Performance analysis of NGAO NGSWFS with and without the IF dichroic

Caltech Optical Observatories

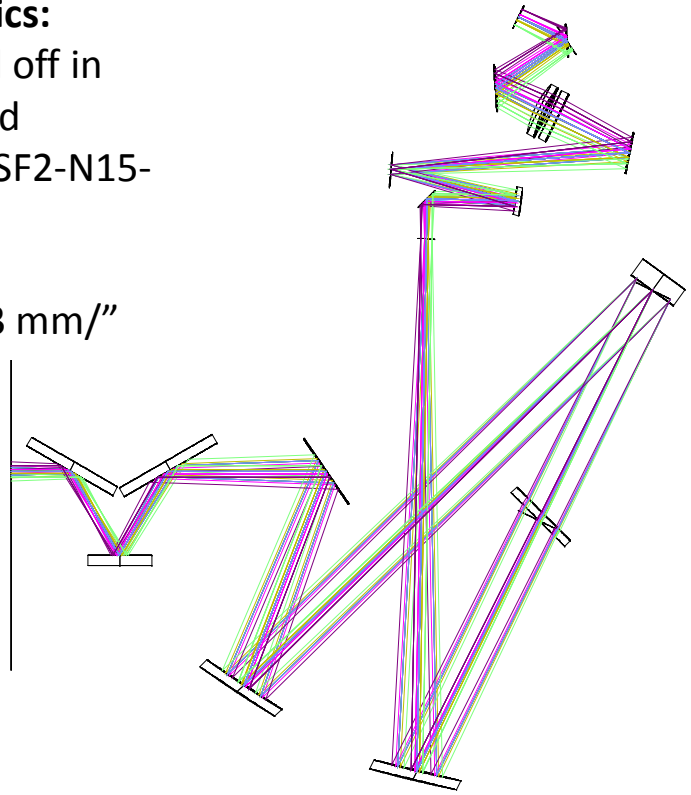
6th April, 2010

Design without IF dichroic

Input to the NGS sensor

Design characteristics:

- NGS light is picked off in collimated space and focused using a (BASF2-N15-BASF2) triplet
- F/# = 20.012
- Plate scale = 1.063 mm/”



