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Discovery of a 12-second radio pulsar and optimally searching for the slowest pulsars in the Galaxy

We will present the latest data on PSR J2251−3711, a radio pulsar with a 12.1-second spin period discovered in the SUPERB survey at Parkes. Combined with the recent unexpected discovery of PSR J0250+5854, which has an even longer 23.5-second spin period, the possibility of finding even slower radio emitting pulsars is now wide open. Not only do these objects challenge our understanding of when radio emission should cease, but their evolutionary history is also a matter of debate. Discovering more slow pulsars will be useful in understanding the links between all the classes of isolated neutron stars. But we need the proper searching arsenal to find them.

The Fast Folding Algorithm (FFA) is a fully phase-coherent search technique for periodic pulsar signals. It has historically seen limited use on large scale surveys, having been supplanted by more computationally efficient Fast Fourier Transform (FFT). We have however demonstrated analytically that a properly implemented FFA is several times more sensitive to the shorter pulse duty cycles (<1%) expected from the slow pulsar population, which has therefore been significantly under-explored until now. We have developed a fast end-to-end FFA search code that we are currently running on the SUPERB and the LOFAR Tied-Array All-Sky (LOTAAS) surveys: we will report on these ongoing searches and advocate running the FFA on all available data.

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