The U.S. Department of Energy’s Princeton Plasma Physics Laboratory (PPPL) is applying its expertise in plasma and computational science to drive the next wave of scientific innovation to maintain U.S. leadership in critical industries.

**Microelectronics**

PPPL works shoulder-to-shoulder with the semiconductor industry to develop optimal ways to fabricate next-generation computer chips.

The Lab’s expertise in low-temperature plasmas, which are used in nearly half of all steps in fabricating computer chips, is helping transform what has been a black-box, Edisonian approach into one based on scientific understanding and engineering control.

*We partner with ...*

- Lam Research Corp., a U.S.-based international supplier of chip manufacturing equipment
- Samsung, the world's largest chip maker
- Applied Materials Corp., a leading equipment supplier

**Quantum Materials & Devices**

The Lab is becoming a leading research facility for the growth of quantum materials. PPPL scientists are exploring the use of diamond-based materials to create alternatives to silicon in the fabrication of microchips. This could enable a wholly new type of chip relying on quantum bits, or “qubits,” to replace standard bits used in silicon-based computers.

A key goal of PPPL is to enhance qubit production with plasma to advance quantum device fabrication for computing, sensing and networking. The Lab recently installed four low-temperature plasma reactors to grow quantum diamond and accelerate this research. Currently, the only way to grow quantum grade diamond (of the quality required) is with plasma.
We partner with …

- Princeton University
- Element Six (E6), a world leader in synthetic diamond

**Sustainability Science**

The Lab is capitalizing on its strengths in plasma and computational sciences to **decarbonize industrial processes** and drive **sustainable manufacturing** technologies forward. New areas of focus include:


**New Initiatives & Funding**

**Energy Earthshot Research Centers**

Funded by the Department of Energy’s Basic Energy Sciences

- Hydrogen Shot™ — “Center for the Science of Plasma-Enhanced Hydrogen Production (PEHPr)” (led by PPPL), **$5 million**
- Industrial Heat Shot™ — “Non-Equilibrium Energy Transfer for Efficient Reactions (NEETER)” (led by Oak Ridge National Lab), **$1 million**

Plus, an additional **$4 million** in funding from the Office of Science, Fusion Energy Sciences and the Office of Energy Efficiency & Renewable Energy to support other research efforts in electromanufacturing.

**Solar radiation management**: Intentionally reflects the sun’s energy back to space to help cool the planet while the world transitions away from fossil fuels. This involves studying the interactions between clouds, light and aerosols. Plasmas are charged turbulent fluids, as in the atmosphere, but with different conditions. PPPL’s expertise in diagnostics and computational science will be key for studying such fluids and understanding these interactions.

We collaborate with …

- Princeton University
- The Geophysical Fluid Dynamics Laboratory
- Simons Foundation