

## **Spontaneous Rotation in Plasmas with No Momentum Input (BI1.003)**

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Plasmas in the Alcator C-Mod tokamak are observed to rotate spontaneously with velocities as high as 100 km/s in spite of the fact that there is no external momentum input.

Rotation plays an important role in improving energy confinement in tokamak plasmas. A tokamak (toroidally-shaped plasma confinement system) is the likely configuration for the first prototype fusion reactor. It is also *unlikely* that in the prototype reactor, conventional methods of external momentum input will be available. Plasmas in the Alcator C-Mod tokamak (operated by the Plasma Science and Fusion Center at the Massachusetts Institute of Technology) are observed to rotate spontaneously with velocities as high as 100 km/s in spite of the fact that there is no external momentum input. Rotation velocities have been determined from the Doppler shifts of x-ray line emission measured with high wavelength resolution x-ray spectrometers. The spontaneous rotation is observed to begin at the edge of the plasma and then propagate in to the center, covering this 20 centimeter distance in 1/10th of a second. (see Figure 1) The rotation is in the same direction as the plasma current, and reverses direction when the plasma current direction is reversed. The rotation seems to be a beneficial attribute as the fastest rotating plasmas have the best energy confinement properties. The mechanism which generates the spontaneous rotation and propagates it to the plasma center is not currently understood. However, this bodes favorably for future reactor plasmas in which rotation is desired, and in which there probably will not be external momentum sources.

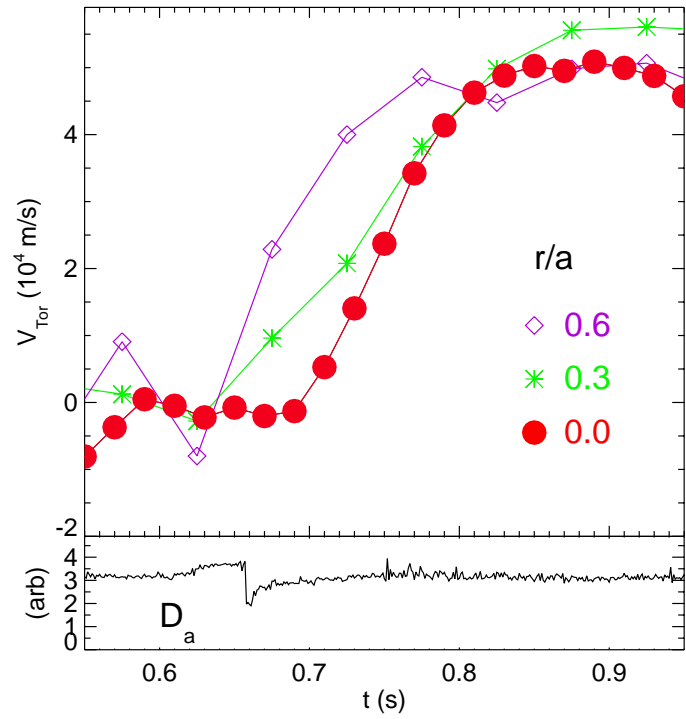


Figure 1: The time evolution of the toroidal rotation velocity at three spatial locations. The transition to the high energy confinement operational regime occurred at 0.657 s (as seen in the drop of the signal in the bottom frame). Immediately following this transition, the rotation began to rise at a radius corresponding to 60% of the machine size (purple diamonds), followed at 30% (green asterisks) and finally appeared at the plasma center (red dots).