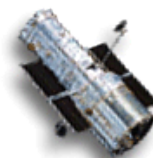




# COS/FUV Wavelength Calibration

## Overview of New Work

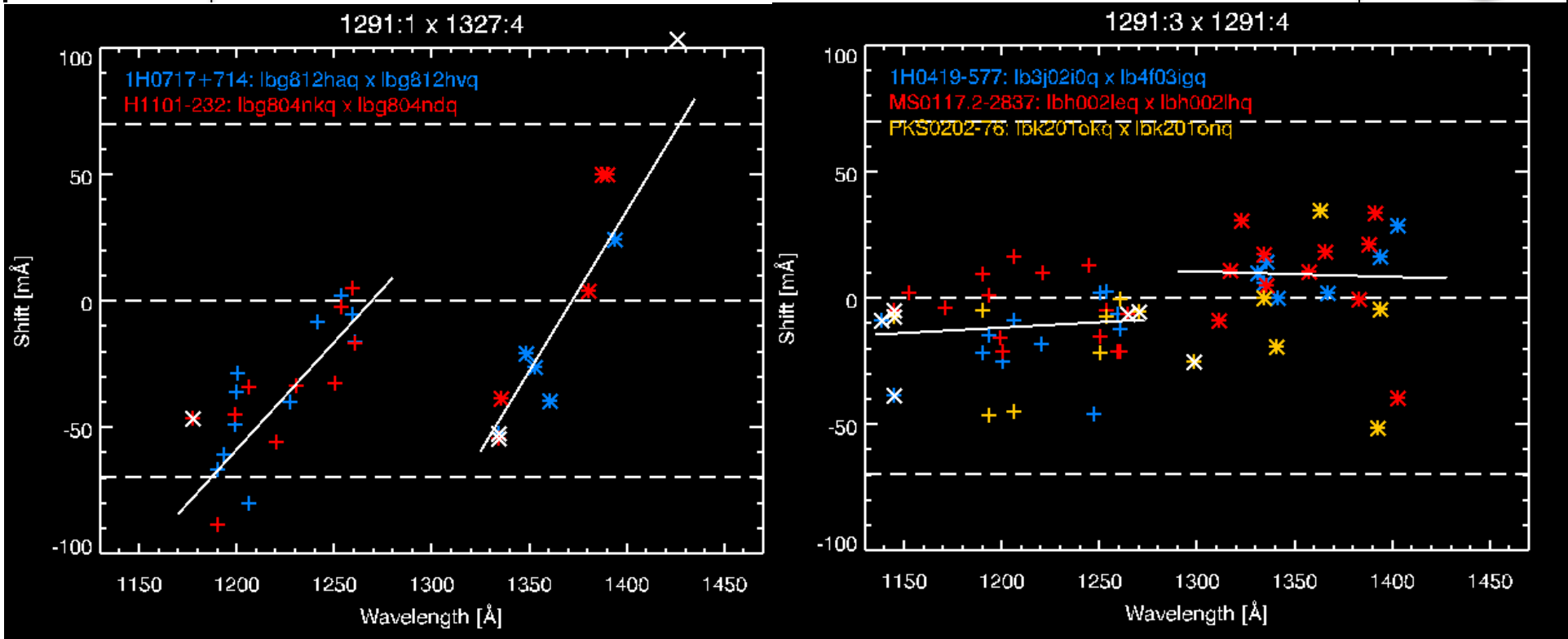
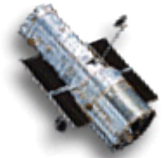


