ZWFS Update

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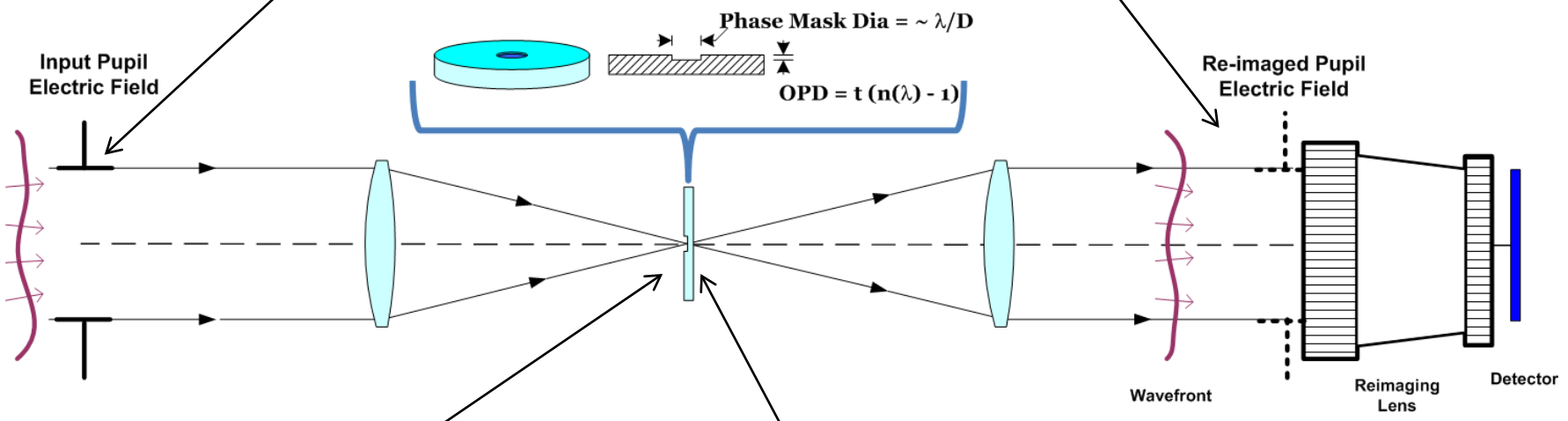
A little Zernike WFS theory

$$E(u,v) = P(u,v)A\big(1+\varepsilon(u,v)\big)e^{i\varphi(u,v)}$$

$$E(x,y) = P(x,y)A\big(e^{i\theta}+\varepsilon(x,y)+i\varphi(x,y)\big)$$

$$E(u,v) \approx P(u,v)A(1+\varepsilon(u,v)+i\varphi(u,v))$$



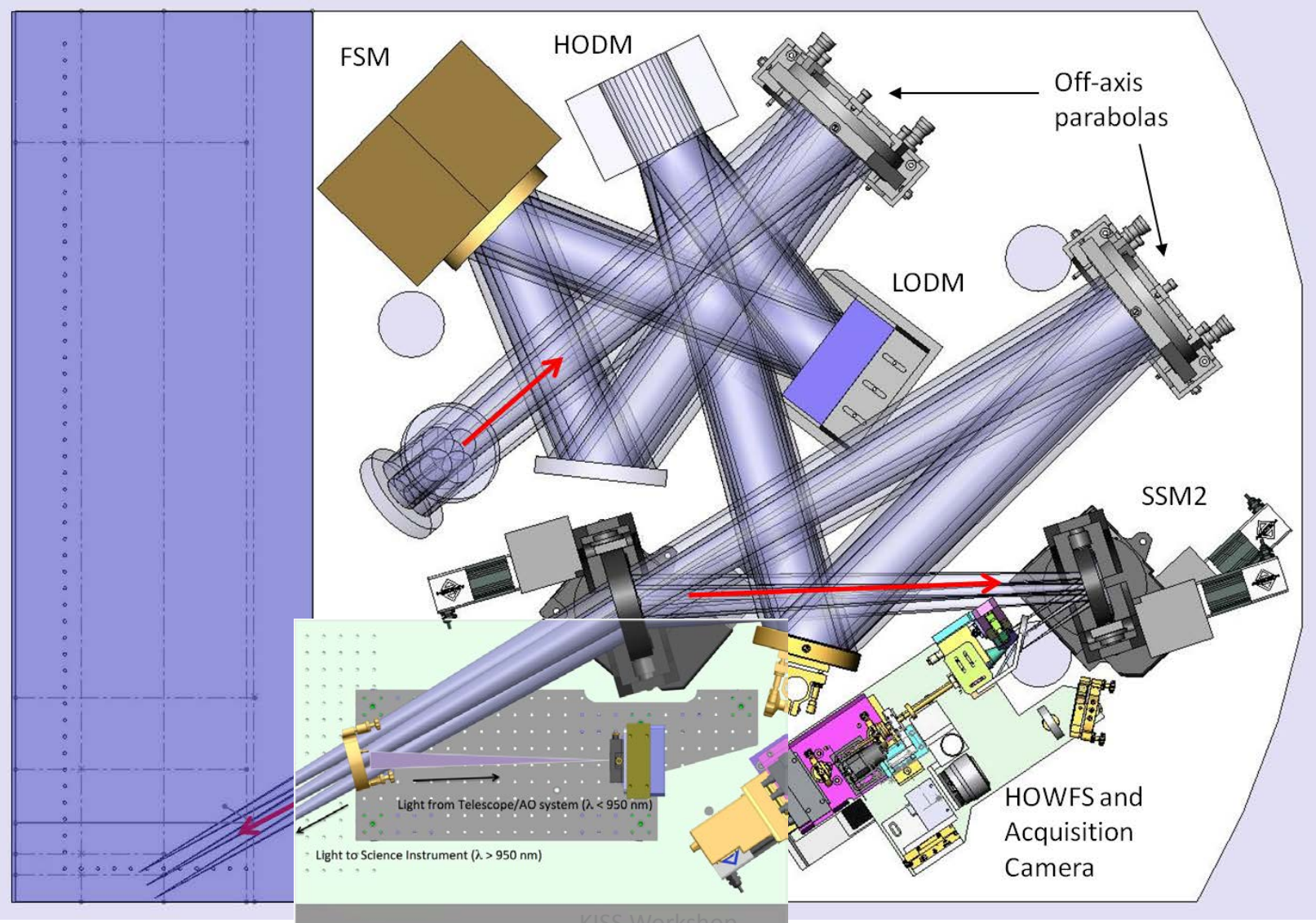
$$E(\zeta,\eta) = A\,PSF(\zeta,\eta)e^{i\theta} + A\,PSF(\zeta,\eta) * \Im[\big(\varepsilon(u,v)+i\varphi(u,v)\big)]$$

$$E(\zeta,\eta) = \Im[P(u,v)] * \Im[A\big(1+\varepsilon(u,v)+i\varphi(u,v)\big)]$$

