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Stochastic modeling of plasma fluctuations with bursts and correlated noise in TCABR

Physics of Plasmas **29**, 052303 (2022); <https://doi.org/10.1063/5.0081281> M. Zurita^{1,a)},  W. A. Hernandez²,  C. Crepaldi¹,  F. A. C. Pereira³, and  Z. O. Guimarães-Filho¹[View Affiliations](#)[View Contributors](#)**Topics** 
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ABSTRACT

Blob-like filamentary structures are omnipresent in magnetized plasmas. Their transport deteriorates the particle confinement and may damage plasma-facing components of future fusion devices. In local measurements of density, these turbulent structures are seen as high-amplitude bursts, and, since the last decade, a stochastic pulse train model (SPTM) has been developed to describe these locally measured signals. The SPTM, which is also known as a filtered Poisson process, models plasma fluctuations as a superposition of pulses plus a background with Gaussian noise. In the present article, a fitting method for this model is introduced, considering a mixture of dynamical and observational noise. The proposed method exploits the fact the model parameters can be fitted in steps, using first the signal characteristic function, then the conditionally averaged burst, and finally the frequency spectrum. By employing this fit, we compare predictions of the model for ion saturation current measurements made with a Langmuir probe mounted in the outboard mid-plane region of the TCABR tokamak. The model is able to highlight a series of differences between the plasma edge and scrape-off layer. Furthermore, radial profiles of the SPTM parameters reveal a relation between the signal kurtosis, the intermittency of the pulses, and background parameters. Also, a linear increase in the pulse duration was found with the position. Finally, by using recurrence quantification analysis, we show evidence that the mixture of dynamical and measurement noise may be more accurate than just one of the two to describe the dynamic behavior of density fluctuations in TCABR.



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