Advanced techniques for neoclassical tearing mode control in DIII-D

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Abstract

Two techniques were developed at DIII-D [J. L. Luxon, Nucl. Fusion **42**, 64 (2002)] to tackle ITER-specific aspects of neoclassical tearing mode (NTM) control, namely: (1) the relatively small size of the rotating islands, smaller than the electron cyclotron current drive (ECCD) deposition region and (2) the increased tendency of the islands, compared to present devices, to lock to the wall or to the residual error field, in a position not necessarily accessible to ECCD. Modulated ECCD is known to suppress small islands more efficiently, when "broad", than continuous ECCD. At DIII-D, an NTM of poloidal/toroidal mode numbers $m/n = 3/2$ was completely stabilized by a new technique where oblique electron cyclotron emission acted at the same time as an indicator of good alignment between ECCD and the island, and as a waveform generator, for modulation in synch and in phase with the island O-point. In another experiment, after locking in an unfavourable position, a 2/1 island was steered by externally generated magnetic perturbations, brought in the view of the gyrotrons and partly stabilized by ECCD in the island O-point. Magnetic perturbations were also used to sustain and control the mode rotation, which has the potential for an easier ECCD modulation.