# VLA Observation Preparation

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# Accessing the OPT and its Suite of Tools

Register at

https://my.nrao.edu

For this event, login to

https://opt-extra-3.aoc.nrao.edu/opt

- This is a special version of the OPT for this Community Days event.
- Do not use this link to prepare and submit VLA observations.

# Observational Considerations

The VLA primarily uses dynamic scheduling, therefore it is difficult to know at what exact time your project will be observed.

- Each scheduling block (SB) must include a range of scheduling constraints:
  - LST start range
  - Weather
    - wind
    - atmospheric phase limit (APL)
- Anticipate:
  - Unknown position of the antennas at the start
    - overhead of start-up slew time
    - cable wrap request
  - Availability of calibrators/slew for different starting times

# Observational Considerations

- Where are my calibrators and target sources on the sky?
- Strong, point-like calibrators are good for bandpass and delay calibration.
- Nearby calibrators are good for complex gain calibration (amplitude and phase).
- Reference pointing calibrators should be in the same general region of the sky.
- What are the choices for a flux density calibrator?
- Can certain calibrations be combined with fewer calibrator sources, i.e., use the flux density calibrator as the bandpass calibrator?

# Designing a Scheduling Block (SB)

- Determine which/what
  - Sources to observe, and for how long (with each resource)
  - Resources (Instrument Configurations):
    - For Continuum
    - For Spectral Line
  - Calibrations to perform:
    - Reference Pointing (mainly for high frequency)
    - Flux Density Scale
    - Delay
    - Bandpass
    - Complex Gain (amplitude and phase)
    - Polarization (when applicable)

# What are we observing?

- Target source: the AGB star IRC+10216
  - RA (J2000) = 09h 47m 57.382s
  - DEC (J2000) = +13d 16’ 40.66”

- D-configuration
- 3 hour long scheduling block

- Ka-band spectral line setup
  - HC3N ($\nu_o$= 36.39232 GHz)
  - SiS ($\nu_o$= 36.30963 GHz)
  - V (radio, LSR) = −26 km/s
  - $\Delta V \sim 35$ km/s

# Differences to Note

The recommended reference pointing strategy since the observation of IRC+10216 in April 2010 has changed.

- The data taken for the IRC+10216 Spectral Line CASA tutorial used a C-band reference pointing resource.

- X-band reference pointing is the recommended and preferred resource. This will slightly change the source selection and SB setup from the original dataset.

# Workflow

## Step 1

**SCT**
Source
Catalog Tool

- Catalog of proposed source(s) are created during import.
- Observer can add calibrators to this catalog for easier access during SB creation.

## Step 2

**RCT**
Resource
Catalog Tool

- Observer creates a resource catalog of proposed instrument configuration(s).
- Create custom continuum or spectral line resources or save default resources to the catalog for easy access.

## Step 3

**OPT**
Observation
Preparation Tool

- Project tree is created during import.
- SBs are created under a Program Block. The SBs contain scans which are defined by sources, resources, scan mode, and scan intents.

# Interactive Slides

Interactive slides will be denoted with color bars at the top of the slide.

Interactive

Interactive

Interactive

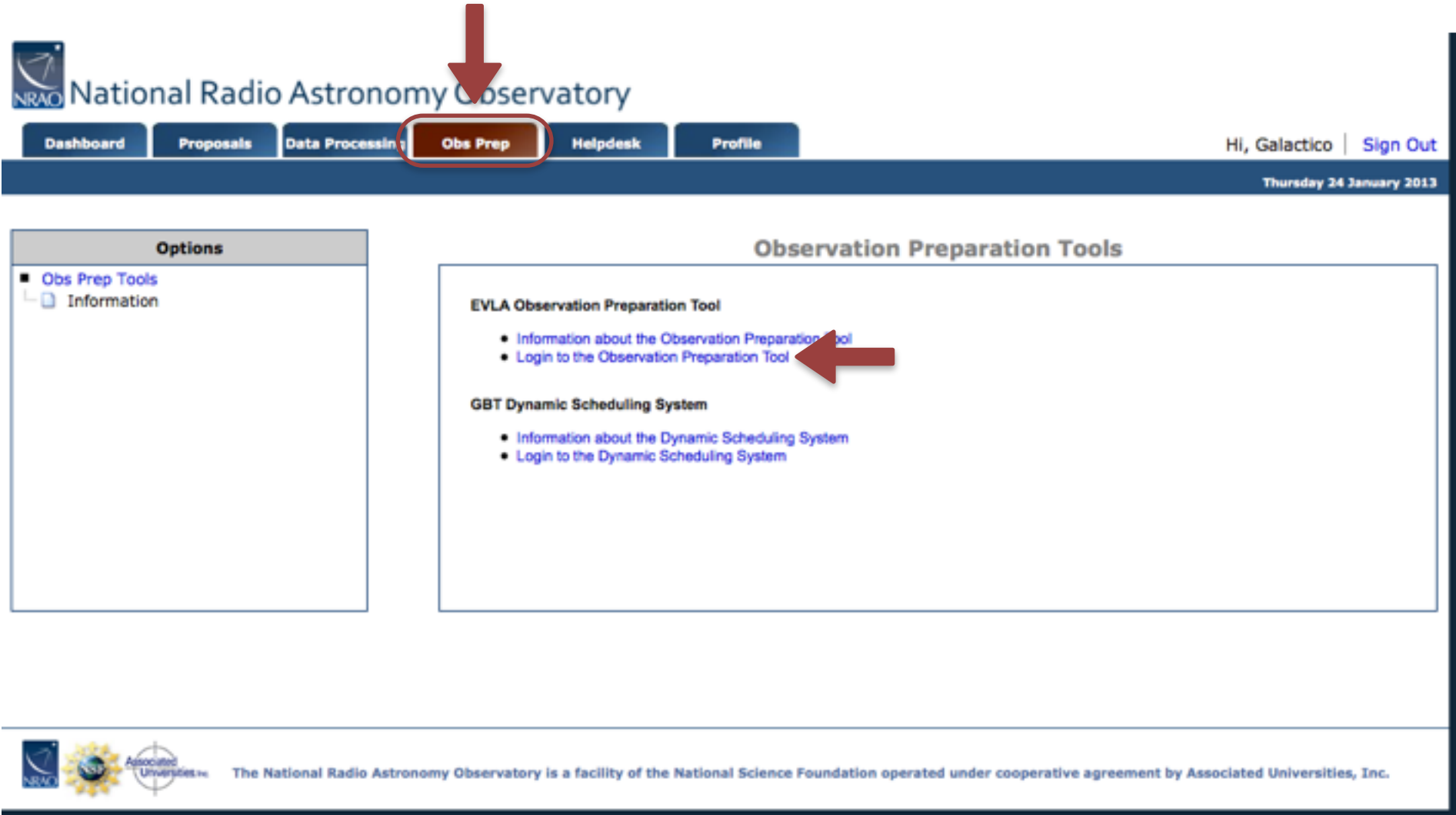
# Step 1 Source Catalog Tool

- Starting **with** a pre-made Source Catalog:
  - Verify the science target positions were imported correctly.

- Starting **without** a pre-made Source Catalog:
  - Create a new Catalog and add the science target(s).

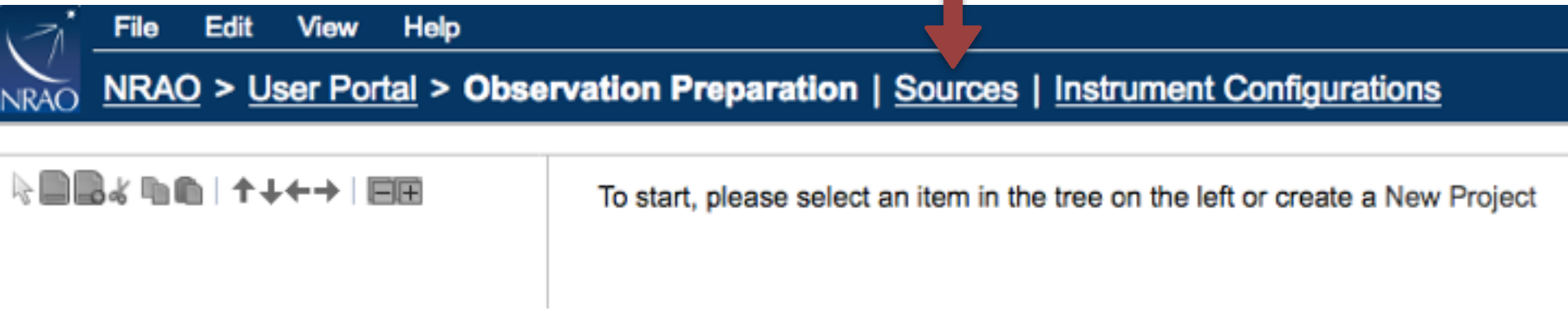
- In both cases, may add the appropriate calibrators to the catalog:
  - complex gain, flux density, bandpass, delay, reference pointing, etc.

# Login to the Observation Preparation Tool



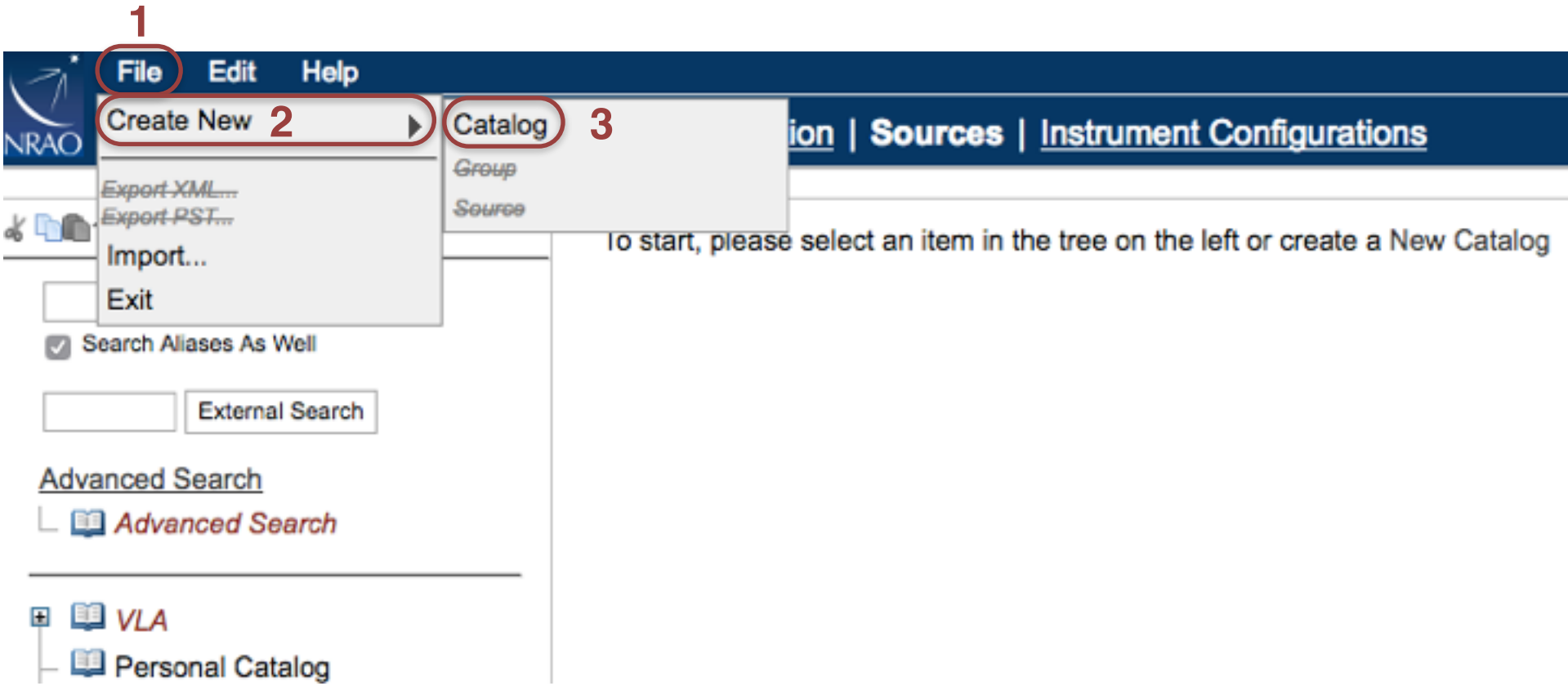
# Step 1 Accessing the Source Catalog Tool

