SBC Acceptance Testing

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Summary

A detailed acceptance test for the SBC has been performed. A regression test shows that BOT is giving the correct answers. The new features (exposure expansion, pointing adjustments, actual duration usage, and visualization) are all functioning properly, and BOT can handle error conditions gracefully and provides meaningful feedback to the users.

Three issues with the Aladin display have been found – a slight misalignment of the BOT overlay with the DSS image, a failure to display all sub-exposures, and a broken link in the Aladin spreadsheet; all of these are known issues with PRs or DRs previously filed. None of these issues is severe enough to warrant a delay in the release of the tool for SBC usage only.

Introduction

For this test, the following target and exposure was used:

Target: G191-B2B – 05h 05m 30.6119s, +52^{o} 49’ 45.95”
(Note that this is slightly off from nominal position of the star)

Exposure: ACS/SBC, ACCUM, F165LP, SBC, 1000s

When appropriate, modifications to the exposure (e.g. POS TARG) are detailed below.

This target/exposure was used to perform the following:

Test	Definition
Regression	Comparison with old VTT/BOT
New features	Exposure expansion, pointing adjustment, actual duration, visualization
Exception Handling	Bad exposure, unsupported exposure, network query, cancel operations

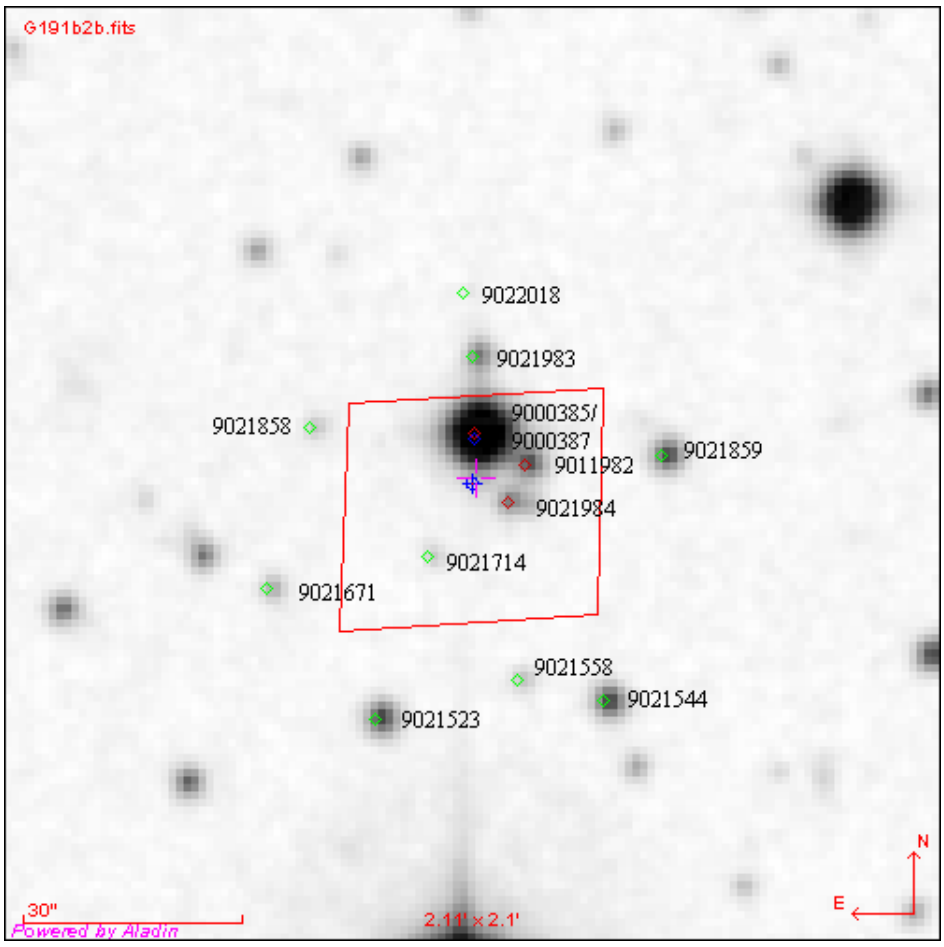
For each test, both the tabular and graphic output products are included for ease of comparison with future test results.

