Statistical analysis of edge-localized mode timing in JET

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Probability distributions of edge-localized mode (ELM) properties in tokamaks under stationary plasma conditions contain information about ELM variability that can potentially be exploited for scenario optimization and ELM control purposes [1–4]. Such information complements averages taken over multiple ELM bursts and enables calculation of occurrence probabilities of specific ELM events. In this work, the distributions of inter-ELM time and ELM duration are studied in a database of JET carbon wall (CW) and ITER-like wall (ILW) plasmas. A new algorithm has been developed, based on gamma mixture modelling for robustly extracting the ELM timing under a wide variety of plasma conditions, with minimal user input. The Weibull distribution is seen to be a good model for the probability density function of the inter-ELM time, as well as the ELM duration [1, 3]. It allows to distinguish between type I ELMs (representing the majority of ELM activity in the database) and small type III ELMs, for similar ELM frequencies. Different distribution shapes are observed throughout the database, characterized by a variety of widths and tail lengths. The typical width of the distribution quantifies the regularity of the ELM timing, while long tails point to intermittent ELM activity. The distribution parameters are visualized using a projection based on a faithful similarity measure between the distributions (Rao geodesic distance), allowing to discern several clusters, including those corresponding to plasmas from baseline and hybrid scenarios in JET ILW [5]. Several trends with the main plasma parameters are observed and quantified. The database is being extended with additional plasmas from JET and other devices, aiming at a systematic characterization of statistical ELM properties and their dependences under various conditions.

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