Gaia-based GFA metrology tweaks

Approach

- In addition to providing pseudo metrology for the two guide cameras lacking real metrology in fp-metrology.csv, the planar surfaces x_fp(x_gfa, y_gfa) and y_fp(x_gfa, y_gfa) can also provide tweaked metrology for the guide cameras with real metrology in fp-metrology.csv

- The idea is that the focal plane corner coordinates provided by the planar surface models should encapsulate information about the Gaia star position residuals relative to the real metrology provided in fp-metrology.csv for GUIDE0, GUIDE2, GUIDE5 and GUIDE8 even though the analysis isn't framed explicitly in terms of metrology residuals

Approach

- The same script I wrote to generate GUIDE3 and GUIDE7 pseudo metrology can also output the pseudo metrology corner coordinates for cameras with real metrology in fp-metrology.csv

  - https://github.com/desihub/desimeter/blob/master/bin/write_guide3_guide7_patch

- There are only two minor differences in methodology for the cameras with real metrology relative to those without real metrology in fp-metrology.csv

  - For the z_ptl and z_fp coordinates of cameras with real metrology, I adopt their real metrology values rather than the average of these quantities across cameras with real metrology

  - When figuring out the shifts to transform between focal surface and physical CCD coordinates, I begin by guessing the XYZ pinhole coordinates based on the real metrology already available for the specific camera in question, rather than starting with a guess that averages across cameras with real metrology

Results
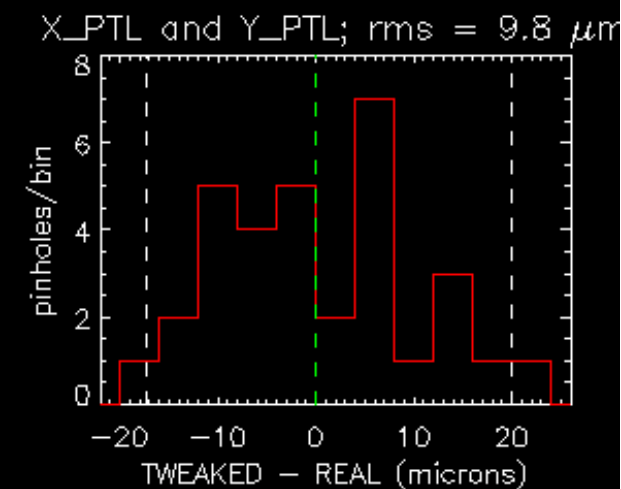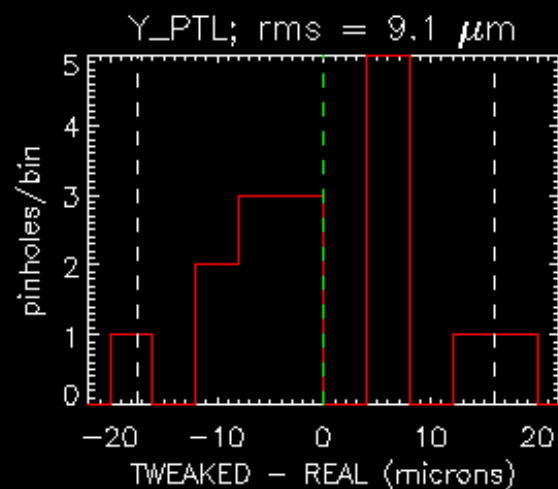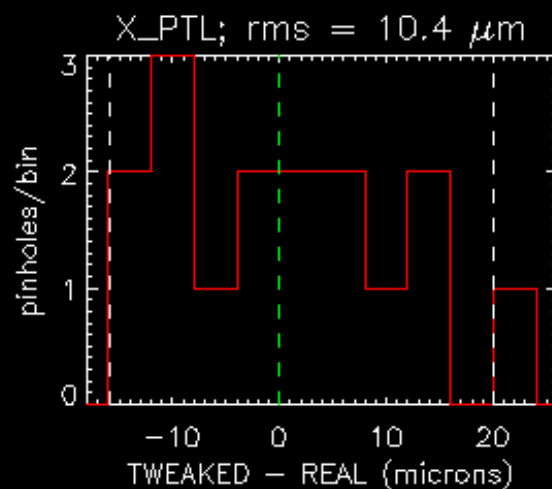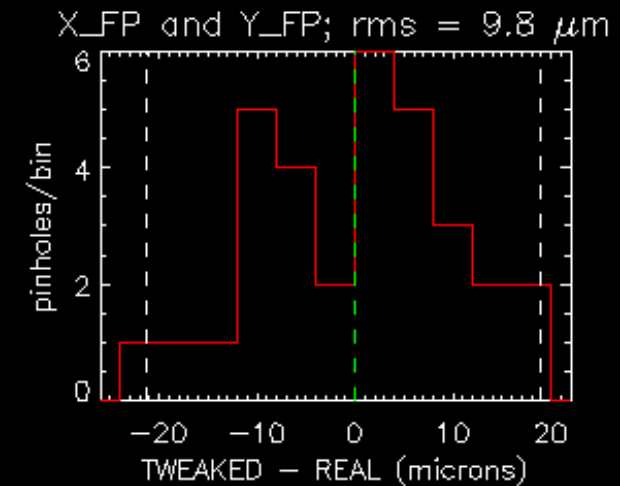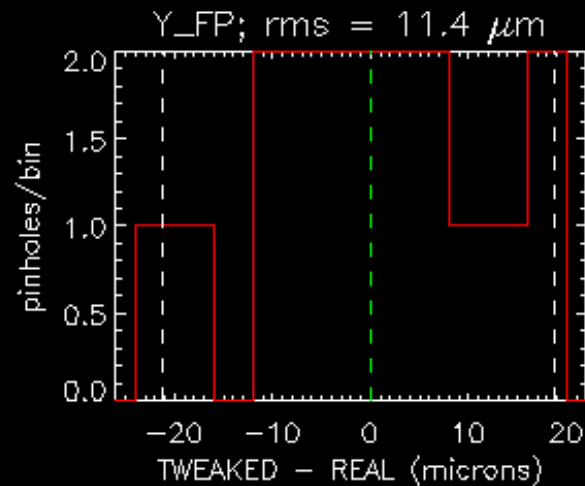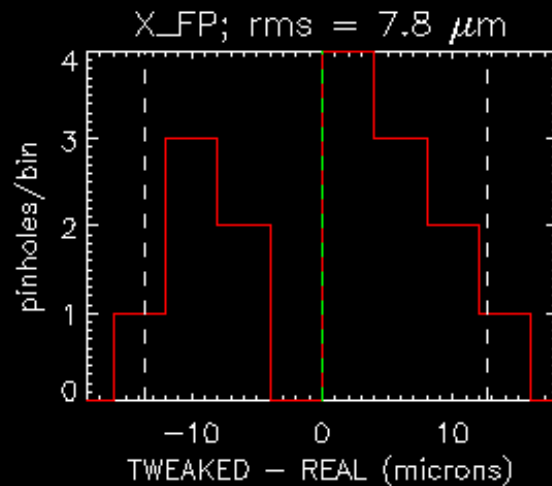
- These plots only include GUIDE0, GUIDE2, GUIDE5, GUIDE8 (the guide cameras with real metrology in fp-metrology.csv)
- RMS values are computed relative to zero
- White vertical dashed lines are the min and max values within each panel

