Physics Colloquium

Reinventing Gravity: Living without Dark Matter

John Moffat
Perimeter Institute for Theoretical Physics
Waterloo, Ontario, Canada

The fact that in the standard model of gravity, astrophysics and cosmology, 96% of matter and energy is invisible is controversial. Until now, experiments have not succeeded in detecting dark matter. Without postulating dark matter and dark energy, Einstein's gravitational theory cannot explain the observational data beyond the solar system and the binary pulsar PSR 1913+16. The possibility of modifying Newtonian and Einstein gravity theory without dark matter is explored. Modified Gravity (MOG) has been used successfully to explain the rotation curves of galaxies, the motion of galaxy clusters, the Bullet Cluster, and cosmological observations without the use of dark matter or Einstein's cosmological constant. It is demonstrated how solutions of the MOG field equations can be obtained directly from the action principle, without resorting to ad-hoc parameter choices or empirical formulae. The solutions to the theory's field equations show good agreement with data from the scale of the solar system to cosmological scales without dark matter. MOG predicts a singularity-free bouncing cosmology with a vacuum energy term that yields accelerating expansion and an age of about 14 billion years from time t=0, with the universe extending into the past in negative time. The issue of how MOG may modify our understanding of black holes is discussed. The controversial issue as to whether "dark energy" postulated to explain the accelerated expansion of the universe exists is debated.

Thursday, November 5, 3:30pm, SCI 234

Refreshments will be served in Sci 103 at 3:00pm