Regression Test

The test exposure was run through both the VTT/BOT and the new BOT/Aladin interface. Both methods used a search radius of 35", and the exact same stars were found in both cases; the magnitudes and derived count rates were identical. The 13 objects detected (1 Health-and-Safety, 9 Safe, and 3 Unknown) were:

GSC2 ID	RA (05 05)	Dec (+52)	F	J	V	B-V	Type	VTT	New
NAP9000385	30.5968	49 52.68	11.84	11.45	11.69	0.62	unknown	X	X
NAP9000387	30.6069	49 51.92	---	---	11.68	-0.25	**O5V**	X	X
NAP9021523	32.0052	49 14.15	16.3	17.85	17.02	0.72	G5V	X	X
NAP9021544	28.6232	49 16.96	16.37	17.3	16.8	0.29	A5V	X	X
NAP9021558	29.9115	49 19.67	18.87	20.18	19.47	0.53	F5V	X	X
NAP9021671	33.6567	49 31.37	18.36	20.37	19.32	1.02	K0V	X	X
NAP9021714	31.2701	49 36.12	19.03	20.35	19.64	0.53	F5V	X	X
NAP9021858	33.0508	49 53.18	18.81	20.48	19.58	0.77	G5V	X	X
NAP9021859	27.8199	49 50.20	16.37	17.42	16.85	0.37	F0V	X	X
NAP9021982	29.8387	49 48.73	16.82	22.16	21.38	3.64	not a star	X	X
NAP9021983	30.6445	50 3.23	17.22	18.56	17.83	0.58	F5V	X	X
NAP9021984	30.0681	49 43.51	17.57	22.16	20.92	3.12	not a star	X	X
NAP9022018	30.7848	50 11.67	20.21	22.16	21.13	1.3	K4V	X	X

The field map, showing the objects found, is given below.



In the figure, all objects were found by the VTT/BOT.

Issue
There appears to be a slight misalignment between the BOT overlay and the DSS image, which is 0.2" in both RA and Dec. The RA offset is consistent (the BOT overlay is always east of the star), while the Dec offset is sometimes north and sometimes south. This discrepancy is small enough (0.2 pixels) to be of no concern, but is covered under APT-VTT DR 1170.

New Features

Exposure Expansion

For the SBC, there are two ways for exposures to be expanded – number of iterations greater than 1 and the use of a pattern. The pattern case is detailed in the Pointing Adjustment section below. For the number of iterations test, a value of 3 was used. In this case, three identical sub-exposures were generated, and BOT processing was performed on all three sub-exposures with identical results. Aladin did display the BOT overlay, although there was only 1 image plane shown, unlike the Pattern case where each sub-exposure was its own plane. Since the number of iterations planes would all be, by definition, identical, showing only 1 plane is acceptable (however, if the actual duration field was used, a problem could result; see below).

Pointing Adjustment

There are 3 different types of pointing adjustments valid for the SBC – POS TARG, PATTERN, and use as a PARALLEL instrument.

