Astronomer’s Proposal Tool
Bright Object Tool Regression Test Document

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1.0 Introduction

A set of proposals to test the functionality of the Bright Object Tool (BOT) are described in the following sections. In order to regression test the Bright Object Tool (BOT), a JUnit Test has been created for each proposal. JUnit is an open source framework designed for the purpose of writing and running tests the Java programming language. Each JUnit test will run a proposal through the BOT within the Astronomer’s Proposal Tool (APT). When the BOT runs, the proposal is expected to generate a set of VOT files, containing the results from the BOT. A baseline set of VOT files have all been verified by comparing the VOT files with the BOT Results Tables and Aladin Graphical view (see Appendix A) in the APT GUI, and those files will be used as a baseline to check for new or missing files. The JUnit test will check for differences between the newly created VOT files and the baselined VOT files. If there are no new, missing, or changed VOT files, then the JUnit test passes. If this is not the case, the test fails. The JUnit Test will email the console output from the run, and the new and different VOT files as attachments to bot-regression@stsci.edu. Details on how to fix the error(s) are included in the email and the requirements of the JUnit test are included as well. The JUnit tests will run nightly and are located in the Regression Tests folder of the APT code repository.

Throughout the following proposals, all detectors are used at least once in order ensure detector coverage (see Table 1-1: Proposal Detector Coverage).

<table>
<thead>
<tr>
<th>Detector</th>
<th>Used In Proposal</th>
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</thead>
<tbody>
<tr>
<td>ACS/SBC</td>
<td>PATTERN</td>
</tr>
<tr>
<td></td>
<td>$V_{crit}$</td>
</tr>
<tr>
<td></td>
<td>Illegal</td>
</tr>
<tr>
<td>ACS/WFC</td>
<td>$B-V \leq +0.1$</td>
</tr>
<tr>
<td></td>
<td>Large Error on $F$ and $J$</td>
</tr>
<tr>
<td></td>
<td>Incomplete Data</td>
</tr>
<tr>
<td>COS/FUV</td>
<td>Modes</td>
</tr>
<tr>
<td></td>
<td>COS Dual Aperture</td>
</tr>
<tr>
<td></td>
<td>No Stars in Field</td>
</tr>
<tr>
<td></td>
<td>Only $F$ or Only $J$</td>
</tr>
<tr>
<td>COS/NUV</td>
<td>Parallel</td>
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<tr>
<td></td>
<td>COS Dual Aperture</td>
</tr>
<tr>
<td></td>
<td>Only $F$ or Only $J$</td>
</tr>
<tr>
<td>NIC1</td>
<td>POS-TARG</td>
</tr>
<tr>
<td>Detector</td>
<td>Used In Proposal</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>NIC2</td>
<td>Parallel</td>
</tr>
<tr>
<td></td>
<td>( V_{crit} )</td>
</tr>
<tr>
<td>NIC3</td>
<td>Illegal ( V )</td>
</tr>
<tr>
<td>STIS/CCD</td>
<td>Ignore ‘Not a Star’ Flag</td>
</tr>
</tbody>
</table>
| STIS/FUV-MAMA            | Bright Stars have \( V \) and \( B-V \) in GSC2  
|                          | \( B-V \leq +0.1 \)                     |
|                          | Only \( F \) or Only \( J \)            |
|                          | Large Error on \( F \) and \( J \)       |
|                          | Ignore ‘Not a Star’ Flag                |
|                          | Trigger Values                          |
| STIS/NUV-MAMA            | Detector Sizes                          |
|                          | Only \( F \) or Only \( J \)            |
|                          | Ignore ‘Not a Star’ Flag                |
| WFC3/IR                  | WFC3 IR with no 2MASS uses GSC2         |
| WFC3/UVIS                | Bright Stars have \( V \) and \( B-V \) in GSC2  |

Table 1-1: Proposal Detector Coverage

Note that the BOT results shown for the following proposals may not match what the current results are, but are included to give an idea of what the results might look like. For instance, the Exposure Time Calculators (ETCs) are updated every cycle, so any test that uses or displays the count rates will change.

2.0 Search Field

The following proposals are verified by comparing the objects listed in the VOT file for each proposal to see that the same object names and coordinates are found in the BOT Search Fields. Crowded fields are used for all targets such that objects lie just inside and just outside the search fields. If the search fields are changed, the same objects may not be found resulting in the test failing. For these tests, we are just concerned with which objects are found in the search (i.e. the details of the objects, such as spectral type and count rates, are not relevant).

2.1 Detector Sizes

This proposal is testing that BOT is properly reading the size of the detector from the instrument table; as the table are all of similar format, one detector will suffice for this test. The proposal is using G191-B2B as the target and the STIS/NUV-MAMA detector. The following table lists the objects that should be found.
2.2 Adjustments

The following proposals are testing the search field where various adjustments are specified.

### 2.2.1 POS-TARG

This proposal is testing that BOT is properly reading the POS TARG value \((x = 10, \ y = 10)\) from the APT file; as the POS TARG values are not detector specific, one detector will suffice for this test. The proposal is using G191-B2B as the target and the NIC1 detector. The following table lists the objects that should be found.

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAP9000385</td>
<td>05 05</td>
<td>30.5969</td>
</tr>
<tr>
<td>NAP9000387</td>
<td>05 05</td>
<td>30.6061</td>
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<tr>
<td>NAP9021714</td>
<td>05 05</td>
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<tr>
<td>NAP9021858</td>
<td>05 05</td>
<td>33.0505</td>
</tr>
<tr>
<td>NAP9021982</td>
<td>05 05</td>
<td>29.8389</td>
</tr>
<tr>
<td>NAP9021983</td>
<td>05 05</td>
<td>30.6445</td>
</tr>
<tr>
<td>NAP9021984</td>
<td>05 05</td>
<td>30.0677</td>
</tr>
<tr>
<td>NAP9022018</td>
<td>05 05</td>
<td>30.7855</td>
</tr>
</tbody>
</table>

**Table 2.1: Detector Sizes BOT Objects**

### 2.2.2 PATTERN

This proposal is testing the BOT Search Field adjustment for a visit containing a pattern. The proposal uses a four-point mosaic box pattern. The target is G191-B2B. There is one ACS/SBC exposure using the four-point mosaic box pattern. There are four overlapping BOT Search Fields due to the four-point box pattern. The following tables list the objects that should be found for each point in the pattern.

