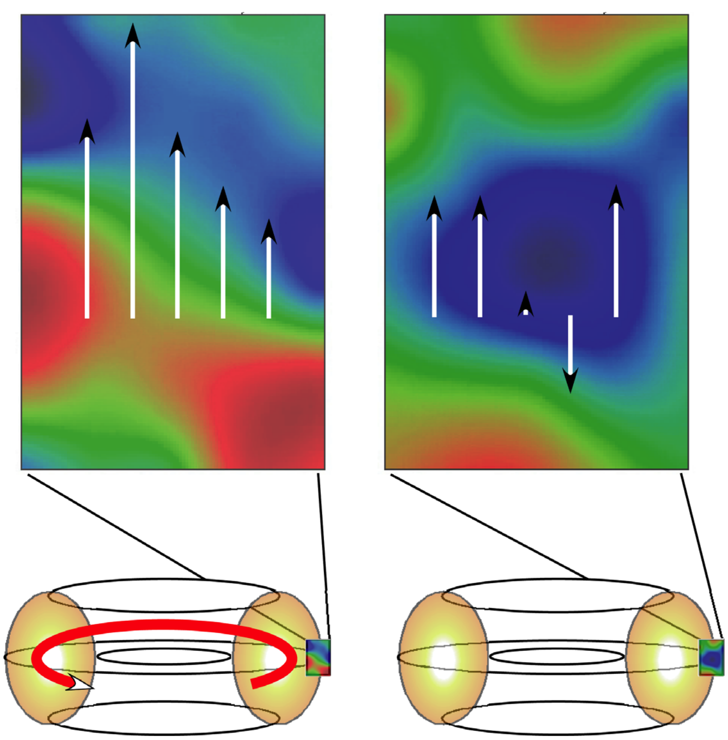
# Reversing Plasma Spin Leads to Higher Performance

*New turbulence imaging measurements show that applying the brakes to plasma rotation allows for easier access to an improved performance state*

Magnetically confined plasmas can undergo a well-known transition to an improved performance state, the so-called High Confinement Mode (or H-mode). Arriving at the H-mode state is readily achieved in most modern fusion experiments, but entering this improved performance state may be more difficult in future large experiments such as ITER because the required trigger power increases strongly with physical size and magnetic field strength. Researchers have long known that this transition can be triggered simply by increasing the energy flow through the boundary of such a plasma sufficiently that turbulent eddies at the edge are sheared apart by the rotation of the plasma.

Recently, researchers at the DIII-D National Fusion Facility have discovered that the energy flow required for entering the H-mode state can be dramatically altered through control of the applied torque on the plasma. In fact, it is found that reducing the torque to near zero or even to a negative value, compared to the direction of the plasma current, can significantly reduce this transition power, thereby easing access to the enhanced performance state. This discovery is welcome news for ITER and future fusion reactors, which are expected to rotate more slowly due to their large size.

The reason for the improved performance appears to reside in the dynamics of plasma turbulence in the edge and boundary region of the plasma. An advanced turbulence imaging system, developed at the University of Wisconsin-Madison, has revealed that the edge turbulence and turbulent flows change dramatically in response to overall plasma rotation. More importantly, they change in a beneficial way such that at slower rotation, or even "counter" rotation, edge turbulence exhibits a natural shearing condition that tends to tear apart turbulent eddies, and thereby facilitates the transition to the H-mode state. The complex interactions of plasma turbulence, electric fields, flows, and flow shears are proving to be crucial to understanding present experiments, and predicting the performance of future fusion systems. For details of the scientific presentation, please see: http://meetings.aps.org/Meeting/DPP07/Event/71447.



A rapidly spinning plasma, shown on left exhibits a much different turbulence flow pattern, indicated by white arrows, than the slowly rotating plasma on right. The arrows are superimposed on images of turbulence eddies measured with Beam Emission Spectroscopy. Movies of this turbulence can be viewed at: http://fusion.gat.com/DIII-D/images/6/6d/BES_2shots_edge.mov

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