POS TARG

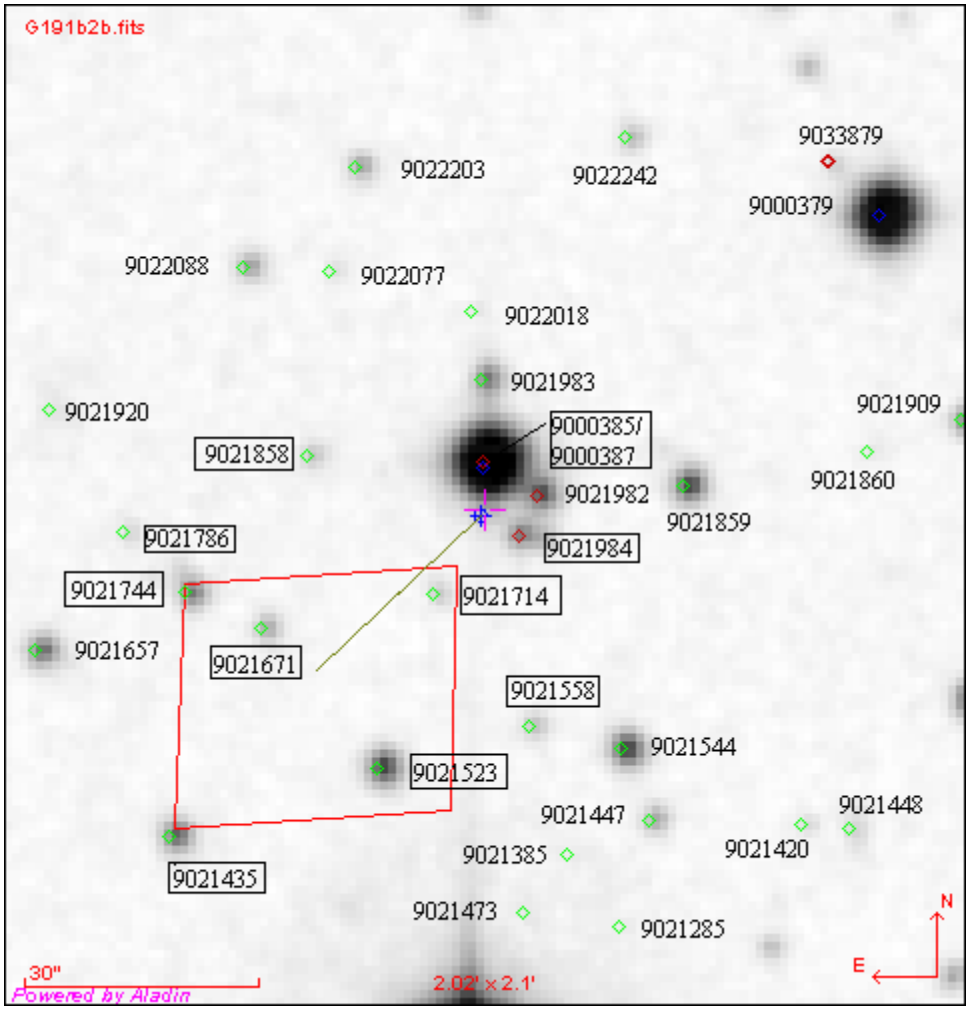
For this test, the standard exposure was modified by adding a POS TARG of X=-20" and Y=-20". The direction of the POS TARG is important in this test, and in order to be able to simply predict the size of the POS TARG motion, the motion must be in the same direction as the "Search Radius Vector" which is defined as the point from the fiducial to the outermost corner of the Aperture; for the SBC this is the lower left corner. A selection in a different direction makes the calculation of the motion vector more complicated.

The test exposure was run through both the VTT/BOT and the new BOT/Aladin interface. The VTT/BOT used a search radius of 35", and only did analysis at the exact pointing (i.e. it assumed ORIENT=0). The new BOT increased the search radius by 28" to 63", which resulted in a circle being analyzed to support any possible ORIENT value; based on the size of the POS TARG, this increase in search radius is exactly what was predicted (i.e. SQRT(20*20 + 20*20) = 28). With the increased search radius, the new BOT analyzed more objects than the VTT/BOT, but all objects in the VTT/BOT were detected, and for those objects, the magnitudes and derived count rates were identical.

The 33 objects (2 Health-and-Safety, 26 Safe, and 5 Unknown) detected were:

GSC2 ID	RA	Dec	F	J	V	B-V	Type
NAP9000379	05 05 25.1517	+52 50 24.68	12.56	14.06	13.25	0.69	**O5V**
NAP9000385	05 05 30.5968	+52 49 52.68	11.84	11.45	11.69	-0.62	unknown
NAP9000387	05 05 30.6069	+52 49 51.92	---	---	11.68	-0.25	**O5V**
NAP9021285	05 05 28.5996	+52 48 54.64	20.26	22.16	21.16	1.27	K4V
NAP9021385	05 05 29.3488	+52 49 3.70	19.98	22.16	21.03	1.47	K4V
NAP9021420	05 05 26.1004	+52 49 7.91	19.76	20.86	20.27	0.27	A5V
NAP9021435	05 05 34.8698	+52 49 5.12	17.03	18.75	17.83	0.83	K0V
NAP9021447	05 05 28.2105	+52 49 8.15	18.4	19.69	18.99	0.53	F5V
NAP9021448	05 05 25.4187	+52 49 7.49	18.91	20.82	19.81	0.88	K0V
NAP9021473	05 05 29.9553	+52 48 56.09	19.97	22.16	21.03	1.47	K4V
NAP9021523	05 05 32.0052	+52 49 14.15	16.3	17.85	17.02	0.72	G5V
NAP9021544	05 05 28.6232	+52 49 16.96	16.37	17.3	16.8	0.29	A5V
NAP9021558	05 05 29.9115	+52 49 19.67	18.87	20.18	19.47	0.53	F5V
NAP9021657	05 05 36.7715	+52 49 28.08	17.06	19.03	18	1.01	K0V
NAP9021671	05 05 33.6567	+52 49 31.37	18.36	20.37	19.32	1.02	K0V
NAP9021714	05 05 31.2701	+52 49 36.12	19.03	20.35	19.64	0.53	F5V
NAP9021744	05 05 34.7154	+52 49 35.81	17.09	18.8	17.88	0.83	K0V
NAP9021786	05 05 35.5867	+52 49 43.14	19.47	20.76	20.06	0.47	F5V
NAP9021858	05 05 33.0508	+52 49 53.18	18.81	20.48	19.58	0.77	G5V
NAP9021859	05 05 27.8199	+52 49 50.20	16.37	17.42	16.85	0.37	F0V
NAP9021860	05 05 25.2752	+52 49 54.84	20.14	22.16	21.1	1.35	K4V
NAP9021909	05 05 23.9571	+52 49 58.98	17.42	18.63	17.97	0.48	F5V
NAP9021920	05 05 36.6385	+52 49 58.55	19.13	21.89	20.57	1.47	K4V
NAP9021982	05 05 29.8387	+52 49 48.73	16.82	22.16	21.38	3.64	not a star
NAP9021983	05 05 30.6445	+52 50 3.23	17.22	18.56	17.83	0.58	F5V
NAP9021984	05 05 30.0681	+52 49 43.51	17.57	22.16	20.92	3.12	not a star
NAP9022018	05 05 30.7848	+52 50 11.67	20.21	22.16	21.13	1.3	K4V
NAP9022077	05 05 32.7828	+52 50 16.40	19.79	22.33	21.07	1.23	K4V
NAP9022088	05 05 33.9734	+52 50 16.81	18.13	19.8	18.9	0.8	G5V
NAP9022203	05 05 32.4531	+52 50 29.57	18.29	19.61	18.9	0.55	F5V
NAP9022242	05 05 28.6863	+52 50 33.77	18.73	20.54	19.58	0.87	K0V
NAP9033879	05 05 25.8698	+52 50 31.17	---	20.7	---	---	not a star
NAP9033881	05 05 25.8671	+52 50 31.18	---	20.66	---	---	not a star

The field map, showing the objects found, is given below.



In the figure, the objects in boxes were found by the VTT/BOT. The new objects are all in the area that is expected.

Pattern

For this test, the standard exposure was modified by putting it in a PATTERN (an SBC-DITHER-LINE with 2 points with a 10" spacing at an orientation of 225°). The orientation of the pattern is important in this test, since in order to be able to simply predict the size of the PATTERN motion, the motion must be in the same direction as the "Search Radius Vector" which is defined as the point from the fiducial to the outermost corner of the Aperture; for the SBC this is the lower left corner. A selection in a different orientation makes the calculation of the motion vector more complicated.

