Two-Gyro Performance: Scheduling and Acquisitions

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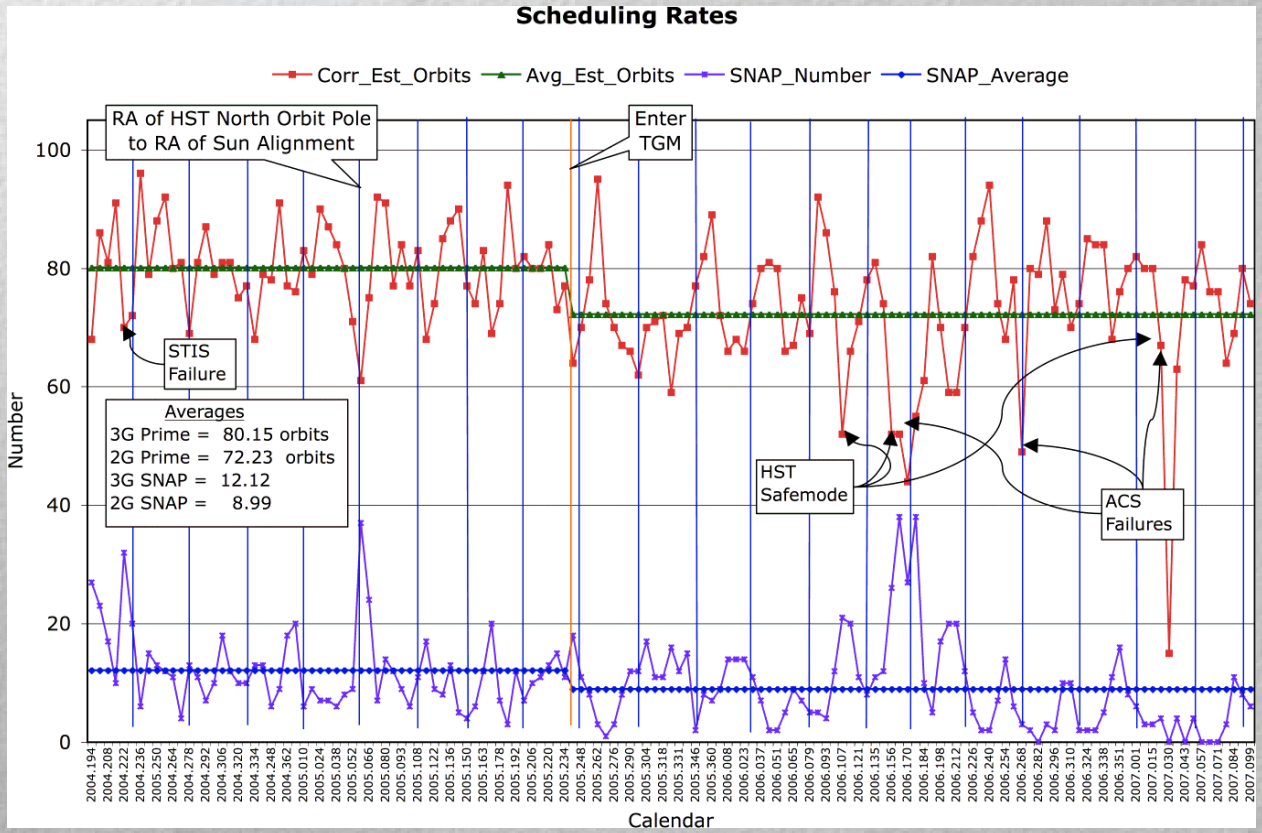
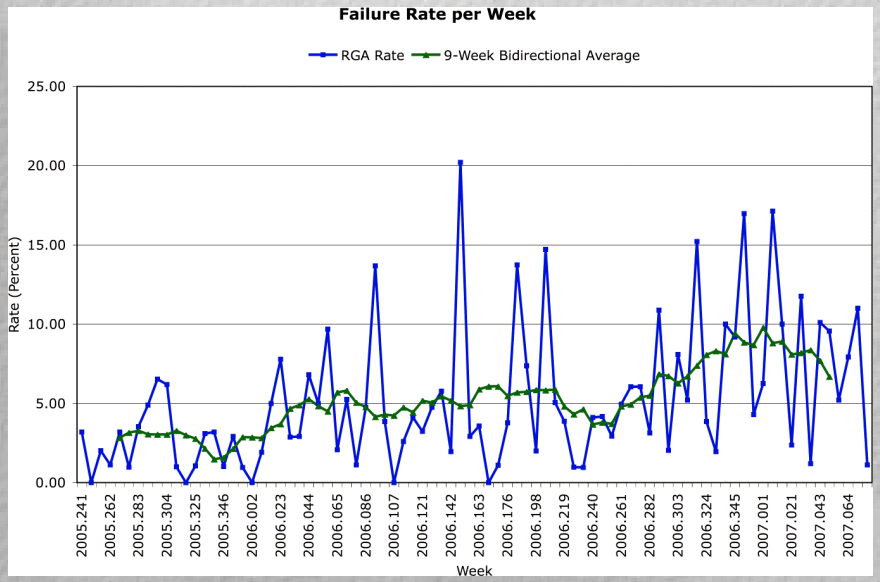
Scheduling