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAP9000385</td>
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<td>30.5969</td>
</tr>
<tr>
<td>NAP9000387</td>
<td>05 05</td>
<td>30.6061</td>
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<tr>
<td>NAP9021714</td>
<td>05 05</td>
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<td>NAP9021858</td>
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<tr>
<td>NAP9021984</td>
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<tr>
<td>NAP9022077</td>
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<td>32.7832</td>
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</table>

**Table 2.2: POS-TARG BOT Objects**
**Pattern Point 1:**
*Instrument/Detector: ACS/SBC*
*Target: G-191-B2B*

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAP9000385</td>
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<td>+52 49 52.68</td>
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<td>NAP9000387</td>
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<td>NAP9021385</td>
<td>05 05 29.3481</td>
<td>+52 49 3.70</td>
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<tr>
<td>NAP9021447</td>
<td>05 05 28.2111</td>
<td>+52 49 8.14</td>
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<tr>
<td>NAP9021523</td>
<td>05 05 32.0050</td>
<td>+52 49 14.15</td>
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<tr>
<td>NAP9021544</td>
<td>05 05 28.6230</td>
<td>+52 49 16.96</td>
</tr>
<tr>
<td>NAP9021558</td>
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<td>NAP9021671</td>
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Table 2-3: Pattern Point 1 BOT Objects

**Pattern Point 2:**
*Instrument/Detector: ACS/SBC*
*Target: G-191-B2B*

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
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<tbody>
<tr>
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</tr>
<tr>
<td>NAP9000387</td>
<td>05 05 30.6061</td>
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Table 2-4: Pattern Point 2 BOT Objects

**Pattern Point 3:**

*Instrument/Detector: ACS/SBC*

*Target: G-191-B2B*

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<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
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<td>+52 50 11.67</td>
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<tr>
<td>NAP9022077</td>
<td>05 05 32.7832</td>
<td>+52 50 16.41</td>
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<tr>
<td>NAP9022088</td>
<td>05 05 33.9734</td>
<td>+52 50 16.82</td>
</tr>
<tr>
<td>NAP9022203</td>
<td>05 05 32.4536</td>
<td>+52 50 29.56</td>
</tr>
<tr>
<td>NAP9022242</td>
<td>05 05 28.6871</td>
<td>+52 50 33.78</td>
</tr>
</tbody>
</table>

Table 2-5: Pattern Point 3 BOT Objects
**Pattern Point 4:**
*Instrument/Detector:* ACS/SBC
*Target:* G-191-B2B

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAP9000385</td>
<td>05 05 30.5969</td>
<td>+52 49 52.68</td>
</tr>
<tr>
<td>NAP9000387</td>
<td>05 05 30.6061</td>
<td>+52 49 51.92</td>
</tr>
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<td>NAP9021385</td>
<td>05 05 29.3481</td>
<td>+52 49 3.70</td>
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<td>NAP9021447</td>
<td>05 05 28.2111</td>
<td>+52 49 8.14</td>
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<td>NAP9021523</td>
<td>05 05 32.0050</td>
<td>+52 49 14.15</td>
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<td>NAP9021544</td>
<td>05 05 28.6230</td>
<td>+52 49 16.96</td>
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<td>NAP9021558</td>
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<td>NAP9021671</td>
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<td>+52 49 35.81</td>
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<td>NAP9021786</td>
<td>05 05 35.5865</td>
<td>+52 49 43.15</td>
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<td>NAP9021858</td>
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</tr>
<tr>
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<td>05 05 30.8752</td>
<td>+52 50 49.48</td>
</tr>
</tbody>
</table>

Table 2-6: Pattern Point 4 BOT Objects

**2.2.3 Modes**

This proposal is checking the BOT Search Field adjustment for the COS modes ACQ/SEARCH and ACQ/PEAKD; an ACCUM mode exposure is included as the baseline.

The proposal uses the COS/FUV detector and has three exposures, one for each mode. The following tables list the objects that are found by the BOT.

**Exposure 1:**
*Instrument/Detector:* COS/FUV
*Mode:* ACCUM (baseline)
*Target:* G-191-B2B

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAP9000385</td>
<td>05 05 30.5969</td>
<td>+52 49 52.68</td>
</tr>
</tbody>
</table>
Exposure 2:
Instrument/Detector: COS/FUV
Mode: ACQ/SEARCH
Target: G-191-B2B

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAP9000387</td>
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<td>+52 49 51.92</td>
</tr>
<tr>
<td>NAP9021714</td>
<td>05 05 31.2708</td>
<td>+52 49 36.11</td>
</tr>
<tr>
<td>NAP9021982</td>
<td>05 05 29.8389</td>
<td>+52 49 48.72</td>
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<tr>
<td>NAP9021983</td>
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</tr>
<tr>
<td>NAP9022018</td>
<td>05 05 30.7855</td>
<td>+52 50 11.67</td>
</tr>
</tbody>
</table>

Table 2-7: Mode: Accum BOT Objects

Exposure 3:
Instrument/Detector: COS/FUV
Mode: ACQ/PEAKD
Target: G-191-B2B

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>NAP9022018</td>
<td>05 05 30.7855</td>
<td>+52 50 11.67</td>
</tr>
</tbody>
</table>

Table 2-8: Mode: ACQ/SEARCH BOT Objects

Table 2-9: Mode: ACQ/PEAKD BOT Objects
Figure 2-1: Exposure 1 ACCUM (baseline) Aladin View
Figure 2-2: Exposure 2 ACQ/SEARCH Aladin View
2.2.4 Parallel

