HST Status

Cycle 14 TAC/Panels

14 March 2005

Telescope and Instrument Status

- Telescope and support systems are all working well – no unexpected limitations on the cycle 14 program
- All Instruments are working well – no unexpected limitations on the cycle 14 program
  - NICMOS continues to perform as expected with the cryo-cooler system
    - NICMOS/AO comparison in Appendix
  - ACS performing well
  - WFPC2 performing well
  - FGS Astrometry performing well

Gyro Situation

- Hubble will eventually have fewer than 3 working gyros
  - Currently HST has 3 operating gyros, and 1 gyro in standby
  - There have been no failures or incidents in the last year
  - Based on a formal reliability model, it is ~50% probable that 3 gyro operation could be sustained until the end of Cycle 14
  - The “1 sigma” uncertainties on the time of gyro end of life are large (of order one year)
- NASA/HSTP and STScI have developed a Two Gyro mode
  - Two Gyro mode was initially developed as a degraded mode, to be used only after two more gyro failures
  - The reliability model indicates this adds ~14 months (Cycle 15) to total lifetime, if we continue to use 3 gyros as long as possible
  - Mode was tested February 21-23

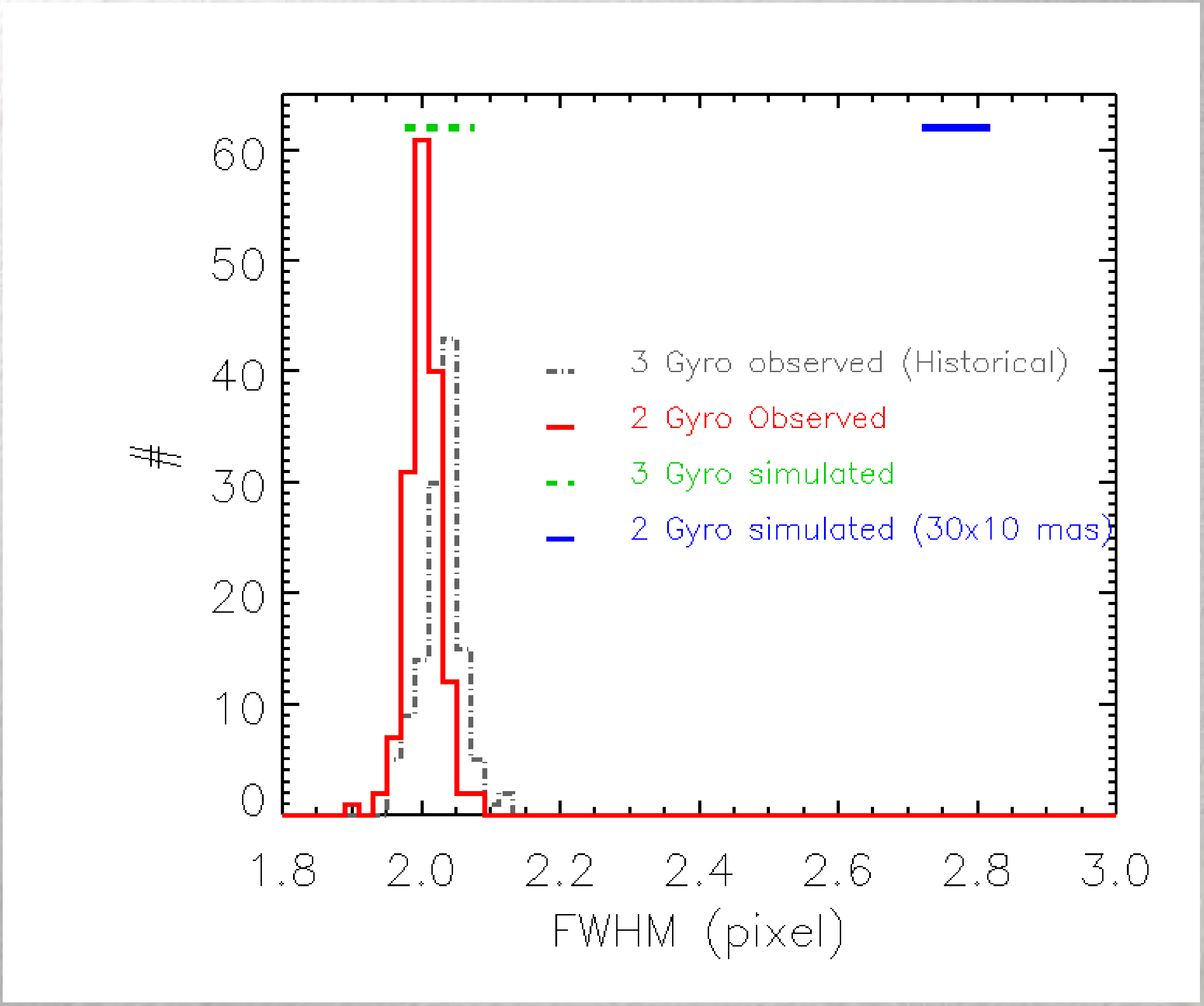
Gyro Situation

- HST Program is considering a preemptive switch to Two Gyro mode
  - Placing a second gyro in standby should extend its lifetime