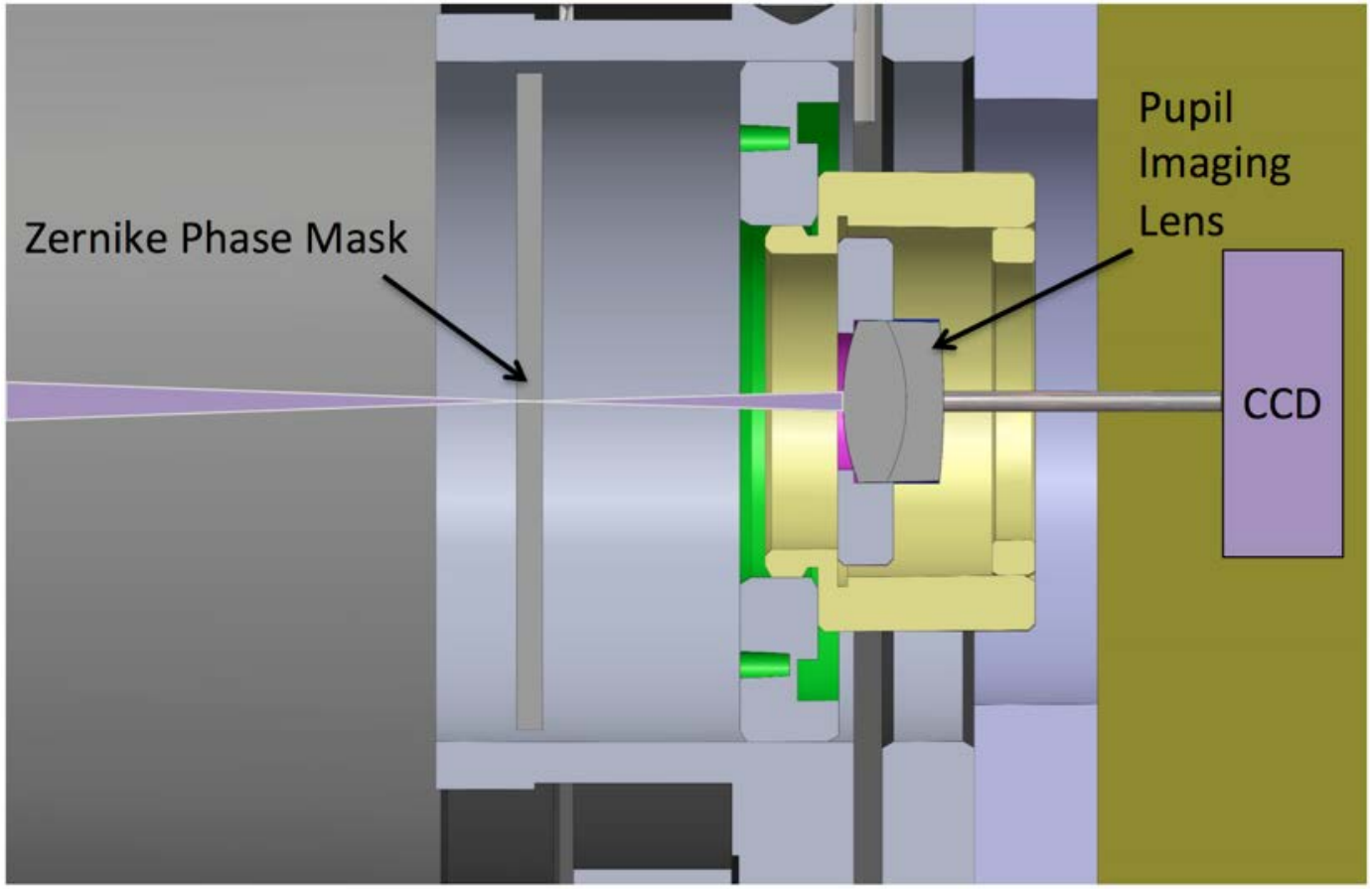
$$I = E\cdot E^* = I_o\big(1+2\varphi+\varepsilon^2+\varphi^2\big);\ \theta = \pi/2$$

Zernike sensor allows us to image phase errors directly.