This proposal will check the BOT Search Field for a parallel exposure. The prime exposure uses COS/NUV, and the parallel exposure uses NIC2. The target is G-191-B2. For this test, we are just concerned with which objects are found in the search for the parallel exposure (i.e. the details of the objects, such as spectral type and count rates, are not relevant). The following tables list the objects that should be found.
Exposure 2 (Parallel):
Instrument/Detector: NIC2
Target: G-191-B2B

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
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<td>05 06</td>
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<td>05 06</td>
<td>29.5807</td>
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<td>NAP9015763</td>
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<td>NAP9015935</td>
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<td>NAP9016063</td>
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<td>05 06</td>
<td>21.4618</td>
</tr>
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</table>

Table 2-10: Parallel Exposure BOT Objects

2.2.5 COS Dual Aperture

This proposal will test the BOT Search Field using the COS Dual Aperture Adjustment. The proposal contains two exposures, one using COS/NUV, and one using COS/FUV. For this test, we are just concerned with which objects are found in the search (i.e. the details of the objects, such as spectral type and count rates, are not relevant). The following tables list the objects that should be found.

Exposure 1:
Instrument/Detector: COS/NUV
Target: G-191-B2B

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
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<td>NAP9000385</td>
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<td>NAP9000387</td>
<td>05 05</td>
<td>30.6061</td>
</tr>
<tr>
<td>NAP9021714</td>
<td>05 05</td>
<td>31.2708</td>
</tr>
<tr>
<td>NAP9021982</td>
<td>05 05</td>
<td>29.8389</td>
</tr>
<tr>
<td>NAP9021983</td>
<td>05 05</td>
<td>30.6445</td>
</tr>
<tr>
<td>NAP9021984</td>
<td>05 05</td>
<td>30.0677</td>
</tr>
<tr>
<td>NAP9022018</td>
<td>05 05</td>
<td>30.7855</td>
</tr>
</tbody>
</table>

Table 2-11: COS/NUV BOT Objects
Exposure 2:
*Instrument/Detector: COS/FUV*
*Target: G-191-B2B*

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<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
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<tr>
<td>NAP9000387</td>
<td>05 05 30.6061</td>
<td>+52 49 51.92</td>
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<tr>
<td>NAP9021714</td>
<td>05 05 31.2708</td>
<td>+52 49 36.11</td>
</tr>
<tr>
<td>NAP9021982</td>
<td>05 05 29.8389</td>
<td>+52 49 48.72</td>
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<tr>
<td>NAP9021983</td>
<td>05 05 30.6445</td>
<td>+52 50 3.22</td>
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<tr>
<td>NAP9021984</td>
<td>05 05 30.0677</td>
<td>+52 49 43.52</td>
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<td>NAP9022018</td>
<td>05 05 30.7855</td>
<td>+52 50 11.67</td>
</tr>
</tbody>
</table>

Table 2-12: COS/FUV BOT Objects

3.0 Catalog Selection and Retrieval

The following section will describe the proposals to test that BOT uses the catalogs correctly in order to retrieve the BOT results.

3.1 Error Checking

This section will test that the tool alerts the user to errors while running the BOT.

3.1.1 No Stars in Field

This proposal will test that the BOT alerts the user when it finds no stars in the BOT search field. The proposal uses the target Messier-031 and contains one exposure using the COS/FUV detector. When the BOT runs, a pop-up appears with a warning that no stars were found (see Figure 3-1). In this example, BOT found no stars because the region is so crowded that the GSC2 could not differentiate objects (see Figure 3-2). This message will also appear when the region is blank.

Figure 3-1: Warning Message for No Stars
3.1.2  WFC3 IR with no 2MASS uses GSC2

This proposal will test that both 2MASS and GSC2 catalogs are used to retrieve information for the BOT. The proposal contains two fixed targets and one exposure for each target. Both exposures use the WFC3/IR detector.
3.0 Catalog Selection & Retrieval

**Exposure 1 (GSC2):**

*Instrument/Detector: WFC3/IR*

*Target: Target 1 (RA: 23 59 52.0400 Dec: -00 00 45.30)*

Target 1 has no 2MASS data. The table below lists the objects found by the BOT, all of which are retrieved from the GSC2 catalog.

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
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<th>Catalog</th>
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<tbody>
<tr>
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<td>+00 00.696</td>
<td>GSC2</td>
</tr>
<tr>
<td>N000000205</td>
<td>23 59.528516</td>
<td>+00 00.1643</td>
<td>GSC2</td>
</tr>
<tr>
<td>N000000225</td>
<td>23 59.552026</td>
<td>+00 00.2868</td>
<td>GSC2</td>
</tr>
<tr>
<td>N000000251</td>
<td>23 59.532764</td>
<td>+00 00.4291</td>
<td>GSC2</td>
</tr>
<tr>
<td>SB28004832</td>
<td>23 59.495410</td>
<td>-00 01.5315</td>
<td>GSC2</td>
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<tr>
<td>SB28005007</td>
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<td>GSC2</td>
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<td>23 59.563232</td>
<td>-00 01.576</td>
<td>GSC2</td>
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</tbody>
</table>

Table 3-1: COS/FUV BOT Objects

**Exposure 2 (2MASS):**

*Instrument/Detector: WFC3/IR*

*Target: Target 2 (RA: 12 34 56.7000 Dec: +12 34 56.70)*

Target 2 has 2MASS data. The table below lists the objects found by the BOT, all of which are retrieved from the 2MASS catalog.

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
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<th>Catalog</th>
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<td>+12 36.820</td>
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<td>12 34.552024</td>
<td>+12 35.920</td>
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<td>12 34.556944</td>
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<td>2MASS</td>
</tr>
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<td>12345617+1234297</td>
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<td>2MASS</td>
</tr>
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<td>12345810+1233325</td>
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<tr>
<td>12350202+1234231</td>
<td>12 35.20220</td>
<td>+12 34.2319</td>
<td>2MASS</td>
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</table>

Table 3-2: COS/FUV BOT Objects

4.0 Convert to $V$ and $B – V$

The following proposals will test the BOT’s use of $V$ and $B – V$.

