RADIAL TRANSPORT EFFECTS ON ECCD IN THE TCV AND DIII–D TOKAMAKS*

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Electron cyclotron current drive experiments in the DIII–D and TCV tokamaks provide excellent data sets for evaluating radial transport effects on the driven current, using the CQL3D Fokker-Planck code. Plasma parameters and EC powers are similar in the two machines, except that TCV dimensions are such that it has 1/15 the volume of DIII–D. Thus DIII–D is in a lower power density regime and TCV in a very high power regime. Neglecting radial transport, ECCD efficiencies calculated with CQL3D have been well benchmarked by DIII–D experiments.[1] Quasilinear effects and synergy between the EC current drive (CD) and toroidal electric field are significant. Radial transport at levels consistent with the ITER L–mode confinement scaling can double the radial width of the ECCD, important for neoclassical tearing mode stabilization, but they do not substantially change the CD efficiency.

For the high power density TCV ECCD experiment, both the quasilinear formation of nonthermal distributions and the transport effects are dramatic: for a particular shot,[2] a radial diffusion coefficient consistent with L–mode thermal energy transport levels reduces the quasilinear calculated CD from 560 kA to the experimentally observed ECCD 100 kA. The diffusion coefficient is constant in velocity space, consistent with electrostatic turbulence as the governing mechanism. Use of a diffusion coefficient proportional to the parallel speed gives only 25 kA. Thus, this data provides incontrovertible evidence that radial transport of tail electrons and current occurs at the same rate as observed energy transport. Evidently electrostatic-type diffusion dominates in this case.

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[1] C.C. Petty et al., Proc. of 14th Top. Conf. on RF Power in Plasmas, Oxnard, AIP Conf. Proc. 595, (2001) 275.
[2] O. Sauter et al., Phys. Rev. Lett. **84**, (2000) 3322.