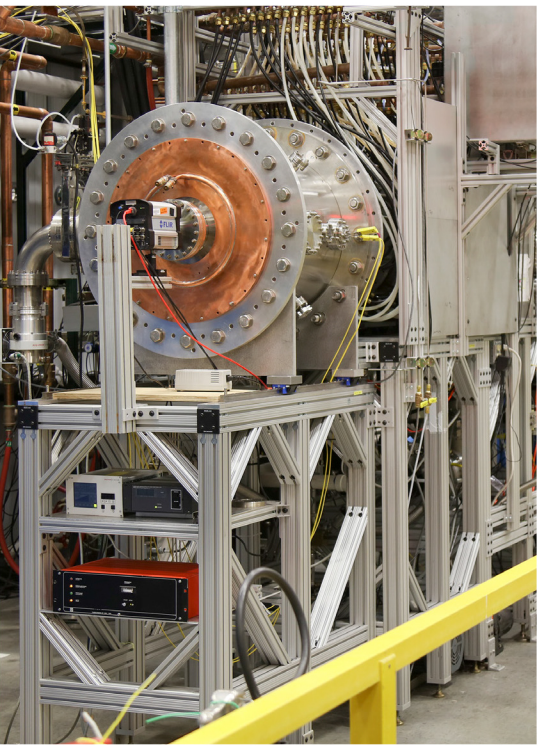
OAK RIDGE NATIONAL LABORATORY

MPEX: Materials Plasma Exposure eXperiment

Oak Ridge National Laboratory's (ORNL's) Materials Plasma Exposure eXperiment (MPEX) is a next-generation linear plasma device that will advance research on the way plasma interactions with materials and components needed for future fusion reactors.



The prototype of the Materials Plasma Exposure eXperiment (Proto–MPEX) explores plasma–material interactions under conditions similar to those on the sun's surface.

Generating fusion energy requires heating subatomic particles to temperatures hotter than the center of the sun and containing them in magnetic fields hundreds of thousands of times stronger than the Earth's. When these particles escape the magnetic field and are incident on surrounding materials, the resulting interactions can change their structure entirely.

Existing linear plasma devices cannot reach the necessary conditions to test and prepare materials for future fusion energy devices. MPEX's versatile design will enable scientists to study the performance of materials from installation through end of life during a two-week exposure in the device. Candidate materials best suited for use in future fusion systems can be quickly identified.

The MPEX project is completing procurement, device assembly is underway, and pre-operations and commissioning activities have started. The critical decision 4 completion date for the project is January 2028.

Up to 10^{21} m^{-3}
Electron density at the target

Up to 10^{31} m^{-2}
Total ion fluence at the target

1 Million Seconds
Steady-state run time

10 MW/m^{-2}
Heat flux produced, similar to what spacecraft experience entering Earth's atmosphere

"MPEX will be a world-leading linear plasma device to test materials suitable for the harsh conditions in a future fusion reactor."

—MPEX Project Director **John Sanseverino**

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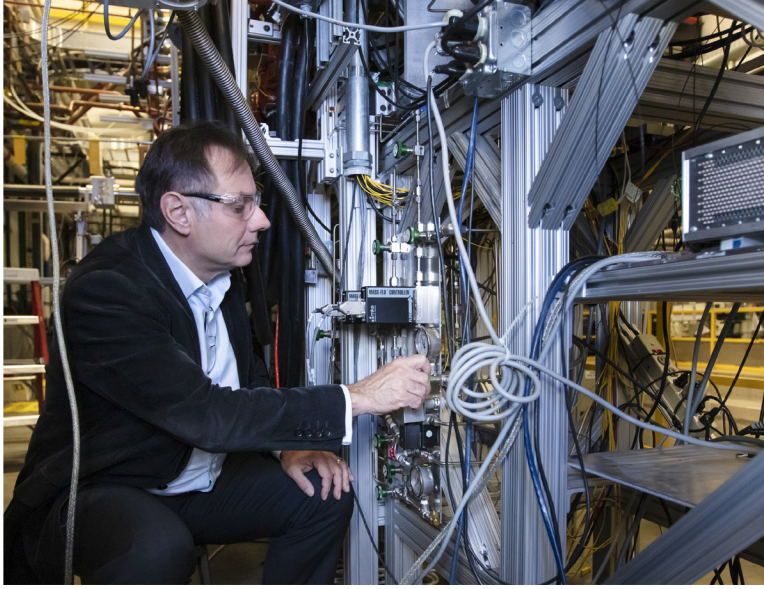
A New Breed of Fusion Materials

