The importance of matched poloidal spectra to error field correction in DIII-D

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Optimal error field correction (EFC) is thought to be achieved when coupling to the least-stable "dominant" mode of the plasma is nulled at each toroidal mode number (n). The limit of this picture is tested in the DIII-D tokamak by applying superpositions of in- and ex-vessel coilset n=1 fields calculated to be fully orthogonal to the n=1 dominant mode. In co-rotating H-mode and low-density Ohmic scenarios the plasma is found to be respectively 7× and 20× less sensitive to the orthogonal field as compared to the in-vessel coilset field. For the scenarios investigated, any geometry of EFC coil can thus recover a strong majority of the detrimental effect introduced by the n=1 error field. Despite low sensitivity to the orthogonal field, its optimization in H-mode is shown to be consistent with minimizing the neoclassical toroidal viscosity torque and not the higher-order n=1 mode coupling.

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