4.1 Bright Stars have $V$ and $B – V$ in GSC2

This proposal will test that BOT correctly retrieves $V$ and $B – V$ values from the GSC2 catalog, and that it correctly computes $V$ and $B – V$ when the values are not specified in the catalog. This proposal contains two targets.
**Exposure 1 (Bright Target):**

**Instrument/Detector:** STIS/FUV-MAMA  
**Target:** MIRA

The figure below shows the BOT Details Dialogue where the object SOF2000125 has $V$ and $B–V$ specified in the GSC2 catalog for the bright target, MIRA.

![BOT Details Dialogue Box](image)

**Exposure 2 (Faint Target):**

**Instrument/Detector:** WFC3/UVIS  
**Target:** BOT-TARGET ($F=13.8$, $J=15$, $V=12.01$, $B–V=0$)

This exposure uses a BOT target where the $F$, $J$, $V$, & $B–V$ values are manually specified. Since $V=12.01$, the target is too faint to have $V$ and $B–V$ specified in the GSC2 catalog. BOT will calculate the values (see Figure 4-2). The calculated values are confirmed below.

\[
V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3 \\
V = 13.83 + 0.44 \times 12 - 0.03 \times 1.2^2 + 0.02 \times 1.2^3 \\
V = 13.83 + 0.528 - 0.03 \times 1.44 + 0.02 \times 1.728 \\
V = 14.358 - 0.0432 + 0.03456 \\
V = 14.34936
\]
4.0 Convert to $B$ and $B-V$

\[ B - V = 0.158 + 0.665 \times (J - F) \]
\[ B - V = 0.158 + 0.665 \times (0 - 0) \]
\[ B - V = 0.158 + 0 \]
\[ B - V = 0.158 \]

Figure 4-2: Faint Target Using F and J to Calculate $V$ and $B-V$ – BOT Details Dialogue Box

4.2 Detector Specific Adjustments

4.2.1 $B-V \leq +0.1$

For UV detectors, there are two checks done for each star, a local and a global. The local looks at the brightest pixel, where the global looks at the total counts from the object. This proposal will test that for UV detectors, objects with a $B-V$ value less than (bluer than) +0.1 are classified as 05V stars. For non-UV detectors, the objects will remain in their normal classification. This proposal contains two exposures, one using a UV Detector and one using a non-UV detector. Each exposure is using a BOT target where $B-V$ is less than +0.1.

**Exposure 1 (UV Detector):**

*Instrument/Detector:* STIS/FUV-MAMA

*Target:* BOT-TARGET ($F=18, J=17.9$)

F and J are used to specify the $B-V < +0.1$ by the following calculation:

\[ B - V = 0.158 + 0.665 \times (J - F) \]
\[ B - V = 0.158 + 0.665 \times (-0.1) \]
\[ B - V = 0.158 + (-0.665) \]
\[ B - V = 0.0915 < +0.1 \]
4.0 Convert to $B$ and $B-V$

For UV detectors, when $B-V < +0.1$, the object is classified as an O5V star (see Figure 4-3).

For non-UV detectors, when $B-V < +0.1$, the object is classified normally. In Figure 4-4, the object is classified as an A1V star.

4.2.2 $V_{\text{crit}}$

This proposal will test the $V_{\text{crit}}$ for a specific UV detector. The proposal will confirm that an object brighter than the $V_{\text{crit}}$ ($< V_{\text{crit}}$) is classified as O5V, and an object fainter than
$V_{\text{crit}} > V_{\text{crit}}$) is classified normally. It will also confirm for a non-UV detector, both objects are classified normally. Two BOT targets are used where $V$ is above and below $V_{\text{crit}}$. There are a total of four exposures, one for each target for each detector.

**Exposure 1 ($V < V_{\text{crit}}$):**

*Instrument/Detector:* ACS/SBC
*Target:* BOT-TARGET ($F=16, J=17.29$)
*ACS/SBC $V_{\text{crit}}$: 16.6

$F$ and $J$ are specified in the BOT-TARGET since $V$ and $B-V$ are ignored for stars fainter than $V=12$. The following calculation confirms the $F$ and $J$ values where $V < V_{\text{crit}}$.

\[
V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3
\]
\[
V = 16 + 0.03 + 0.44 \times (17.29 - 16) - 0.03 \times (17.29 - 16)^2 + 0.02 \times (17.29 - 16)^3
\]
\[
V = 16.03 + 0.44 \times 1.29 - 0.03 \times 1.29^2 + 0.02 \times 1.29^3
\]
\[
V = 16.03 + 0.5676 - 0.03 \times 1.6641 + 0.02 \times 2.146689
\]
\[
V = 16.5976 - 0.049923 + 0.04293378
\]
\[
V = 16.59061078
\]

$V \approx 16.59 < V_{\text{crit}} = 16.6$

Figure 4-5 confirms that for UV detectors, the BOT classifies objects brighter than $V_{\text{crit}}$ as O5V.

**Exposure 2 ($V > V_{\text{crit}}$):**

*Instrument/Detector:* ACS/SBC
*Target:* BOT-TARGET ($F=16, J=17.33$)
*ACS/SBC $V_{\text{crit}}$: 16.6
$F$ and $J$ are specified in the BOT-TARGET since $V$ and $B-V$ are ignored for stars fainter than $V=12$. The following calculation confirms the $F$ and $J$ values where $V < V_{\text{crit}}$.

\[
V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3
\]

\[
V = 16 + 0.03 + 0.44 \times (17.33 - 16) - 0.03 \times (17.33 - 16)^2 + 0.02 \times (17.33 - 16)^3
\]

\[
V = 16.03 + 0.44 \times 1.33 - 0.03 \times 1.33^2 + 0.02 \times 1.33^3
\]

\[
V = 16.03 + 0.5852 - 0.03 \times 1.7689 + 0.02 \times 2.352637
\]

\[
V = 16.6152 - 0.053067 + 0.04705274
\]

\[
V = 16.6918574
\]

\[
V \approx 16.61 > V_{\text{crit}} = 16.6
\]

Figure 4-6 confirms that for UV detectors, the BOT classifies objects fainter than $V_{\text{crit}}$ normally.