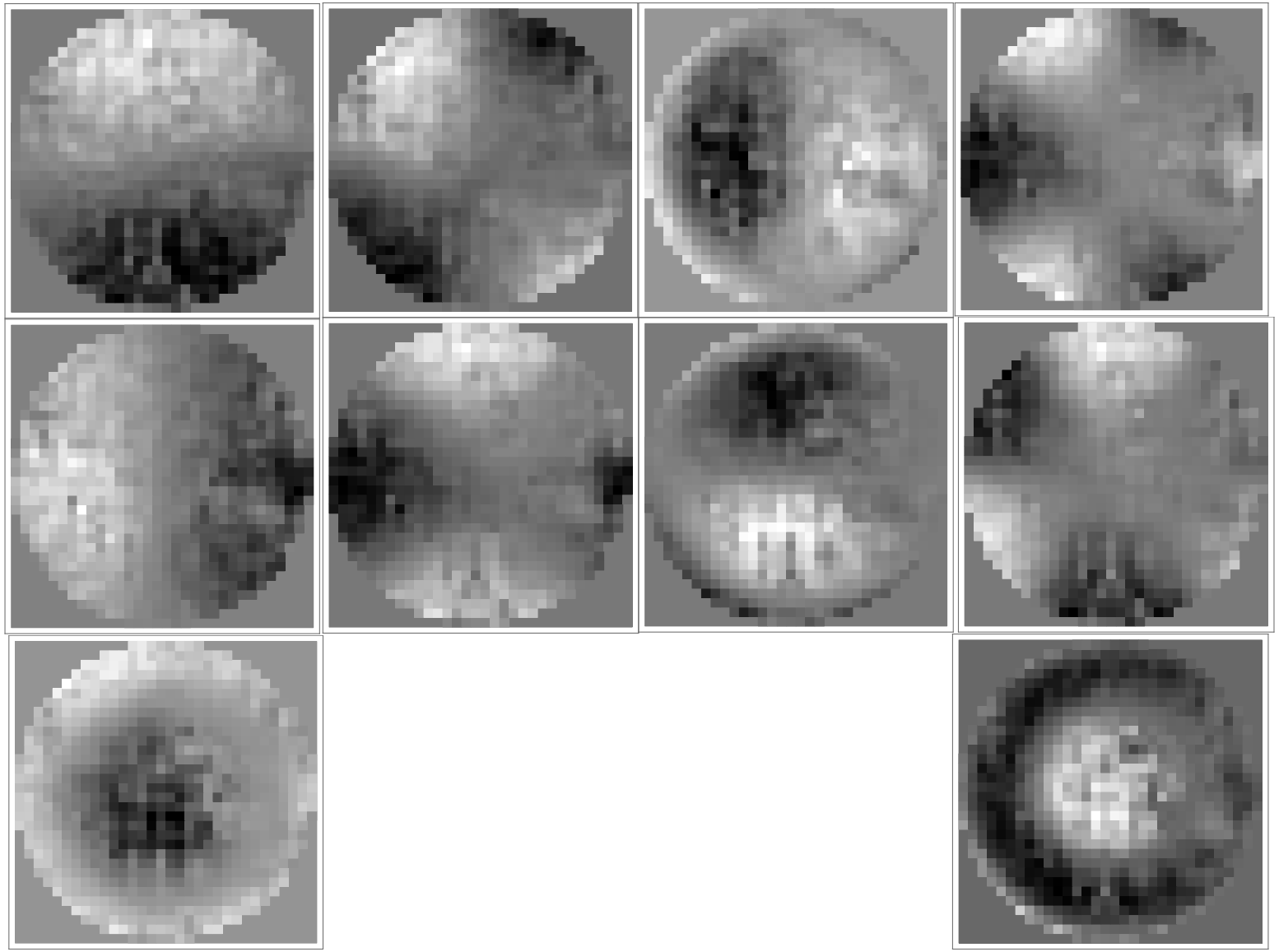
Implementation on the P3K system



Implementation on the P3K system



Astig 1/Astig 2 Coma1/Coma2



Tip

Tilt

