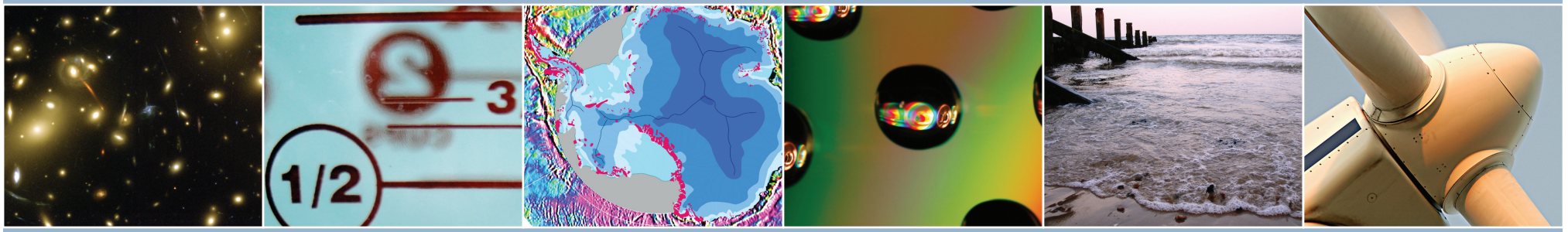
An Education in Discovery

for a New Generation of Canadian Scientists and Thinkers

Building Teaching Laboratories for First-Year Physics Practicals

Partnership Opportunities



"Physics occupies a central role in the sciences. As a core discipline and the most quantitative of the natural sciences, it provides the intellectual infrastructure behind many scientific advances. For the same reasons, physics fulfills a critical educational role for students in all disciplines. A strong physics department is at the core of a strong university."

Professor Michael Luke
Chair, Department of Physics
University of Toronto

UNIVERSITY OF TORONTO
FACULTY OF ARTS & SCIENCE

U of T's Department of Physics: Leading Research, Leading Education

Physics—the study of matter, energy and their interactions—is an intellectual adventure that expands our knowledge about Nature and underlies technological advances driving the world's economic engines. Physics is essential to both an individual's education and humankind's progress. The Department of Physics at the University of Toronto is a place where that adventure begins—where discovery happens and knowledge can inspire.

U of T's Department of Physics is one of the top physics departments among North American public universities (according to the American Physical Society), offering an exceptionally broad range of theoretical and experimental research opportunities and educational programs. In addition to the traditional core areas of condensed matter physics, quantum optics, subatomic physics and astrophysics, it encompasses environmental science, with influential work in geophysics and atmospheric physics that is advancing a global understanding of our natural world. Keeping pace with the rapid evolution of physics, the department has expanded into emerging areas of quantum information, string theory and biological physics. The department is committed to strengthening its position in all of these areas, while playing a leadership role in global change science, quantum information and optical sciences. These exciting interdisciplinary initiatives are opening up new avenues of investigation and international collaboration, and training future generations of scientists—all in a concerted effort to respond strategically to some of the most pressing questions of our age.

The key to this successful department is its people. Over the past decade, the department has recruited no fewer than 22 talented researchers and educators. Eight hold prestigious Canada Research Chairs. Nine are fellows or scholars of the Canadian Institute of Advanced Research. Six have received Sloan Fellowships. The Canadian Association of Physicists' (CAP) Herzberg Medal, awarded annually to recognize outstanding achievement by a physicist under the age of 40, has gone to a member of our department for three of the past five years. Together with an impressive cadre of senior faculty who are acknowledged luminaries and pioneers in their fields, this renewal bodes well for a vibrant future for the department—and a sustained corps of mentors for students.

Excellent faculty attract excellent students, and ours are exceptional—having taken first place on the national CAP University Prize Examination in six of the past eight years. As the skills of physicists become increasingly relevant across the sciences and beyond, the department is not only educating new physicists, but also actively engaging and inspiring students from a variety of disciplines.

The quality of the graduates, the rigor and comprehensiveness of the programs, the accolades and high grant levels awarded to faculty—U of T's Department of Physics has earned its strong reputation as an international leader in physics education and research.