- Bart Wakker (U. of Wisconsin) used COS/FUV AGN data to measure absorption line centroids (white paper submitted to COS helpdesk on Mar 18 2014)
  - Multiple targets observed with different CENWAVE/FP-POS settings
  - For each ISM line, he measured the shift in the centroid between the observations obtained with the different settings
  - Produced master file of offsets vs. wavelength that he kindly provided to B. Keeney
- In the context of the Spectroscopic Legacy Working Group, Brian Keeney (U. of Colorado) has used Bart Wakker's master file to try to improve the COS/FUV wavelength calibration
  - Used 1059 individual measurements from 68 exposures for G130M, 550 measurements from 62 exposures for G160M, at a variety of CENWAVE/FP-POS
  - Went from  $\lambda$  and  $\delta\lambda$  to pixel space
  - Start with CalCOS  $\lambda$  dispersion solution, perturb it slightly, to come up with new solution, so that when applied to pixel positions above the predicted  $\lambda$  shift between measurements can be minimized
  - Use information from all measurements: shifts for 1291:3 are measured with respect to 1291:2, 1300:3, 1327:4, then all info used to refine 1291:3 values





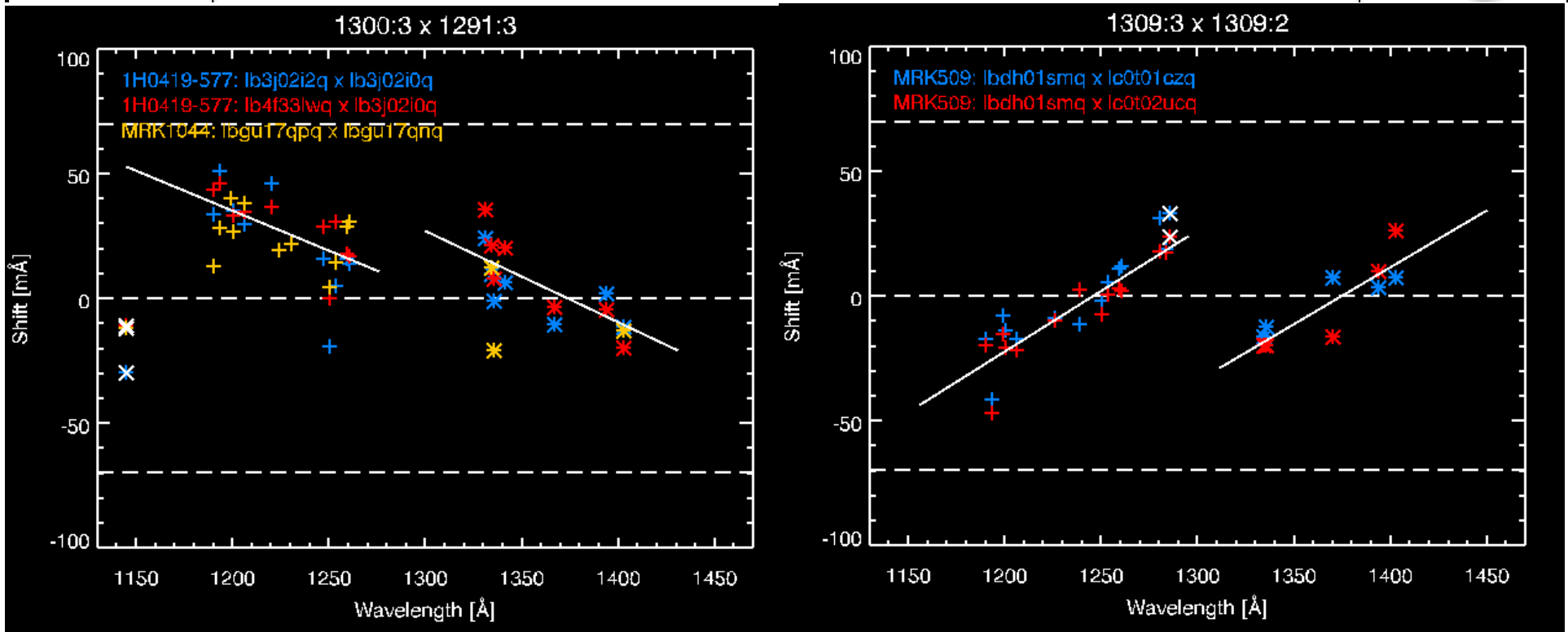
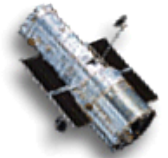
# COS/FUV Wavelength Calibration Results