**In the OPT: click on Sources**

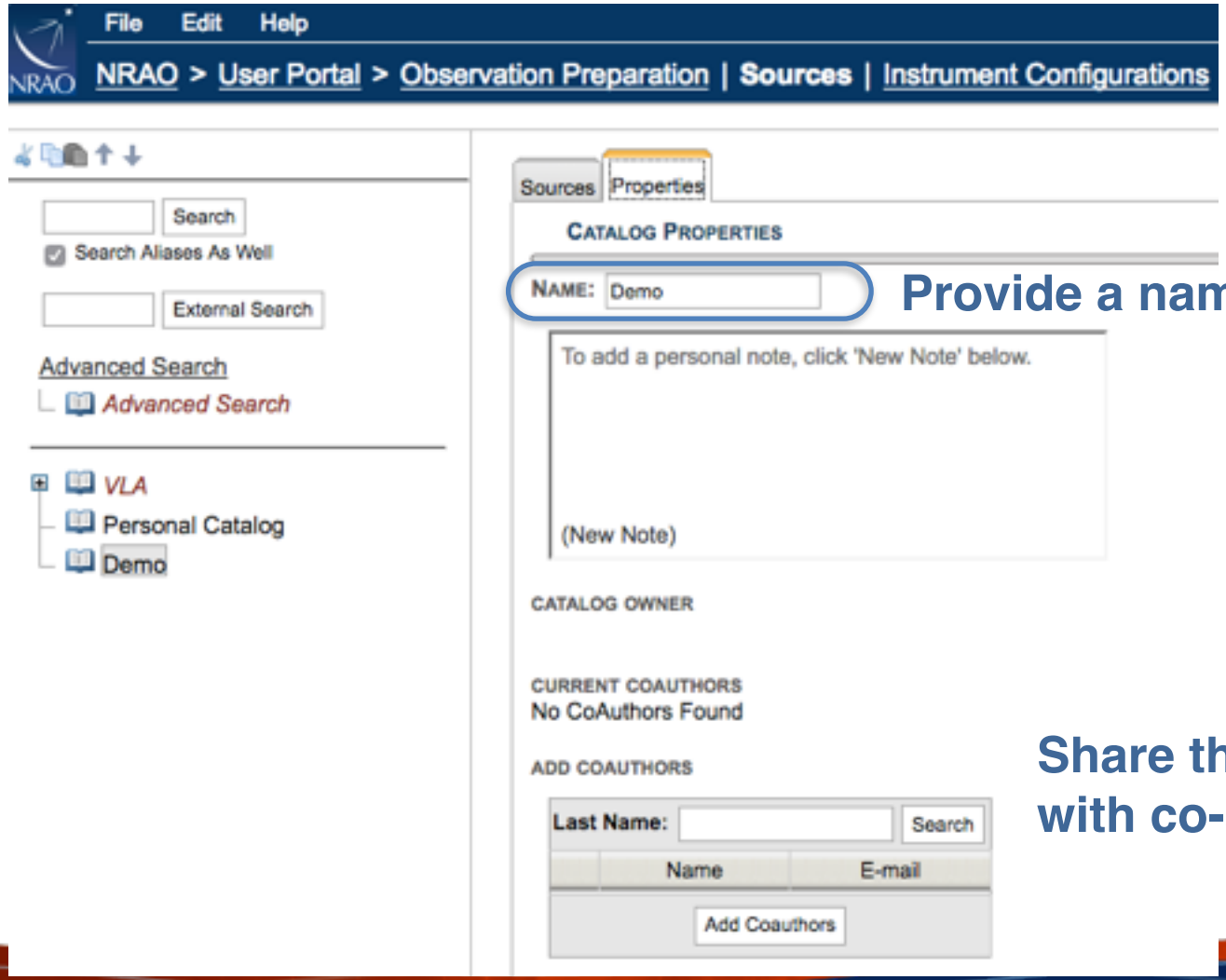


# Step 1 Create a Source Catalog

**File → Create New → Catalog**



# Step 1 Edit the New Source Catalog

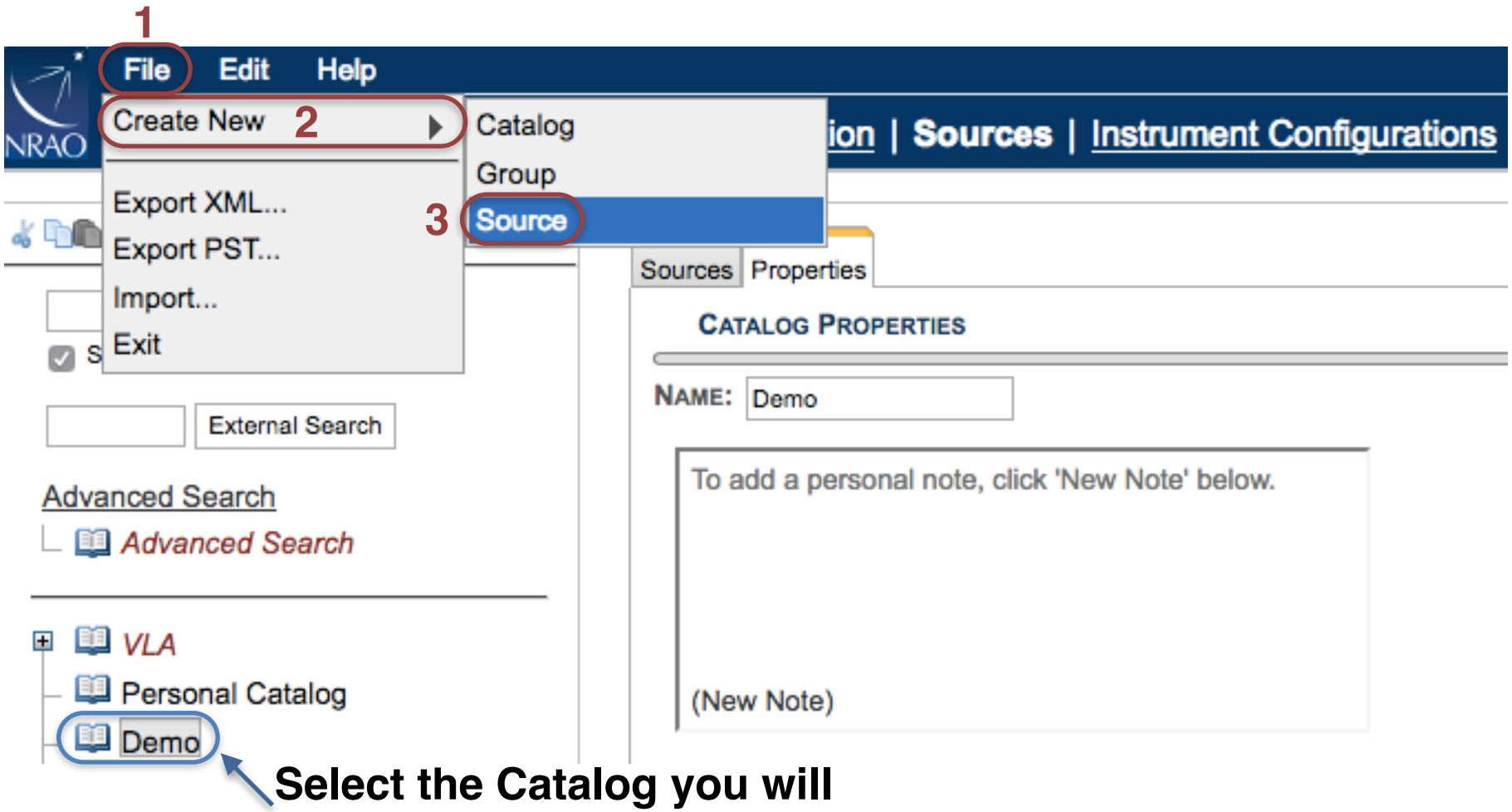



Provide a name for the catalog

Share the catalog with co-authors

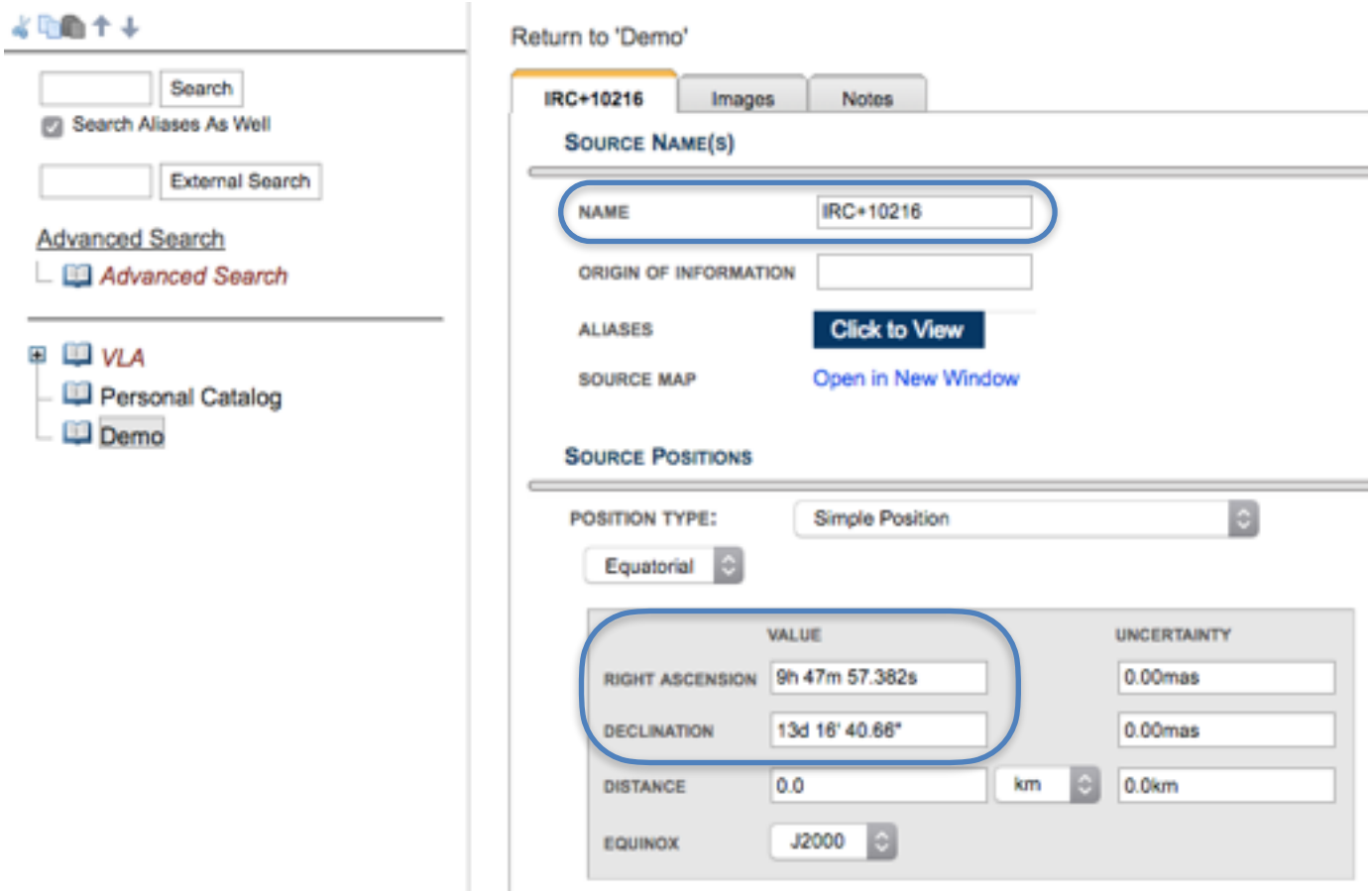
# Step 1 Create a Source in the Source Catalog

**File → Create New → Source**




**Select the Catalog you will be creating the source in.**

# Step 1 Edit the Source Name and J2000 Position

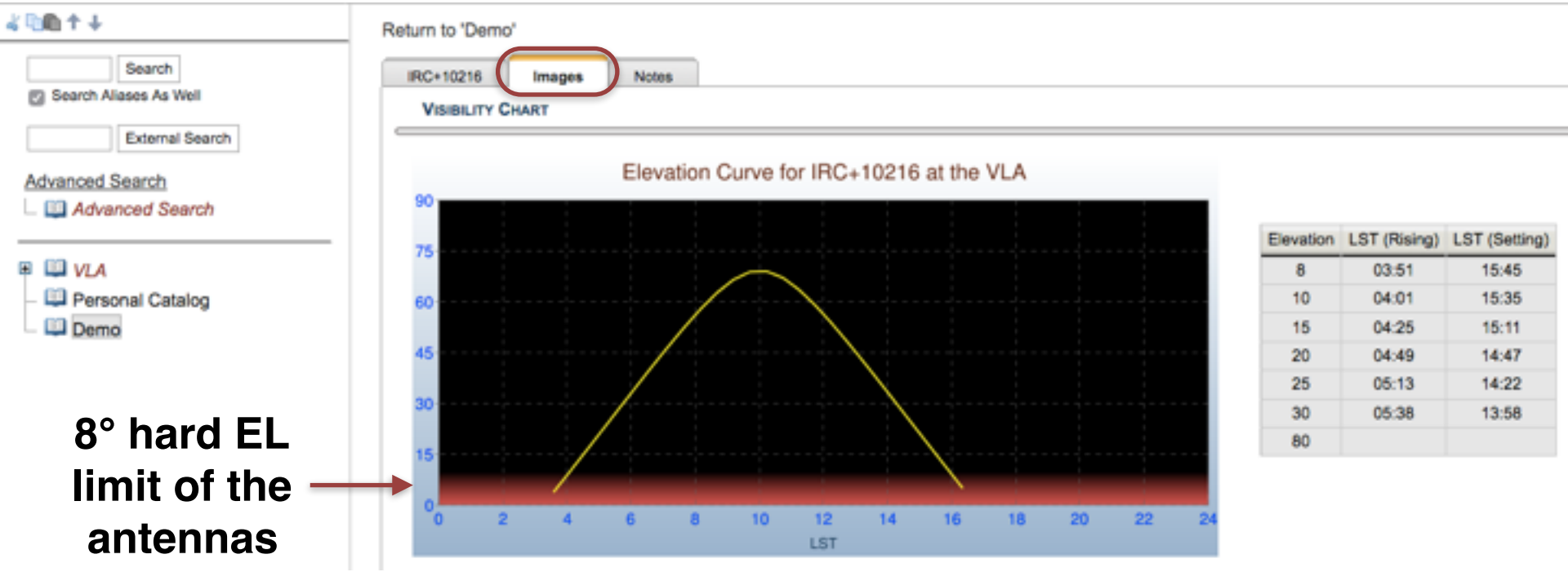



Target source:
IRC+10216

RA (J2000)
09:47:57.382

DEC (J2000)
+13:16:40.66

# Step 1 Source LST range at the VLA




| Elevation | LST (Rising) | LST (Setting) |
|---|---|---|
| 8 | 03:51 | 15:45 |
| 10 | 04:01 | 15:35 |
| 15 | 04:25 | 15:11 |
| 20 | 04:49 | 14:47 |
| 25 | 05:13 | 14:22 |
| 30 | 05:38 | 13:58 |
| 80 | | |

**8° hard EL limit of the antennas**

**05:40–13:50 LST**

**30° < EL < 80°**

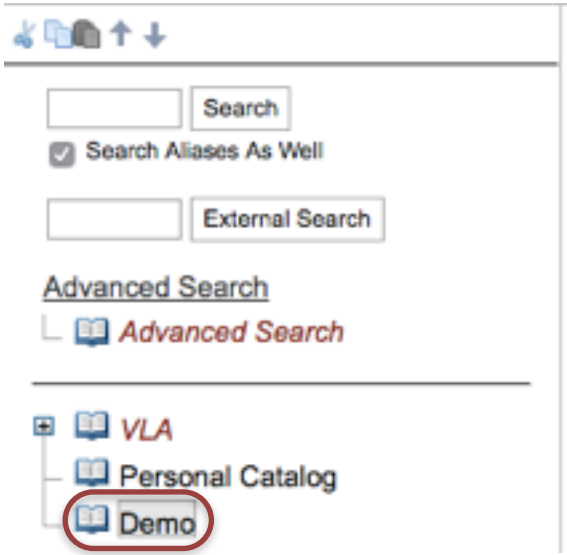
**(EL limits recommended for high frequency observing in D-configuration to avoid antenna shadowing)**

