ALMA Observing Tool Setup: A CSV Nuts-And-Bolts Guide To Scheduling Block Creation

Standard Interferometry Mode

Preamble

Purpose of this document: What this document is, and what it is not

The purpose of this document is not to provide full instructions on the general use of the ALMA Observing Tool (OT). The development team delivery includes several detailed documents on this, including a full user manual and a reference manual. Users intending to prepare full proposals or complex, high-level projects for ALMA should instead refer to those fine documents instead. The low-level, grisly details of parameters such as correlator dump time, etc. will normally be handled by the automatic Scheduling Block (SB) generation features of the OT.

The sole objective of this document is to provide functional instructions on how to prepare simple, fully-functional SBs from the ground up, based around the Standard Interferomentry observing mode, primarily for CSV purposes.

OT Versioning Note

These notes were created on the assumption that version R7.0 (the version currently deployed on the OSF STEs, as of February, 2010) is used. Some menu options, etc. will vary slightly from the UT7.0 version that was subsequently circulated for the purposes of the January/February 2010 OT user test. Given that it is expected that subsequent releases of the OT will use the newer menu structure, any such differences will be identified in the text below in red and alternate instructions provided.

The version you are currently running is indicated in several locations. It is shown in the top-right of the splash screen on startup, and usually at the top of the title bar of the window when creating a new project. The splash screen can also be viewed at any time by using the "Help / About" drop-down menu.

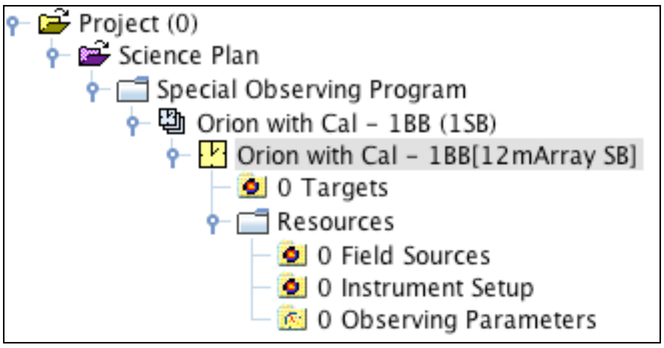
Various Useful things to know before beginning…

- In general, select the project component with details to be edited (e.g. Field Source, SB, Science Parameters, etc.) should first be selected in the "Project Structure" panel. This will then cause the contents of the "Editors" panel to be updated, showing all the details of that particular item
- In OT terminology, a "Target" is not simply the astronomical object to be observed: it is an observational target or objective, and incorporates a specification of the type of observation, the astronomical object to be observed, and the instrumental setup to be used (including exposure times, etc.).

- As of OT version 7.0, Observing Groups must always be used in SBs.
- If using the UT 7.0 version of the OT for the first time, go to the "Options" drop-down menu, select "Advanced", and ensure that the "Enable Advanced User Features" option is enabled. If not, enable it and click the "Apply" button. This just ensures that all the same advanced features as for R7.0 are available.
- It is probably not necessary to keep the "Contextual Help" panel at the bottom open for these purposes. As with all OT panels, this can be hidden by clicking on the small downward-pointing arrow on the top-left of its border.
- For SBs like the ones created here, the "Indefinite Repeat" option (available under the Scheduling Block, "yellow clock" entry) should always be checked, or the SB will disappear from the Scheduling list after it has been executed…
- Although the positions of the calibrator objects are good, the fluxes provided by the OT should not be trusted, as many calibrator sources are intrinsically variable. The current fluxes of any calibrators should therefore be checked against more recent catalogues.

Initial Project Creation and Structure

1. **Create a New Project:** Launch the OT. It should come up with a new blank Proposal. Make sure that the "Program" tab is selected in the "Project Structure" panel on the left-hand side.
2. **Add an ObsUnitSet:** In the "Project Structure" tab, right-click on the purple "Science Plan" folder, and select "Add ObsUnitSet". This should result in the insertion of a "Special Observing Program" folder inside the Science Plan, and a new "UnitSet (empty)" entry (with a white stacked clock icon) – this is the actual ObsUnitSet. Right-clicking on this allows it to be renamed to something more specific to the project (e.g. "Orion with Cal – 1BB").
3. **Add a SchedBlock:** Right-click on the ObsUnitSet entry (in the "Project Structure" tab) and select "Add Scheduling Block". This should add a "SchedBlock" entry (with a yellow clock icon). This may also be re-named in the same way as for the ObsUnitSet. Right-click on this and choose "Expand All" to see it's full internal structure. This should show that the SB contains a set of (0) "Targets", and a "Resources" folder, which in turn contains a set of (0) "Field Sources", (0) "Instrument Setup"(s), and (0) "Observing Parameters". The Project Structure panel should look something very like the following:



An aside: as was briefly noted earlier, a "Target" in the OT is more than just the astronomical object towards which the telescope is to be pointed. For each target, it is necessary to include an association to one of each of the three resource types listed

(Field Source, Instrument Setup, Observing Parameters). The above is the basic underlying structure required for the specification of all SBs/ObsUnitSets.

4. **Save a local copy of the Project (do this periodically):** As with most content creation programs, it is usually wise to save a copy of one's progress periodically. From the "File" drop-down menu, select "Export to disk…" to save a copy of your work-in-progress OT Project to your local hard disk drive. Note: In UT7.0 and later versions, this is instead done by using the "File" drop-down menu and selecting the "Save Project / To File…" option instead.

The next step is to specify the details of the individual resources that will be needed for the Project.

Resource Creation: Field Sources

5. **Create a new Field Source entry:** Right-click on the "0 Field Sources" entry in the "Project Structure" panel and select "Add Field Source". This should add a new Field Source entry, and the parent "0 Field Sources" container entry label should have changed to "1 Field Source" to reflect the existence of the new Field Source.
6. **Specify a Field Source Object:** This is done in the "Editors" panel in the upper right of the OT. There are two ways to do this:

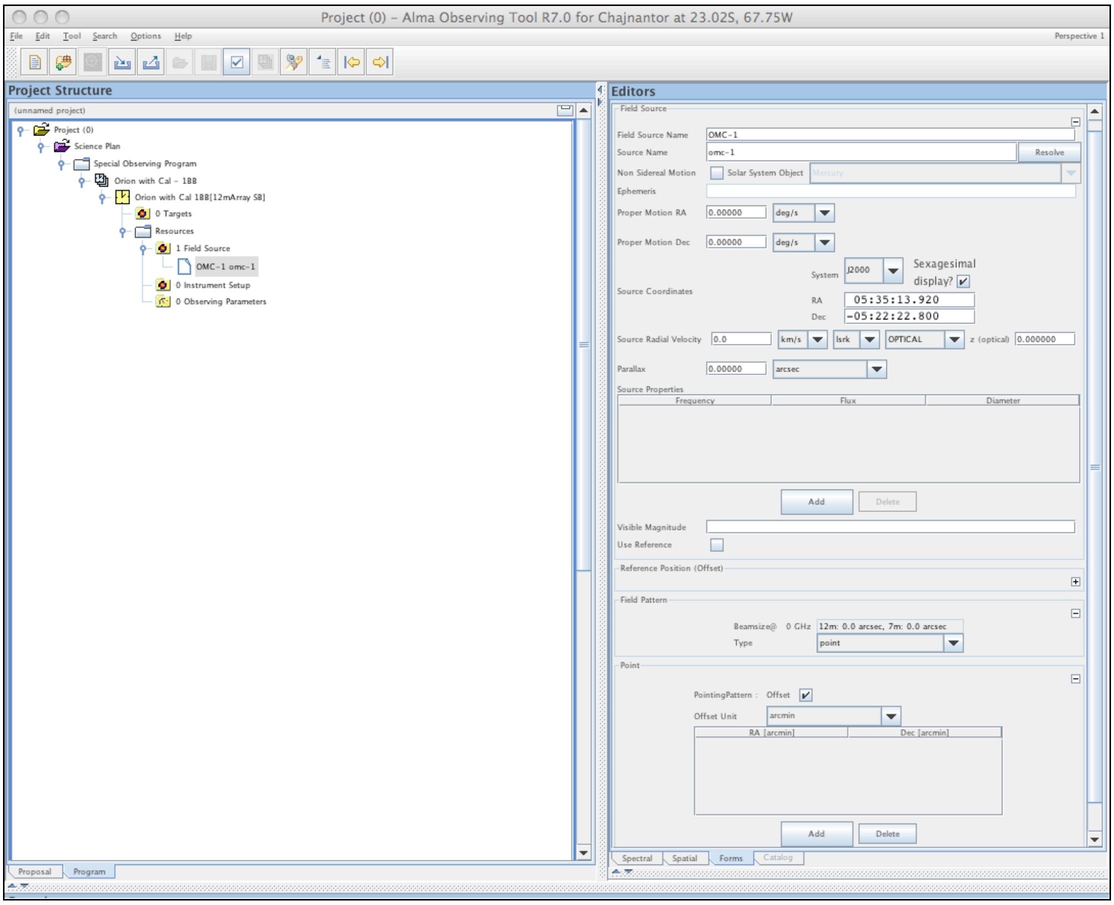
    - **Using the "Forms" tab of the "Editors" panel**

      - **Label the source:** Click on the "Field Source Name" data entry field, and enter a name for the object. This is just an label for the object, for easy reference by the Program creator and executor.
      - **Identify the source:** If the object has sidereal motion and a well-known, database-resolvable name, this can be entered in the "Source Name" field and the name will be checked against online object databases (e.g. SIMBAD). If the name is successfully resolved, then the OT will insert the position in R.A. and Dec.) in the appropriate lower fields. Be sure to check the positional information generated by the name resolution: some of the supplementary fields may end up with nonsensical numbers (e.g. the "Source Radial Velocity" is sometimes nonsensical for some quasars). If a resolvable name is not available for the object in question, it will need to be specified manually in the "Source Coordinates" and other fields. If the source has non-sidereal behaviour, check the "Non Sidereal Motion box", and this will cause the form to change to allow the selection of Solar System objects from a drop-down menu. For the current purposes, it is probably not necessary to enter explicit "Source Properties".
      - **Set the Field Pattern:** Below the "Source Properties" specification, the Field Pattern may be specified. Note that the "Beamsize" settings will be automatically generated, based on the input for other fields. However, a "Field Pattern Type" still needs to be specified. Currently, the only supported options are "Point", "Rectangle" and "Cross". Selection of any one of these will result in the generation of an additional form immediately below, allowing the specifics of the field pattern to be set, such as any pointing offsets to be applied, the size

