INTERFEROMETRIC POLARIMETRY: CALIBRATION AND RESULTS FROM THE SMA

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The Submillimeter Array (SMA) is an 8-element interferometer on Mauna Kea. The array is presently equipped with single, linearly-polarized feeds in each of three bands: 183–245, 265–354, and 600–700 GHz. An experimental polarimetry system has been installed, which uses narrow-band quarter-wave plates to generate circularly-polarized feeds. Two sets of waveplates allow polarimetry in all three bands, with one set tuned to 348 GHz, and the second set tuned to 230 (quarter-wave retardation) and 690 GHz (three-quarter wave retardation) for simultaneous polarimetry in two bands. The waveplates are quartz, with low-density polyethylene anti-reflection coatings. They are mounted in motorized rotation stages under computer control, allowing rapid switching between left- and right-circular polarization (LCP and RCP) sensitivity. All four combinations of LCP and RCP on each baseline are efficiently sampled by switching the antenna polarizations in period-16 Walsh function patterns, with full cycles requiring four to seven minutes for typical integration times.

Since its installation in 2004, the polarimetry system has received extensive testing and calibration. Cross-polar contamination ("leakage") is measured through observations of bright, linearly-polarized quasars, with the leakages and source polarization simultaneously determined. The use of a single linear feed to measure both circular polarization states fixes the relative phase of the LCP and RCP feeds (zero phase offset); with separate feeds this phase freedom corresponds to an arbitrary rotation of the sky polarization and can only be determined through observations of a source with known polarization position angle. Here we present the results of our commissioning observations. We discuss the frequency dependence of the leakages, which limits the frequency range over which each waveplate can produce reliable polarization images. Calibration observations of multiple quasars and unpolarized sources have been obtained together to provide cross checks on the derived leakages. With these data we examine calibration stability, measurement repeatability, and polarization image fidelity. Finally, we show sample science observations in all three observing bands.

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