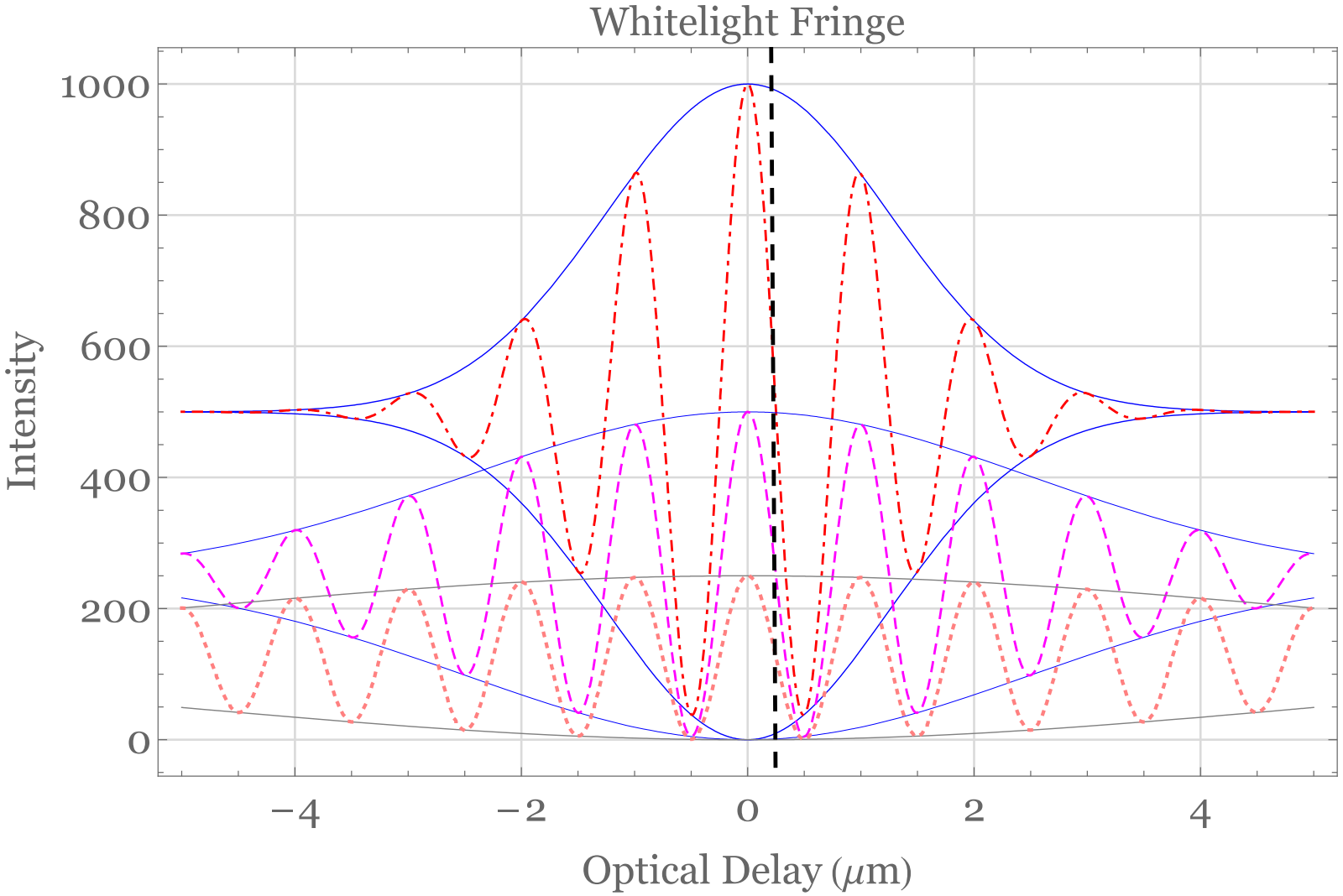
Focus

Trefoil 1

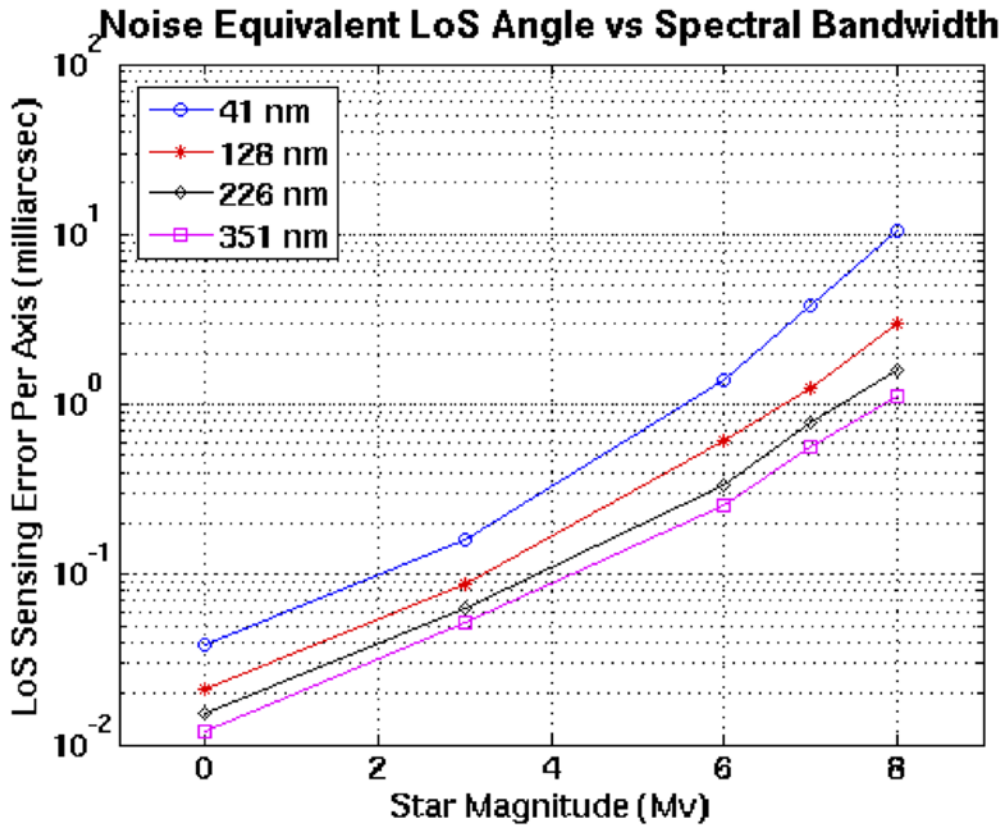
Trefoil 2

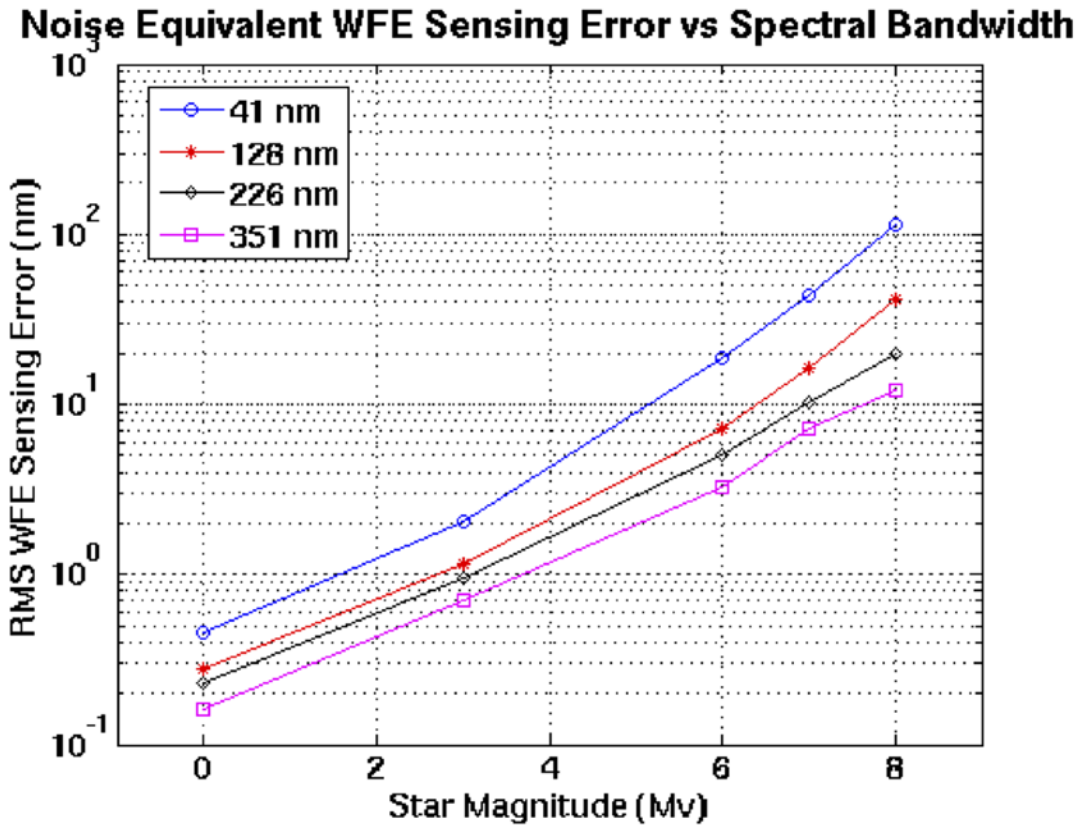
Spherical