3D LAYOUT

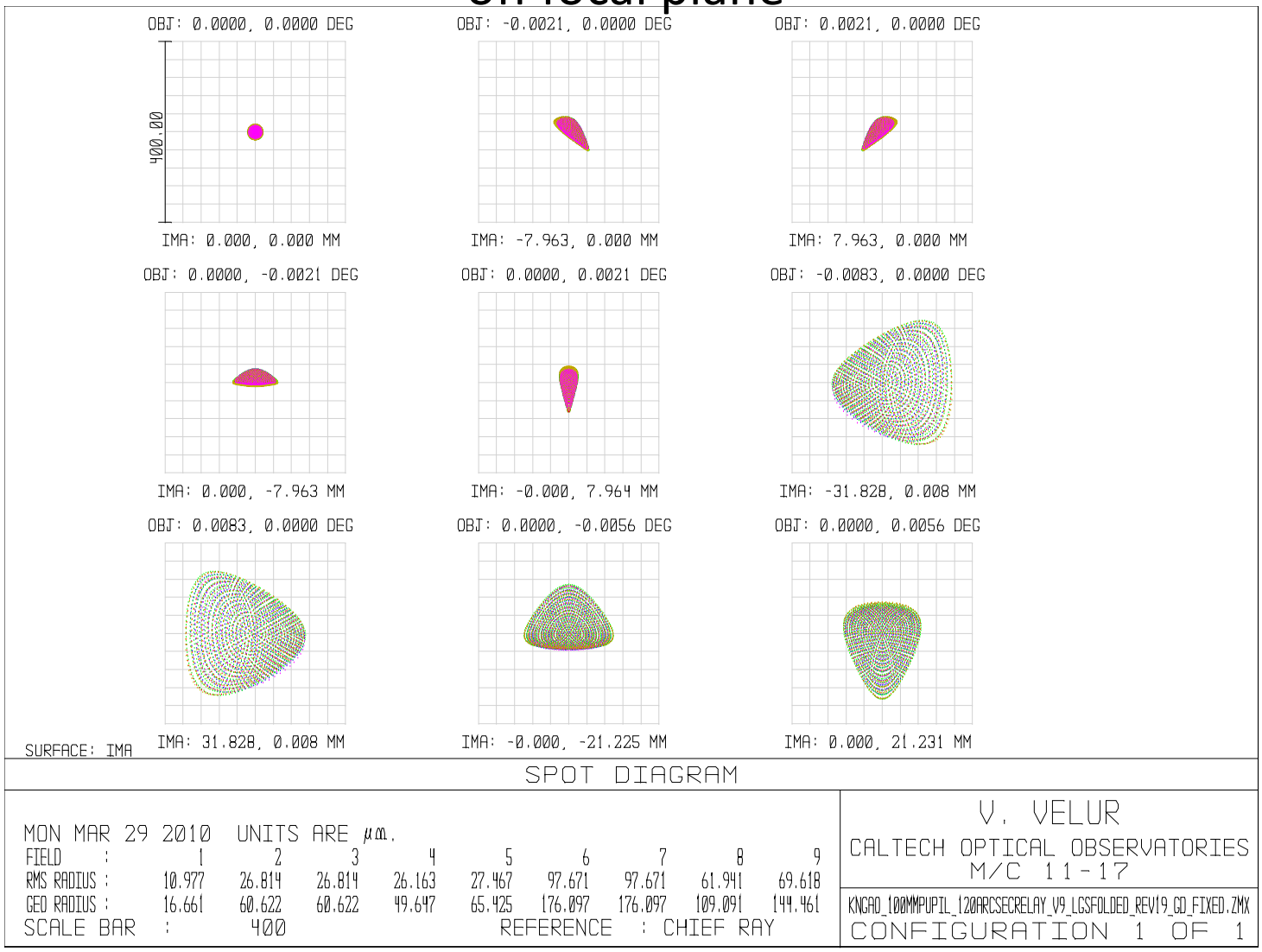
TUE MAR 23 2010

V. VELUR
CALTECH OPTICAL OBSERVATORIES
M/C 11-17

KNGAO_100MMPUPIL_120ARCSECRELAY_V9_LGSFOLDED_REV18.ZMX
CONFIGURATION: ALL 1