- Dashed horizontal lines indicate COS/FUV  $\lambda$  calibration specs
- Fits in the plots used all the relevant information (more than shown in plot)
- G130M/1309/3 used as reference (original  $\lambda$  dispersion coefficients assumed)
- X indicates points excluded from fit, due to being too close to detector edge
- Modified wavelength solution (zero point and dispersion coefficient) differ from original  $\lambda$  solution by  $< 0.1\%$



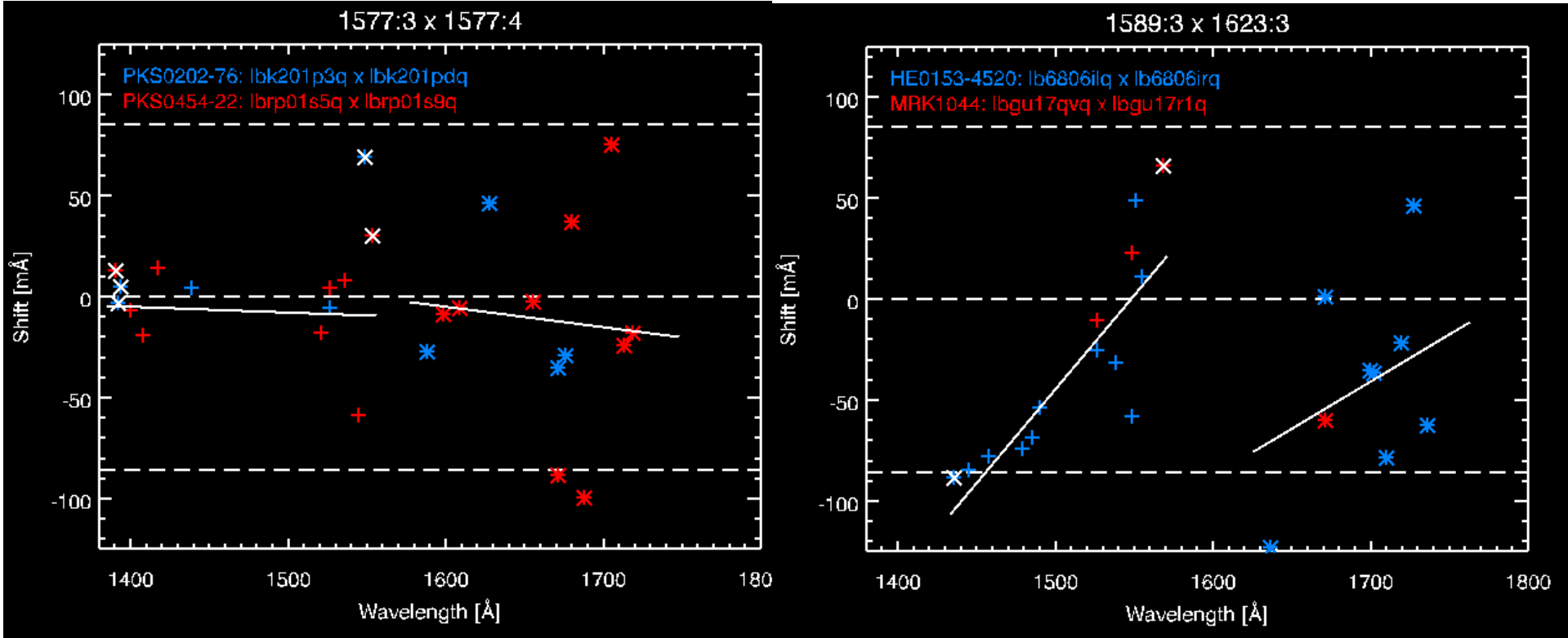
# COS/FUV Wavelength Calibration Results



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# COS/FUV Wavelength Calibration Results



