Seven Element Bolometer Array for the Nobeyama 45-m Telescope(Abstracts of Doctral Dissertations)

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for the Nobeyama 45-m Telescope

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Abstract

1. Introduction

Improving the sensitivity of detectors has been a problem for near-millimeter/submillimeter astronomy. And development of array systems is necessary to progress the efficiency of observation. An array of detectors is more advantageous than a single detector. By using an array of detectors, it is possible to measure the atmospheric fluctuations while simultaneously observing astronomical objects. The bolometer is most sensitive detector for near-millimeter/submillimeter band. We have developed seven element bolometer array for the Nobeyama 45-m telescope. In this chapter we explain the background of our study.

2. The Nobeyama Bolometer Array

The characteristics of the array are described in this chapter. AC bridge readout technique is adopted for the array. By this technique, we can make modulation frequency larger than 1/f knee of the read out circuit noise without the restriction due to the thermal time constant of the bolometer by making the frequency of AC bias larger than the 1/f knee.

3. Receiver

The detail of the array system is described. The optical design, the performance of the bolometers and AC bridge readout circuit are explained.

4. Operation

The operation of the array is described. The ways of mapping, pointing and calibration with the array are described. The responsivities of the bolometers are corrected by using the correlation between the sky temperature as monitored by the center bolometer and each bridge outputs.

5. Data reduction

We have developed a new reduction method to restore a source image from six differential outputs. With the AC read out technique and this new method, we can eliminate a mechanical beamswitching system.

6. Performance

The performance of the array system is described. We have achieved the detection limit of 50mJy/$\sqrt{Hz}$ in good sky condition, which is now most sensitive millimeter observation system in the world. Moreover, the efficiency of observation is improved by using the array.

7. Observation of M82

The results of the observations of M82 with the array are shown. The map shows the spurlike features. They correspond to those seen in the molecular gas distributions. We suggest that these are dust outflows driven by successive supernovae explosions in the central region. The features are consistent with the cylinder-model.

8. Summary

The study is summarized in this chapter.