**Exposure 3 (Non-UV Detector):**

**Instrument/Detector:** NIC2

**Target:** BOT-TARGET ($F=16$, $J=17.29$)

See calculation for $V$ in Exposure 1.

\[
V \approx 16.59 < V_{\text{crit}} = 16.6
\]

Figure 4-7 confirms that for non-UV detectors, the BOT classifies the object normally.
**Exposure 4 (Non-UV Detector):**

*Instrument/Detector: NIC2*

*Target: BOT-TARGET (F=16, J=17.33)*

See calculation for $V$ in Exposure 3.

$$V \approx 16.59 < V_{crit} = 16.6$$

Figure 4-8 confirms that for non-UV detectors, the BOT classifies the object normally.
4.2.3 Only F or Only J

This proposal will test the BOT’s conversion to \( V \) and \( B-V \) when only \( F \) or only \( J \) is specified. Four BOT targets are used, two where only \( F \) is specified and two where only \( J \) is specified. There are four exposures, one for each target.

For both STIS-MAMA and COS detectors, for objects where no \( J \) is specified or no \( F \) is specified, the BOT assumes the object is an O5V star where \( J-F = -0.42 \), and processes normally. If the object does not trigger an alert, BOT will list the \( F \) or \( J \), \( V \), spectral type (O5V), count rates, and status. If the object does trigger an alert, BOT will list the \( F \) or \( J \), spectral type as “no color info,” and reason as “unknown.”

**Exposure 1 (Only F):**

*Instrument/Detector: STIS/FUV-MAMA*
*Target: BOT-TARGET (F=10)*

The following calculations are used to determine \( V \) and \( B-V \):

\[
\begin{align*}
J - F &= -0.42 \\
J - 10 &= -0.42 \\
J &= 9.58 \\
V &= F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3 \\
V &= 10 + 0.03 + 0.44 \times (-0.42) - 0.03 \times (-0.42)^2 + 0.02 \times (-0.42)^3 \\
V &= 10.03 + (-0.1848) - 0.03 \times 0.1764 + 0.02 \times (-0.074088) \\
V &= 9.8452 - 0.005292 - 0.00148176 \\
V &= 9.83842624 \\
B - V &= 0.158 + 0.665 \times (-0.42) \\
B - V &= 0.158 + (-0.2793) \\
B - V &= -0.1213
\end{align*}
\]

See Figure 4-9 below where no alert has been triggered so BOT lists \( F \), spectral type, count rates, and status.
4.0 Convert to $B$ and $B-V$

**Exposure 2 (Only $F$):**

*Instrument/Detector*: STIS/NUV-MAMA  
*Target*: BOT-TARGET ($F=2$)

The following calculations are used to determine $V$ and $B-V$:

\[
J - F = -0.42 \\
J - 2 = -0.42 \\
J = 1.58 \\
V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3 \\
V = 2 + 0.03 + 0.44 \times (-0.42) - 0.03 \times (-0.42)^2 + 0.02 \times (-0.42)^3 \\
V = 2.03 + (-0.1848) - 0.03 \times 0.1764 + 0.02 \times (-0.074088) \\
V = 1.8452 - 0.005292 - 0.00148176 \\
V = 1.83842624 \\
B - V = 0.158 + 0.665 \times (-0.42) \\
B - V = 0.158 + (-0.2793) \\
B - V = -0.1213
\]

See Figure 4-10 below where an alert has been triggered so BOT lists $F$, “no color info,” and reason as “unknown.”
4.0 Convert to $B$ and $B-V$

**Figure 4-10:** Only $F$, Object Unknown

**Exposure 3 (Only J):**
- **Instrument/Detector:** COS/FUV
- **Target:** BOT-TARGET (J=10)

The following calculations are used to determine $V$ and $B-V$:

\[
J - F = -0.42 \\
10 - F = -0.42 \\
F = 10.42 
\]

\[
V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3 \\
V = 10.42 + 0.03 + 0.44 \times (-0.42) - 0.03 \times (-0.42)^2 + 0.02 \times (-0.42)^3 \\
V = 10.45 + (-0.1848) - 0.03 \times 0.1764 + 0.02 \times (-0.074088) \\
V = 10.26252 - 0.005292 - 0.00148176 \\
V = 10.25842624 \\
B - V = 0.158 + 0.665 \times (-0.42) \\
B - V = 0.158 + (-0.2793) \\
B - V = -0.1213 
\]

See Figure 4-11 below where no alert has been triggered so BOT lists $J$, spectral type, count rates, and status.
The following calculations are used to determine $V$ and $B-V$:

$$J - F = -0.42$$
$$2 - F = -0.42$$

$$F = 2.42$$

$$V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3$$

$$V = 2.42 + 0.03 + 0.44 \times (-0.42) - 0.03 \times (-0.42)^2 + 0.02 \times (-0.42)^3$$

$$V = 2.45 + (-0.1848) - 0.03 \times 0.1764 + 0.02 \times (-0.074088)$$

$$V = 2.26252 - 0.005292 - 0.00148176$$

$$V = 2.25842624$$

$$B - V = 0.158 + 0.665 \times (-0.42)$$

$$B - V = 0.158 + (-0.2793)$$

$$B - V = -0.1213$$

See Figure 4-12 below where an alert has been triggered so BOT lists $J$, “unknown,” and reason as “unknown.”
4.2.4 Large Error on $F$ and $J$

This proposal will test how $V$ and $B-V$ are calculated when there exists a large (>0.28) error on $F$ and $J$. The proposal contains two BOT targets. The first target specifies $F$ and $J$. The second specifies $F$ and $J$, and a large error for both parameters.

