



Office of Science

Princeton Plasma Innovation Center Heralds a New Era at the Princeton Plasma Physics Laboratory

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A rendering of the PPIC building shows the three-story north wing with the roof garden to the left, and the south wing laboratory building.

Image courtesy of SmithGroup.

The Princeton Plasma Innovation Center (PPIC) will be the first new building at the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory in decades. It will provide much needed modern state-of-the-art adaptable laboratory and collaboration space. It is the "centerpiece" to a reinvigorated campus and heralds a new era for PPPL. DOE was honored to celebrate the groundbreaking of this new building with PPPL, Princeton Site Office, Congressional and Princeton University officials on May 9th.

The building will provide space during a crucial time at PPPL. The laboratory is expanding its research mission and increasing its workforce. Notably, PPIC will support PPPL's efforts to diversify its research in applied materials and sustainability sciences. This work will strengthen the United States' position in key industries, including semiconductor manufacturing. It will also enable scientists to develop research methods that can help sustainably decarbonize industries.

PPIC will provide collaboration space with cutting-edge visualization capabilities. These spaces will promote research with scientists around the world. The new building will have space for a science education laboratory to train and inspire the next generation of researchers.



The Princeton Plasma Innovation Center will replace two aging buildings and support the lab's efforts to diversify its research.

Image courtesy of Michael Livingston.

PPIC will include several sustainable features. A geothermal system will provide a fully electrified, zero emissions building. This system will also provide energy-efficient heating and air conditioning. PPIC is designed to use carbon free energy, which will bring the site closer to eliminating fossil fuel emissions. The building also includes many other environmentally sensitive features such as sunshades and energy/water efficient equipment. It has achieved Leadership in Energy and Environmental Design (LEED) gold certification for sustainability, a major achievement.

PPIC will replace two aging buildings: the Theory Wing, which has housed theoretical physicists for five decades, and part of the Administration Wing.

PPPL has maximized the new facilities' capabilities, sustainability, and resilience by leveraging partnerships outside of the Office of Science. The DOE's Princeton Site Office will receive nearly \$2.3 million from the [Assisting Federal Facilities with Energy Conservation Technologies \(AFFECT\) program](#). This funding program, which the DOE's Federal Energy Management Program runs, will help expand the geothermal system to other facilities. PPPL also received \$10 million in funding from Princeton University to prepare the site. Princeton University's financial commitment to the PPIC project demonstrates their support of the laboratory mission and partnership with the DOE, bringing the overall investment to more than \$100 million.

DOE is committed to investing in our national laboratory infrastructure. Most of the funding is from the DOE's Science Laboratories Infrastructure program. The PPIC is just the latest showcase of our dedication to creating environments for the scientific discoveries of the future.

JEANNE JACKSON DEVOE

PPPL looks to the future as it breaks ground on the Princeton Plasma Innovation Center



Taking part in the Princeton Plasma Innovation Center groundbreaking ceremony are, from left: Assemblywoman Tennille McCoy (D-NJ); Plainsboro Township Mayor Peter Cantu; PPPL Vice President David McComas; PPPL Laboratory Director Steve Cowley; Juston Fontaine, deputy director for field operations of the Department of Energy's Office of Science; Princeton Site Office Manager Sandy Rogan; and PPPL Chief Operating Officer Tim Meyer. (Photo credit: Michael Livingston / PPPL Communications Department)

Written by
Jeanne Jackson DeVoe
May 13, 2024

[Click on underlined words throughout the article for website links](#)

State-of-the-art building will support new research areas in microelectronics, quantum sensors and devices, and sustainability sciences

The U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) broke ground May 9 on the new Princeton Plasma Innovation Center (PPIC), a state-of-the-art office and laboratory building that signals a new era for PPPL, providing space for research supporting PPPL's expanded mission into microelectronics, quantum sensors and devices, and sustainability sciences.

The gleaming 68,000-square foot, \$109.7 million project is the first new building at PPPL in several decades and will replace two buildings that date back to the 1950s: the Theory Wing and Administration Wing. It is designed to be a high-performance, sustainable building that will be gold certified in Leadership in Energy and Environmental Design (LEED). The goal is for PPIC to be a zero-carbon emissions building that complies with President Biden's Executive Order 14057.

Leaders from PPPL, the DOE and Princeton University, along with local government officials and dozens of staff members, gathered on the lawn of the Theory Wing for the ceremony in the area where the new building will be constructed.

PPIC is a sign "the Lab is moving forward," said Steve Cowley, Laboratory director. "We're strengthening our commitment to deliver fusion energy," Cowley said. "We're also using our expertise to help other parts of the economy, particularly in microelectronics and sustainable manufacturing. We're going to need the labs and offices in PPIC in order to drive that vision forward."

First major building in more than 50 years

Cowley noted the last major building to break ground at PPPL was the Tokamak Fusion Test Reactor (TFTR) in 1977. (A silver shovel from that groundbreaking had a place of honor at the podium.) He paid homage to the Theory Wing, which was built in the 1950s and was home to many great physicists. Cowley said he spent many years early in his career in the building, first as a Princeton University graduate student and later as a physicist. "Demolishing the building is a bit bittersweet for me," he said. "It's a bit like demolishing my childhood home."