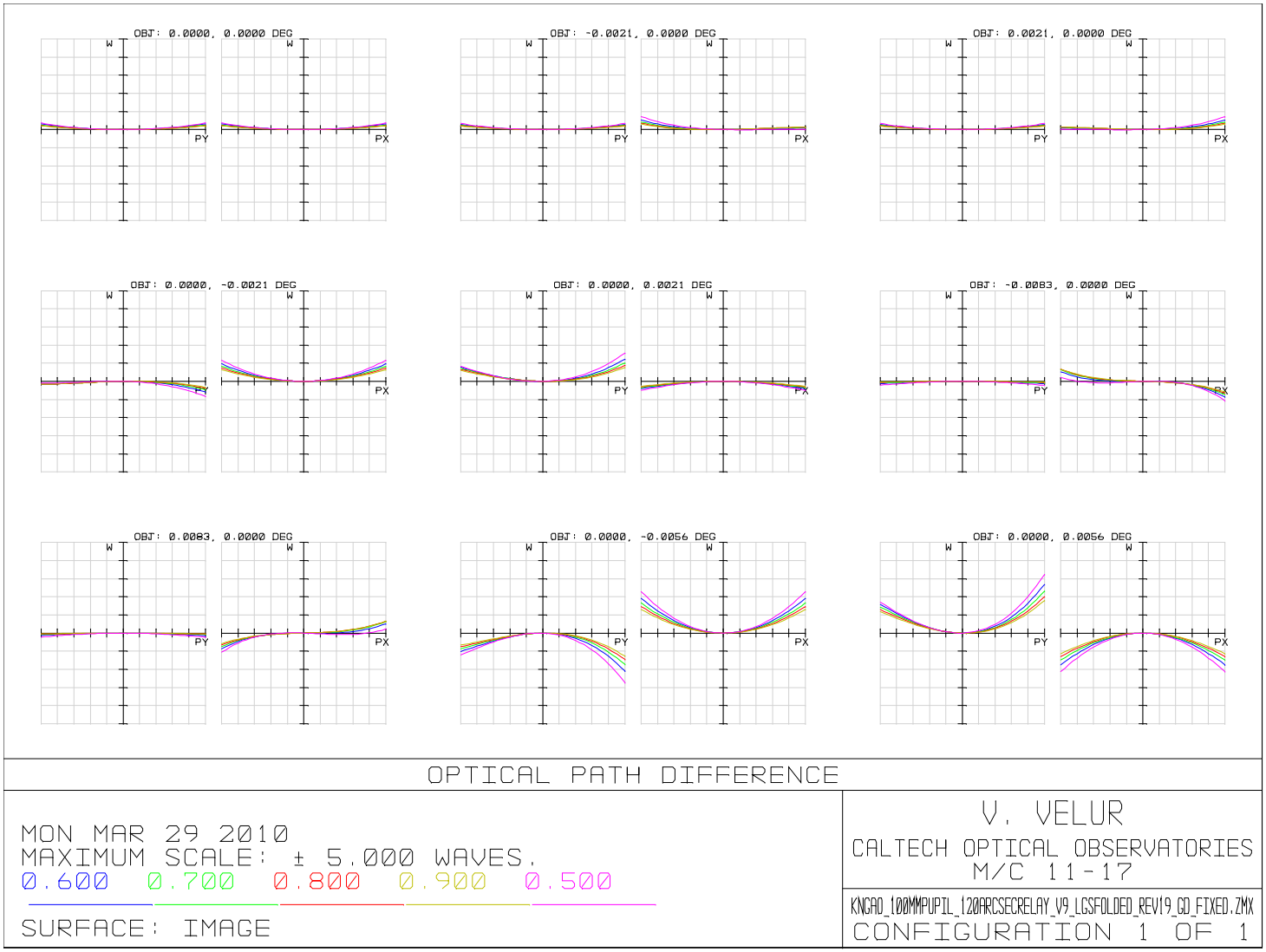
Without IF dichroic

Input to the NGS sensor – spot diagram at the NGS sensor pick-off focal plane



Without IF dichroic

