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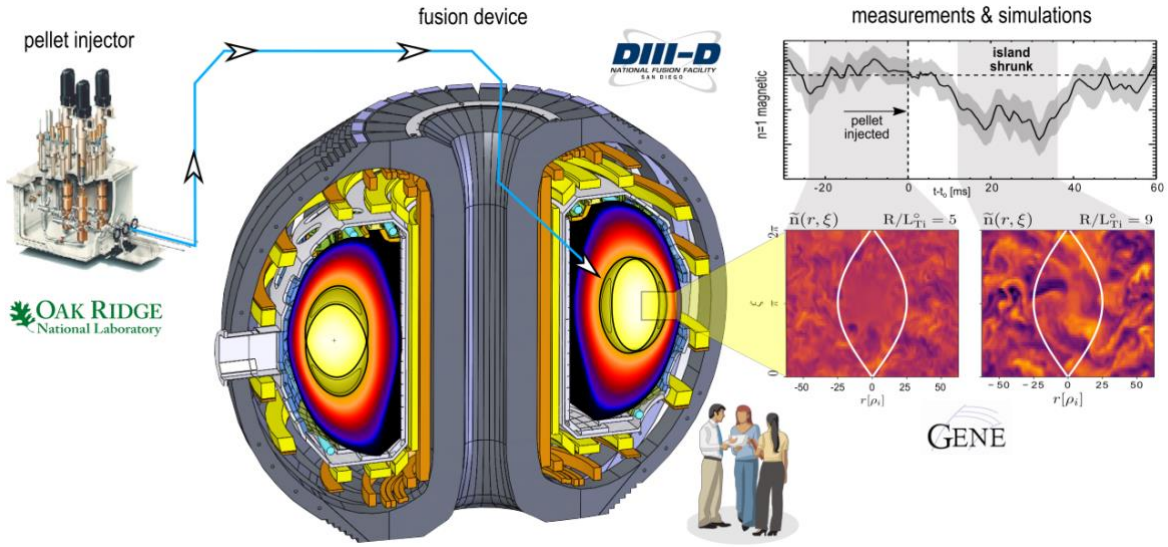
# Island Retreat: Pellets Help Remove Magnetic Island Instabilities

Injecting pellets helps repair tears in the magnetic field of fusion plasmas, improving prospects for fusion energy.




*By shooting pellets of frozen hydrogen, scientists at the DIII-D National Fusion Facility in San Diego have been able to control instabilities in the magnetic field that holds the fusion plasma together. The graphs at right illustrate the measured shrinking of the magnetic island magnitude and simulations of turbulence inside the island before and after a pellet injection. Composite image by the author; graphics courtesy General Atomics and Oak Ridge National Laboratory.*

## The Science

"Magnetic islands" are unstable structures in a fusion tokamak's magnetic fields that release energy from the plasma and stop the fusion reaction. Researchers at the DIII-D National Fusion Facility in San Diego discovered that firing frozen pellets of deuterium deep into the plasma causes magnetic islands to shrink. Simulations suggest that the pellets cause turbulence which changes the current distribution in the island that drives its size.

## The Impact

In a fusion reactor, these islands have to be stabilized by using microwave beams. Calculations show that the shrunken islands can be completely eliminated with far less microwave power than would otherwise be needed. This makes the fusion process more efficient and reduces risk of instability.

## Summary

Fusion tokamaks operate by confining a plasma within powerful magnetic fields long enough that it can be heated to the extreme temperatures where fusion reactions can occur. Instabilities in the magnetic

fields can allow energy to escape, stopping the reaction. One such instability is a phenomenon known as a magnetic island, which is a structure that tears holes in the magnetic field. In some cases, islands can be eliminated by driving a localized current inside them with microwave beams, but this requires a significant amount of energy. Researchers at DIII-D observed that firing frozen pellets of deuterium deep into the plasma caused magnetic islands to shrink. Computer simulations determined that the shrinkage was likely caused by increased turbulence in the plasma due to the injected pellets. The shrunken islands can then be completely eliminated with 70% less microwave power than what is normally required. Saving these resources could improve the net electricity output of a reactor. Thus, the approach may offer substantial benefits for future fusion reactors.

## Contact

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## Publications

Bardoczi et al., 2019, *Nucl. Fusion*, Controlled NTM Healing via Fueling Pellets and its Impact on ECCD Requirements for Complete NTM Stabilization, https://doi.org/10.1088/1741-4326/ab472d.