

Title

Fundamental physics and astrophysics with the Double Pulsar

Abstract

The Double Pulsar is a unique binary system made up of two active radio pulsars in a compact relativistic orbit. In many ways, the results obtained so far with the Double Pulsar define the current state of the art of the field. With seven specific and distinct scientific objectives, we aim to take advantage of the unrivalled capabilities of MeerKAT to observe the Double Pulsar to achieve further exciting breakthroughs in a wide range of physics: 1) performing the first quantitative test of the relativistic deformation of the orbit as predicted by general relativity (GR); 2) measuring the moment-of-inertia of a neutron star using pulsar timing to determine the neutron star's equation of state, or testing frame-dragging effects or next leading order (3.5PN) gravitational wave attenuation in GR; 3) using scintillation studies to independently measure the orientation and kinematics of the orbit and to probe the ISM-informative properties of our Galaxy; 4) performing the best test for GR's relativistic spin precession; 5) timing pulsar B using eclipse studies; 6) making direct measurements of the magneto-ionic properties (including the plasma density) of a pulsar magnetosphere; 7) investigating new effects that are expected but not yet detected, such as latitudinal signal deflection and a lensing correction of the Shapiro delay.