# The radial electric field as a measure for field penetration of resonant magnetic perturbations

**S. Mordijck**

Dept of Computer Science, College of William and Mary, PO Box 8795, Williamsburg, VA 23187-8795, USA

E-mail: mordijck@cs.wm.edu

**R.A. Moyer**

Center for Energy Research, University of California San Diego, 9500 Gilman Dr., La Jolla, CA 92093-0417, USA

**N.M. Ferraro, M.R. Wade, and T.H. Osborne**

General Atomics, PO Box 85608, San Diego, CA 92186-5608, USA

**Abstract.** In this paper we introduce a new indirect method for identifying the radial extent of the stochastic layer due to applying resonant magnetic perturbations (RMPs) in H-mode plasmas by measuring the spin-up of the plasma near the separatrix. This spin-up is a predicted consequence of enhanced loss of electrons due to magnetic stochastization [E. Kaveeva, et al., Nucl. Fusion **48**, 075003 (2008)]. We find that in DIII-D H-mode plasmas with $n = 3$ RMPs applied for edge localized mode (ELM) suppression, the stochastic layer is limited to the outer 5% region in normalized magnetic flux, $\Psi_N$. This is in contrast to vacuum modeling predictions where this layer can penetrate up to 20% in $\Psi_N$. Theoretical predictions of a stochastic red radial electric field, $E_r$ component exceed the experimental measurements by about a factor 3 close to the separatrix, suggesting that the outer region of the plasma is weakly stochastic. Linear response calculations with M3D-C1, a resistive two-fluid model, show that in this outer 5% region, plasma response often reduces the resonant magnetic field components by 67% or more in comparison with vacuum calculations. These results for DIII-D are in reasonable agreement with results from the MAST tokamak, where the magnetic field perturbation from vacuum field calculations needed to be reduced by 75% for agreement with experimental measurements of the x-point lobe structures [16].

PACS numbers: 52.55.Fa, 52.35.Ra, 52.25.Fi