KFPA Beam Spacing

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The table below gives the array beam spacing S, in units of FWHM beamwidths, for two values of center-center feedhorn spacing. 8.8 cm (3.45 in) is the current design feed spacing, and 7.1 cm (2.8 in) is the minimum value felt possible (but difficult). Smaller yet would require redesign of the OMT and possibly other components, outside the scope of the current project.

Freq	Lambda (cm)	FWHM (asec)	S (8.8 c-c)	S (7.1 c-c)
18	1.67	40	2.3	1.9
22	1.36	32	2.8	2.3
26.5	1.13	27	3.4	2.8

The GBT full-width-half-maximum beamwidth is approximately:

$$FWHM = 66° / D / \lambda = 23.8 \text{ (asec)} * \lambda \text{ (cm)}$$

The pointing coefficient for lateral feed offsets is taken from GBT Memo 155:

$$PC = 10.5 \text{ arcsec/cm} = 26.7 \text{ arcsec/inch.}$$

Using this value, the beam spacing for 8.8 cm c-c feed spacing is 92 asecs. For 7.1 cm c-c feed spacing, 75 arcsecs.

Combining the two previous equations, the feed spacing to achieve one FWHM beam spacing can be expressed in terms of wavelengths:

$$S_{1FWHM} = 2.28 \lambda$$

Therefore, to achieve 2 FWHM beam spacing, the required feed c-c spacing is 4.56 λ or 6.2 cm (2.45 in) at 22 GHz.

To summarize, there is reasonable confidence the 3.45 inch spacing can be achieved. Spacing down to 2.8 inches will be difficult physically but may be possible with some degradation in performance (cross-polarization, spillover efficiency). The magnitude of degradation is to be evaluated.