WMAP - RESULTS AND LESSONS LEARNED

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The Wilkinson Microwave Anisotropy Probe (WMAP) has measured intensity and linear polarization of the emission of the full sky in 5 frequency bands between 22 and 100 GHz. The angular resolution ranges from 0.9 degrees at 23 GHz to 0.2 degrees at 94 GHz. The average instrument noise in each 0.3 square degree pixel will range from 19 muK at 23 GHz to 23 muK at 94 GHz after 4 years of integration. The WMAP instrument is differential, measuring the difference in temperature in one polarization between two telescopes pointing 135 degrees apart on the sky. The main scientific goal of the experiment is to characterize the Cosmic Microwave Background Radiation (CMBR) in order to constrain models of early universe evolution and cosmological parameters. The extraction of information from the CMBR requires the spatial autocorrelation of very low contrast temperature and polarization signals in the presence of relatively bright foreground signals with differing emission spectra. A number of stringent instrument performance requirements and the need for detailed characterization of the receivers and telescope optics follow from the science goals and the nature of the signal. The accuracy of the final maps and science results depend most strongly on control and knowledge of the following parameters. 1) The frequency band passes, especially for the polarization measurement. 2) The radiometer white noise 1/f knee frequency. 3) Knowledge of the beam of the telescope and the polarized beam. 4) Knowledge of the far-sidelobe telescope response. 5) The total beam solid angle and the instrument gain. 6) The gain imbalance between the two beams.

Flight operations, now three years, have been nominal. In flight, the radiometers have followed pre-flight measured parameters closely except for the radiometer offsets. A radiometer gain model has been added after launch making use of the radiometer total power monitor to interpolate the gain measurement which uses the CMBR dipole. In flight measurements of the beam far sidelobes made using the moon during the lunar phasing loops in the first month after launch have been important for generating the final telescope beam far-sidelobe model. The WMAP radiometers were configured principally to optimize the measurement of the temperature power spectrum specially at large angles. The configuration is not optimal for the extraction of polarization information requiring differences between different radiometer signals. The nature of the analysis needed to cope with these non-idealities will be discussed.