

Title

Unveiling the nature of a compact object in the mass-gap: lightest black hole or heaviest neutron star?

Abstract

A pulsar orbiting a stellar-mass black hole is one of the 'Holy Grails' of pulsar astronomy, and such a system would allow novel tests of Einstein's general relativity. In this proposal, we aim to obtain precise mass measurements for NGC 1851E, a massive binary pulsar in a globular cluster, where both components are compact stars and the total binary mass is 3.887 ± 0.004 solar masses. The mass of the companion to the millisecond pulsar is larger than the largest reliably measured neutron star (NS) masses, but smaller than the smallest black hole (BH) masses (with the exception of objects deduced from LIGO/Virgo data); however its large current uncertainty makes it difficult to determine if it is the most massive NS or the lightest BH. With the continued radio timing of this system using MeerKAT, we aim to measure the component masses to a precision of 0.02 solar masses in the next four years, and likely uncover the nature of the massive companion.