A New Vision for Undergraduate Physics Education: Innovative First-Year Physics Practicals

An education in physics, at all levels, is not simply learning a set of facts or well-defined skills. Most significantly, it teaches a student to "think like a physicist." This involves learning abstraction and generalization, analyzing problems quantitatively and building on a set of underlying principles. It encompasses experimental measurement, theoretical and computational calculation, and the ability to model physical systems and to connect them with experimental results. It is precisely these sophisticated skills that make physicists in such high demand—not only in traditional physical science jobs, but in a variety of fields where the ability to think critically and analyze situations is paramount.

The Department of Physics continues to review, evolve and adapt its curriculum according to the latest pedagogical standards in order to actively engage both science and non-science students in the study of physics. Over a decade of research into physics education has revolutionized the way introductory physics is being taught at peer institutions. The conclusions are:

- most students learn best and develop core skills in a small-class environment that requires participation and discussion among peers led by an experienced instructor; and

- the single, most effective pedagogical technique uses conceptually-based, guided discovery activities involving actual apparatus.

In order to accommodate the latest teaching methods for the all-important practical portion of first-year physics courses, the Department of Physics has completely redesigned course labs and tutorials, adopting a new, discovery-based learning methodology. Key to the success of this curriculum renewal is the renovation of the physical space in the undergraduate wing—the physics laboratories.

The Pod: A Collaborative Workspace

1,600 students, the majority of whom are in the life sciences, enroll each year in first-year physics courses.

In the new first-year, non-specialist, physics practicals, laboratories and tutorials have been combined into interactive, small-group sessions, emulating the private college experience. These half-year courses offer students greater curricular flexibility and smaller class sizes, and deliver a more integrated educational experience:

- A sequence of common experiments is tied closely to the lecture material. Discovery activities have students designing and implementing their own procedures to solve a given problem, which is introducing general principles of best practices in experimental science.

- Students are learning computer skills in data acquisition and analysis that are essential for modern experimental work.

- The focus is on physics rather than math with the introduction of computer simulations to assist comprehension through problem visualization and intuitive problem-solving techniques.

In addition:

- The streamlined structure means that teaching assistants need only be familiar with the best experiments.

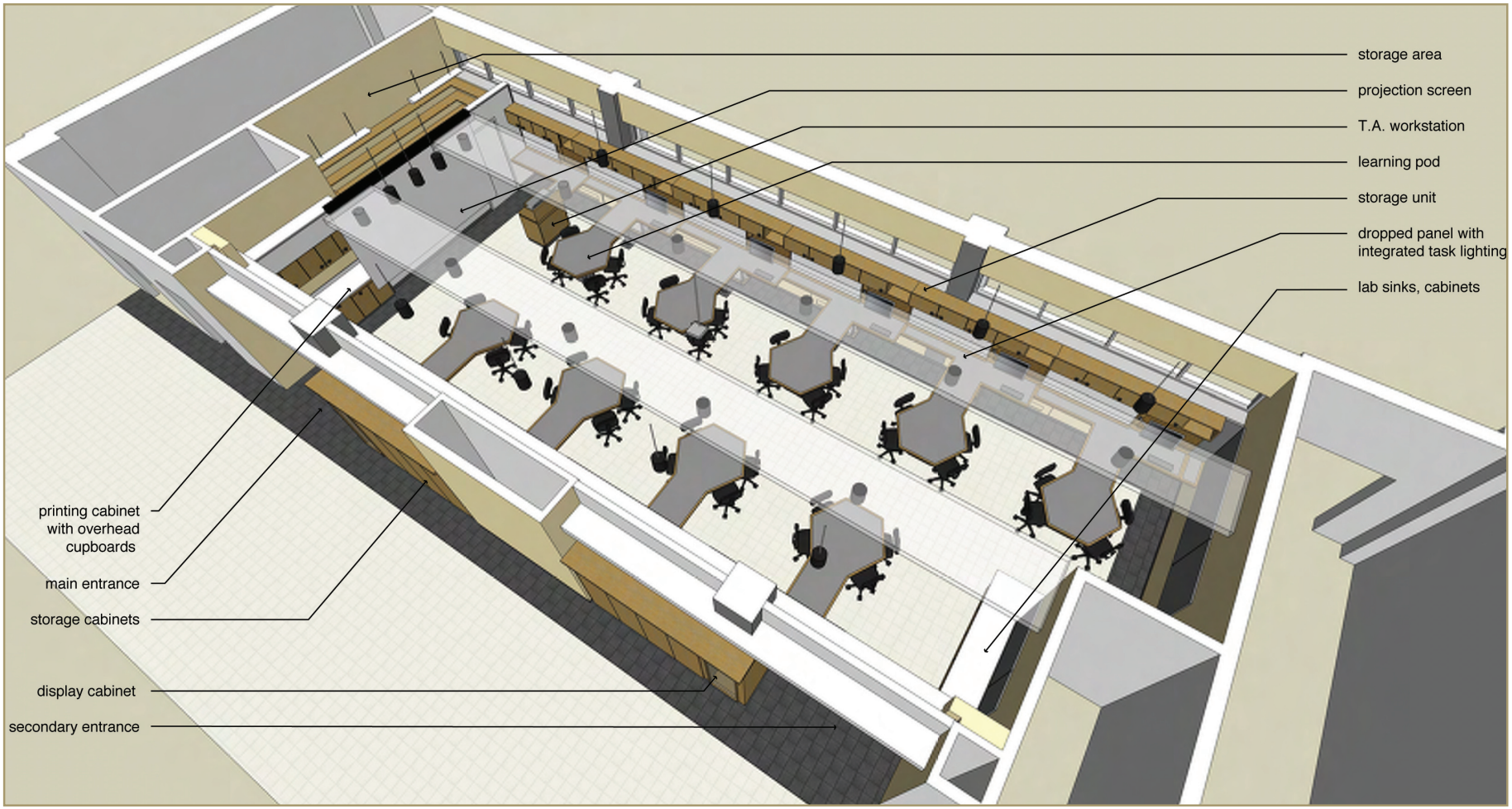
- More effective teacher training has resulted, as team-teaching is enabling more experienced graduate teaching assistants to mentor less experienced ones.

