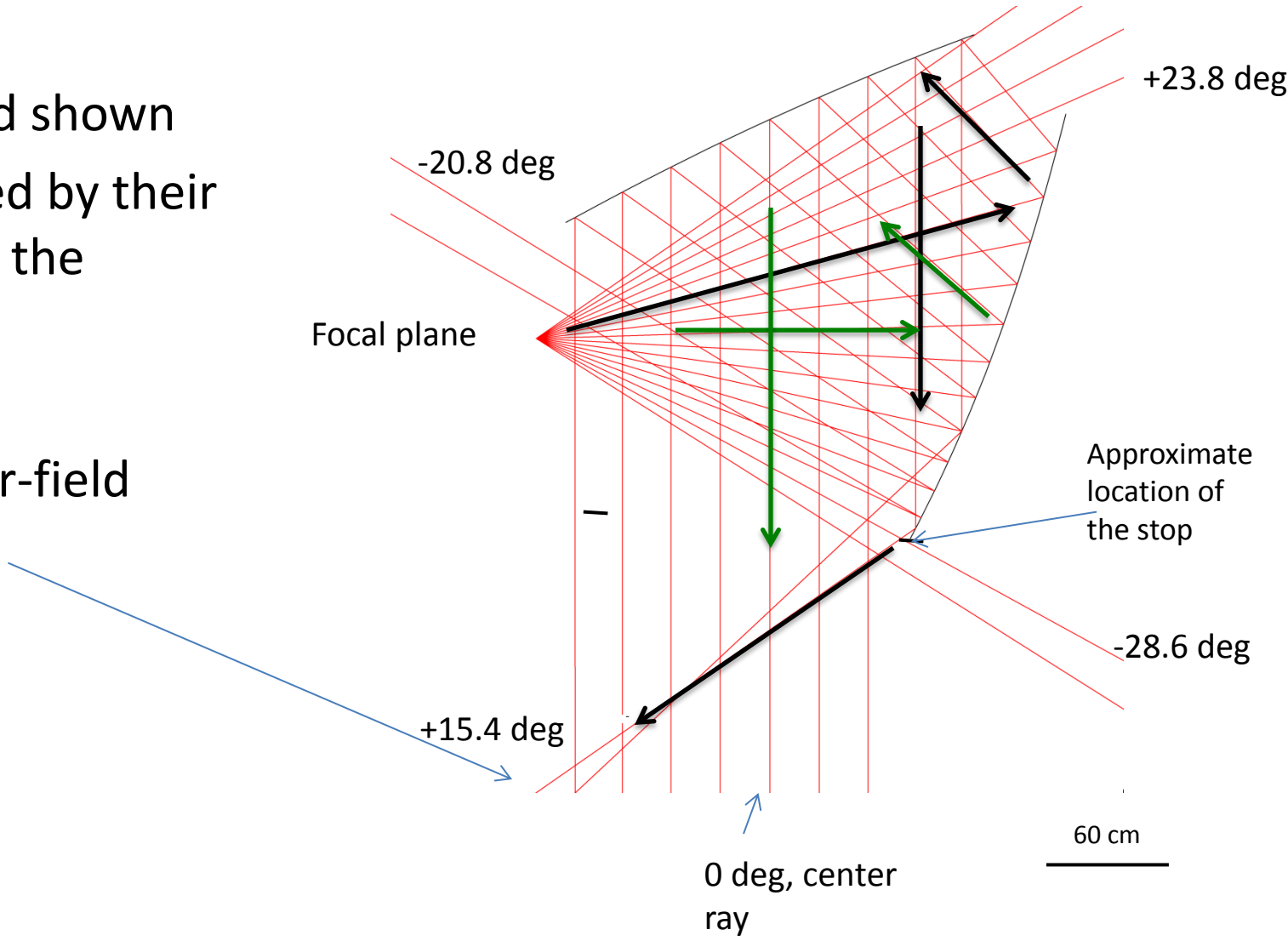
Stray light analysis and DLFOV

UMN, July 31, 2017

- Analysis done by ray tracing in CodeV. No pixel beamforming parameters or diffraction are accounted for.

