Feedback control of the safety factor profile evolution during formation of an advanced tokamak discharge

J.R. Ferron,[a] P. Gohil,[a] C.M. Greenfield,[a] J. Lohr,[a] T.C. Luce,[a] M.A. Makowski,[b] D. Mazon,[c] M. Murakami,[d] C.C. Petty,[a] P.A. Politzer,[a] and M.R. Wade[a]

[a] General Atomics, P.O. Box 85608, San Diego, California 92186-5608, USA
[b] Lawrence Livermore National Laboratory, Livermore, California, USA
[c] Association Euratom-CEA, CEA-Cadarache, St Paul lez Durance, France
[d] Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA

E-mail: ferron@fusion.gat.com

Abstract. Active feedback control for regulation of the safety factor (q) profile at the start of the high stored energy phase of an advanced tokamak discharge has been demonstrated in the DIII-D tokamak. The time evolution of the on-axis and minimum values of q is controlled during and just following the period of ramp-up of the plasma current using electron heating to modify the rate of relaxation of the current profile. In L-mode and H-mode discharges, feedback control of q is effective with the appropriate choice of either off-axis electron cyclotron heating or neutral beam heating as the actuator. The q profile is calculated in real time from a complete equilibrium reconstruction fitted to external magnetic field and flux measurements and internal poloidal field measurements from the motional Stark effect diagnostic.