Results
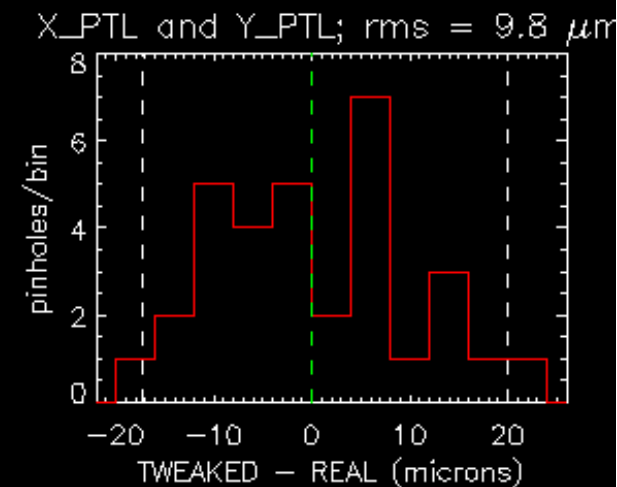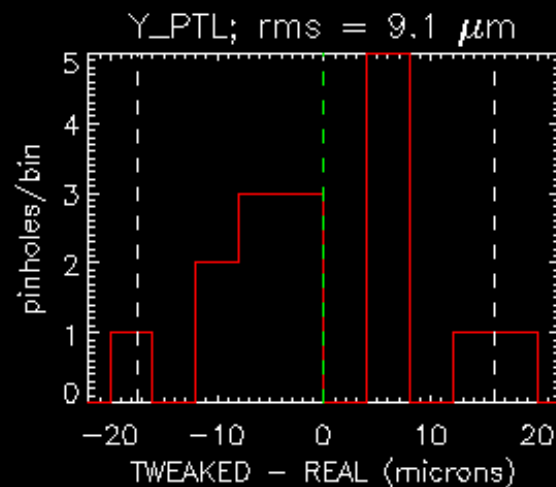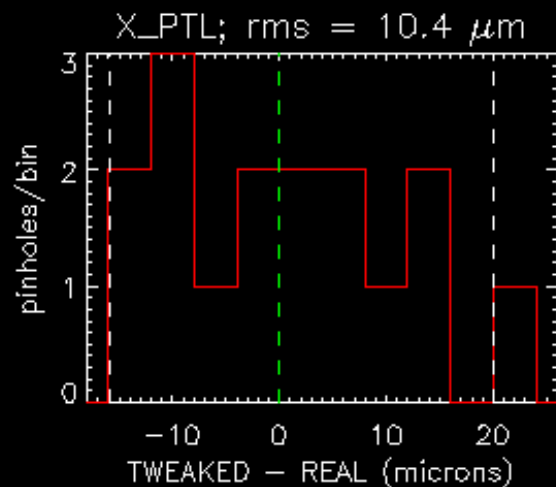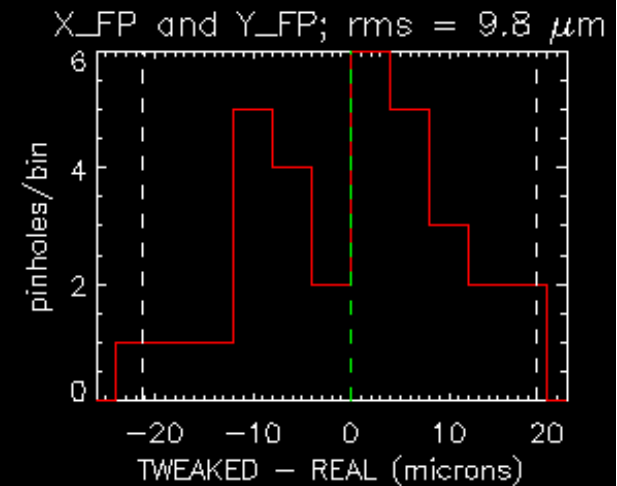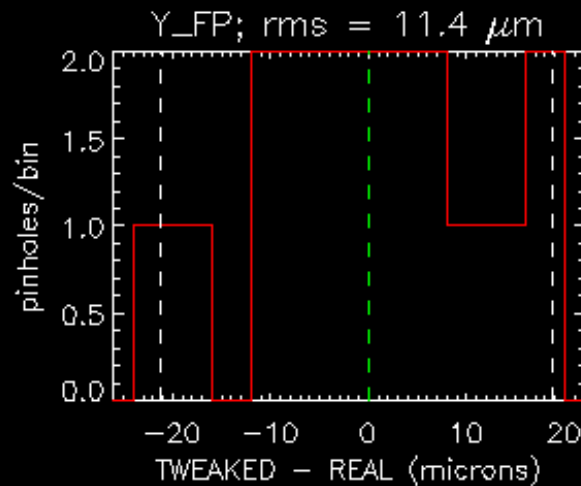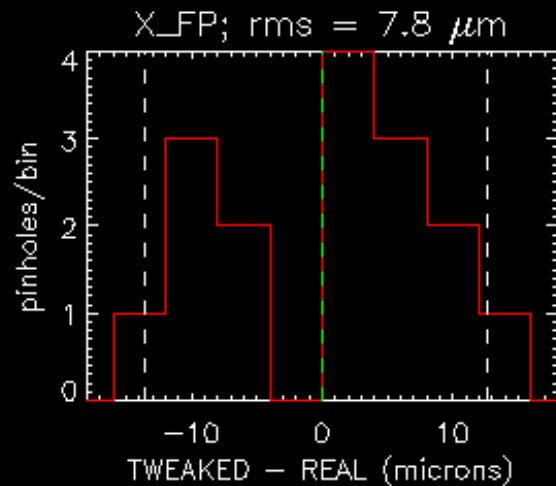
- The largest shift for any pinhole in any of X_PTL, Y_PTL, X_FP, Y_FP is 21.2 microns
- 21.2 microns also happens to be the largest 2D shift inferred for any of the 16 pinholes from GUIDE0, GUIDE2, GUIDE5, GUIDE8
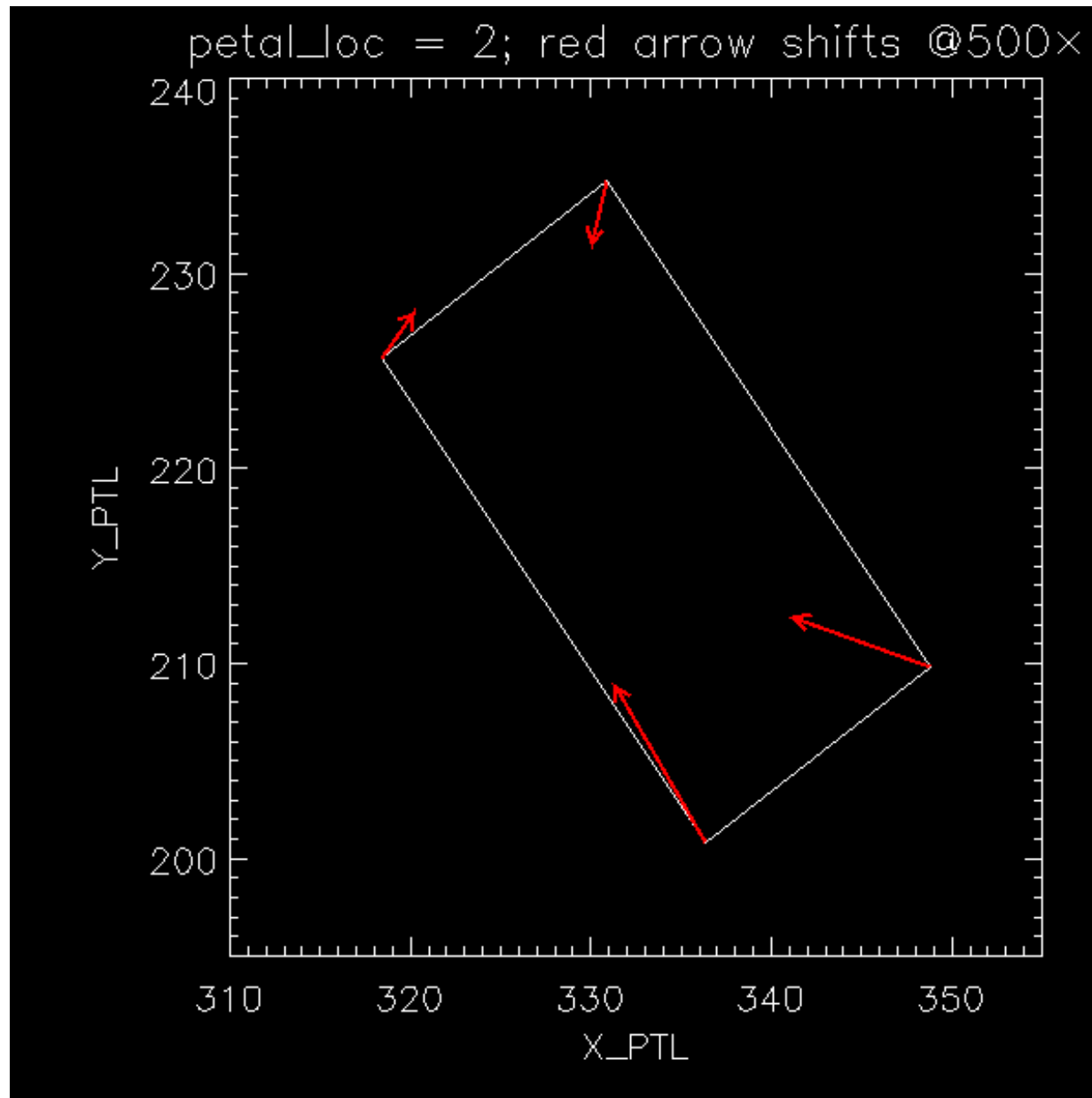
Sanity check: running another iteration