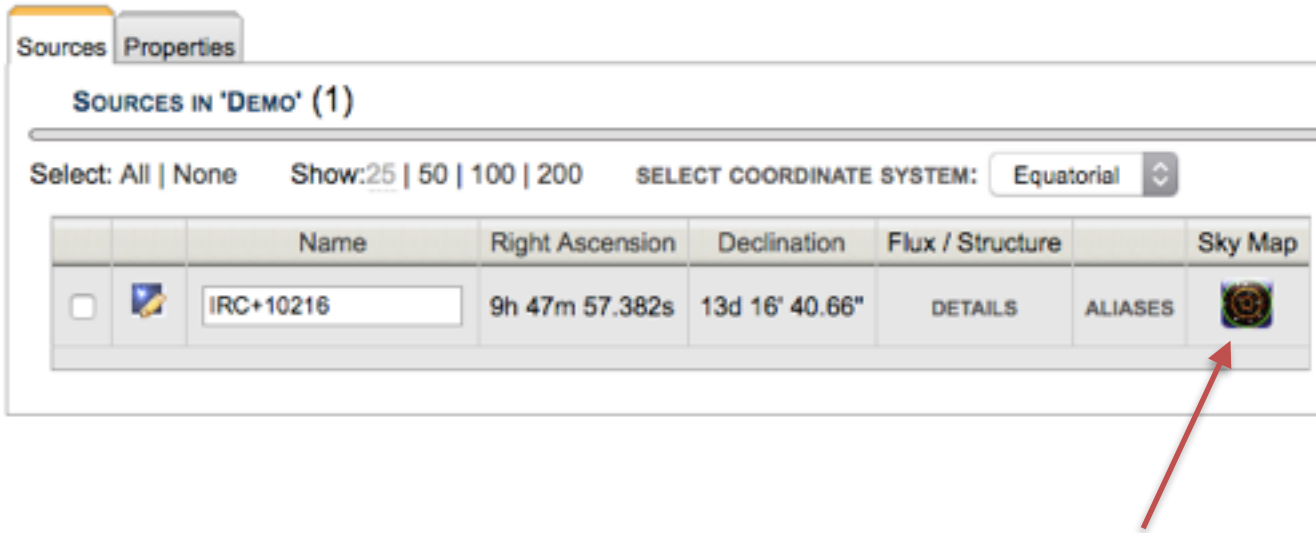
# Step 1 Determine & Select Calibrators

Target source: IRC+10216
RA (J2000): 09h 47m 57.382s
DEC (J2000): +13d 16’ 40.66”
LST range: 05:40–13:50

- What calibrators are needed?
  - Complex Gain (amplitude and phase)
  - Flux Density Scale
  - Bandpass
  - Delay
  - Reference Pointing in X-band (within 10°)

# Step 1 Finding a Complex Gain Calibrator




Select the Catalog to view the source list.

Click on the Sky Map icon for a Bullseye view of the nearby calibrators.

# Step 1 Finding a Complex Gain Calibrator (Bullseye view)

**J0954+1743 is appropriate for both complex gain and reference pointing (X-band flux density is ≥ 0.3Jy)**


## J0954+1743

*Aliases:* 0954+177 B0952+1757 0952+179

*Positions:*
*RA:* 9h 54m 56.824s
*Dec:* 17° 43' 31.222"

*Uncertainties (mas):*
*RA:* 2.0
*Dec:* 2.0

*Flux / Structure*

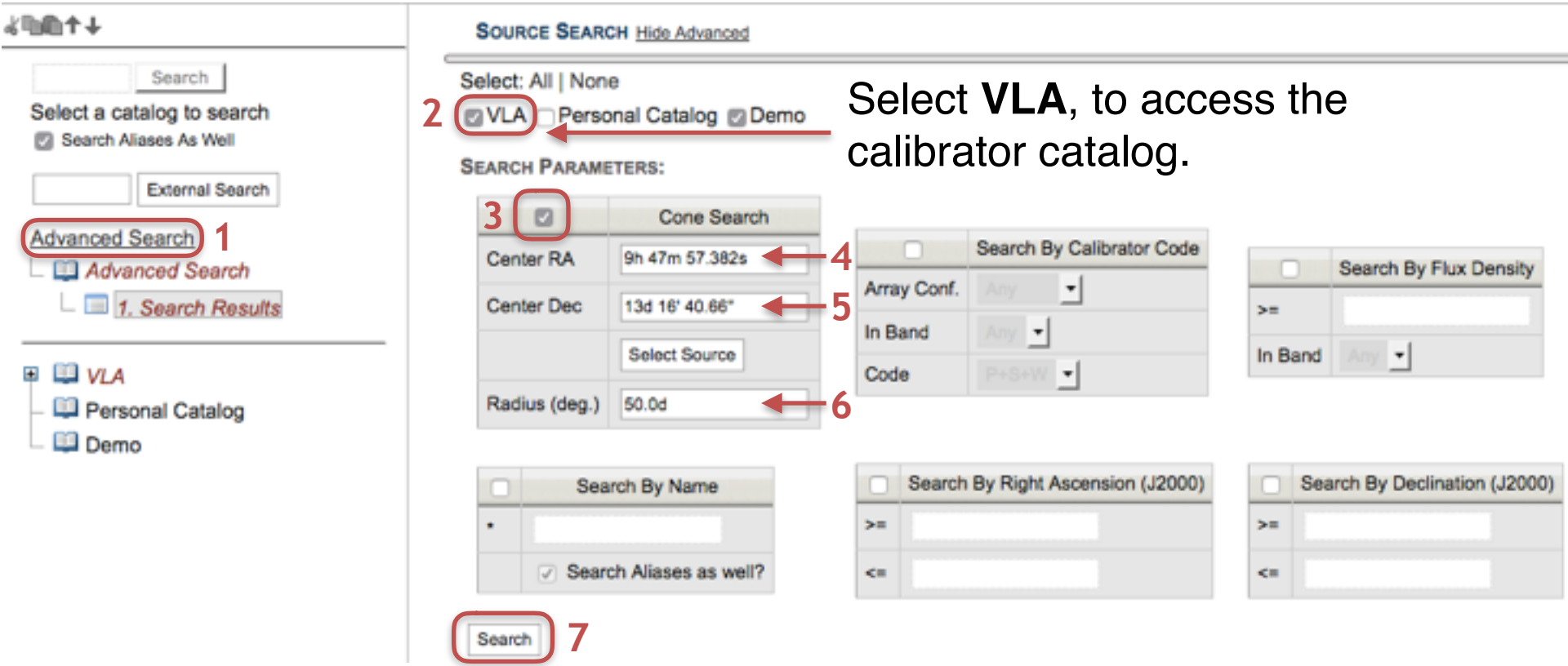
| Band | Flux | A | B | C | D | $UV_{min}$ (kλ) | $UV_{max}$ (kλ) |
|---|---|---|---|---|---|---|---|
| L (20.0cm) | 1.1Jy | P | X | X | X | 45.0 | |
| C (5.0cm) | 0.7Jy | S | S | S | X | 20.0 | |
| X (3.0cm) | 0.61Jy | P | P | P | P | | |
| Ku (2.0cm) | 0.6Jy | S | S | S | S | | |
| Q (0.7cm) | 0.4Jy | W | W | W | W | | |

*Velocities:*
No Information

*Images:*
None

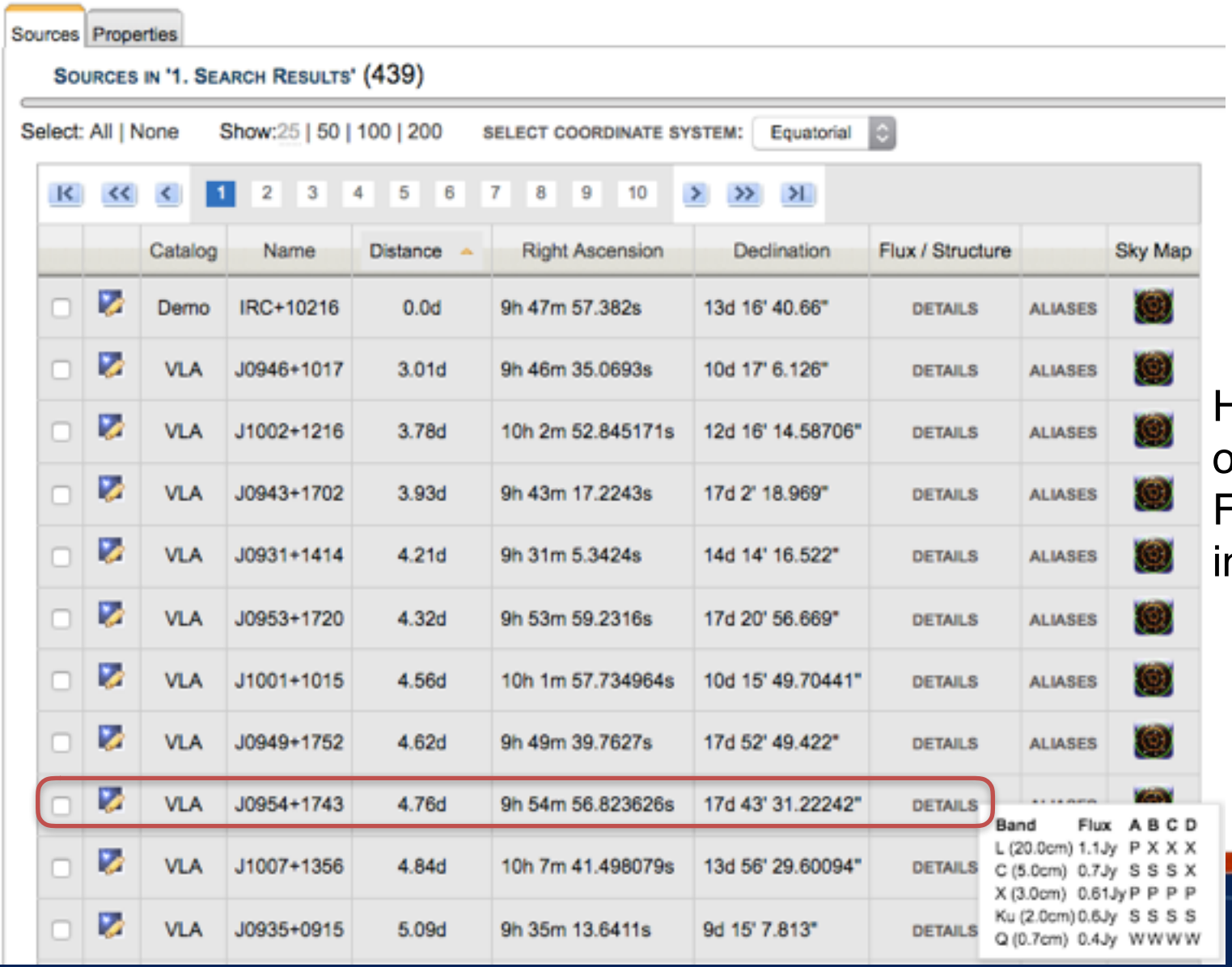
# Step 1 Advanced Search: Cone Search

Enter target source coordinates (09:47:57.382, 13:16:40.66) to search for an appropriate phase calibrator.




Select **VLA**, to access the calibrator catalog.

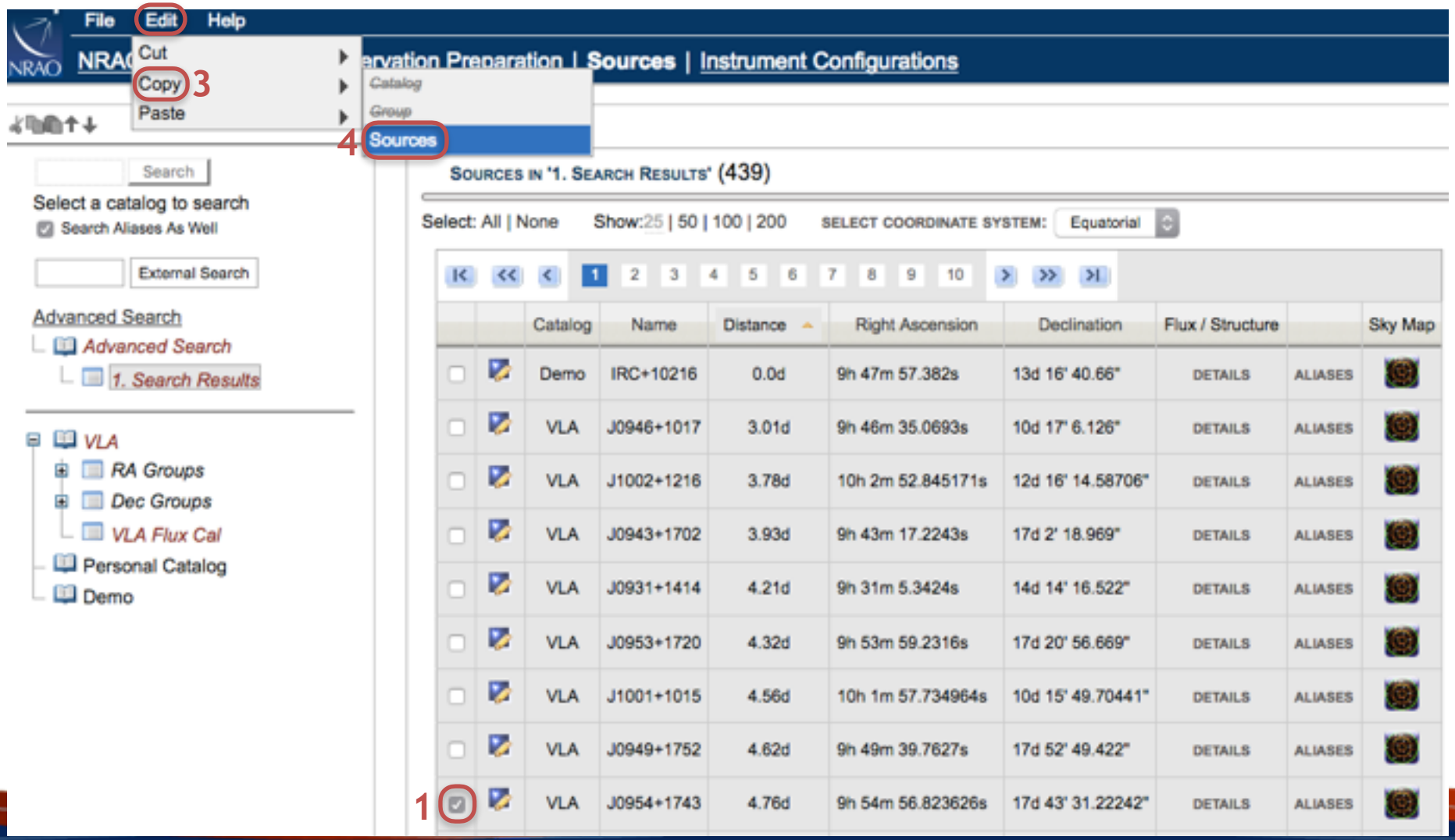
# Step 1 Cone Search Results




Hover mouse over **Details** for Flux / Structure information.

