A Resistive Wideband Beam-Splitter Screen

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We present the design, construction and measurements of the electromagnetic performance of a wideband space beam splitter. The beam splitter is designed to power divide the incident radiation into reflected and transmitted components for interferometer measurement of spectral features in the mean cosmic radio background. A 2-element interferometer configuration with a vertical beam splitter placed at the geometric center of a pair of antennas is analyzed. The antenna pair is potentially sensitive to the uniform component of the sky brightness; therefore, we refer to this configuration as 'zero-spacing interferometer'. Maximizing the sensitivity to this component leads to the requirement that the beam splitter be a resistive sheet with sheet resistance $\eta_o/2$, where η_o is the impedance of free space. The transmission and reflection properties of such a sheet is computed for normal and oblique incidences and for orthogonal polarizations of the incident electric field. We have constructed such an electromagnetic beam splitter as a square soldered grid of resistors of value 180 Ohms (approximately $\eta_o/2$). The grid size will set an upper limit of frequency up to which the grid may be approximated as a continuous sheet. Through analytical calculations, it was inferred that 0.125λ of grid size leads to 10% loss in correlator output. We present measurements of the reflection and transmission coefficients of the constructed beam splitter over a wide frequency range between 50 and 250 MHz in which the wavelength well exceeds the mesh size. Our measurements of the coefficients for voltage transmission and reflection agree to within 5% with physical optics modeling of the wave propagation, which takes into account edge diffraction.