- I ran another iteration of my entire analysis (i.e., re-fitting all FieldModel's and planar surfaces) where I replaced all guide GFA metrology with my pseudo metrology, to check for indications of non-convergence

- The largest per coordinate shift in the second iteration of the pseudo metrology relative to the first iteration is < 1 micron

- The RMS per-coordinate shift between first and second iterations of pseudo metrology is 0.36 microns

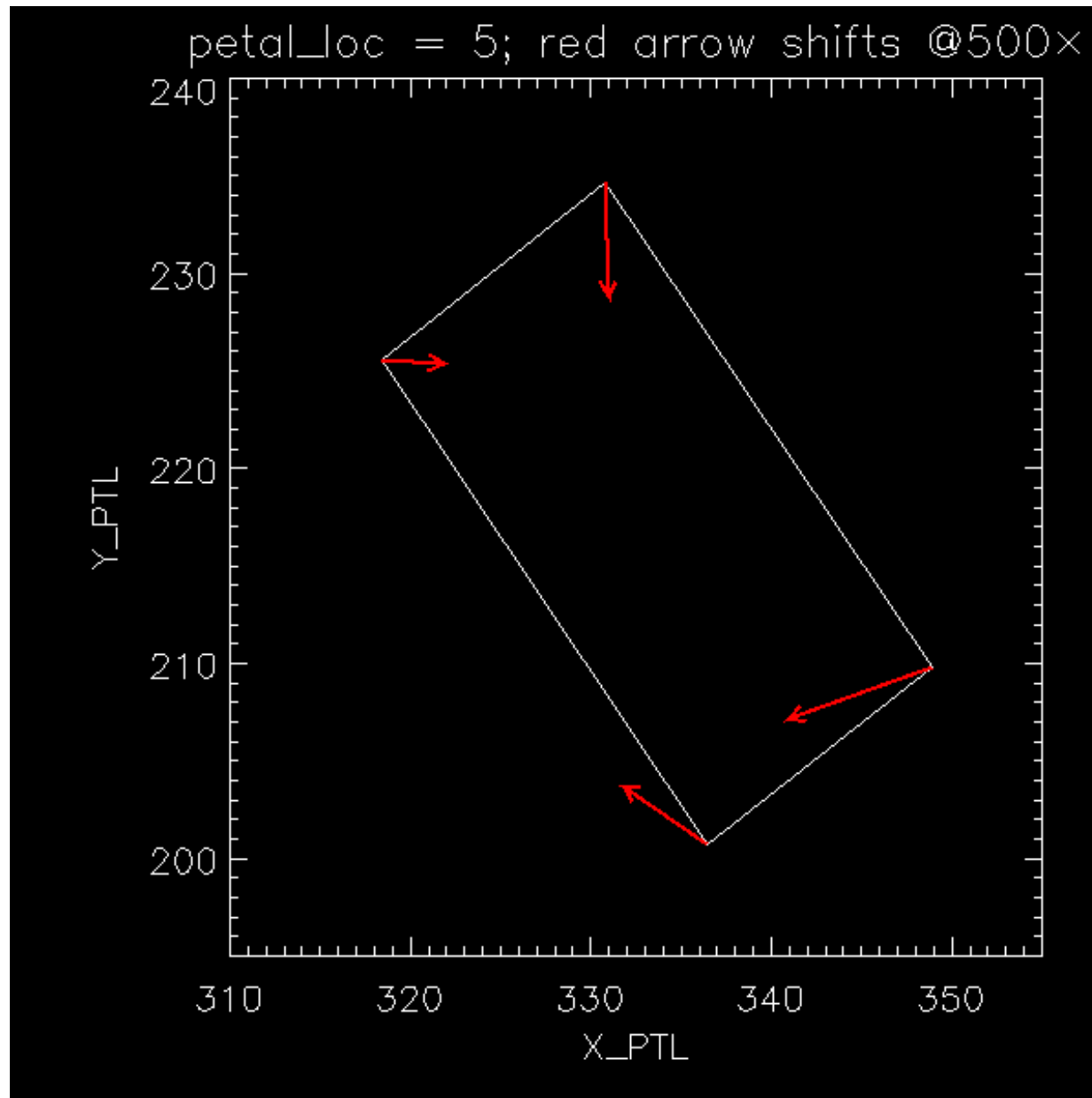- So my methodology seems convergent/self-consistent

Vector plots showing magnitude/ direction of corrections derived
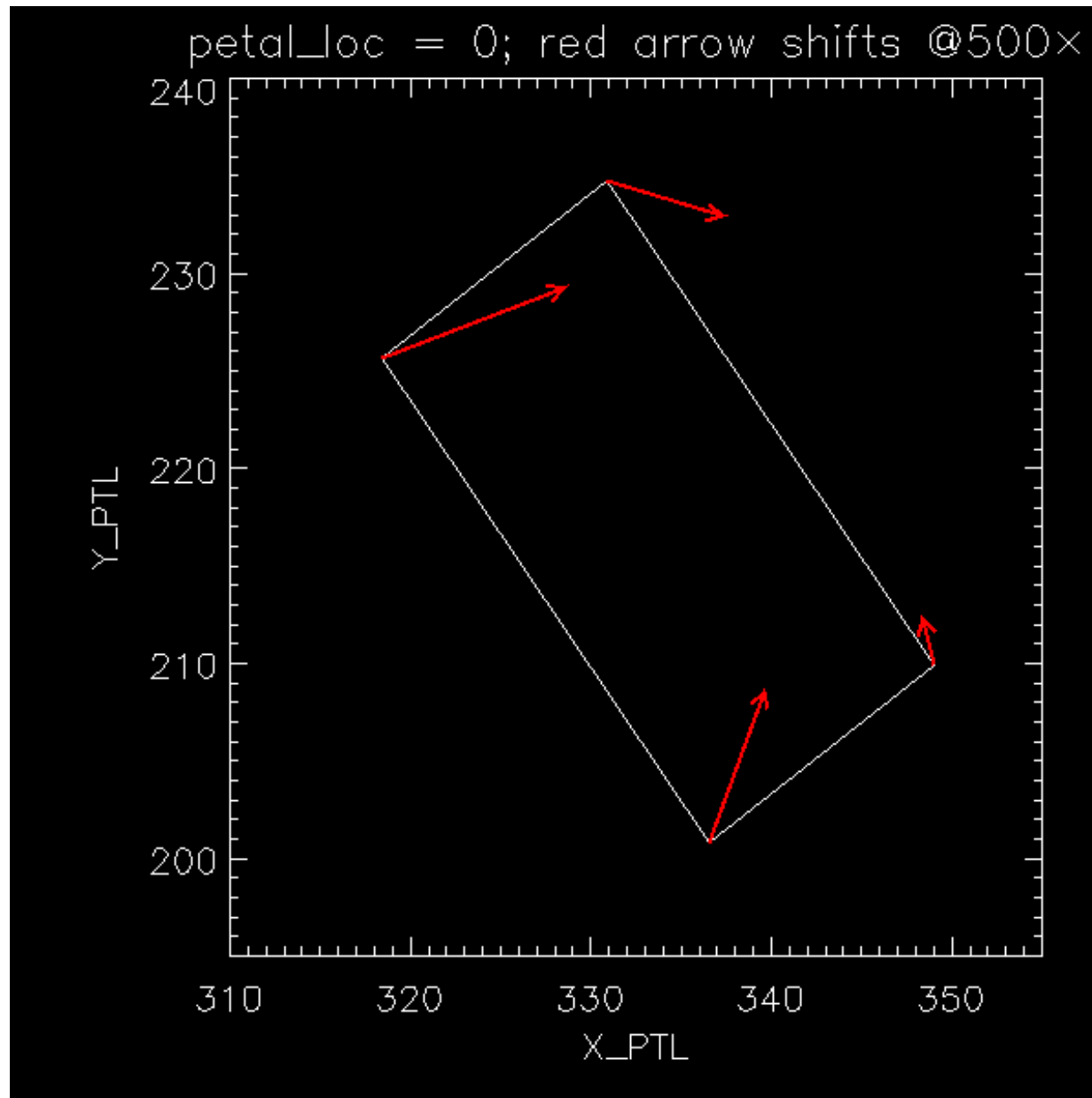
Vector plots showing magnitude/ direction of corrections derived