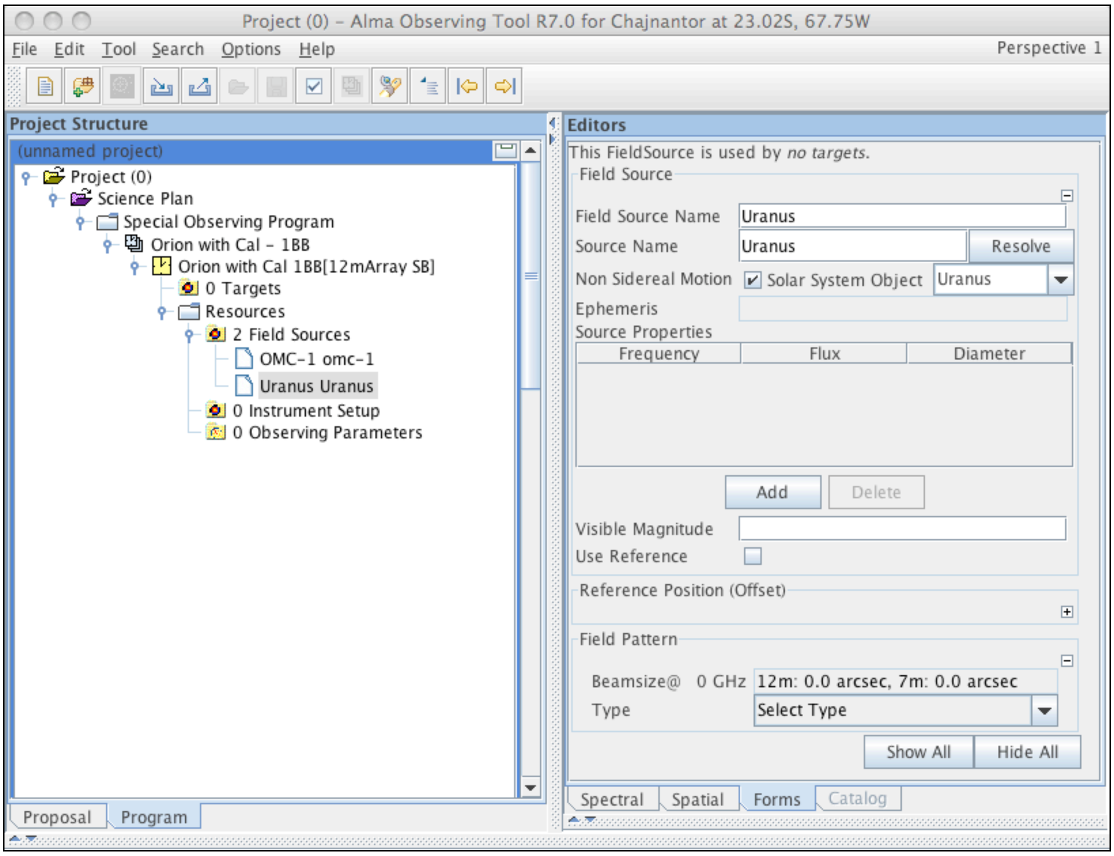
and sampling of the rectangle chosen, the orientation of the cross, etc. The rectangle option may in turn be used to generate a rectangular mosaic of pointings. For more details of all the possibilities available here, please see the OT User and Reference Manuals.

- **Using the "Spatial" tab of the "Editors" panel:** All of the above notes in (a) for the "Forms" tab apply equally to the right-hand side of the "Editors" panel. In addition, a graphical display panel of the target field may be displayed on the top left-hand side of the "Spatial" panel. The various settings for the image query and display parameters are towards the lower-left of this panel: the online image database to be queried, the field-of-view and frequency used, etc. may all be set up here. The image display will also allow the overplotting of the Field Pattern pointings. This is particularly useful for (e.g.) mosaics. For more details of all the possibilities available here, please see the OT User and Reference Manuals.

The following figure shows an example of a simple sidereal motion source, with its position obtained via automatic name resolution:



Using the above procedure to also add a non-sidereal object (Uranus) gives:



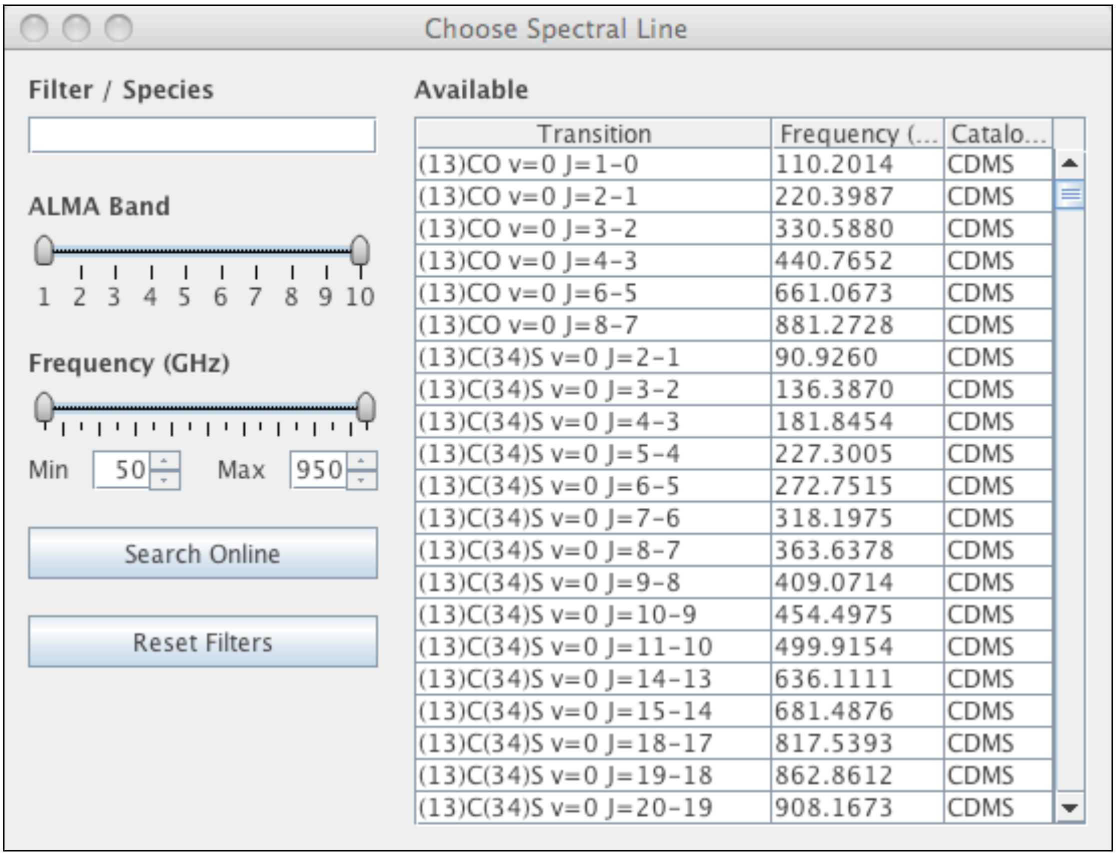
Note that the ultimate intention here is that Uranus will later be identified for use as an amplitude calibrator source, so there is no need to specify a Field Pattern at this stage.

Resource Creation: Instrument Setup (Spectral Spec)

This is probably the most complicated part of the whole process (so it's all downhill after this!). For the purposes of retaining some (relative) simplicity in this document, the creation of an SB with a single BaseBand Configuration will be described here. For a good example of a setup involving four BaseBand Configurations, see Figure 10.3 in Section 10.2.5 of the ALMA OT User Manual.

7. **Create a New Instrument Setup Resource (Spectral Spec in this case):** Right-click on the "0 Instrument Setup" entry in the "Project Structure" panel and select "Add Spectral Spec with BL Corr Config". This will update the selected entry to read "1 Instrument Setup", and create a single Instrument Setup resource, initially labelled "SpectralSpec[12mArray SB] (0BBCs)". As usual, right'clicking on this entry (or using the first data entry field in the "Editors" panel) allows the label for this Spectral Spec to be changed to a more meaningful, user-chosen label (in the example being developed in this document, the Spectral Spec will be renamed to "Single BB TDM", to denote that a single baseband will be specified for TDM mode).
8. **Select a Rest Frequency/Transition and Receiver Band (Spectral Spec pane):** Although it is perfectly possible to just enter the rest frequency information into the appropriate data entry fields in the "Forms" tab of the "Editors" panel, the OT also provides access to a spectral Line Catalogue (courtesy of "Splatalog"). To use

this, click on the “Line Catalogue” button. This produces a window as in the following figure:



