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Map-Based Multipactor Theory for Two-Carrier Operation

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Multipactor is a vacuum discharge based on secondary electron emission that plagues microwaves devices, accelerator structures, and space-borne systems [1]. A novel theory based on principles from nonlinear dynamics and chaos theory has been introduced, in which all possible modes are recovered with no a priori assumptions on the electron trajectories [2-3]. The new methodology systematically applies iterative maps to identify multipacting boundaries more reliably and comprehensively than existing models. It does so by globally analyzing the structure of dynamical space, resulting in bifurcation diagrams that predict susceptibility to multipactor over a wide range of parameters.

This model is generalized to multi-carrier operation, as found in modern space-communication devices [4]. These systems, where several radio-frequency (RF) carriers coexist, are especially challenging to analyze with conventional methods. As a result, little theoretical study on this area has been done [5-6]. Since the map-based theory rapidly scans vast areas of parameter space with no a priori assumptions, it is ideally suited to analyze this problem. This is illustrated for the lowest-order system, namely two RF carriers. Validation is conducted by scanning, in both the theory and the simulation, parameters such as the field strengths and geometry dimensions. The resulting multipactor growth rates are then compared, validating the accuracy of theoretical predictions. The effects of the second RF carrier on multipactor suppression are presented.

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