Cowley and Richard Hawryluk, a senior technical advisor in the Office of the Deputy Director for Science Programs in the DOE's Office of Science, who is a former interim director of the Laboratory and former head of the Tokamak Fusion Test Reactor (TFTR). Hawryluk is holding a silver shovel used in the TFTR groundbreaking in 1977. (Photo credit: Elle Starkman / PPPL Communications Department)

PPIC will help PPPL contribute research to achieve President Biden's "Bold Decadal Vision for Commercial Fusion Energy" to achieve commercial fusion energy by 2035 or 2040, Cowley said.

PPPL is partnering with commercial fusion companies to work toward that “ambitious” goal, he said in his remarks. PPIC will house theoretical and computational scientists and will support artificial intelligence and high-performance computing. Some laboratory space will be devoted to computational sciences and tools that analyze and understand plasma, the ionized gas in fusion reactions. The Lab’s expertise in computation is unparalleled and already yielding significant research results.

Facilities to communicate with collaborators around the world

PPIC will also have remote collaboration space and a virtual reality cube where PPPL scientists can communicate with research partners at experiments around the world, such as the international ITER in France, the Wendelstein 7-X in Germany and the KSTAR in Korea, among others.

PPPL’s science education team will have a new laboratory in PPIC where they can teach young people about plasma and fusion energy and train the next generation of scientists. Assemblywoman Tennille McCoy (D-NJ) said workforce development is essential. “Diversity is so important. We have one of the most diverse talent pipelines here in New Jersey, and it’s really important that we provide the necessary tools and resources for individuals to be successful, to meet expectations and for us to support organizations as they thrive here in New Jersey.”

Strong partnerships with the DOE and Princeton University

PPIC would not be possible without a strong partnership between PPPL, the DOE and Princeton University, said Sandy Rogan, Princeton Site Office manager, and David McComas, vice president for PPPL. The building is primarily funded by the DOE’s Science Laboratories Infrastructure (SLI) program. Princeton University contributed \$10 million to the project for preconstruction activities. These include site preparation, clearing, underground utility relocations and demolition of the Theory Wing and part of the Administration Wing, slated for late summer.



DOE and Princeton University partners, from left: Jaime Hrzic, federal project director; David McComas, vice president for PPPL; Sandy Rogan, Princeton Site Office manager; Juston Fontaine, deputy director for field operations of the DOE's Office of Science; Chelle Reno, assistant vice president for operations for PPPL; Amro Habib, Princeton Site Office deputy site manager; Brandon Thorne, director of the Office of the Vice President for PPPL. Rogan's (right-side image) oversight of the project has been instrumental in leading the effort forward. (Photo credit: Michael Livingston and Elle Starkman / PPPL Communications Department)

PPIC is the "cornerstone for a new vision for the Laboratory," said Juston Fontaine, deputy director for field operations of the DOE's Office of Science. Fontaine said he has noticed a change at PPPL over the past few years as the Laboratory's mission has expanded and its staff has grown. "It's really a joy to see the evolution that has taken place here," he said. "I want to take a moment just to thank the Laboratory staff. Thank you, and I hope you take pride in the fact that you're associated with this great Laboratory."

PPPL has provided jobs and educational opportunities while also supporting Plainsboro Township's emergency services, said Mayor Peter Cantu. "We're proud to have you in our community, and we wish you great success on this new project," he said. He recalled receiving a five-inch thick environmental impact statement from PPPL about the TFTR in the 1970s. Cantu joked that he didn't understand the report, but the PPPL director at the time made a presentation to the council, "and he made it almost understandable," Cantu said. "The thing that I came away with from that is the importance of the work that you are doing and its potential to benefit not just the state, not just the locality, but the world."

Tim Meyer, chief operating officer, noted that the groundbreaking took place during Fusion Energy Week, which is dedicated to educating the public about the research aimed at developing fusion energy. "Change is a necessary part of growth and development," Meyer said. "PPIC is literally going to be a place where this Laboratory and its stakeholders will push the frontiers of discovery and innovation in partnership with collaborators from around the region and the world."

Meyer especially thanked those deeply involved with the PPIC project, along with the original leaders of the effort: David Carle, head of facilities and site services; Stephen Langish, senior project manager; Dennis Pasternak, facilities project manager; Gjergj

Shota, construction project manager; Margaret Carideo, project planning and control officer; Joy Fleming, construction and project safety lead; Marlo Ramos, senior quality assurance engineer; Chi Man Cheung, senior procurement manager; Venkat Bommisetty; science infrastructure and operations coordinator; and Kenyon Petura, campus development manager.

“We couldn’t have reached this milestone without the help, passion and dedication of everyone at PPPL, particularly the PPIC project team,” he said.



