Analysis of shot-to-shot variability in post-disruption runaway electron currents for diverted DIII-D discharges

V.A. Izzo[1], D.A. Humphreys[2] and M. Kornbluth[3]

[1]*University of California-San Diego, La Jolla, California*

[2]*General Atomics, P.O. Box 85608 San Diego, California 92186-5608 USA*

[3]*Yeshiva University, New York, New York*

ABSTRACT

In DIII-D experiments, rapid termination by Ar pellet injection sometimes produces a post-termination runaway electron (RE) current plateau, but this effect is highly non-reproducible on a shot-to-shot basis, particularly for diverted target plasmas. A set of DIII-D discharges is analyzed with two MHD codes to understand the relationship between the current profile of the target plasma and the amplitude of the RE current plateau. Using the linear stability code GATO, a correlation between the radial profile of the unstable n=1 mode just after Ar pellet injection and the observed appearance of an RE plateau is identified. Nonlinear NIMROD simulations with RE test-particle calculations directly predict RE confinement times during the disruption. With one exception, NIMROD predicts better RE confinement for shots in which higher RE currents were observed in DIII-D. But, the variation in confinement is primarily connected to the saturated n=1 mode amplitude and not its radial profile. Still, both sets of analyses support the hypothesis that RE deconfinement by MHD fluctuations is a major factor in the shot-to-shot variability of RE plateaus, though additional factors such as seed current amplitude can not be ruled out.

This work supported in part by the U.S. Department of Energy under DE-FG02-05ER54809, DE-FG02-95ER54309 and DE-FC02-04ER54698. This research used resources of the National Energy Research Scientific Computing Center, which is supported by the Office of Science of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.