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University of Miami, Physics Department Colloquium

Date: Wednesday, Mar 20, 2024
Time: 4:00 pm – 5:00 pm
Location: Wilder Auditorium – Rm 112, Knight Physics Building

Fingerprints of the Cosmic Dawn in the Global Radio Spectrum

Dr. Raul Monsalve

Space Sciences Laboratory, UC Berkeley

Abstract

Observing the appearance of the first stars during the period known as the Cosmic Dawn is one of the main objectives of modern cosmology. According to the standard model of the Universe's evolution, the first stars and galaxies formed around 50-200 million years after the Big Bang. The James Webb Space Telescope has made extraordinary progress in the detection of early galaxies. However, the very first stars, which most likely were very massive and short-lived, are too faint and far away to detect directly. A complementary and exciting technique to detect the first stars is through their impact on the intergalactic medium (IGM), which primarily consisted of neutral hydrogen atoms. The UV radiation emitted by the first stars induced the coupling of the 21-cm spin temperature of neutral hydrogen atoms to the cold kinetic temperature of the IGM. This coupling generated an absorption feature in the global radio spectrum. Detecting and characterizing this absorption feature will reveal the properties of the first stars and provide access to the Cosmic Dawn. The global radio spectrum has also the potential to provide unique constraints on models for Dark Matter and exotic physics in the early Universe.

In this talk, I will introduce and describe recent developments by the EDGES and MIST radio experiments, which are trying to detect for the first time the global 21-cm signal from the Cosmic Dawn. In 2018, EDGES reported evidence for the expected absorption feature using observations conducted from Western Australia. MIST will soon report its first constraints on the 21-cm signal. These constraints are being obtained from measurements conducted in Western United States and the Canadian High Arctic since 2022. In my talk I will also introduce the LuSEE-Night experiment, which will observe the global radio spectrum from the far side of the Moon starting in 2026. Taking advantage of the radio-quiet environment of the lunar far side, LuSEE-Night will target the signal from the period before the first stars appeared, known as the Dark Ages.