Preliminary Volume allocation of the various NGAO WFSs:

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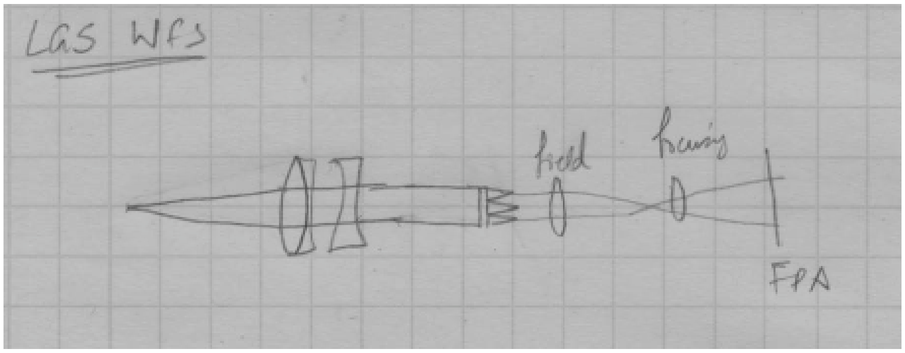
LGS WFS: (3 pupil sampling scales)



fc+fc+f_l + u + v = Length

d_fp = 21 * 64 * 2 = 2.688 mm

say a 3.2 mm pupil

fc = 3.2 * 15 = 48 mm

m = u/v = 0.84

f_l = say f/30 or so. f = d_lenslet * 30 = 1.5 mm

48 + 48 + 1.5 + 1.84 u = Length

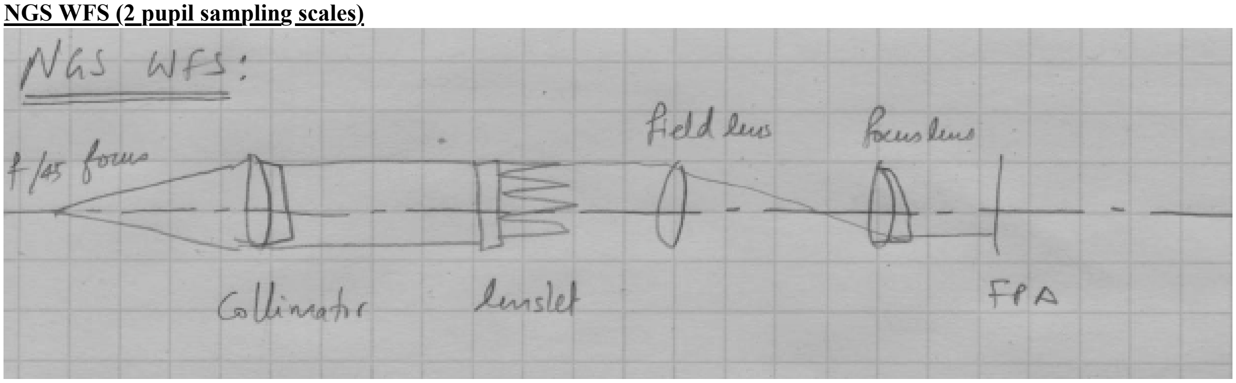
say Length = 150

u = 28.5326 mm
v = 23.96 mm

f = 13.03 mm

Volume requirement per channel = 200 x 100 x 100 mm from focus. Some part of this length will be used by the kick-bots.

