A new mechanism for sawtooth period control

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Abstract. Experiments and simulations show that the sawtooth period can be influenced and precisely tuned by modulated ECCD power.

1 Introduction

In past experiments, the sawtooth period has been controlled by feedback with a variable electron cyclotron current drive (ECCD) deposition location, see e.g.[1] . An alternative is to use open loop control periodically modulating the ECCD power. Simulations [2] predict that for a range of modulation periods and duty cycles (percentage of power on during modulation) the sawtooth period becomes the same as the power modulation period (i.e. sawtooth locking).

Experiments on TCV [3] show indeed convincing evidence of sawtooth locking. In these experiments, the gyrotron power was modulated with periods that were larger than the natural sawtooth period in that operating point. Depending on the duty cycle, locking appeared for certain combinations of the modulation period and duty cycle. The combinations for which locking occurs form a sizeable space in the duty cycle-modulation period graph, the so-called locking range. During a final experiment the modulation period and duty cycle were jointly varied to stay within this locking range and the sawtooth period stayed locked to the modulation period. This open loop control, based on the nonlinear phenomenon of period locking, responds rapidly, often within a few periods, and obviates the slower closed loop sawtooth period control inherent in moving launcher mirrors. It is likely that locking with the input occurs for other periodic processes in the plamsa and that similar methods can be used to control these processes.

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