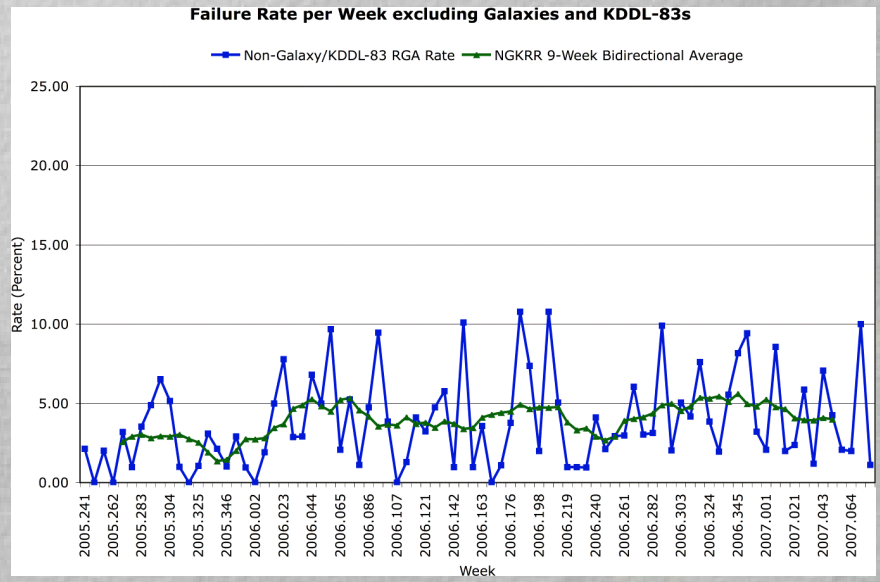
- Two-Gyro Mode scheduling rates are currently at 72 orbits per week (74 orbits per week excluding the 5 weeks of ACS hardware issues in 2006/2007 when we scrambled to schedule other SIs).
- Our prediction prior to Two-Gyro Mode entry was 71-73 orbits per week.