Members of the larger PPIC team, from left: Gjergj Shota, construction project manager; Dennis Pasternak, facilities project manager; Stephen Langish, senior project manager; Kenyon Petura, campus development manager; Hekima Qualls, chief procurement officer; David Carle, head of facilities and site services; Joy Fleming, construction and project safety lead; Margaret Carideo, project planning and control officer; and Venkat Bommisetty, science infrastructure and operations coordinator. (Photo credit: Michael Livingston / PPPL Communications Department)

A new “town center” on PPPL’s campus

PPIC is envisioned as an iconic building that will become “the town center” of PPPL’s campus. The U-shaped building has three axes: the first floor of the north wing is a collaborative wing where visitors will enter. Above it are the second and third floors of the north wing, which are set at an angle to overlap the first floor and will be dedicated mostly to office space for around 170 staff members. The laboratory wing to the south has 10 medium-bay laboratories and 13 small-bay laboratories on the ground floor. These include fusion-centric laboratories, such as diagnostic development and X-ray labs, as well as laboratories that support PPPL’s research diversification in microelectronics, quantum sensors and devices, and sustainability sciences.

The laboratory wing connector and the north wing intersect at the cafe, which connects with PPPL’s main office building, the Lyman Spitzer Building. The cafe features retractable walls on each side, opening up to the courtyard and the north garden, as

does the science education laboratory and other meeting rooms on the first floor. The overlapping buildings create a triangular roof garden to the north of the building entrance.



An aerial rendering of PPIC. (Photo credit: SmithGroup)

Light, shadow and colors

The building was designed to use light, shadow and colors, symbolizing solar plasma, movement, energy, synergy and impact, according to [SmithGroup](#), the building's architects. Sustainability is an integral part of the architectural features. Architects will use glass extensively in the building, especially on the north wing, for example, to maximize daylight for offices and reduce the use of electric lights. Rows of colorful shades extending alongside the north wing in rows at the front of the building will add color and enhance shading. The shades reduce direct heat and glare from the sun by 88%, reducing the need for air conditioning.

The geothermal exchange system is based on 70 new geexchange wells that will be dug 500 feet beneath the ground in the football field-sized courtyard in between the north and south wings. The geexchange technology extracts heat from the building in the summer and stores it deep beneath the ground to heat the building in winter. It will provide about two-thirds of the heating and cooling for the building.

The PPIC project team consulted experts at Princeton University, which has installed 700 new geexchange wells on the University's campus to achieve a zero-carbon footprint by 2046.



Members of SmithGroup's team of architects in front of a PPIC rendering. From left: Tom Faucette, principal science and technology studio leader; Sven Shockey, vice president and design director; and Maryjane King, lead campus planner. (Photo credit: Michael Livingston / PPPL Communications Department)

Sustainable materials

The building is designed to incorporate sustainable materials as much as possible, and materials will be purchased from American companies, a DOE requirement. The roofs on the two wings of the building will accommodate solar cells if a future phase of the project includes solar power. Other sustainable features are designed to save water by installing efficient features, such as a rain garden that absorbs water and native plants with low irrigation requirements.

A community swell gathers at the event



PPPL staff at the PPIC groundbreaking. (Photo credit: Michael Livingston / PPPL Communications Department)

Lab employees were invited to the event, and more than 250 gathered for the groundbreaking ceremony on the lawn outside the Theory Wing, along with invited guests from Princeton University. They wore PPIC buttons and collected stickers made for the occasion to commemorate the event and gave each of the speakers a warm round of applause. The event was followed by the Lab's staff picnic, informally called the "P-Picnic," in which staff and visitors celebrated the momentous occasion.

"This is one of those moments when we all work for the beginning of something transformational," Meyer said. "We are building a new future for this legendary Laboratory."



Top images: Stickers and buttons helped to celebrate the occasion. Bottom image: A few staff members enjoy the P-Picnic. (Photo credit: Gwen McNamara and Elle Starkman / PPPL Communications Department)

PPPL is mastering the art of using plasma – the fourth state of matter – to solve some of the world's toughest science and technology challenges. Nestled on Princeton University's Forrestal Campus in Plainsboro, New Jersey, our research ignites innovation in a range of applications including fusion energy, nanoscale fabrication, quantum materials and devices, and sustainability science. The University manages the Laboratory for the U.S. Department of Energy's Office of Science, which is the nation's single largest supporter of basic research in the physical sciences. Feel the heat at <https://energy.gov/science> and <https://www.pppl.gov>

Project to date



100% Design Deliverable (May 2024)

