A wideband analog correlating spectrometer for millimeter astronomy

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Abstract

This project developed an analog correlating spectrometer intended for use in millimeter Astronomy. It is based in part on the Wideband Analog Spectrometers (WASP and WASP-II) built by Harris, et al (See Harris, et al, (1998), and Harris and Zmuidzinas, (2001)). Like WASP, we use tapped microstrip traces etched on a circuit board as delay lines to produce the autocorrelation function (ACF) of the incoming signal. We then get the spectrum by taking the Fourier Transform of the ACF.^ A major innovation of our design is the use of a single delay line (per segment) where the signal to be analyzed is launched on to the same delay line from either end. We produce the discrete autocorrelation function of the incoming signal via resistive taps coupled to detector diodes. Multiplication of the signals from each end is accomplished using the detector diode characteristics, along with phase switches and synchronous detectors, eliminating the need for expensive Gilbert Cell multipliers.^ We designed, built, and tested a complete prototype system with a bandwidth of 6.7 GHz and a resolution of 31 MHz. In this work we describe the detailed design, operation and performance of the prototype spectrometer.^ The work culminated with the observation of several nearby galaxies; M82, NGC253, IC342 and NGC1068 as well as Sagittarius B2 and Venus, using the prototype spectrometer. We used the FCRAO 14 meter radio telescope with the SEQUOIA receiver, which covers from 85 to 115.5 GHz. Our observations produced continuous spectra over 4 bands, giving near continuous coverage from 86 GHz to 115.5 GHz.^

Subject Area

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