OBSERVATION OF NEUTRON AND X-RAY SAWTEETH IN ALCATOR

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ABSTRACT

Sawtooth oscillations in the thermonuclear neutron production rate have been observed in Alcator. They are correlated with oscillations in soft x-ray emission from the plasma and indicate large (>15%) oscillations of central ion temperature.

Soft x-ray emission from the Alcator plasma has been observed using a multi-diode imaging apparatus built by Petrasso et al [1]. The x-ray flux exhibits the characteristic sawtooth behavior first noted by Von Goeler [2]. In addition, similar fluctuations have now been seen in the emission of D-D fusion neutrons (Figure 1). The strong temporal correlation between these two diagnostic signals indicates that similar processes affect both the electron and ion temperatures during the internal disruption. This would follow if present theories of the disruption process are correct [3, 4].

The rapid growth of magnetic islands from the q=1 surface and reconnection of magnetic field lines is a process which should affect both the electron and ion radial temperature profiles. We have developed a quantitative picture by fitting temperature profiles to the experimental data and studying the effects of the disruptions on the calculated x-ray and neutron emission.

Prior to the internal disruption, the temperature profiles are approximated by Gaussian functions [5]. The peak electron temperature is determined by matching the measured x-ray flux with that calculated using a computer code developed here [6]. The code takes into account the specialized geometry of the detectors and aperture, the transmission effects