OPD at the NGS sensor pick-off focal plane



Without IF dichroic

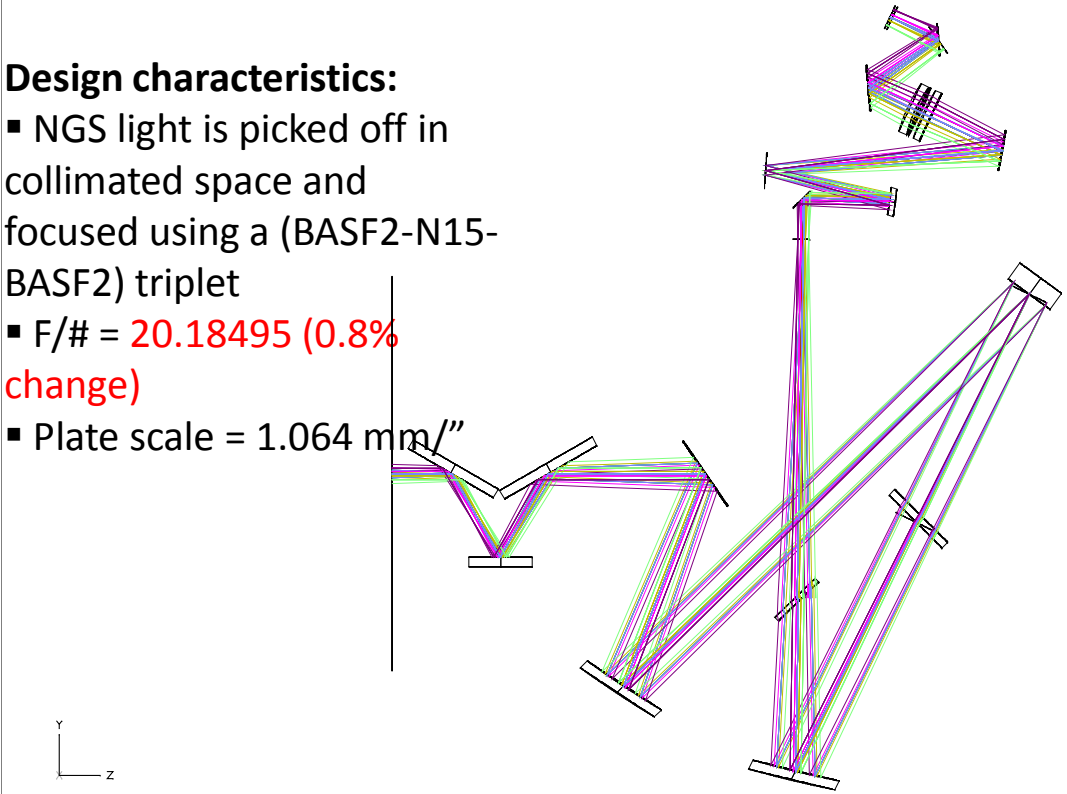
Design with IF dichroic – if one does nothing (w/ the telescope) but re-focus the NGSWFS