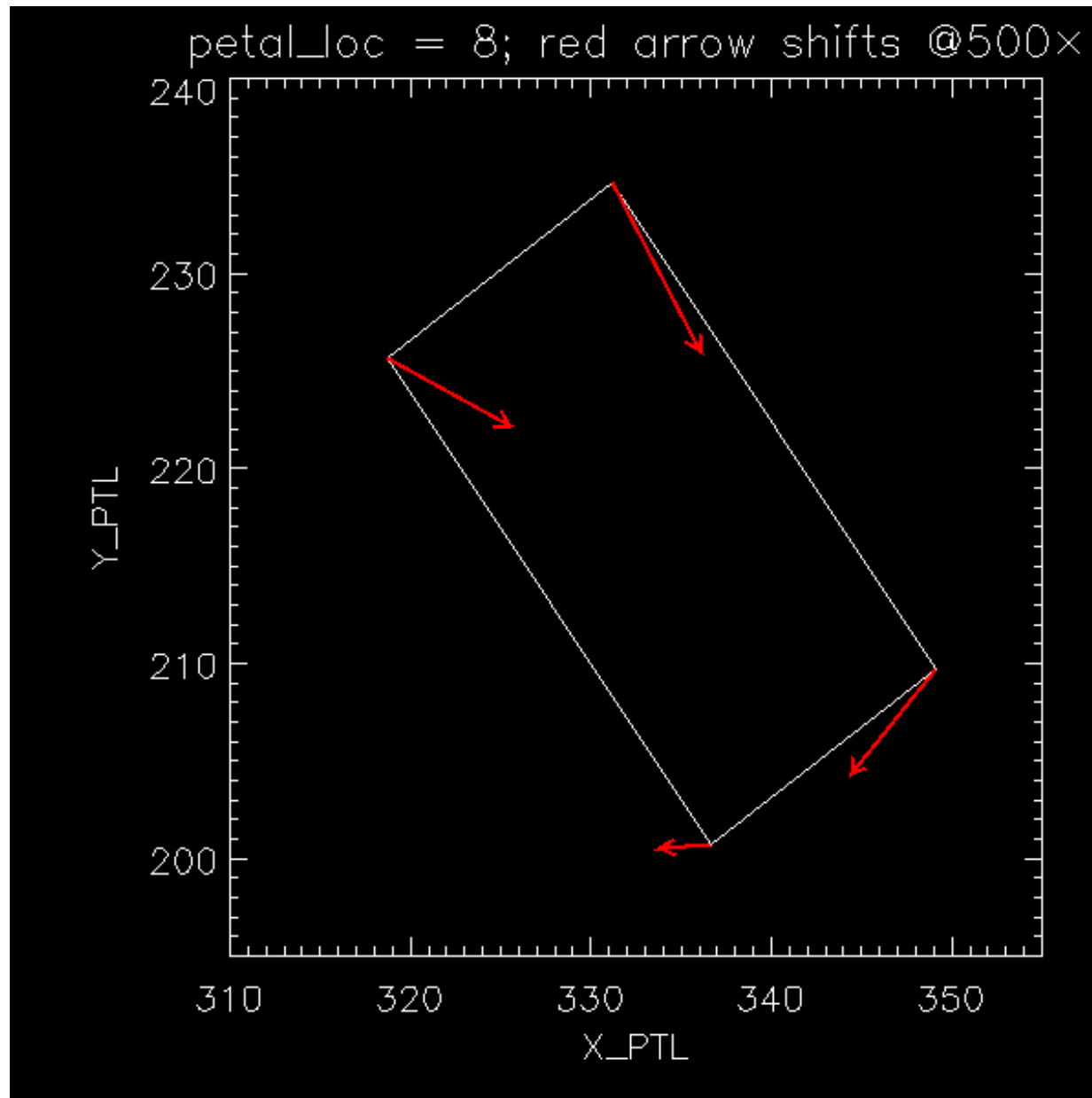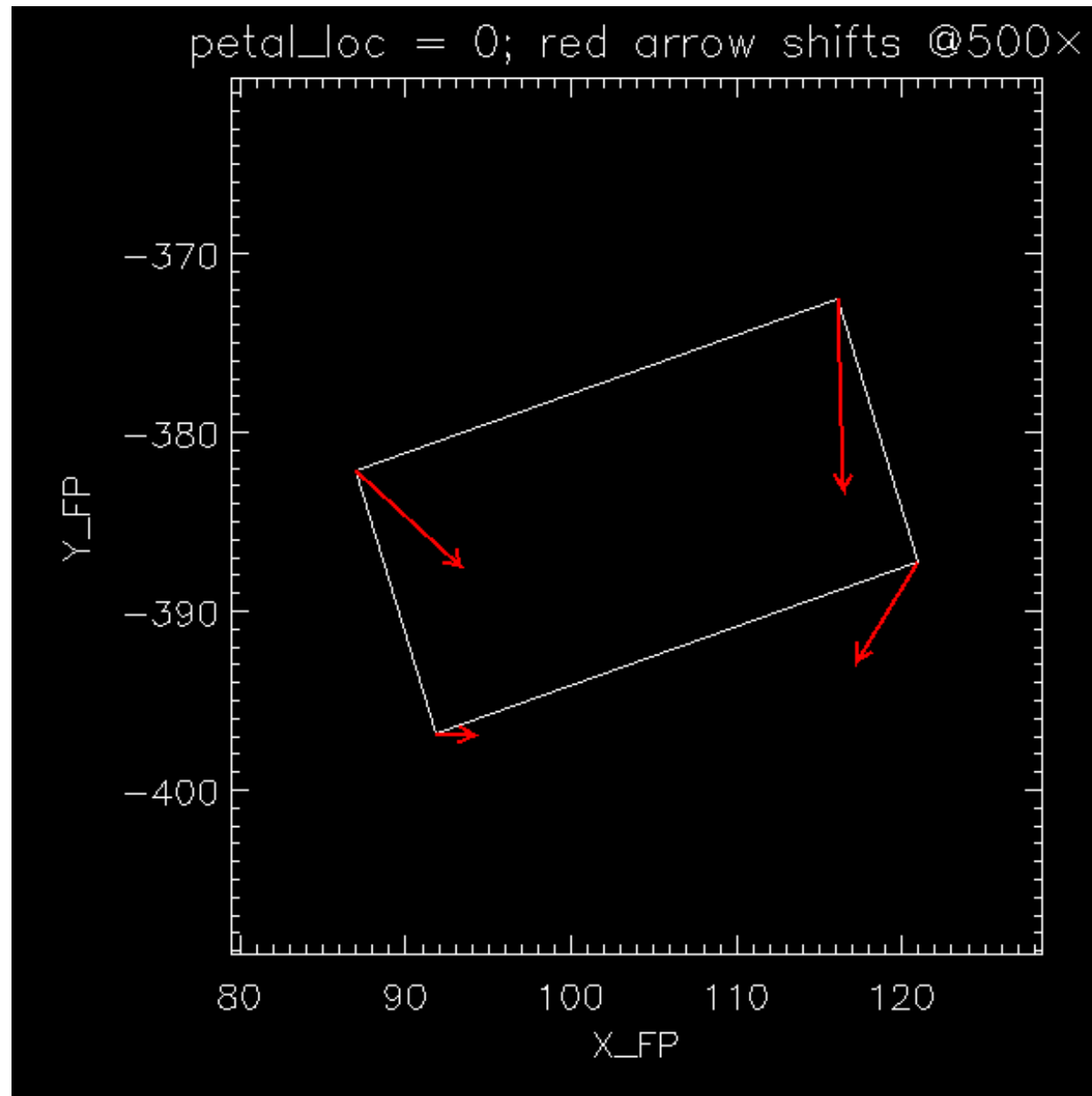# Vector plots showing magnitude/ direction of corrections derived
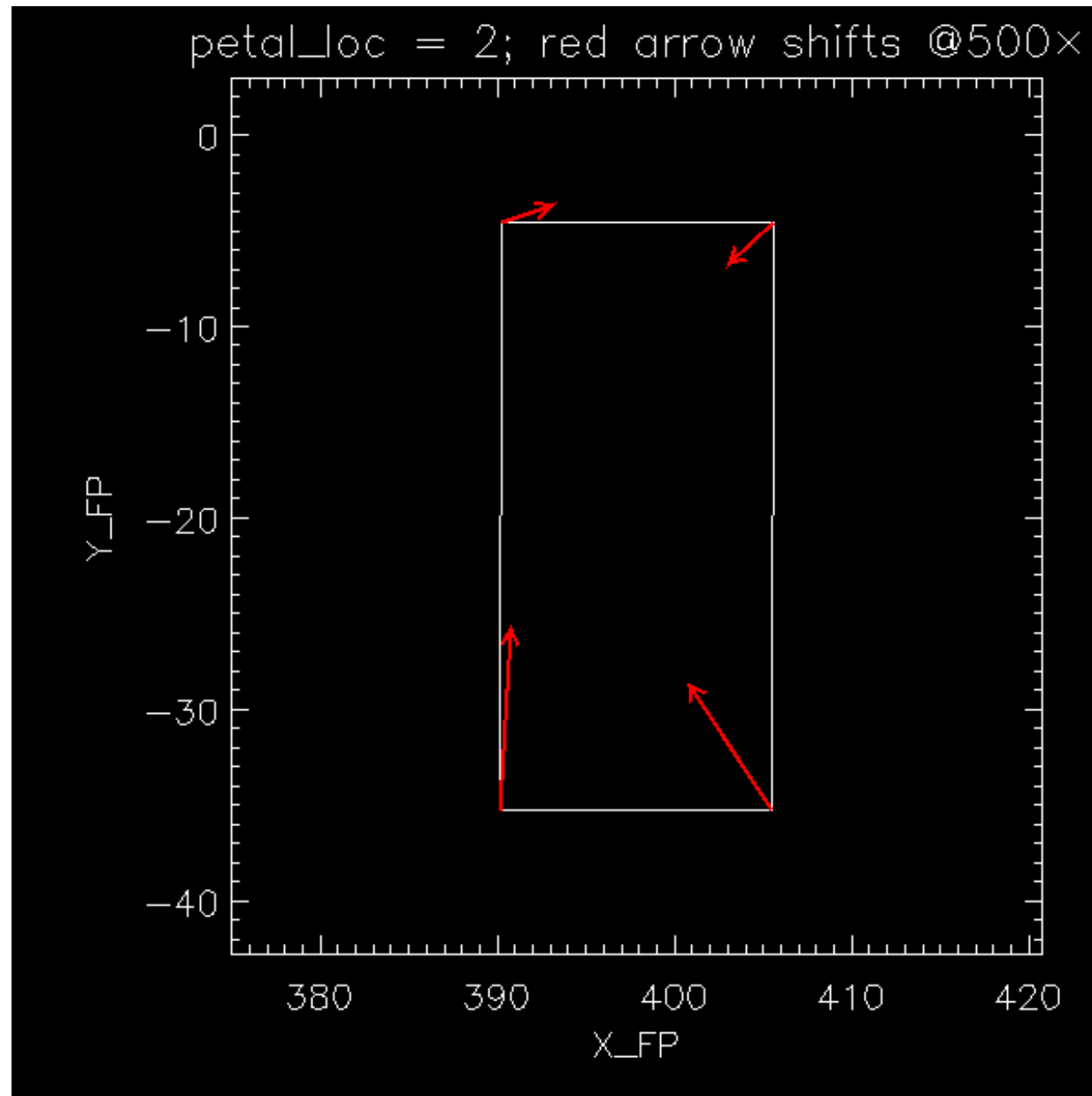