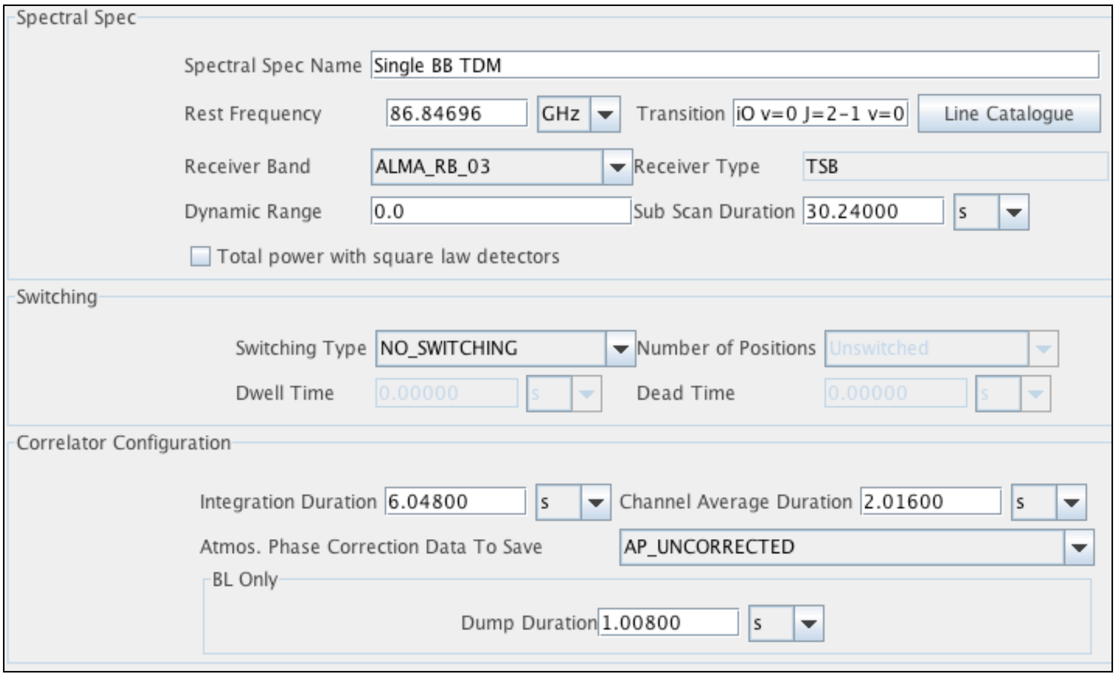
The various options on the left-hand side of the panel (“Filter/Species”, “ALMA Band”, “Frequency (GHz)”) allow the user to filter on the displayed list of “Available” lines on the right-hand side and hence more easily select the specific line to be observed. The “Search Online” button allows the user to access additional lists of lines not currently included in the flat field line list distributed as part of the OT. When the desired line has been identified, double-clicking on its entry in the list will automatically insert the appropriate information into the main OT Spectral Spec form, and an ALMA Receiver Band will also be suggested in the appropriate field.

In the worked example being developed here, the “SiO v=0 J=2-1 v=0” line at 86.84696 GHz will be chosen.

The “Dynamic Range” may be left with a default value of 0.0 for this case. The contents of the “Sub Scan Duration” will be discussed below (step 10).

9. **Switching:** The switching type may be left as “NO_SWITCHING” for now. This will result in the rest of this pane being greyed out.
10. **Correlator Configuration and Sub Scan Duration:** At the time of writing Atmospheric Phase correction is not being performed. The field “Atmos. Phase Correction Data To Save” should therefore always be set to “AP_UNCORRECTED”. In Baseline Correlator mode, it is necessary to set the correlator “Dump Duration” time. This should be set to a multiple of 16 milliseconds (0.0016 s); in practice, this should normally be ≥ 48 or 96 ms. For

this worked example, a value of 1.00800 s will be adopted. The “Channel Average Duration” is the period of time over which the channel average region will be averaged, and must therefore always be an integer multiple of the “Dump Duration.” For the presented example, a “Channel Average Duration” of 2.01600 s will therefore be adopted. The “Integration Duration” must also always be an integer multiple of the “Channel Average Duration”, so for the presented example, a value of 6.04800 s will be adopted. The “Sub Scan Duration” field entry (in the Spectral Spec pane) must also always be an integer multiple of the “Integration Duration” field entry: for the presented example, a value of 30.24000 s will be adopted. At this point, the first three panes of the “Forms” tab of the Spectral Spec for the presented example are as shown below:



11. **Create one or more Baseband Configurations:** The next step is to set up the baseband configuration(s). For the purposes of simplicity, only one baseband will be set up for the presented example. Click on the “Add Baseband” button. This will add an entry to the “BaseBand Configurations” table in the “Forms” tab of the “Editors” panel. By default, up to four of these may be added, but to retain simplicity in the presented example, just one will be set up.
12. **Set up the details of the BaseBand Configuration:** This can be done by either double-clicking on the appropriate entries in the table and typing in replacement values, or by entering the details in the approriately tabbed pane just below the BaseBand Configuration table. The second method will be described here:
    - If more than one BaseBand Configuration is being set up, ensure that the intended tab has been selected.
    - **Enter the “Desired Center Freq (Rest)”.** For the presented single-BaseBand Configuration example, just enter the frequency of the line to be that of the line to be observed. For the presented example (the SiO , this would be 86.8470 GHz.
    - **Set the “Accumulation Mode”:** For current purposes, this should be set to “NORMAL”.

- **Set the "Products & Sideband Separation":** For current purposes, this should be set to "CROSS_AND_AUTO & NONE".

13. **For each BaseBand Configuration, set up the Spectral Window(s)**:
    - **Add a Spectral Window:** Click on the "Add" button, just below the (currently empty) table of "Spectral Windows". This will add a (first) tabbed Spectral Window (SW) pane called "SW-1". Note that there must be a least one spectral window specified.
    - **Set the "Center Offset Frequency":** This can be left with the default value of 3000.00 MHz for the purposes of the presented example. This is the center frequency of the spectral window, between 2000 and 4000 MHz. This value is an offset into the 2GHz bandwidth of the baseband, and can only take discrete values, determined by the step size of the band, i.e. 2GHz / 2^{16} = 30.517578125 kHz.
    - **Set the "Polarization Products":** This should be chosen so as to (obviously) select the desired polarization products. For the presented example, "Polarization Products" will be set to "XX, YY".
    - **Set the "Nominal BW / # Channels":** These may be adjusted to suit the specific needs of the SB being created. Note that each of these two have drop-down menus that include entries in black, grey and grey-with-strikethrough. Choices in grey with or without strikethrough are invalid. Choices in grey without strikethrough in the "Nominal BW/ # Channels" fields will be valid and turn black when one of the valid choices is chosen for the other. Strikethrough indicates that the value is not available as a valid option against *any* of the choices of the other (note that availability also depends on the displayed settings of other, related parameters, including "Polarization Products", "Correlation Bits", "Oversampling", and "Quantization Correction").

      In summary: *If the "Nominal Bandwidth" entry is grey-with-strikethough, then none of the listed options for "# Channels" will be available in black (i.e. valid). Conversely, if the "# Channels" entry is grey-with-strikethough, then none of the listed options for "Nominal Bandwidth" will be available in black (i.e. valid).*

      For instance, for a setup along the lines of the presented example, a combination of a "Nominal Bandwidth" of 2000 MHz, "# Channels" of 128 and "Polarization Products" of "XX" would be identified as an invalid mode. Under these circumstances, the "# Channels" value of 128 is displayed as grey+strikethrough because there are no valid selectable options for "Nominal BW" that are available for the combination of "# Channels" setting of 128 together with a "Polarization Products" setting of "XX". However, the "Nominal BW" field value of 2000 MHz is only displayed in grey, because this quantity may be made valid by changing to one or more of the other "# Channels" options.

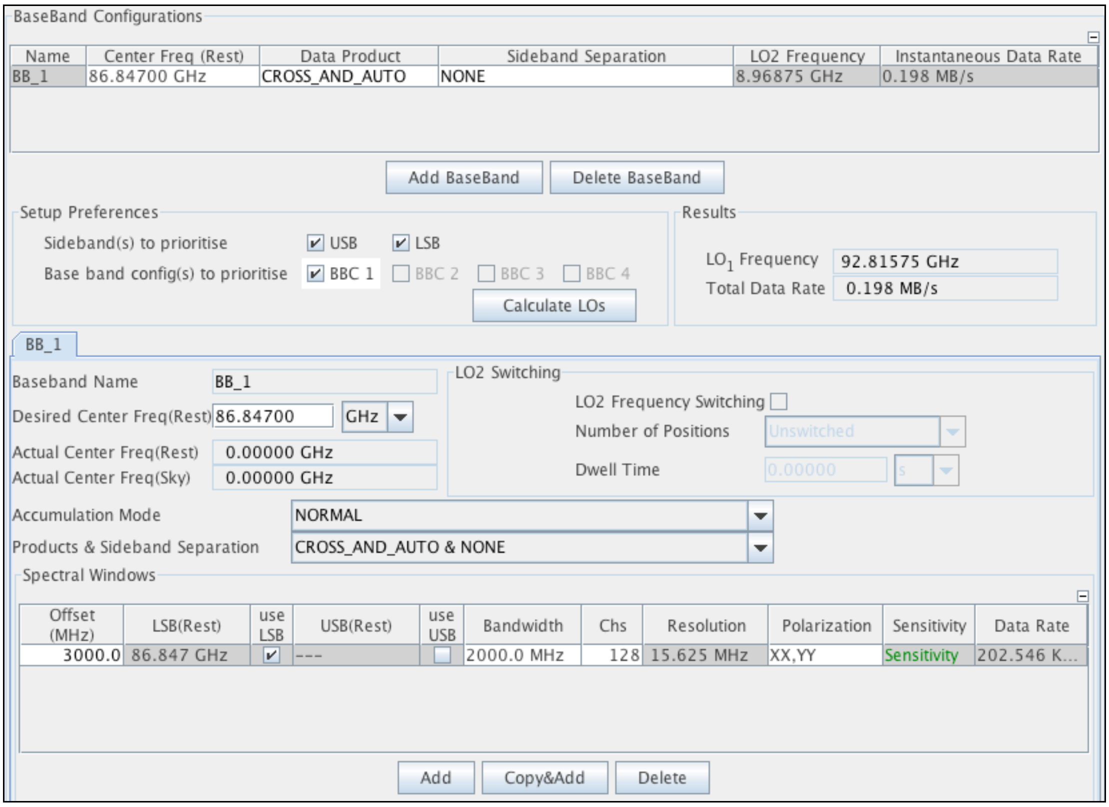
      An important general note on correlator modes: Only certain combinations of settings for "Polarization Products", "Nominal BW", "# Channels", "Correlation Bits", "Oversampling" and "Quantization Correction" are possible, due to hardware limitations on the correlator data rates. If, during the creation of a future SB, the reader values resolution more than polarizations, then the “Nominal BW / # Channels” values should probably be chosen first, with the “Polarization Products” option selected after that. Conversely, if the primary objective of the new SB to be created is the acquisition of polarization data, then “Polarization Products” should probably be set first in the OT, and the “Nominal BW / # Channels” set after that.