- I am using a N-BK7 dichroic that is 12.5 mm thick (and 135 mm diameter). The fold angle is 45 deg. As used by Reni in her Version 10 optical design.
- The NGS WFS needs to move back by ~6 mm to accommodate the introduction of the IF dichroic.

Input to the NGS sensor

Design characteristics:

- NGS light is picked off in collimated space and focused using a (BASF2-N15-BASF2) triplet
- F/# = 20.18495 (0.8% change)
- Plate scale = 1.064 mm/”



3D LAYOUT

TUE APR 6 2010

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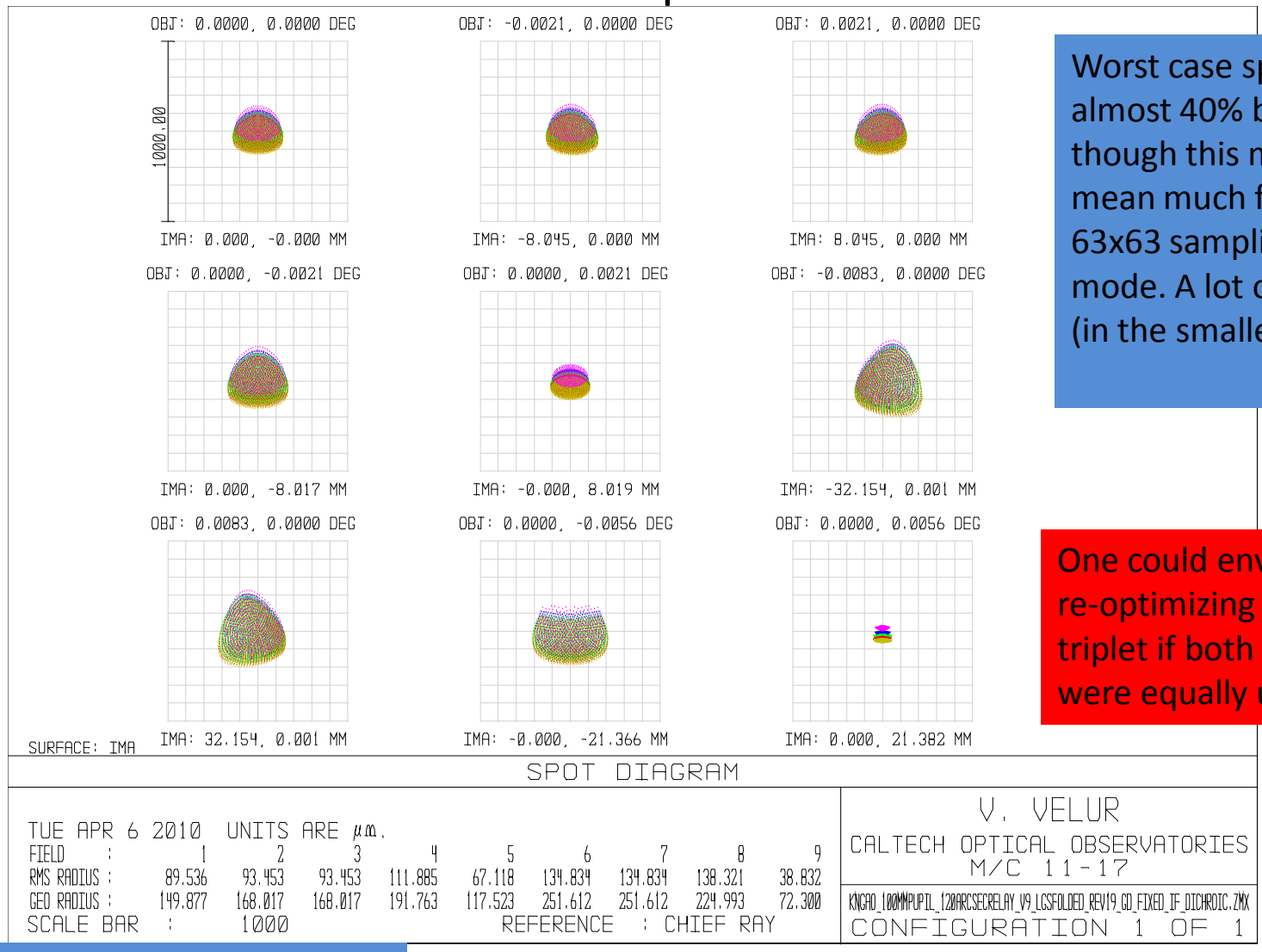
KNGAO_100MMPUPIL_120ARCSECRELAY_V9_LGSFOLDED_REV19_GD_FIXED_IF_DICHROIC.ZMX
CONFIGURATION: ALL 1

