Dragone Telescope Trade-off Study

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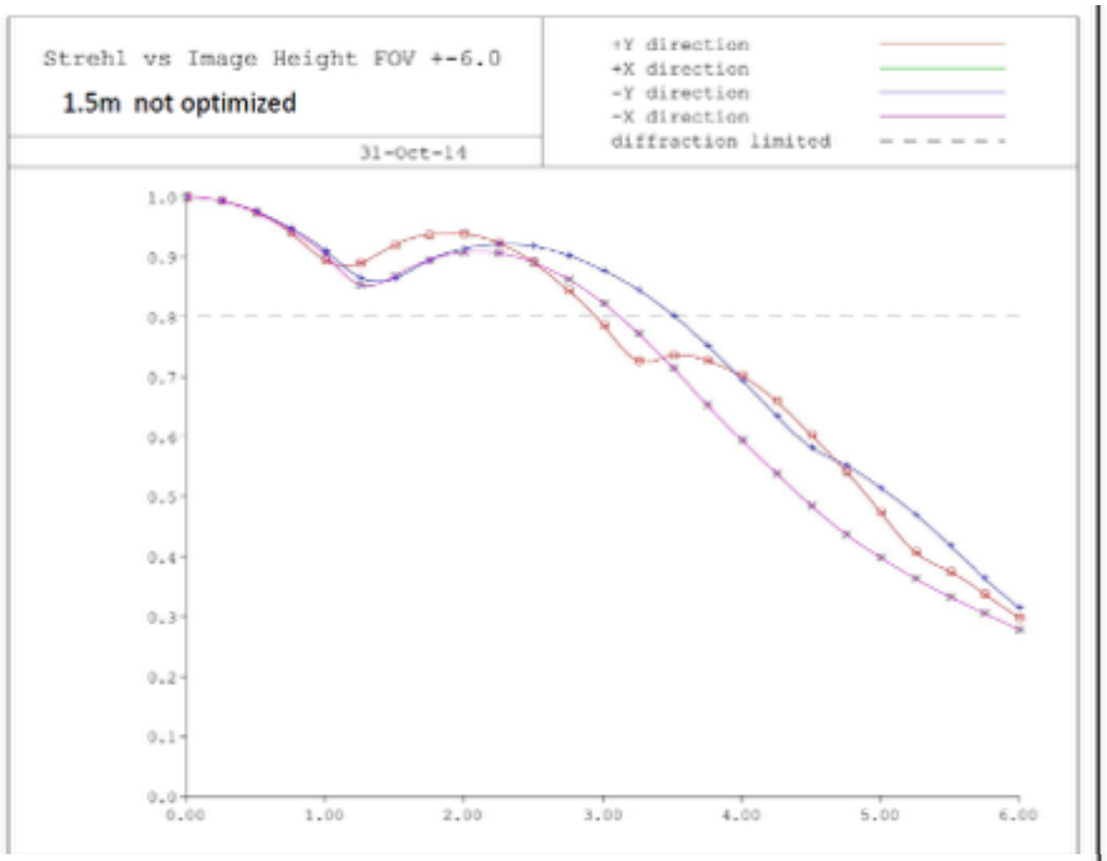