ZWFS Chromaticity



ZWFS Chromaticity 2: The more photons the better





Why the ZWFS?

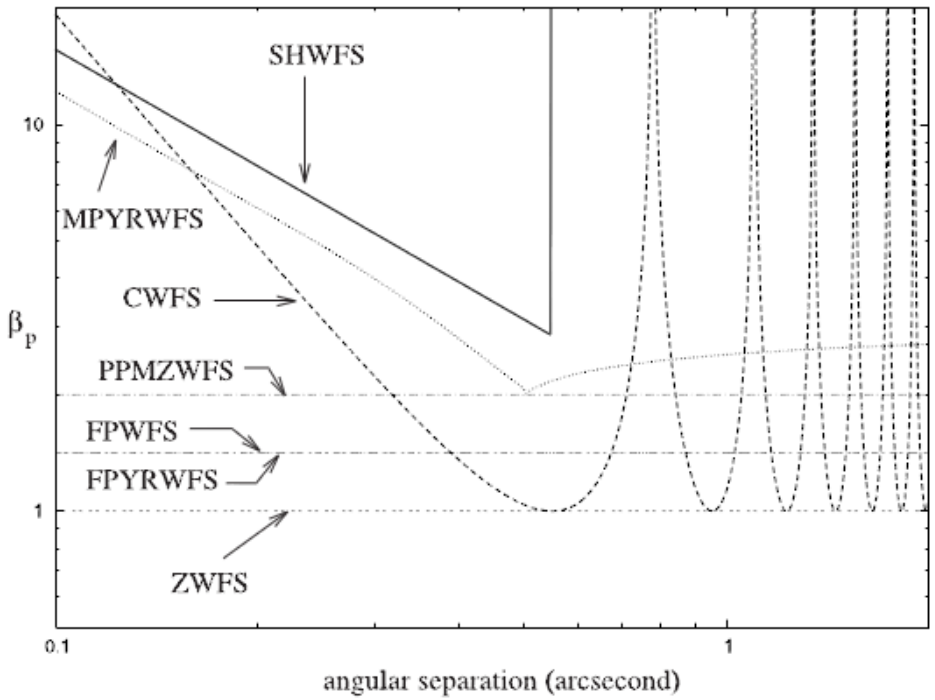
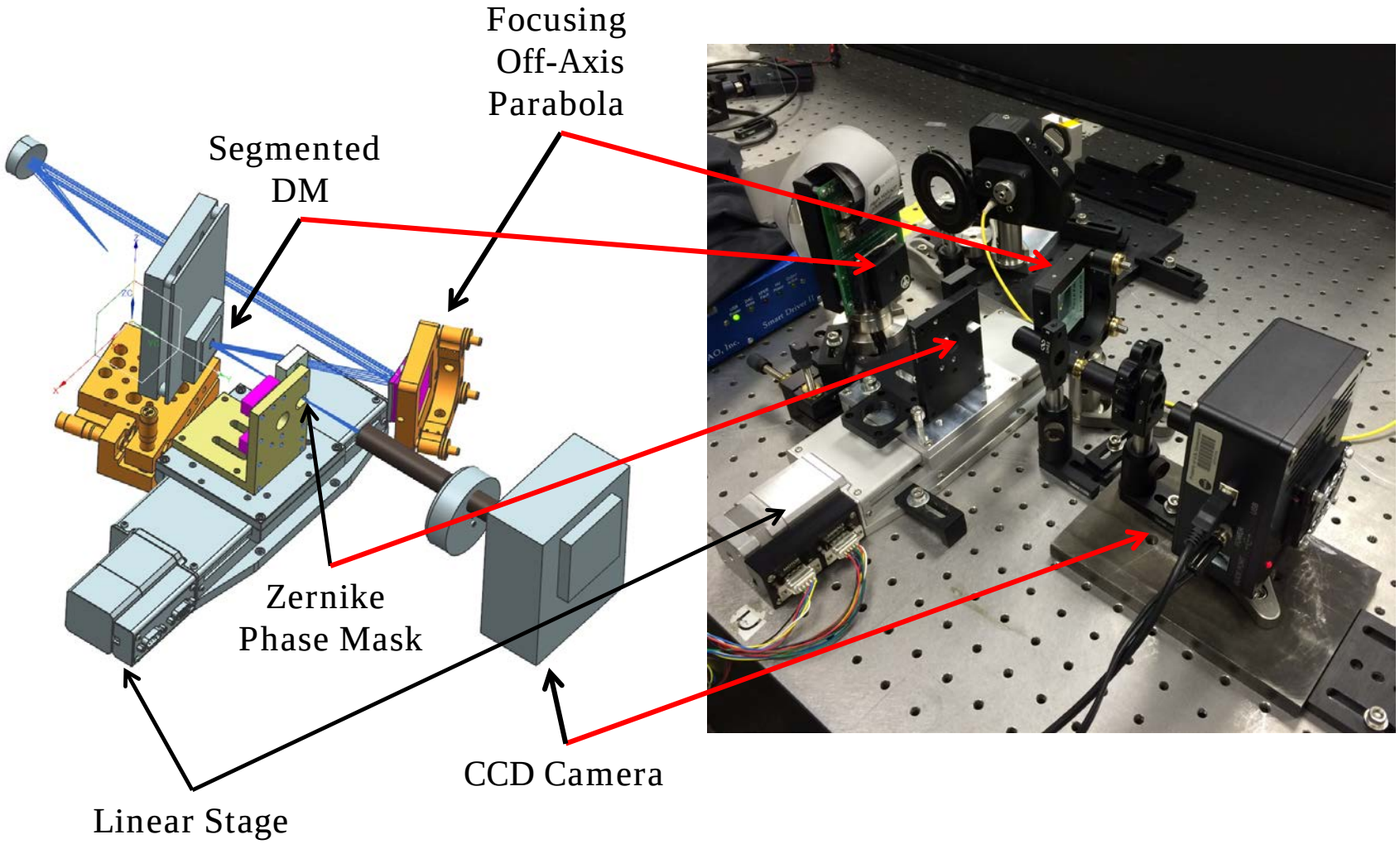


