FGS SMOV 4 Requirements

• SM4 will install a refurbished FGS
  – either bay 2 or bay 3
  – Phase 2 proposals will be provided for either possibility

• FGS considerations generate 11 requirements
  – Very similar to SMOV2 and SMOV3A
  – Approximately 59 HST orbits will be required.
## SMOV4 FGS Requirements

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FGS 01: Guide Star Acquisition Test

- Acquire and track (finelock) guide stars with FGS1, FGS2
  - verifies critical capability
  - characterizes spacecraft jitter
- First pointed observations following release (in BEA).
- Use 2 pairs of guide stars which have been used in the past.
- Cycle between FGS1, FGS2 as the dominant, primary FGS.
- Track guide stars, drop to gyros for several minutes, re-acquire guide stars.
- Merle Reinhart, George Chapman will likely produce the phase2 (after launch of SM4).
FGS 02: S-curve Optimization

• FGS3r observations of a standard star in Transfer mode at selected locations in FGS FOV.
  – uses F583W and 2/3 Pupil
  – provides data needed to determine adjustment of articulated mirror assembly (AMA).
  – assess field dependence of interferometric response
  – iterative process, convergence historically achieved in 4 to 5 iterations.
  – 25 orbits over a 7 day period will be required.

• This is a prerequisite for commissioning FGS3r as a guider.
FGS 02: S-curve Optimization

pre-AMA adjustment

post-AMA adjustment
FGS 03: FGS-FGS Alignment

- Propose a full FGS-FGS alignment calibration along with FGS3r commissioning as a guider.

- Current accuracy of the FGS-FGS alignment is too poor (~400 mas) to support COS target acquisitions (2” aperture).

- Re-calibrating the FGS1r, FGS2r alignments will leave GSC-2 as the dominant source of pointing errors. This is adequate to support COS.

- Total additional cost (over just calibrating FGS3r) is 8 HST orbits.
FGS 04: Mini-OFAD Calibration of FGS3r

- Geometrical distortions, or Optical Field Angle Distortions (OFAD) of FGS3r to be calibrated down to \( \sim 30 \) mas.

- Calibration will use an astrometric field in M35 (calibrated by HST with FGS3 and FGS1r).

- 6 HST orbits are required to achieve the required accuracy.

- This calibration is prerequisite to the FGS-FGS alignment calibration.
FGS 05: Guide Star Acquisition Verification for FGS3r

- Verify that FGS3r can acquire and track both bright (V~9) and faint (V~14) guide stars in finelock.

- Final step in commissioning FGS3r for operations.

- Prerequisites
  - K-factors derived from observations following final AMA adjustment.
  - PDB updates with the calibrated OFAD distortion coefficients and FGS-FGS alignment matrices.

- Use guide star pairs that have been successfully used in the past.

- 2 HST orbits required.
FGS 06: Pre-SM4 FGS1r, FGS2r Characterization

- Characterize FGS1r, FGS2r plate scale, geometric distortions, and interferometric response prior to SM4.

- Provides baseline data to assess impact of SM4 on guiders.
  - Astrometric field to be observed in Position mode
  - Standard star (Upgren69) to be observed in Transfer mode.

- Total of 4 HST orbits required.
FGS 07: FGS1r, FGS2r Re-commissioning

- Characterize the stability of the S-curves, plate scale, and distortions in FGS1r and FGS2r.
- Repeats observations made by FGS 06 after SM4.
- Assess the validity of the operational calibrations after SM4.
- Enables resumption of astrometry science with FGS1r.

- 4 HST orbits required.
FGS 08: Near Term Stability of FGS3r

- After insertion into orbit, FGS3r performance is expected to evolve as the instrument desorbs H$_2$O from its graphite epoxy composites.

- Observe a standard star in Transfer mode at 2 and 4 months after commissioning FGS3r.
  - monitors interferometric response, validity of K-factor values used for guide star acquisitions.

- Observe an astrometric cluster in Position mode at 2 and 4 months after commissioning FGS3r.
  - monitors plate scale, geometric distortion, and FGS3r-FGS alignment calibrations. (2 orbits)

- Total of 4 HST orbits required. Longer term monitoring to be carried by FGS/AST yearly calibration program.
FGS 09, 10, 11

- **FGS 09: FGS3r PMT calibration**
  - maps stellar V magnitudes to FGS3r photon counts.
  - needed to compute K-factors and fine error signal averaging times.
  - uses data from observations made during OFAD calibration (FGS 04)

- **FGS 10: OCS Obscuration Zone Location:**
  - observe the internal test source (ITS) to locate the OCS, a zone of exclusion for acquiring guide stars.

- **FGS 11: FGS3r Dark Count Measurement:**
  - needed to compute K-factors
  - uses data acquired during FGS functional aliveness test (in shuttle bay)