A new statistical toolbox for studying variability in fast transients
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Propositions belonging to this thesis

1. Short magnetar bursts excite QPOs at similar frequencies and with similar properties to those seen in the giant flares. (Chapter 3)

2. There is no convincing evidence in the data for the 625 Hz QPO in the 2004 giant flare from SGR 1806-20 persisting without interruption for more than a cycle. (Chapter 4)

3. A Bayesian hierarchical model that decomposes magnetar light curves into a superposition of simple underlying shapes offers new detailed insights into magnetar variability beyond basic QPO searches and can help us constrain the underlying physical processes. (Chapter 6)

4. Although magnetar bursts show a behaviour reminiscent of self-organised criticality when seen as an ensemble, differential distributions of fluence, duration, amplitude and waiting time indicate that this is not the case for variability within bursts. (Chapter 6)

5. Standard statistical analysis of the power spectrum of magnetar bursts and GRBs to search for QPOs does not produce well-defined results, as the standard condition of stationarity over the timescales of physical interest is not fulfilled. (Chapters 2-6)

6. It is possible to reliably search for QPOs in magnetar bursts observed with Fermi/GBM using a Bayesian approach to modelling the power spectrum. (Chapters 2 and 3)

7. For the low-background RXTE observations of the strong, very fast variability in magnetar bursts neither standard statistical methods nor the Bayesian analysis of power spectra introduced in Chapter 2 can reliably detect QPOs, because the condition of a stochastic process over a wide range of frequencies with a simple underlying power spectral shape is not fulfilled. (Chapter 5)

8. An important consideration in determining whether a result in a scientific publication is trustworthy is its reproducibility: just as one cannot publish an equation without its derivation, one should not publish a computational result without publishing the code that produced it.

9. The question should not be whether frequentist or Bayesian statistics are the right way to do statistics, but whether a given statistical method is appropriate for the inference problem at hand.

10. Research is, in large parts, an exercise in feeling stupid.