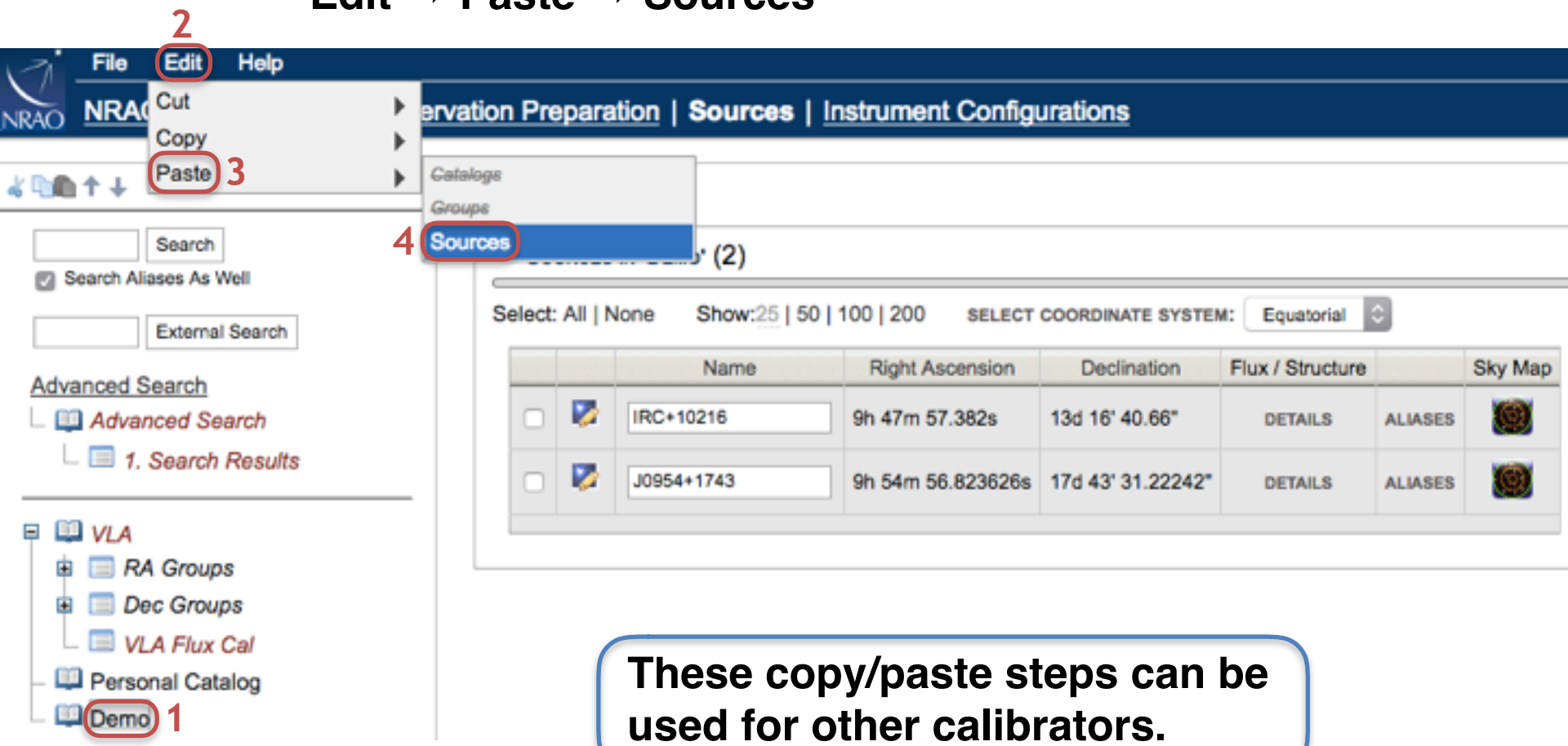
# Step 1 Copy Calibrator from VLA Catalog

**Edit → Copy → Sources**



# Step 1 Paste Calibrator to Your Source Catalog

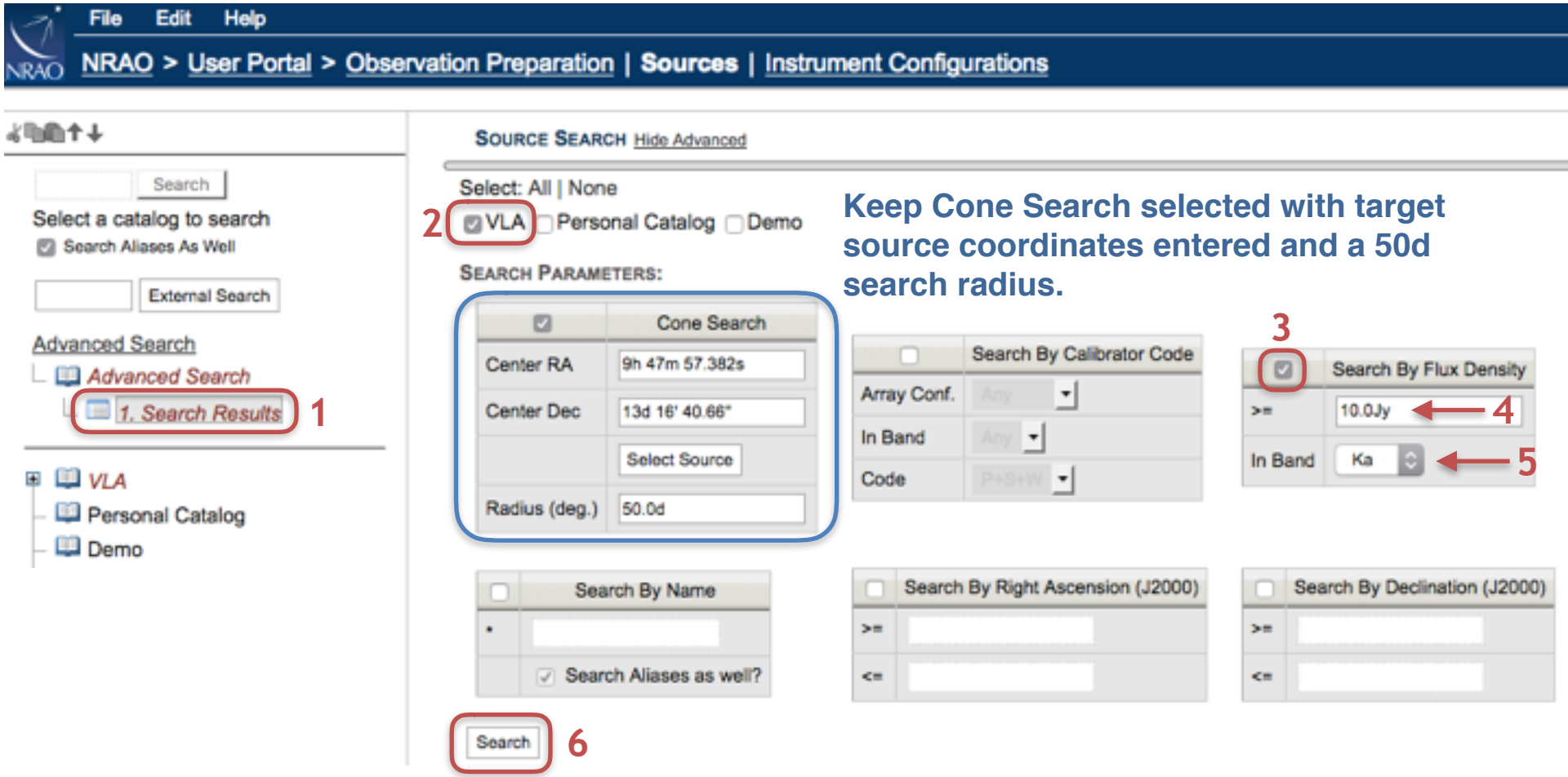
**Edit → Paste → Sources**




**These copy/paste steps can be used for other calibrators.**

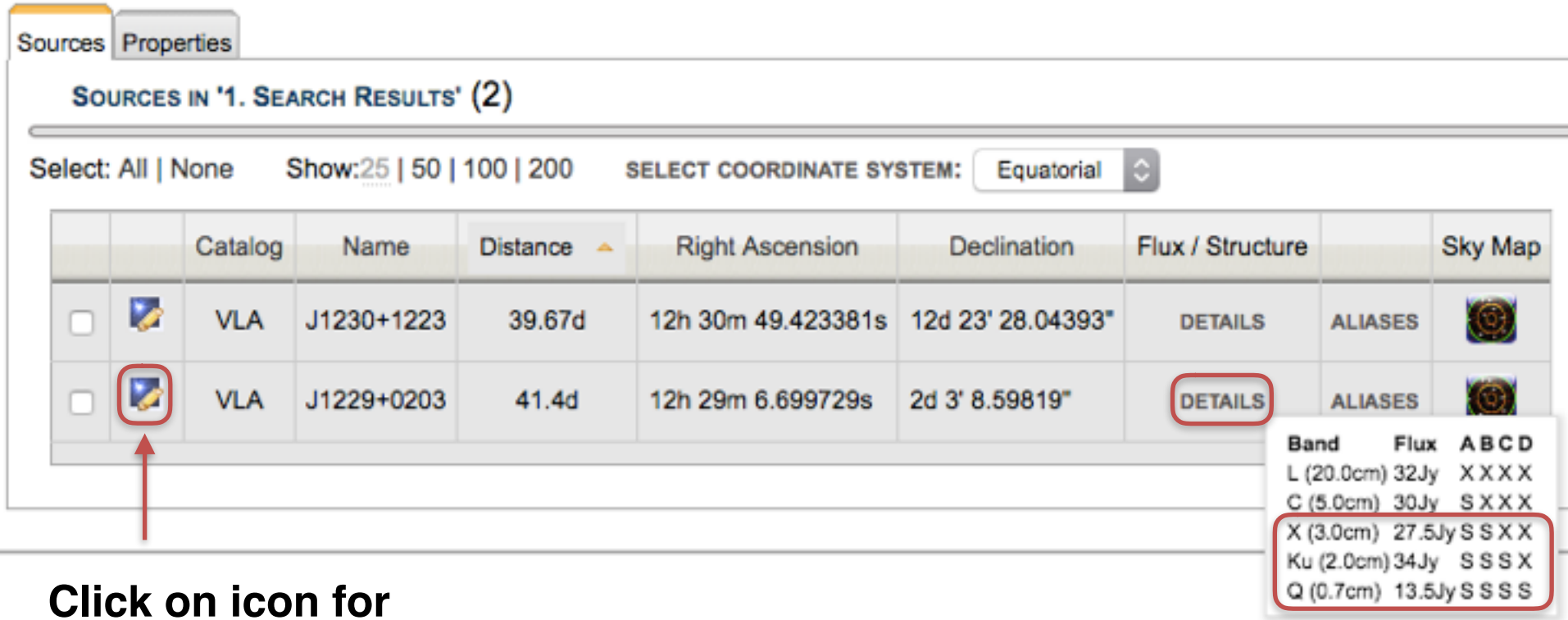
# Step 1 Advanced Search for Bandpass Calibrator