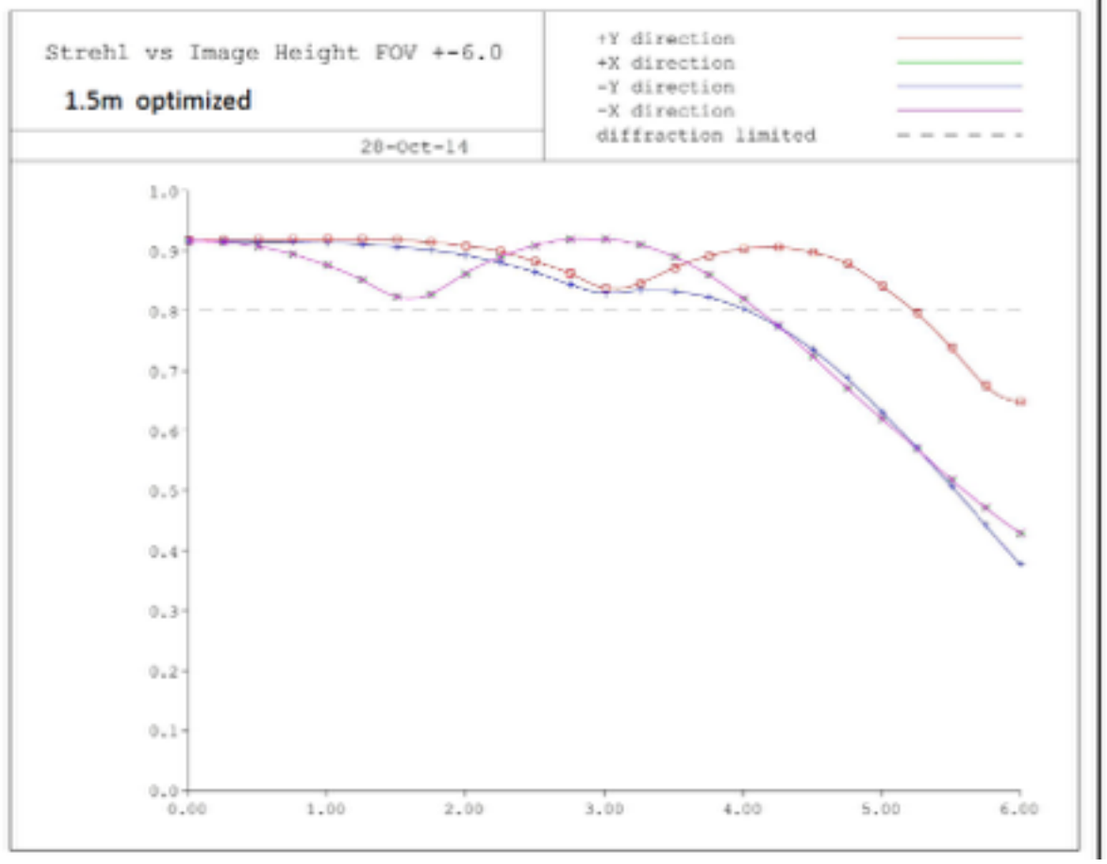
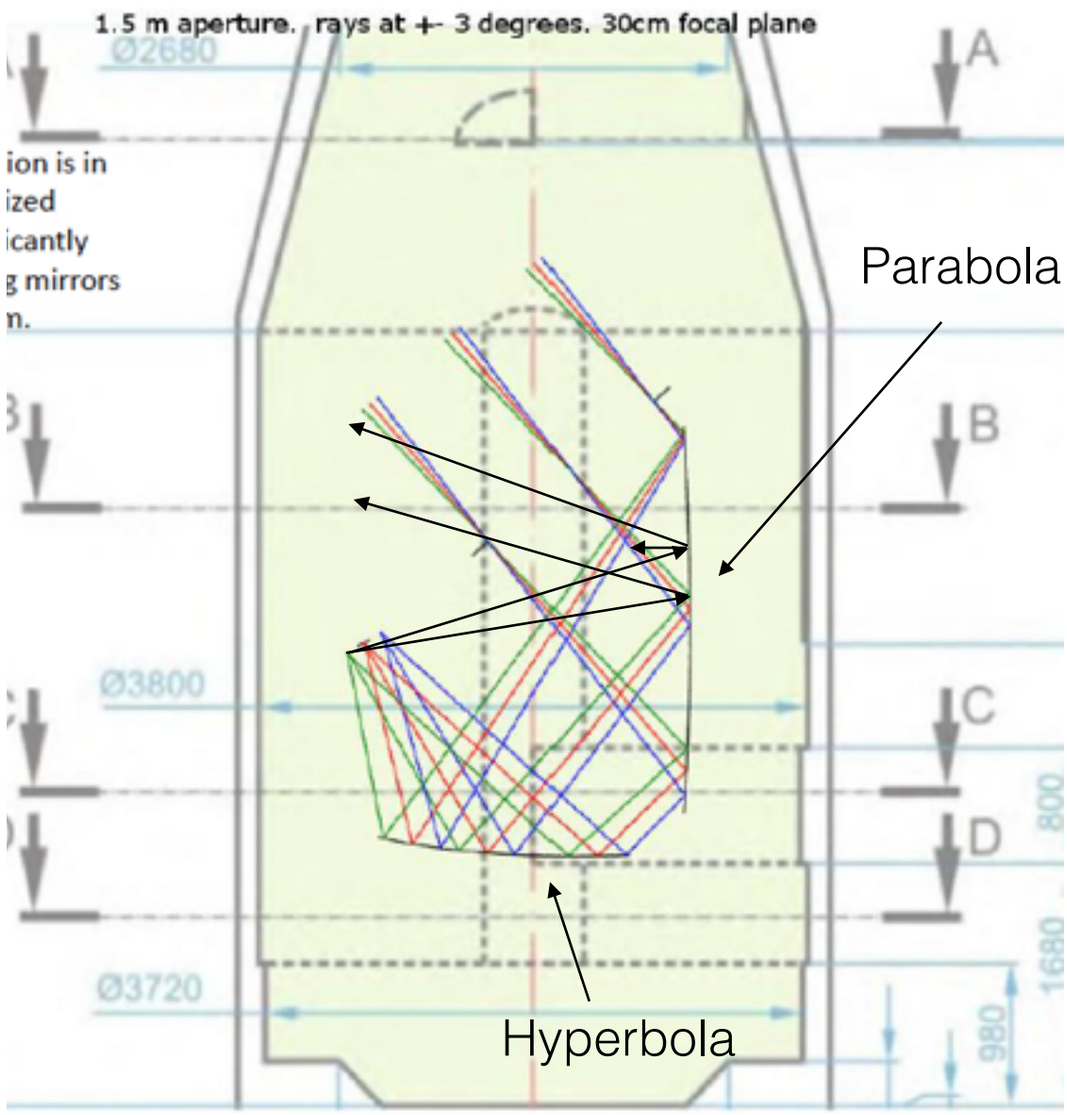
Common Threads

