The CDF-S Viewed with SIMBA

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Abstract. Observations of the Chandra Deep Field South (CDF-S) with the bolometer array SIMBA on the SEST 15m telescope is presented. SIMBA operates at 1250μm and uses a fast-scanning observing technique suitable for large fields. An effective area of 110 sq arcmin was observed to a homogeneous noise level of 1.5 mJy.

1 Introduction

Observations at sub-millimeter wavelengths have revealed a population of dusty high redshift far-infrared luminous (FIR) galaxies [4] [12] [13] [19] [25], emitting most of their bolometric luminosity in the FIR. This population accounts for a large portion of the far-infrared background [7]. The main questions associated with this population has from the beginning been the nature of their high FIR luminosities, the nature of their power source, their redshift distribution and their dynamical masses. The question of their redshift has been addressed through the use of 'photometric' techniques, such as the radio-FIR flux ratio [8], and FIR/submm flux ratios [3] [19] [20] [30]. These techniques have shown that the redshift distribution of the submillimeter galaxies (SMGs) is dominated by objects at redshifts z$\geq$1-2. Recently however, direct optical spectroscopy has provided a first derivation of the redshift distribution, showing it to have a median redshift of z=2.4 [10].

Redshift information has allowed estimations of the masses of the SMGs, both through observations of CO emission [14] [15] [16] [21], and optical/NIR

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photometric measurements [27]. Both the gas and stellar masses are found to be $\sim 10^{11}$ $M_{\odot}$ and the co-moving density, corrected for an estimated duty cycle of the high FIR luminosity of $\sim 10^{8}$ years, is $\sim 10^{-4}$ Mpc^{-3} [16]. Recent studies show a correlation between X-ray sources detected with Chandra and SMGs [1] [2] [28], where ~40% of SMGs contain an AGN. The AGN activity, however, accounts for only 10-20% of the bolometric luminosity [2], leaving the rest to be powered by massive star formation. A seemingly robust signature of clustering has been detected among the SMGs [27] and in the cases where optical/NIR counterparts have been securely identified, they often show strongly interacting systems [7] [9] [11]. The co-moving space density, mass and environment together suggest that the SMG population constitutes the formation of massive elliptical galaxies in the central region of galactic proto-clusters. The inferred star formation rates, given the modest contribution from AGNs, further implies that the formation occurs on a relatively short time scale, followed by passive evolution.

The SCUBA and MAMBO bolometers operate at 850μm and 1250μm, respectively. The longer wavelength of MAMBO means that it is more sensitive to higher redshifts than SCUBA, assuming all dust properties remain constant for the sources. Unfortunately, there has been relatively little overlap between the SCUBA and MAMBO fields. One exception is the Lockman Hole [18] [24], where some sources detected at 1250μm are not seen at 850μm, and vice-versa [18]. It is presently unclear if this means that a different, higher redshift and/or cooler, population is seen at longer wavelengths or if these sources represent spurious detections.

Here we present the first results from a deep survey made with the SEST IMaging Bolometer Array (SIMBA) on the 15m SEST telescope at ESO La Silla. The survey covered a substantial part of the Chandra Deep Field South (CDF-S) and was done at 1250μm. A more detailed account will be presented in [5].

2 The SIMBA Bolometer

SIMBA was installed on the SEST in June 2001 as a collaborative project between the University of Bochum, the Max-Planck Institute for Radio Astronomy in Bonn, the Swedish National Facility for Radio Astronomy and ESO. SIMBA is a 37-channel bolometer array operating at wavelengths of 1.2 mm. The telescope beam size of the SEST is $24''$ at the operating wavelength. The 37 channels are arranged in a hexagonal , non-overlapping pattern, with a total extent of slightly more than $4'$.

As SEST did not have a nutating subreflector, images were produced in a fast-scanning mode, where the modulation is achieved through rapid, ~15 ms, sampling as the array is moved over the sky. The atmospheric fluctuations are assumed to affect the entire array elements in a similar manner over one sampling period, creating correlated noise over the array elements. This correlated signal is removed during the data reduction stage. A description of the fast-scanning observing mode can be found in [23][29]. The typical scanning speed was $60'' - 120''$/sec. A map is created by scanning the telescope in azimuth, shifting $8''$ in