- **68,047 GSF**
- Labs: 38,291 GSF
- Collab: 12,455 GSF
- Office: 17,301 GSF

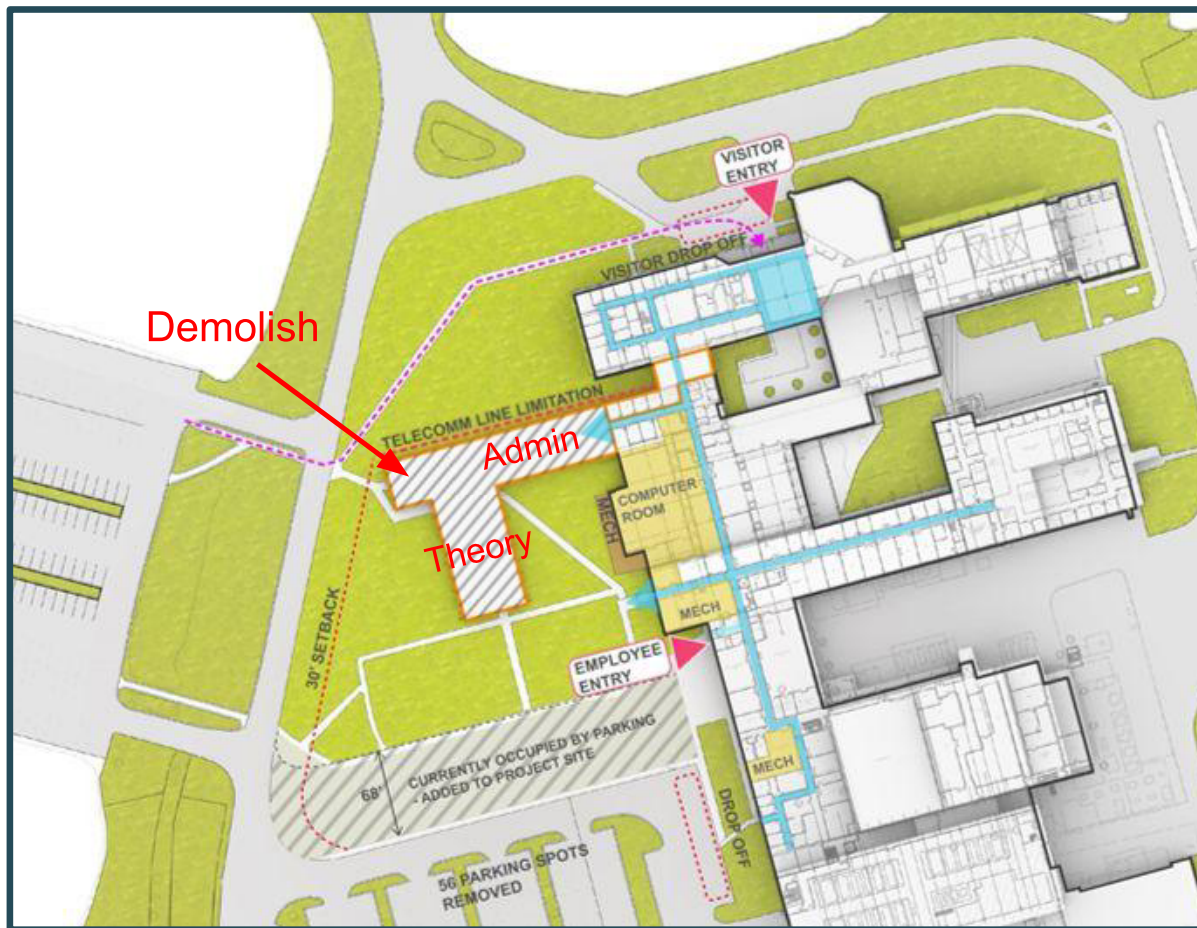


Getting ready

PPIC will replace (and transcend) selected, existing, aged facilities including the Theory and Administration wings of the main building.

- Staff are already being relocated as part of post-pandemic shuffle
- Site and utility work are in development

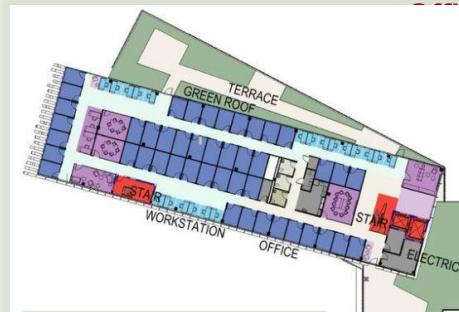
Note: PPPL is exploring options to execute the demolition & site-prep work package off-project and with Princeton University contributions



