

COLLOQUIUM

Department of Physics, Temple University

Black Holes in the 21st Century

**Dr. Yuan K. Ha
Department of Physics
Temple University**

Abstract

The discovery of gravitational waves in 2015 confirmed the existence of black holes. Black holes are now real astrophysical bodies with a mass, length and lifetime. They may be abundant in the Universe and their properties can be investigated by the gravitational waves they release during black hole merging.

In this colloquium, we report on some exciting results on black hole research done at Temple in recent years. They are summarized as follow:

1. A new theorem for black holes is established. The Horizon Mass Theorem states that for all black holes: neutral, charged or rotating, the mass observed at the event horizon is always twice the irreducible mass observed at infinity. A distant observer will always see a positive mass of the black hole as required by the Positive Mass Theorem.
2. A new paradigm to understand black holes is introduced. The External Energy Paradigm asserts that all energies of a black hole are external quantities. These include constituent mass, gravitational energy, electrostatic energy, rotational energy, heat energy, etc. As a result, *quantum* particles carrying charges and spins are forbidden inside the black hole. All mass of a black hole is to exist on the surface where the entropy is.
3. A new property of black holes is found. Every rotating black hole has a moment of inertia. The moment of inertia exists even when the black hole stops rotating, analogous to the rest mass of a moving body. The black hole has an extended structure and the classical singularity does not exist.

These surprising results would provide a new understanding of the nature of black holes with potential impact on cosmology, information theory and quantum gravity.

**Monday, October 21, 2019 at 3:00 pm
SERC, Room 116
Refreshments served at 2:45 pm**