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SIMULATING SURVEYS OF THE HIGH-Z MM UNIVERSE

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The next generation of large single-dish mm and sub-mm (hereafter mm) telescopes (ground-based, balloon-borne, satellites) and interferometers, using new large-format fully-sampled focal-plane arrays, will provide greatly improved mapping speed, sensitivity, wavelength coverage, and resolution. These new instruments will determine the evolutionary history of high-z dusty starburst galaxies first discovered with SCUBA and MAMBO blank-field surveys. Furthermore, they will conduct the first large-area blank-field mm searches for clusters using the Sunyaev-Zeldovich (S-Z) effect, and they will measure the amplitude of fluctuations in the Cosmic Microwave Background (CMB) down to arcminutes. In this poster we present a mapping simulation for the 50-m Large Millimeter Telescope[2] (LMT), that combines a detailed model of the mm extra-galactic sky and noise, with the performance of the detector system and scanning strategy.

Our model of the extra-galactic mm sky includes i) realizations of the CMB anisotropy power spectrum using CMBFAST[3], ii) S-Z clusters (Aghanim et al. 1997) and iii) dusty starburst galaxies (Hughes & Gaztañaga 2000). Added to this model is foreground emission from Galactic cirrus (Lagache & Puget 2000), and a 2-dimensional map of fluctuations that reproduces the observed power-spectrum of sky-noise. A model for the telescope and camera which includes the array geometry, beam size, detector response, noise characteristics, and sample rate is "scanned" in a realistic pattern across the multi-component model of the sky. Signals and astrometry are thus generated for each pixel, and maps are made with a data reduction pipeline[4] (Figure 1). Overlap of the scan pattern in the central region results in higher S/N compared with the edges. Simple baseline removal is used to subtract sky-noise, leaving residual streaks in the final map.

The simulated maps are used to test the ability to disentangle each of the sky components. Successful extraction depends critically upon the understanding of the noise, since each component of the astronomical signal peaks at characteristic spatial scales and wavelengths. If, for example, one wishes to extract CMB fluctuations from a mm-wavelength map, the "foreground" galaxies, clusters and cirrus must be removed, and the $1/f$ noise of the instrument must be controlled, so that the large spatial scale of the CMB fluctuations are not erased by detector drift. In the case of this LMT simulation, the sky $1/f$ has decreased the sensitivity to extended structure, so that only point sources (galaxies) can be reliably detected, and extended S-Z clusters are barely visible.

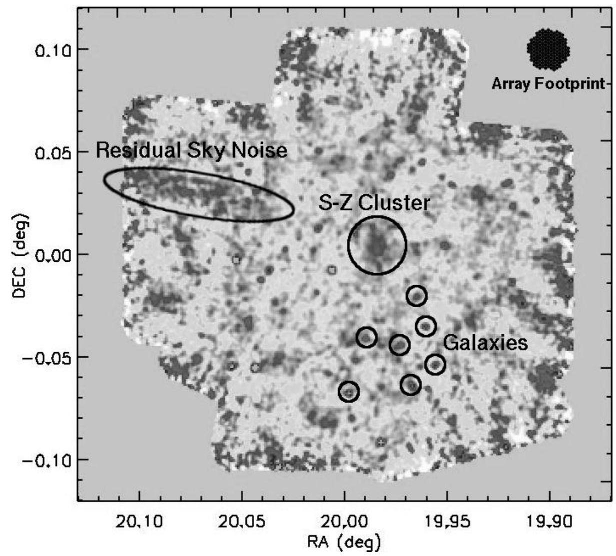

Fig. 1. Simulated map for the LMT operating at 1.1mm.

Our understanding of the effect of noise and calibration accuracy through simulations will lead to the design of more sophisticated data reduction, and source extraction algorithms. Finally, simulations, such as those described here, will help design surveys that maximize the scientific output of the LMT.

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[2]http://www.lmtgtm.org

[3]http://physics.nyu.edu/matiasz/CMBFAST/cmbfast.html

[4]http://www.inaoep.mx/∼echapin/scansim.html