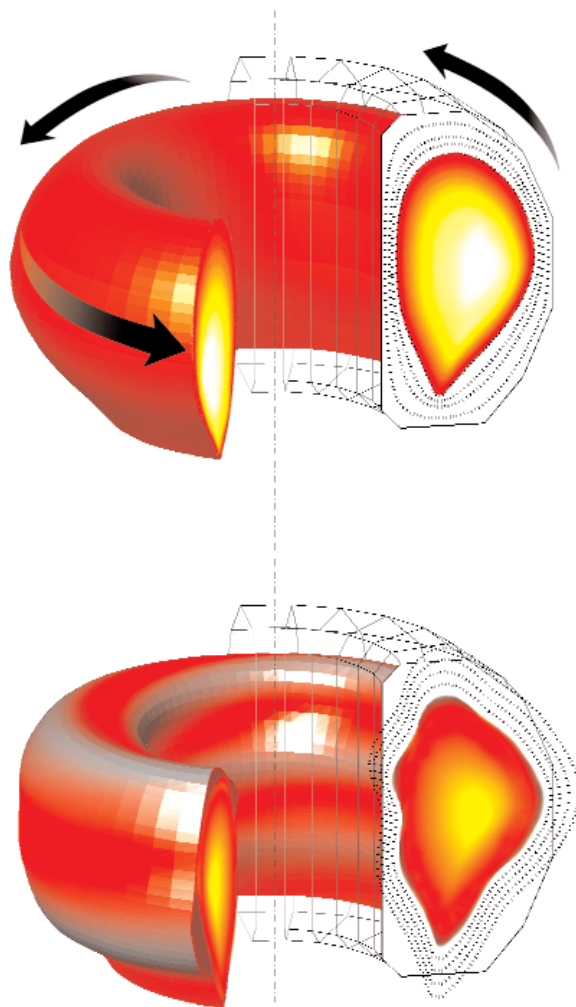


## ***Spinning Plasma Improves Prospects For Fusion Energy***

Stable operation at high pressure is crucial for a fusion plasma, because the power released from fusion reactions increases rapidly with the pressure. Unfortunately, as plasma pressure increases, the plasma itself can cause deformations of the magnetic field configuration, which very rapidly destroy the plasma confinement. A long-standing theoretical prediction has been that a perfectly conducting wall surrounding the plasma can improve its stability. It was also believed that when the plasma spins rapidly, an ordinary metallic wall should have the same stabilizing properties of a perfectly conducting wall. However, in the initial experiments on DIII-D that sought to raise the plasma pressure while spinning the plasma, the spin rate would always slow down and the plasma would become unstable.

Recent experiments at DIII-D by a collaborative team of scientists from General Atomics, Columbia University and Princeton Plasma Physics Laboratory have made use of new systems for controlling the plasma to improve stability in two ways. The control system itself detects and opposes deformations of the plasma in much the same way that a superconducting wall would. The control system also automatically corrects small irregularities in the magnetic field, which would otherwise tend to have a “braking” effect on the rotation of the plasma.

With the new control system, the plasma’s duration above the conventional pressure limit was extended, and in some cases with rapid rotation the pressure was increased stably up to levels almost twice as high as the conventional limit. The implications of this work are potentially important for the development of steady-state advanced tokamaks and may allow these devices to operate stably well above the conventional pressure limit if plasma rotation can be maintained.



*When stable, the plasma in the DIII-D tokamak has a tear-drop shaped cross-section as shown in the upper cut-away figure. When unstable, the plasma surface distorts as shown in the lower figure (exaggerated about 10 times). Control magnet coils (not shown) act to oppose these distortions, keeping the surface smooth, which allows the plasma to continue spinning rapidly (in the direction of the arrow) and to remain stable to higher pressure.*