FIG. 10.—Value of β_p as a function of angular separation for the WFSs compared in this study. The WFSs were optimized for a separation of 0.″5. For the SHWFS, $r_0 = 0.2$ m and $\lambda_0 = 0.5$ μm.

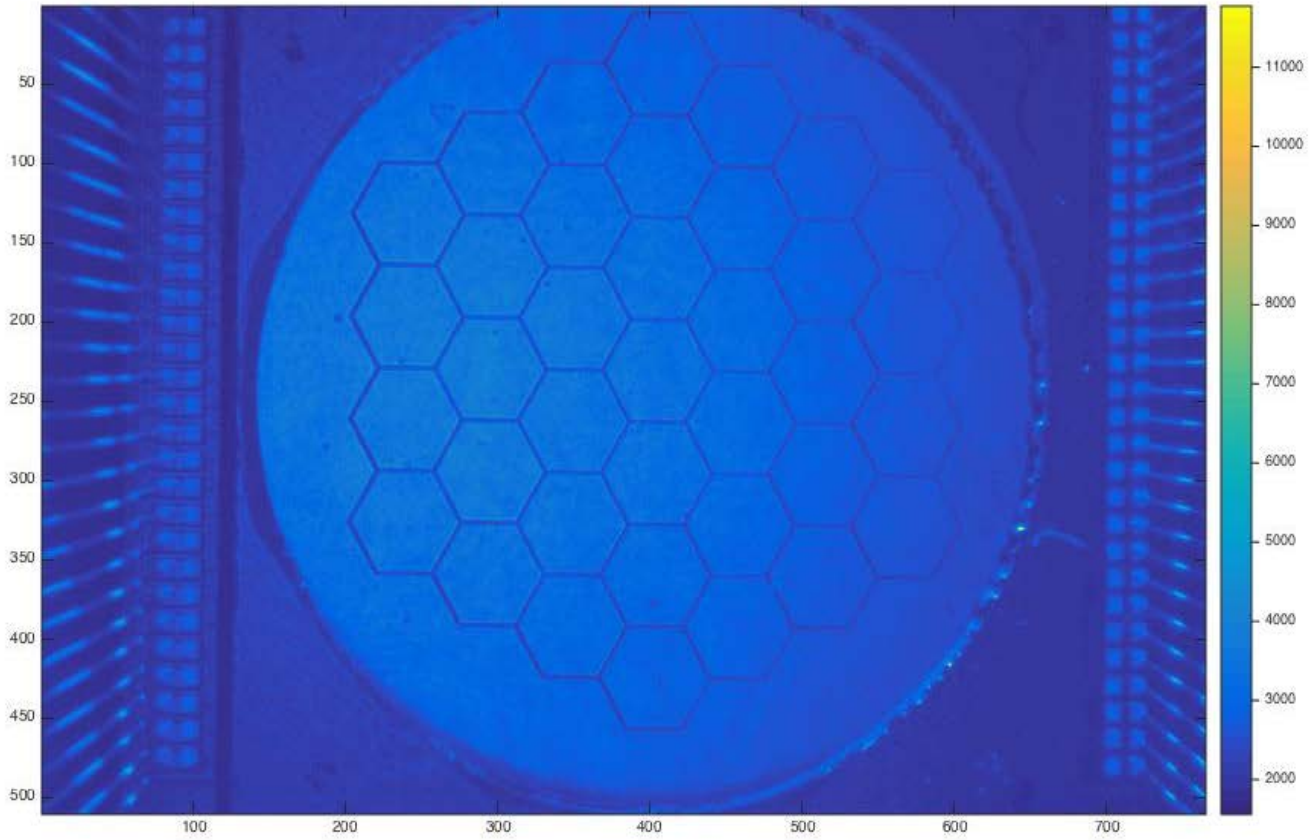
Credit: O. Guyon, ApJ, 2005

ZWFS for phasing segmented apertures

Opto/mech Hardware



Pupil Image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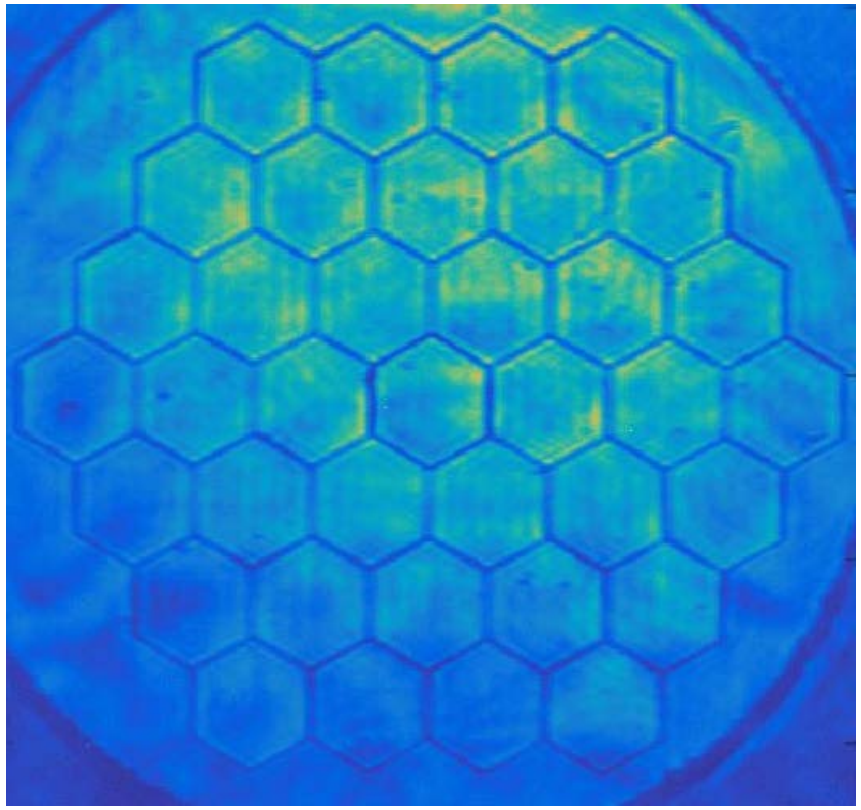
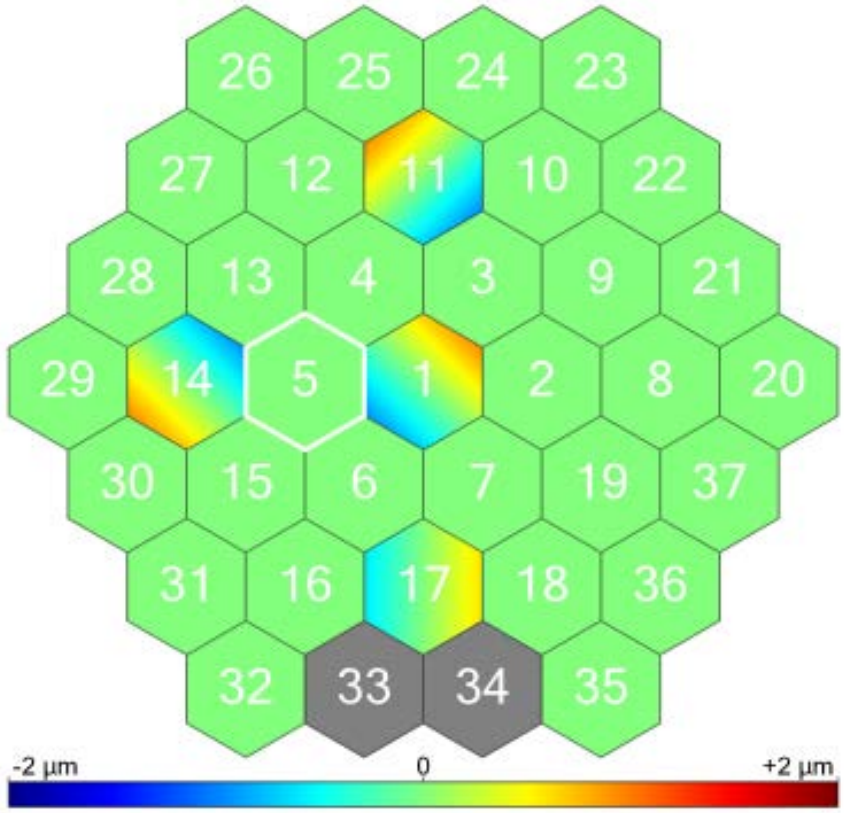
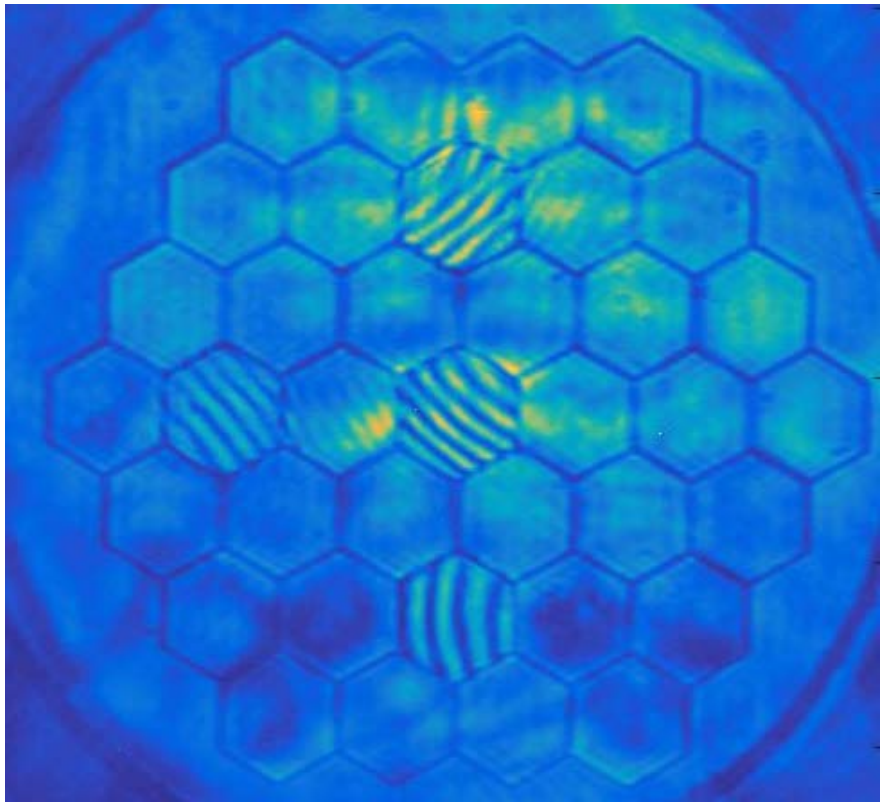
Pupil with phase plate inserted
0 OPD

