PHYSICS AND ASTRONOMY

SEMINAR

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"Searching for Ultralight Particles with Black Holes and Gravitational Waves"

Abstract

The LIGO detection of gravitational waves has opened a new window on the universe. I will discuss how the process of super radiance, combined with gravitational wave measurements, makes black holes into nature's laboratories to search for new light bosons, from axions to dark photons. When a bosonic particle's Compton wavelength is comparable to the horizon size of a black hole, super radiance of these bosons into bound "Bohr levels" extracts energy and angular momentum from the black hole. The occupation number of the levels grows exponentially and the black hole spins down. For efficient super radiance of stellar black holes, the particle must be ultralight, with mass below 10^-10 eV; one candidate for such an ultralight boson is the QCD axion with decay constant above the GUT scale. Measurements of black hole spins can disfavor or provide evidence for an ultralight scalar or vector particle. Particles transitioning between levels of the gravitational "atom" and annihilating to gravitons may produce thousands of monochromatic gravitational wave signals, and turn LIGO into a particle detector.

Monday January 23, 2017
11:00 a.m.
Clearihue Building
Room C108