With IF dichroic – refocus NGSWFS (instead of the telescope)

Input to the NGS sensor – spot diagram at the NGS sensor pick-off focal plane

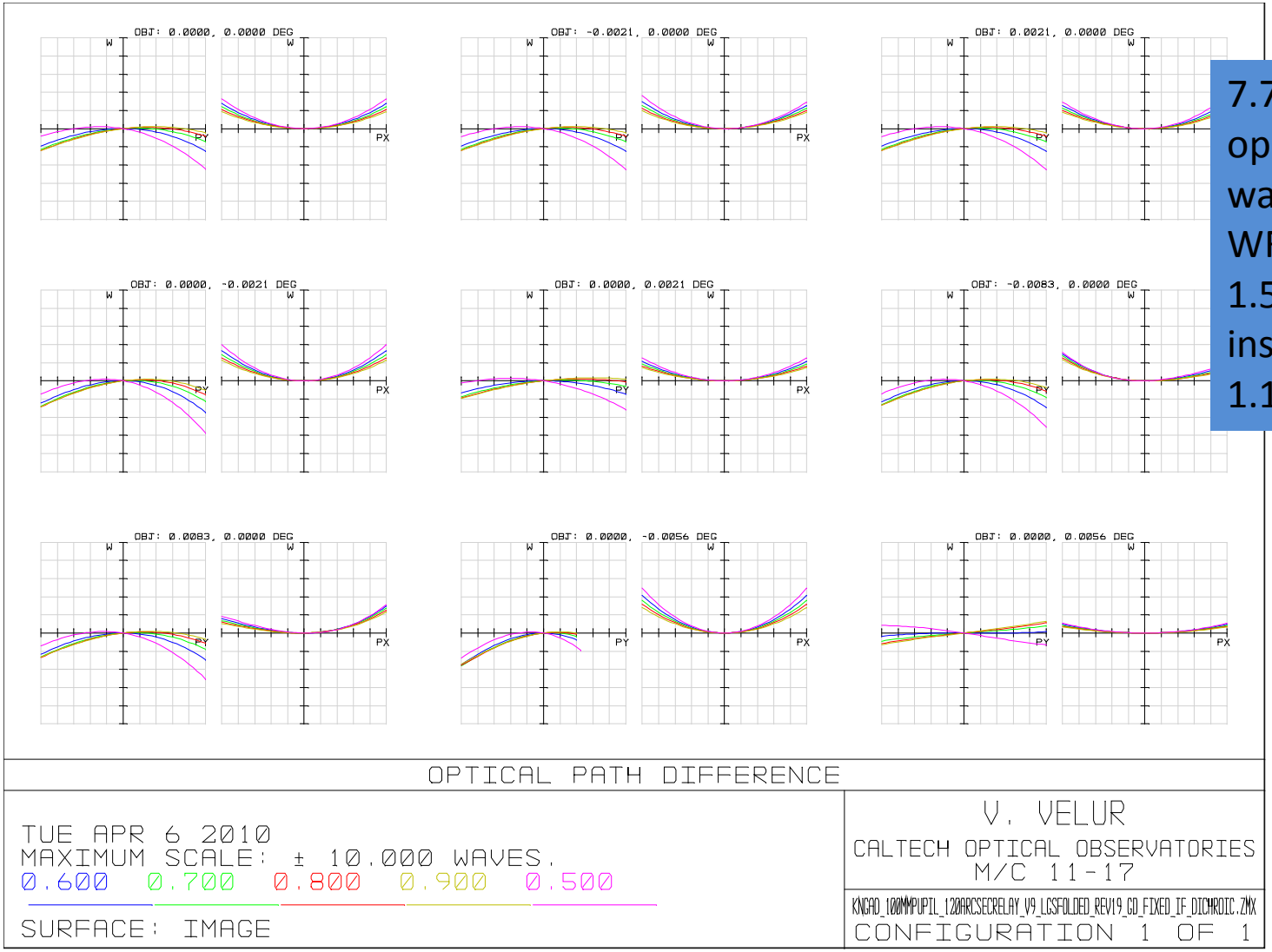


Worst case spot is almost 40% bigger, though this may not mean much for the 63x63 sampling mode. A lot of color (in the smaller spot).

One could envision re-optimizing the triplet if both modes were equally used.

With IF dichroic – refocus NGSWFS (instead of the telescope)

OPD at the NGS sensor pick-off focal plane



7.7 waves as opposed to <6 waves of P-P WFE. (RMS is 1.51 waves instead of 1.15 waves.

With IF dichroic – refocus NGSWFS (instead of the telescope)

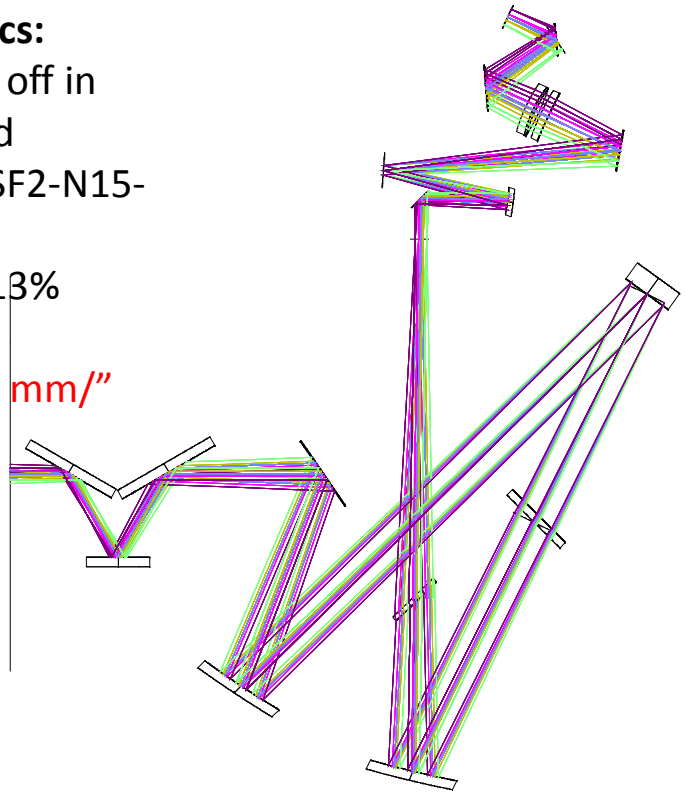
With IF dichroic with telescope re-focus

- In this optical design, the science instrument (and hence the WFS is static), the telescope is refocused to keep the science instrument in focus following the introduction of the IF dichroic in the optical beam.

Input to the NGS sensor

Design characteristics:

- NGS light is picked off in collimated space and focused using a (BASF2-N15-BASF2) triplet
- F/# = 19.9856 (-0.13% change)
- Plate scale = 1.053 mm/” (0.9% change)



