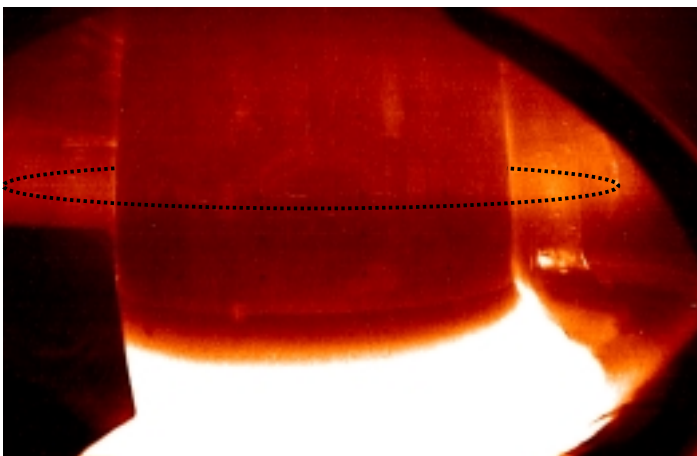


Multiple Frequency Waves Used to Create and Maintain Internal Transport Barrier Plasmas on the Alcator C-Mod Tokamak

Significant progress has been made in the understanding and control of radio frequency-wave-triggered internal transport barrier modes at the Alcator C-Mod National Tokamak Facility, located at the MIT Plasma Science and Fusion Center. By the application of strong radio-frequency waves that resonate with the circular motion of ions in the doughnut-shaped magnetic field of the tokamak, the plasma can be efficiently heated. In an exciting discovery made more than 1 year ago, researchers on the C-Mod facility learned that by matching the waves to a frequency that heats ions away from the hottest core region of the plasma, it was possible to reproducibly trigger a spontaneous transition into a greatly improved particle and energy confinement regime, near the center of the plasma, which results in a doubling of the central plasma density. In subsequent studies, the team discovered that this *Internal Transport Barrier* (ITB) could be

controlled, by combining the off-axis heating with additional power applied to heat the plasma at the very center. In this way, the central pressures are also strongly increased, but perhaps even more importantly, the ITB plasmas have been maintained in quasi-steady-state for as long as 6 energy confinement times, being limited only by the time for which the RF heating was applied. This new approach of controlling internal barriers could prove to be extremely important, as it is potentially attractive for reactor applications. In another remarkable set of experiments, the ITB formation was stimulated by heating alternately on the high magnetic field and low magnetic field sides of the plasma center. This latter result has important implications for theoretical models that might explain the phenomenon, and should lead to further fruitful collaboration with theoreticians who are examining these questions. For more information, contact John Rice, MIT, rice@psfc.mit.edu.



Television Image of an Alcator C-Mod Plasma with an Internal Transport Barrier. This false color image, taken in visible light, shows a toroidal band of enhanced emission near the central region of the plasma, indicating the volume of highest density hot plasma.