IR Background Fluctuations in NICMOS Ultra and Hubble Fields and the Surface Density of First-Light Galaxies

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Abstract

We propose an archival analysis of F160W and F110W NICMOS Ultra Deep Field (NUDF) and Hubble Deep Field North (HDFN) data, combined with deep HST ACS images of the same field, to measure clustering of unresolved IR background (IRB) present in "empty" pixels. These clustering measurements will be used to study any indications for the presence of an unresolved, diffuse IR background from redshifts related to reionization and associated with redshifted UV emission from first-light galaxies and Lyman-alpha emission from recombinations in surrounding HII halos. The IR background from these sources are expected to peak at wavelengths between 1 and 2 microns and it's fluctuations have a clustering spectrum distinctively different from that of low-redshift faint galaxies. We will account for the confusion from latter with ACS detections of faint blue optical galaxies with no IR counterparts in NICMOS images. We will cross-correlate unresolved IR fluctuations between F110W and F160W images of the same field to determine any wavelength dependence of the IR background and to separate various noise and systematic effects which are not common to both passbands. We will simulate to estimate the noise floor generated by residual flat-field errors and the pedestal effect involving varying bias in different quadrants of the NICMOS array. For IR anisotropy power spectrum measurements, we will borrow and implement well established techniques used with cosmic microwave background (CMB) anisotropy maps by the CMB community. At a wavelength of 1.25 microns, DIRBE indicates a total IRB intensity of 54 +/- 17 nW/m^2/sr or 28 +/- 15 nW/m^2/sr, while about 8 nW/m^2/sr comes from known galaxy counts. Our clustering measurements, combined with analytical and numerical models, will lead to a detection of the total IRB intensity from first-light galaxies containing Pop III stars during reionization as low as 3 nW/m^2/sr. A direct estimate on the integrated intensity, and thus the surface density of first-light galaxies, from unresolved IR fluctuations has strong consequences for imaging searches for high-redshift Lyman-alpha emitters and for models of galaxy formation and evolution.

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Number of investigators: 9

Dataset Summary:

Instrument	No. of Datasets	Retrieval Method	Retrieval Plan
NICMOS	2	FTP	We already have data. Data from second reduction of NUDF will be used through a STSCI-based team member.