

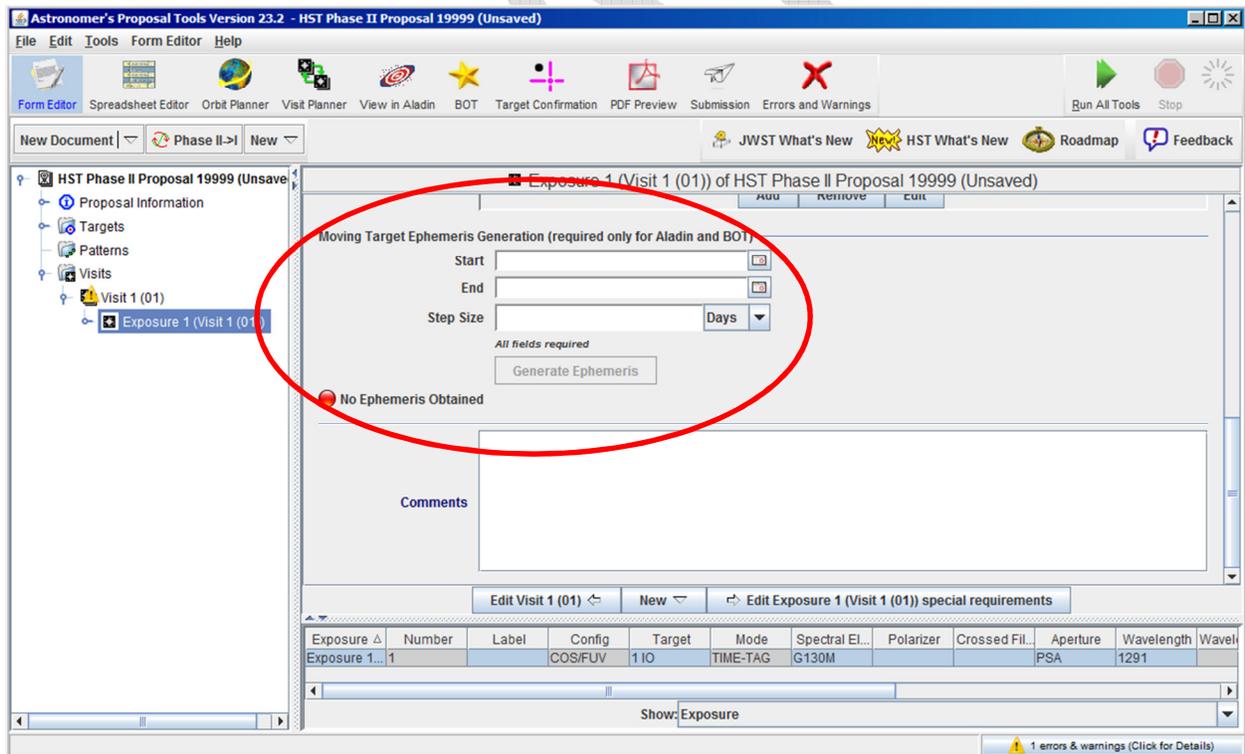
# How to use the Moving Target Tool in APT version 23.4

## Overview

The APT Moving Target Tool (MTT) calculates ephemeris information for moving targets when in Phase II mode. This allows observers to visualize the path of a moving target on the sky, and allows bright object checking using the standard Bright Object Tool (BOT). This tool is available to GOs in order to help them plan their observations. Although this may be helpful, use of the tool is NOT REQUIRED in Cycle 23.

## Generating a Moving Target Ephemeris for an Exposure

When an exposure using a Solar System Target is created, an additional section, labeled Moving Target Ephemeris Generation (required only for Aladin and BOT) is created near the bottom of the Form Editor view for that exposure:



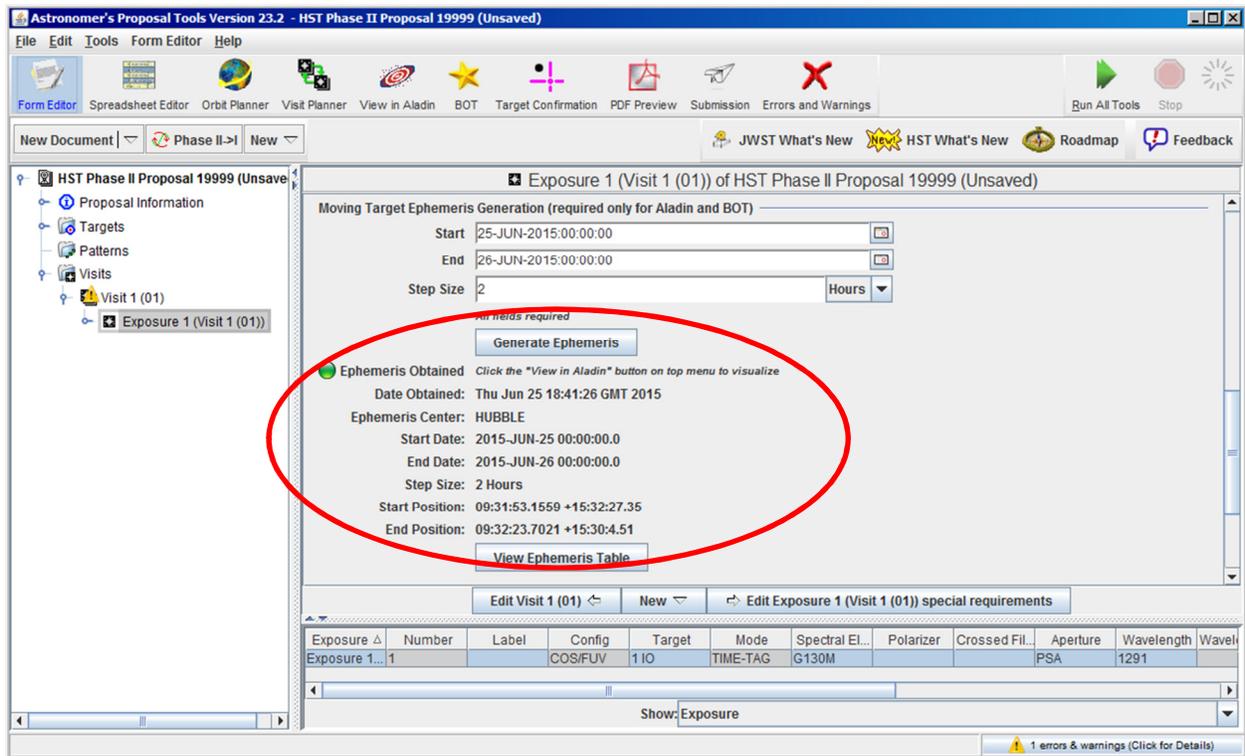
Note that these fields will not appear for fixed targets.

Moving targets are modeled for a single exposure at a time as a series of fixed targets over a specified time period. Clicking on the calendar icon on the right side of the Start and End fields will allow the user to enter a time range. Choosing a large range (e.g. a full year) can be useful to see a target's movement across the sky over a full HST Cycle; shorter periods (e.g. hours), are more useful for identifying bright objects in the field which may interfere with a specific observing window.

A **Step Size** must also be provided; it specifies the time between each of the target positions to be calculated. On the first run for a given target, it is generally a good idea to specify the time range and step size so that there are 5 – 20 steps. A smaller number of steps is preferred for short (less than an hour) windows unless the target is moving very quickly; more steps is best for longer times. The numbers can be updated and the ephemeris regenerated after the initial results are examined. If you are running the BOT after the MTT, you will want to adjust the size in order to ensure adequate overlap between adjacent macroapertures (see below).

Planning Moving Target observations in APT is described in the *Phase II Proposal Instructions*. The details of the observing constraints are typically specified in the Observing Windows field of the target specification (Section 4.4), and additional requirements about the orientation, timing, etc. can be provided as Special Requirements (Chapter 7). That information, along with other HST observing constraints (e.g. the location of the earth, moon and sun), is used for identifying appropriate observing windows for HST. **The Moving Target Tool does *not* consider any of this information when calculating the track of a target on the sky; only the position of the target on the sky is considered.**

After populating the fields, click on the **Generate Ephemeris** button and wait. A progress meter will appear on the screen while the calculation is being made. It will take a minimum of ~30 seconds to complete the process, but may take significantly longer if there are many time steps. When the process completes, a summary of the calculations appears below the input fields (you may have to scroll back down to the bottom of the window):



The green light next to Ephemeris Obtained shows that a valid ephemeris is now available, and the 'Date Obtained' field shows when the calculation was made. The results of the ephemeris calculation will be saved with the proposal, so it will be available the next time the proposal is loaded into APT.

