

Parallel Observations with HST

Information and Guidance for Proposers and Observers

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ABSTRACT

This UIR describes how HST Parallel observations will be specified and scheduled in Cycle 20.

1 Parallel Observing

The scientific instruments of the Hubble Space Telescope lie in a common focal plane. This feature allows more than one instrument to be operated in parallel. Parallel observing provides an opportunity to increase the scientific productivity of HST by taking advantage of the parallel instrument apertures that fall on scientifically interesting objects or regions of the sky. Since all of the instrument fields of view are fixed relative to one another in the focal plane, the pointing and orientation of the primary instrument on the sky dictate the specification of the parallel target position. Parallel observing provides an opportunity to increase the scientific productivity of HST by taking advantage of serendipitous views of the sky.

2 Pure and Coordinated Parallels

Proposers can specify parallel observations in two ways: as “Coordinated Parallels” or “Pure Parallels”. Coordinated Parallels are designed, implemented and executed as part of a specific Regular GO program that explicitly ties parallel exposures to its primary exposures. An example would be a program carrying out imaging of M31 using the Advanced Camera for Surveys(ACS). The large size of M31 means that other HST instruments have it within their fields of view as well, and the GO might propose that the ACS primary exposures have WFC3 exposures added as Coordinated Parallels. The alignment of the parallel instrument aperture on the sky will usually be determined explicitly by the PI as part of the design of his/her program.

Pure parallel proposals, by comparison, are defined independently of a particular Regular GO program. Since they are not *coordinated* with a primary program, they do not have specific predefined telescope pointings. Instead, they propose for generic regions of the sky over which they could obtain useful data if the telescope happened to be observing in that vicinity using a different instrument. A typical example would be fields at a Galactic latitude over 20 degrees. Pure Parallel visits are included in the observing schedule as that schedule is developed at the STScI.

3 Parallels in Cycle 20

The processes and ground rules for Coordinated Parallels have not changed for Cycle 20. Most of the instruments and modes are available for Coordinated Parallels. Proposers need to be aware of the requirements for Bright Object protection for some of the Instrument modes and factor those

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requirements into their planning of Coordinated Parallels. Also, using multiple instruments can overload the on-board data paths. APT includes these considerations, so proposers can use it to determine whether Coordinated Parallel observations with multiple instruments and readouts can be carried out.

The current Parallel Observation Processing System (POPS), which debuted in Cycle 17, had its origin on December 12, 2006 with a memo from Rodger Doxsey that began a study into how to take maximum advantage of the instrument complement after SM4. This led to the current implementation which focuses on taking advantage of inherent multi-orbit parallel opportunities of the prime GO observations. The Phase I process for Pure Parallels is described in the HST Call for proposals for Cycle 20. The Phase II process for accepted pure parallel programs begins after the Regular GO Phase II programs have been submitted to STScI via APT in a process that identifies the parallel observing opportunities intrinsic to the pool of Regular GO observations. PIs of accepted pure parallel proposals use APT to identify and select opportunities that satisfy their pointing and exposure duration requirements. Then the Pure Parallel PI submits a Phase II program that contains a list of parallel visits which define the exposures that are required to complete their observations. The submission will also include the list of the prime visits that comprise the scheduling opportunities for those parallel observations. Selection of the "Pure Parallel Proposal" box in the Proposal Information section in the APT identifies the Phase II submission as a GO/PAR program. The STScI will then use the submitted pool of Pure Parallel visits to make final assignments of Pure Parallel visits to prime visits. In this operating paradigm, Pure Parallels in effect become quasi-coordinated parallel observations.

4 The Characteristics and Availability of Parallel Opportunities

A parallel opportunity is represented by a set of one or more primary visits from a single Regular GO program. At least one orbit in these visits will satisfy the pointing and parallel instrument usage requirements of a parallel observation. Multi-orbit parallel observations will be possible since the POPS can identify multiple primary visits with common pointing and instrument usage characteristics as a single opportunity. Because of this, it is also possible that more than one parallel observation may be satisfied by a single opportunity.