Scheduling

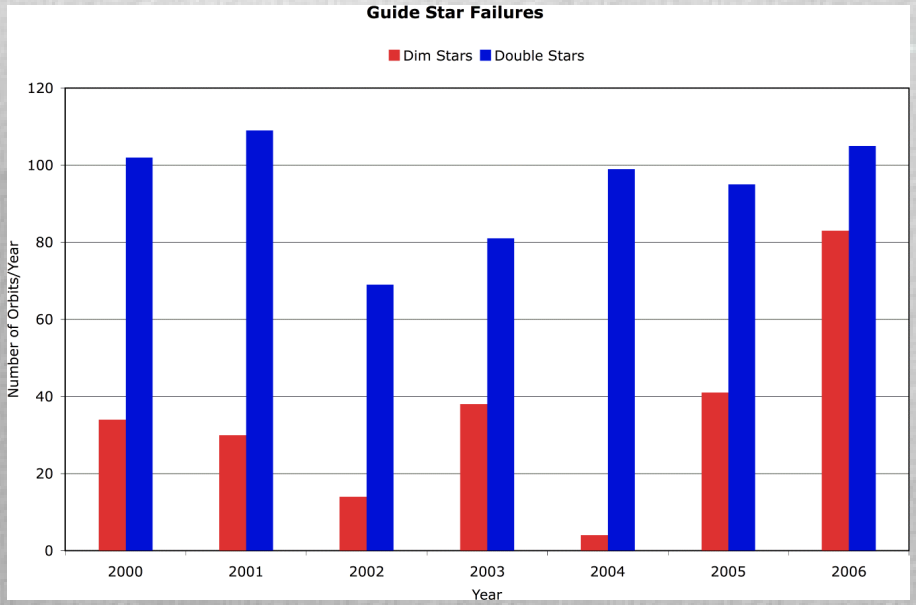
- Our Two-Gyro Mode average failure rate (Fine-Lock Backup not considered a failure) is 5.39%.
  - 3.11% in 2005
  - 5.66% in 2006
  - 7.80% in 2007 through the end of the 07.078 SMS
- However, we noticed a significant upturn in the failure rate in December, 2006 that continued through January, 2007.
- The Institute and GSFC Systems Engineers did a lot of analysis and have found two main impacting effects
  - Galaxies being attempted as guide stars
  - Cases where the S-Curve is missed in the walkdown to fine-lock during the acquisition (KDDL-83)
    - Pointing Control System Engineers are still investigating but believe the issue is related to inaccuracies in the Inertia Tensor used in the Flight Software

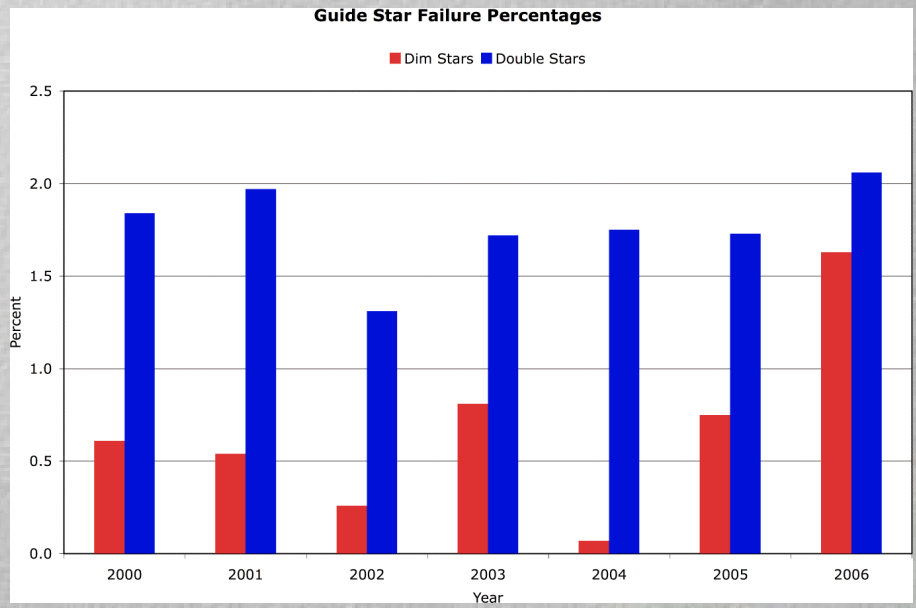




Guide Star Catalog Issues

- Historically, “bad stars” are typically caused by:
  - Double Stars
  - Dim Stars, Galaxies, Variable Stars, Blends, Plate Defects, Asteroids, etc
  - Failure rate due to catalog issues is ~2.42%