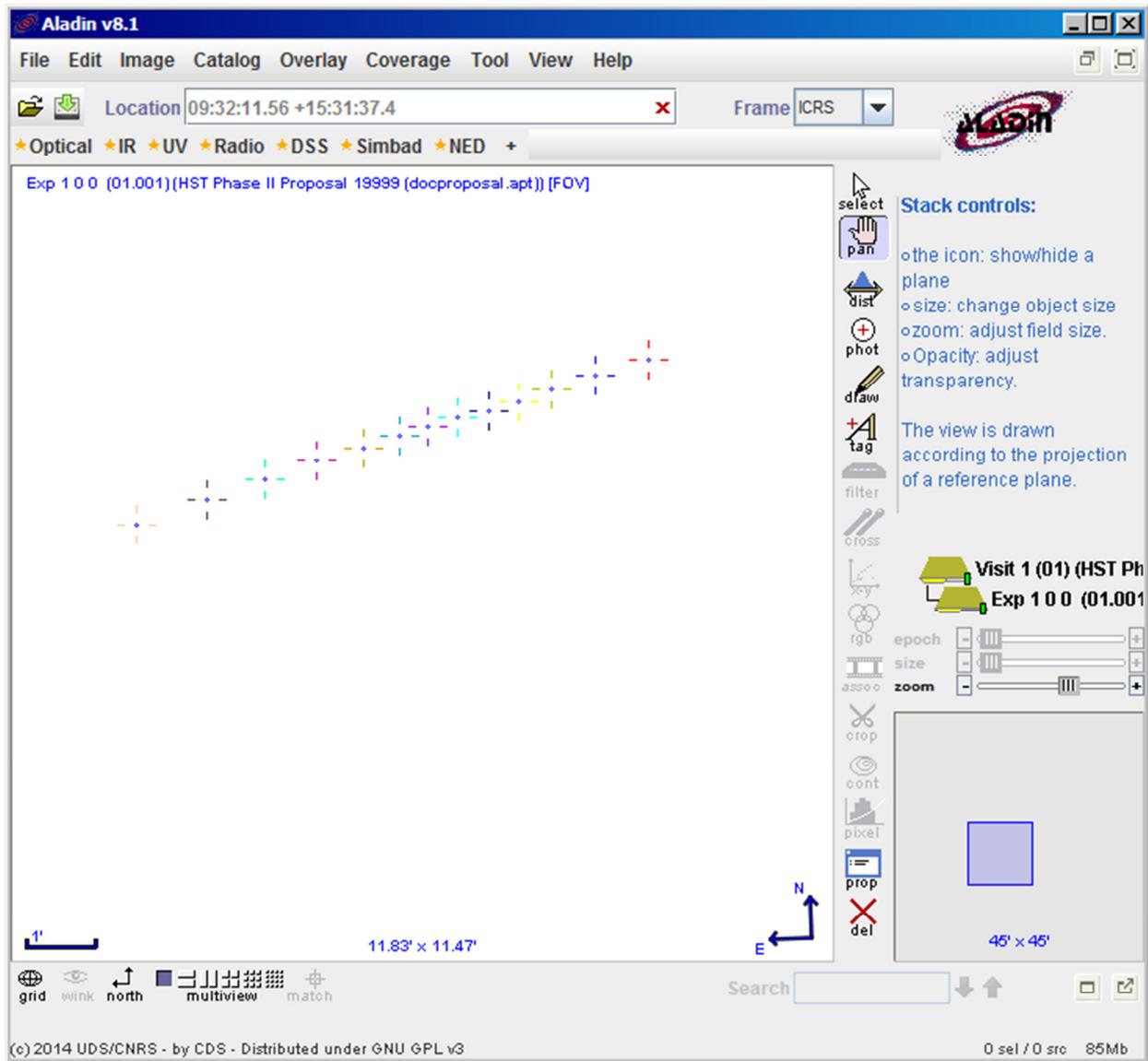
## Displaying the Results

To view a table showing the apparent RA, Dec, and distance to the target as a function of time, click on View Ephemeris Table. Note that because the calculations are done using HST as the ephemeris center, they account for the parallax due to HST's orbit around the earth. Thus, depending on the distance to the target, the RA and Dec may differ from a geocentric calculation.