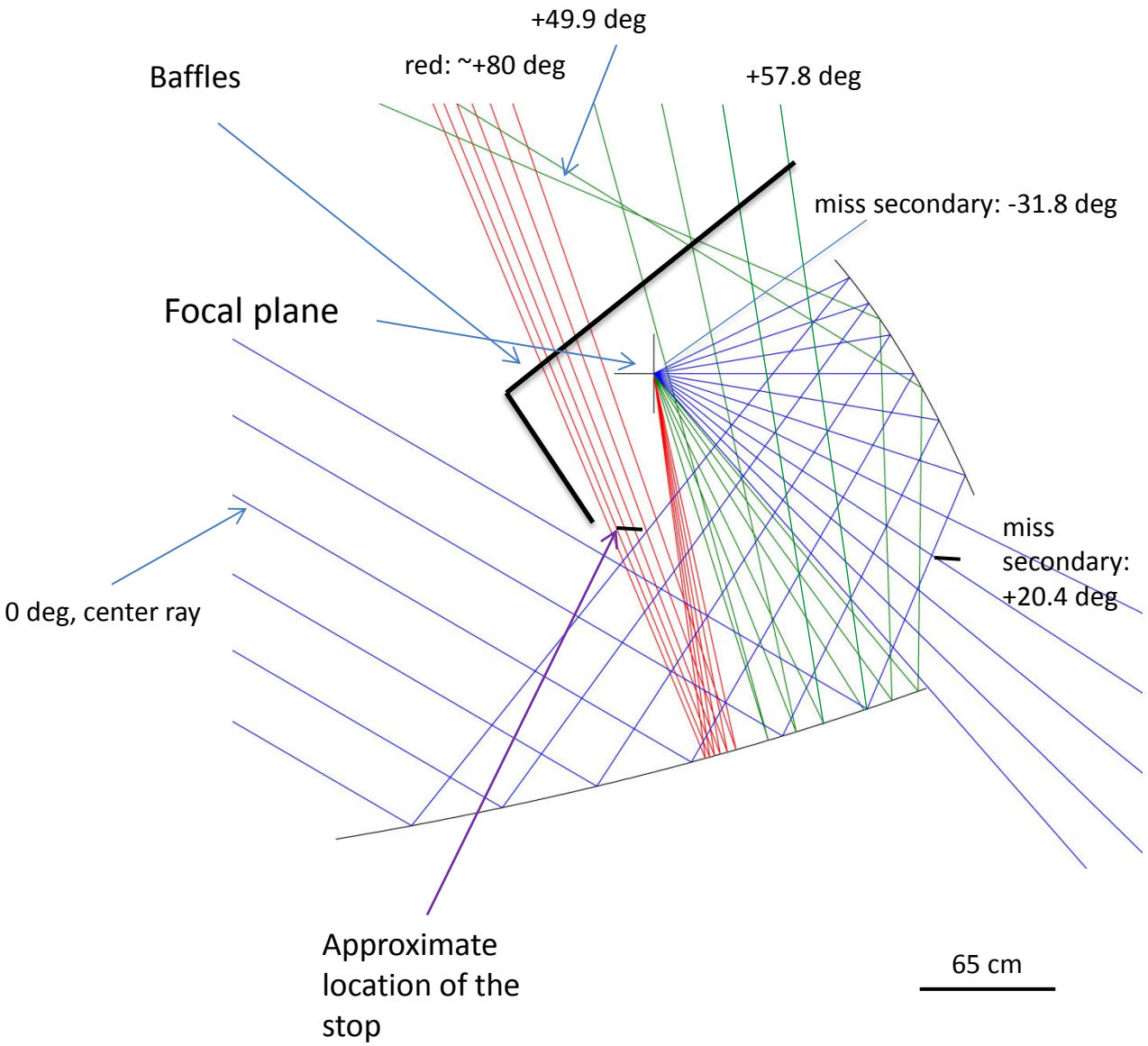
Stray light for 1.4 m crossed dragone

- Center feed shown
- Rays labeled by their angle from the center ray.
- Strong near-field sidelobe.