**Exposure 1 (No Error, Non-UV):**

- **Instrument/Detector:** ACS/WFC
- **Target:** BOT-TARGET ($F=15$, $J=15$)

The following calculations confirm $B-V$:

\[
B - V = 0.158 + 0.665 \times (J - F)
\]
\[
B - V = 0.158 + 0.665 \times (15 - 15)
\]
\[
B - V = 0.158 + 0.665 \times (0)
\]
\[
B - V = 0.158 + 0
\]

\[
B - V = 0.158
\]

**Spectral Type:** A5

BOT displays A5 as the spectral type in Figure 4-13.
The tool will adjust the color by the difference between the nominal error and the actual error by making the color bluer by \((\text{Error} – 0.28m)\). The \(\text{Error}\) is calculated by taking the square root of the sum of the squares of the \(F\) and \(J\) errors.

The following calculations confirm \(B–V\) with the errors on \(F\) and \(J\):

\[
B – V = 0.158 + 0.665 \times (J – F)
\]
\[
B – V = 0.158 + 0.665 \times (15 – 15)
\]
\[
B – V = 0.158 + 0.665 \times (0)
\]
\[
B – V = 0.158 + 0
\]

\[
B – V = 0.158
\]

\[
\text{ERROR} = \sqrt{F_{\text{ERROR}}^2 + J_{\text{ERROR}}^2}
\]
\[
\text{ERROR} = \sqrt{0.5^2 + 0.5^2}
\]
\[
\text{ERROR} = \sqrt{0.25 + 0.25}
\]
\[
\text{ERROR} = \sqrt{0.5}
\]

\[
\text{ERROR} \approx 0.707
\]
$B - V = 0.158 - (ERROR - 0.28)$
$B - V = 0.158 - (0.707 - 0.28)$
$B - V = 0.158 - 0.427$

$B - V = 0.269$

**Spectral Type: O5**

BOT displays O5 as the spectral type in Figure 4-14.

**Figure 4-14: Error, Non-UV Detector; Spectral Type O5 – BOT Details Dialogue Box**

**Exposure 3 (No Error, UV):**

**Instrument/Detector:** STIS/FUV-MAMA

**Target:** BOT-TARGET (F=15, J=15)

*See Exposure 1 for B-V calculation.*

$B - V = 0.158$

**Spectral Type: A5**

BOT displays A5 as the spectral type in Figure 4-15.
4.0 Convert to $B$ and $B-V$

**Exposure 4 (Error, UV):**

**Instrument/Detector:** STIS/FUV-MAMA  
**Target:** BOT-TARGET ($F=15, J=15, F_{ERROR}=0.5, J_{ERROR}=0.5$)

*See Exposure 2 for $B-V$ calculation.*

$$B - V = -0.269$$

**Spectral Type: O5**

BOT displays O5 as the spectral type in Figure 4-16.

---

4.2.5 Ignore ‘Not a Star’ Flag

This proposal will test that the GSC2 ‘Not a Star’ Flag is ignored for all faint objects when using a UV detector, which is implemented in order to account for objects that have
poor S/N in the PSF. These objects are relevant for bright object checking, so they are included in the BOT results appearing as “unknown” objects when the flag is ignored.

The proposal contains three exposures, one UV detector exposure with a target whose $V$ value is fainter than the limit for accepting the ‘Not a Star’ flag, one UV detector exposure with a target whose $V$ value is brighter than the limit for accepting the ‘Not a Star’ flag, and one non-UV detector exposure with a target whose $V$ value is brighter than the limit for accepting the ‘Not a Star’ flag. In order to enable the ‘Not a Star’ flag, the parameter Type=“?” is used when defining the BOT targets.

**Exposure 1 (UV Detector):**

**Instrument/Detector:** STIS/NUV-MAMA  
**Target:** BOT-TARGET (F=16, J=17.12)  
**Not a Star Flag Set:** $V>16.5$

The following calculations confirm $V>16.5$ where the ‘Not a Star’ flag is set but ignored:

\[
V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3 \\
V = 16 + 0.03 + 0.44 \times (17.12 - 16) - 0.03 \times (17.12 - 16)^2 + 0.02 \times (17.12 - 16)^3 \\
V = 16.03 + 0.44 \times 1.12 - 0.03 \times (1.12)^2 + 0.02 \times (1.12)^3 \\
V = 16.03 + 0.4928 - 0.03 \times 1.2544 + 0.02 \times 1.404928 \\
V = 16.5228 - 0.037632 + 0.02809856
\]

$V \approx 16.513 > 16.5$

The BOT displays the objects where the ‘Not a Star’ flag is set but ignored in Figure 4-17.

**Figure 4-17:** STIS/NUV-MAMA; $V > 16.5$; Not a Star Flag Ignored
**Exposure 2 (UV Detector):**

*Instrument/Detector:* STIS/FUV-MAMA  
*Target:* BOT-TARGET (F=15, J=16.7)  
*Not a Star Flag Set:* V>15.8

The following calculations confirm \( V < 15.8 \) where the ‘Not a Star’ flag is not ignored:

\[
V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3
\]

\[
V = 15 + 0.03 + 0.44 \times (116.7 - 15) - 0.03 \times (116.7 - 15)^2 + 0.02 \times (116.7 - 15)^3
\]

\[
V = 15.03 + 0.44 \times 1.7 - 0.03 \times (1.7)^2 + 0.02 \times (1.7)^3
\]

\[
V = 15.03 + 0.748 - 0.03 \times 2.89 + 0.02 \times 4.913
\]

\[
V = 15.778 - 0.0867 + 0.09826
\]

\[ V \approx 15.790 > 15.8 \]

The BOT displays the object type as ‘not a star’ because the ‘Not a Star’ flag is not ignored in Figure 4-18.