- Compare crossed, front-fed, and Gregorian Dragone designs
- All f#~2
- No reimaging optics
- Use plain conics, and optimize with higher order aspherics at 150 GHz (more details in additional slides)
- Fit 1.5 m aperture in shroud

Front Fed Dragone - I - Front Stop

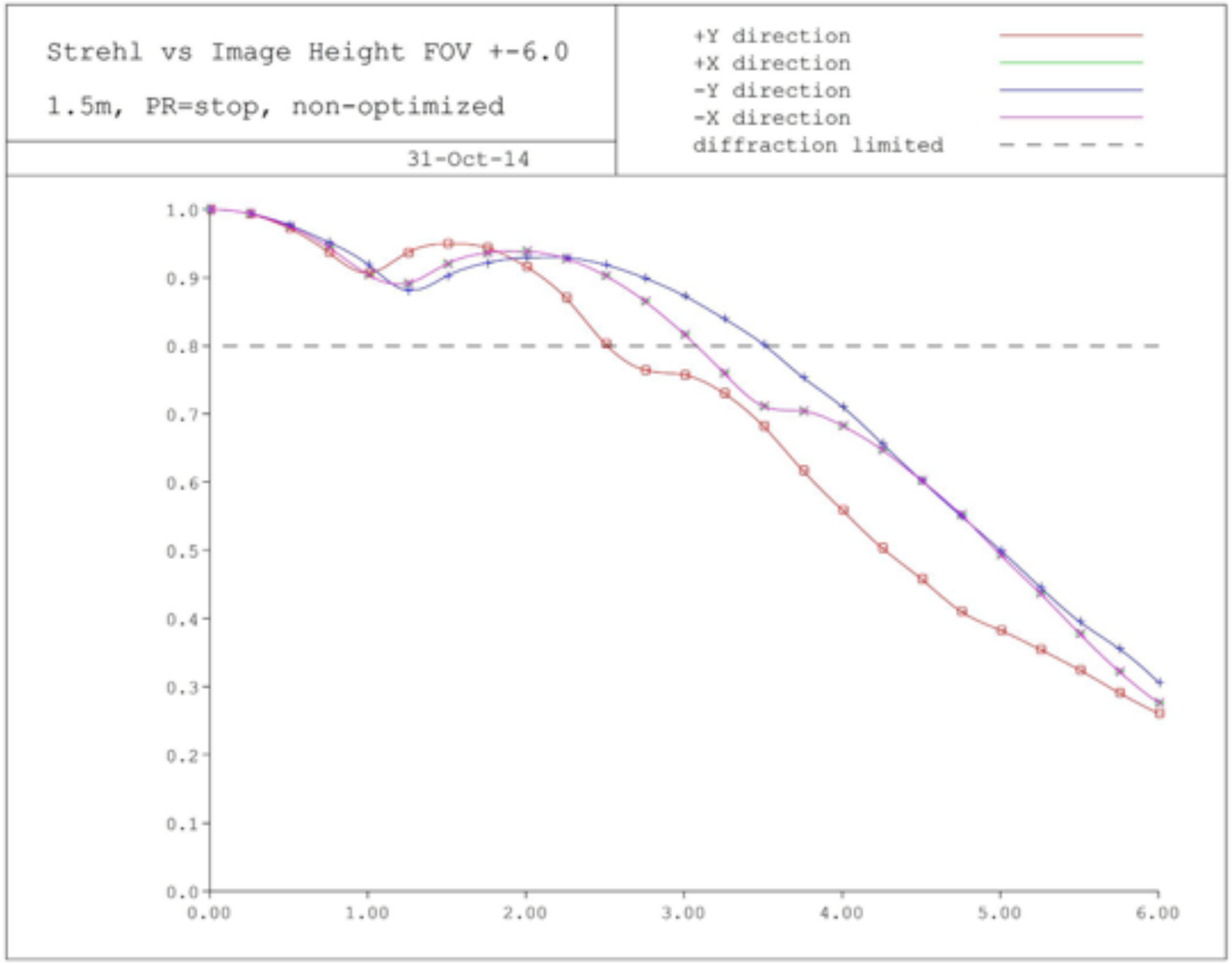


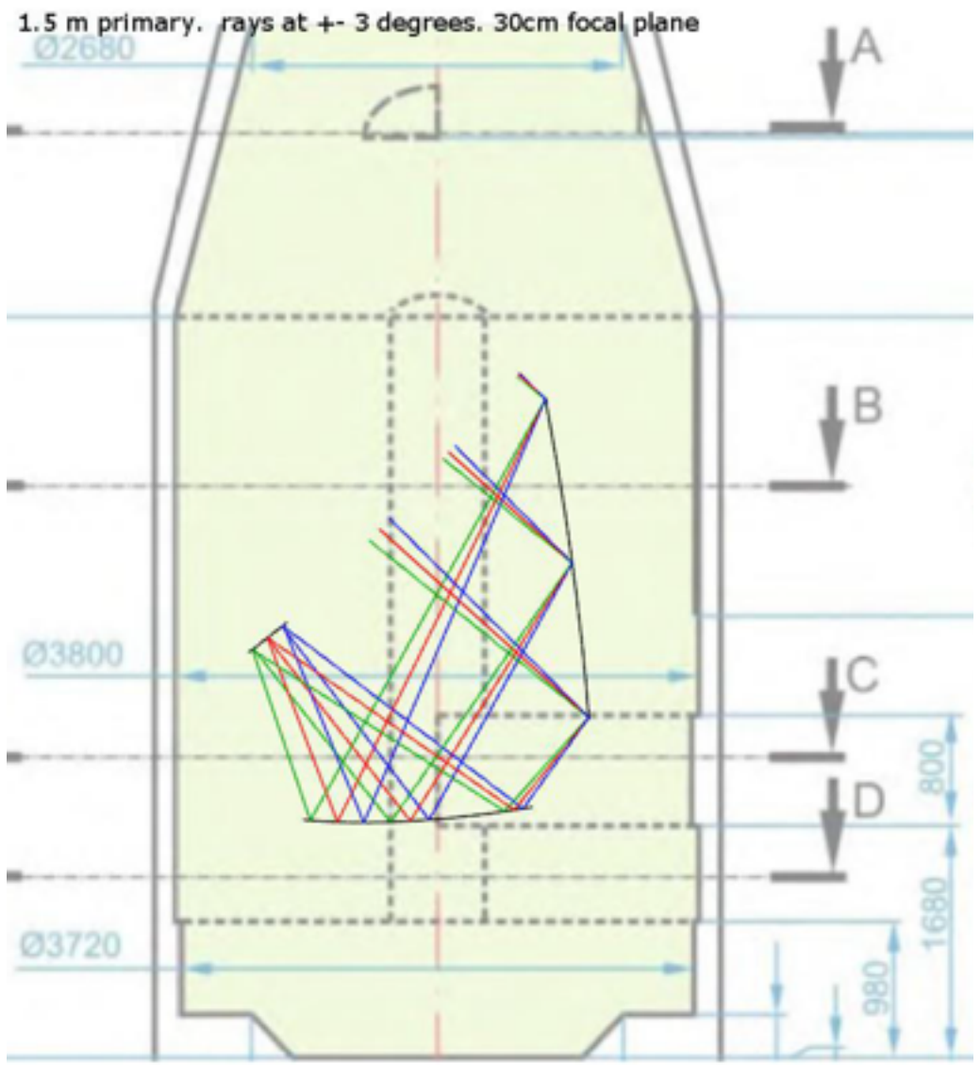