Program



1st floor



2nd floor



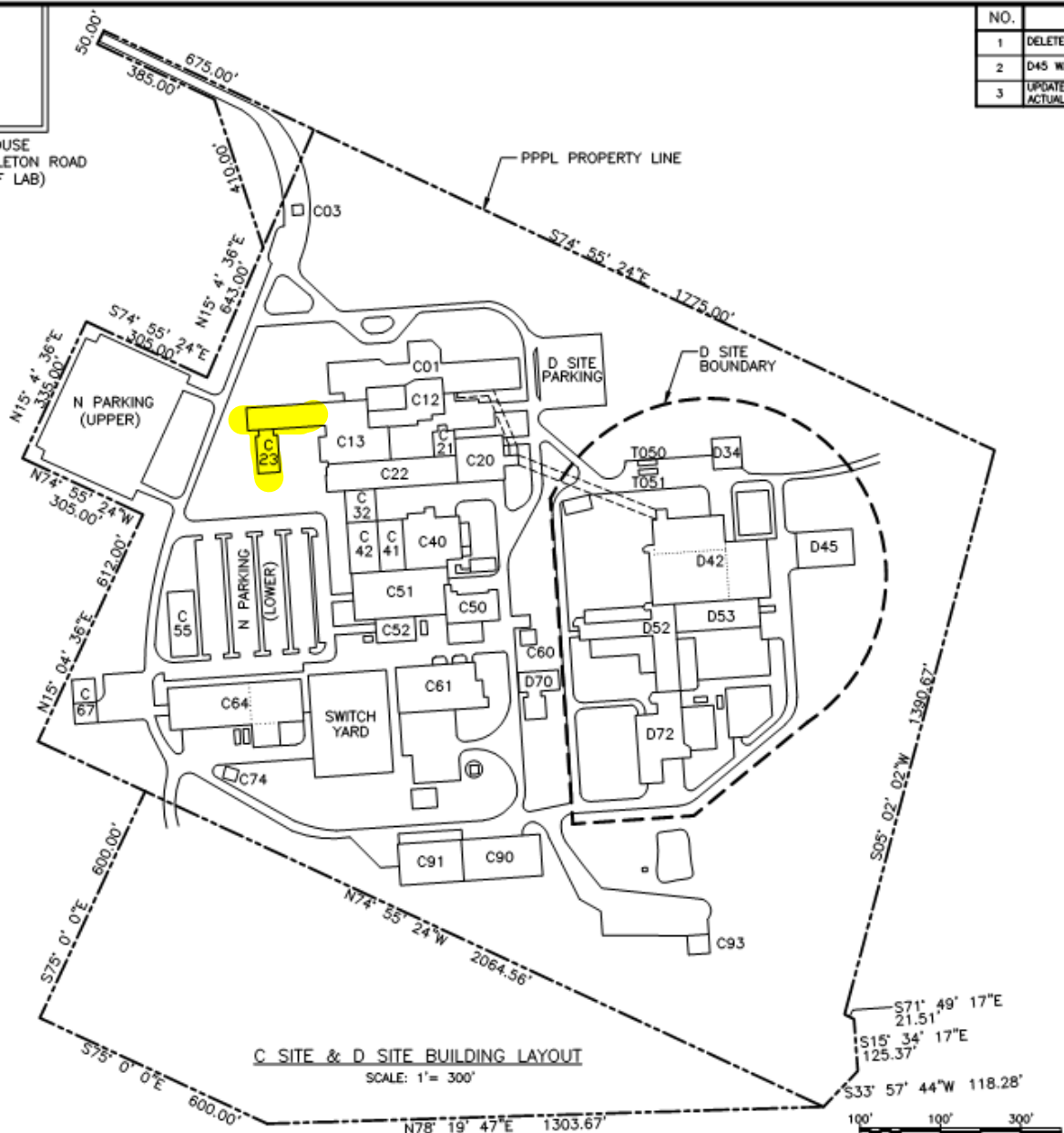
3rd floor

Lab Name	Type	Program
Quantum Information Science Lab	Medium Bay	BES/FES
Surface Science Microscopy Lab	Small Bay	BES
Materials Discovery and Processing Lab	Medium Bay	FES/BES/BER
Diagnostic Development Labs	Small Bay	FES
Vacuum Prep Lab	Medium Bay	FES
Sustainability Sciences Lab	Small Bay	BER/FES/BES
X-Ray Labs	Medium Bay	FES
HEDLP Lab	Medium Bay	FES
Microelectronics Lab	Medium Bay	FES/BES
PCRF Lab	Small Bay	FES/BER
PCRF (Sustainability) Lab	Small Bay	FES/BER
Superconducting Magnet Prep Lab	Medium Bay	BES/FES
Coil Winding Lab	Medium Bay	BES/FES



D&R
CANAL

P1 - CANAL PUMP HOUSE
LOCATED OFF SITE ON MAPLETON ROAD
(APPROX. 1 MILE WEST OF LAB)



NO.	REVISION	BY	CH	SUP	APPROVED	DATE
1	DELETED D33, REV. C60 PER ECN-5127	FJ	JN		JG	05/10/06
2	D45 WAS D35 PER ECN-5342	JJN	JS		EJ	03/27/08
3	UPDATE AD-300 DRAWINGS TO REFLECT ACTUAL CONDITIONS PER ECN-7424	TK	DS	LM	MV	05/04/15

C SITE

- C01 Lyman Spitzer Building (LSB)
- C03 Guard Booth
- C12 Admin. Wing/Cafeteria
- C13 Admin. Building/Library/Computer Addition
- C20 Engineering Wing
- C21 L-Wing
- C22 Laboratory Building
- C23 Theory Wing
- C32 Shop Building
- C40 RF Building
- C41 CS Building
- C42 COB Building
- C50 ESAT Building
- C51 C Site MG Building
- C52 PLT Power Building
- C55 Module 6
- C60 C Site Pump House
- C61 Facilities Engineering Building
- C64 Material Services Building
- C67 Emergency Services Building (ESU)
- C74 Gas Cylinder Storage
- C90 RESA Building (Research, Equipment, Storage & Assembly)
- C91 CAS Building
- C93 Hazmat Storage Building

D SITE

- D34 Liquid Effluent Collection Tank
- D42 D Site Experimental Area
- D45 Rad. Waste Handling Facility
- D52 FCPC Building
- D53 NBPC Building
- D70 D Site Cooling Tower Pump House
- D72 D Site MG Building
- T050 Office Trailer
- T051 Office Trailer

