B03r Studying Gravity with Pulsars and the SKA

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In this talk I will review pulsar science and the applications of pulsar research to studies of gravity, in particular as enabled by the SKA. Pulsars are small stars that emit a reliable beacon of radio light which, combined with their rapidly spinning nature, results in pulsars being essentially 'super clocks' in space. The Square Kilometre Array (SKA) will be the largest telescope ever built and will be capable of studying every pulsar in the Galaxy whose beacon sweeps past the Earth. Using the SKA to perform pulsar timing we can study gravity in two very different regimes. Firstly there is the strong field regime: this concerns binary systems with orbital periods of just a few hours. In these systems strong-field effects predicted by Einstein's General Relativity arise and can be tested against the predictions of alternative theories of gravity — where does General Relativity break down? The SKA will also identify the coveted pulsar-black hole binary systems so that using pulsar timing techniques we can test black hole theorems such as the Cosmic Censorship Conjecture and the No Hair Theorem. Secondly, in the radiative regime, we can use pulsars to directly detect gravitational waves for the first time. Gravitational waves produced by supermassive black hole binaries, by cosmic strings and in the early Universe ripple through spacetime, passing by thousands of pulsars as they propagate. By careful measurement we can detect the distortions imparted by these waves on the ticks of the pulsar clocks. All of this cutting edge fundamental physical research is made possible by pulsars, Nature's best laboratories, and the astounding capabilities of the SKA telescopes: together they will unlock the secrets of gravity.