The allowed pure parallel observing modes are ACS/WFC, WFC3/UVIS or WFC3/IR. Opportunities for attaching parallel exposures to Regular GO visits are restricted to where COS and STIS are the prime instruments. The total time available for a parallel observation is defined by the structure of the primary visits that comprise the parallel scheduling opportunity. New for Cycle 20, opportunities will no longer be limited to those Regular GO visits that specify a single uninterrupted primary exposure in an orbit. Instead, POPS will allow a pure parallel exposure to span one or more primary exposure readouts. This enhancement will provide more parallel time in each prime orbit and is expected to increase the total time available for pure parallel observing. The enhancement will help offset the parallel time reductions experienced in Cycle 19 that were partially due to changes in the way COS exposures must now be structured to manage the effects of geo-coronal Lyman alpha contamination on the COS FUV detector.

There were 360 orbits in 141 opportunities allocated in Cycle 19 that provided over 680,000 seconds of exposure time for pure parallel observing. With the changes in the parallel opportunity definition planned for Cycle 20, we hope to see results similar to the ~1.1 million seconds that were available in Cycle 18.

5 More on Defining and Scheduling Pure Parallel Observations

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A Phase I Pure Parallel proposal is defined as a set of Parallel Observations each of which has a generic pointing, a pass-band (filter) and an exposure duration requirement. This observation description is used by a pure parallel PI in Phase II to provide input to a *parallel opportunity match selection process* that they access via APT. This matching activity is the component of the POPS that is visible to the pure parallel PI. The tool allows the PI to find prime GO visits to which their pure parallel observations may be attached. It uses the PI's observing parameters as input selection criteria for searching the list of parallel opportunities that have been identified by STScI as being available for pure parallel observing. An opportunity is returned as a list of orbits from one or more prime GO visits that satisfy the input criteria. An important benefit of this process is that the APT immediately informs PIs if no opportunity exists for one or more of their desired observations. In that case, PIs will have the option to modify their search criteria and repeat their opportunity search. Based on the output from APT for the opportunity search, PIs will make a preliminary selection of the opportunities that satisfy their science goals. The final selection of the opportunities will be done after resolving conflicts between pure parallel programs that compete for the same opportunity. At this point the STScI may require PIs to participate in an interactive matching process to resolve the conflicts between GO/PAR programs.

As a result of the parallel opportunity matching, APT will produce one Phase II visit for each orbit of the pure parallel observation that describes how it will be executed. Each description will also include information about the prime visits to which the pure parallel visits must be attached in order to complete the observation. The set of parallel visits that represent the parallel observation will be processed and set Flight Ready by a Program Coordinator. The pure parallel visits will then be scheduled simultaneously with their matched primary visits.

There will be cases where modifications to the prime visits that comprise a parallel opportunity occur after they have been matched with a parallel observation. If such changes invalidate the match between the parallel and its original host, then the parallel PI may be given a chance to rework the pure parallel observation to allow it to be re-matched with that modified opportunity. If that re-match is not possible, then the PI may also be given a chance to select a new opportunity if one exists.

During the construction of each weekly calendar, the builder will schedule all prime and parallel GO science prior to adding the internal calibrations. In some cases there may be too few orbits of calibration time available to meet an instrument's needs as defined in the calibration plan. In this event, the builder will either reschedule the prime and parallel visits or remove parallels until critical calibrations can be fitted in. If pure parallels are removed, STScI will work with the Pure Parallel PI to attempt to match the parallel observation to an alternate opportunity. The goal is to include all the parallel science observations without compromising calibrations that are critical for instrument characterization and monitoring.

6 Summary

STScI encourages the use of observing modes that take advantage of all possible opportunities to maximize the productivity of HST for individual observers and the astronomical community at large. Coordinated and pure parallel observing are important and valuable options in the HST toolset.

7 Further information and help

Please also refer to the APT Help material and help@stsci.edu for assistance in developing a pure parallel program in Cycle 20 Phase I and Phase II. Links to the Call for Proposals and HST Phase I Roadmap can be found at <http://www.stsci.edu/hst/proposing/docs/cycle20announce>. The "Hubble

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Space Telescope Astronomer's Proposal Tool (APT) web page can be found at <http://www.stsci.edu/hst/proposing/apt>.