Developments of a Multi-Fourier Transform interferometer

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Abstract
Developments in direct detection technologies are clue to high-sensitivity continuum and wide-band spectroscopic observation in terahertz frequencies, expecially for future space-based astronomical observatories. Here we presents recent developments in aperture systhesis interferometers using direct detectors for use in astronomical observations. The interferometer use Martin-Puplett type interferometer to obtain mutual correlation of input signals from two apertures. A bolometer is used to measure an interferograms, or mutual correlation, which is fourier transformed to obtain spectral information. The mutual correlation is measured at various baseline configuration of two input apertures to obtain complex spectral informations, which is then fourier transformed in baseline vector plane to obtain a two dimensional image of source distribution. The Martin-Puplett type interferometer is advantageous for wide-band measurements in terahertz frequency range as well as polarization measurements. This aperture synthesis method is demonstrated in laboratory measurement using blackbody source with various shape of masks in front of it. One of the great advantage of this interferometer is that, because of the wide frequency coverage, UV plane is well sampled by many frequency components within the bolometer bandwidth and dynamic range and image quality is enhanced, as well as advantage in wide-band sensitivity of direct detectors. We have started measurements in Nobeyama Radio Observatory using a 700mm aperture heliostat combined with 50mm double input aperture interferometer. A liquid helium cooled 1.5K bolometer is used for the interferometry experiments to observe Sun and Moon. An 0.3K bolometer is in preparation to measure molecular clouds and Sunyaev-Zel'dovich effect of nearby clusters of galaxies. Combined with superconducting direct imaging detectors, now under developement, the Martin-Puplett type aperture synthesis interferometer will be a powerful tool for wide-field imaging, spectroscopy and polarimetry in terahertz frequency range.