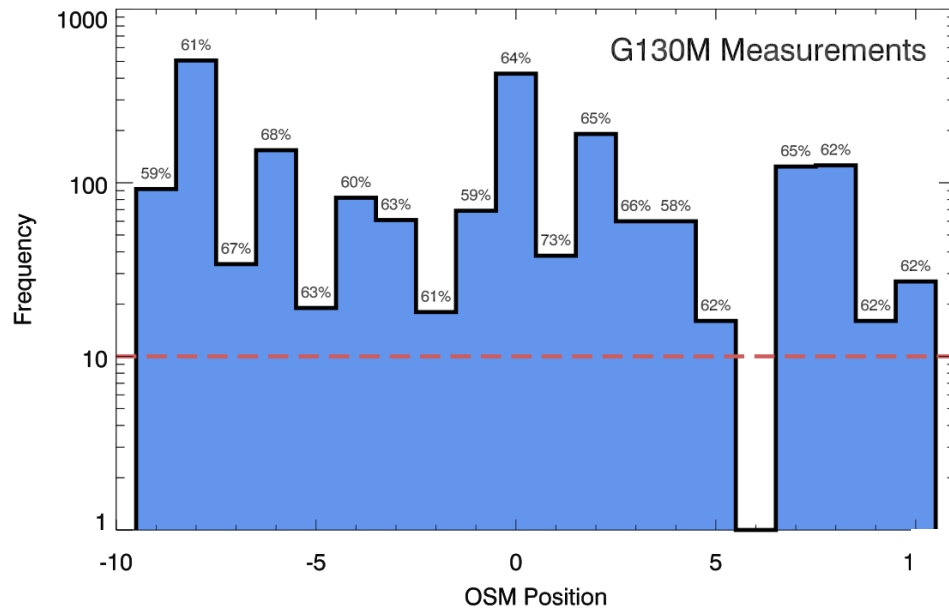
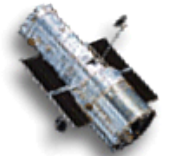
- Dashed horizontal lines indicate COS/FUV  $\lambda$  calibration specs
- Fits in the plots used all the relevant information (more than shown in plot)
- G160M/1600/3 used as reference (original  $\lambda$  dispersion coefficients assumed)
- X indicates points excluded from fit, due to being too close to detector edge
- Modified wavelength solution (zero point and dispersion coefficient) differ from original  $\lambda$  solution by  $< 0.1\%$





# COS/FUV Wavelength Calibration

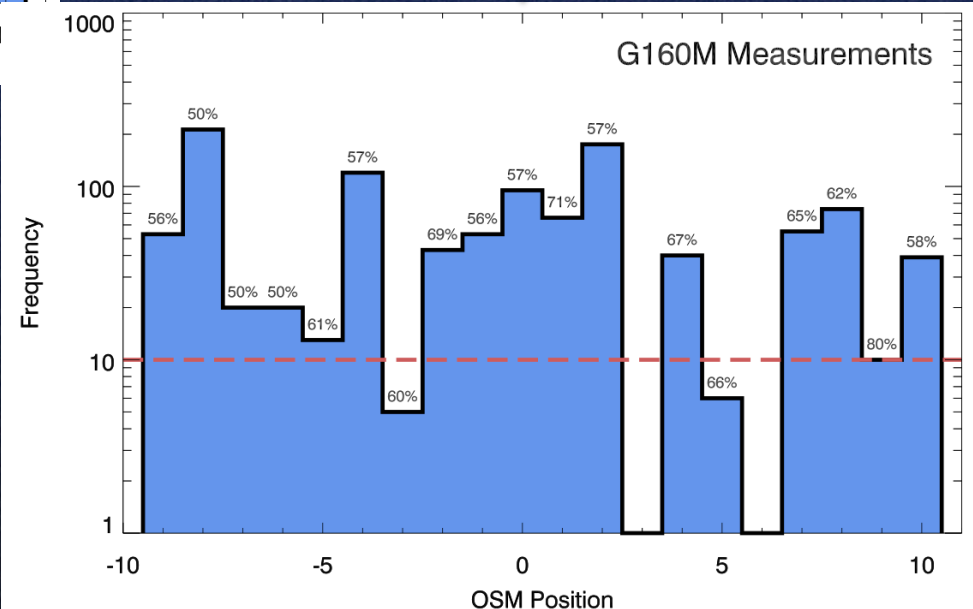
## # of Measurements Used per Setting



Reference: G160M/1600/3



Reference: G130M/1309/3

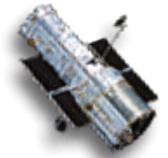


\*Percentages indicate number of measurements from segment B  
 \*\* Minimum of 10 measurements per setting required for reliability (dashed red line)

