Studies of fundamental physics with GBT observations of pulsars

Tests of the Theory of General Relativity  The pulsars in the unique double pulsar system PSR J0737-3039 have higher orbital velocities and accelerations than other binary pulsars and therefore allow stringent tests of Einstein’s theory of general relativity and alternate theories of gravity. GBT observations of the double pulsar system at monthly intervals have constrained post-Neutonian gravitational parameters with an uncertainty of only 0.05%, providing the most stringent test to date of the theory of General Relativity in the strong field limit. The GBT data are now becoming so precise that gravitational phenomena such as spin-orbit coupling, which have never before been observed, might be detectable in a few more years of observation.

This figure summarizes tests of General Relativity parameters in terms of constraints on the masses of the two pulsars derived from the relativistic precession of the orbit, gravitational redshift and time dilation, the decrease in orbital period due to the emission of gravitational waves, and the Shapiro delay.


The equation of state of neutron stars  GBT measurements of the mass function and rotation rate of milli-second pulsars constrain the equation of state of nuclear matter, giving observational insight into the nature of superdense matter which cannot be obtained in any other way.