Vector plots showing magnitude/ direction of corrections derived
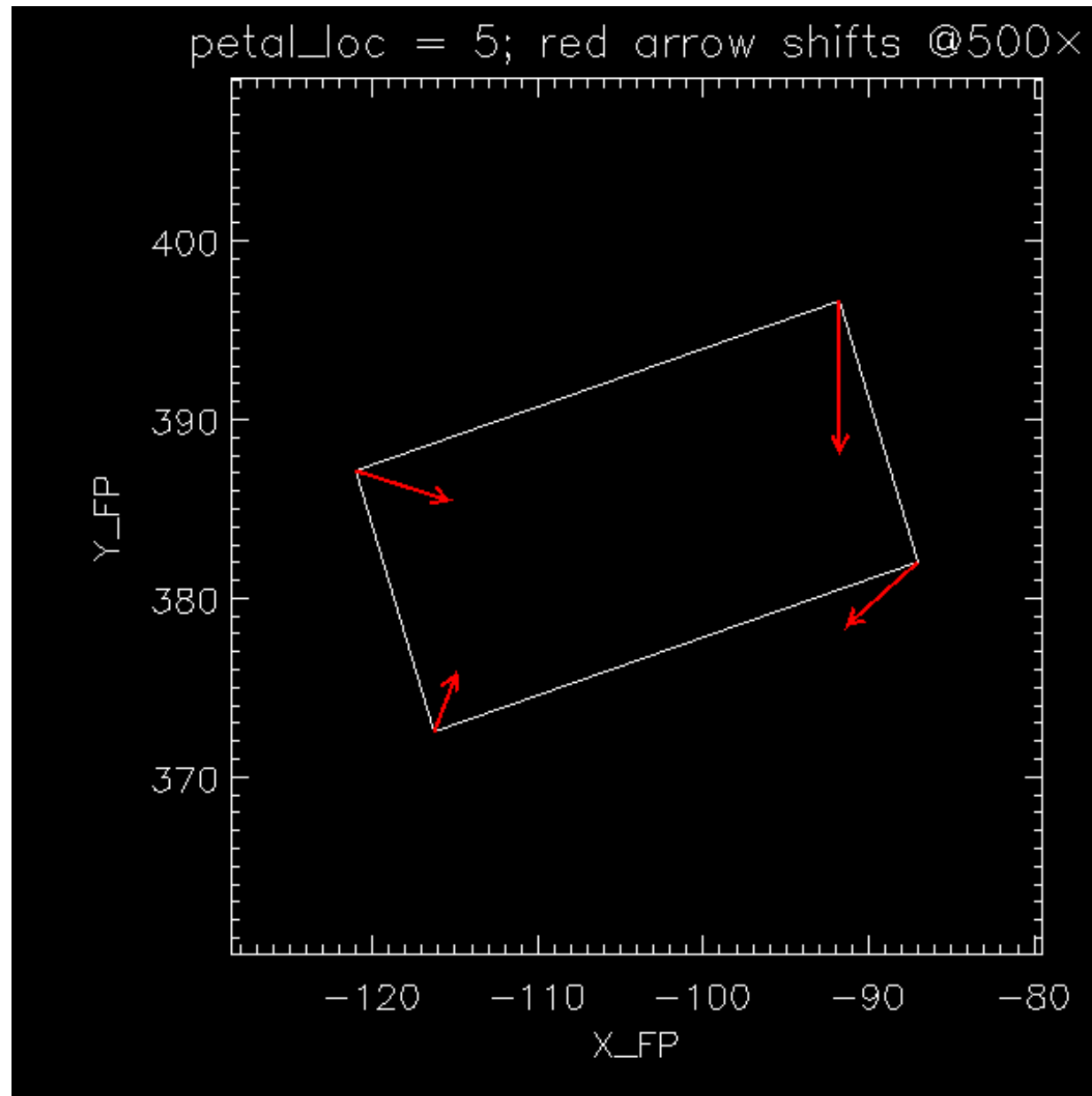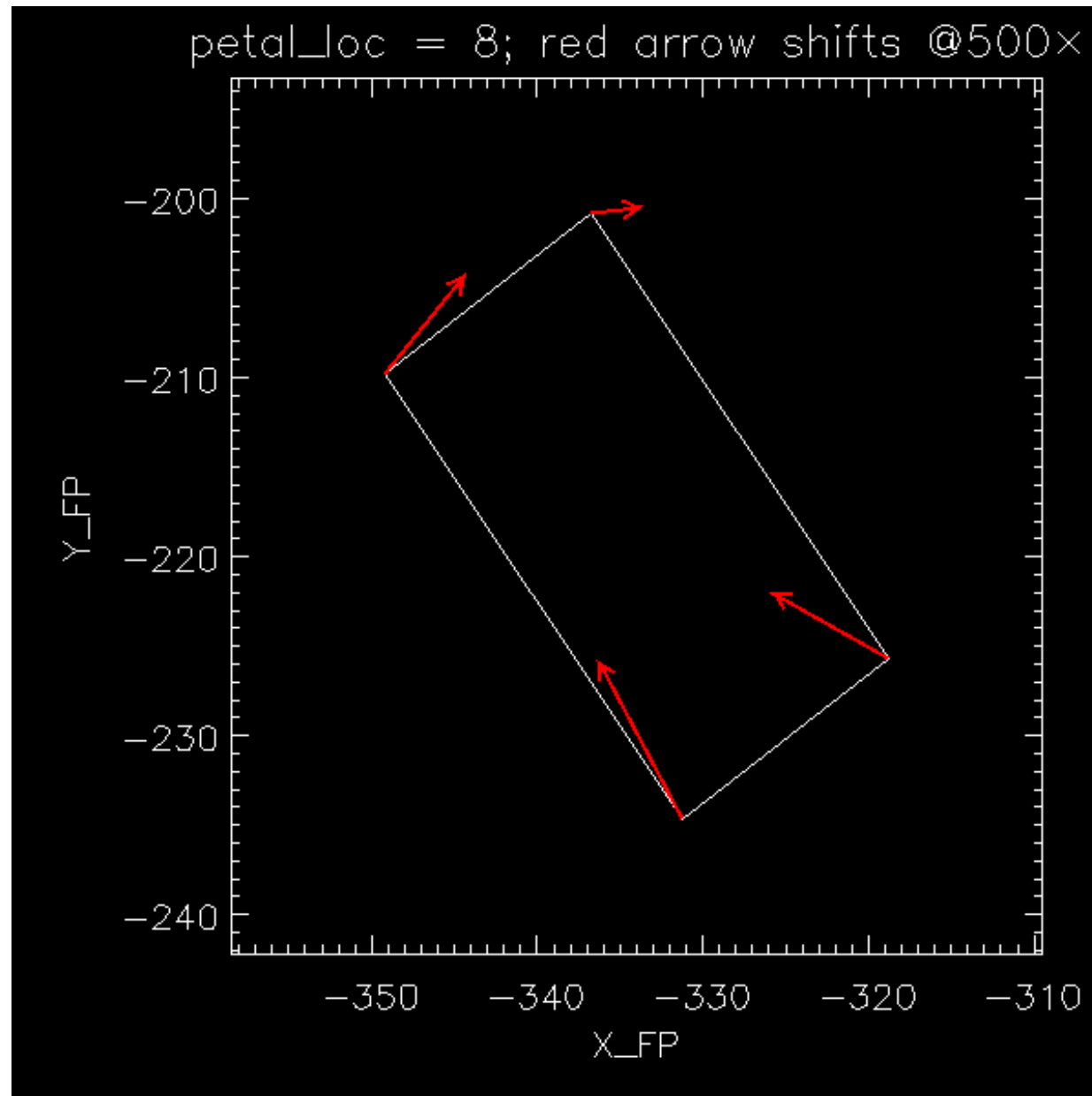
Vector plots showing magnitude/ direction of corrections derived