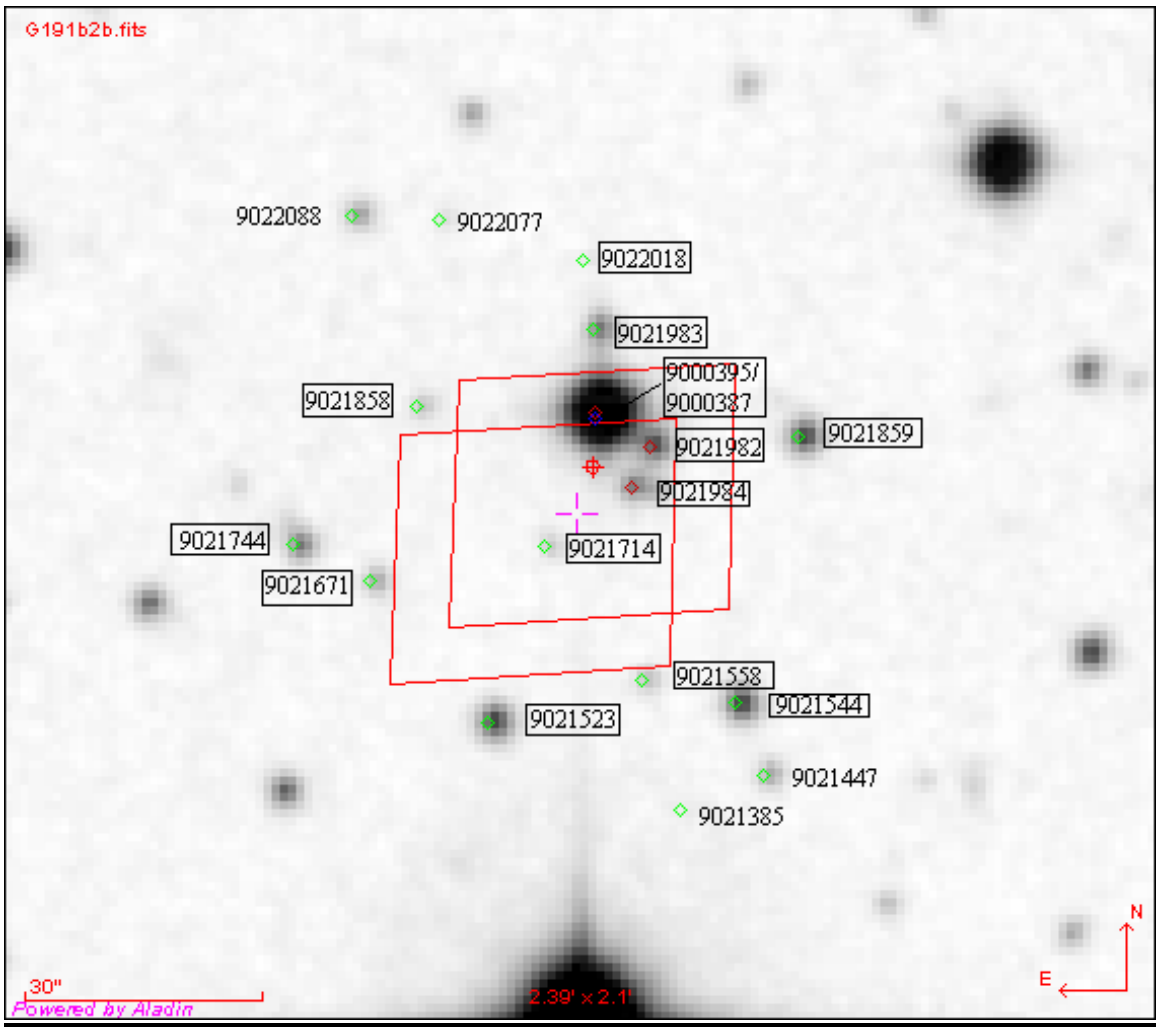
The test exposure was run through both the VTT/BOT and the new BOT/Aladin interface. The VTT/BOT used a search radius of 35", and only did analysis as if there were no pattern. The new BOT did 2 searches – one for the initial pointing (with the

standard 35” search radius) and one for the second pattern exposure (with the search radius increased to 45”); all objects in the initial pointing were included in the larger second pattern pointing report, as expected. The expanded search radius was calculated correctly (35” standard + 10” for the pattern = 45”). With the increased search radius, the new BOT analyzed more objects than the VTT/BOT, but all objects in the VTT/BOT were detected, and for those objects, the magnitudes and derived count rates were identical.