## Search By Flux Density



# Step 1 Bandpass Calibration Search Results

**J1229+0203 is a good bandpass and delay calibrator candidate, but not appropriate for X-band reference pointing.**



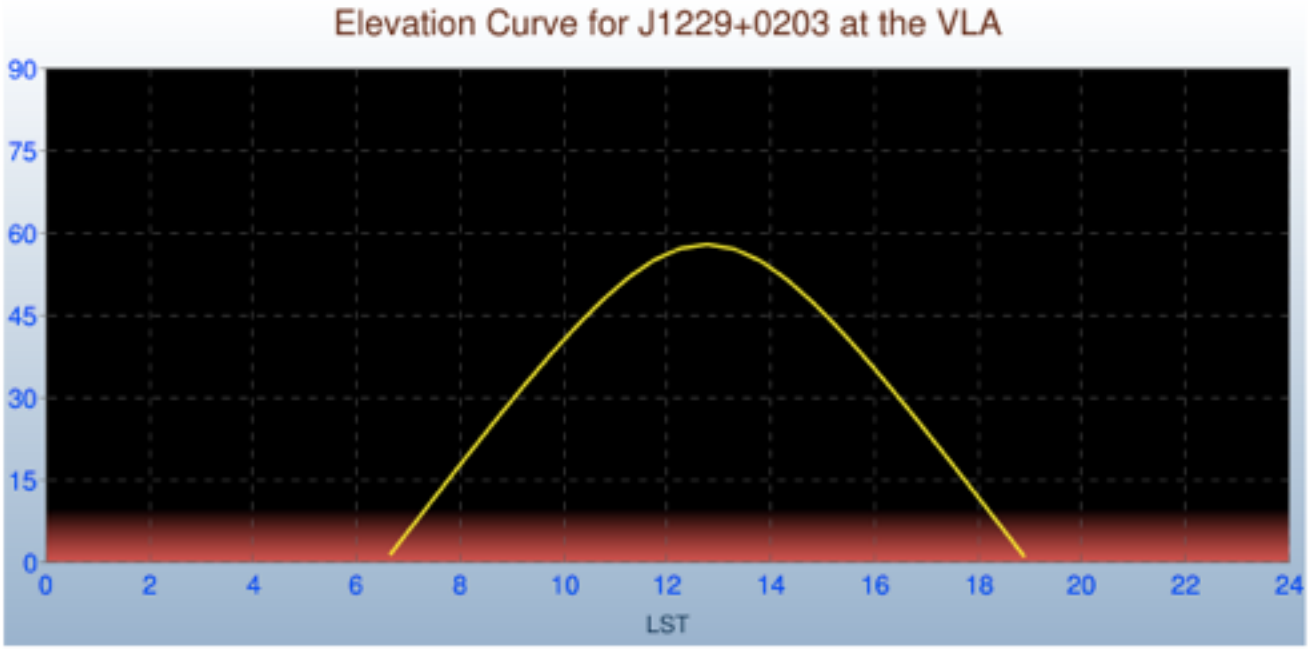

**Click on icon for source information.**

# Step 1 Images Tab: Check LST Range

**J1229+0203 LST range falls within the LST range of IRC+10216.**
**08:55–16:00 LST (30° < EL < 80°)**

J1229+0203 | Images | Notes

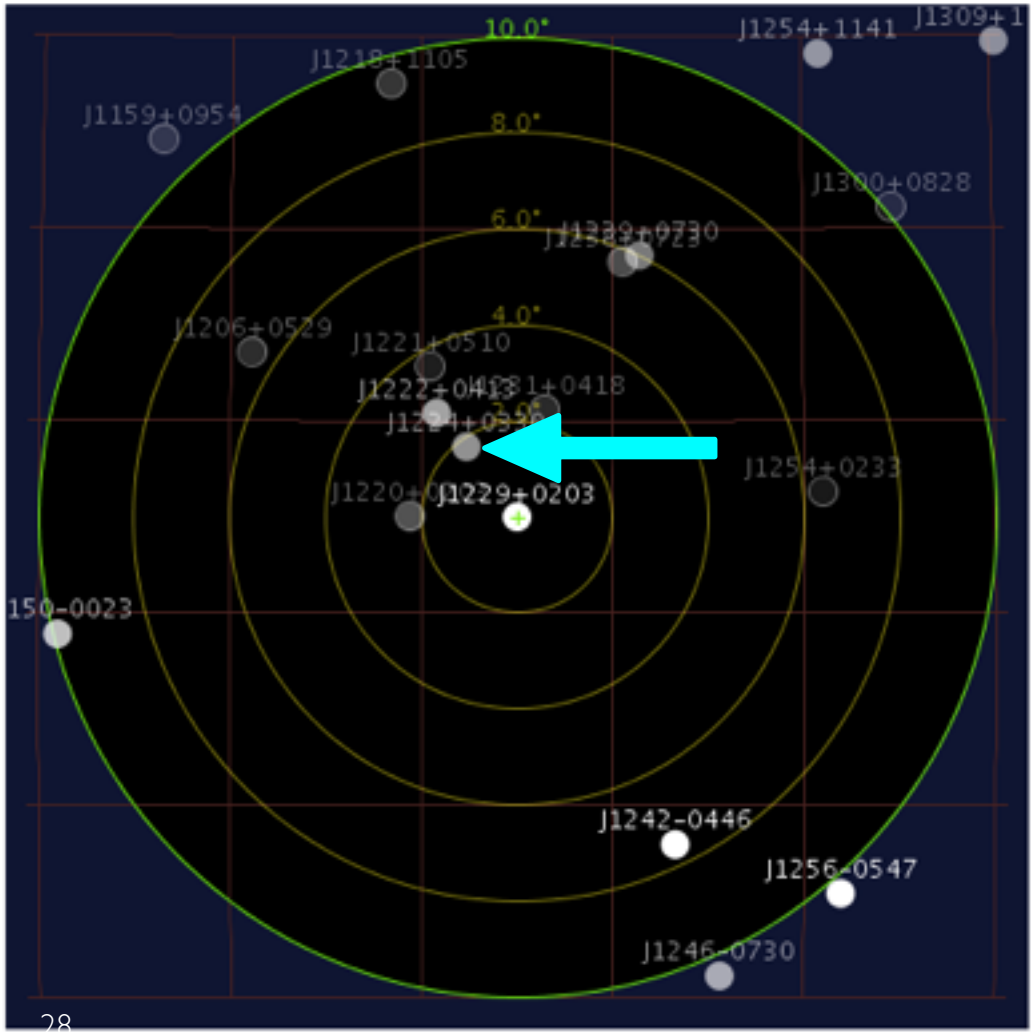
VISIBILITY CHART




| Elevation | LST (Rising) | LST (Setting) |
|---|---|---|
| 8 | 07:02 | 17:56 |
| 10 | 07:12 | 17:46 |
| 15 | 07:36 | 17:22 |
| 20 | 08:01 | 16:58 |
| 25 | 08:26 | 16:33 |
| 30 | 08:51 | 16:07 |
| 80 | | |

# Step 1 Bandpass/Delay Cal Reference Pointing

**J1224+0330 is an appropriate X-band reference pointing source for J1229+0203.**




## J1224+0330

*Aliases:* 1224+035 B1222+0347 1222+037

*Positions:*
*RA:* 12h 24m 52.422s
*Dec:* 3° 30' 50.293"

*Uncertainties (mas):*
*RA:* 10.0
*Dec:* 10.0

*Flux / Structure*

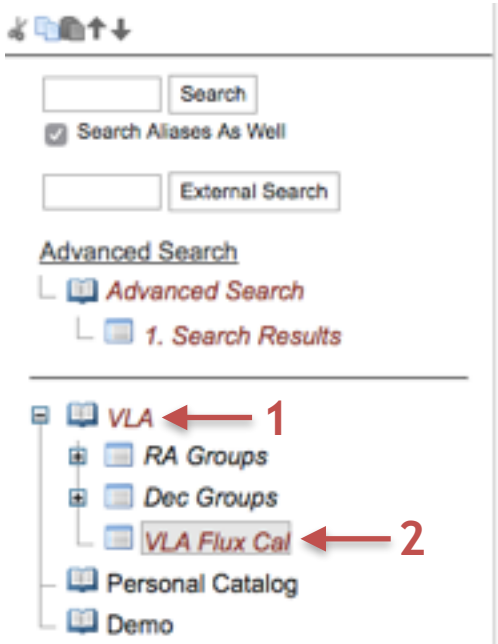
| Band | Flux | A | B | C | D | $UV_{min}$ (kλ) | $UV_{max}$ (kλ) |
|---|---|---|---|---|---|---|---|
| L (20.0cm) | 1.1Jy | S | S | S | X | 6.0 | |
| C (5.0cm) | 1Jy | P | P | P | P | | |
| X (3.0cm) | 1.04Jy | P | P | P | P | | |
| Ku (2.0cm) | 1.1Jy | P | P | P | P | | |
| Q (0.7cm) | 0.8Jy | S | S | S | S | | |

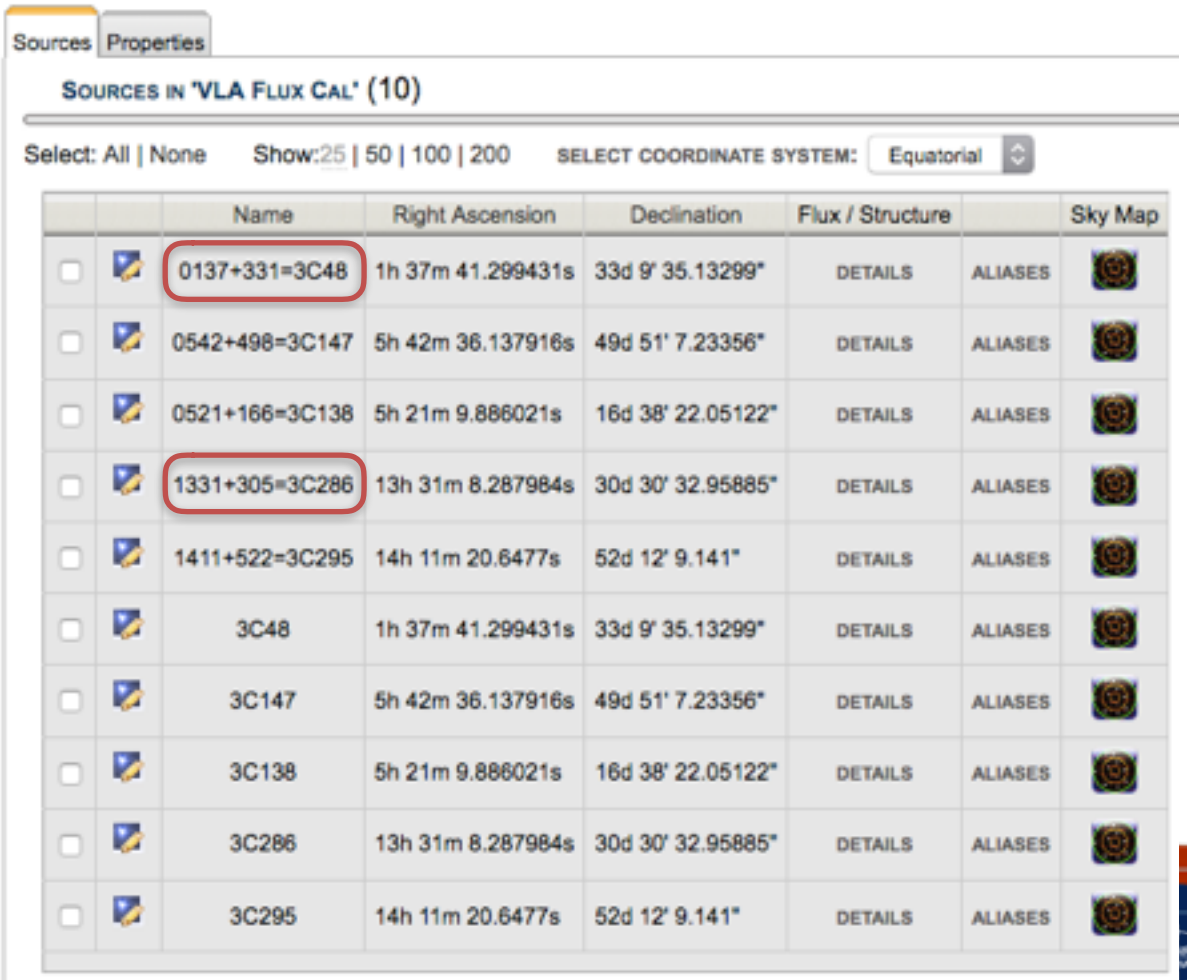
*Velocities:*
No Information

*Images:*
1224+035.1.png
1224+035.uv.png

# Step 1 Choose a Flux Density Calibrator

**Choose from one of the standard VLA flux density scale calibrators.**
3C286 and 3C48 are recommended for high frequency observing

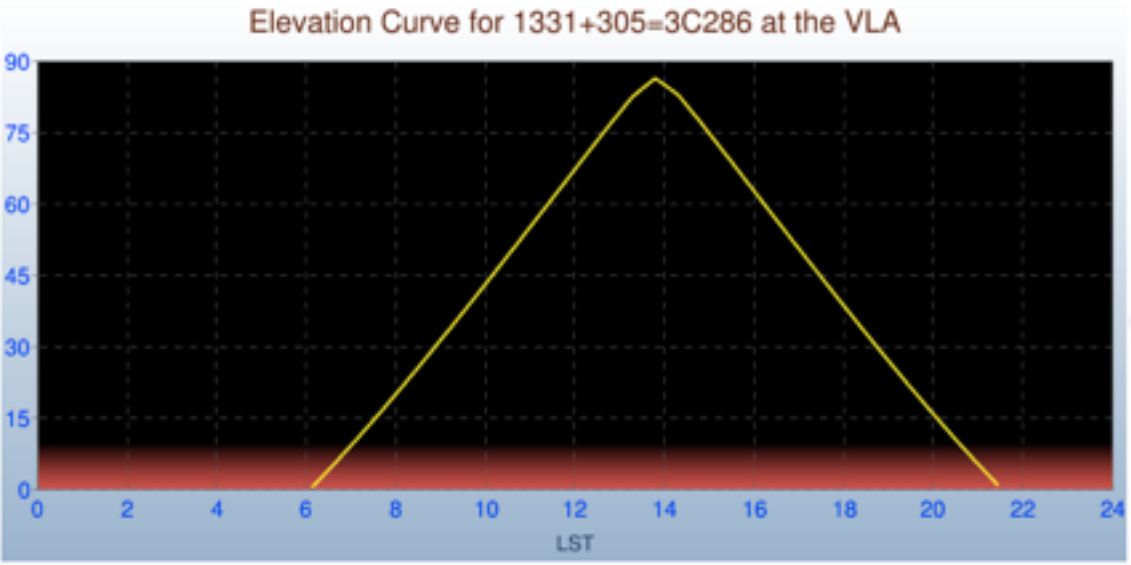



| Name | Right Ascension | Declination | Flux / Structure | | Sky Map |
|---|---|---|---|---|---|
| 0137+331=3C48 | 1h 37m 41.299431s | 33d 9' 35.13299" | DETAILS | ALIASES | |
| 0542+498=3C147 | 5h 42m 36.137916s | 49d 51' 7.23356" | DETAILS | ALIASES | |
| 0521+166=3C138 | 5h 21m 9.886021s | 16d 38' 22.05122" | DETAILS | ALIASES | |
| 1331+305=3C286 | 13h 31m 8.287984s | 30d 30' 32.95885" | DETAILS | ALIASES | |
| 1411+522=3C295 | 14h 11m 20.6477s | 52d 12' 9.141" | DETAILS | ALIASES | |
| 3C48 | 1h 37m 41.299431s | 33d 9' 35.13299" | DETAILS | ALIASES | |
| 3C147 | 5h 42m 36.137916s | 49d 51' 7.23356" | DETAILS | ALIASES | |
| 3C138 | 5h 21m 9.886021s | 16d 38' 22.05122" | DETAILS | ALIASES | |
| 3C286 | 13h 31m 8.287984s | 30d 30' 32.95885" | DETAILS | ALIASES | |
| 3C295 | 14h 11m 20.6477s | 52d 12' 9.141" | DETAILS | ALIASES | |

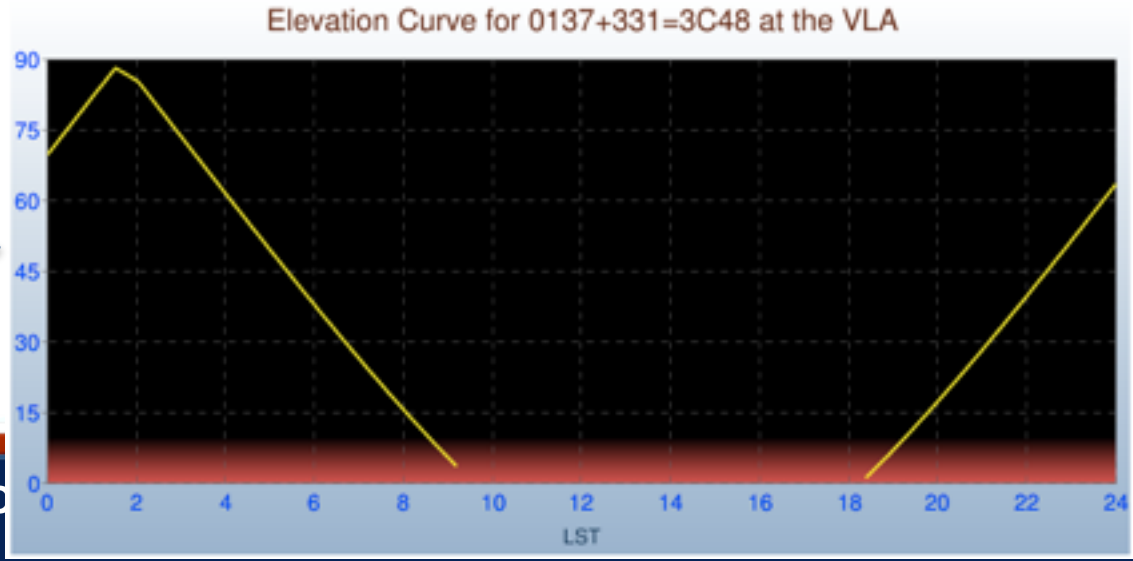
# Step 1 Choose a Flux Density Calibrator

