-private partnership model shares the opportunities and benefits of long-term investment in fundamental research. Independent reviews and audits demonstrate Perimeter's excellent return on investment.

This year, Perimeter continued to seek – and attract – increased private support. Perimeter's volunteer Leadership Council and Emmy Noether Council champion Perimeter through their networks to widen the circle of supporters.

"...there is no better strategy than to aim high, recruit the world's best minds, provide the best environment for discovery, and to partner with others who share that vision."

– The Honourable Elizabeth Dowdeswell,
Lieutenant Governor of Ontario



STRONG SUPPORT ENSURES STRONG SCIENCE

The hardest problems eventually yield the most important – and the most far-reaching – solutions. These are the leaps that push humanity forward.

In its 2016 evaluation report, Perimeter's independent Scientific Advisory Committee lauded the Institute and its funders for promoting the science that will enable innovation. The report authors noted: "It is difficult to conceive of a research institute of similar scope and size that would generate as much visibility and impact for every dollar invested in it as does the Perimeter Institute."

This year, the Government of Canada and the Province of Ontario reaffirmed their commitments to foundational science through support of Perimeter Institute. Each level of government pledged \$50 million over five years, recognizing the Institute as a strategic asset for our future.

Thanks to over \$5 million in new commitments from individuals, corporations, and foundations, Perimeter is also making strong advances in its multi-year campaign to boost private sector support for game-changing science, training, and educational outreach.



Canada

Perimeter is proud to be the lead partner of Innovation150, sharing the spark of innovation across the country for Canada's 150th celebrations. Look for us in communities across Canada throughout 2017!





IT'S A BIG UNIVERSE.
FORTUNATELY, WE HAVE BIG IDEAS.



www.perimeterinstitute.ca

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