For the presented example, values of 2000 MHz and 128 channels will be used (in conjunction with the “XXYY” setting for the “Polarization Products” field as already indicated in the previous bullet point).

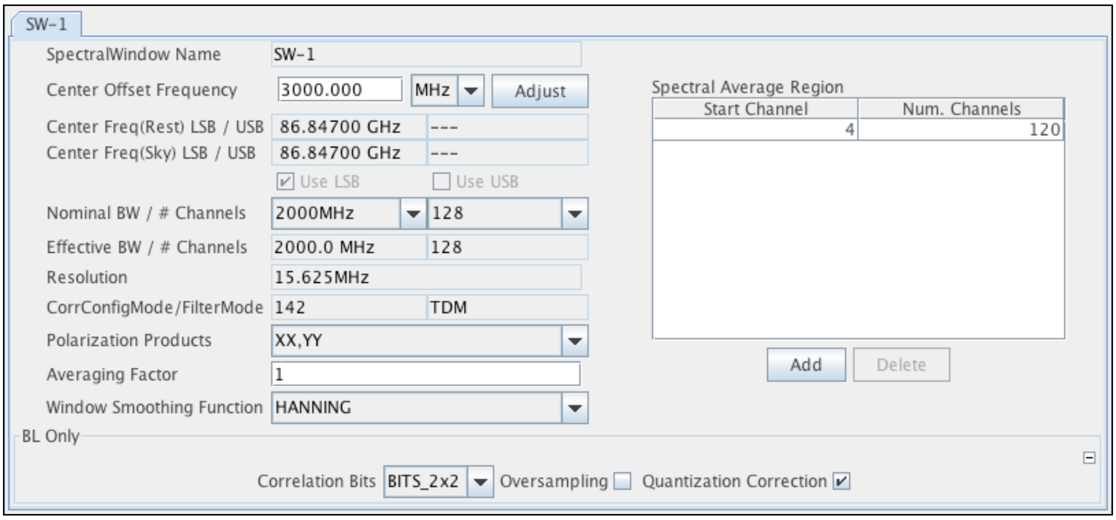
- **Set the remaining SW parameters:** As mentioned above, the remaining SW parameters are affected by the nominal bandwidth and number of channels chosen. The remaining parameters will be left with defaults (i.e. “Averaging Factor” will be left with a default value of “1”, Window Smoothing Function” will be left as “HANNING”).
- **Set the “Spectral Average Region”:** One should normally attempt to crop a bit from each end of the region used when calculating the spectral average. Note that at least one spectral average region must be specified. For the presented example, 128 channels in total are to be used, so it probably makes sense to clip (e.g.) 4 channels from each end for averaging purposes. Under the “Spectral Average Region” table to the right of the tabbed SW pane, click on the “Add” button. This should produce a new row in the “Spectral Average Region” table, containing two “0” entries. Double-click on the “0” in the “Start Channel column, and replace the zero with the number of channels to be excluded. For the presented example, this will be 4. Then, double-click on the “0” in the “Num. Channels” column, and set this to be the total number of channels being used, minus twice the entry in the “Start Channel” column. For the presented example, this would therefore be 128 – (2 × 4) = 120. This ensures equal clipping at both ends of the frequency range.

14. **Calculate the LO settings:** Scroll back up to the “Setup Preferences” section of the “BaseBand Configurations” section of the “Forms” tab, and click on the “Calculate LOs” button. This should result in the automatic correction of the “LO_2 Frequency” and “Instantaneous Data Rate” fields. For the presented example, the “LO_1 Frequency” will be automatically set to 92.81575 GHz, and the “Instantaneous Data Rate” will be set automatically.

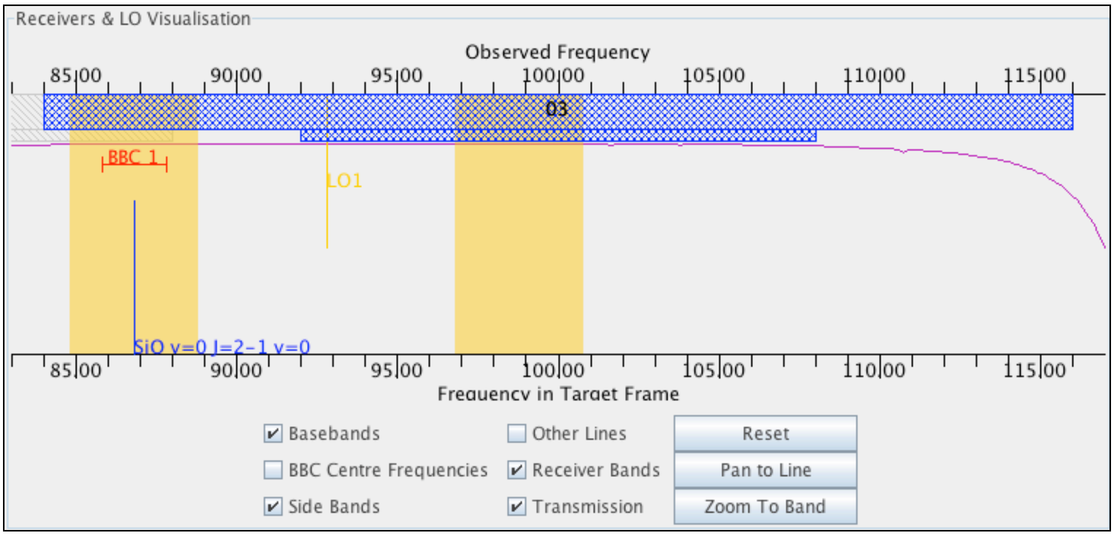
For the presented example, the “BaseBand Configurations” section of the “Forms” tab of the “Editors” window then looks like the following:



The corresponding Spectral Window setup for the same presented example appears as follows:



It is also possible to sanity-check the Spectral Spec somewhat using the "Spectral" tab of the "Editors" panel. Click on this, and a pair of plots will be shown, with all the previously-edited Spectral Spec forms information to the right of these. For a full explanation of all the components of the plots, see the OT User and Reference Manuals, but to obtain a quick view of the Spectral Spec already specified, click on the "Zoom to Band" button just below the first of the frequency plots, and this will cause the plot to be redrawn on a zoomed scale. It should then be possible to see the LO_1 frequency, the frequency coverage of the sidebands used, the frequency range of the BaseBand Configuration(s) used (indicated by "BBC" plus a number), and the frequency of the spectral line chosen for observation. For the presented example, this display is as follows:



Note that the chosen SiO line falls in the middle of the "BBC 1" range. Also note that it is possible to interactively adjust the frequencies covered by the sidebands by click-dragging the line indicating the LO_1 frequency. For the purposes of this document, the details of the lower plot will be skipped. Once the "Spectral" view looks satisfactory, click back to the "Forms" tab.

OK, that's all the really complicated stuff done…

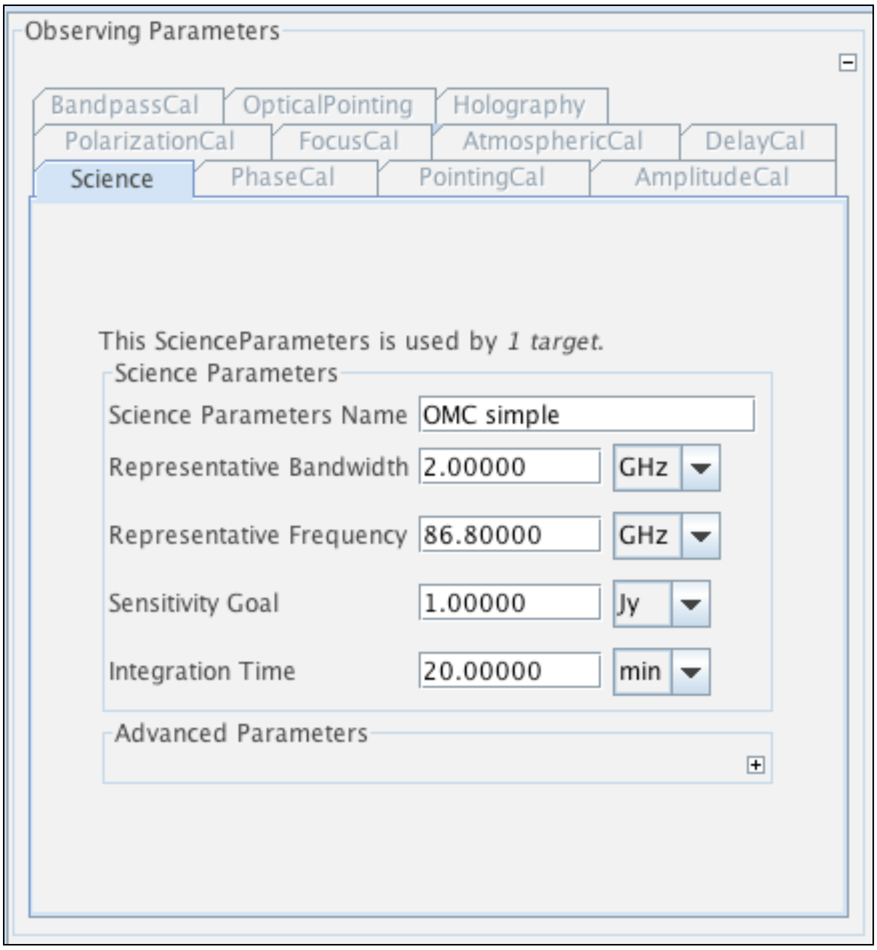
Resource Creation: Observing Parameters

The third and final type of Resource to be set up are the "Observing Parameters".