IRC+10216
LST range: 05:40–13:50



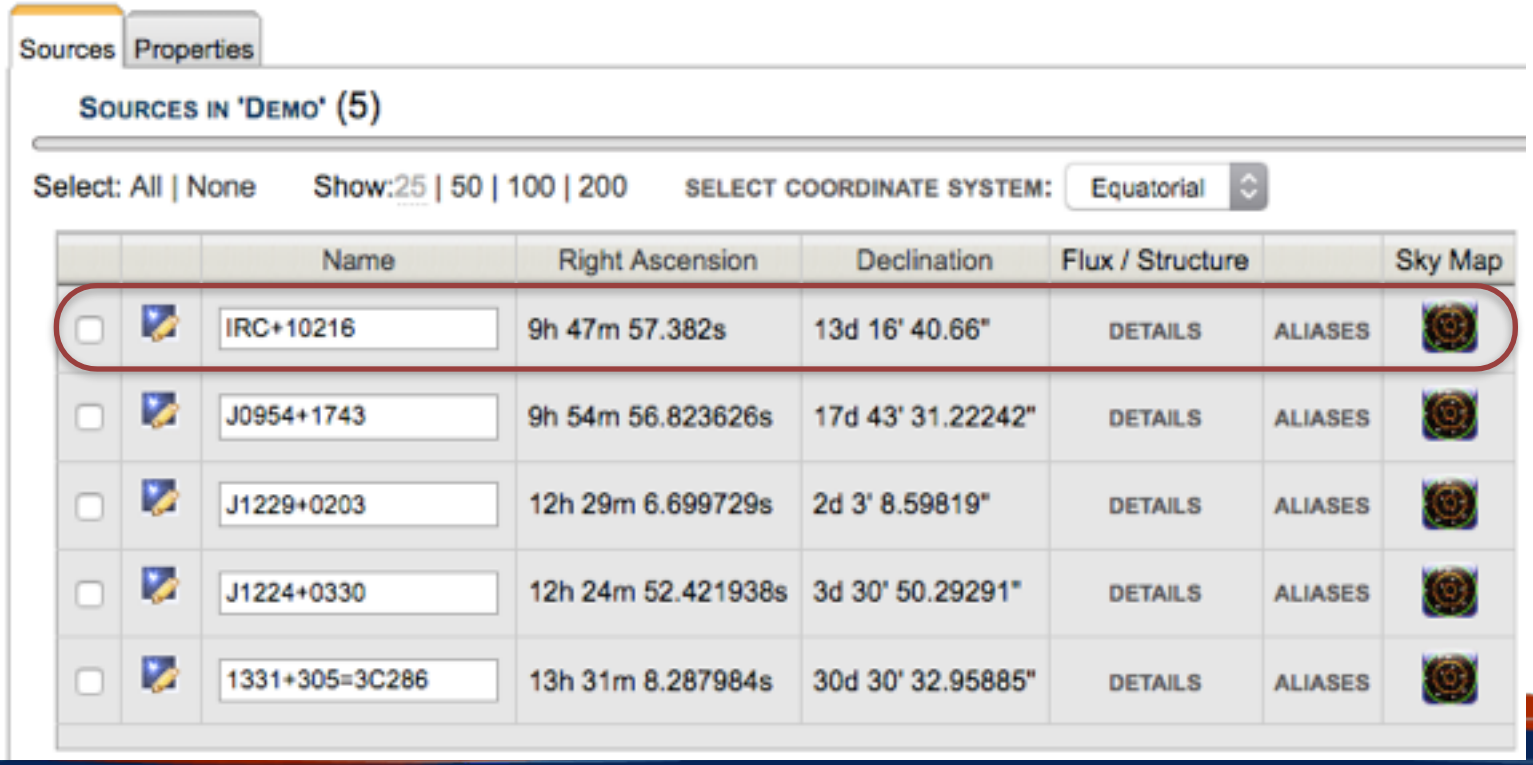

3C286 LST range:
08:40–12:45 or 14:15–18:25
(30° < EL < 80°)

3C48 LST range:
20:45–00:50 or 02:30–06:30
(30° < EL < 80°)



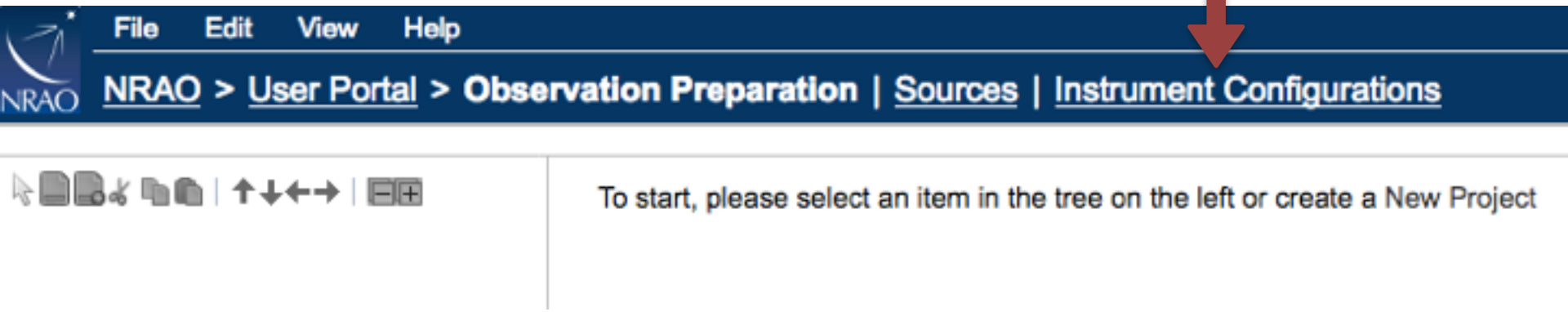
# Step 1 Source Catalog is Complete

IRC+10216 → Science Target
J0954+1743 → Complex Gain Calibrator (plus reference pointing)
J1229+0203 → Bandpass & Delay Calibrator
J1224+0330 → Reference Pointing Calibrator for Bandpass/Delay
3C286 → Flux Density Scale Calibrator (plus reference pointing)



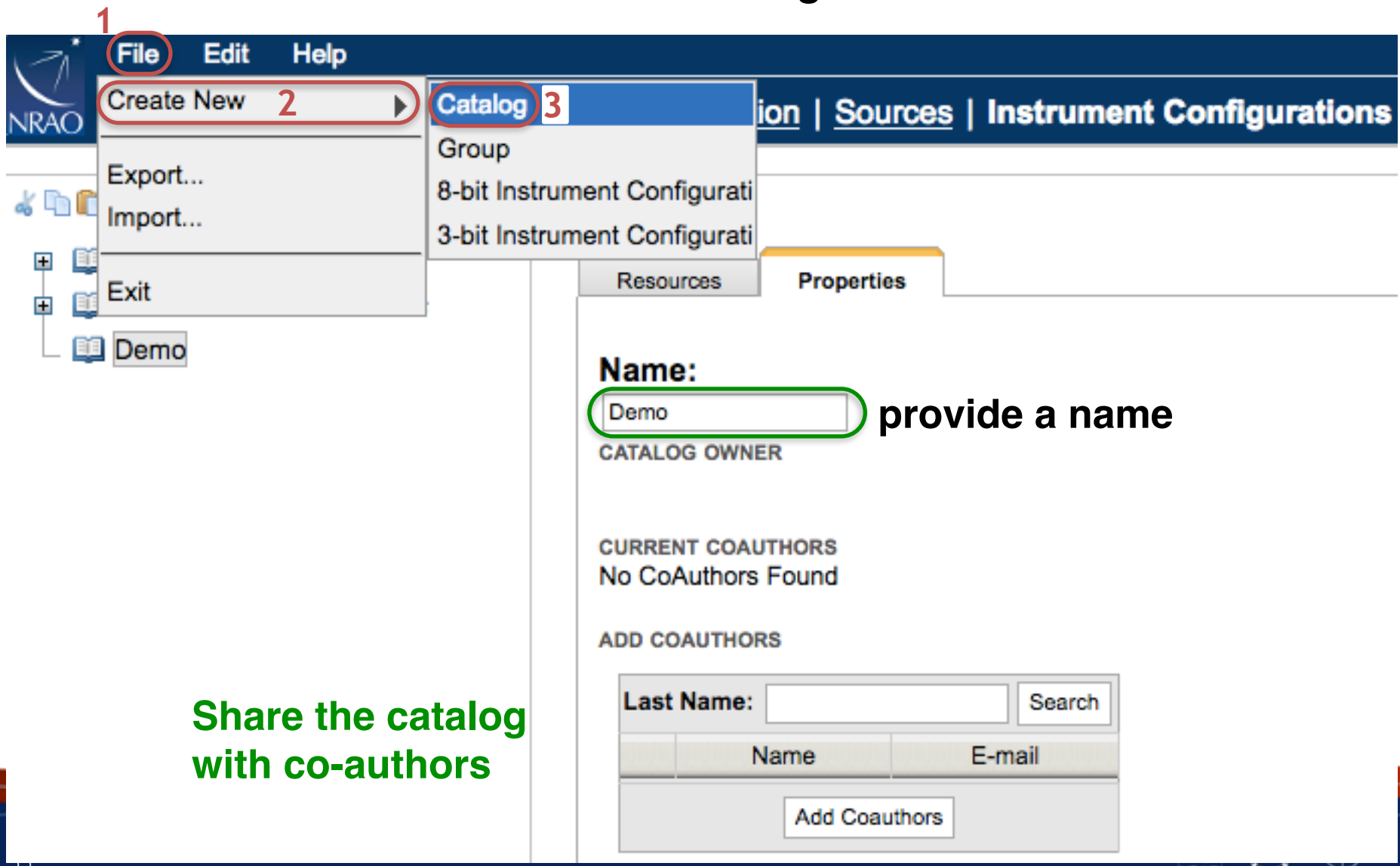
# Step 2 Accessing the Resource Catalog Tool

**In the OPT: click on Instrument Configurations**



# Step 2 Create a Resource Catalog

**File → Create New → Catalog**




**Share the catalog with co-authors**

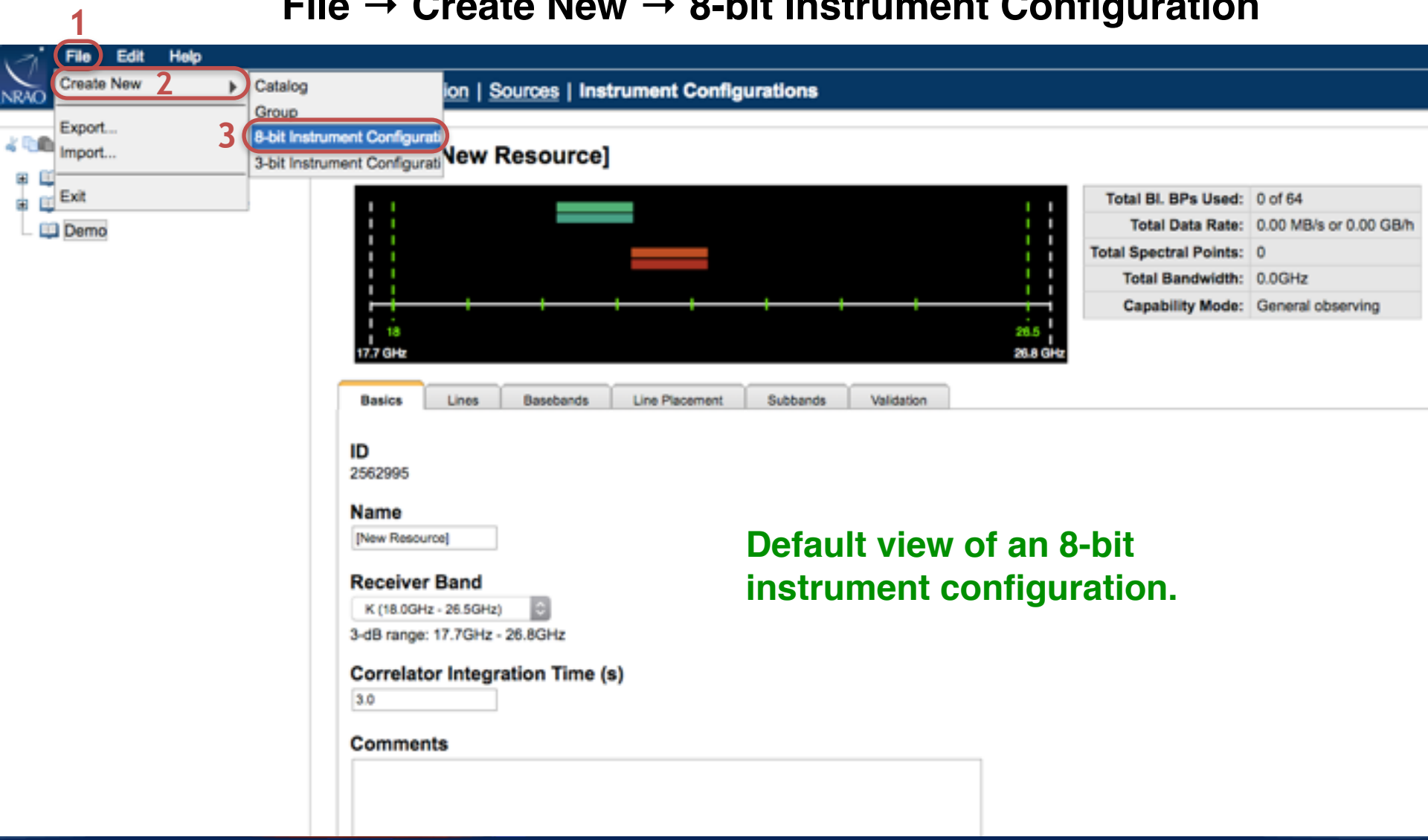
# Step 2 Resource to be Created

Ka-band 8-bit instrument configuration

- Spectral Lines
  - HC3N ($\nu_o$= 36.39232 GHz)
  - SiS ($\nu_o$= 36.30963 GHz)
  - V (radio, LSR) = −26 km/s
  - $\Delta V \sim 35$ km/s