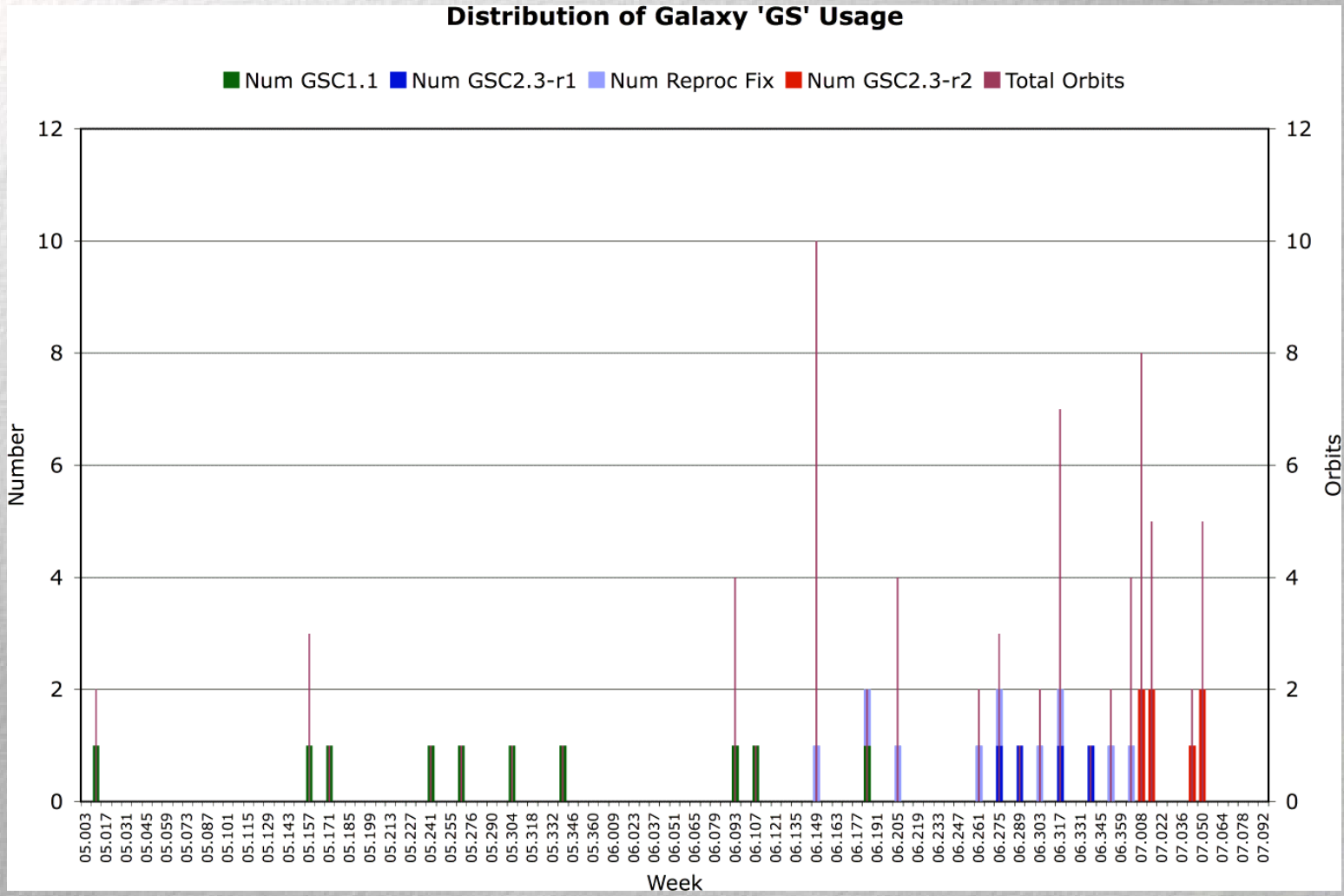




Guide Star Catalog Issues
Galaxies

- Two issues contributed to the 2006 increase in Galaxy usage
  1. Identified a bug in the GSC2 catalog construction in late Summer as a result of some preliminary Coma Galaxy Cluster observations.
     - Galaxy information from GSC1 was not consistently propagated into GSC2.
     - Corrected catalog was delivered to Operations on Sept 12, 2006 (day 255).
     - However, only the Coma Observations were explicitly reprocessed to use the updated catalog.
     - ~0.77% of the 2006 failure rate was this bug
  2. Dramatic increase in Observations in the Coma Galaxy Cluster in December.
     - This is primarily two large programs using ACS/WFC.
     - Since the galaxy to star ratio is very high in this area, there is a higher chance of trying to use a misidentified galaxy as a guide star.
- To help mitigate the second problem, we began manually pre-checking the guidestars used by the Coma Cluster programs.
  - 6 galaxies were found and avoided
- Utilizing currently available Digitized Sky Survey query capabilities, a tool was developed to allow the calendar builder to quickly examine the 100-150 guide stars used each week.
  - Usage began on the 07.064 calendar
  - 7 *stars* found to not be good candidate guide stars and removed (through the 07.099 calendar)
    - 3 galaxies, 3 double-star blends, 1 star with fuzz
    - This was about 14 orbits
  - For 07.064 through 07.084 calendars, reported guide star failures due to bad stars have so far been only for double and faint stars.

Guide Star Catalog Issues



Other Guide Star Acquisition Issues
Mispointings

- Pointing error after a successful ReAcquisition following a failed GSAcq/ReAcq (Two-Gyro Mode specific)
  - Dec 7 - One of the our Instrument Scientists, Tom Brown, was not able to identify the ACS/SBC field in an observation taken the previous day. This was immediately recognized as a Bright Object Health & Safety concern.
