ALESS: An ALMA survey of submillimeter galaxies

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Introduction

Submillimeter galaxies (SMGs) are high-z dusty starbursts that were originally discovered in the first single-dish submillimeter surveys. Unfortunately, the typical resolution of such surveys (~15"-20") makes it difficult to identify the exact source of the emission.

We observed 126 SMGs with ALMA in Cycle 0, producing maps which are ~3× deeper and which have a resolution ~200× better than the discovery map. The precise positional information afforded by these maps allows us to resolve sources that were previously blended and accurately identify counterparts for these SMGs. The observations took only *two minutes* per source, demonstrating the power of ALMA already in early science.

Discovery map: The Extended Chandra Deep Field South

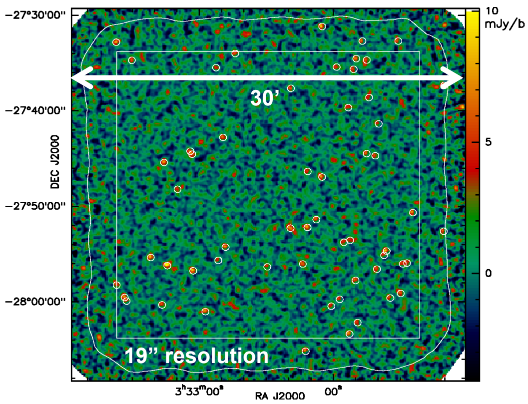

Figure 1: The original APEX/LABOCA 870μm map toward the ECDFS. Circles show the location of the 126 submillimeter sources identified in the LABOCA deep field (known as `LESS').

ALMA Cycle-0 observations

The original 870μm `LESS' survey with APEX/LABOCA identified 126 SMGs in the extended Chandra deep field south (ECDFS). To improve the relatively poor positional accuracy of the APEX/LABOCA-detected SMGs, we used ALMA in Cycle 0 to observe the 870μm (344 GHz) continuum emission in all LESS SMGs, doubling the current number of interferometrically-observed submillimeter sources. Our `ALESS' observations produced maps with a median resolution of 1.6" x 1.1" and an rms of 0.4 mJy beam^{-1}.

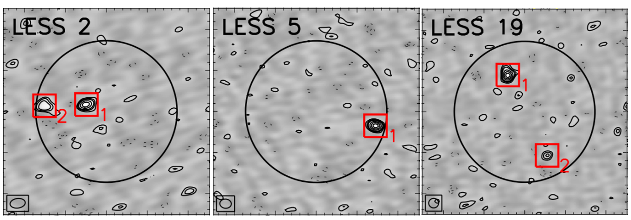

Figure 2: ALMA 870μm maps of some example sources. The resolution of the original LESS observations is shown by the large circle. The detected sources are indicated with red squares.

Results

Multiplicity: We find that 35%-50% of the sources have now been resolved into multiple, fainter sources, and that the brighter sources are essentially all multiples.

Reliability of previous counterpart identification: We find that the previous multi-λ matching missed ~1/3 of SMG counterparts and misidentified 1/3 of those it claimed to find.

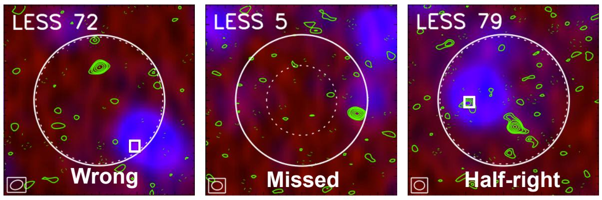

Figure 3: ALMA 870μm contours over the 1.4 GHz radio and 24μm MIPS data previously used for counterpart identification. The thick white squares indicate the radio/MIPS sources previously identified as the counterpart. The search radius used for that identification (dashed circle) was set by the LESS source strength. **Left:** The previously identified counterpart was incorrect. **Middle:** No counterpart was previously identified, as the correct counterpart is outside the search radius. **Right:** One counterpart was correctly identified, but the brighter source of submillimeter emission was missed.

Implications

The source counts and redshift distribution of SMGs are both important parameters to investigate this population in the context of galaxy evolution studies. Both are affected by source multiplicity and false counterpart identification, underlining the importance of high spatial resolution studies. Based on our ALMA data, we find that the source counts are much steeper for bright (>9mJy) sources than suggested by single dish observations, and the overall normalization is lower.

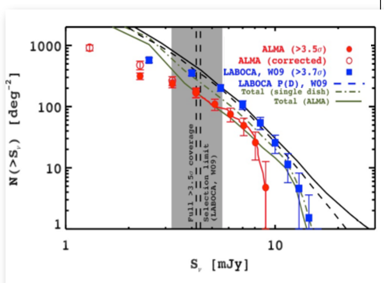

Figure 4: Source counts from our ALMA observations compared with the LABOCA-derived counts

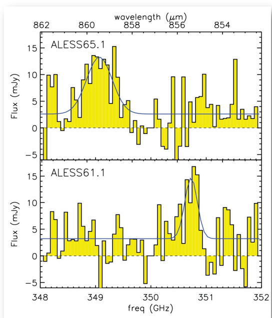

Figure 5: [CII] in two ALESS SMGs

Serendipity

The broad (8GHz) bandwidth of ALMA even resulted in the serendipitous detection of [CII] in two previously-unidentified SMGs, allowing us to place them at z=4.42 and z=4.44. This detection rate is broadly consistent with that expected based on the SMG redshift distribution.

Want more info?

Hodge et al 2013, ApJ, 768, 91
Karim et al 2013, MNRAS, 432, 2
Swinbank et al 2012 MNRAS 427, 1066
Weiß et al 2009, ApJ, 707, 1201
http://www.eso.org/public/news/eso1318/ (Press release)

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