MPEX will advance the science of plasma–material interactions, which is essential for a viable path **to abundant and affordable** fusion energy. ORNL brings to this challenge a long history of materials science leadership and the largest US effort in fusion materials.

Currently, no plasma-facing materials and components are qualified for fusion reactors. Such materials will need to be strong enough to withstand the harsh radiation and erosion conditions of steady-state fusion reactors running over a long period of time with high-temperature environments and high ion and neutron fluences.



Proto-MPEX officially completed its research operations in 2021, after almost 7 years of service and delivering multiple first-of-a-kind demonstrations key for MPEX success.

Hot Target

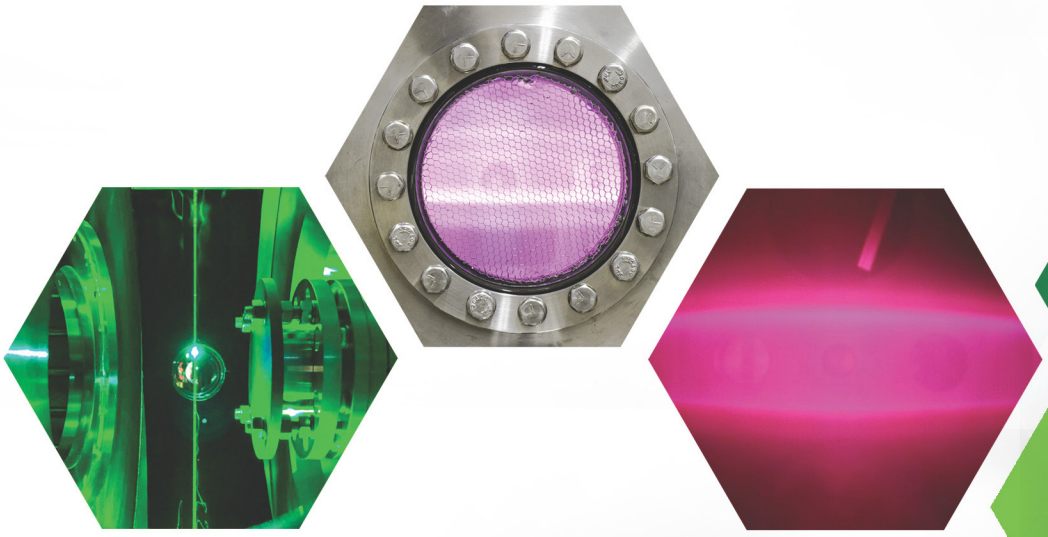
Using MPEX, scientists will strive to advance the science of PMI and the technology of plasma-facing components for fusion reactors. MPEX will also enable researchers to understand how extreme conditions affect the divertor—considered the power and particle exhaust system of a fusion reactor—along its length. To achieve these goals, MPEX is being developed in collaboration with ORNL's capabilities in plasma physics, radio frequency heating, and high heat flux engineering.

Collaboration at Its Finest

As the flagship U.S. Department of Energy Office of Science laboratory, ORNL brings cross-cutting R&D capabilities to bear for the successful completion of MPEX .

ORNL has the largest fusion materials program in the U.S. and access to leading computational facilities along with key expertise in artificial intelligence and machine learning, materials science, advanced manufacturing, robotics, and remote maintenance.

ORNL is positioned to provide a wealth of interdisciplinary capabilities to build and operate MPEX to advance fusion energy R&D for the nation's energy demands.



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