New method to replicate harsh conditions for materials

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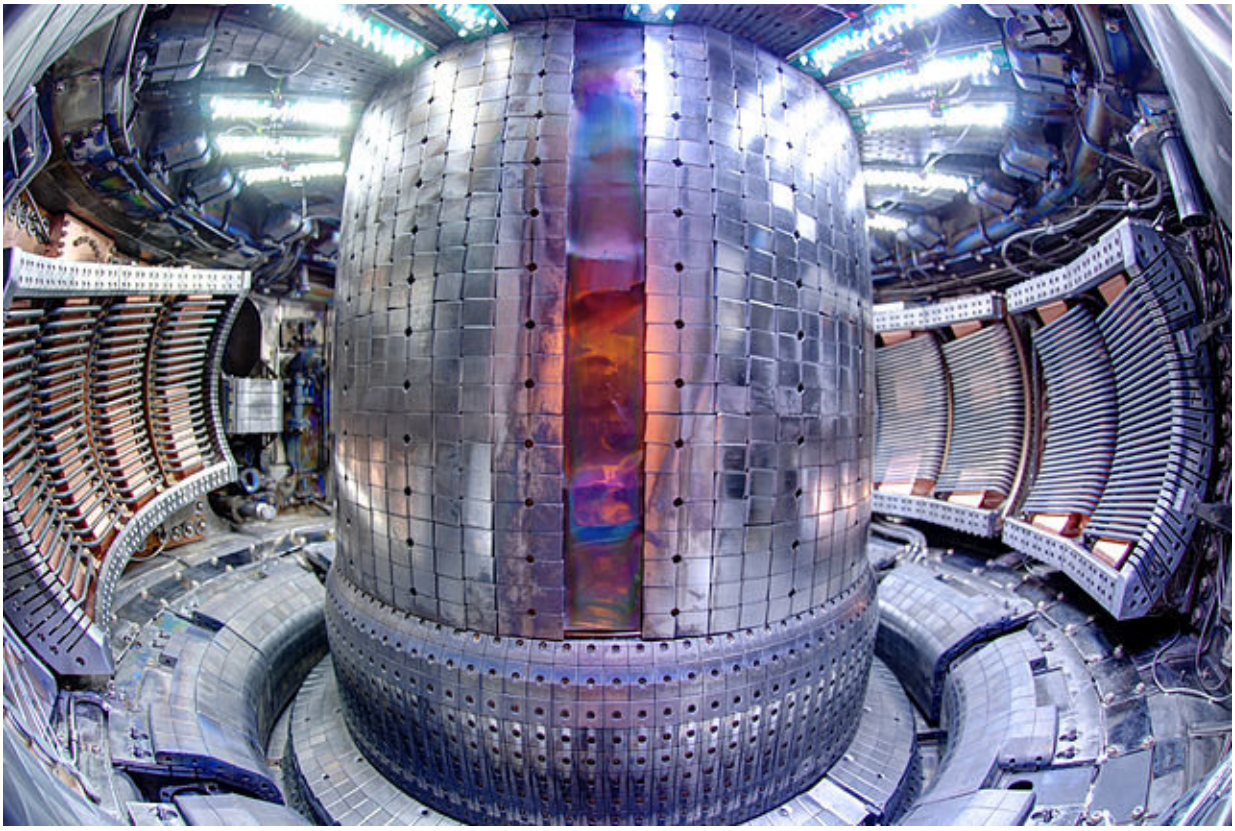

Credit: Chris Bolin, Wikimedia Commons

Confining a plasma jet can be stress-inducing, especially on the shielding materials. Noting the limits inherent in the test methods currently used for such materials, Professor Patrizio Antici and his colleagues have

proposed a groundbreaking new solution: using laser-accelerated particles to stress test materials subject to harsh conditions. Recently published in the journal *Nature Communications*, his method holds promise for a number of applications.

In many domains characterized by exposure to high energy, materials are subjected to intense stress. No matter what the high-energy application—aerospace, nuclear power plants, certain research equipment—the ability of materials to withstand the physical stress imposed on them must be assessed to avoid breakage.

Professor Antici works with state-of-the-art equipment that has to be protected at all costs from premature wear and tear, and he wanted to evaluate the effectiveness of laser-accelerated particles in inducing controlled stress on materials. His method was to focus a particle beam on materials including tungsten, graphite, titanium, tantalum and molybdenum, which are employed in facilities using plasma or for inertial or magnetic confinement fusion.

Currently, several methods are used to simulate wear and tear and measure the strength of these materials, but typically, they provide only a partial picture, require longer protocols and are hard to model. Patrizio Antici's high-energy experiments demonstrate that the laser-generated proton beam can reproduce damage equivalent to several months of full operation of facilities producing a harsh environment for materials. The tests are also much faster since they can be performed with more compact instruments and in a few single laser shots. Compared to conventional methods, his more accurately reproduces the exact operational environment to which materials are subjected.

The innovative method, which reproduces mechanical, electrical, and optical stress on five materials, can be used to improve facilities that experience conditions warranting increased protection.

More information: M. Barberio et al, Laser-accelerated particle beams for stress testing of materials, *Nature Communications* (2018). DOI: 10.1038/s41467-017-02675-x