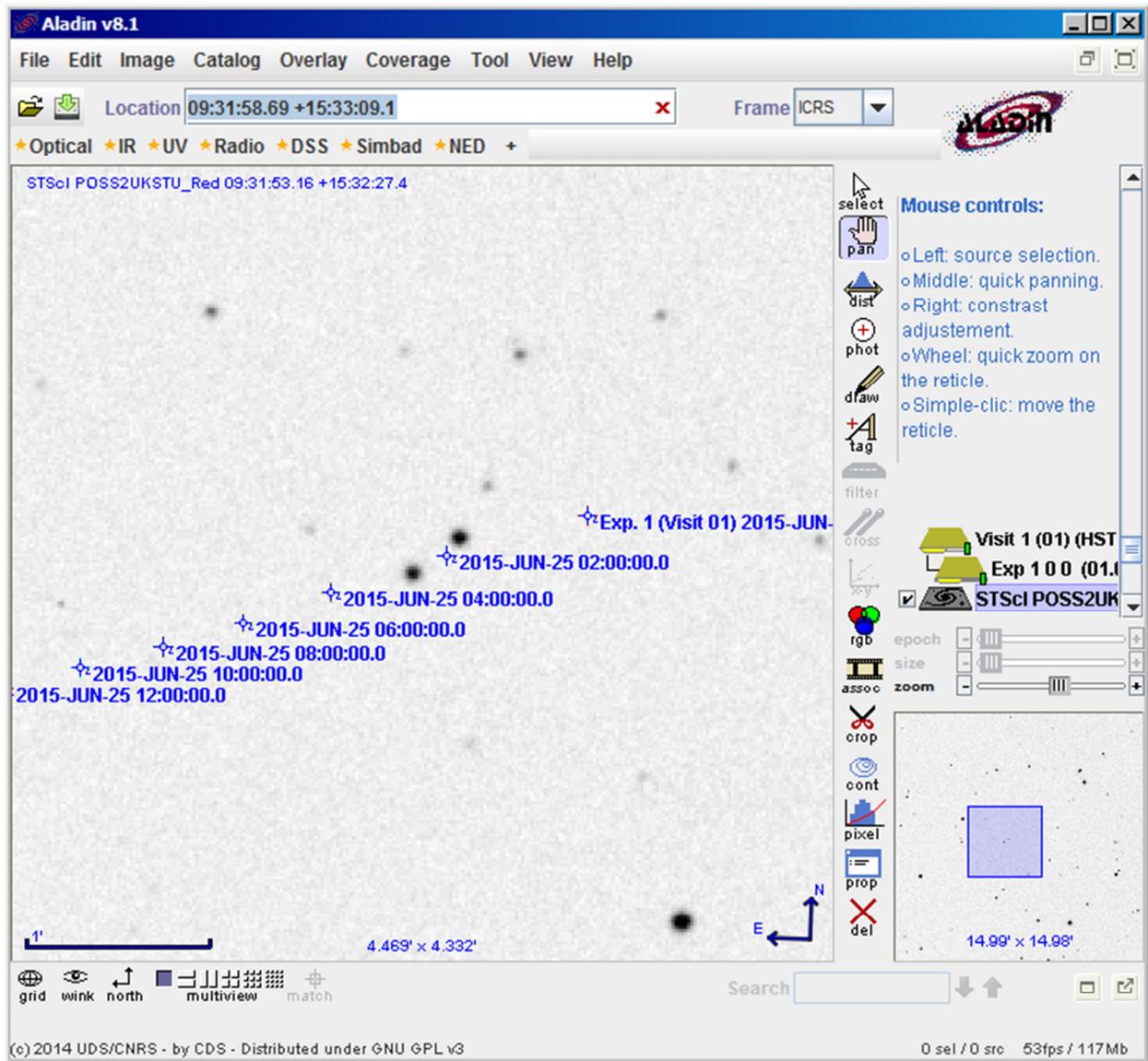
Date	RA	Dec	Distance (AU)
2015-JUN-25 00:0...	09 31 53.1559	+15 32 27.35	6.009
2015-JUN-25 02:0...	09 31 56.3374	+15 32 13.64	6.009
2015-JUN-25 04:0...	09 31 58.9378	+15 32 1.95	6.009
2015-JUN-25 06:0...	09 32 0.9293	+15 31 51.53	6.009
2015-JUN-25 08:0...	09 32 2.7270	+15 31 43.46	6.01
2015-JUN-25 10:0...	09 32 4.5633	+15 31 37.03	6.011
2015-JUN-25 12:0...	09 32 6.2935	+15 31 29.63	6.012
2015-JUN-25 14:0...	09 32 8.0142	+15 31 20.54	6.013
2015-JUN-25 16:0...	09 32 10.1755	+15 31 10.69	6.015
2015-JUN-25 18:0...	09 32 12.9240	+15 30 59.16	6.017
2015-JUN-25 20:0...	09 32 16.0268	+15 30 43.86	6.018
2015-JUN-25 22:0...	09 32 19.5181	+15 30 25.10	6.02
2015-JUN-26 00:0...	09 32 23.7021	+15 30 4.51	6.022