Vector plots showing magnitude/direction of corrections derived

Vector plots showing magnitude/direction of corrections derived
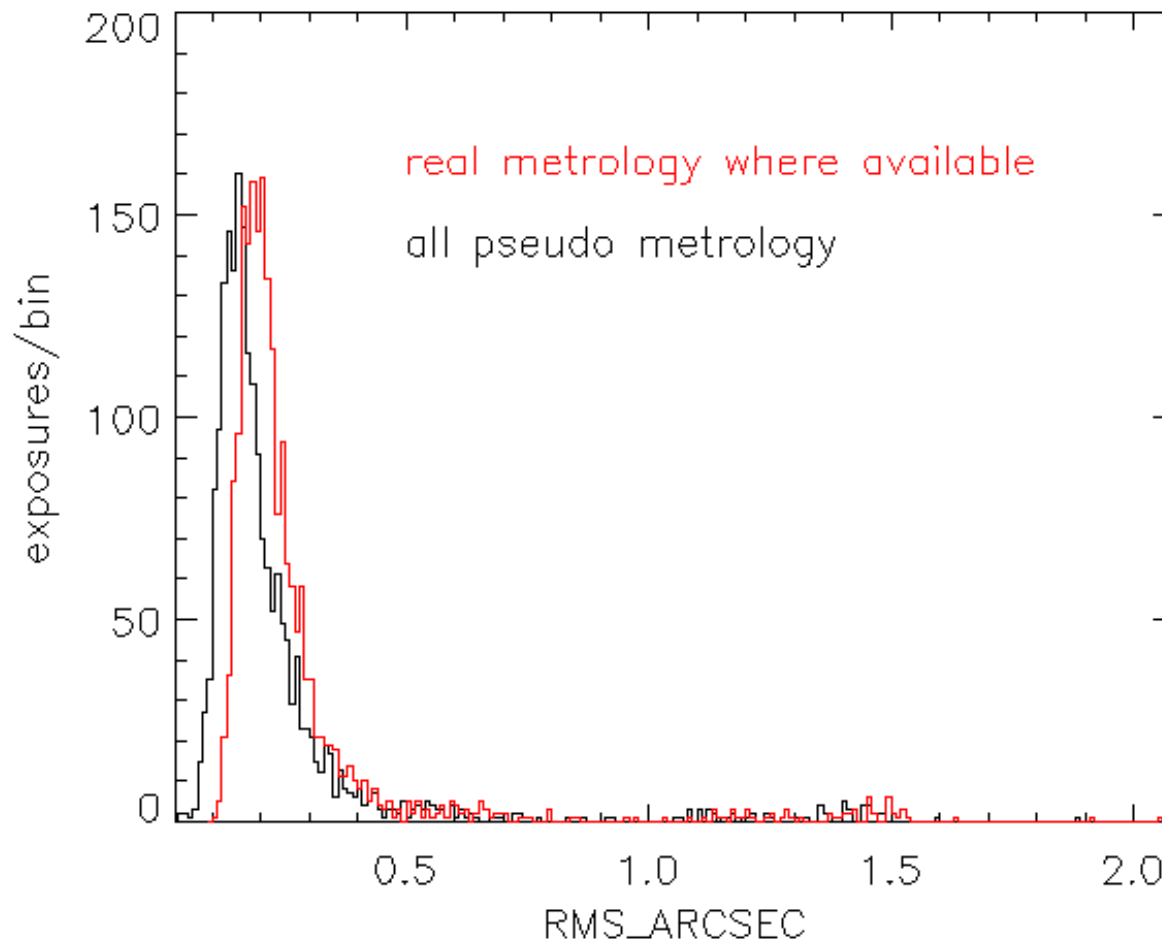
Vector plots showing magnitude/ direction of corrections derived
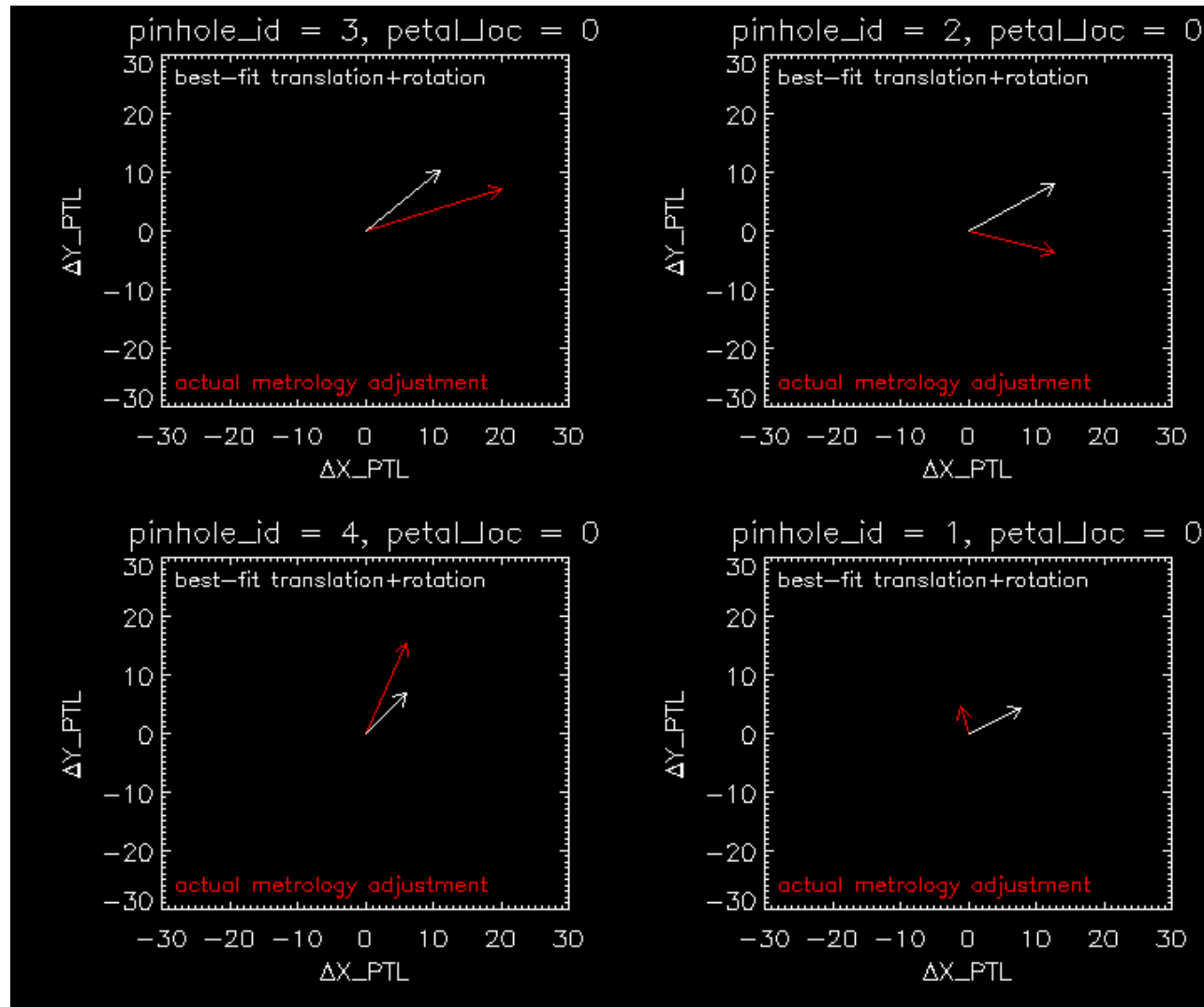
RMS_ARCSEC with pseudo metrology replacing real metrology