15. **Create a new Observing Parameter Resource:** In the "Project Structure" panel, right-click on the "0 Observing Parameters" entry. This will produce a contextual menu containing a rather long list of possible types of "Observing Parameter" sets. For the presented example, a set of Science Observing Parameters will first be set up just to illustrate the general process, so "Add Science Parameters" will be chosen here. This will result in the addition of a new "ScienceParameters" entry under the "Observing Parameters" parent item. Click on this new entry.
16. **Rename the "Observing Parameter" entry and set up the relevant parameters:** As for other entries in the "Project Structure" panel, right'clicking on the new "ScienceParameters" entry will allow it to be renamed. This can also be done by entering a suitable string in the "Science Parameters Name" field in the "Observing Parameters" pane of the "Forms" tab of the "Editors" window. For the presented example of a "ScienceParameters" entry, this will be renamed "OMC simple", and the "Representative Bandwidth" and "Representative Frequency" fields set to at least roughly reflect the values already entered earlier for this example: "Representative Bandwidth" will be chosen to be 2.0 GHz, and the "Representative Frequency" set to be 86.8 GHz (these numbers do not have to be exact, as they are included principally to allow simple characterization of the project with reference to the original PI source proposal, and this is not a factor for the purposes of CSV test SBs). Some numbers also need to be entered for "Sensitivity Goal" and "Integration Time" for the program to be regarded as valid,

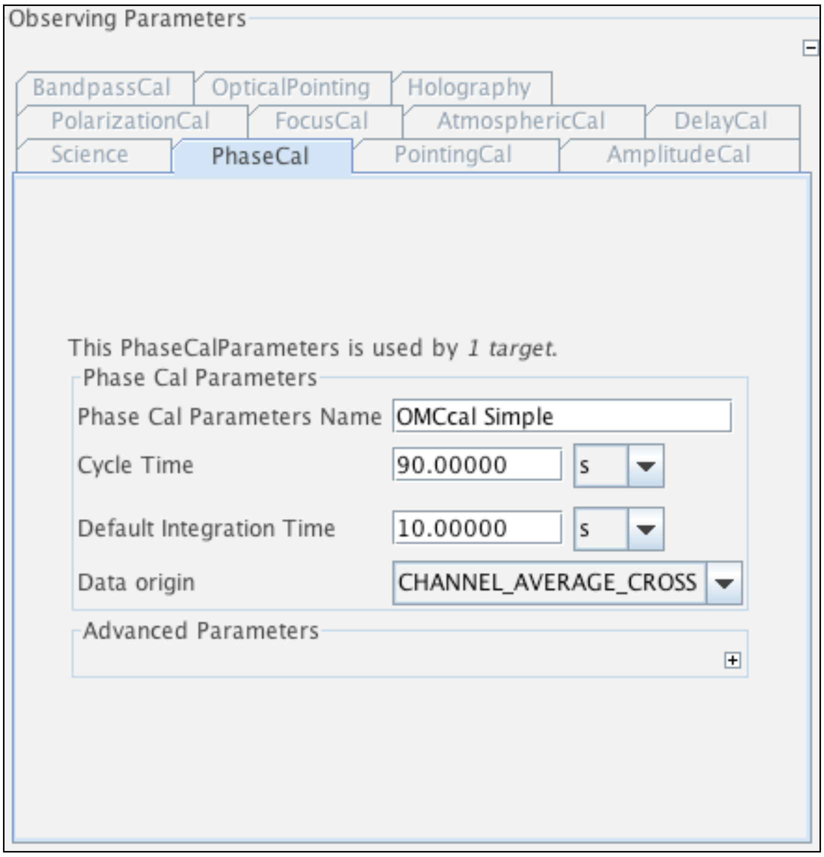
so values of 1 Jy and 20.0 min will be chosen in order to be sufficiently generous as to ensure that the SB runs to full completion. The "Advanced Parameters" pane may be left minimized, and will not be discussed here.

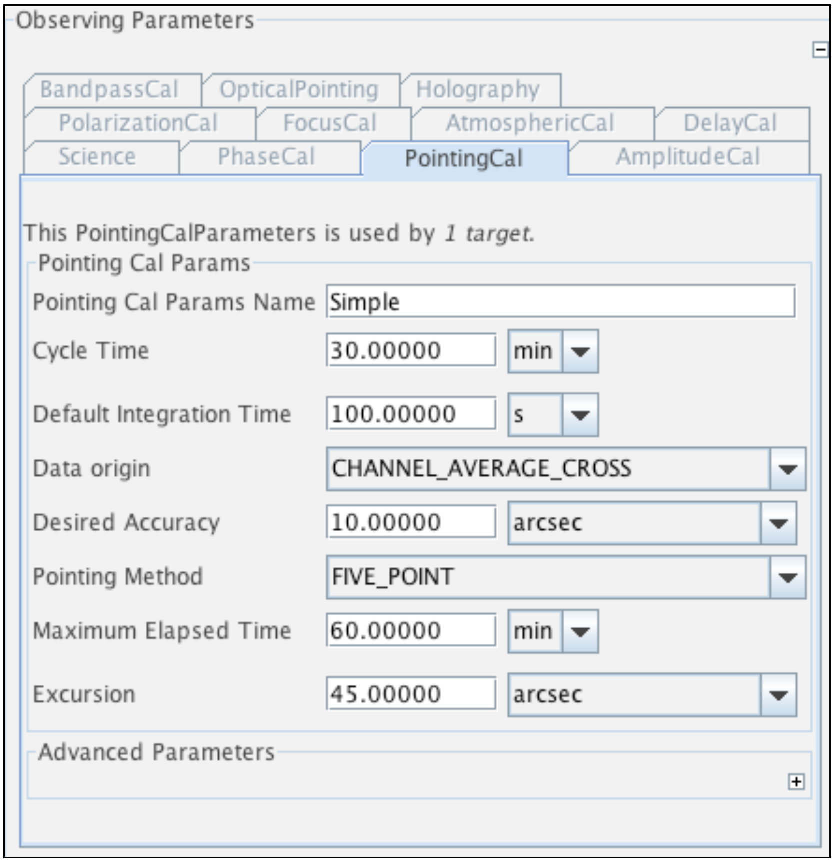
The "Observing Parameters" part of the form then appears as follows:

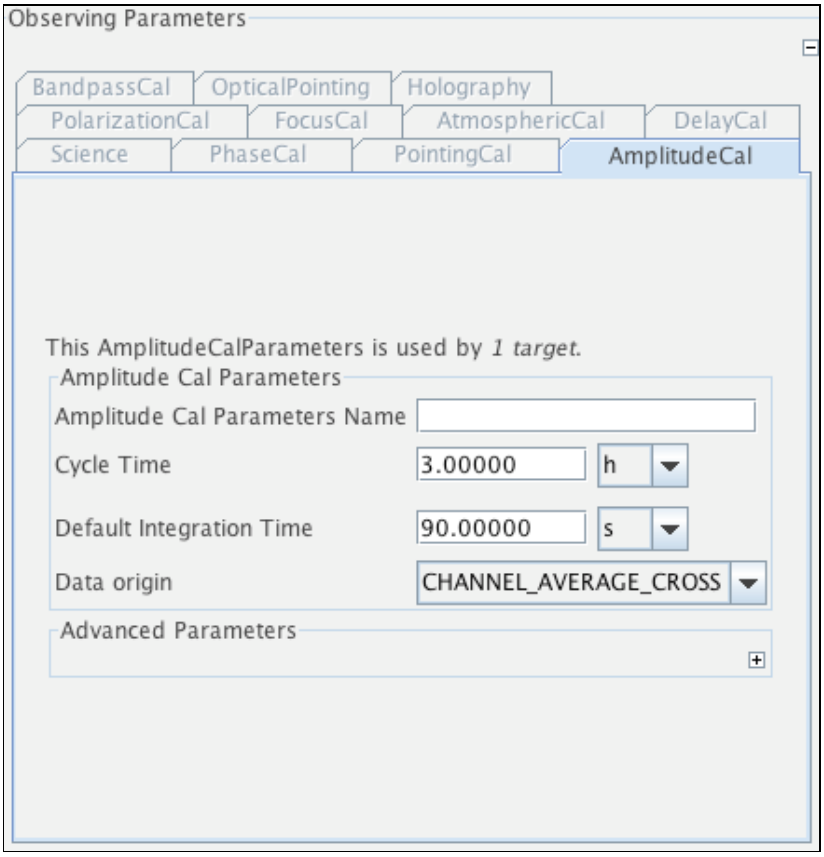


Note that in the above figure, there are a much larger number of tabs that are greyed out. Each of these contains a set of parameter fields that are unique to the type of observation type to be done.

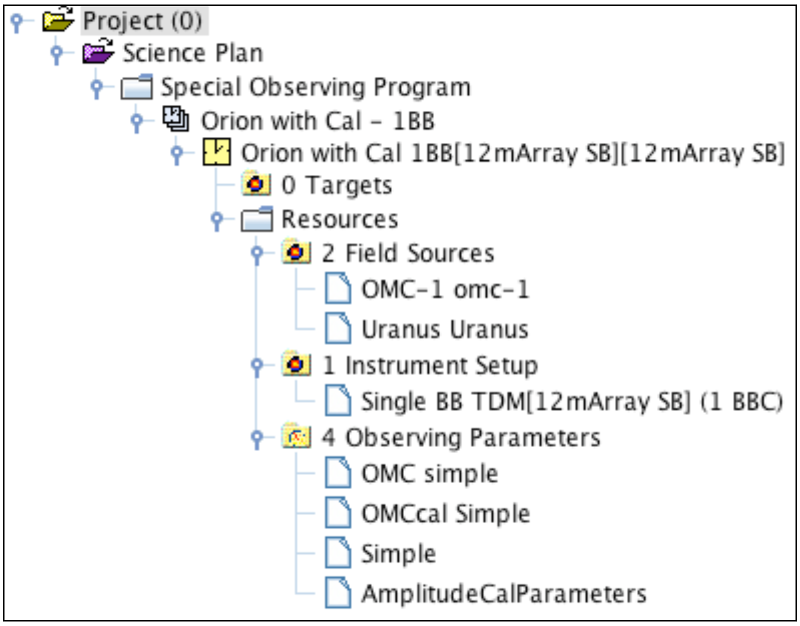
Using the above method, additional sets of Observing Parameters will also be set up for the presented example for Phase Calibration (called "OMCcal simple" here), Pointing Calibration (called "Simple" here), and Amplitude Calibration (called the default "AmplitudeCalParameters" here). These various sets of parameters are indicated below:


Observing Parameters
BandpassCal
OpticalPointing
Holography
PolarizationCal
FocusCal
AtmosphericCal
DelayCal
Science
PhaseCal
PointingCal
AmplitudeCal
This PhaseCalParameters is used by 1 target.
Phase Cal Parameters
Phase Cal Parameters Name
OMCcal Simple
Cycle Time
90.00000
s
Default Integration Time
10.00000
s
Data origin
CHANNEL_AVERAGE_CROSS
Advanced Parameters


Observing Parameters
BandpassCal
OpticalPointing
Holography
PolarizationCal
FocusCal
AtmosphericCal
DelayCal
Science
PhaseCal
PointingCal
AmplitudeCal
This PointingCalParameters is used by 1 target.
Pointing Cal Params
Pointing Cal Params Name
Simple
Cycle Time
30.00000
min
Default Integration Time
100.00000
s
Data origin
CHANNEL_AVERAGE_CROSS
Desired Accuracy
10.00000
arcsec
Pointing Method
FIVE_POINT
Maximum Elapsed Time
60.00000
min
Excursion
45.00000
arcsec
Advanced Parameters



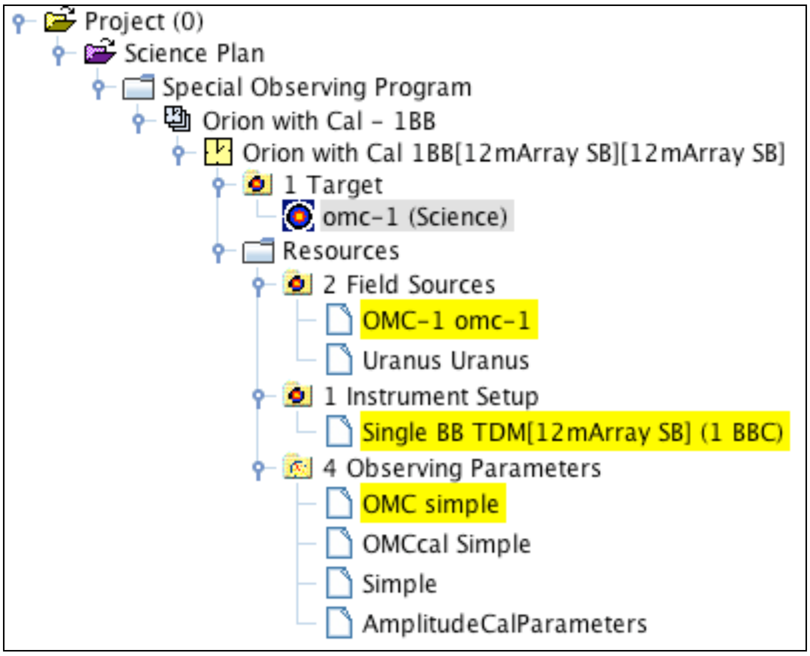
The Project Structure panel for the presented example is then as follows:



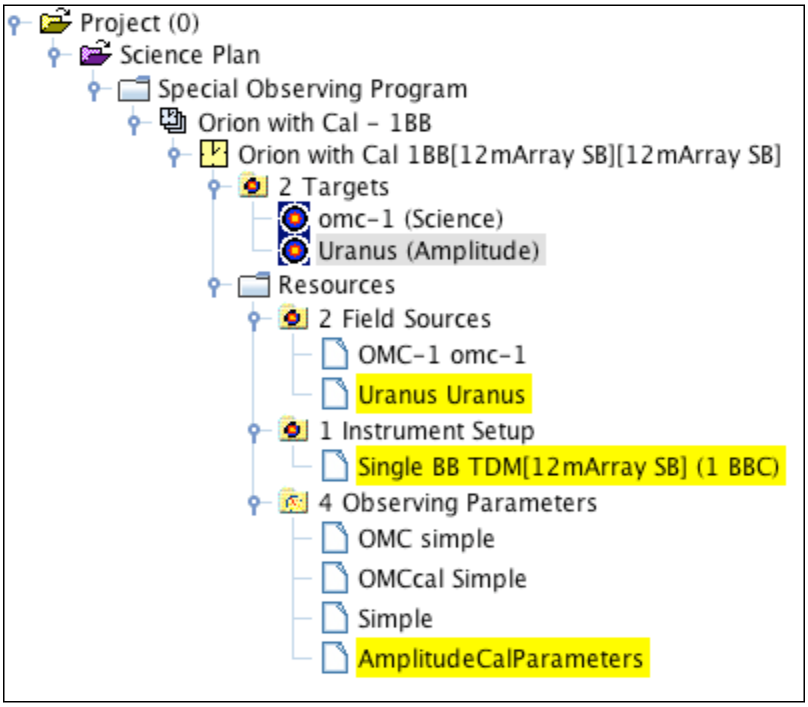
Association of Resources with Targets

Once all the independent Resources have been created, it is necessary to link together one of each type in order to fully define a Target. To illustrate this process for the presented example, a Science Target shall be created.

17. **Create a new Target:** In the "Project Structure" panel, right-click on the "0 Targets" entry, and select "Add Target". This will generate a new "Target" entry under the "0 Target" heading, which will have also changed to read "1 Target".
18. **Set up the new "Target"/Field Object association:** Click on the new "Target" component, and the "Forms" tab in the "Editors" window will show a set of three panes, one for each Resource type. Each panel will contain a "*Resource* to Use" drop-down menu with a "Create New" option, followed by a table of all the resources of that type already defined. All of the necessary Resources for the Science Target that is being created for the example have already been defined, so it is only necessary to identifty them with the target. To select the appropriate "Field Source" for the presented example, double-click on the "OMC-1" entry in the table. This will cause it to be displayed in the "Field Source To Use" box above the table. Then, simply click on the "OK" button below the table, and the whole panel will be replaced by the "Field Source" set-up form used earlier, but containing all of the previously-supplied information for the OMC-1 science object. The "OMC-1" entry in the project structure panel will also now be highlighted, to reflect its direct association with the "Target" entry, the name of which will have also changed to reflect the use of the "omv-1" field source.
19. **Set up the new "Target"/Spectral Spec association:** The same method as above can then be used to associate "Instrumental Setups" and "Observing Parameters". In the "Spectral Spec" pane of the "Forms" tab of the "Editors" panel for the target, double-click on "Single BB TDM" and click on the corresponding "OK" button.
20. **Set up the new "Target"/Observing Parameters association:** For the "Observing Parameters" pane of the "Forms" tab of the "Editors" panel, it is first necessary to indicate the type of "Observing Parameters" to be specified. For the science target in the worked example, the "Science" checkbox should be selected (note that it is actually possible here to associate a given Target with more than one set of "Observing Parameters", but for the simple example here, only one ("Science") will be used. When the "Science" selection box has been checked, this will produce an adjacent drop-down menu. From this menu, the existing sets of "Science" Observing parameters are available for selection, plus the option to create a new one. For the presented example, "OMC simple" will be chosen. Clicking on the "OK" button at the bottom of the pane will replace the pane with the familiar set of Science Observing Parameters previously set up for "OMC Simple". The "Project Structure" for the presented example now appears as follows:



Note the highlighting of the three resources associated with the selected “omc-1 (Science)” Target. Also note that a resource may be used by more than one Target. For the presented example, an amplitude calibration target may also be set up using the above methods for approriate Resources, resulting in the following associations:

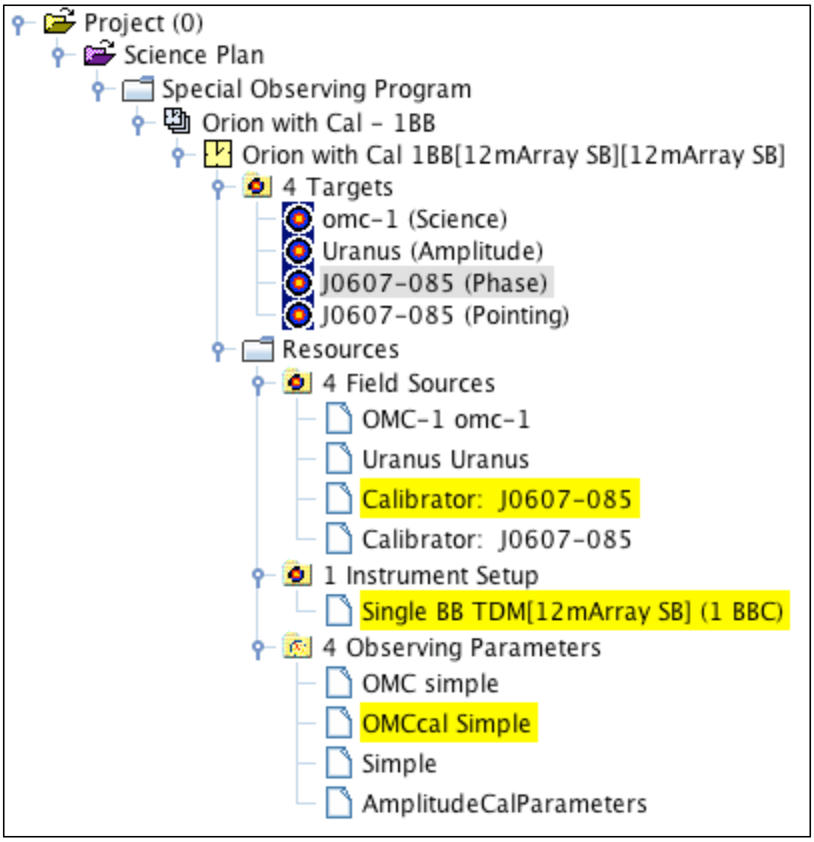


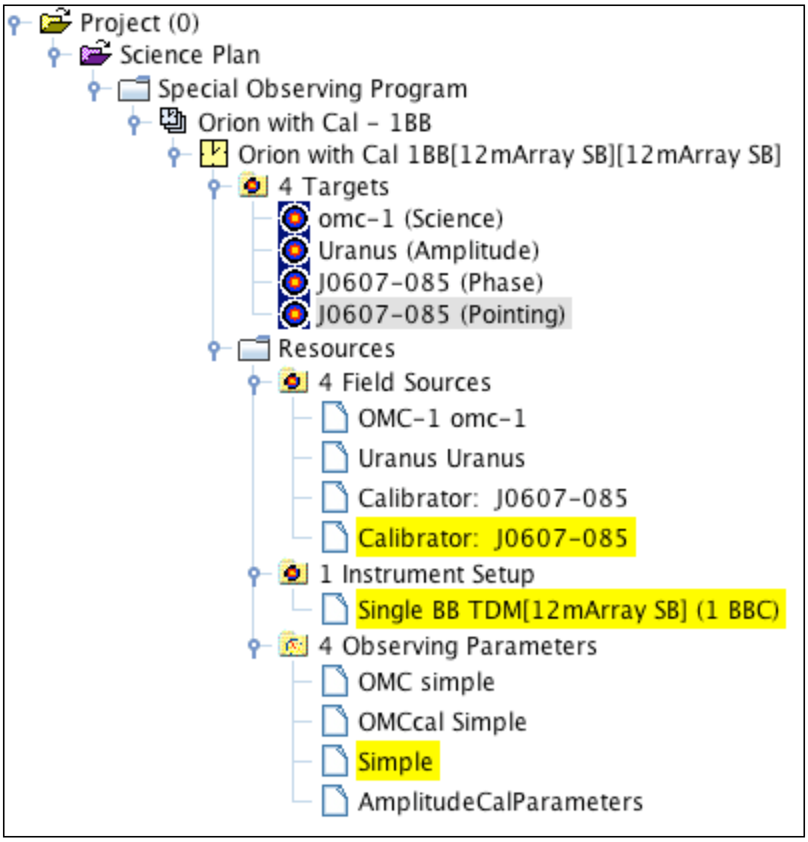
Addition of Calibrators: The Easy Way

It is possible to add suitable calibrator sources to a project in the OT relatively easily using the included “ALMA Calibrator Selection Tool”, which allows the easy identification and selection of nearby calibration objects.

21. **Select the target needing a calibrator and launch the Calibrator Selection Tool:** In the “Project Structure” panel, click on the *Target* entry needing a calibration source. For the presented example, the “omc-1” Target will be used. Clicking on the “Tool” drop-down menu and selecting the “ALMA Calibrator Selection Tool” option will result in the Calibrator Selection Tool window being launched, with the desired Field Object position already entered.
22. **Specify a Search Radius and run the search:** Enter a search radius in degrees in the “Radius (deg)” field of the Calibrator Selection window (e.g. “10” for the presented example), and click on the “Filter” button.
23. **Filter the calibrator search result by type (if necessary):** The resultant search list may be further filtered by clicking on the “Best Phase Cal”, “Best Pointing Cal”, etc. buttons in the Calibrator Selection window. Clicking on the “Filter” button undoes this further selection. Note that the current list of objects available to the tool is very limited. ***Also note that although the positions of the objects are good, the flux densities should not be trusted, as many calibrator sources are intrinsically variable.*** The current flux densities of any calibrators should therefore be checked against more recent catalogues. For the worked example, the calibrator source “J0607-085” will be selected for use as a Phase and Amplitude Calibrator.
24. **Select the calibrator object and indicate its role:** Click on the row of the chosen calibrator in the search results table, and click the “Select As…” button. This will result in the production of another window called “Create Calibrators”, which contains a form allowing the selection of the calibrator role(s) of the object. At the right-hand side of the window are options (under the heading “Copy SpectralSpec”) for automatically generating associations between the new calibrator Target and existing Resources. The first option, “Copy to new setup” will create a full set of new resources (including a Spectral Spec) that would then need to be defined. The second option “Link to same setup” will automatically create associations with the Spectral Spec used by the previously-selected Target (omc-1 in the example) and create a new blank set of associated Observing Parameters. The third option “Do nothing” will create the new calibrator Target with no Spectral Spec association, allowing the user to create an association manually as described above. For the sake of maintaining simplicity in the presented example (and for the reason that pointing calibrators and phase calibrators are generally selected based on different criteria), the actual calibrator object used in the presented example will be treated as two different objects but using the same Spectral Spec, and so the “Link to same setup” option will be used for both the phase calibrator and the pointing calibrator. The Target/Resource associations will then be set up manually, as already described above.

For the presented example, the source “J0607-085” will be selected as a Phase Calibrator, and then the resultant target associated with the pre-existing “OMCCal Simple” Observing Parameters and “Single BB TDM Instrument Setup. Note that the “Link to same setup” option will still create a new empty “PhaseCalParameters” Observing Parameters Resource, which will need to be detached from the new “J0607-085” Target and deleted. The new calibrator Target can then be associated with the “OMCcal Simple” set of Observing Parameters previously created. Similarly, an additional Pointing Target using the existing calibrator Field Source J0607-085 can be set up to use the “Simple” set of Observing Parameters. The resulting extensions to the presented example are as follows:


Project (0)
Science Plan
Special Observing Program
Orion with Cal - 1BB
Orion with Cal 1BB[12mArray SB][12mArray SB]
4 Targets
omc-1 (Science)
Uranus (Amplitude)
J0607-085 (Phase)
J0607-085 (Pointing)
Resources
4 Field Sources
OMC-1 omc-1
Uranus Uranus
Calibrator: J0607-085
Calibrator: J0607-085
1 Instrument Setup
Single BB TDM[12mArray SB] (1 BBC)
4 Observing Parameters
OMC simple
OMCcal Simple
Simple
AmplitudeCalParameters


Project (0)
Science Plan
Special Observing Program
Orion with Cal - 1BB
Orion with Cal 1BB[12mArray SB][12mArray SB]
4 Targets
omc-1 (Science)
Uranus (Amplitude)
J0607-085 (Phase)
J0607-085 (Pointing)
Resources
4 Field Sources
OMC-1 omc-1
Uranus Uranus
Calibrator: J0607-085
Calibrator: J0607-085
1 Instrument Setup
Single BB TDM[12mArray SB] (1 BBC)
4 Observing Parameters
OMC simple
OMCcal Simple
Simple
AmplitudeCalParameters

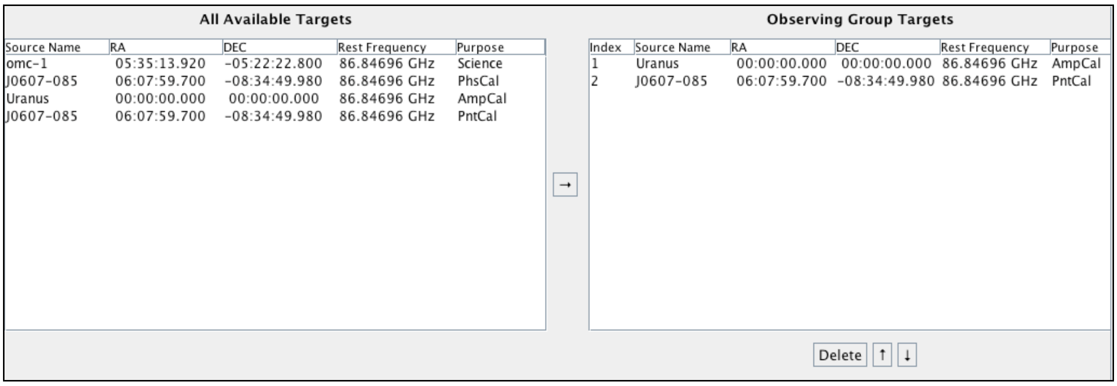
Additional General SB Setup and Observing Groups Creation

In order to complete a functioning SB, some additional general parameters must be set, and the Targets associated with Observing Groups within the SB.

25. **Select the SB to be finished off:** Ensure that the "Forms" tab of the "Editors" panel has been selected, and click on the "Scheduling Block" entry in the "Project Structure" panel (with the yellow clock icon).
26. **Set the remaining top-level SB parameters:** In the "Editors" panel, a number of remaining SB parameters are presented. These may be set as follows (skipping fields that are greyed out and not changeable):
    - **"Basics":** The "SchedBlock Name" field was already set above.
    - **"Control":** "Array Type" should be left with the default value of "TWELVE-M".
    - **"Unit Dependencies":** This is not currently used.
    - **"Preconditions":** These mauy all be left with the default settings for the current purposes.
    - **"SchedBlock":** The "Standard Mode" checkbox should be checked. The "Mode Name" field should be set to "Standard Interferometry". The "Mode Type" should be "User". **The "Execution Count" "Indefinite Repeat checkbox should be checked (N.B. This is very important, in order to ensure that the SB can be re-run as many times as needed for Commissioning).** The "Max. Time" field, which denotes a maximum allowed wall-clock execution time should be set to something large but realistic: for the presented example, a value of 60.0 minutes will be adopted. The "Obs. Procedure" field should have been automatically set to "StandardInterferometry.py" when the "Mode Name" field was set. The "Run Quick Look" checkbox should always be checked.
    - **"Advanced Parameters":** This should be skipped.
    - **"Performance Goals":** These can probably be left with default values for the current purposes.
    - **"Temporal Constraints":** This is not currently used.
27. **Create the Observing Groups:** In the "Project Structure" panel, right-click on the SB item (with the yellow clock icon), and select "Add Observing Group". **This must be done at least twice, as it is necessary to ensure that each SB has at least an Amplitude Calibration target in the first Observing Group. The Science observation target(s) should then be placed in the subsequent group(s).**
28. **Set up the first observing group:** Click on the new "Observing Group 1" item in the "Project Structure" panel. This will present the user with an "Editors" panel containing two tables, the first headed "All Available Targets" and the second headed "Observing Group Targets". Clicking on a table entry in the former allows it to be selected, and the right-pointing arrow button between these two tables can then be used to add or the selected entry from the "Observing Group Targets" table. A similar process using the left-pointing button allows objects to be deselected for inclusion in the currently-chosen Observing Group. A different Observing Group may be chosen by clicking on its entry in the "Project Structure" panel. For the presented example, the amplitude calibration "Uranus (Amplitude)" and pointing calibration "J0607-085 (Pointing)" Targets will be included in "Observing Group 1", and the "omc-1 (Science)" and "J0607-085 (Phase)"