OK

For a graphical view, click on **View** in **Aladin** at the top of **APT** window, and you'll get a display like this:



The Aladin window shows crosshairs at the position of the aperture for each of the times listed in the table. Standard APT and Aladin procedures can be used to overlay astronomical images and catalogs, zoom, pan, etc. For example, the Load DSS button on APT's Aladin controls can be used to load the appropriate Digitized Sky Survey image in order to see where your Moving Target is with respect to background objects, and the Labels button will display the date and time for each step:



This example shows that the target passes very close to several stars between 01:45 and 03:00.

After your initial run, you may decide that you would like to change the time range or step size. To do that, enter your updated values in the appropriate fields, then click on **Generate Ephemeris** again.

## Using the BOT for Moving Targets

For instruments that require Bright Object checking, nearby field objects which could possibly end up in the aperture must be shown to be safe for the detector. For fixed targets, the Bright Object Tool (BOT) must be run by the GO before submission of the Phase II file to show that the field is safe, and that information is checked at STScI by the Contact Scientist.

For moving targets, GOs are not required to do the checks ahead of time because the region to be checked is potentially very large until the observing windows have been identified. After potential windows are identified, the CS checks the field. If bright field objects are identified at that time (which may be very close to the desired time of the observation) adjustments to the windows may have to be made in order to ensure that the detector is safe. In some cases, it may not be possible to show that the observations are safe in the time available. Thus the earlier that Bright Object checks can be done, the better, especially in cases where there are tight observing constraints limit.

The Moving Target Tool, in conjunction with the BOT, makes it possible for GOs to preview the safety of their fields. Once the MTT is run as described above, the BOT can be run as usual. The following figure and table show the Aladin display and a portion of the BOT Details Table after running the BOT on the above example. The COS macroapertures are displayed in Aladin, and objects identified as safe by the BOT are marked with green diamonds. The BOT Details Table shows all the targets identified as falling inside the macroaperture for any of the times in the ephemeris table; the last column lists the earliest time each object appeared.

Since the BOT checks are only made at the locations specified in the ephemeris table, it is important to choose the spacing carefully in order to ensure (nearly) complete coverage of the track. The spacing shown here does a good job of covering the field with the COS BOA macroaperture (the outer circle), but does not provide complete coverage for the PSA (the third largest circle at each position) at all times.

**Exposure Parameters**

- Visit #: 01
- Exposure #: 1
- Exposure Name: Exp 1Split 1
- Instrument: COS
- Detector: FUV
- Spectral Element: G130M
- Aperture: PSA
- Exposure Time: 200.0
- Central Wavelength: 1291

