

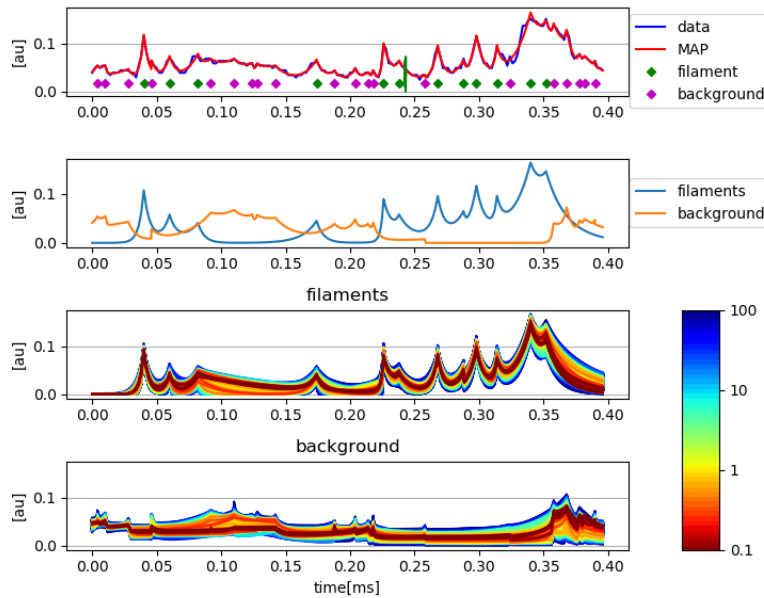
A Bayesian model of filamentary dynamics in MAST¹

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A novel approach using Bayesian inference has been implemented using the Bayesian Framework Minerva² to interpret the filamentary dynamics measured by a Langmuir probe fixed to a reciprocating assembly on MAST. The model describes the system as a superposition of time-displaced filaments and a fixed background component. Each filament is parameterised in terms of a characteristic rise and fall time and maximum amplitude centred on local maxima in the measured data time-series. A distinctive feature of the approach is that no minimum threshold is set for the existence of filaments. Furthermore, the model uncertainty is provided as an additional free parameter. It is observed that whereas large amplitude filaments are well characterised in terms of rise times, smaller amplitude filaments are often unconstrained by the data and are limited by the details of the prior. Based on these findings, a new definition for the plasma filaments is proposed based on the uncertainty in the filament rise times. The remaining filaments together with the constant background component forms a new time-dependent signal referred to as the computed *background fluctuation* signal (shown in the figure below). The characteristics of these signals (for the *plasma filaments* and for the *background fluctuations*) are reported in terms of their spatial variation as the probe moves through the SOL and into the core plasma.



Measured data from a Langmuir probe in the SOL region of MAST. Figures from top to bottom: (i) measured fluctuations showing fit to model and identification of discrete filaments; (ii) the computed signal for the filaments and the background fluctuations using MAP parameters; (iii) and (iv) computed signals for the filaments and background fluctuations using Monte Carlo Markov Chain sampled parameter values.

References:

¹ L C Appel et al, PPC, 4(12), page 125002, 2020;

² J Svensson et al, Plas Cont. Fus. 50 085002, 2008.