# Step 2 Create a Resource in the Catalog

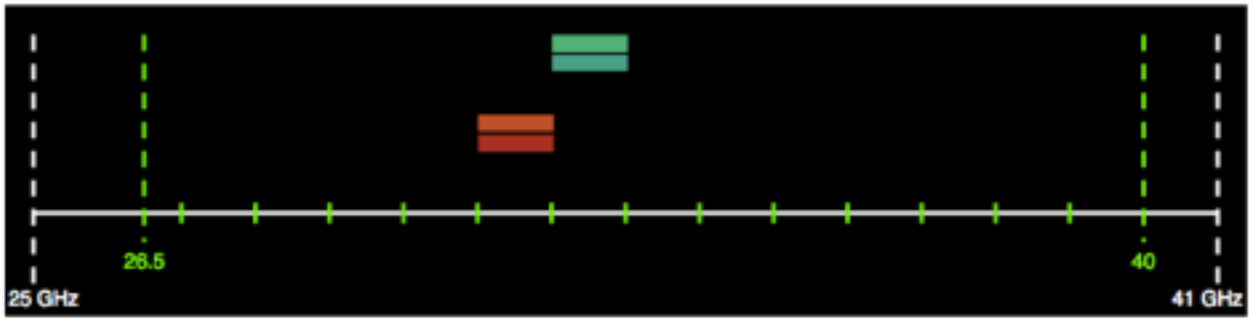
**File → Create New → 8-bit Instrument Configuration**




**Default view of an 8-bit instrument configuration.**

# Step 2 Basics Tab

## Demo » Ka-band demo




| | |
|---|---|
| Total BI. BPs Used: | 0 of 64 |
| Total Data Rate: | 0.00 MB/s or 0.00 GB/h |
| Total Spectral Points: | 0 |
| Total Bandwidth: | 0.0GHz |
| Capability Mode: | General observing |

Basics | Lines | Basebands | Line Placement | Subbands | Validation

**ID**
2517977

**Name**
Ka-band demo ← provide a name

**Receiver Band**
Ka (26.5GHz - 40.0GHz) ← select receiver band: Ka (26.5GHz - 40.0GHz)
1-dB range: 26.0GHz - 40.0GHz
3-dB range: 25.0GHz - 41.0GHz

**Correlator Integration Time (s)**
3.0 ← adjust the correlator integration time according to array configuration (3 sec for D-config)

**Comments**

# Step 2 Create a Spectral Line Resource

1. **Lines Tab:** Enter source position and line setup.
   - HC3N ($\nu_o$= 36.39232 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)
   - SiS ($\nu_o$= 36.30963 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)

2. **Basebands Tab:** Adjust the baseband center frequencies as needed and turn on the Doppler Line setting.

3. **Line Placement Tab:** Generate the lines within the basebands.

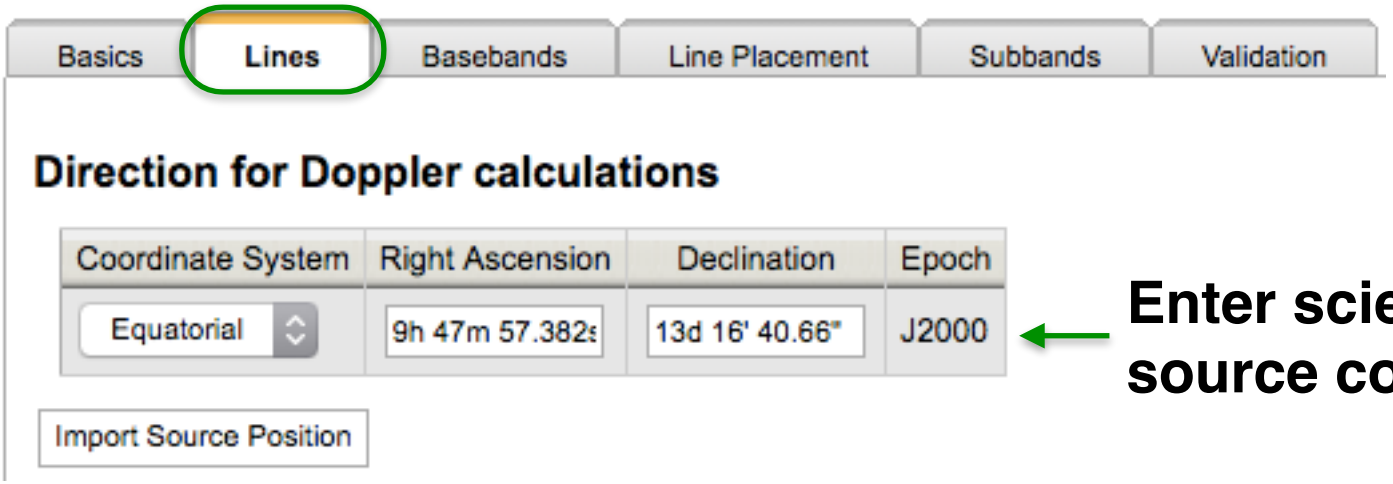
4. **Subbands Tab:** Check the location of the lines to see where they fall relative to the 128 MHz boundaries (should be > 6 MHz from them).

5. **Validation Tab:** Check for errors and warnings.

Once we import the resource into an SB within the OPT, we will then be able to double check the center frequency calculations using the Dopset tool.

# Step 2 Lines Tab

**Enter source position**
**09:47:57.382, 13:16:40.66**




**Enter science target source coordinates.**

# Step 2 Lines Tab

Enter spectral line information

HC3N ($\nu_o$= 36.39232 GHz)

SiS ($\nu_o$= 36.30963 GHz)

V (radio, LSR) = -26 km/s

$\Delta V \sim 35$ km/s

**Spectral line frequencies and coverage**

| | Line | Rest Frequency | Rest Frame | Convention | Velocity | Minimum Range | Channel Separation | Polarization | Use Recirculation? | Bl.BPs Required | Delete |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | HC3N | 36.39232<br>36.396GHz | LSR | Radio (km/s) | -26.0 km/s | 35.0 km/s<br>4.249MHz | 2.0 km/s<br>242.783kHz | Full | ☑ | 1 | ⊖ |

Add Line | Copy Last Line | Download Spectral Lines | Import Spectral Lines...

**Add Line**

# Step 2 Lines Tab

Enter spectral line information

HC3N ($\nu_o$= 36.39232 GHz)

SiS ($\nu_o$= 36.30963 GHz)

V (radio, LSR) = -26 km/s

$\Delta V \sim 35$ km/s

**Spectral line frequencies and coverage**

| | Line | Rest Frequency | Rest Frame | Convention | Velocity | Minimum Range | Channel Separation | Polarization | Use Recirculation? | Bl.BPs Required | Delete |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | HC3N | 36.39232<br>36.396GHz | LSR | Radio (km/s) | -26.0 km/s | 35.0 km/s<br>4.249MHz | 2.0 km/s<br>242.783kHz | Full | ☑ | 1 | ⊖ |
| L2 | SiS | 36.30963<br>36.313GHz | LSR | Radio (km/s) | -26.0 km/s | 35.0 km/s<br>4.239MHz | 2.0 km/s<br>242.232kHz | Full | ☑ | 1 | ⊖ |

Add Line | Copy Last Line | Download Spectral Lines | Import Spectral Lines...

Copy Last Line

# Step 2 Lines Tab

Take note of these two calculated values:
**36.396 GHz** and **36.313 GHz**

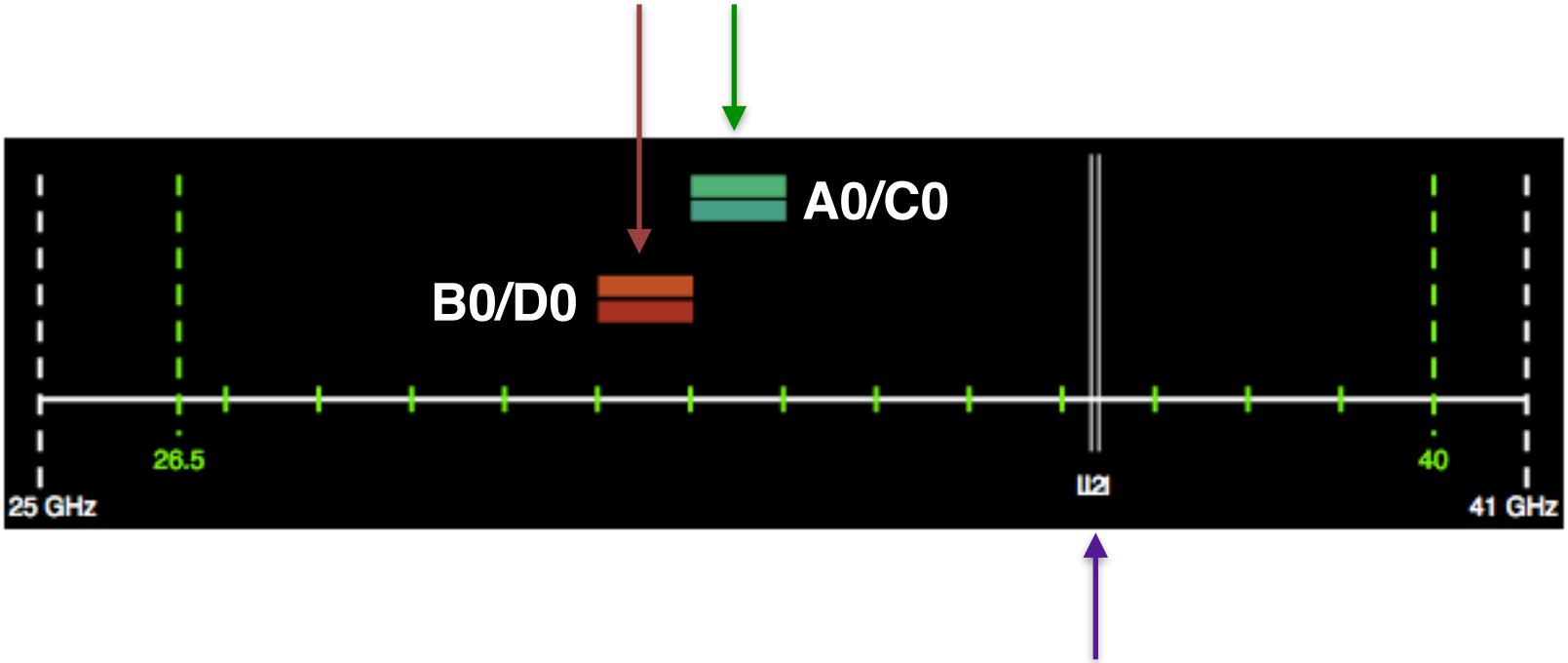
**Spectral line frequencies and coverage**

| | Line | Rest Frequency | Rest Frame | Convention | Velocity | Minimum Range | Channel Separation | Polarization | Use Recirculation? | BI.BPs Required | Delete |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | HC3N | 36.396GHz | LSR | Radio (km/s) | -26.0 km/s | 35.0 km/s 4.249MHz | 2.0 km/s 242.783kHz | Full | ☑ | 1 | ⊖ |
| L2 | SiS | 36.313GHz | LSR | Radio (km/s) | -26.0 km/s | 35.0 km/s 4.239MHz | 2.0 km/s 242.232kHz | Full | ☑ | 1 | ⊖ |

Add Line | Copy Last Line | Download Spectral Lines | Import Spectral Lines...

# Step 2 Ka-band Spectral Line Resource

**The two 1 GHz wide basebands of the 8-bit samplers.**




**We need to adjust the baseband center frequencies so they overlap with the lines.**

# Step 2 Create a Spectral Line Resource

1. **Lines Tab:** Enter source position and line setup.
   - HC3N ($\nu_o$= 36.39232 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)
   - SiS ($\nu_o$= 36.30963 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)

2. **Basebands Tab:** Adjust the baseband center frequencies as needed and turn on the Doppler Line setting.

3. **Line Placement Tab:** Generate the lines within the basebands.

4. **Subbands Tab:** Check the location of the lines to see where they fall relative to the 128 MHz boundaries (should be > 6 MHz from them).

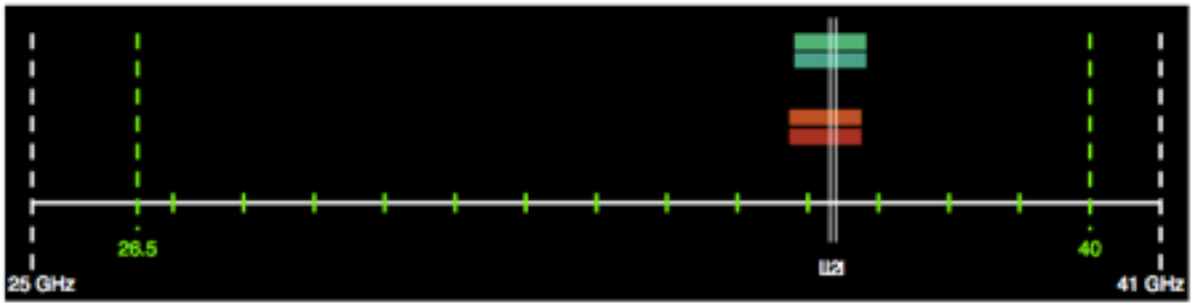
5. **Validation Tab:** Check for errors and warnings.

Once we import the resource into an SB within the OPT, we will then be able to double check the center frequency calculations using the Dopset tool.

# Step 2 Basebands Tab

Adjust baseband center frequencies and turn on the Doppler Line setting for HC3N in A0/C0 and SiS in B0/D0. (Ignore the error message at the bottom of the Basebands tab. It is generated because there are no subbands within the basebands.)

