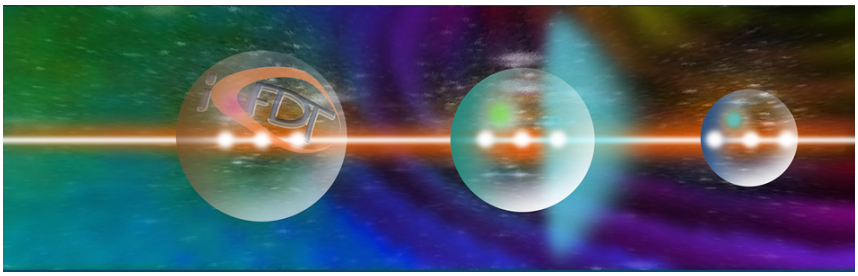

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Determining the causality horizon in synchronization experiments

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Synchronization can be defined as the coordination of events to operate a system in harmony. It is important in the operation of manmade systems and in the investigation of natural events. In the last decade or so, synchronization of multiple interacting dynamical systems has become a lively field of study for control. In Magnetic Confinement Nuclear Fusion, various pacing concepts have been recently proposed to control various instabilities, such as sawteeth and ELMs. Some of the main difficulties of these experiments is the quantification of the synchronization efficiency and its role in the understanding of the main physical mechanisms involved. In this paper, various classes of independent of statistical indicators are introduced to address these issues. In metallic Tokamaks, one of the most recent applications of ICRH heating on JET is sawtooth control by ICRH modulation, for avoiding triggering dangerous NTM and counteracting impurity accumulation. Various forms of ELM pacing have also been tried to influence their behaviour using external perturbations and the one studied in this paper, injection of pellets, seems the most promising in the perspective of future devices. In the application to JET experiments with the ILW, the proposed indicators provide sound and coherent estimates of the efficiency of the synchronisation scheme investigated. They also confirm the interpretation that the fast ions play a fundamental role in the stabilization of the sawteeth, in both L and H mode.

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