3D LAYOUT

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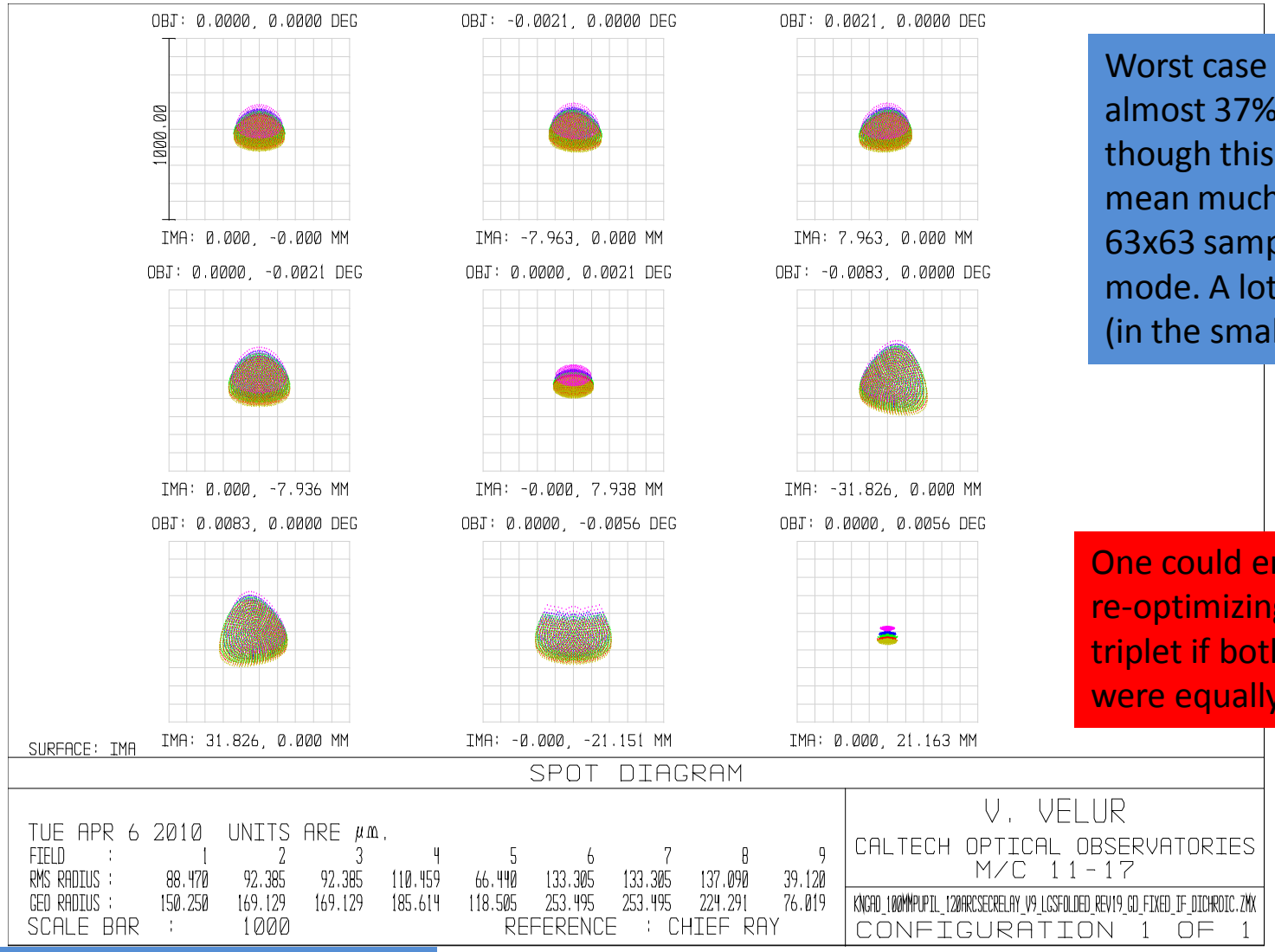
KNGAO_108MMPUPIL_120ARCSECRELAY_V9_LGSFOLDED_REV19_GD_FIXED_IF_DICHROIC.ZMX
CONFIGURATION: ALL 1

With IF dichroic – refocus telescope (and not move NGSWFS)