---

**Exposure 3 (Non-UV Detector):**

*Instrument/Detector:* STIS/CCD  
*Target:* BOT-TARGET (F=16, J=17.12)  
*Not a Star Flag Set:* V>16.5

For STIS, when both \( F \) & \( J \) are listed as parameters, the object is flagged as ‘Not a Star.’ The BOT details dialog lists \( V \), \( B-V \), spectral type = ‘not a star,’ and Reason = ‘unknown.’
See Calculation for $V$ in Exposure 1.

$V \approx 16.513 > 16.5$

The BOT displays the object type as ‘not a star’ because the ‘Not a Star’ flag is not ignored in Figure 4-19.

4.3 Error Checking

This section will test that BOT correctly handles illegal $V$ & $B-V$ values, as well as incomplete data.

4.3.1 Illegal $V$

This proposal will test that for any $V$ value brighter (less) than -2.0 or fainter (greater) than 24.0, the photometry is faulty and should not be used. These objects types will be listed as ‘unknown’ or ‘no color info’ and spectral elements will be listed as ‘unknown’ in the BOT details dialogue. This proposal will use four exposures with targets to test four cases of $V$ values, one slightly inside and outside each bound.

Exposure 1:

Instrument: NIC3

Target: BOT-TARGET ($V=-1.99, B-V=0$)

The $V$ value can be defined directly within the BOT-TARGET definition.

$$V = -1.99 > -2.0$$

The BOT does not consider the object as faulty since $V > -2.0$ (see Figure 4-20).
Exposure 2:

**Instrument: NIC3**

**Target: BOT-TARGET** (*V*= -2.01, *B–V*=0)

The *V* value can be defined directly within the BOT-TARGET definition.

\[ V = -2.01 < -2.0 \]

The BOT considers the object as faulty since *V* < -2.0 (see Figure 4-21).

Exposure 3:

**Instrument: NIC3**

**Target: BOT-TARGET** (*F*=23.96, *J*=23.97)
$F$ and $J$ values are used to define $V$ since $V$ and $B-V$ values are not in GSC2 for objects fainter than $V=12.0$ (See Bright Stars have $V$ and $B-V$ in GSC2).

$$V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3$$

$$V = 23.96 + 0.03 + 0.44 \times (23.97 - 23.96) - 0.03 \times (23.97 - 23.96)^2 + 0.02 \times (23.97 - 23.96)^3$$

$$V = 23.99 + 0.44 \times 0.01 - 0.03 \times (0.01)^2 + 0.02 \times (0.01)^3$$

$$V = 23.99 + 0.0044 - 0.03 \times 0.0001 + 0.02 \times 0.000001$$

$$V = 23.9944 - 0.000003 + 0.00000002$$

$V \approx 23.994 < 24.0$

The BOT does not consider the object as faulty since $V < 24.0$ (see Figure 4-22).

**Exposure 4:**

*Instrument:* NIC3  
*Target:* BOT-TARGET ($F=23.98$, $J=23.97$)

$F$ and $J$ values are used to define $V$ since $V$ and $B-V$ values are not in GSC2 for objects fainter than $V=12.0$ (See Bright Stars have $V$ and $B-V$ in GSC2).
4.0 Convert to \( B \) and \( B-V \)

\[
V = F + 0.03 + 0.44 \times (J - F) - 0.03 \times (J - F)^2 + 0.02 \times (J - F)^3
\]

\[
V = 23.98 + 0.03 + 0.44 \times (23.97 - 23.98) - 0.03 \times (23.97 - 23.98)^2 + 0.02 \times (23.97 - 23.98)^3
\]

\[
V = 24.01 + 0.44 \times (-0.01) - 0.03 \times (-0.01)^2 + 0.02 \times (-0.01)^3
\]

\[
V = 24.01 + 0.0044 - 0.03 \times 0.0001 + 0.02 \times 0.000001
\]

\[
V = 24.0056 - 0.000003 + (-0.000000002)
\]

\[V \approx 24.006 < 24.0\]

The BOT considers the object as faulty since \( V > 24.0 \) (see Figure 4-23).

![ BOT Details: NIC3 - Faint Bad (01.004) ]

<table>
<thead>
<tr>
<th>Concern</th>
<th>Aperture</th>
<th>OBJECT ID</th>
<th>RA</th>
<th>Dec</th>
<th>Catalog</th>
<th>J</th>
<th>H</th>
<th>K</th>
<th>Tgg</th>
<th>Jpg</th>
<th>V</th>
<th>B–V</th>
<th>Type</th>
<th>Signal</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td>NIC3</td>
<td>BOT-TARGET-0SC2-FANT-BAD</td>
<td>00 00 00.000</td>
<td>+00 00 00.00</td>
<td>00C2</td>
<td>--</td>
<td>--</td>
<td>23.97</td>
<td>--</td>
<td>--</td>
<td>V</td>
<td>B-V</td>
<td>no color info</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>

NOTE(s):

(1) Spectral types designated **NO** and **HOT** are assumed types due to incomplete Catalog information.
(2) Equivalents enclosed in [] are inferred from neighboring stars.
(3) WARNING: this tool does not check for ISISG PERSISTENCE caused by bright objects in the field of view.

Figure 4-23: \( V > 24.0 \) and listed as unknown

4.3.2 Illegal \( B-V \)

This proposal will test that for any \( B-V \) value bluer (less) than -0.5 or redder (greater) than 3.0, the photometry is faulty and should not be used. These object types will be listed as ‘no color info’ and spectral elements will be listed as ‘unknown’ in the BOT details dialog. This proposal will use four exposures with targets to test four cases of \( B-V \) values, one slightly inside and outside each bound.

**Exposure 1:**

**Instrument:** ACS/SBC

**Target:** BOT-TARGET (\( F=15.0, J=19.27 \))

\( F \) and \( J \) values are used to define \( B-V \) since \( V \) and \( B-V \) values are not in GSC2 for objects fainter than \( V=12.0 \) (See Bright Stars have \( V \) and \( B-V \) in GSC2).
4.0 Convert to $B$ and $B-V$

\[
B - V = 0.158 + 0.665 \times (J - F)
\]

\[
B - V = 0.158 + 0.665 \times (19.27 - 15.0)
\]

\[
B - V = 0.158 + 0.665 \times (4.27)
\]

\[
B - V = 0.158 + 2.83955
\]

\[
B - V \approx 2.998 < 3.0
\]

The BOT does not consider the object as faulty since $B - V < 3.0$ (see Figure 4-24).

