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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

HAYSTACK OBSERVATORY

WESTFORD, MASSACHUSETTS 01886

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Telephone: 508-692-4764
Fax: 617-981-0590

To: Holographers

From: Alan E.E. Rogers AEER

Subject: Proposal to use various offset mirrors to improve 80-120 GHz radiometry

The beam switcher being built by Joe Crowley has a mirror in the offset beam which can be shaped for various purposes.

1] Flat mirror

Initial uses of the beam switcher will use a flat mirror. Because the off-axis path has an additional 12" path the off-axis beam will be out of focus. For double-Dicke switching in which the source is alternately placed in the main and offset beams I suggest that a 0.12" subreflector refocus be applied when the source is in the off-axis beam.

2] Convex mirror

A convex mirror could be used to correct the 12" focus error in the off-axis beam. Unfortunately the curved mirror also changes illumination. A convex mirror broadens the illumination and increases the over-illumination. A compromise mirror which corrects only 8" of focus so that each beam would be only 2" out of focus (0.02" at subreflector) has been designed. Calculations show that this mirror will reduce efficiency by about 10%. Because of the loss this mirror may be of little utility.

3] Concave mirror

A concave mirror can be used to narrow the illumination and in theory improve the aperture efficiency at 86 GHz in the off-axis beam. The limiting factor in changing the illumination is the large focus change which cannot be completely corrected by subreflector refocus. Subreflector refocus is limited by spherical aberration. 20" of change in secondary focus position (0.2" forward motion of subreflector towards the box) towards the back of box produces 17 mils (34 mils path length) of equivalent surface deviation at the edge of the dish with ρ^4 dependence. This amount of spherical aberration can be largely corrected by an additional focus shift (for a total of 0.24" subreflector motion) so that the net rms increase is only 3 mils. Figure 1 shows a schematic of the optics. Since the mirror is in the far field of the feed the ray optics should be reasonably accurate. The mirror curvature alters the illumination by 36/28=1.28 which is close to frequency ratio 112/86 and should increase the edge taper from 5 to 10 dB which should increase the aperture efficiency by 25% or more.

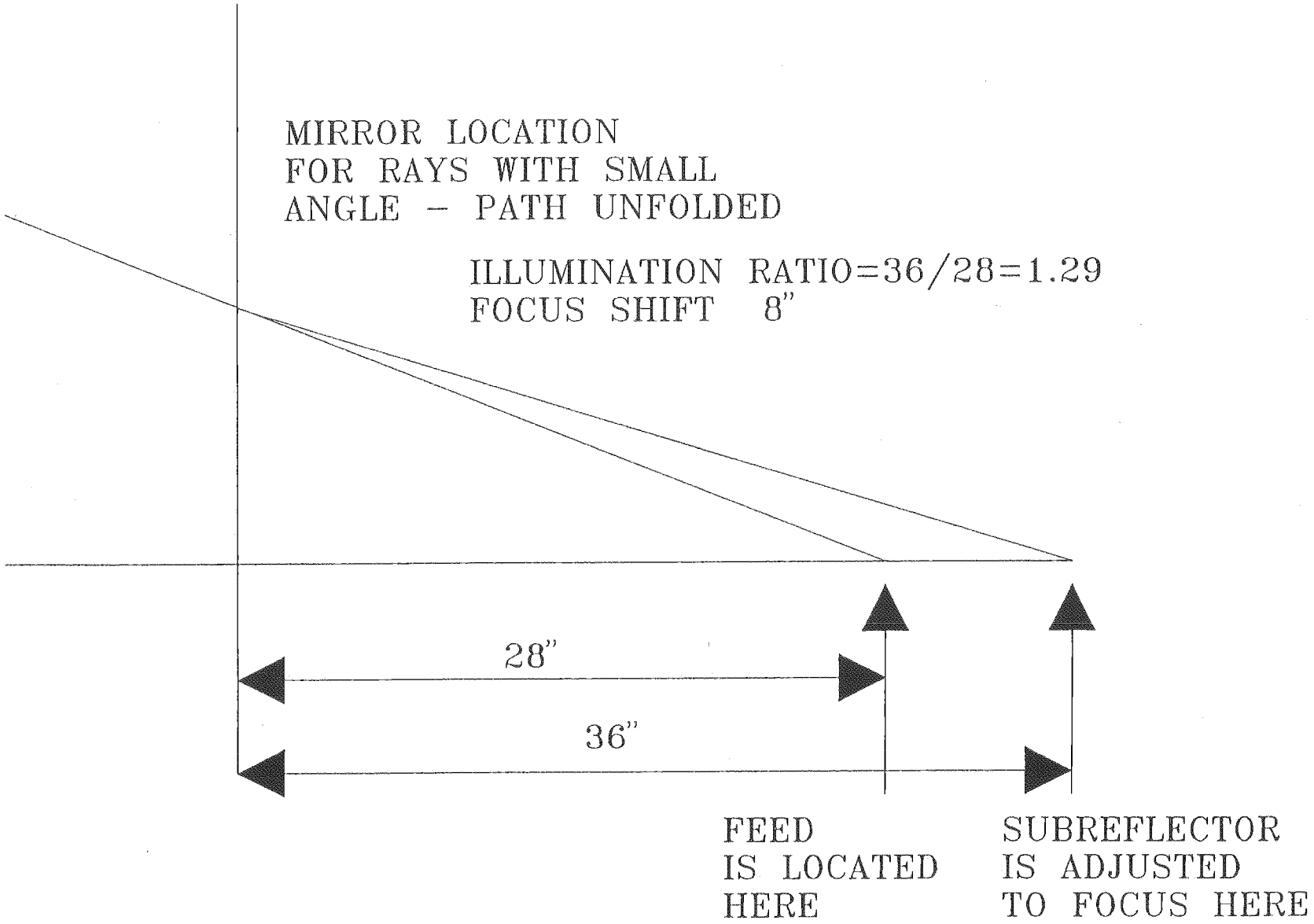

Figure Ray optics for concave offset mirror