NGS WFS (2 pupil sampling scales)



fc = 45 * 3.2 = 144 mm (same math as above)
Length = 342 mm

Volume requirement per channel = 400 x 150 x 150 mm + pick off mechanism

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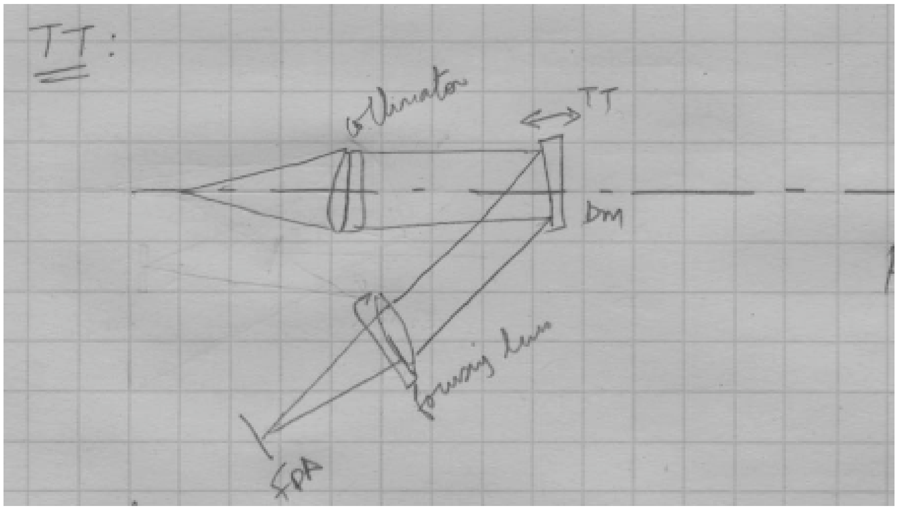
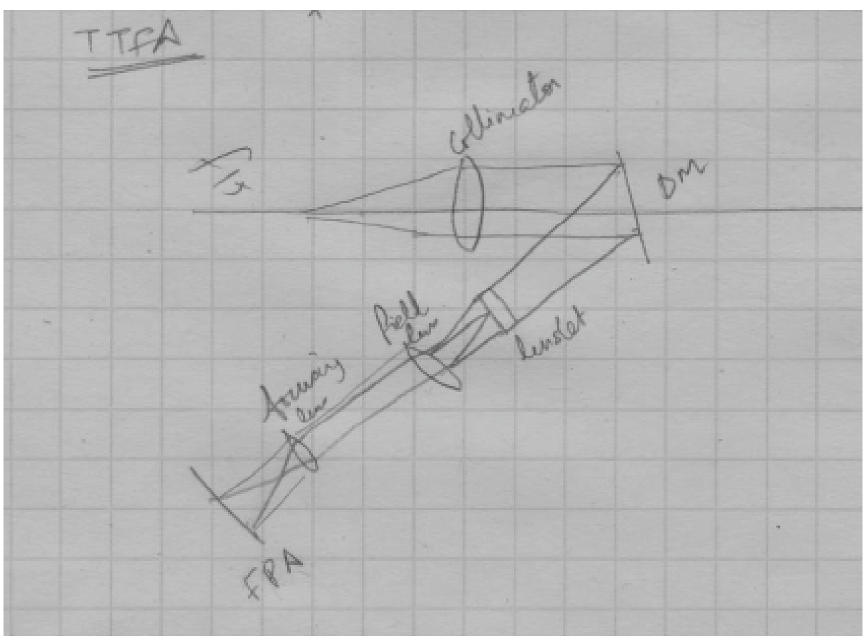
TT



fc = 12.7 * 15 = 190 mm
Length = 190 + 190 + 200 = 0.6 m

Volume requirement per channel = 650 x 150 x 150 mm from focus. Some part of this length will be used by the kick-bots.

TT(FA)



fc = 190 mm

m = u/v = 6.35 mm/(N*18) = 2.9 (for N = 120) => u = 2.9 v

fc+fc+u+v = length

190*2 + 3.9 u = length

L = 600 mm (say)
u = 56.4103 mm
v = 19.45 mm

Volume requirement per channel = 650 x 150 x 150 mm from focus. Some part of this length will be used by the kick-bots.