RELEASED FOR
FABRICATION/INSTALLATION
PPPL Building, Leash Morris

PRINCETON PLASMA PHYSICS LABORATORY
PRINCETON UNIVERSITY

C & D SITES BUILDING LAYOUT & NUMBER IDENTIFICATION PROPERTY LINE

DIV: P.M. & E.	DATE: 03/03/2003	CADD FILE: 3BAD3002.DWG
ENG: C. POTENSKY	APPROVED:	B-AD-300
DWN: R. VAN KIRK		
CHK: S.FLOHR	CHK: SUPV/CP	
		SHEET 2 REV 3

Princeton Plasma Innovation Center (PPIC)

Plainsboro Township Planning Board

Steve Cowley - Lab Director

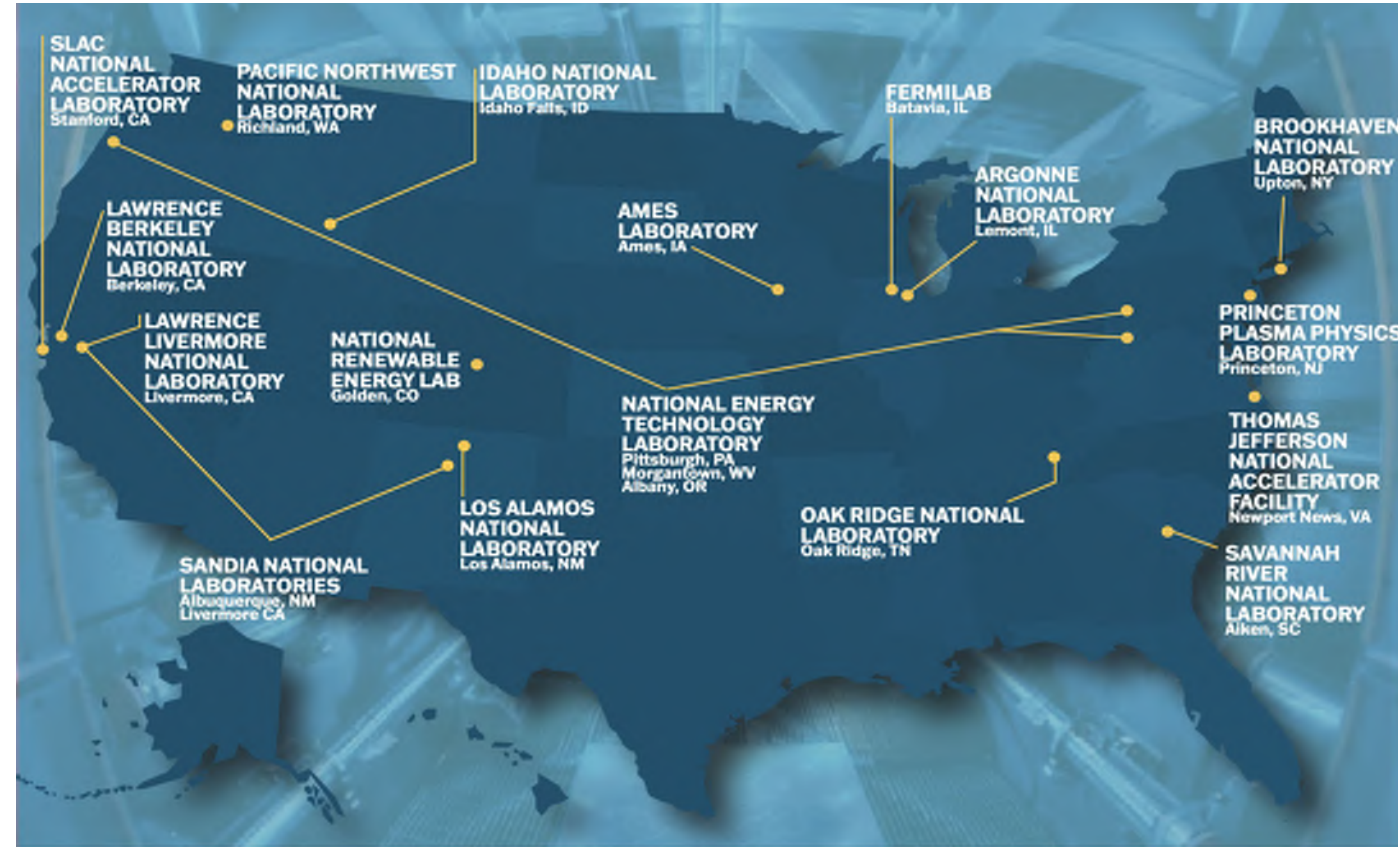
Tim Meyer - Deputy Director of Operations

June 17, 2024



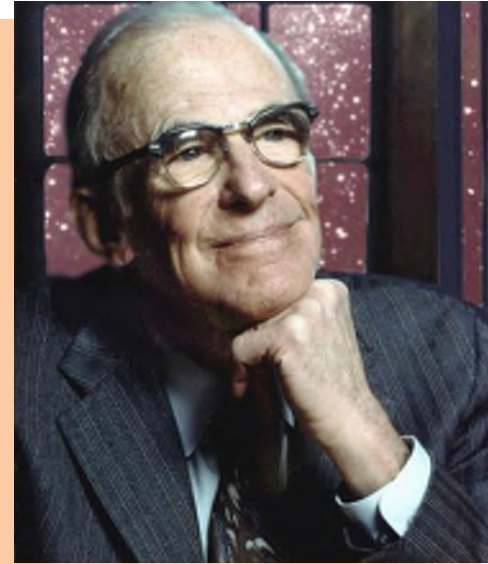
What is PPPL?

