Interaction of oblique propagation extraordinary electron waves and runaway electrons in tokamaks

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Disruptions in tokamaks can sometimes lead to the generation of highly energetic runaway electrons. Different high-frequency instabilities driven by runaway electrons have been studied before, using various models for the initial runaway distribution function [1, 2, 3]. Recently, it was shown that a strongly anisotropic runaway electron distribution can destabilize also the so-called oblique propagation extraordinary electron (EXEL) wave through the anomalous Doppler resonance, and influence the runaway distribution through a quasi-linear interaction [4].

This paper presents an analysis of some practical aspects of the interaction of EXEL waves and runaway electrons. First the scaling of the quasi-linear interaction dynamics with post-disruption plasma parameters is investigated using the analytical secondary generation distribution described in earlier analysis [3, 4]. As a further generalization, numerical runaway electron distribution functions from kinetic modelling [5] are used to evaluate the stability threshold of the EXEL waves in different plasma scenarios.

Finally, detection possibilities of the EXEL-runaway interaction are briefly discussed focusing on the deviation in the synchrotron radiation spectrum caused by the EXEL wave-induced pitch-angle scattering of the resonant electrons. A difference in shape as well as amplitude of the synchrotron spectrum with and without the quasi-linear interaction is predicted.

References

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