**Field Level Concerns**

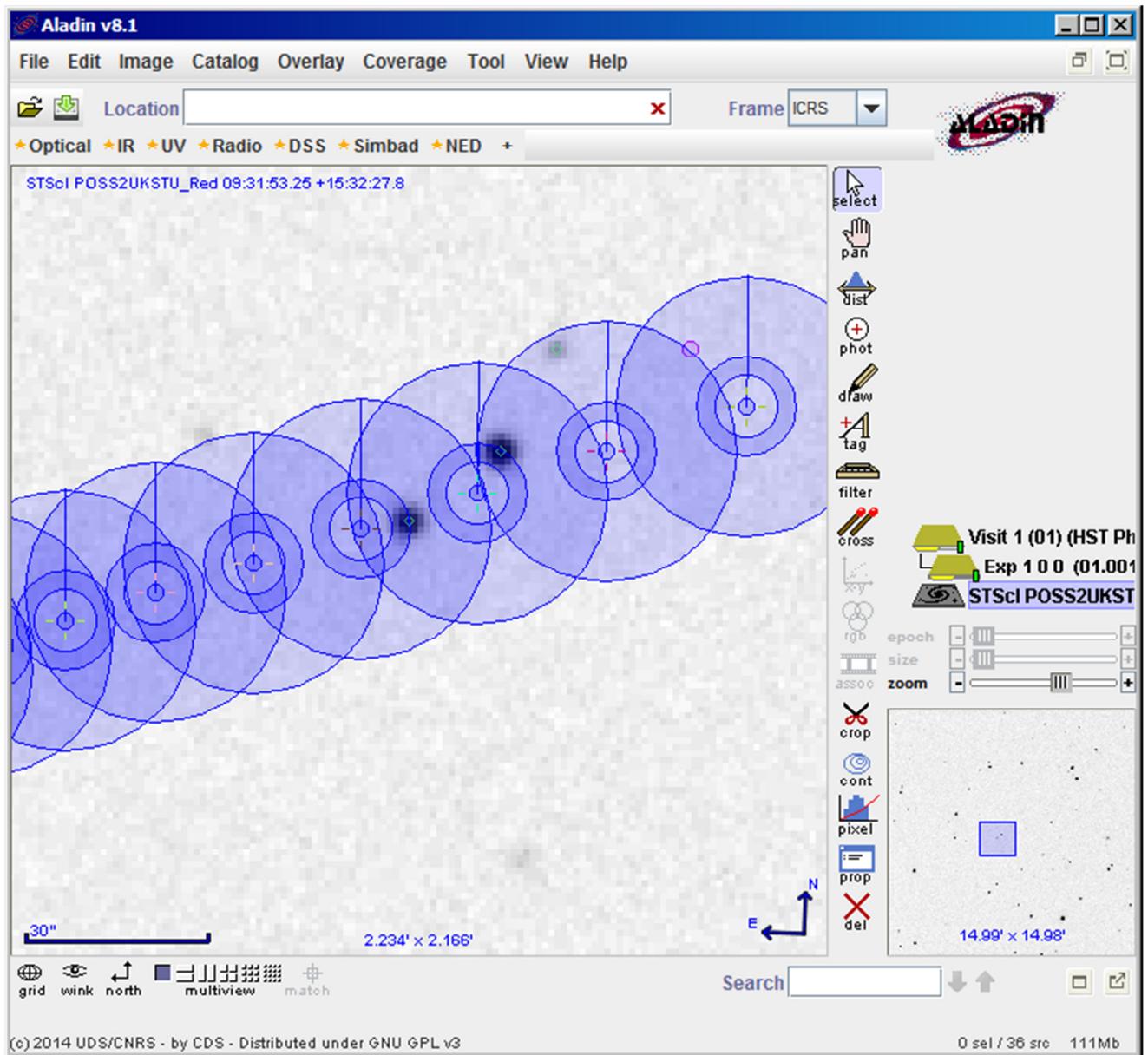
- 2015-JUN-25 01:00:00.0  
The Field Health and Safety (global A) is safe.  
The Total global Rate for this field is: 2.054E-1 counts/second
- 2015-JUN-25 02:00:00.0  
The Field Health and Safety (global A) is safe.  
The Total global Rate for this field is: 3.5405E-1 counts/second
- 2015-JUN-25 03:00:00.0

