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Parameter estimation for a two-component neutron star model with a Kalman filter

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Timing noise in a pulsar is the stochastic deviation of the pulse arrival times of the pulsar away from its long term spin down trend. In the classic two-component neutron star model, interactions between the crust and superfluid cause these perturbations to decay exponentially with a characteristic timescale. This research uses a Kalman filter to track the pulsar frequency through time and to calculate a posterior on the parameters of the two-component pulsar model. Our method is reliable on simulated data, which we show through both individual and large-scale Monte Carlo tests. We will also show some representative examples on publicly available data from real pulsars, where we aim to test the two-component model and to use it to efficiently measure physical properties of the star. Our measurements of the properties of neutron stars will provide insight into their internal structure and will also provide evidence for or against the two-component model.

Primary authors: Mr O'NEILL, Nicholas (University of Melbourne); Dr MEYERS, Patrick (University of Melbourne); Prof. MELATOS, Andrew (University of Melbourne); Prof. EVANS, Robin (University of Melbourne)

Presenter: Mr O'NEILL, Nicholas (University of Melbourne)

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