Input to the NGS sensor – spot diagram at the NGS sensor pick-off focal plane

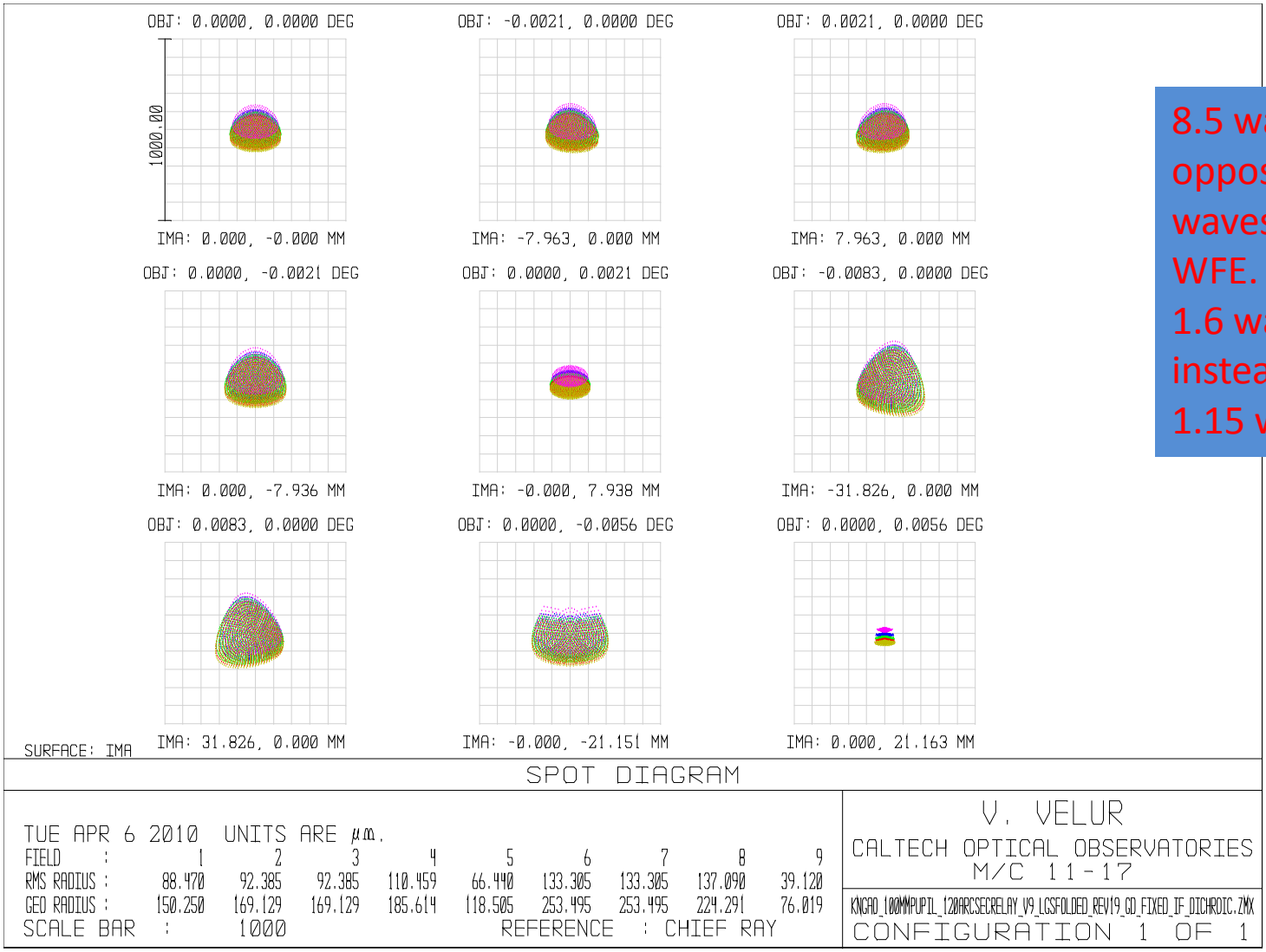


Worst case spot is almost 37% bigger, though this may not mean much for the 63x63 sampling mode. A lot of color (in the smaller spot).

One could envision re-optimizing the triplet if both modes were equally used.

With IF dichroic – refocus telescope (and not move NGSWFS)

OPD at the NGS sensor pick-off focal plane



8.5 waves as opposed to <6 waves of P-P WFE. (RMS is 1.6 waves instead of 1.15 waves.

With IF dichroic – refocus telescope (and not move NGSWFS)

Implications

- The NGSWFS sub-apertures (in 63x63 mode) will see a spot blur of ~ 3 um NGSWFS pick-off plane [the plate scale in this mode is 1.053 mm/”] – so, the effect is negligible with the introduction of the IF dichroic whether the telescope is refocused or if the WFS is moved to account for the path-length change due to the introduction of the dichoric.