The 18 objects (1 Health-and-Safety, 14 Safe, and 3 Unknown) detected were:

GSC2 ID	RA	Dec	F	J	V	B–V	Type
NAP9000385	05 05 30.5968	+52 49 52.68	11.84	11.45	11.69	–0.62	unknown
NAP9000387	05 05 30.6069	+52 49 51.92	---	---	11.68	–0.25	**O5V**
NAP9021385	05 05 29.3488	+52 49 3.70	19.98	22.16	21.03	1.47	K4V
NAP9021447	05 05 28.2105	+52 49 8.15	18.4	19.69	18.99	0.53	F5V
NAP9021523	05 05 32.0052	+52 49 14.15	16.3	17.85	17.02	0.72	G5V
NAP9021544	05 05 28.6232	+52 49 16.96	16.37	17.3	16.8	0.29	A5V
NAP9021558	05 05 29.9115	+52 49 19.67	18.87	20.18	19.47	0.53	F5V
NAP9021671	05 05 33.6567	+52 49 31.37	18.36	20.37	19.32	1.02	K0V
NAP9021714	05 05 31.2701	+52 49 36.12	19.03	20.35	19.64	0.53	F5V
NAP9021744	05 05 34.7154	+52 49 35.81	17.09	18.8	17.88	0.83	K0V
NAP9021858	05 05 33.0508	+52 49 53.18	18.81	20.48	19.58	0.77	G5V
NAP9021859	05 05 27.8199	+52 49 50.20	16.37	17.42	16.85	0.37	F0V
NAP9021982	05 05 29.8387	+52 49 48.73	16.82	22.16	21.38	3.64	not a star
NAP9021983	05 05 30.6445	+52 50 3.23	17.22	18.56	17.83	0.58	F5V
NAP9021984	05 05 30.0681	+52 49 43.51	17.57	22.16	20.92	3.12	not a star
NAP9022018	05 05 30.7848	+52 50 11.67	20.21	22.16	21.13	1.3	K4V
NAP9022077	05 05 32.7828	+52 50 16.40	19.79	22.33	21.07	1.23	K4V
NAP9022088	05 05 33.9734	+52 50 16.81	18.13	19.8	18.9	0.8	G5V

The field map, showing the objects found, is given below.



In the figure, the objects in boxes were found by the VTT/BOT. The new objects are all in the area that is expected.