Concern	Aperture	OBJECT ID	RA	Dec	Catalog	Fpg	Jpg	Y	B-V	Type	Signal	Reason	Date
Safe	BOA	N8Z1001233	09 32 17.0764	+15 30 34.07	GSC2	19.33	20.83	20.02	0.79	G5V/6.6106E-3 counts/second	Health and Safety (global A) (Okay)	2015-JUN-25 20:00:00.0	
Safe	BOA	N8Z1001233	09 32 17.0764	+15 30 34.07	GSC2	19.33	20.83	20.02	0.79	G5V/6.7174E-3 counts/second	Health and Safety (global B) (Okay)	2015-JUN-25 20:00:00.0	
Safe	BOA	N8Z1001233	09 32 17.0764	+15 30 34.07	GSC2	19.33	20.83	20.02	0.79	G5V/6.1347E-9 counts/second/pixel	Health and Safety (local A) (Okay)	2015-JUN-25 20:00:00.0	
Safe	BOA	N8Z1001233	09 32 17.0764	+15 30 34.07	GSC2	19.33	20.83	20.02	0.79	G5V/8.0128E-8 counts/second/pixel	Health and Safety (local B) (Okay)	2015-JUN-25 20:00:00.0	
Safe	BOA	N8Z1001417	09 31 57.0740	+15 32 8.45	GSC2	16.07	17.99	16.98	1.13	K0V/1.0885E-1 counts/second	Health and Safety (global A) (Okay)	2015-JUN-25 02:00:00.0	
Safe	BOA	N8Z1001417	09 31 57.0740	+15 32 8.45	GSC2	16.07	17.99	16.98	1.13	K0V/1.1051E-1 counts/second	Health and Safety (global B) (Okay)	2015-JUN-25 02:00:00.0	
Safe	BOA	N8Z1001417	09 31 57.0740	+15 32 8.45	GSC2	16.07	17.99	16.98	1.13	K0V/1.0101E-7 counts/second/pixel	Health and Safety (local A) (Okay)	2015-JUN-25 02:00:00.0	
Safe	BOA	N8Z1001417	09 31 57.0740	+15 32 8.45	GSC2	16.07	17.99	16.98	1.13	K0V/1.3194E-6 counts/second/pixel	Health and Safety (local B) (Okay)	2015-JUN-25 02:00:00.0	
Safe	BOA	N8Z1001440	09 31 56.0339	+15 32 20.10	GSC2	15.68	17.09	16.33	0.79	G5V/1.9802E-1 counts/second	Health and Safety (global A) (Okay)	2015-JUN-25 01:00:00.0	
Safe	BOA	N8Z1001440	09 31 56.0339	+15 32 20.10	GSC2	15.68	17.09	16.33	0.79	G5V/2.0122E-1 counts/second	Health and Safety (global B) (Okay)	2015-JUN-25 01:00:00.0	
Safe	BOA	N8Z1001440	09 31 56.0339	+15 32 20.10	GSC2	15.68	17.09	16.33	0.79	G5V/1.8377E-7 counts/second/pixel	Health and Safety (local A) (Okay)	2015-JUN-25 01:00:00.0	
Safe	BOA	N8Z1001440	09 31 56.0339	+15 32 20.10	GSC2	15.68	17.09	16.33	0.79	G5V/2.4003E-6 counts/second/pixel	Health and Safety (local B) (Okay)	2015-JUN-25 01:00:00.0	
Safe	BOA	N8Z1001473	09 31 55.4077	+15 32 36.93	GSC2	18.60	21.16	19.90	1.52	M2V/7.375E-3 counts/second	Health and Safety (global A) (Okay)	2015-JUN-25 01:00:00.0	
Safe	BOA	N8Z1001473	09 31 55.4077	+15 32 36.93	GSC2	18.60	21.16	19.90	1.52	M2V/7.4941E-3 counts/second	Health and Safety (global B) (Okay)	2015-JUN-25 01:00:00.0	
Safe	BOA	N8Z1001473	09 31 55.4077	+15 32 36.93	GSC2	18.60	21.16	19.90	1.52	M2V/6.8441E-9 counts/second/pixel	Health and Safety (local A) (Okay)	2015-JUN-25 01:00:00.0	
Safe	BOA	N8Z1001473	09 31 55.4077	+15 32 36.93	GSC2	18.60	21.16	19.90	1.52	M2V/8.9393E-8 counts/second/pixel	Health and Safety (local B) (Okay)	2015-JUN-25 01:00:00.0	
Safe	BOA	N8Z1006243	09 32 19.8010	+15 30 39.60	GSC2	---	21.73	---	---	**O5V**/6.9599E-2 counts/second	Health and Safety (global A) (Okay)	2015-JUN-25 22:00:00.0	
Safe	BOA	N8Z1006243	09 32 19.8010	+15 30 39.60	GSC2	---	21.73	---	---	**O5V**/1.2991E-1 counts/second	Health and Safety (global B) (Okay)	2015-JUN-25 22:00:00.0	
Safe	BOA	N8Z1006243	09 32 19.8010	+15 30 39.60	GSC2	---	21.73	---	---	**O5V**/9.2123E-7 counts/second/pixel	Health and Safety (local A) (Okay)	2015-JUN-25 22:00:00.0	

