Disruption Studies on Alcator C-Mod

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Abstract: This lecture will focus on three different disruption-related research topics that we've studied on Alcator C-Mod over the past two years:

(1) synchrotron emission at B = 2.7, 5.4, and 8 tesla
The extremely large loop voltages generated during disruptions can accelerate significant fractions of electrons to relativistic energies, with the potential to severely damage the first wall. We have studied the spectra and spatial images of synchrotron emission from these runaway electrons in C-Mod to learn about their maximum energies, radiation losses, and spatial distributions.

(2) high-resolution halo current measurements
Halo currents generated during the disruption current quench can generate large electromagnetic forces on parts of the first wall. We have found that an optimised set of Langmuir 'rail' probes embedded in the C-Mod divertor can provide information about the halo current spatial distribution with unprecedented poloidal resolution, as well as directly measure the resistance of the scrape-off layer region where halo currents are driven.

(3) large databases for developing disruption warning algorithms
In order to effectively employ a disruption mitigation system, a robust ability to recognise upcoming disruptions with sufficient warning time is required. Toward this goal, we have developed databases from thousands of discharges on C-Mod, DIII-D, and EAST, containing disruption-relevant signals vs time for both disruptive and non-disruptive plasmas. These databases are being used to develop and test a number of machine learning algorithms for disruption prediction.