- f#=~2
- 6 deg FOV above Strehl 0.8 (@ 150 GHz) not optimized
- 8 deg FOV optimized
- plate scale = 4.4 cm/deg

Front Fed Dragone - II - Primary Stop

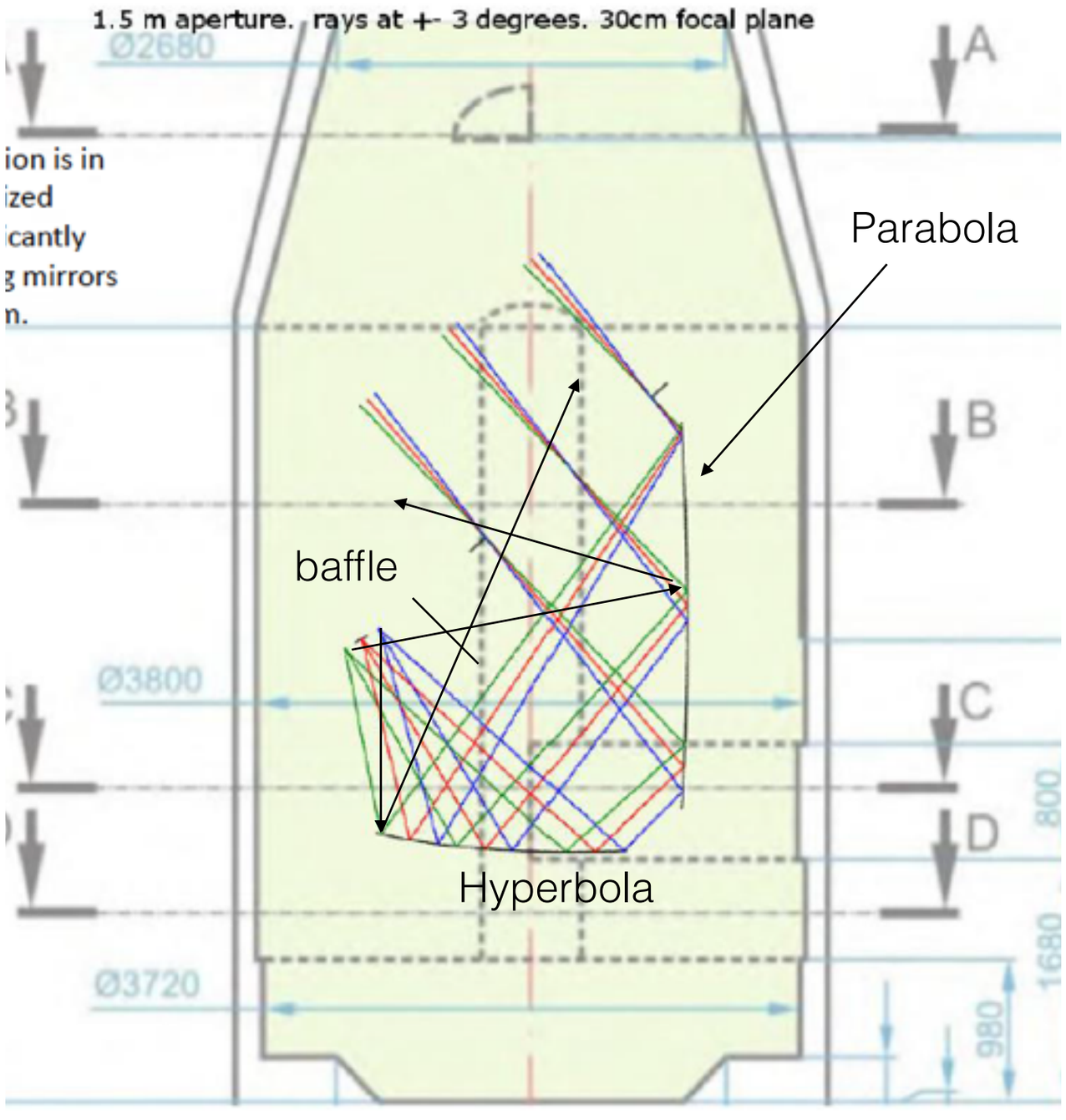




- Not Optimized
- f#=~2
- Conclusion 1: For non-optimized telescopes FOV largely independent of stop location
- Plate scale = 4.2 cm/deg