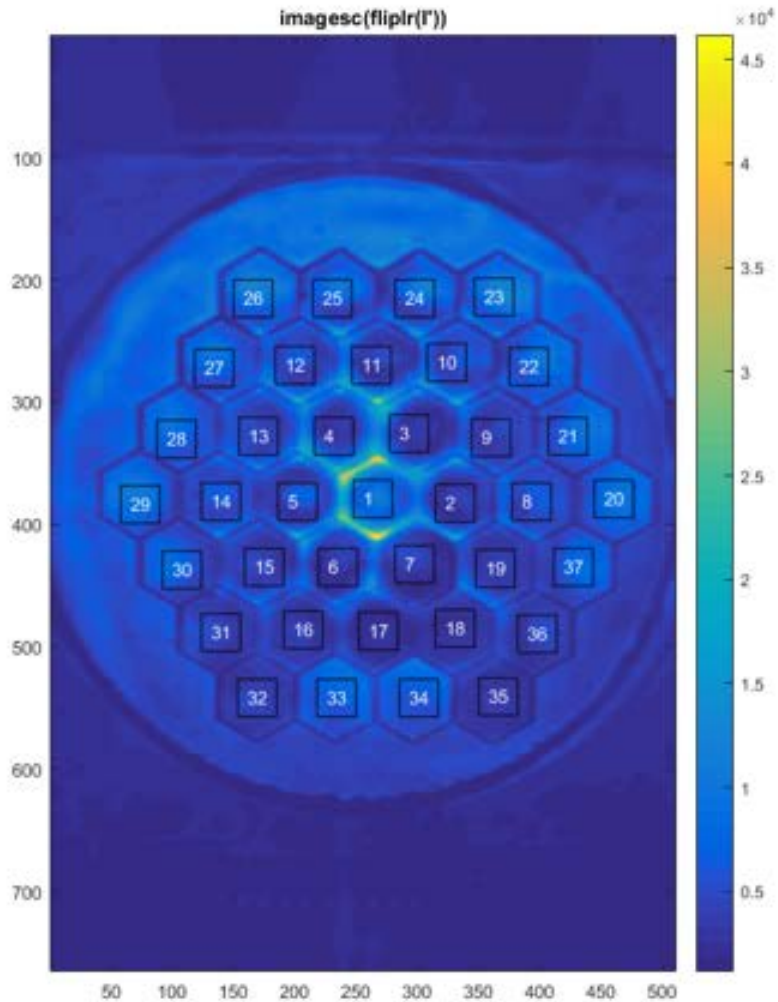


Commanded Segments



Resulting Pupil Image when centered on a phase dimple

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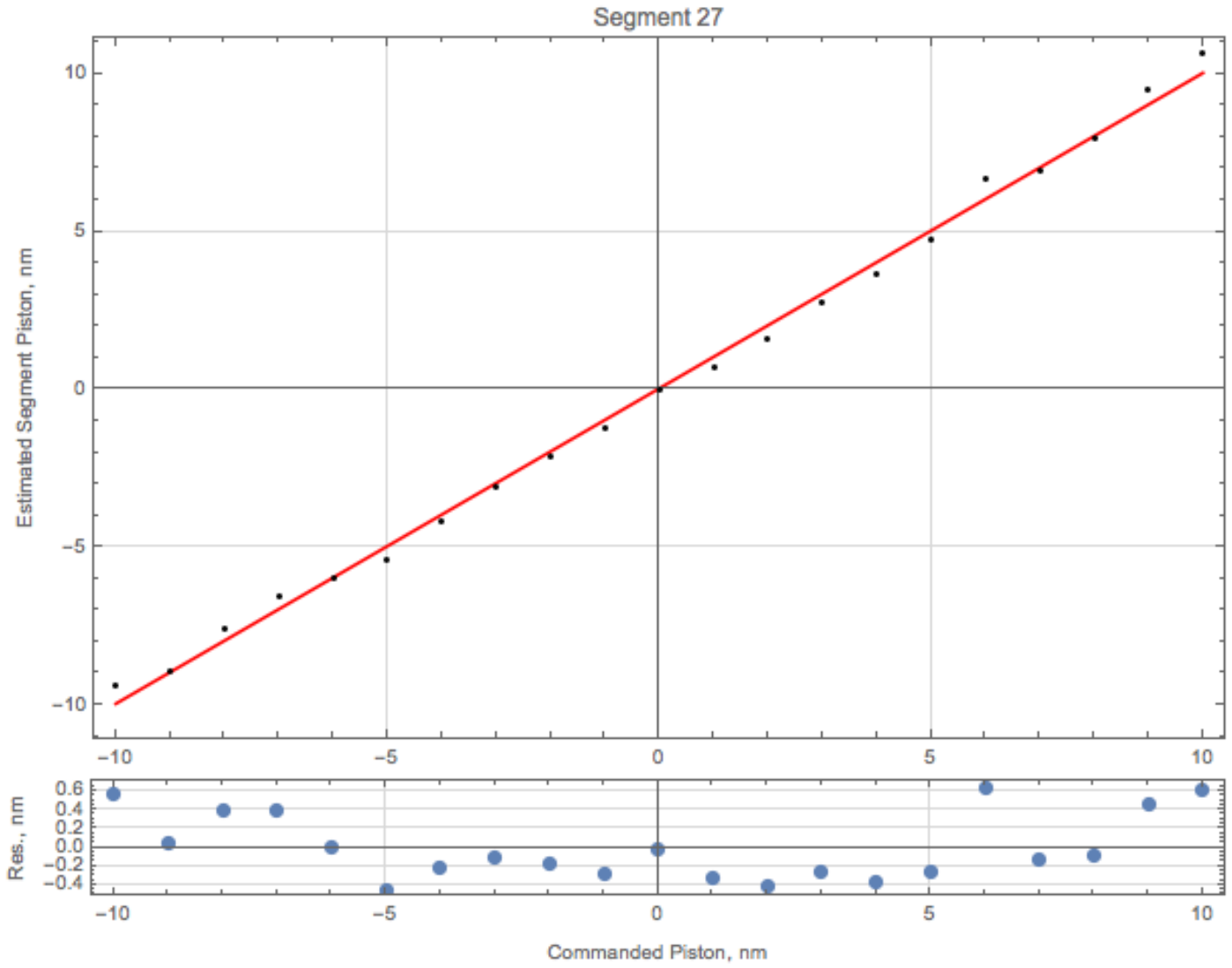
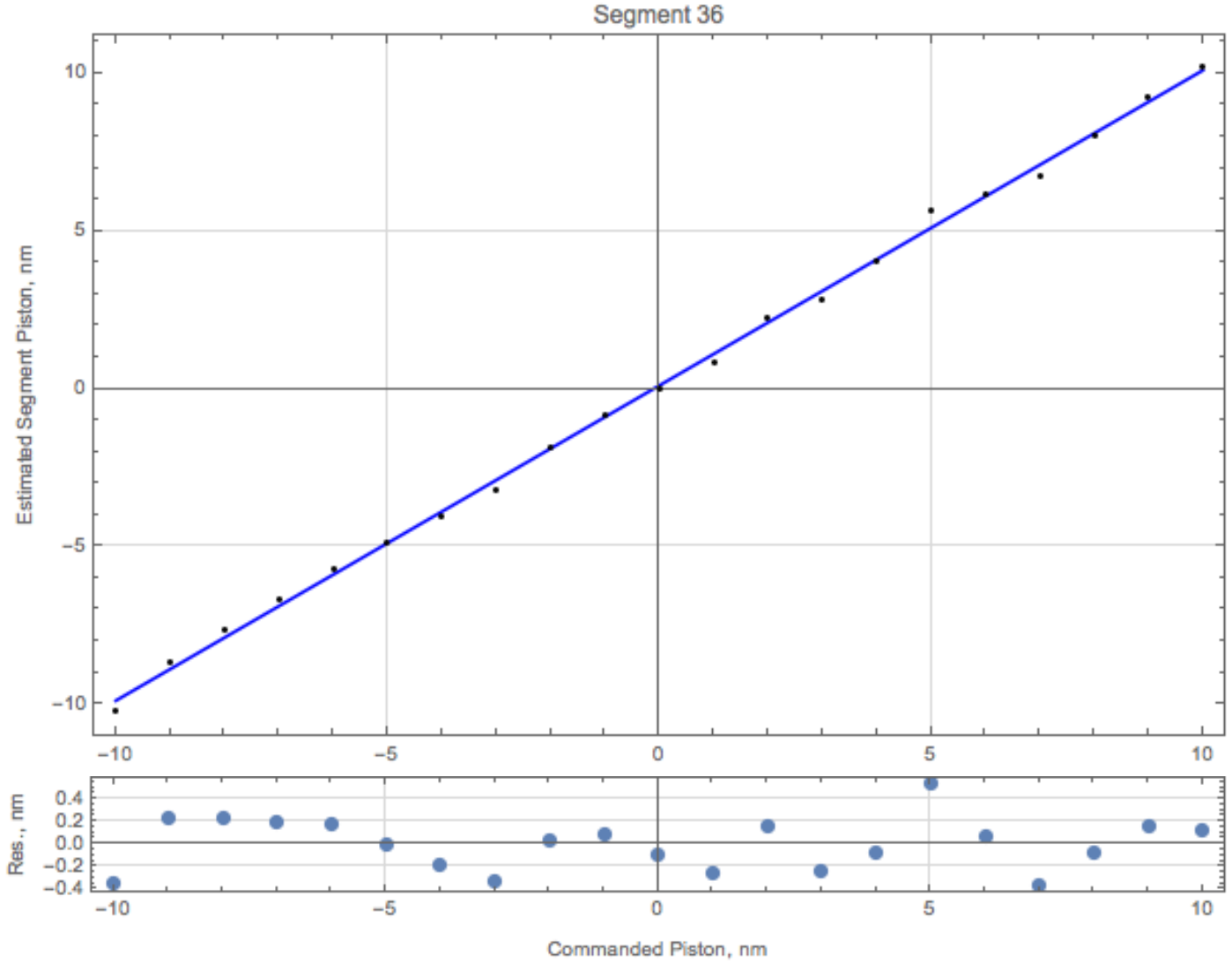
DM Segment 27