- Demand for the new labs is moving beyond first-year physics, and the space is now being used for other courses that adopt a discovery-based approach.

"The labs allowed our group to explore the topics more deeply, which truly helped me to develop a physical correlation and greater intuition for the material."

Our students speak

The physics laboratories are more than just new space—they represent a new concept in learning. Other departments at U of T, inspired by the collaborative work spaces and state-of-the-art facilities, have expressed interest in adopting a similar approach in their own curriculum development.



Partnering To Educate A New Generation Of Physicists

A pilot lab was completed in January 2008 and the response from both students and instructors has been overwhelmingly positive. Four more labs are planned for a total complement of five labs—enough to accomodate all of our first-year students.

The plans also encompass the creation of a Student Common Room, with wireless connectivity, public-access terminals and work tables, to foster discussions, quiet study and collegial interactions. And finally, a Technologists' Centre—complete with a help desk where students can obtain equipment and materials, offices, a meeting room and sound-insulated work area—will ensure optimal functioning of all labs in the undergraduate wing.

Naming Opportunities

The total cost for transforming the undergraduate physics wing is $4.5 million. Given the importance of this initiative and the positive impact it will have on learning, the University has committed seed money and made matching funds available. But we will need private-sector investment to transform these exciting plans into a reality that will benefit generations of students.

Leadership gifts will be recognized with a naming opportunity and tailored recognition program. The University will provide matching funds equivalent to 50% of the following naming levels:

Undergraduate Physics Laboratory: $500,000, per lab (5 total)

Student Common Area: $250,000

Technologists' Centre: $250,000

Donors to this core project will make an important contribution towards optimizing the quality of the undergraduate students' experience at the University of Toronto and will help to educate the next generation of Canadian scientists and thinkers.

"Being a part of the pilot was an amazing opportunity and I attribute the bulk of my physics understanding to the interactive practicals."

Our students speak

We would be happy to discuss these naming opportunities, as well as other high priority partnership opportunities at the Department of Physics.

For more information, contact:

Professor Michael Luke
Chair
Department of Physics
University of Toronto
(416) 978-5205
luke@physics.utoronto.ca

Or

Ingrid Silm
Development Officer
Department of Physics
University of Toronto
(416) 978-1548
isilm@artsci.utoronto.ca

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