- Using real metrology when available: median(RMS_ARCSEC) = 0.212

- Replacing real metrology with tweaked metrology: median(RMS_ARCSEC) = 0.172

- So RMS_ARCSEC is improved by ~20% when replacing the real metrology for GUIDE0, GUIDE2, GUIDE5, GUIDE8 with the tweaked metrology based on Gaia

RMS_ARCSEC with pseudo metrology replacing real metrology

Decomposing the metrology adjustments into rotation+translation

- The metrology tweaks don't decompose well into rotation (about the GFA center) plus translation; this seems consistent with my visual impression of the measured amplitudes/directions
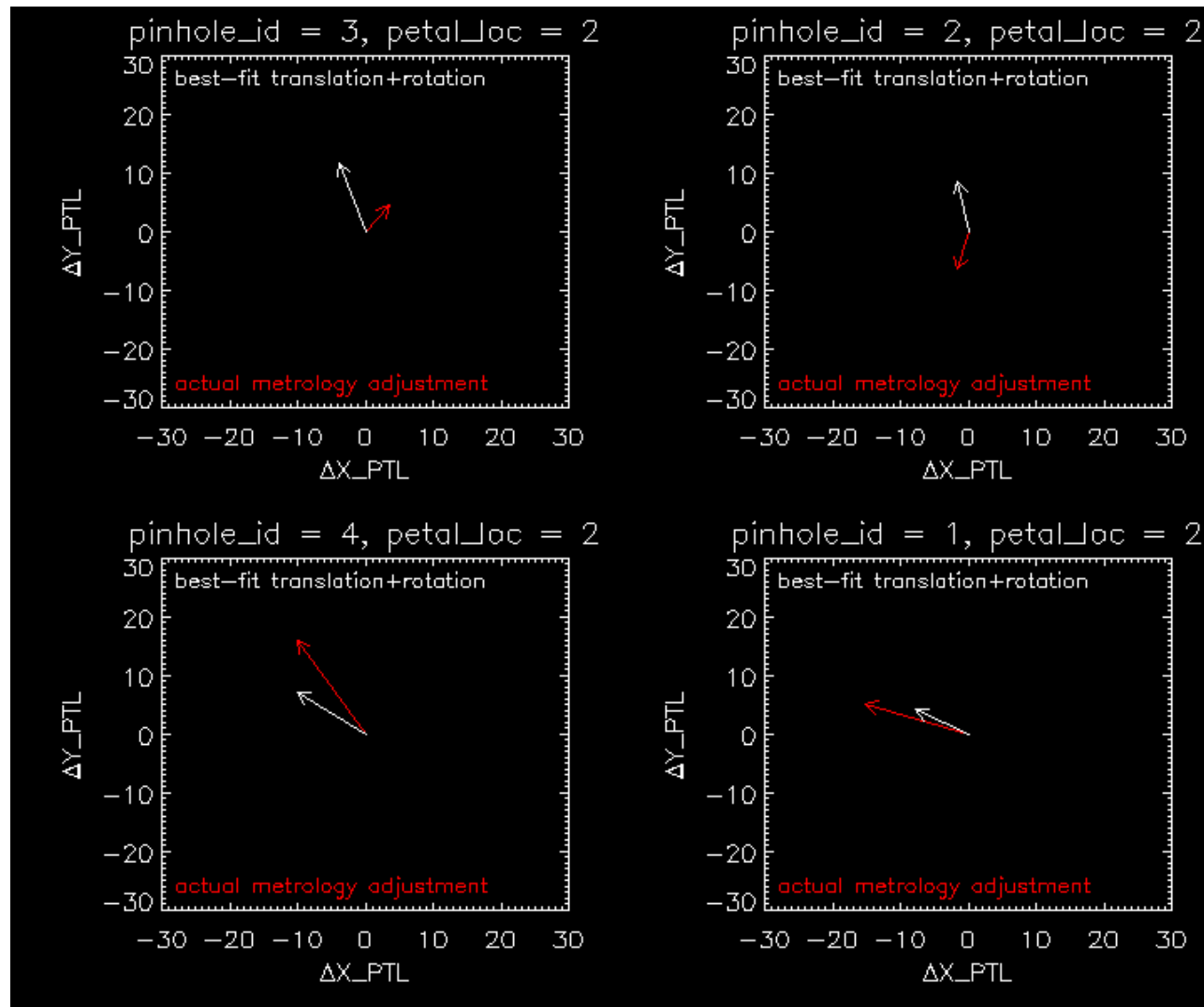
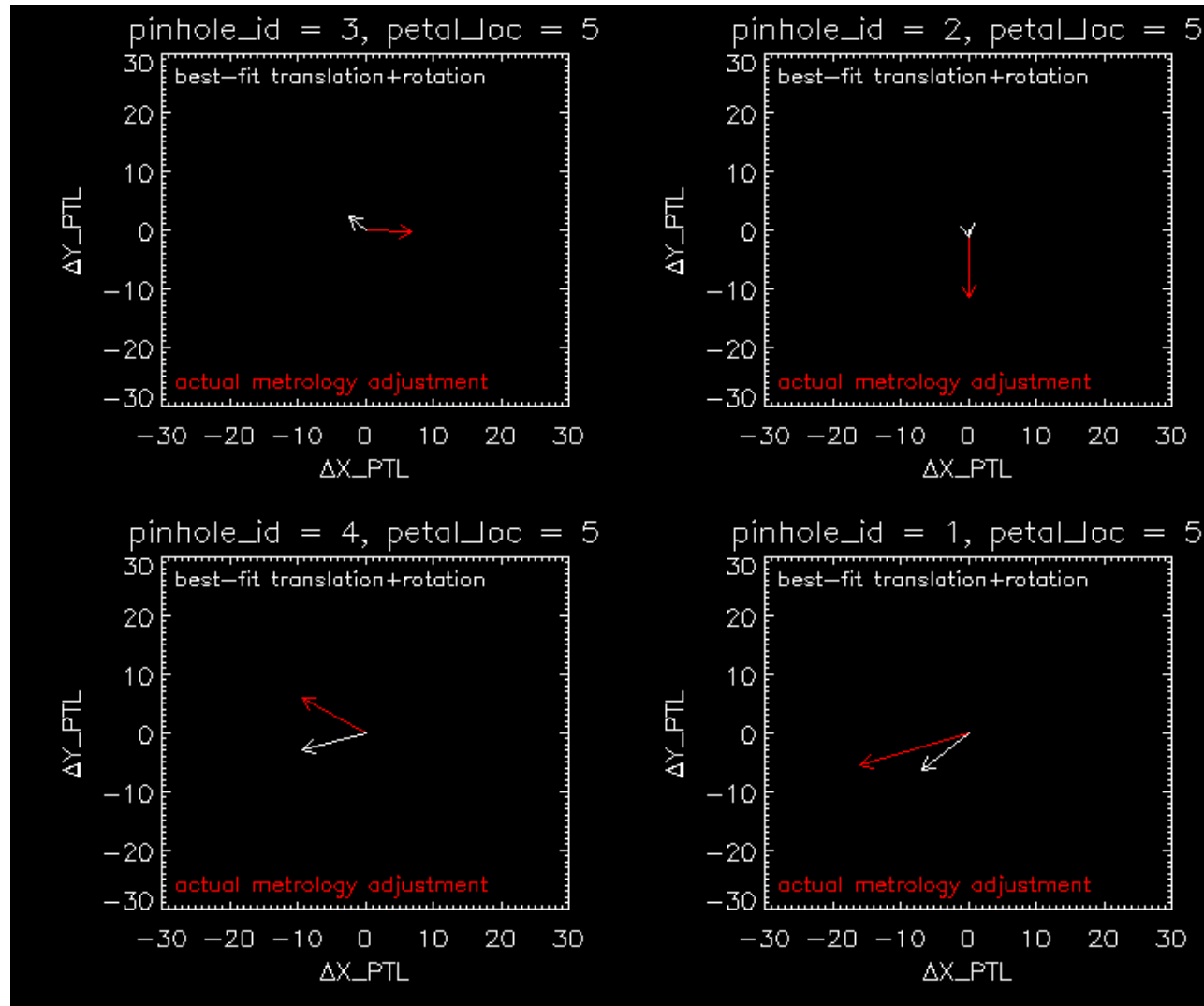# Decomposing the metrology adjustments into rotation+translation

