

APS/DPP 2005

Gas Jet Disruption Mitigation in Alcator C-Mod

Experiments with gas jet injection prove effective at reducing effects of disruptions.

Tokamak plasmas are subject to disruptions, which are rapid, undesirable terminations of the plasma discharge. Disruptions can suddenly release large amounts of energy and generate large electromagnetic forces that can damage the tokamak. Disruptions are a major concern for high-field, high-energy density devices such as Alcator C-Mod, ITER, and future tokamak reactors. Reliable mitigation of these effects using benign techniques would be a key improvement in tokamak operation.

High-velocity noble gas jet injection on other tokamaks[1] has shown promise of reducing the deleterious effects of disruptions. These experiments are now being carried out on the Alcator C-Mod tokamak, which has ITER-relevant plasma pressures, energy densities, and magnetic fields. Initial experiments using several different noble gases have shown that halo currents (a major contributor to electromagnetic forces) can be cut in half (Fig 1), and much of the plasma energy can be rapidly converted to light, thus reducing high thermal deposition on divertor surfaces (Fig 2). The use of noble gases is found to be quite benign as far as subsequent discharges are concerned. In addition, a battery of detailed measurements and calculations are revealing the mechanisms by which gas jets penetrate into high performance fusion plasmas.

Please see invited paper LI1b.00001, "Gas Jet Disruption Mitigation Studies on Alcator C-Mod"

Contacts:

Robert Granetz <granetz@mit.edu>

Dennis Whyte <whyte@engr.wisc.edu>

References

[1] D.G. Whyte, et al Phys. Rev. Lett. 89 (2002) 055001.

Fig. 1 - Argon gas jets reduce disruption-generated halo currents by 50% compared to unmitigated disruptions. Neon and helium gas jets have also been tested. Halo current reduction is found to be less effective as the atomic number is reduced.

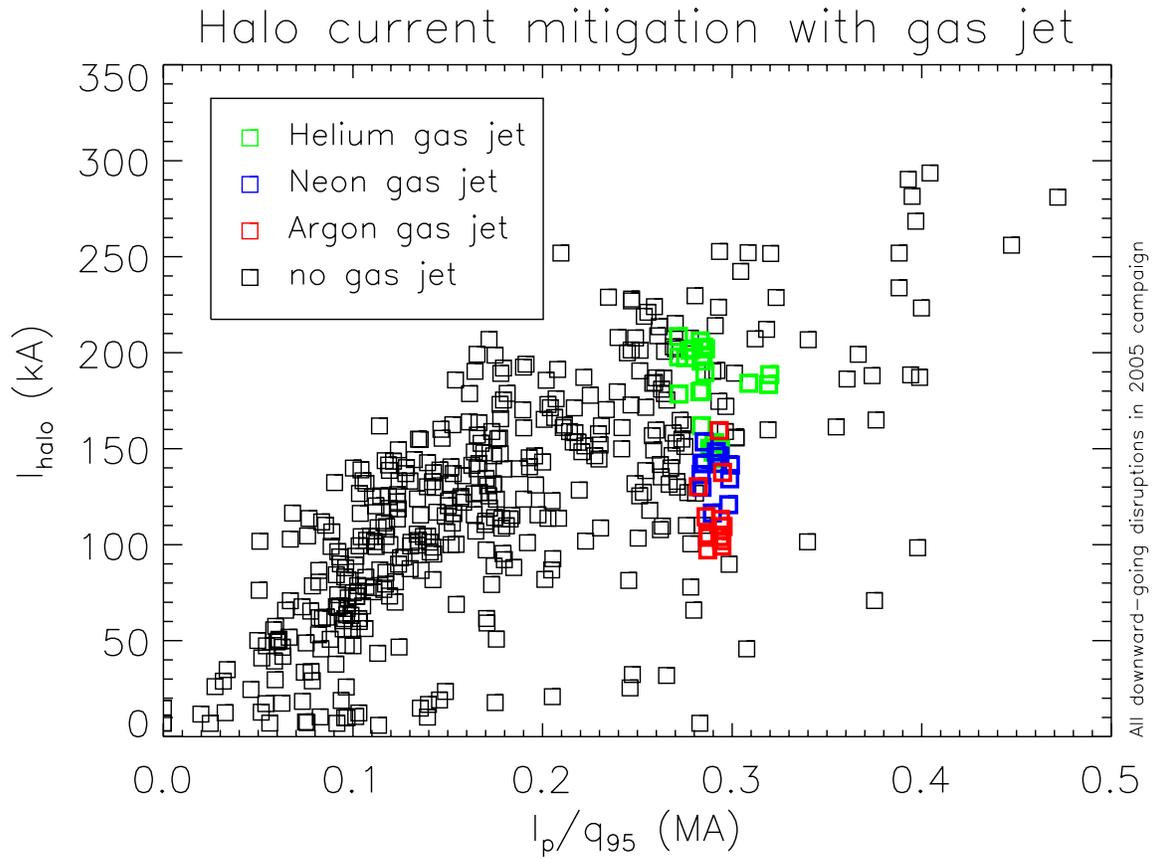


Fig. 2 - Infrared image of the C-Mod divertor region shortly after a disruption. These images are used to measure the thermal energy deposited on internal surfaces of the tokamak.

