

Optimizing Open Dragone Optics and Focal Plane

October 31, 2017

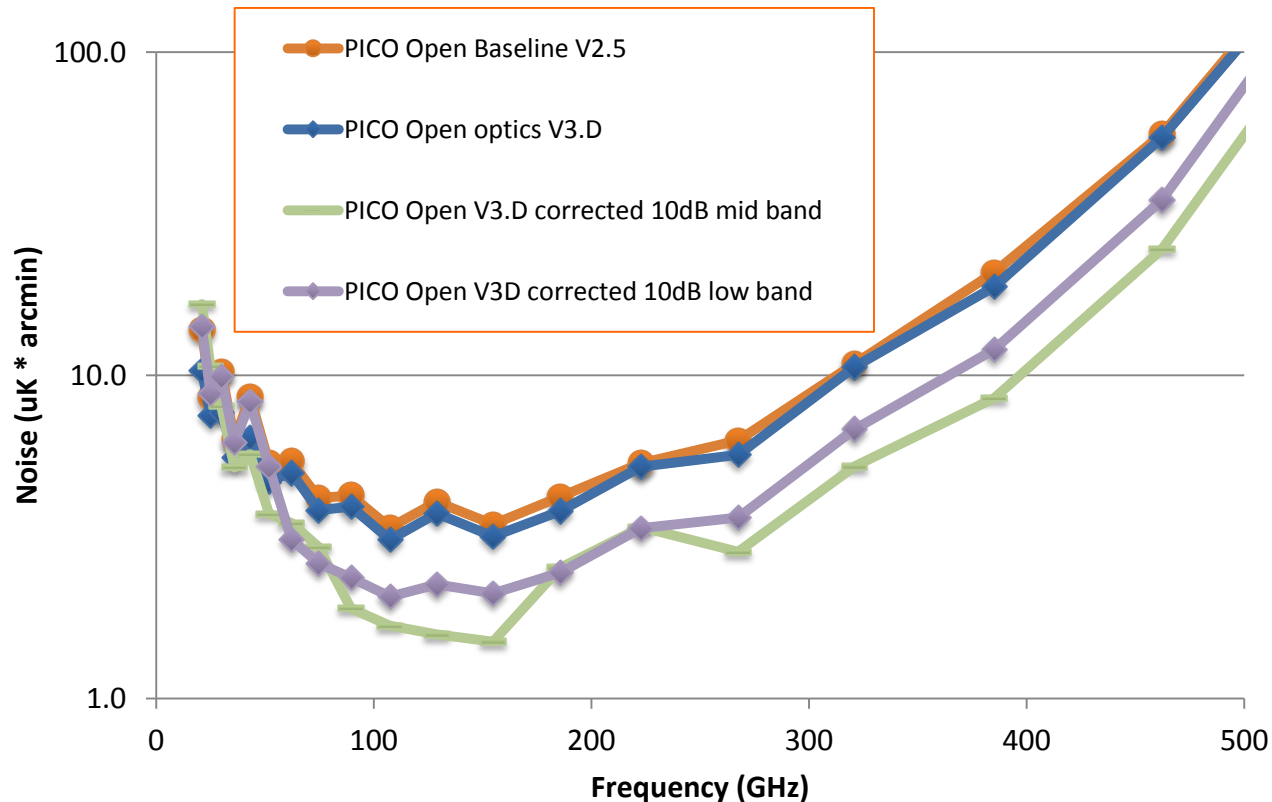
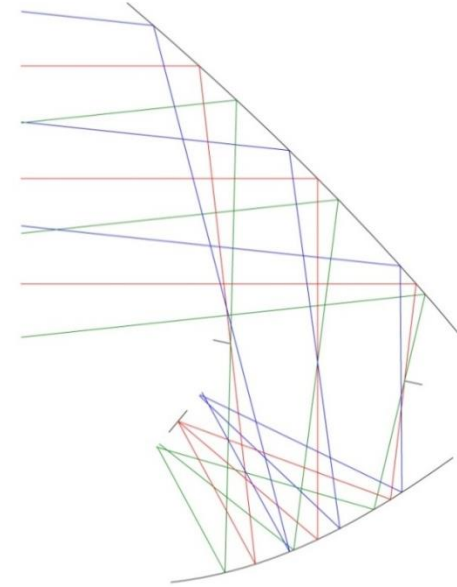
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Summary

- Coma corrected V3D, compared to baseline
- Which band to use when choosing pixel size
- Redistributing frequency bands amongst pixels