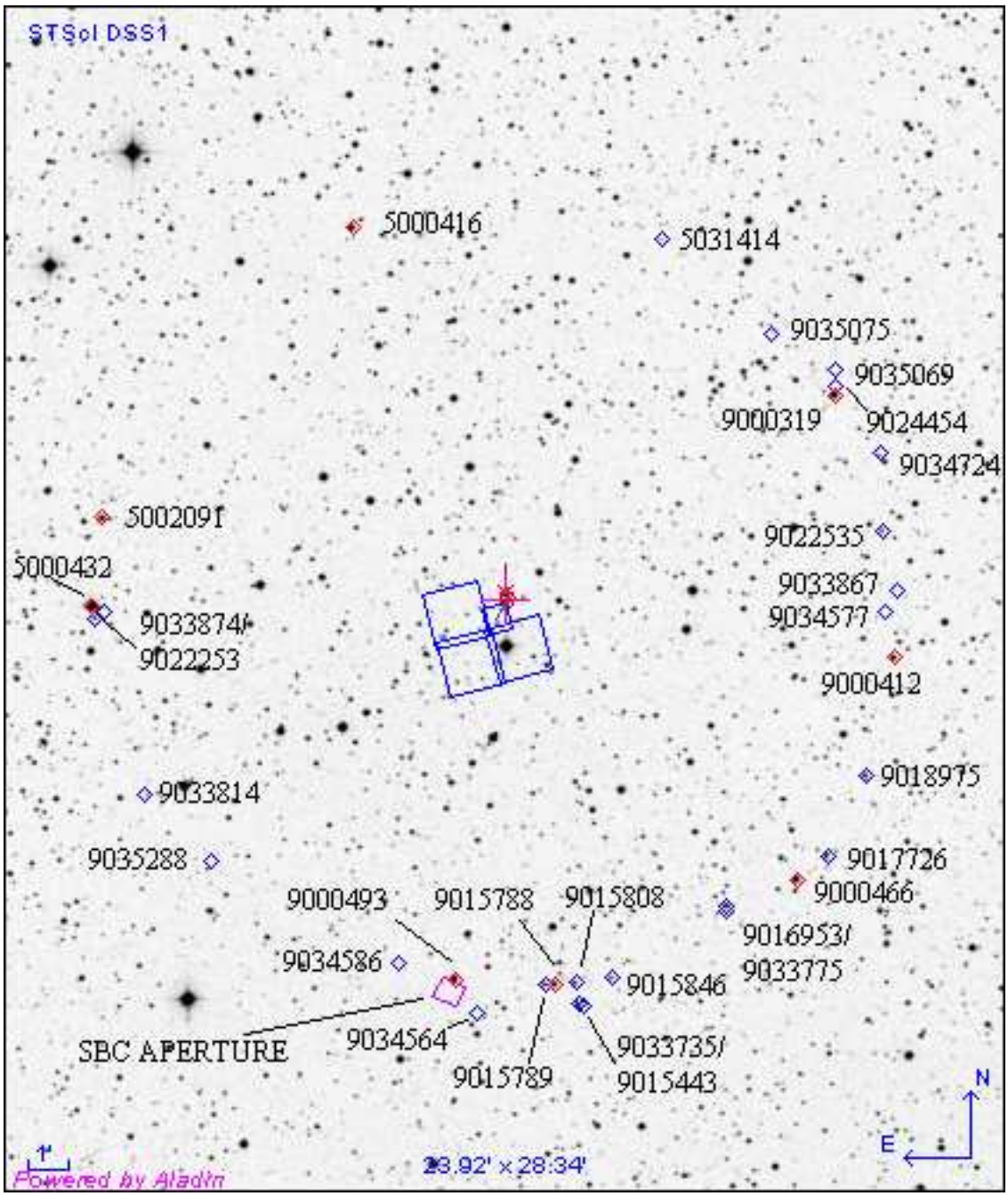
Parallel

For this test, the standard exposure was modified making it be a coordinated parallel observation with a WPFC2 prime exposure. The test exposure was run through the new BOT/Aladin interface only; the old VTT/BOT did not take the position of the parallel aperture into account when performing its checking. The search radius used by BOT was 9.89'. The separation between the PC and SBC is 8.95', and after adding 0.58' for the standard search radius, the approximate search radius BOT should have used is 9.53', very close to what was actually used. Given that the apertures are not aligned along the Search Radius Vector (described above), this small difference (especially given that BOT uses a larger radius) is not important.

A total of 544 stars were found in the new BOT, so the table below only lists the health-and-safety (8) and unknown objects (23). The objects detected were:

GSC2 ID	RA	Dec	F	J	V	B-V	Type
NAP5000416	05 05 53.3884	+52 58 46.42	13.3	14.34	13.77	0.37	**O5V**
NAP5000432	05 06 35.9942	+52 49 54.10	---	---	10.23	0.49	**O5V**
NAP5002091	05 06 34.0849	+52 52 0.38	13.78	15.04	14.35	0.52	**O5V**
NAP5031414	05 05 4.4513	+52 58 16.19	---	19.95	---	---	not a star
NAP9000319	05 04 37.7069	+52 54 26.89	12.94	13.95	13.41	0.35	**O5V**
NAP9000412	05 04 29.6451	+52 48 7.56	13.87	15.18	14.47	0.56	**O5V**
NAP9000466	05 04 46.1343	+52 42 54.64	12.88	14.19	13.48	0.56	**O5V**
NAP9000493	05 05 40.5056	+52 40 46.37	12.54	14.2	13.31	0.79	**O5V**
NAP9015443	05 05 21.0352	+52 40 4.94	14.23	17.1	---	---	not a star
NAP9015788	05 05 24.6834	+52 40 34.57	14.04	15.12	14.54	0.4	**O5V**
NAP9015789	05 05 26.2108	+52 40 34.60	15.35	16.77	---	---	not a star
NAP9015808	05 05 21.4288	+52 40 35.36	15.26	17.13	---	---	not a star
NAP9015846	05 05 15.7279	+52 40 40.95	15.9	17.27	---	---	not a star
NAP9016953	05 04 57.3620	+52 42 18.90	15.39	17.06	---	---	not a star
NAP9017726	05 04 41.2143	+52 43 27.04	14.69	16.44	---	---	not a star
NAP9018975	05 04 34.7088	+52 45 20.02	15.09	16.8	---	---	not a star
NAP9022253	05 06 35.6413	+52 49 36.97	15.47	16.59	---	---	not a star
NAP9022535	05 04 30.8107	+52 51 9.95	15.99	17	---	---	not a star
NAP9024454	05 04 37.6053	+52 54 37.78	14.75	22.16	24.53	5.07	Unknown
NAP9033735	05 05 20.4493	+52 40 4.24	---	19.29	---	---	not a star
NAP9033775	05 04 57.3781	+52 42 13.61	---	20.03	---	---	not a star
NAP9033814	05 06 28.4097	+52 45 23.78	---	20.64	---	---	not a star
NAP9033867	05 04 28.9743	+52 49 45.35	---	20.84	---	---	not a star
NAP9033874	05 06 34.4240	+52 49 45.24	---	20.86	---	---	not a star
NAP9034564	05 05 37.2871	+52 39 57.28	---	20.75	---	---	not a star
NAP9034586	05 05 49.3109	+52 41 10.60	---	21.95	---	---	not a star
NAP9034677	05 04 30.7036	+52 49 12.92	---	22	---	---	no color info
NAP9034724	05 04 30.8796	+52 53 2.68	---	21.26	---	---	not a star
NAP9035069	05 04 37.4282	+52 55 2.89	---	---	---	---	not a star
NAP9035075	05 04 47.4664	+52 55 57.90	---	---	---	---	not a star
NAP9035288	05 06 18.4136	+52 43 43.19	---	---	---	---	not a star

