Error Field Tolerance and Error Field Correction Strategies and Their Applicability to ITER

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Abstract. Tokamak plasmas can be sensitive to external non-axisymmetric magnetic perturbations that are several orders of magnitude smaller than the axisymmetric field. These perturbations, which are usually undesired and referred to as "error fields", can limit operation by braking the plasma rotation until an instability such as a tearing mode, a resistive wall mode, or an error field driven locked mode leads to an unacceptable confinement degradation or a disruption. Auxiliary heating can have two competing effects: On the one hand higher β leads to a degradation of the error field tolerance through plasma amplification and stronger braking, and on the other hand higher toroidal rotation can tolerate a higher magnetic braking torque. A widely used technique to detect and correct error fields is based on the characteristic density dependence of the error field tolerance in Ohmic plasmas. An alternative technique is based on the measurable plasma amplification of the error field in high β plasmas. However, the detection and correction of error fields in ITER will require a modification of the present techniques in order to avoid disruptions and deal with insufficient plasma amplification of the error field at low β, before the full set of auxiliary heating systems will be available. The adaptation of current techniques to address these concerns is likely, but an experimental demonstration as well as an improved physics basis is needed and remains the subject of current research.