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Innovative pulsar searching techniques, and the discovery of a relativistic binary pulsar

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Pulsars, rapidly-rotating and highly magnetised neutron stars, can be utilised as tools in the study of many fundamental physical questions, most notably in the application of binary pulsars to the study of gravitational theories such as General Relativity. The discovery of ever-more relativistic binary systems than those presently known will allow for such tests to probe even deeper into the nature of gravity. Here, I will present results from the processing of 44% of the the HTRU-South Low Latitude pulsar survey, the most sensitive blind survey of the southern Galactic plane taken to date. This includes the discovery and long-term timing of 40 new radio pulsars identified through the continued application of a novel “partially-coherent segmented acceleration search” technique, which was specifically designed to discover highly-relativistic binary systems. These pulsars display a range of scientifically-interesting behaviours including glitching, pulse-nulling and binary motion, and along with other discoveries from the HTRU-S Low Latitude survey appear to comprise a population of older, lower-luminosity pulsars as compared to the previously-known population. In addition, I will also present an in-depth study of PSR J1757-1854, the only relativistic binary pulsar to have been discovered in the HTRU-S Low Latitude survey. This extreme binary system promises to provide new insights into gravitational theories within the coming years.

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