Front Fed Dragone - Sidelobs

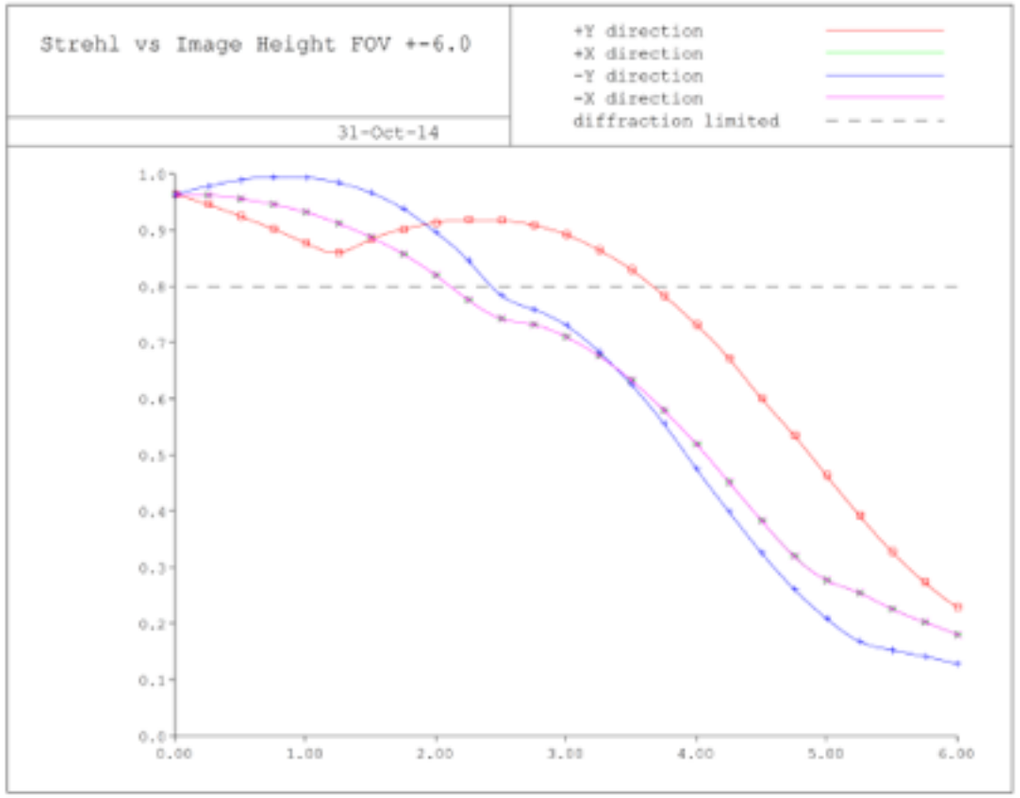
- At first look sidelobes appear to be manageable.



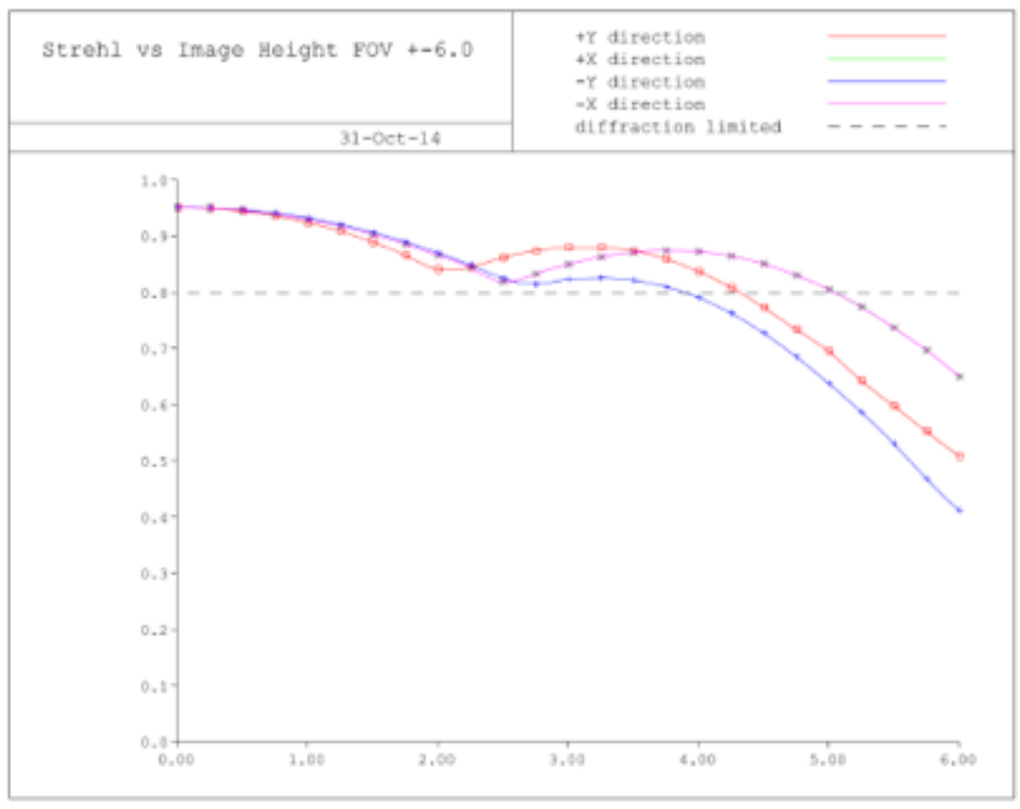
Gregorian vs. Front-Fed Dragone

- Same aperture (1 m)
- Both not optimized
- Plate scale = 3.2-3.3 cm/deg
- EBEX (Gregorian, telescope only): 5 deg FOV
- Front Fed: ~8 deg FOV
- Conclusion 2: comparing 1 m to 1.5 m (not optimized) looks like throughput is conserved. There is gain in FOV at expense of beam size.