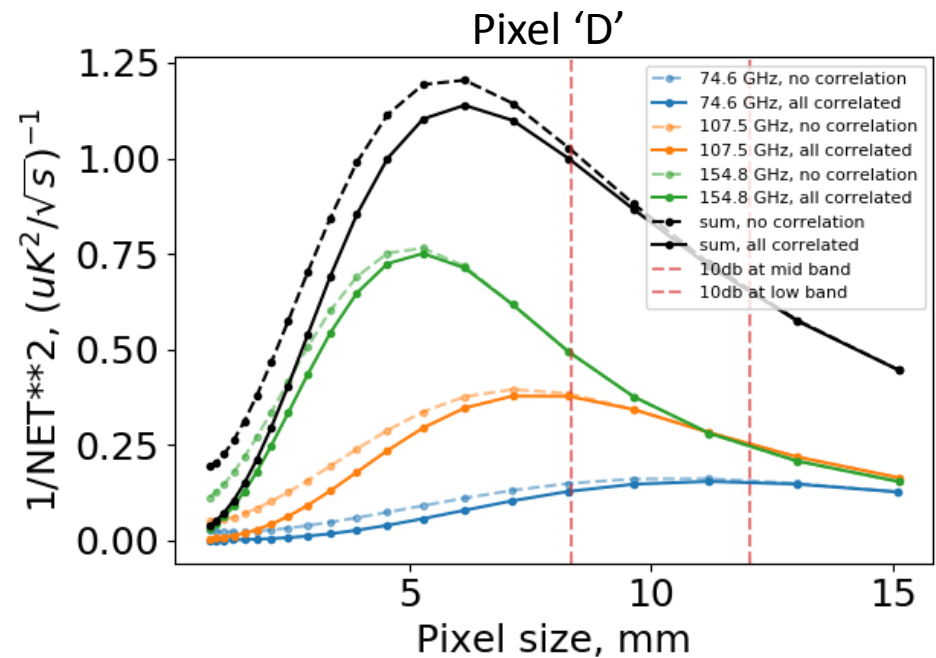
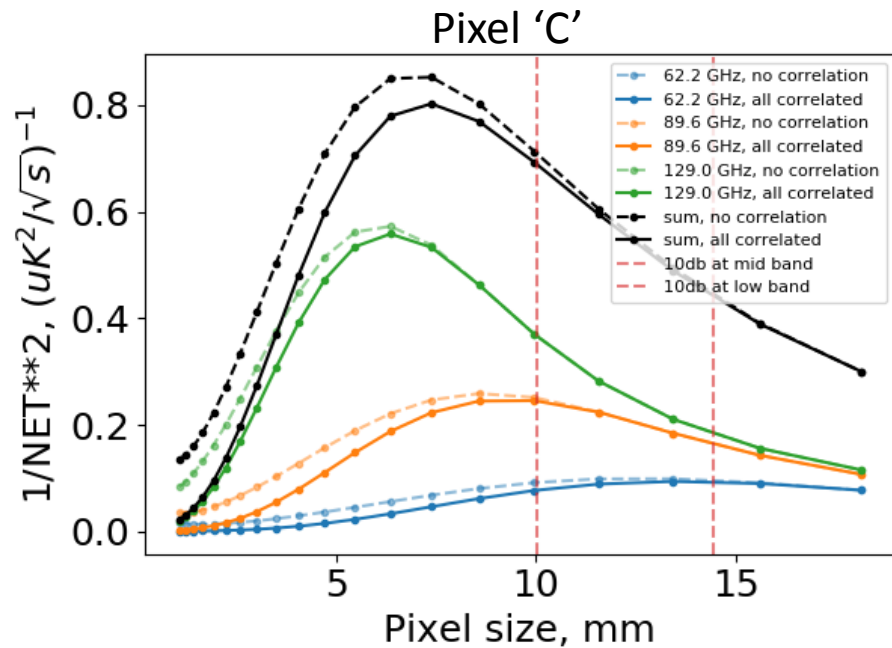
Sensitivity of Various Cases

- Using optics V3D
 - Alpha = 22, beta = 73
 - X fields limited to ± 8 deg (60cm), could be ± 10 deg (70 cm)
 - Only effects A, B pixels (up to 58 GHz)
- Dragone condition optics, mirrors are conic sections
 - 10 db set at lowest band, 3660 bolos, (Blue)
- Optimized mirrors are 8th order polynomials
 - 10 db lowest band, 7350 bolos, (Purple)
 - 10 db mid band, 15030 bolos, (Green)



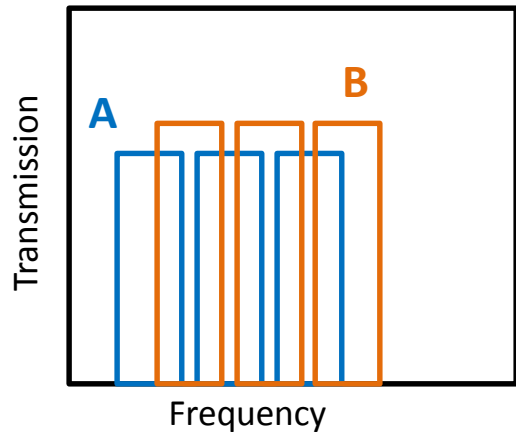
Pixel size trade-offs

- Pros of setting pixel size by 10 dB edge taper for middle band
 - Pixels are 2x smaller in area, get 2x more pixels
 - Stop illumination is flatter, so on-sky beams are roughly 10% smaller
 - Overall CMB mapping speed is higher
- Cons of 10 dB edge taper at middle band
 - The stop is viewed more strongly. Not a loading issue for a 4K stop.
 - 32 % of throughput terminated on stop for lowest band, 10 % for middle band.
 - Sidelobes are higher
 - Near sidelobe at -20 dB for lowest band, -25 dB at mid band, -40 dB for upper band. (vs -25,-40,< -50)
 - Unknown how far sidelobes are affected (need GRASP type simulation)

