Influence of mutual coupling between ICRH antenna straps on the load resilience of hybrid couplers

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The mutual coupling present between ICRF antenna straps can strongly reduce the performance of quadrature hybrid couplers when used as "ELM dump" circuits. A first analysis starting from the measured scattering matrix of the ITER array mock-up has been given in [1]. We present an analytical study of this effect and show that during resistive ELM-like load perturbations of a reference matched configuration, the fraction of the reflected power returned to the generator through the hybrid has a lower bound that rapidly increases with the ratio ξ=(mutual reactance between straps) / (strap input resistance). (An analytical expression is given.) At very low levels of mutual the reflected power is efficiently diverted to the dummy load. However when ξ becomes of order 1, which readily occurs at low resistive loading, the load resilience of the quadrature hybrid coupler becomes inhibited. Further analysis and illustrations based on matching circuit simulations for the JET ITER-like ICRF antenna [2] are presented. The behaviour of the hybrids is found the same with the load resilient 'conjugate T' circuit as in the case of 'classic' tuners. It is finally shown that the insertion of decoupling circuits between the tuners and the antenna significantly improves the load resilience.

[1] A. Messiaen et al, Nucl. Fusion **46** (2006) S514.
[2] F. Durodié et al, this Conference.