Hubble Space Telescope

Cycle 16 AR Proposal

IR Background Intensity, Anisotropy, and Lyman-alpha Sources in Large Volume Simulations of Reionization

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Scientific Category: COSMOLOGY

Scientific Keywords: GALAXY FORMATION AND EVOLUTION, HIGH REDSHIFT GALAXIES, IR-LUMINOUS GALAXIES, LARGE SCALE STRUCTURE AND PECULIAR VELOCITIES, STAR FORMATION

Total Budget Amount: $44,000 (0.5 month PI+CoI, 4 month Postdoc, other)

Theory: Yes

Abstract

We propose to analyze properties of the UV photon background emitted by reionizing sources redshifted to IR wavelngths today in a set of large volume, (100 Mpc)^3, high resolution simulations (24 billion particles) of the cosmic reionization process. Using these cosmological simulations, we will establish, for the first time, the expected IR background intensity at wavelengths between ~1 micron and ~4 microns as well as the anisotropy power spectrum of fluctuations observable with NICMOS F110W/F160W bands and WFC3 IR bands. The new hybrid code for reionization simulations developed at Princeton by CoIs Cen & Trac includes an adaptive ray tracing algorithm for radiative transfer of ionizing photons from first-light galaxies containing both population II and population III stars. Fluctuation studies of the unresolved intensity in deep IR images, including those with NICMOS, have shown an excess anisotropy contribution above noise when resolved sources down to very faint flux levels are masked out. This excess has been described as a signature of first galaxies containing Pop III stars. While fluctuation measurements have not conclusively established the presence of Pop III stars, we do expect unresolved IR background to fluctuate due to clustering of first-light sources. Given differences in model assumptions, analytical predictions on the fluctuation strength vary widely in the literature, while numerical simulations of reionization have not been used to study IR background statistics. These will be compared to existing measurements and to establish requirements (depth, area) for a WFC3 survey to measure statistics of first galaxies. We will investigate how color information, in terms of fluctuation amplitude ratios of IR bandpasses of NICMOS and WFC3, can be used to study the redshift duration of reionization. Simulations will be used to update number counts, luminosity functions, and clustering of Lyman-alpha sources, and to compare with recent measurements of Lyman-alpha source statistics at z > 6 by taking into account of sample variance within the ~1 degree^2 field provided by simulations. Simulations will also be used to study the transition between dominant Pop III to dominant Pop II starformation, and any observable signatures. In addition to results in peer-reviewed publications, simulation outputs in the form of Lyman-alpha source maps at various passbands of both NICMOS and WFC3 will be made available publicly on the web within a year of beginning this research.

Investigators:

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Number of investigators: 10

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Dataset Summary:

Instrument	No. of Datasets	Retrieval Method	Retrieval Plan
NICMOS	1	DVD	Primary theory proposal.