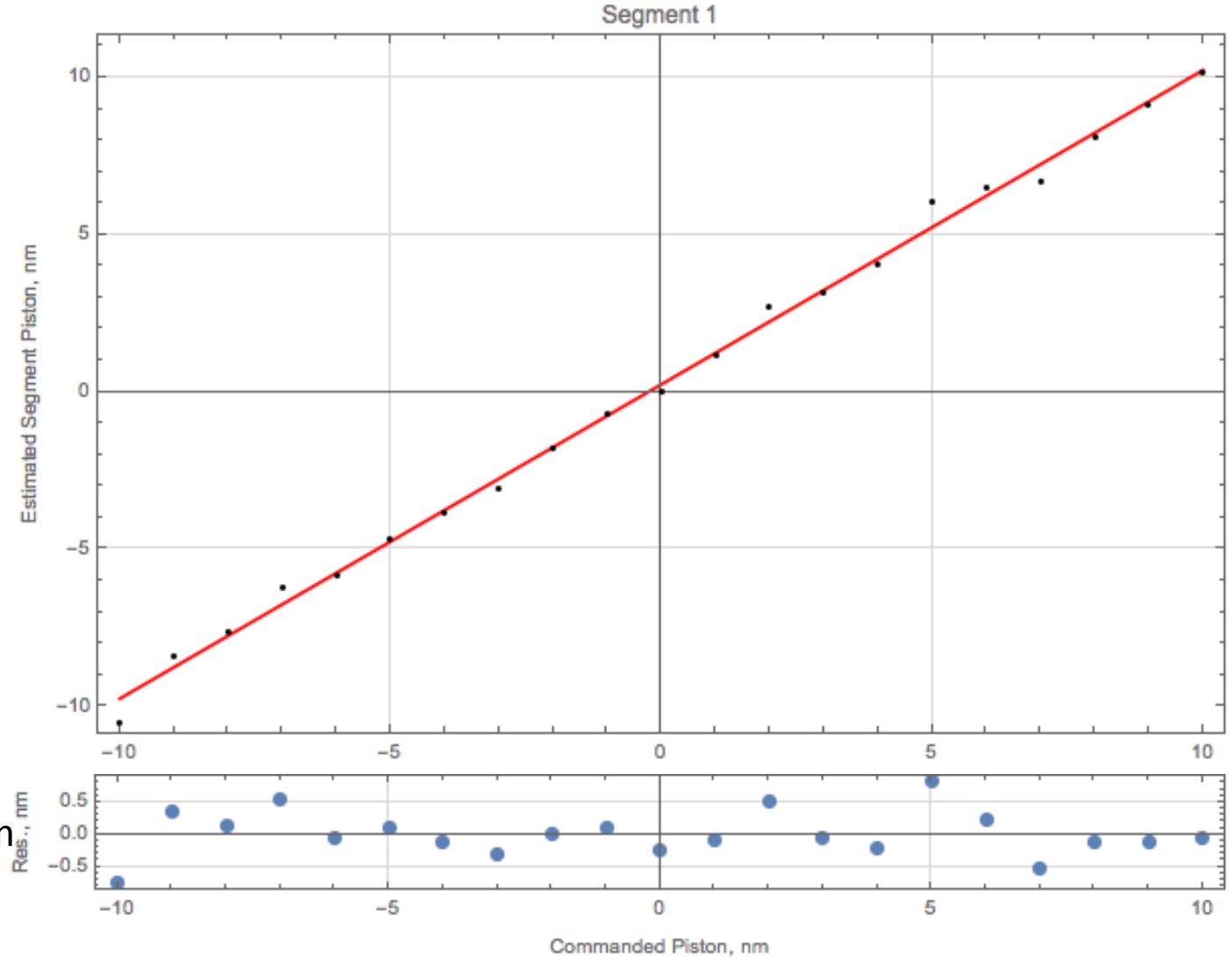
Piston Est. Error = 0.35 nm

DM Segment 36



Piston Est. Error = 0.22 nm

DM Segment 1



Piston Est. Error = 0.348 nm