  - He also mentioned that a different ACS/WFC observation taken a couple of months earlier was mispointed by ~80" after a similar GSAcq/ReAcq failure sequence of events.
  - Using the ACS/WFC observation, a quick analysis indicated that the mispointing was almost exactly the size of the decenterline maneuver that should have been executed at the end of the GSAcq/ReAcq.
  - Turned over to the Lead OTA Systems Engineer at GSFC for further analysis. Problem was identified to be a timing problem between two commands in the failure path of the GSAcq execution group.
  - Dec 8 - Based upon the understanding of the issue, computed where the Dec 6 ACS/SBC observation was pointed. Instrument Scientist confirmed the pointing within a few arcseconds of the prediction.
  - Dec 20 - Flight Readiness Review for the changes. Implemented for the 06.359 calendar.
    - 2 weeks from identification to FRR
    - 2 1/2 weeks from identification to flying

Other Guide Star Acquisition Issues
Mispointings

- Pointing error after Single-GS ReAcqs with Small Angle Maneuvers in the previous orbit.
  - This problem was identified by the OTA SEs in some follow-on analysis of the previous problem's test results. However, the cause of this problem is different.
  - Problem only occurs with Two-Gyro Mode style Acqs/ReAcqs where both the ground software and the onboard ReAcq process are effectively accounting for a portion of the SAMs in the previous orbit.
  - Developed a workaround of doing a full GSAcq every orbit. This is difficult to impossible to implement for some science observations.
  - Solution is to have the ground software use the gs centerline acquisition position of the primary gsacq for all the Two-Gyro Mode style reacqs (this is what the onboard process expects).
  - It was later discovered that this problem can also affect pair acquisitions in certain limited situations.
  - The ground software fix was put into place for the 07.071 calendar.