  - Reliability model indicates this would extend HST lifetime by another ~9 months (Cycle 16)
  - Would implement at Cycle13/Cycle 14 boundary (~August 1)
  - We would like feedback from TAC/Panels on this matter
    - Given your overall recommended program, does this make sense ?
    - Are there specific science programs/priorities that would indicate staying in 3 gyro mode ?
- Decision is to be made over ~ next several weeks
  - TAC/Panel advice will be an important factor in the decision

Two Gyro Mode Performance

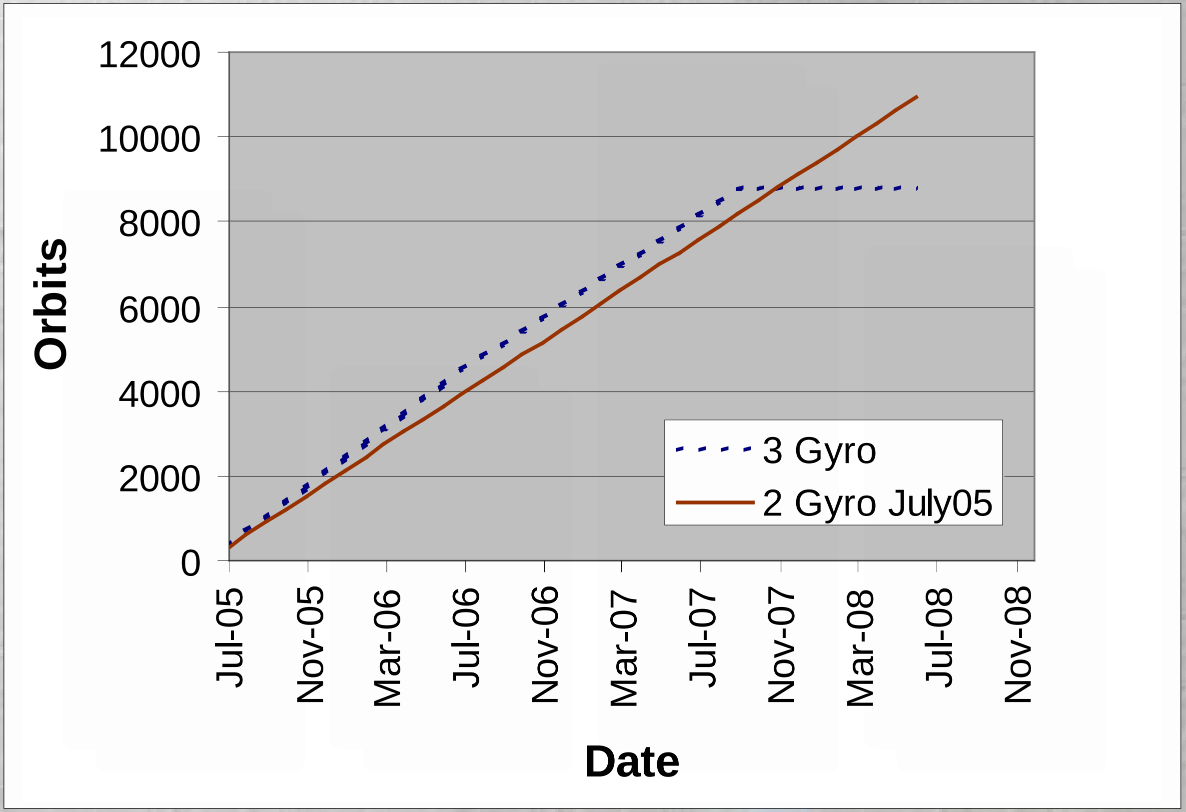
- Four areas of potential impact to the science program
  - Scheduling restrictions: They are what they are
    - See Handbook, web tools for details
    - Proposers were asked to consider these restrictions
    - February test has not changed these restrictions
  - Orbital viewing
    - GS Acquisition impacts are minimal
    - February test has not changed these restrictions
  - PSF
  - Orbits gained

ACS/HRC PSF size: summary plot



Orbits Gained

- Three Gyro rate is 80 TAC orbits/week
- Two Gyro rate:
  - Scheduling rate in Two Gyro mode will be 71-73 orbits/week
  - Guiding success rate in Two Gyro will be ~94-98% that of Three Gyro mode
  - Net effective rate in Two Gyro Mode is 70 orbits/week



- Deliberate Two Gyro mode entry will accumulate a ~ 500 orbit "deficit", which is recovered in 2007/2008

