A 9-beam 2SB Receiver for Millimeter-wave Radio Astronomy

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Abstract

A 3x3 multi-beam receiver is being developed for Delingha millimeter telescope, the major open facility for millimeter-wave radio observation in China, aiming to significantly enhance the mapping capability in millimeter-wave line observation. The receiver employs sensitive SIS mixers, working over 85-116GHz frequency range. Sideband separation (2SB) scheme is adopted to enable high-precision calibration procedure and to reduce the idle sideband noise especially when the atmosphere transparency is not good in some seasons. The SIS mixers were designed to have nearly constant dynamic resistance and uniform conversion gain, allowing stable bias and direct connection of the SIS mixer and the cryogenic low noise amplifier without an IF isolator. Besides, low noise and stable digital SIS bias circuit has been designed to operate the SIS mixer efficiently. The nine 2SB mixers are driven by a single LO signal source. Two stages of cascaded power dividers realized by 6-branch line directional couplers distribute the LO signal with good isolation between paths. The LO is generated by a frequency synthesizer followed by an amplifier-multiplier module providing output put power not less than 10mW across the RF band. The IF band is centered at 2.64GHz and bandwidth 1GHz allowing simultaneously observing three CO lines ($C^{18}O$, ^{13}CO and ^{12}CO), which has been proved to be an efficient observation mode in probing a broad range of gas density. The nine pixels yield 18 independent IF outputs. Each of them is processed by a digital FFT spectrometer with 200MHz-1GHz reconfigurable bandwidth and 16384 channels, which has obvious merits over the present analog AOS system to form a compact and reliable backend system for focal array receiver. In this symposium the design and the performance of this multi-beam receiver will be presented.