# MINIMIZATION OF CASSEGRAIN SPILLOVER NOISE FOR ARRAY RECEIVERS

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## ABSTRACT

Although Cassegrain antennas are superior to prime-focus fed reflectors for ground spillover noise, the pick-up of ambient radiation from diffraction at the rim of the secondary is nevertheless an important contribution to the received signal. Nutating secondary mirrors are commonly used to enable subtraction of atmospheric noise on a time-scale that is short compared to atmospheric fluctuations. While this removes most of the sky noise, the asymmetry of the diffraction spillover with offset array feeds produces a non-zero signal after the differencing process. This residual has to be removed by, for example, an observation of nearby blank sky. Typical diffraction spillover is at the level of a few percent, contributing noise on the order of a kelvin. For offset feeds the difference between the two positions of the secondary may be of a comparable magnitude to this. Very sensitive total-power systems such as bolometers can detect signals at the mK level, so suppression of the synchronous noise pick-up needs to be good to much better than 0.1 %.

Feed offset, antenna optical geometry, the angular throw of the secondary mirror, and the observing wavelength all affect the severity of the noise pickup. We evaluate the magnitude of these effects and discuss the scaling with the relevant instrumental parameters. As examples we use the IRAM 30-m telescope and the SEST 15-m telescope. A Physical Optics calculation is used to get a realistic estimate of the diffraction spillover from the secondary.

The diffraction generally spans an angle of a few degrees outside the geometrical optics region (which usually co-incides with the rim of the primary mirror). Since this spillover varies as the square root of the wavelength the effect is not strongly frequency dependent and can be significant even in the submillimeter regime.

Several different schemes that may be used to reduce the systematic errors are evaluated and compared. Undersizing the secondary mirror reduces the amount of diffraction past the primary mirror, but results in slightly reduced aperture efficiency. Addition of a shield round the primary avoids this problem, but adds to the dimensions of the antenna, with ramifications for clearances and wind-loading. An annular shield may be added just in front of the secondary mirror, producing a diffraction edge that does not change with secondary mirror nutation. This solution also has the advantages that it is an easy retro-fit to existing antennas and can be removed if required. Another possible solution that is discussed is the use of a cold stop at the image plane of the secondary mirror.