# Taming plasmas: Improving fusion using microwaves

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We all know microwaves are good for cooking popcorn, but scientists have recently shown they can also prevent dangerous waves in plasmas and help produce clean, nearly limitless energy with fusion. Fusion takes place when fast moving atomic particles slam into each other and stick together. The particles need to be so hot that atoms break down, leaving a gas of charged particles called a plasma. The energy given off when plasma particles fuse can be harnessed to make electricity.

To harness fusion energy, the fast particles can be confined by a strong magnetic field, which guides the particles along a closed path. If the particles get knocked off their closed path, they make fusion less efficient and can even damage the fusion device. Scientists, therefore, are looking for ways to prevent the energetic particles from veering off course.

One way a particle can be kicked out of the fusion device is by interacting with waves. Just as a boat in a lake can be jostled by waves passing by, a particle in a plasma can get a boost of energy from waves moving along the magnetic field used to confine the plasma. In the work here, the waves are called Alfvén waves named after the Nobel Prize winner Hannes Alfvén who discovered them. Such waves are problematic for future tokamak fusion reactors because they make it more challenging to keep the plasma hot and undergoing fusion.

"Controlling these waves helps us hold onto the fast particles that heat fusion plasmas," said Dr. Michael Van Zeeland from General Atomics,

who led the research. The international team that carried out this research was composed of more than 30 scientists from across the globe who worked together to develop an approach to keep the waves in check.

The research, which was conducted at the DIII-D National Fusion Facility in San Diego, California, and the ASDEX-Upgrade facility in Germany, will be presented at the American Physical Society Division of Plasma Physics meeting in Portland, Oregon. The scientists used a specific kind of microwaves, electron cyclotron waves, which they precisely directed near the location of the waves on the magnetic field. The microwaves were found to modify the wave activity significantly-in some cases completely removing them.

This research yielded insight into these particular microwaves and how they interact with waves on the magnetic fields. The researchers believe the results can lead to the development of approaches to control or reduce the presence of waves on the magnetic fields and could help chart a path to more efficient fusion energy.

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