The field map, showing the objects found, is given below.



Actual Duration

There are two ways in which the SBC can use actual durations – a pattern exposure and a number of iterations greater than 1 exposure. For this test, the second piece of the pattern will have the actual duration set to 500s, and the second of three exposures in a number of iterations=3 will have the actual duration set to 500s.

Pattern
An examination of the BOT details shows that the revised exposure time for the second piece of the pattern was indeed detected by the tool; note that since only count rates are determined for the SBC, the actual value of the exposure time is not used (a check with the HRC shows that the revised exposure time is used in determining total counts).

Number of iterations
An examination of the BOT details shows that the revised exposure time for the second sub-exposure was indeed detected by the tool.

Issue
For actual duration and number of iterations, only the first sub-exposure is shown in Aladin. If there were different actual durations, both sub-exposures would need to be display, as they could have different answers. This is a problem is covered in APT-BOT OPR 56136.

Visualization

There are many aspects to this test, many of which have already been verified by the previous testing. Specifically, the following items have already been verified:

- alignment of BOT overlay on DSS image
- BOT overlay displayed by default
- Selected objects in Aladin display appear in spreadsheet
- Comparison of BOT display with independent (VTT) tool
- VTT/BOT matches Aladin (where appropriate)

New items that were check (using the simple exposure):

- Visibility of all objects can be toggled on and off
- Visibility of each class of object can be toggled on and off
- Selection of individual objects, with details appearing in spreadsheet
- Star state precedence maintained (e.g. star with Health and Safe checks is listed as Health)
- Aladin display automatically updates as new exposures are selected
- BOT automatically clears objects that are in exposures not yet processed

Issue
Aladin spreadsheet name link to an external html page with more details fails for the GSC2; this is covered with APT-VTT DR 1197.

Exception Handling

There are four types of exception handling to be tested.

Bad Exposure Parameters

In this case, three copies of the simple exposure are processed at once, with the middle copy missing the aperture name. When processed, the first and third exposure complete normally, while the second exposure has an error (unable to load exposure) indicating that the exposure is in error.

Unsupported Exposures

There are no such exposures for the SBC. When a STIS exposure that is unsupported is used, an error message (exposure not supported) is given, and the remaining exposures are properly processed.

Network Query Error

With the network connection disabled, BOT gives a clear message that the SkyNode Server is not available, and the summary table indicates that the query failed. After reconnecting, the BOT behaves normally.

Cancel Ongoing Operations

A visit with 9 exposures was created, and after 6 had been processed, the processing was cancelled. The BOT table showed that none of the processing was saved.