Stray light for 1.4 m open dragone

- Center feed shown
- Baffling is simpler than the crossed dragone
- Analysis is independent of stop location



Focal plane size comparisons

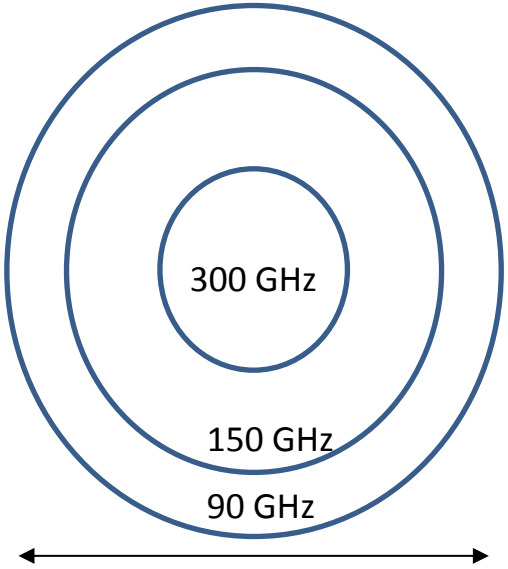
- Goal: compare DLFOV of optical systems with different f-numbers
- Diffraction limited field of view (DLFOV) where Strehl > 0.8
- At fixed edge taper (a), pixel size depends on f-number(F) and wavelength,

$$D_{pixel} = a\,F\lambda$$

- Number of pixels depends on D (not just wavelength)
- To compare systems we assume a=1.
- At each lambda we count the number of Dpixel in the DLFOV
- # = DLFOV (cm)/ Dpixel (cm)

giving the number of F*lambda diameter pixels that fit in the diameter of the DLFOV

Typical focal plane
Contours at 80 % strehl

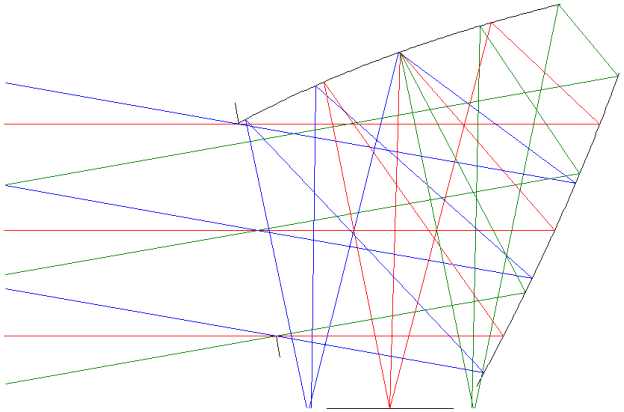


D focal plane at 90 GHz = 50 cm

Comparing crossed and open Dragones

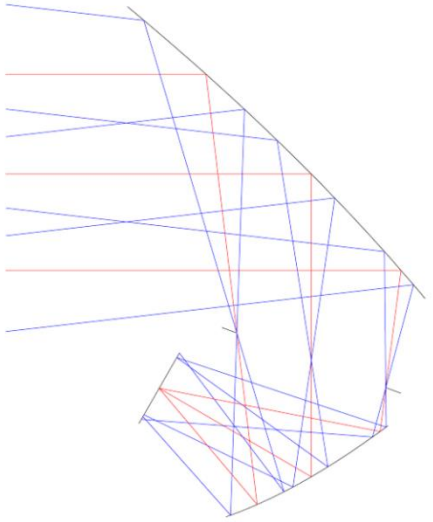
1.4 m crossed, F = 2.14

Frequency	Lambda	Focal Plane Diameter		Focal Plane Diameter	
		X	Y	X	Y
(GHz)	(mm)	(cm)	(cm)	(Fλ)	(Fλ)
70	4.285714	97.9	78.7	106.7	85.8
100	3	77.2	74.1	120.3	115.4
150	2	57.4	53.4	134.1	124.6
220	1.363636	42.3	38.5	145.1	132.0
350	0.857143	28.1	24.9	153.0	135.7
500	0.6	19.6	17.0	152.8	132.5



1.4 m open, stop between mirrors, F = 1.5

Frequency	Lambda	Focal Plane Diameter		Focal Plane Diameter	
		X	Y	X	Y
(GHz)	(mm)	(cm)	(cm)	(Fλ)	(Fλ)
70	4.285714	40.4	36.4	62.8	56.5
100	3	30.9	28.3	68.7	62.9
150	2	22.0	20.8	73.3	69.2
220	1.363636	15.6	15.2	76.4	74.3
350	0.857143	10.1	10.1	78.3	78.3
500	0.6	7.1	7.2	78.7	79.9



Comparing crossed and open Dragones

- In this case, the open dragone provides about 60% the usable focal plane diameter of the crossed.
- Re-checking results for CORE
- And comparing open and crossed with same f-number to understand performance difference.