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## Resistive Wall Mode Studies Utilizing External Magnetic Perturbations

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Experimental methods for resistive wall modes studies utilizing external magnetic perturbations have been developed in the reversed field pinch experiment EXTRAP T2R. This work describes experimental techniques that employ external magnetic perturbations to estimate the resistive wall magnetic diffusion times for non-axisymmetric fields, to assess the machine error field and to extract resistive wall mode dynamics. The techniques are experimentally implemented in the EXTRAP T2R reversed-field pinch. The extension of the techniques to the tokamak configuration is discussed.

A method based on the application of rotating external fields has been developed for the estimation of the wall diffusion times for non-axisymmetric fields. The method provides the estimate of the wall diffusion time for each Fourier harmonic. This technique intrinsically incorporates the effects of three-dimensional structures such as shell gaps.

A machine error field assessment technique utilizing externally applied controlled magnetic perturbations has been developed. The method is based on the generation of stable or marginally stable external RWMs, and sustaining their rotation by means of a rotating external magnetic perturbation. Due to the machine error field, the RWMs rotate non-uniformly and are modulated in amplitude. This behavior is utilized to infer the amplitude and the toroidal phase of the corresponding error field harmonic. The technique is tested against externally applied, as well as intrinsic machine error fields.

Resistive wall mode dynamics is extracted from a set of experiments using randomized low amplitude external magnetic perturbations. Stable and unstable non-resonant modes are accurately identified. Previous work on this method at EXTRAP T2R using a 2x32 sensor array were suggestive of RWM spectrum spatial under-sampling, potentially leading to aliasing of mode numbers. This work presents new results with a 2x64 sensor array that is dense enough to avoid the aliasing problem. The RWM growth rate spectrum obtained from the generically estimated linear time-invariant system compares well to the ideal MHD model calculation. Using an extended sensor array of 2x64 coils, the method has provided the first generic and simultaneous measurement of the full RWM dispersion relation in reversed field pinch plasma.

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