HIGH SENSITIVITY SIDEBAND-SEPARATING RECEIVERS FOR MILLIMETER ASTRONOMY: ACHIEVING THE ULTIMATE IN ASTROPHYSICAL SPECTROSCOPY

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High resolution rotational spectroscopy of astronomical objects has usually been limited by receiver sensitivity, narrow instantaneous IF bandwidth, and image contamination arising from the heterodyne nature of these devices. Through a joint collaboration between the Arizona Radio Observatory (ARO) and the Central Development Laboratory of the National Radio Astronomy Observatory (NRAO), new receiver architecture has been developed and put in use on the ARO Submillimeter Telescope (SMT) on Mt. Graham, Arizona, that overcomes many of these limitations. This design, utilizing sideband-separating mixer technology, allows for a wide instantaneous IF bandwidth of 8 GHz and the availability of both upper and lower sidebands simultaneously, with at least 15 dB rejection of the respective image sidebands. The receiver implements the mixer design developed for the ALMA project (Band 6: 211-275 GHz) and has been used successfully for astronomical measurements at the SMT–the first time this type of system has been employed for actual observations. At 230 GHz, single-sideband system temperatures on the sky were 120 K, with $>$20 dB image rejection in the LSB and 10-15 dB rejection in the USB. Approximately 1.5 GHz of bandwidth was simultaneously measured in each sideband for a total of 3 GHz instantaneous bandwidth, limited by the current spectrometer backends at the SMT. Baselines over this frequency range were excellent, even in position-switching mode with a 4^o offset. Multiple line searches have been conducted using this new receiver at the SMT in the 211-275 GHz range towards Sgr B2(N), W51M, VY Canis Majoris, and IRC+10216. In several sources, the confusion limit (3 mK rms) was quickly achieved in about an hour of observing. Observational and technical results will be presented.