**NOTE(s)**

- (1) Spectral types designated \*\*O5\*\* and \*\*M2\*\* are assumed types due to incomplete Catalog information. They are chosen to give the worst case (highest) count rates for the ultraviolet and infrared detectors, respectively.
- (2) Magnitudes enclosed in [ ]s are inferred.
- (3) Objects in the Type column displayed in blue (for ACS/SBC, COS, and STIS/MAMA detectors) are categorized by GSC2 as 'NOT A STAR'.

Print... Save To File... Done



As noted above, the Moving Target Tool does not consider the observing constraints when calculating the ephemeris, and since the BOT uses the calculated ephemeris as its output, it doesn't either. The BOT uses the ephemeris calculated by the MTT and the details of the observing configuration (instrument, grating, filter, aperture, etc.). Therefore, the safety of a particular observing mode only has to be checked once, i.e. the MTT and BOT don't have to be run for every exposure; just once for each unique mode used in the proposal.

## FAQ

- **Q.** Why are MTs specified at the exposure level rather than the visit level? **A.** A visit can have multiple moving targets, e.g. an offset field and a target, or a planet and a moon, so doing the checks at the exposure level is the only way to properly check each unique target configuration.
- **Q.** Should I check each exposure in my proposal with the BOT? **A.** It is only necessary to check each unique observing configuration.
- **Q.** Are GOs required to use the MT tool? **A.** Not in Cycle 23.
- **Q.** Why can't I find the MT tool under the BOT dropdown menu any longer? **A.** It was moved to the exposure page when it became a more general visualization tool.
- **Q.** Why don't my constraints (BETWEENs, CMLs, etc.) supplied appear in the Moving Target Tool? **A.** The MTT does not include observing constraints since it is intended to be a visualization tool. It is possible that the option to include constraints will be included in the future.
- **Q.** What should I do if I find a bug? **A.** Send email to [help@stsci.edu](mailto:help@stsci.edu) and let us know. You can also send suggestions to this address.
- **Q.** Are the time ranges specified in the MTT used in the scheduling process? Do I have to enter numbers in every exposure so that my observations get scheduled? **A.** No. The information you enter in the MTT fields is not used for scheduling your observations.
- **Q.** Why does the ephemeris information calculated in the Moving Target Tool differ from what I calculate using other tools? **A.** The ephemeris calculation done by the MTT calculates the apparent position of the target as observed from HST, not from the center of the earth. So if your target is nearby, you may see a difference.
- **Q.** What should I use for the step size? **A.** For visualization with the MTT, choosing a time range and step size so that there are 5 – 20 steps is usually a good place to start. If you're running the BOT, you want the time steps close enough so that the macroapertures have overlap between steps.
- **Q.** Will I have to recreate/regenerate my ephemeris information every time I reload my Phase II into APT? **A.** No, the window information you enter, along with the calculated ephemeris information, will be saved when you save your .apt file.
- **Q.** When should I choose to regenerate a MT ephemeris? **A.** If you want to change the time range or step size, you will have to regenerate the ephemeris.
- **Q.** Do I have to use the BOT to clear my entire observing window? **A.** Not necessarily. For instance, if an acquisition exposure is scheduled at the beginning of an observing window, followed by spectroscopic exposures, it isn't necessary to show that the entire window is safe in the acquisition configuration.

## Bugs

The Moving Target Tool is a relatively new enhancement to APT and is still evolving. Please report unexpected behavior or suggestions for improvements to [apt@stsci.edu](mailto:apt@stsci.edu).

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