- **Princeton Plasma Physics Laboratory** is one of 17 U.S. Department of Energy National Laboratories
- The only Laboratory focused on fusion energy and plasma science
- Expanding research into applied materials and sustainability sciences to meet urgent national priorities

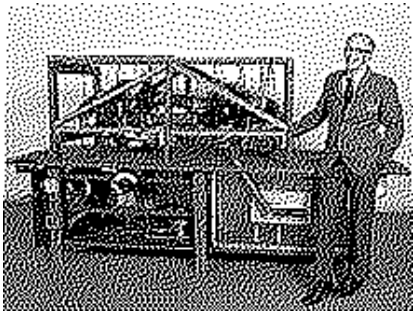


70+ years of PPPL Accomplishment

PPPL was born in 1951 when magnetic fusion research at Princeton began. Under the code name “Project Matterhorn” Lyman Spitzer Jr., professor of astronomy at Princeton University, conceived a plasma being confined in a figure-eight-shaped tube by an externally generated magnetic field. He called this concept the “stellarator,” and took this design before the Atomic Energy Commission in Washington.



**Introducing the Next 70 year - PPIC
Groundbreaking
May 7, 2024**



1953 Model A Stellarator



**1970 Symmetric
Tokamak (ST)**



**1974-1997 Tokamak fusion
Test Reactor (TFTR)**



**1995-2011 National Spherical
Torus Experiment (NSTX)**



**2016-present National
Spherical Torus Experiment
(NSTX-U)**

PPPL At A Glance



Operated by Princeton University
on 90 acres of the Princeton
University Forrestal Campus

Funding by Source

Fiscal Year 2023
Total Laboratory Operating Costs: \$206M

Fusion Energy Sciences (including PPPL/ITER)	\$128.6M
ITER (via Oak Ridge National Laboratory)	\$44.3M
Science Laboratories Infrastructure, General Plant Projects	\$10M
Basic Energy Sciences	\$2.3M
Princeton University	\$2.1M
Advanced Scientific Computing Research Program (including the Exascale Computing Program)	\$1.8M
Strategic Partnership Projects (\$1.2M NASA)	\$1.7M
Office of Science (other)	\$6.5M
National Nuclear Security Administration	\$0.8M
Department of Energy	\$0.5M

Website: pppl.gov

Physical Assets

90.7 acres
30 buildings + 2 trailers
\$874 million replacement value
912,000 gross square feet in buildings and infrastructure

Human Capital

752 Full-time Employees
Total by type of position:
88 Physicists & Faculty
136 Engineers
208 Technicians
15 Apprentices
199 Administrators
28 Postdoctoral Researchers
42 Graduate Students
36 Subcontract/Hourly Employees
308 Facility Users
31 Visiting Scientists

Mission Unique Facilities

Facility for Laboratory Reconnection Experiments
Laboratory for Plasma Nanosynthesis & Nanofabrication
Lithium Tokamak Experiment
Magnetic Reconnection Experiment
National Spherical Torus Experiment-Upgrade
Princeton Collaborative Low Temperature Plasma Research Facility

Mechanical Design and Engineering
Power Systems and Electrical Engineering

The PPPL Community

- Joint Research Opportunities and Faculty Appointments, Graduate Student Program, Apprenticeships
- Public Engagement
 - Public Tours
 - Science on Saturdays
 - National Science Bowl
 - Eco Expo
- PPPL Emergency Response
 - Over 200 Fire & EMS (2024)



International Hub of Fusion Research....

....here in Central New Jersey

Princeton Plasma Innovation Center (PPIC)

a transformational facility heralding a new era for
PPPL capitalizing on its research skills for future opportunities

Enable Science - **Medium Bay Laboratories**

Diverse science & engineering portfolio
help advance industries of the future.

People - **Modern post pandemic workspaces**

Attract and retain next-generation research and technical talent
First new “people” building since the early 1980s

Engagement - **highly collaborative interaction spaces**

National and international partners
Employees, users, students, and visitors

The Go-To place for access to Fusion Energy and Plasma Science!



