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Plasma Acting Up? Try a Little Lithium

Lithium powder can calm damaging heat bursts in fusion reactors.

MILWAUKEE, Wis.—Lithium, a soft metal known as a source of medicine for a host of human conditions and for its use in rechargeable batteries, can help calm unruly plasma in fusion devices as well. So found an international collaboration led by physicist Rajesh Maingi at the Princeton Plasma Physics Laboratory (PPPL). The scientists have shown that intense bursts of heat in plasma, which can shut down a fusion reaction, can be avoided by adding a little bit of the powdered form of the element.

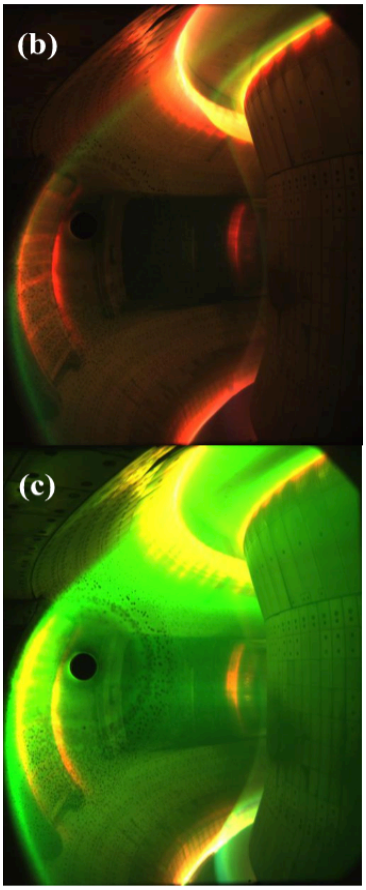

Figure 1: The red color in the top image (b) comes primarily from deuterium that has been allowed to recycle without the use of lithium, while the image below (c) is largely free from recycling as a result of lithium.

When applied in fusion devices called tokamaks, lithium helps avoid plasma outbursts called "Edge-Localized Modes" (ELMs) that could potentially damage the surrounding walls of the reactor. Lithium also helps keep the plasma hot, with temperatures exceeding 100 million degrees needed to realize this clean and virtually limitless source of energy. The work, done on the Experimental Advanced Superconducting Tokamak (EAST) in China, deployed lithium in three different ways inside the powerful machine, with all three showing excellent progress.

The researchers, from PPPL and seven different U.S. institutions, sprinkled a powder of the silvery metal into the EAST fusion device, shot in larger lithium granules, and held a sheet of molten lithium up against the edge of EAST plasmas. When sprinkled as a powder, lithium prevented ELMs entirely. When injected in larger granules, the element gave researchers fine control over how often the ELMs occurred.

Researchers went on to observe improved phases of energy confinement when using the flowing liquid lithium system. The molten substance reduced the amount of deuterium—the main plasma fuel—at the edge of the plasma that bounced back and cooled the core of

the plasma, a process that can halt fusion reactions. Fast-camera images showed potentially damaging deuterium recycling without lithium, compared with lithium in place (Figure 1). These results took a strong step toward optimizing plasma confinement in the long-pulse tokamak, which aims to ultimately produce high-performance plasma for up to 1,000 seconds.

Hosting these experiments was the Institute for Plasma Physics, Chinese Academy of Science (ASIPP), with strong collaboration between the U.S. participants and Chinese colleagues. Principal ASIPP contact is Prof. Jiansheng Hu, head of the EAST wall-conditioning group.

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Abstract

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Session
First results from the US-PRC PMI collaboration on EAST
Poster Session VIII: Non-Neutral, Antimatter and Strongly Coupled Plasmas; Waves; Conventional and Spherical Tokamaks; Magneto-Inertial Fusion
Thursday, October 26, 2017
Room: Exhibit Hall D