**Figure 4-24:** $B - V < 3.0$

**Exposure 2:**

**Instrument:** ACS/SBC  
**Target:** BOT-TARGET ($F=15.0$, $J=19.29$)

$F$ and $J$ values are used to define $B-V$ since $V$ and $B-V$ values are not in GSC2 for objects fainter than $V=12.0$ (See Bright Stars have $V$ and $B-V$ in GSC2).

\[
B - V = 0.158 + 0.665 \times (J - F)
\]

\[
B - V = 0.158 + 0.665 \times (19.29 - 15.0)
\]

\[
B - V = 0.158 + 0.665 \times (4.29)
\]

\[
B - V = 0.158 + 2.83285
\]

\[
B - V \approx 3.011 > 3.0
\]

The BOT considers the object as faulty since $B - V > 3.0$ (see Figure 4-25).
Exposure 3:
Instrument: ACS/SBC
Target: BOT-TARGET (F=15.0, J=14.02)

$F$ and $J$ values are used to define $B-V$ since $V$ and $B-V$ values are not in GSC2 for objects fainter than $V=12.0$ (See Bright Stars have $V$ and $B-V$ in GSC2).

\[
B-V = 0.158 + 0.665 \times (J - F) \\
B-V = 0.158 + 0.665 \times (14.02 - 15.0) \\
B-V = 0.158 + 0.665 \times (-0.98) \\
B-V = 0.158 + (-0.6517) \\
B-V \approx -0.494 > -0.5
\]

The BOT does not consider the object as faulty since $B-V > -0.5$ (see Figure 4-26).
**Exposure 4:**

**Instrument:** ACS/SBC  
**Target:** BOT-TARGET (F=15.0, J=14.0)

$F$ and $J$ values are used to define $B-V$ since $V$ and $B-V$ values are not in GSC2 for objects fainter than $V=12.0$ (See Bright Stars have $V$ and $B-V$ in GSC2).

\[
B - V = 0.158 + 0.665 \times (J - F) \\
B - V = 0.158 + 0.665 \times (14.0 - 15.0) \\
B - V = 0.158 + 0.665 \times (-1.0) \\
B - V = 0.158 + (-0.665) \\
\]

Thus, $B-V \approx -0.507 < -0.5$

The BOT considers the object as faulty since $B-V < -0.5$ (see Figure 4-27).

4.3.3 Incomplete Data

This proposal will test that BOT correctly handles incomplete data, i.e. if only $F$ is specified in the target. Since one case will suffice, the proposal contains one exposure with one target where only $F$ is specified. The BOT details dialog will display $F, V, B-V$ ($V$ and $B-V$ are shown only if present in the GSC2), the reason as "unknown," $F$ as GSC2 value, and spectral type as "unknown" (See Figure 4-28).

**Exposure 1:**

**Instrument:** ACS/WFC  
**Target:** BOT-TARGET (F=15.0)
5.0 Trigger Values

This proposal will test the trigger values for the local limit and the global limit. Two real targets are used for two exposures.

The global count rate limit for STIS/FUV-MAMA is 200,000 and the local count rate limit is 100. The saturation for the global count rate is 65,536 electrons.

**Exposure 1:**

**Instrument/Detector:** STIS/FUV-MAMA  
**Target:** G-191-B2B (RA: 05 05 28.0305 Dec: +52 49 8.52)

The object NAP9021544 in the BOT results exceeds the local limit:

7.8182E2 = 781.82 > 100 counts/second  
7.8182E5 = 781,820 > 65,536 electrons

The table below displays the object data taken from the VOT file.

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
<th>Signal</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAP9021544</td>
<td>05 05 28.6230</td>
<td>+52 49 16.96</td>
<td>7.8182E2 counts/second/pixel</td>
<td>Local Health and Safety (Exceeded)</td>
</tr>
<tr>
<td>NAP9021544</td>
<td>05 05 28.6230</td>
<td>+52 49 16.96</td>
<td>7.8182E5 counts</td>
<td>Saturation (Exceeded)</td>
</tr>
</tbody>
</table>

Table 5-1: VOT File Object Information, Local Limit Exceeded
Exposure 2:
Instrument/Detector: STIS/FUV-MAMA
Target: Messier 15

Object N2QO000908 exceeds the global limit:

\[2.2278 \times 10^5 = 222,780 > 200,000 \text{ counts/second}\]
\[7.1477 \times 10^4 = 71,477 > 65,536 \text{ electrons}\]

The table below displays the object data taken from the VOT file.

<table>
<thead>
<tr>
<th>Object ID</th>
<th>RA</th>
<th>Dec</th>
<th>Signal</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2Q0000908</td>
<td>21 30 8.4448</td>
<td>+12 16 14.47</td>
<td>2.227E5 counts/second</td>
<td>Global Health and Safety (Exceeded)</td>
</tr>
</tbody>
</table>

Table 5-2: VOT File Object Information, Global Limit Exceeded
Appendix A. Aladin Displays

1.0 Search Field

1.1 Detector Sizes

Figure 1-1: Detector Specific Sizes Aladin View
1.2 Adjustments

1.2.1 POS-TARG

Figure 1-2: POS TARG Adjustment Aladin View
1.2.2 PATTERN

Figure 1-3: Pattern Adjustment Aladin View
1.2.3 Parallel

Figure 1-4: Prime and Parallel Exposures in Aladin View
Figure 1-5: Parallel Exposure in Aladin View
1.2.4 COS Dual Aperture

Figure 1-6: COS/NUV Exposure in Aladin View
Figure 1-7: COS/FUV Exposure in Aladin View