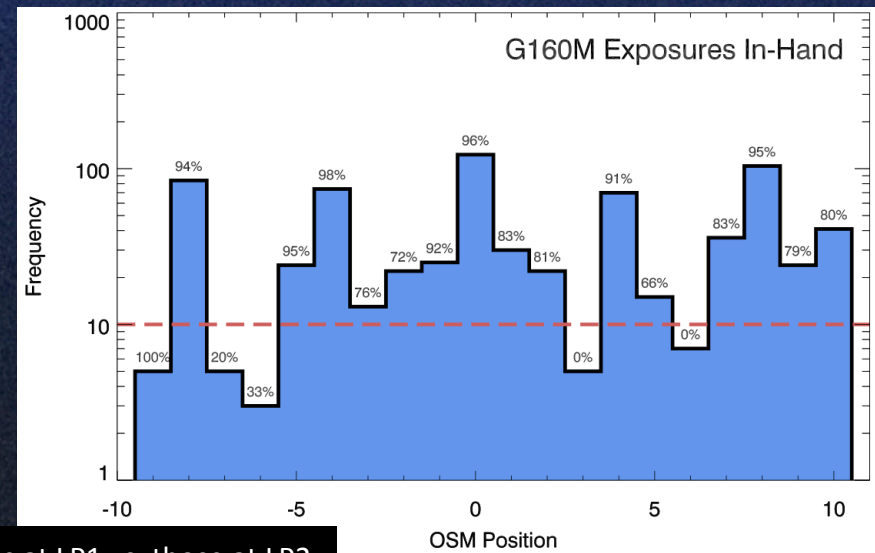
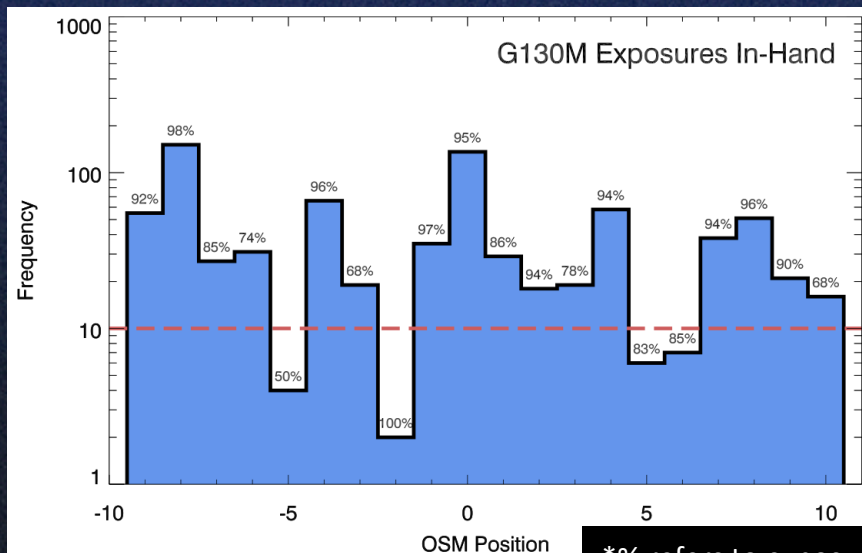


# COS/FUV Wavelength Calibration

## Path Forward



- A small contract is being put in place for Brian Keeney to continue this work
  - Scope and amount work more than can be accomplished as regular spec. working group member
- Can expand dataset used to include the moderate S/N QSO sample used in Danforth et al. (2014arXiv1402.2655D) – setting/LP distribution shown below
  - 789 G130M exposures, 732 G160M exposures
  - Can test wavelength solutions that were derived so far and can use this dataset to supplement setting deficiencies in the original dataset
  - Will need to investigate LP dependence



\*% refers to exposures at LP1 vs. those at LP2