Chapter 5

Conclusions

We have used mock observations to study the feasibility of SMA and ALMA in detecting submillimeter sources, which are assumed as distant star-forming galaxies at high redshifts. The submillimeter skies are simulated from the source count models, which are obtained by fitting the observed submillimeter source counts from SCUBA, by assuming they are all point sources and have no angular correlations. To simulate the submillimeter skies observed by SMA and ALMA, we use *Miriad* to carry out a series of mock observations and produce synthesis images. Procedures used to search for sources are mainly based on an IDL subroutine, *find.pro*. The numbers of sources detected are compared with the numbers of sources input from the source count models. These numbers are used to calculate the SMA and ALMA detection ratios (DRs), false detection ratios (FRs) and error propagation factors (EPFs) for different skies and settings (observation times and configurations).

With the uncertainties of current submillimeter data, we have discussed 3 possible models of submillimeter sky. The source count model of Sky 1 predicts little number of sources at faint end and its total intensity contributed to 850 μm EBL is 61%. This implies a large fraction of the submillimeter background is unknown and not detected. Source count models Sky 2 and Sky 3 predict that the numbers of sources increase at faint end. Both source count models are as counted for 100% of 850 μm EBL. For the different source count models and telescopes, the optimal settings are shown in Table. 4.2. The optimal settings provide the lowest EPF values in source count observations. However, for the large number of sources detected, we can lower the significance level and use compact array for ALMA and SMA, so that the sensitivity of observation can go deeper.

We have compared the detection speed of ALMA, SMA and future single dish telescopes based on the significance levels and EPFs from mock observations. Fig. 4.3 to Fig. 4.5 shows the detection speed of submillimeter telescopes of different source count models, Sky 1, Sky 2 and Sky 3, respectively. One can see that SMA has a similar detecting speed to SCUBA when the observation time for each pointing is less than 15 hours. The curve of the SMA detection speed starts downgrading, when the exposure time is more than 30 hours per field.

Combining EPFs and sensitivities obtained from mock observations, we can estimate the ALMA and SMA contributions to constrain errors of source count models. SMA observations will reduce the fitting error bar of the slope of Sky 1 from -2.2 ± 0.14 to -2.2 ± 0.10 when the total time budget is 1000 hours and each pointing is 20 hours. For Sky 2, the SMA 1000-hour observation of 20 fields can reduce the error bar both in faint and bright end. The slope and error of faint end will be reduced from -1.05 ± 0.71 to -1.05 ± 0.40. If the total time budget is the same for ALMA, and observation time per pointing is set as 1 hours. the error of Sky 2 will be reduced from -1.05 ± 0.71 to -1.07 ± 0.30. This improvements can help us study source evolutions.

Current SMA testing reveals that our estimate of sensitivity is 3 times better than that of current status of SMA. The SMA observation of APM 08279+5255 of one track, 10 base lines and 1 GHz bandwidth gives the rms as 10 mJy. Although SMA is not design for resolving the submillimeter sky or carrying out a large sky coverage survey, the success of SMA observation of extragalactic source shows that SMA is able to help us answer the question about the natures of submillimeter sources, for example, high angular resolution will provide accurate positions of submillimeter sources for multiwavelength observations. We believe the sensitivity will be better when the system of SMA become stable. We also exam our simulation results using the updated SMA information. The total observation times and strategies are also shown for SMA to carry out SCUBA follow up observations.

Our study also shows that SMA can make more contributions in studying the SFR at high redshifts. SMA is able to observe submillimeter sources at $z = 3$, if we assume the a source has a M82-like SED and its luminosity equal to $4 \times 10^{12} L_{\odot}$. The photometric redshift can be obtained from observed 850/450 μm flux ratio, which is based on local ULIRG SED. The SFR can be calculated from 60 μm luminosity, which is converted from 850 μm luminosity. Then the 850 μm flux is taken into formula to calculate dust mass . For a submillimeter source, whose L_{60} is 4×10^{12}L$_\odot$ at $z = 2.5$, it represents the SFR equal to 880 M$\odot$ yr^{-1}and its dust mass is 5.5×10^8 M$_\odot$. The high sensitivity of ALMA enables us to observe sources at $z = 12$. In other words, if we can observe these submillimeter sources at different epochs, we can trace the star formation history of dusty galaxies, which are absent in optical bands.