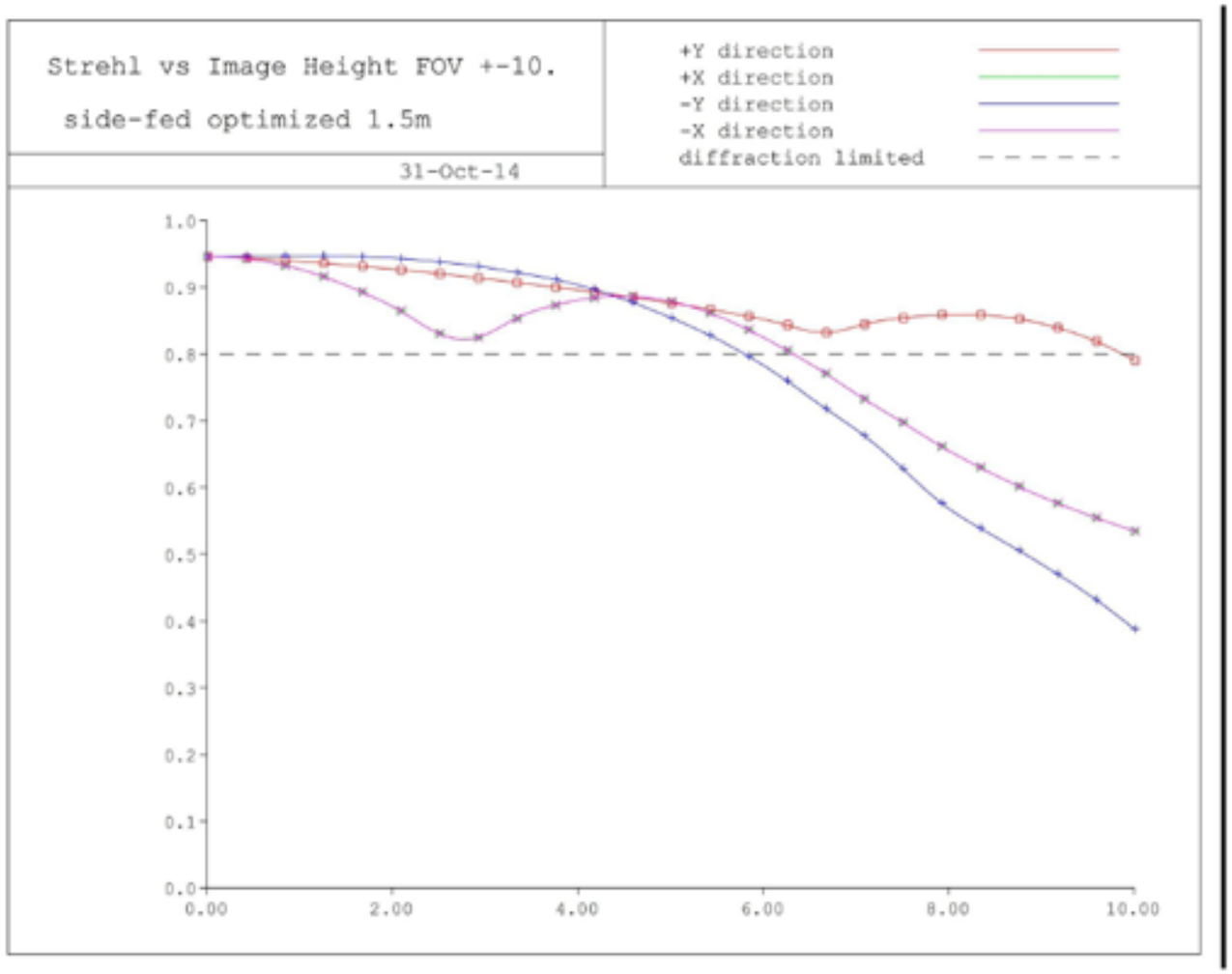
FOV of EBEX mirrors, 1m aperture

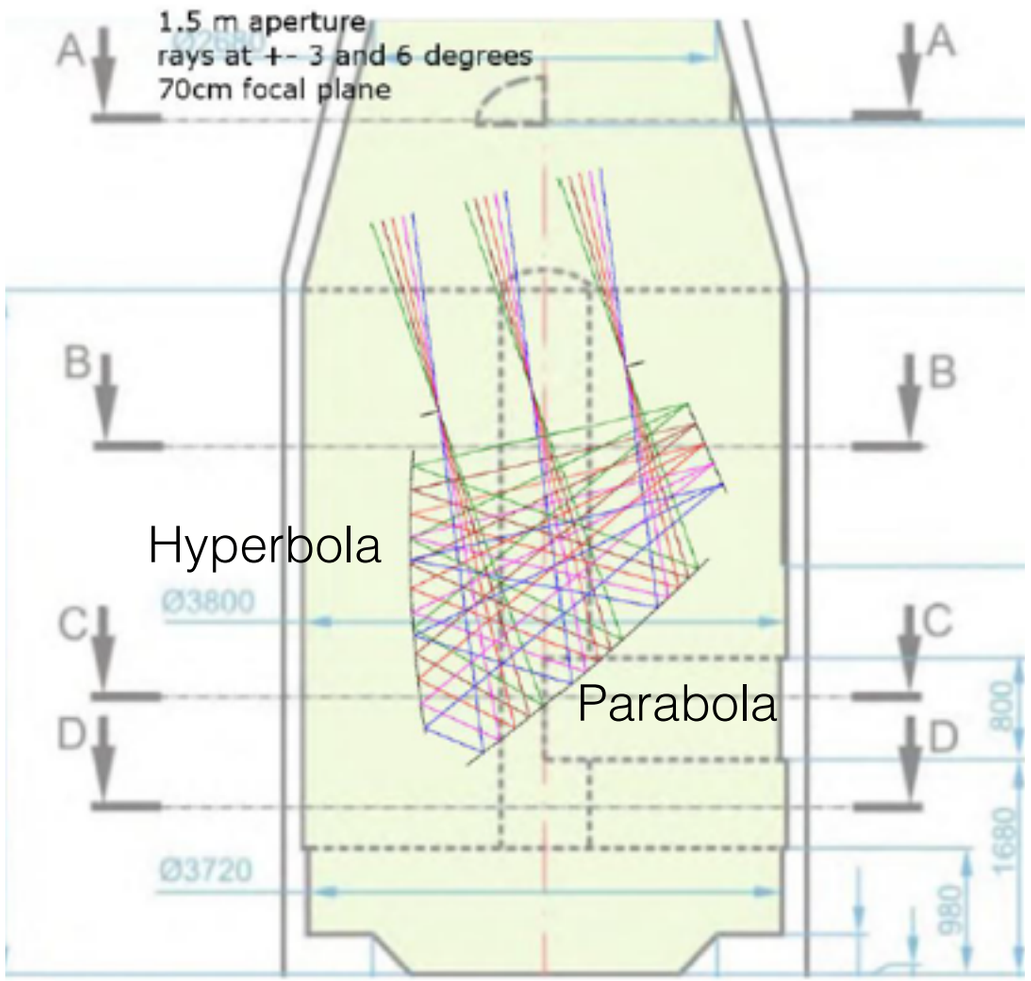


FOV of 1m front fed x-dragone



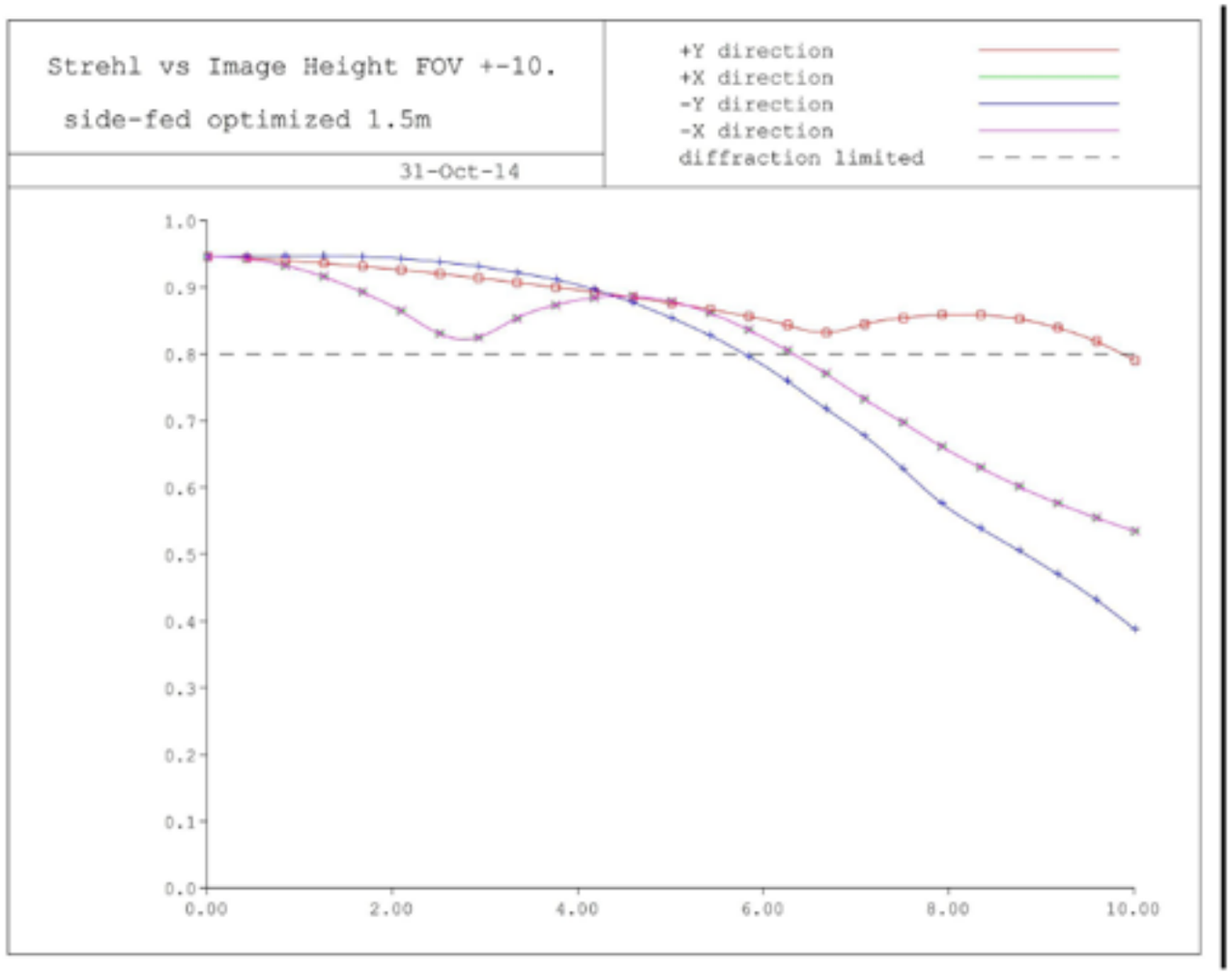
Crossed Dragone - Front Stop

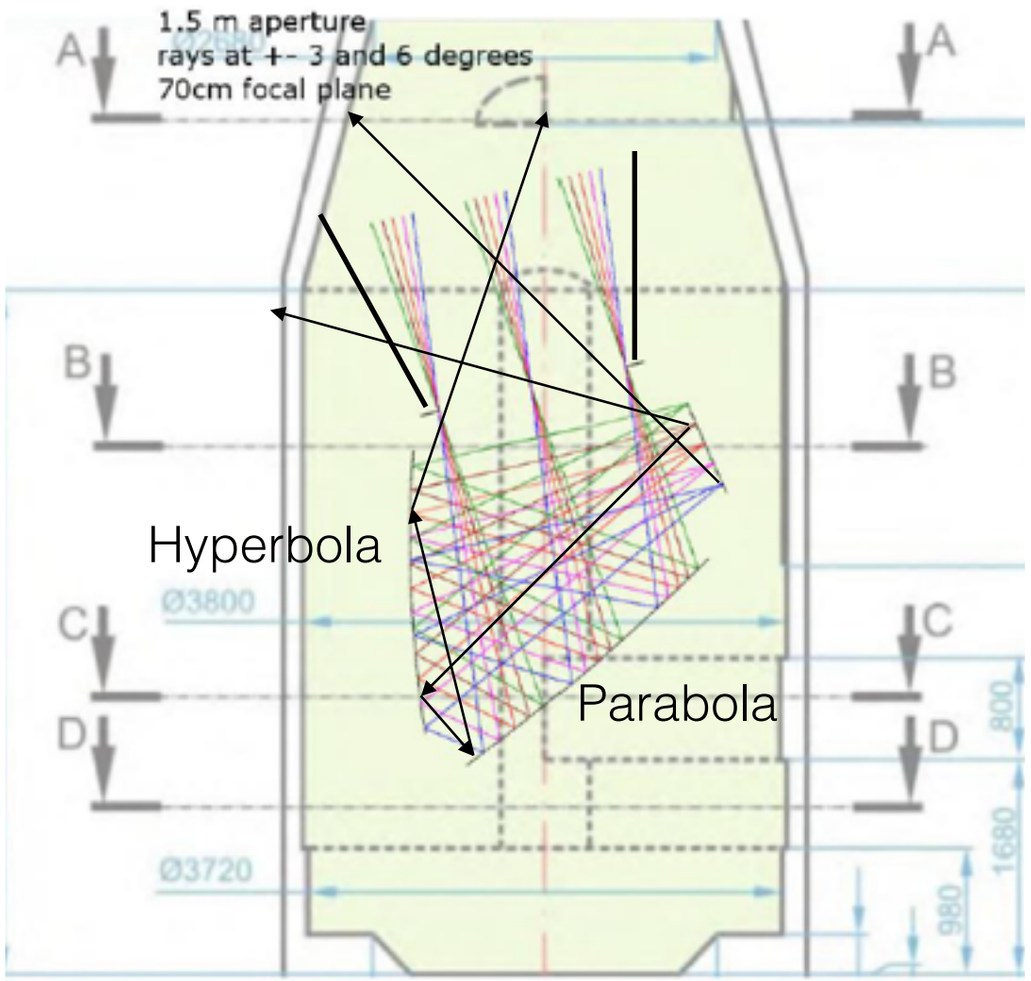




- Optimized
- f#=2.7
- 6 deg FOV
- But note differences in f#. If normalize back to f#=2, [(2/2.7)*6]=4.4 deg FOV
- Conclusion 3: DLFOV increases somewhat faster than f#.

Crossed Dragone - Stray Light





- Issues
  - Three bounces
  - Direct view of sky
- Would further increasing f# solve the issue?

Cold Aperture Stop for COrE+

- Why aperture stop? To control sidelobes by controlling the illumination on the primary mirror.
- Why cold? To reduce loading on the detectors
- Does COrE+ need a stop?
  - Depends on how beams are coupled to free space
  - Planck does not have a stop. WMAP did not have a stop. Beams are coupled with feedhorns. Sidelobes are measured sufficiently well for mission goals.
  - For COrE+ Sidelobes will need to be measured as well, modeled and accounted for.
  - Are asymmetrical beams an issue? To first order no, if the asymmetry is the same for both polarization states then no beam leakage of T to P.

Now Studying

- Fix f# at 2
- Optimize the 1 meter version
  - front fed: check for FOV
  - crossed Dragone: check for stray light
- Check stray light with side-fed Dragone
- Performance vs. Frequency

Additional Slides

Optimization

- optimize WFE over FOV
  - uniform distribution of fields
- adding aspherics, adjusting defocus and mirror curvatures, and allowing one of the Dragone angles to vary