- The metrology tweaks don't decompose well into rotation (about the GFA center) plus translation; this seems consistent with my visual impression of the measured amplitudes/directions

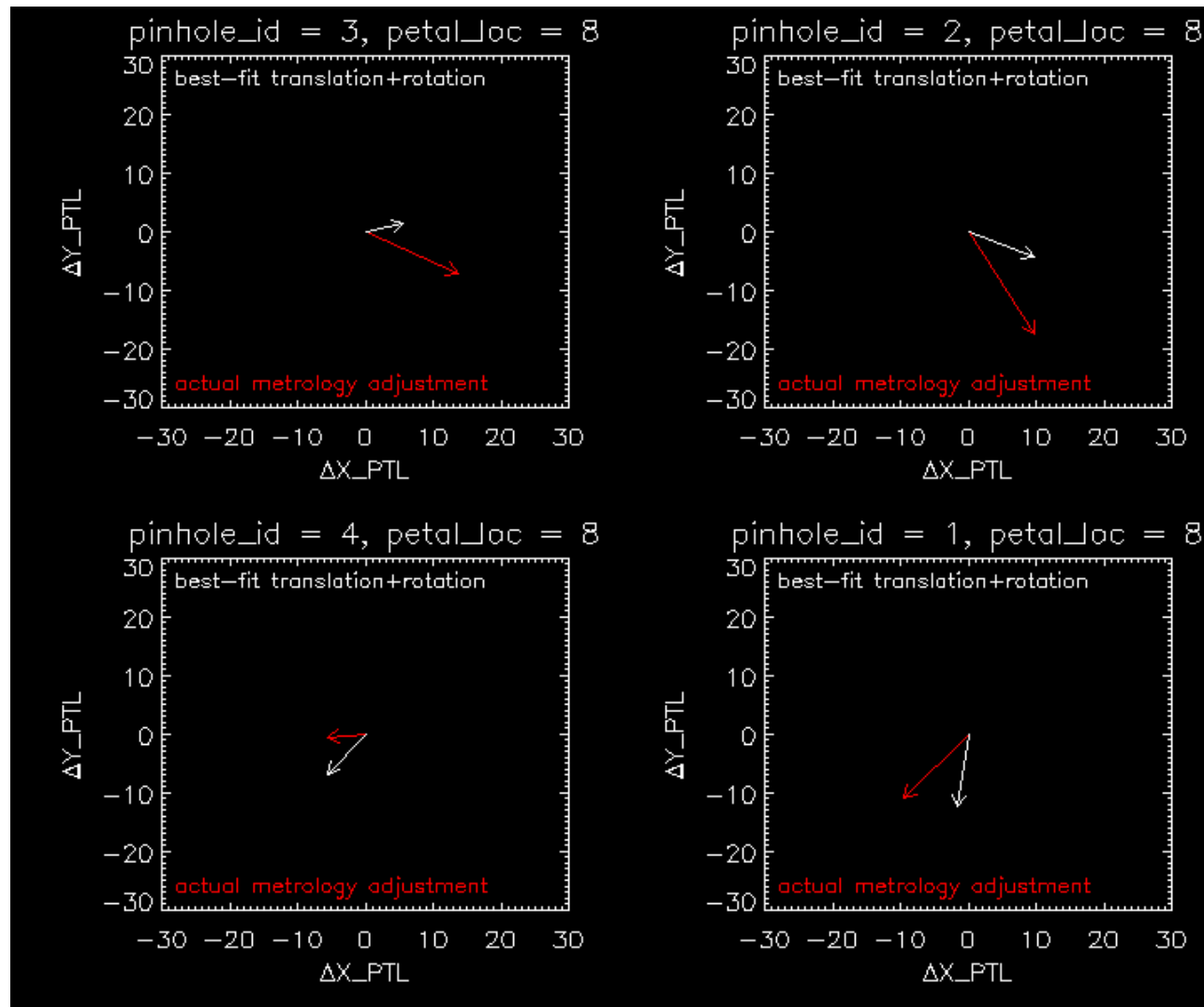# Decomposing the metrology adjustments into rotation+translation

- The metrology tweaks don't decompose well into rotation (about the GFA center) plus translation; this seems consistent with my visual impression of the measured amplitudes/directions

Decomposing the metrology adjustments into rotation+translation

- The metrology tweaks don't decompose well into rotation (about the GFA center) plus translation; this seems consistent with my visual impression of the measured amplitudes/directions