Targets will be included in “Observing Group 2”. The presented example project is then as follows:

For “Observing Group 1”:



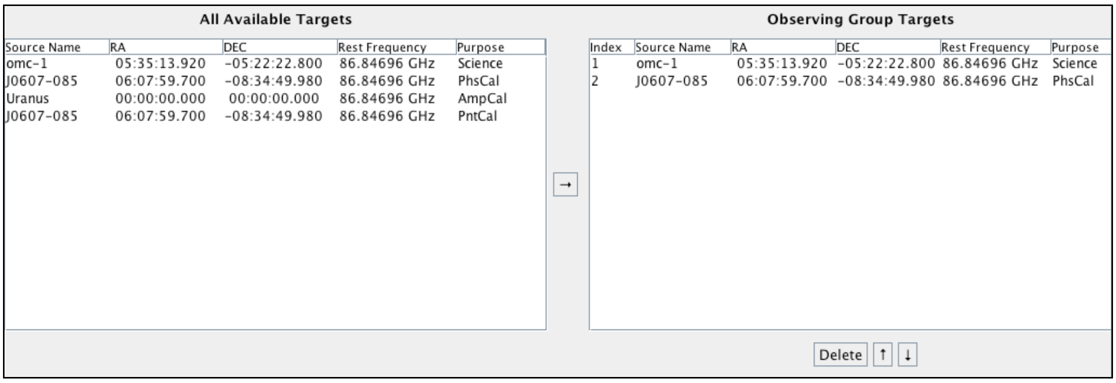
All Available Targets

Source Name	RA	DEC	Rest Frequency	Purpose
omc-1	05:35:13.920	-05:22:22.800	86.84696 GHz	Science
J0607-085	06:07:59.700	-08:34:49.980	86.84696 GHz	PhsCal
Uranus	00:00:00.000	00:00:00.000	86.84696 GHz	AmpCal
J0607-085	06:07:59.700	-08:34:49.980	86.84696 GHz	PntCal

Observing Group Targets

Index	Source Name	RA	DEC	Rest Frequency	Purpose
1	Uranus	00:00:00.000	00:00:00.000	86.84696 GHz	AmpCal
2	J0607-085	06:07:59.700	-08:34:49.980	86.84696 GHz	PntCal

For “Observing Group 2”:



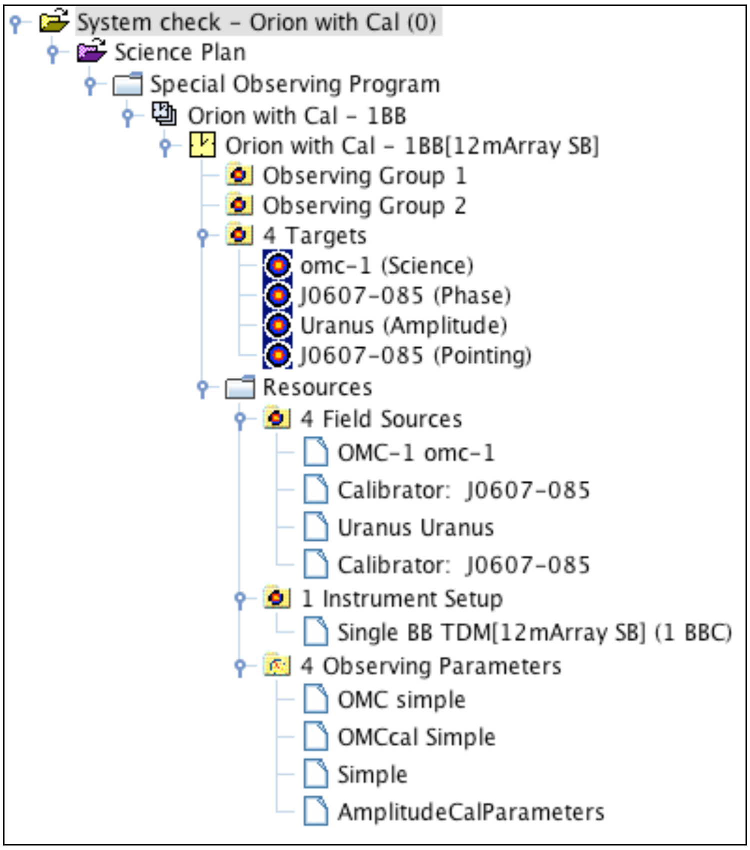
All Available Targets

Source Name	RA	DEC	Rest Frequency	Purpose
omc-1	05:35:13.920	-05:22:22.800	86.84696 GHz	Science
J0607-085	06:07:59.700	-08:34:49.980	86.84696 GHz	PhsCal
Uranus	00:00:00.000	00:00:00.000	86.84696 GHz	AmpCal
J0607-085	06:07:59.700	-08:34:49.980	86.84696 GHz	PntCal

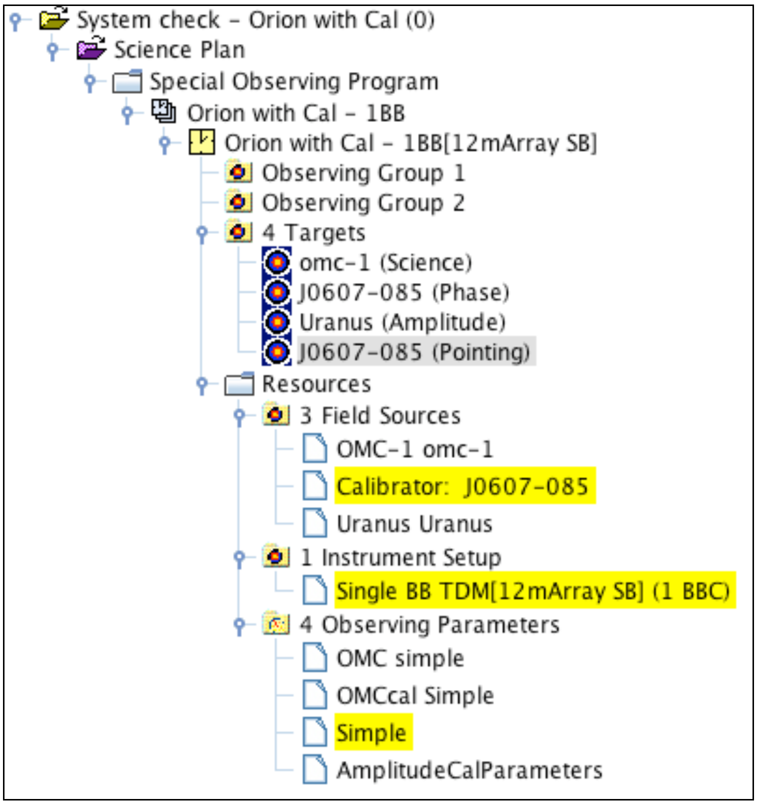
Observing Group Targets

Index	Source Name	RA	DEC	Rest Frequency	Purpose
1	omc-1	05:35:13.920	-05:22:22.800	86.84696 GHz	Science
2	J0607-085	06:07:59.700	-08:34:49.980	86.84696 GHz	PhsCal

The example SB is then functionally complete, with a structure as below:



As a final exercise, the reader is encouraged to try to streamline the above example so that only three Field Sources are used without sacrificing any functionality, as below:



A short Appendix on how to cheat: Using Templates

To speed up the process of SB creation considerably, it is possible to open an existing SB to use as a non-writeable template, and then copy/paste (or simply drag and drop) items in the “Project Structure” panel.

A set of standard examples are included within the distributed OT. To access this in OT R7.0, use the “File / Open Standard Library” drop-down menu option. This will open up a set of standard examples in a lower, read-only pane of the “Project Structure” panel.

To access the standard template library in OT UT7.0, use the “File / Show ALMA Template Library” drop-down menu option.

Similarly, it is possible to open up a locally-stored .aot file to act as a template in the same manner. This is done in OT R7.0 using the “File / Import Project/Library” drop-down menu option.

To open a locally-stored .aot file to use as a read-only template, use the “File / Use Project as Template / From File” drop-down menu option.

“Very nice, but does it actually work?” - A short Appendix on how to test newly-created SBs

In Chile, some testing of an SB may be conducted using the Observing Script Simulator. This is essentially a program that just parses the XML in the SB.

1. On an STE on which the ALMA Common Software (ACS) is available, establish if the ACS system is already running (this may be checked by attempting to run the simulator as below in Steps 3 – 6, without first attempting to start ACS). If ACS is already running, jump straight to Step 2 (below). If ACS is not already running, it should be started. This may be done by typing:

   acsStart

2. Create a new subdirectory and copy the *.aot* file (produced by the OT) into it.
3. The *.aot* file format is essentially a zipped file which will need to be unzipped:

   unzip <filename>

   in which *<filename>* is the name of the *.aot* file.

4. The project will unzip to create at least 3 XML files:

   - *ObsProject.xml*
   - *ObsProposal.xml*
   - *SchedBlock0.xml*

5. The Observing Script Simulator can be found at the following filesystem location: */alma/ACS-8.1/ACSSW/bin/ObservingScriptSimulator*
6. The following can then be typed to run the simulator:

   ObservingScriptSimulator -v -s <foo.py> -f SchedBlock0.xml

   In which *<foo.py>* should be replaced with the name of the script that is intended to be used with the SB (e.g. *StandardInterferometry.py*). The *-v* option provides verbose output.
7. If the ACS system was already running at the start of SB testing (established during Step 1), then the system should be left as it is when the SB testing has been completed. If the ACS system was started in Step 1, then to finish the testing session, type:

   acsStop