Advice to Cycle 14 TAC

- Recommend the best possible science program
  - 3 Gyro ranked list
  - 2 Gyro ranked list
  - Comments on the science impact of a preemptive switch to Two Gyro mode
- Keep future cycle (15,16) advanced allocations at historical levels, ~200 orbits

Allocations for Cycle 14

- Total orbits in cycle 14:
  - Three gyro: 3100 orbits
  - Two gyro: 2900 orbits
  - We will go deeper into ranked lists, as circumstances dictate
- Parallels – as a transmitter lifetime extension measure:
  - Coordinated parallels should be scientifically justified
  - Default pure parallel programs have been discontinued
  - ~ 350 orbits available for GO pure parallel programs in Cycle 14
    - Submitted pure parallel proposals are ~comparable to allocation
- Snapshot targets: ~2000, ~ half will execute

Scheduling considerations for Cycle 14

- Large + Treasury Programs (>100 orbits)
  - Survey type programs (many scattered targets) are generally easy to schedule
  - Tightly constrained programs (mosaics, continuous coverage, timing requirements, etc.) can interfere with one another
  - From a scheduling perspective, we recommend < 6-8 Large + Treasury programs total
    - Prefer no more than 3 large, very constrained programs
    - We assume at least 2-3 multi-target surveys

Scheduling considerations for Cycle 14

- Targets of Opportunity
  - Ultra-fast activations (24-48 hrs): Limit to 3 total. Experience has shown that it is difficult to meet 24 hour goal
    - 15 orbit penalty for each activation
  - Fast ToOs (2-11 days): 15 – 30 activations. Stay at low end if there are many constrained, large programs

Appendix

- Comparison of NICMOS performance with ground based AO

Comparison HST/NICMOS – 8-10 m AO telescopes (1)

Parameter		Adaptive Optics	NICMOS
Wavelength Coverage		Atmosph. windows	Continuous 0.8 - 2.5 μm
Diffraction limit (λ/D)	@ J @ K	0.02” – 0.03” 0.04” – 0.05”	0.08” 0.17”
FWHM	@ J @ H @ K	0.035” – 0.095” 0.040” – 0.110” 0.050” – 0.150”	0.110” 0.165” 0.220”
Core/halo light (Strehl) ratio		10% - 30% @ J[a] 20% - 70% @ K	98% (NIC1/2) 85% (NIC3)
FOV of high-resolution (corrected) observations		10” – 40” [b]	11” (NIC1) 19” (NIC2) 51” (NIC3)
Depend. of Strehl ratio on guide star distance[c]: Strehl(10”)/Strehl(0”) Strehl(20”)/Strehl(0”)		 0.6 @ J, 0.8 @ K 0.3 @ J, 0.5 @ K	None

Comparison HST/NICMOS – 8-10 m AO telescopes (2)

Parameter	Adaptive Optics	NICMOS
Depend. of Strehl ratio on guide star brightness	High[d]	None
Depend. of Strehl ratio on seeing	High[e]	None
PSF uniformity across FOV	No	Yes
PSF repeatibility	No[f]	Yes (1-2% stability)
Photometric accuracy/stability	?? [g]	2-3% absolute ~2% stability
Sky coverage fraction	<~ 10% with NGS[h] <~ 50% with LGS	100%

Notes to Table:

a. In AO systems, the halo light is uncorrected (uncontrolled), and produces a diffuse `background' that decreases detection limits. Particularly relevant for crowded field observations (Stolte et al. 2002, A&A, 394, 459). No uncontrolled light is present in NICMOS.
b. The limit is set in some cases by the size of the detectors for Nyquist-sampled observations. The actual isoplanar angle is 20" – 60", but performance quickly decreases for increasing off-axis distance (see line 6 of Table).
c. The ratios of the Strehl at X" to the Strehl at 0" are given for the Gemini/Hokupa'a system. This ratio is a measure of the degradation of the system performance with distance from the guide star, reletive to the best performance as listed in line 4 of Table.
d. The Strehl ratio in AO systems decreases with decreasing brightness of the guide star. Guide star brightness limits are in the range V~12-18 mag, with typical V~14 mag.
e. Strehl ratio in AO systems depends on atmospheric conditions at time of observation. A system delivering a K-band Strehl ratio = 0.45 for 0.3" seeing will deliver Strehl ratio=0.29 for 0.6" seeing, and 0.07 for 1" seeing. For the Gemini/Hokupa'a system, a seeing of 1" or worse produces little or no improvement of the J-band image quality.
f. Subject to atmospheric conditions both on short and long timescales.
g. No clear information available for AO systems. In the only case known to the author of the Table, the Gemini/Hokupa'a observations were photometrically calibrated using archival HST/NICMOS images of the same target (Stolte et al. 2002).
h. NGC = Natural Guide Star; LGS = Laser Guide Star. Sky coverage fraction for AO systems decreases at high galactic latitudes.