PPIC becomes the new focus of the campus



PPIC Design Highlights

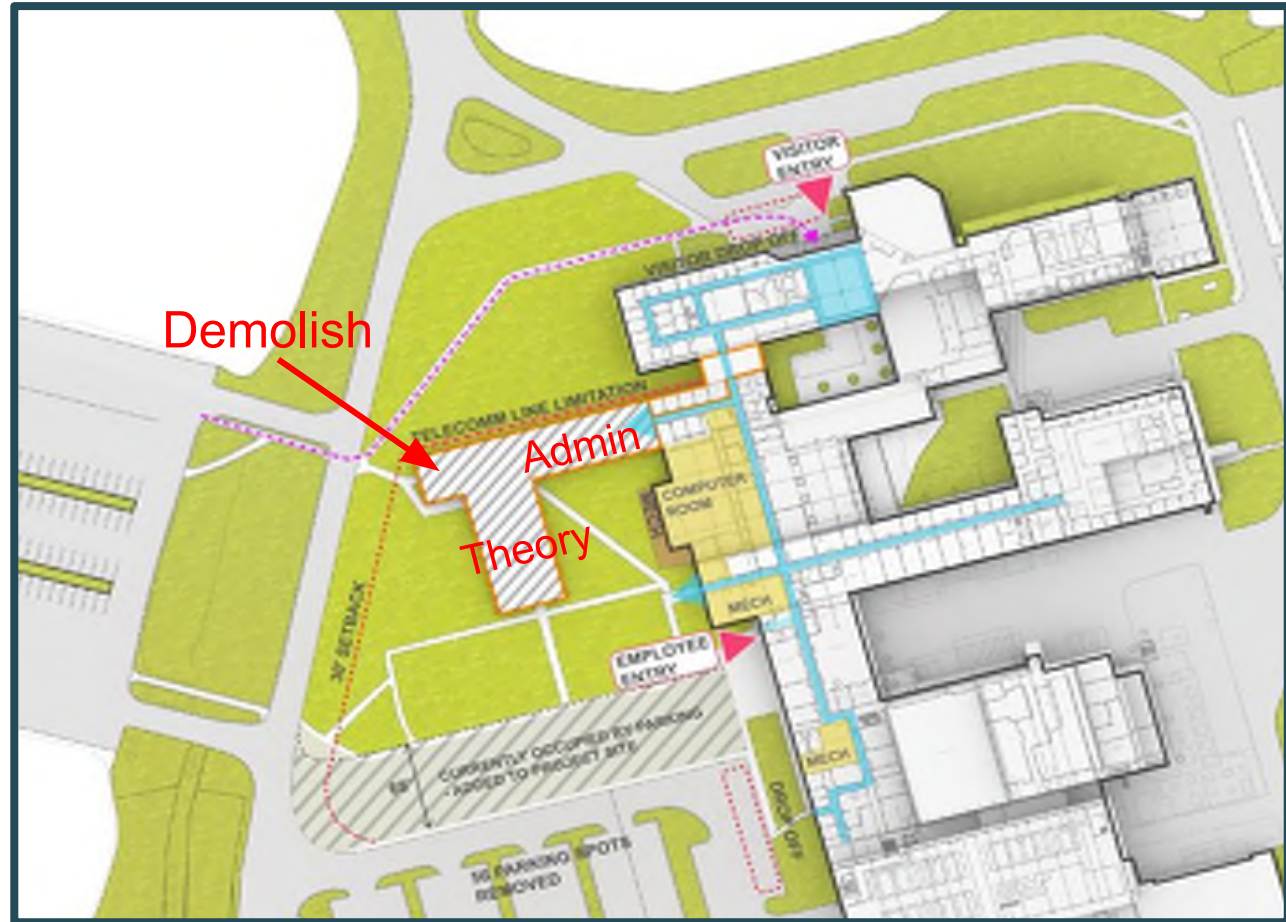
- 71,108 GSF
- Labs: 38,831 GSF
- Collab: 14,380 GSF
- Office: 17,897 GSF



Getting ready

First building since 1984

- Landmark Building at Entrance
- Replaces old single story Admin and Theory buildings
- Preparing Site for Construction
- Ground Break Ceremony - May 7



Program to meet the needs of a growing laboratory



1st floor



2nd floor



3rd floor

- First Floor Cafe
- Science Education
- Mixed Use Office Spaces
- Green Roof Terrace

Research Program

- Microelectronics
- Quantum Diamond
- Advanced Conducting Magnets
- Sustainability Sciences

Flexible design for future growth



- General lab infrastructure systems (RO water, compressed air, lab exhaust) with connections at corridors
- Fume Hoods in select labs with infrastructure for expansion
- Overhead and wall electrical distribution to support future 480V, 208V and DC
- Service Corridors for future equipment (pumps, chillers, transformers, etc) and cylinders
- Minimal Fixed Casework (sink)
- Unistrut grid or raceways
- Safety cabinets, eye washes, etc.

PPIC design for LEED GOLD



- **PPIC FEATURES PHOTOVOLTAIC (PV) PANEL READY INFRASTRUCTURE**

- Design alternates include PV panels at the office and lab wing roof. Decision points on bid day, during construction, or in a future project.
- PV's would provide a 30% energy offset moving towards a fully netzero building with additional future PV efforts.



- **PPIC FEATURES GEOTHERMAL WELLS DAY 1 READY FOR FUTURE EXPANSION**

- Base scope includes 70 wells for a fully electrified building (no emissions) in line with the executive order.
- AFFECT funded design alternate is included to add 30-50 wells early on in the project.
- This provides the ability to further increase performance and move towards a fully netzero building with PV panels noted above.

StormWater Management

- Best practices in design
 - Bioswales
 - Rain gardens
 - Subsurface storage
 - Water quality
- PPIC is an example of stewardship for sustainability and stormwater management



Ready to Go!

- Enabling work starting late June
 - demolition of old buildings
 - drilling of Geothermal wells
- PPIC Building construction
 - Early 2025 - Mid 2027
- Occupancy
 - Mid 2027
- Blue Ribbon AE firm SmithGroup



Thank You!!

