CNAM Condensed Matter Colloquium

2 p.m., Thursday, September 30, 2010

Room PHYS1201

Refreshments will be served at 1:30 p.m. in Room 1305F – Behind the IT Help Desk.

μ-Spec – A New Tool for Probing the Early Universe

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Abstract:

The great success of COBE and WMAP, along with a number of pioneering balloon-based and ground-based experiments have produced a remarkably consistent view of the early universe up to the formation of the Cosmic Microwave Background radiation. Subsequent CMB experiments are measuring its small scale structure to reveal the growth history of mass condensations in the universe through gravitational lensing of the CMB.

While these measurements will measure the mass distrbution over cosmic time, we need to understand what the baryons are doing. They are a small constituent by mass, but their development defines the universe we see. We are developing an instrument concept for flight on the Japanese SPICA mission, a cryogenically cooled 3-m telescope, that will allow us to observed the physical conditions in early galaxies and to measure the growth in concentrations of the abundant elements, C, N, and O over Cosmic time. Our instrument, μ-Spec, operating in the 250 -700 μm spectral region, will also be a powerful tool for studying the energy balance of the gas in our Galaxy, allowing us to observe the emission from hydrides, which probe the dense regions of clouds, to CO lines that measure the cooling and radiation field in the lower density material.

μ-Spec combines a number of new technologies to enable the production of compact high performance submillimeter spectrometers. First, we use low loss superconducting transmission lines to create the analog of a grating spectrometer in a volume thousands of times smaller than in conventional instruments. This configuration allows convenient coupling to the large arrays of detectors required for the instrument in a very small volume. We are also developing detectors for this instrument that have sufficient sensitivity to allow us to reach the limits set by input photon statistics, around 10-20 W/√Hz for our spectrometer. Ultimately, the photon rates are sufficiently low that photon counting may provide significant stability benefits, so we are also exploring designs that will allow counting of individual 1 THz photons.

I will describe our development efforts on both the integrated spectrometer and the detector. The photon counting detector is a very exciting possibility, and promises to have significant applications in a wide range of applications from cosmology to quantum information experiments.

Host: Gus Vlahacos