On-sky procedure to acquire and lock IR TT stars:

1. Point to the part of the sky where observations are to be performed. Lock the high-order LGS loops (woofer and MEMS DMs using MOAO), the TT mirrors are left static. Short exposure Strehls are 50\% in J band with TT 150 maSec TT jitter.
2. There appear 3 TT stars that are jittering about with approximately 50\% J-band Strehl at current laser powers as per the error budget spreadsheet.
3. Acquire the stars on the TT(FA) detectors, which will look like a streak. Lock the TT(FA) TT loops by pointing the streak to the closest pixel cross-hair. This is expecting the control system to capture the star for us. If the stars are hard to capture, a detector program must be developed to start with a larger ROI and reduce the window progressively with time.
4. Off-load global tilt to the AO TT mirror. Now the TT(FA) TTs have to just deal with differential tilt.
5. If MCAO, use differential tilt to stabilize TT stars.

TWFS (5x5 with guard bands)

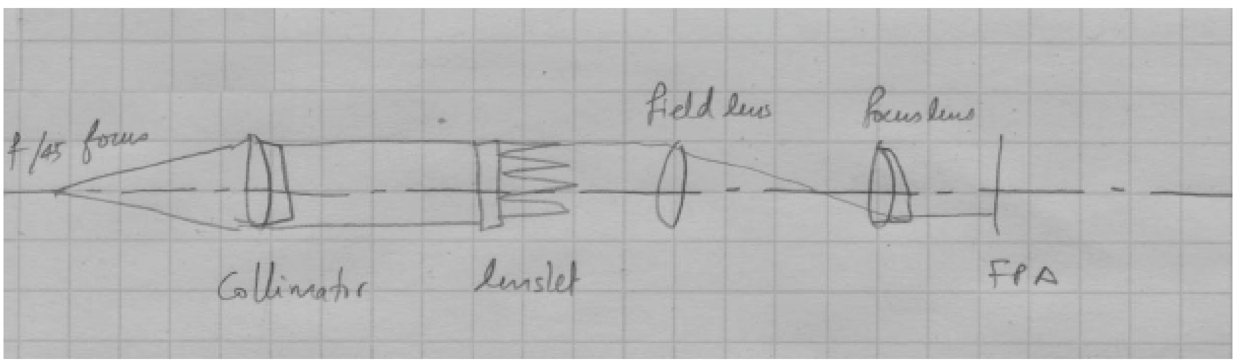


image size 5*8 = 20 * 0.021 = .8 mm
lenslet size = 0.16 mm
f/30 => f_lenslet = 4.8 mm
fc = 45 mm say

m = 1/0.8 = u/v = 1.25

length = 45+ 45 + 2.25u
Length = 150 mm
u = 26.667mm
v = 20.80
Volume requirement per channel = 200 x 100 x 100 mm + pick off mechanism

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Outstanding questions on requirements and the above volume calculations are based on:

1. 32x32 vs. 64x64 MEMS mirrors on TT(FA) channels. - I have chosen 32x32 for for the above calculation.
2. Is there a reason for the TTFA to act as a configurable TT? - I assume that the TTFA always acts as a TTFA and can't be configured to act as a TT for the above calculation.
3. I assume all WFSs are Shack Hartmann with rectilinear CCDs.
4. The smaller the pupil sampling the harder it gets to design the WFS ... but the length may not change too much (I hope).

5. Lengths are measured from focus, so mechanical design must account for pick-off schemes and fore optics.

Volume envelope table:

WFS/ dimensions [mm]	Length (Z)	Breath (X)	Width (Y)	# of sensors	Pick off mechanisms	Comments
LGS WFS	150	100	100	9	Kick bots (same as d-NIRI)	moving lens to keep pupil fixed, 3 pupil sampling scals
NGS WFS	400	100	100	1	Fishing rod??	2 pupil sampling scales, near the NF sci. instrument
TT	650	150	150	2	Kick bots (same as d-NIRI)	
TTFA	650	150	150	1	Kick bots (same as d-NIRI)	
TWFS	200	100	100	1	Fishing rod??	near the NF sci. instrument