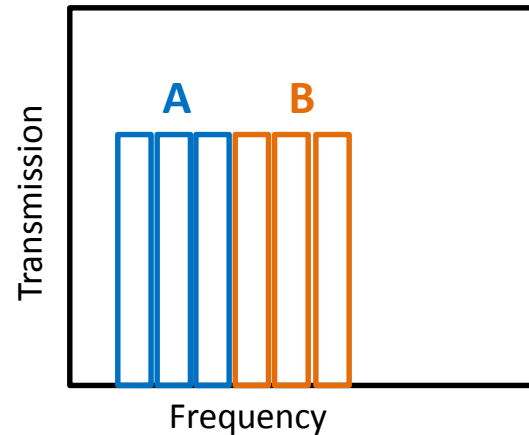


Bands per pixel

Current layout

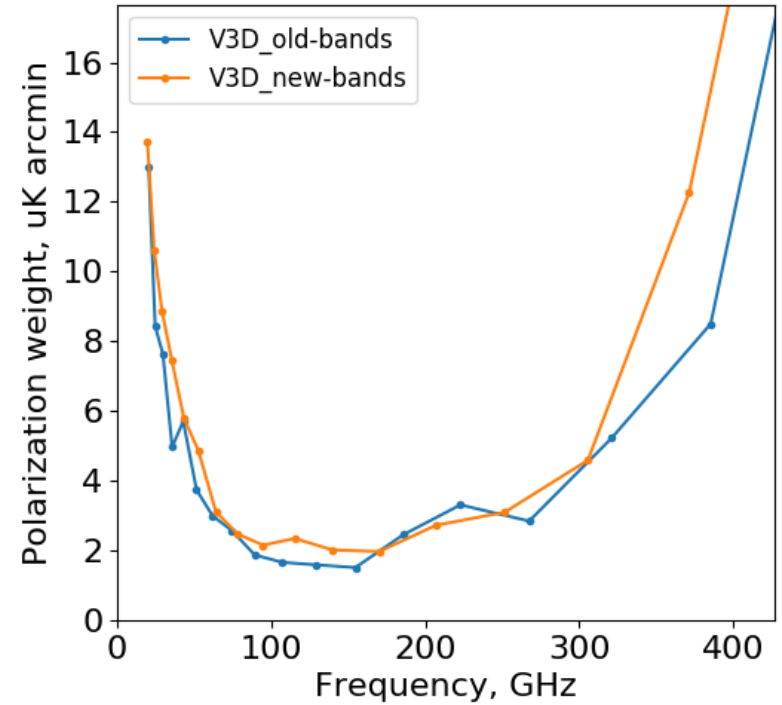
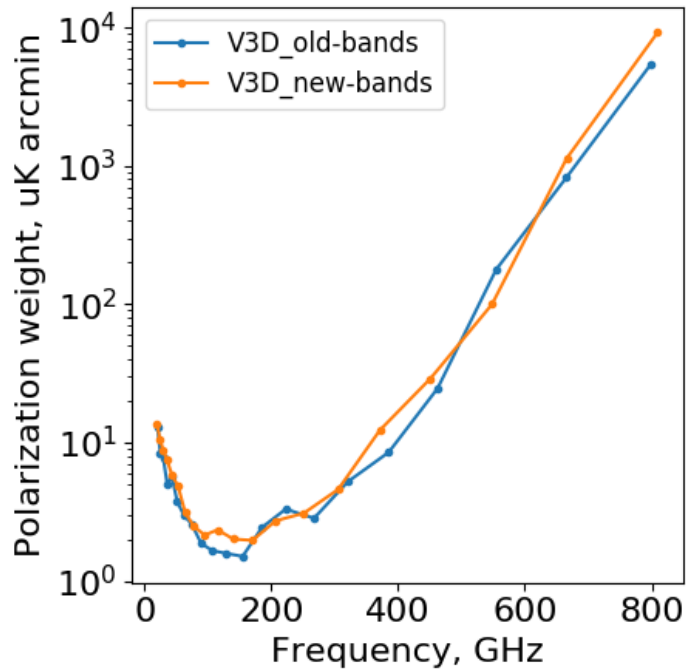


New possibility



- New version assumes:
 - Log spaced, non-overlapping top-hat bands
 - Fractional bandwidth is 16% instead of 25%
 - Spacing between band edges is 5 GHz at 150 GHz, scales with frequency.
- Bandwidth of single pixel reduced, less variation in spillover
 - 20%, 10%, 4%
- Bands are narrower, penalty in NET
- Questions:
 - What band overlap level is reasonable? 10%? 1%? Is there a science driver?
 - Is 5 GHz spacing at 150 GHz technically feasible?
 - If not, what is?
 - At what level of overlap?

Bands per pixel



- Both cases are V3D optics with pixel size set by middle band
- Penalty in NET because bands are narrower
- Similar number of bolometers, 15030 vs 15260 (old vs new)