ANALYSIS OF THE OFFSET QUASAT ANTENNA

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ABSTRACT. In the ESA phase A of the Quasat project the use of a 10 m offset antenna, has been suggested (1). In the present work the use of the multifrequency coaxial feed, developed by ESA for the symmetric configuration, is analyzed with a multireflector configuration. The coaxial feed has the advantage of a more compact configuration. However reduced efficiency and higher cross polarization are expected at the lower frequency, due to the scattering on the subreflector surfaces.

THE OFFSET REFLECTOR AND THE COAXIAL FEED

The major disadvantage of the offset configuration is the depolarization effect which introduces beam squint (2). In a prime focus configuration multifrequency operation would imply the use of a complex feed (i.e. cluster of corrugated horns or dichroics). Multireflector may be used in order to compensate depolarizing effects and to change the feed configuration. In the assessment phase, ESA has commissioned to CSELT the development of a multifrequency feed prototype for the prime focus symmetric reflector. The system is composed of an innner circular waveguide feed at 22.2 GHz surrounded by two waveguide feeds at 4.9 and 1.6 GHz. Aperture and spillover efficiencies of about 0.7 are obtained for symmetrical parabolic reflectors, having f/D=0.43.

THE MULTIREFLECTOR OFFSET ANTENNA

Ray tracing has been used in order to match the sequence of quadric surface reflectors to the radiation pattern of the coaxial feed. A possible configuration, based on clear aperture, is shown in fig.1. An ellipsoid is used in order to concentrate the feed broad beam on the hyperboloid of the Cassegrain antenna. Physical optics analysis (3) has been applied to the quadric surface multireflector antenna. The scattered field of the feed-ellipsoid system has been analyzed at 1.6 GHz. The result is shown in fig 2a. Examples of hyperboloid and primary reflector scattered fields are reported in figs 2b and 2c. A

M. J. Reid and J. M. Moran (eds.), The Impact of VLBI on Astrophysics and Geophysics, 447–448.

https://doi.org/10.1017/S0074180900135235 Published online by Cambridge University Press

clear aperture multireflector design offer a superior performance compared to the standard symmetric system in terms of blockage efficiency. The shaping of the surface by means of geometrical optics synthesis analysis (4) can improve the aperture and spillover efficiency. In Table 1 a budget, limited to some of the total efficiency parameters, is shown (5).

TABLE 1

Efficiency	Symmetric quadric	Offset quadric	Offset shaped
Illumination	0,83	0,83	0,99
Spillover	0,94	0,94	0,99
Blockage	0,85	1,00	1,00

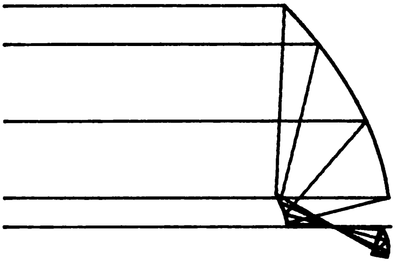

Figure 1. Clear aperture configuration.

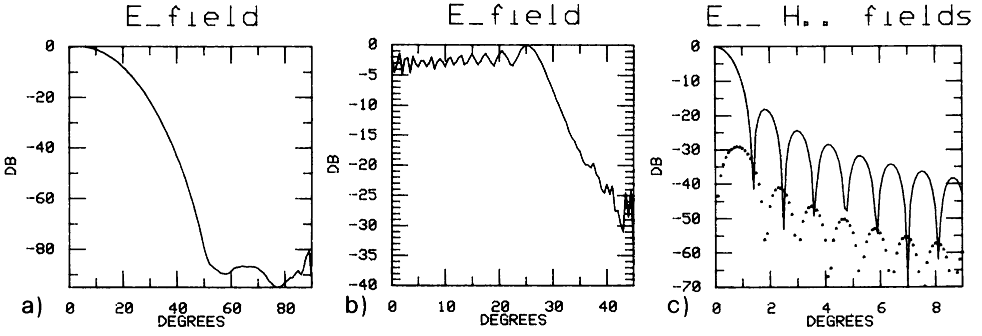

Figure 2. Scattered fields from:
2a) Ellipsoid; 2b) Hyperboloid; 2c) Primary Reflector.

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https://doi.org/10.1017/S0074180900135235 Published online by Cambridge University Press