**Demo » Ka-band demo**




| | |
|---|---|
| Total BI. BPs Used: | 0 of 64 |
| Total Data Rate: | 0.00 MB/s or 0.00 GB/h |
| Total Spectral Points: | 0 |
| Total Bandwidth: | 0.0GHz |
| Capability Mode: | General observing |

Basics | Lines | **Basebands** | Line Placement | Subbands | Validation

**Sampler Input Mode**

Two 1-GHz 8-bit samplers (A0/C0 and B0/D0)

| Name | Bits | Center Frequency | Sky Range |
|---|---|---|---|
| A0/C0 1.024GHz | 8 | 36.32GHz | 35.808GHz - 36.832GHz |
| B0/D0 1.024GHz | 8 | 36.25GHz | 35.738GHz - 36.762GHz |

← A0/C0 adjust to 36.32 GHz

← B0/D0 adjust to 36.25 GHz

| Name | Doppler Line | Offset From Center | Target Sky Frequency | Position | Velocity | Rest Frame | Convention |
|---|---|---|---|---|---|---|---|
| A0/C0 | HC3N - 36.392GHz | -75.521MHz | 36.396GHz | 9h 47m 57.382s 13d 16' 40.66" | -26.0km/s | Lsr Kinematic | Radio |
| B0/D0 | SiS - 36.310GHz | -62.824MHz | 36.313GHz | 9h 47m 57.382s 13d 16' 40.66" | -26.0km/s | Lsr Kinematic | Radio |

# Step 2 Create a Spectral Line Resource

1. **Lines Tab:** Enter source position and line setup.
   - HC3N ($\nu_o$= 36.39232 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)
   - SiS ($\nu_o$= 36.30963 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)

2. **Basebands Tab:** Adjust the baseband center frequencies as needed and turn on the Doppler Line setting.

3. **Line Placement Tab:** Generate the lines within the basebands.

4. **Subbands Tab:** Check the location of the lines to see where they fall relative to the 128 MHz boundaries (should be > 6 MHz from them).

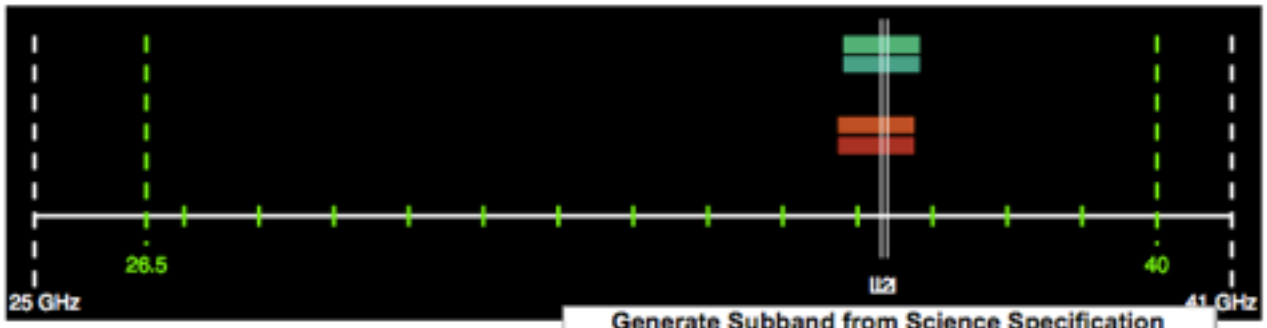
5. **Validation Tab:** Check for errors and warnings.

Once we import the resource into an SB within the OPT, we will then be able to double check the center frequency calculations using the Dopset tool.

# Step 2 Line Placement Tab

**Generate the HC3N line within the A0/C0 baseband.**

Demo » Ka-band demo




| | |
|---|---|
| Total Bl. BPs Used: | 0 of 64 |
| Total Data Rate: | 0.00 MB/s or 0.00 GB/h |
| Total Spectral Points: | 0 |
| Total Bandwidth: | 0.0GHz |
| Capability Mode: | General observing |

Basics | Lines | Basebands | Line Pl

| | Line | Rest Frequency | Rest Frame | C | Use Recirculation? | Bl.BPs Required | Generate |
|---|---|---|---|---|---|---|---|
| L1 | HC3N | 36.39232GHz 36.396GHz | Lsr Kinematic | F | Yes | 1 | Generate |
| L2 | SiS | 36.30963GHz 36.313GHz | Lsr Kinematic | F | Yes | 1 | Generate |

1

**Generate Subband from Science Specification**

Using line **HC3N - 36.39232GHz**

**Baseband**

A0/C0 ← 2

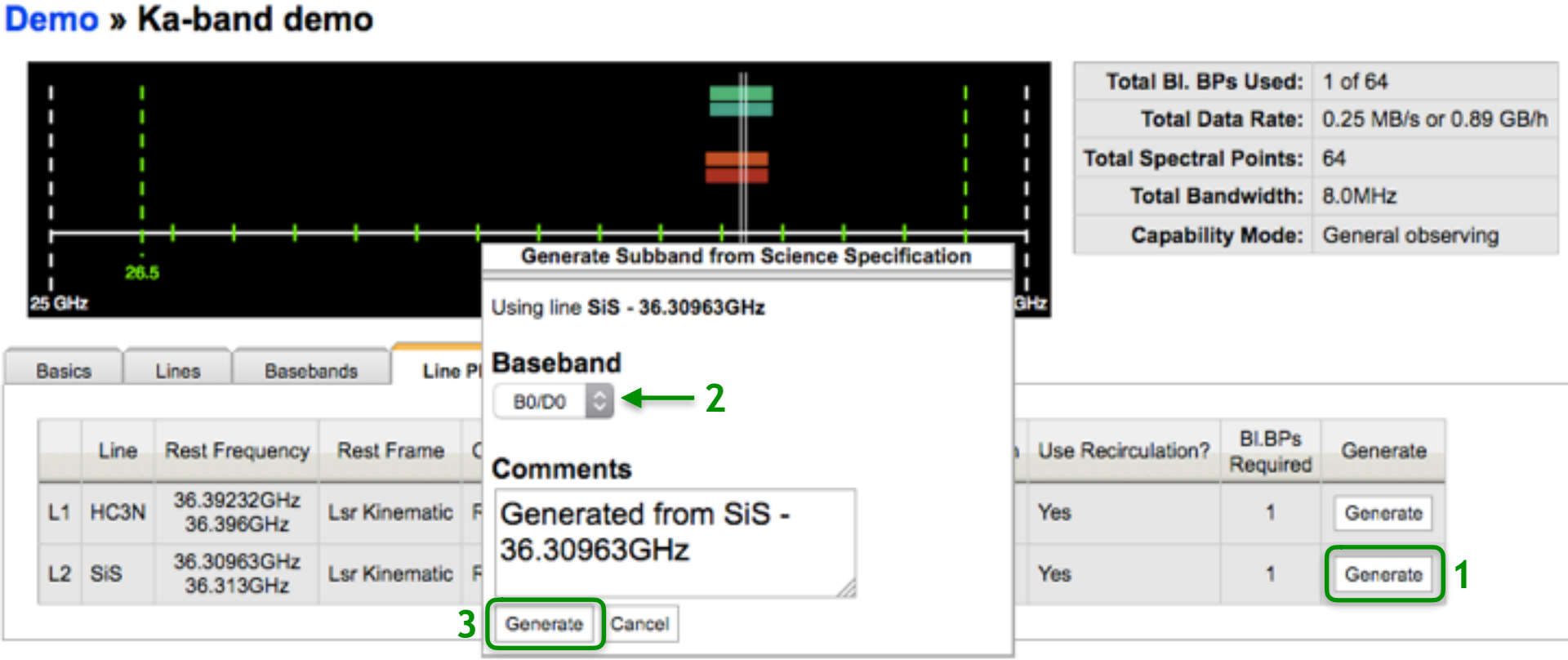
**Comments**

Generated from HC3N - 36.39232GHz

3 Generate Cancel

# Step 2 Line Placement Tab

**Generate the SiS line within the B0/D0 baseband.**



# Step 2 Create a Spectral Line Resource

1. **Lines Tab:** Enter source position and line setup.
   - HC3N ($\nu_o$= 36.39232 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)
   - SiS ($\nu_o$= 36.30963 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)

2. **Basebands Tab:** Adjust the baseband center frequencies as needed and turn on the Doppler Line setting.

3. **Line Placement Tab:** Generate the lines within the basebands.

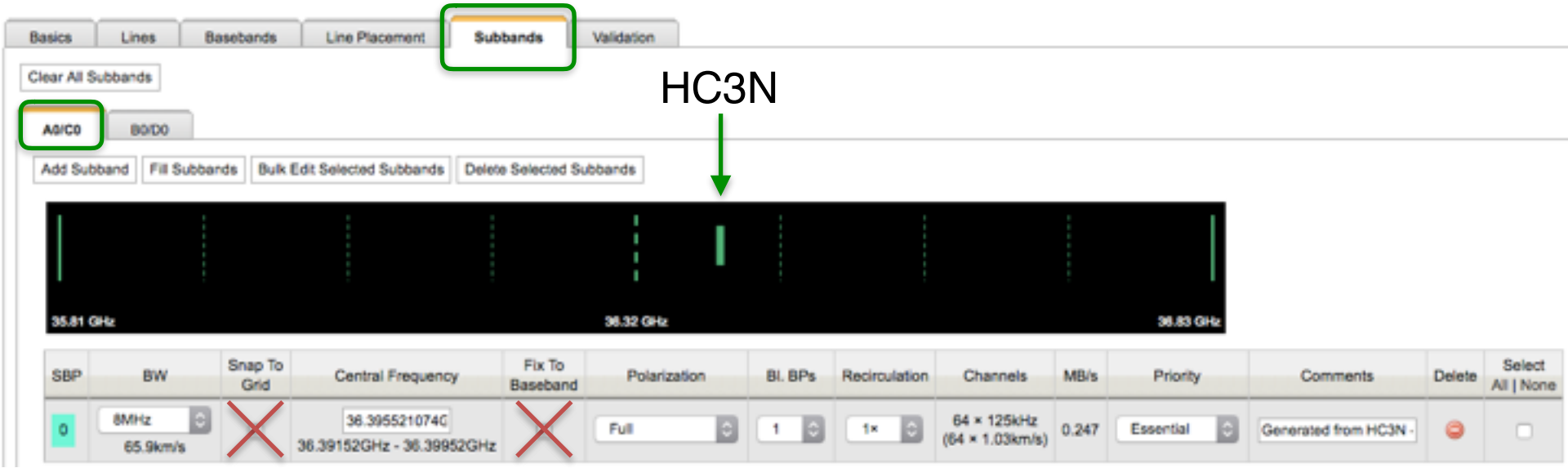
4. **Subbands Tab:** Check the location of the lines to see where they fall relative to the 128 MHz boundaries (should be > 6 MHz from them).

5. **Validation Tab:** Check for errors and warnings.

Once we import the resource into an SB within the OPT, we will then be able to double check the center frequency calculations using the Dopset tool.

# Step 2 Subbands Tab

**Check line placement within the subband (spectral window).**




Avoid using Snap To Grid and Fix To Baseband when preparing spectral line observations.

# Step 2 Subbands Tab

**Check line placement within the subband (spectral window).**


Avoid using Snap To Grid and Fix To Baseband when preparing spectral line observations.

# Step 2 Create a Spectral Line Resource

1. **Lines Tab:** Enter source position and line setup.
   - HC3N ($\nu_o$= 36.39232 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)
   - SiS ($\nu_o$= 36.30963 GHz, V (radio, LSR) = −26 km/s, $\Delta$V ~ 35 km/s)

2. **Basebands Tab:** Adjust the baseband center frequencies as needed and turn on the Doppler Line setting.

3. **Line Placement Tab:** Generate the lines within the basebands.

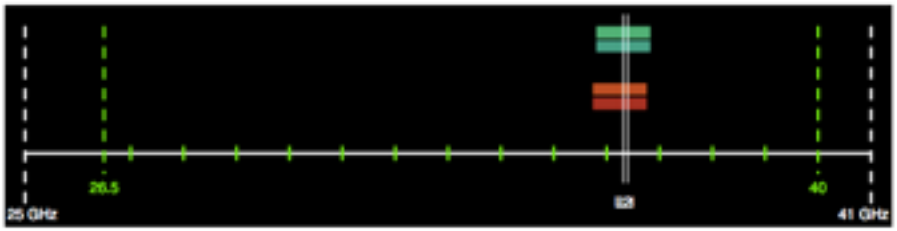
4. **Subbands Tab:** Check the location of the lines to see where they fall relative to the 128 MHz boundaries (should be > 6 MHz from them).

5. **Validation Tab:** Check for errors and warnings.

Once we import the resource into an SB within the OPT, we will then be able to double check the center frequency calculations using the Dopset tool.

# Step 2 Validation Tab

**Check for errors and warnings.**




| | |
|---|---|
| **Total BI. BPs Used:** | 2 of 64 |
| **Total Data Rate:** | 0.49 MB/s or 1.78 GB/h |
| **Total Spectral Points:** | 128 |
| **Total Bandwidth:** | 16.0MHz |
| **Capability Mode:** | General observing |

Basics | Lines | Basebands | Line Placement | Subbands | **Validation**

| | |
|---|---|
| **Name:** | Ka-band demo |
| **Tint:** | 3.0 |
| **Receiver Band:** | Ka (26.5GHz - 40.0GHz) |

| $T_{int}$ | AC $BB_{center}$ Freq | AC Summed BW | AC Coverage | Req. BIBPs | # Channels | AC Doppler Line | AC Doppler Vel. | AC Doppler Pos. | AC Doppler Off. | Data Rate |
|---|---|---|---|---|---|---|---|---|---|---|
| Band | BD $BB_{center}$ Freq | BD Summed BW | BD Coverage | Act. BIBPs | Min/Max Width | BD Doppler Line | BD Doppler Vel. | BD Doppler Pos. | BD Doppler Off. | |
| 3s | 36.32GHz | 8.0MHz | 0.78125 % | 2 | 128 | 36.39232GHz | -26.0km/s LSR Radio | 9h 47m 57.382s 13d 16' 40.66" | -75.521074 | 0.494 MB/s |
| Ka | 36.25GHz | 8.0MHz | 0.78125 % | 2 | 125.0kHz / 125.0kHz | 36.30963GHz | -26.0km/s LSR Radio | 9h 47m 57.382s 13d 16' 40.66" | -62.823801 | 1.777 GB/h |

| Baseband | ID | SB Bandwidth | Frequency Range | Fixed To Baseband | Center | Polarization | BIBPs | Recirculation | Channels | Ch. Width | Phased | Data Rate | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A0/C0 | 0 | 8MHz | 36.39152107GHz - 36.39952107GHz | No | 36.39552107GHz | Full | 1 | 1× | 64 | 125.0kHz | No | 0.247 MB/s | 0 | Generated from HC3N - 36.39232GHz |
| B0/D0 | 0 | 8MHz | 36.30882380GHz - 36.31682380GHz | No | 36.31282380GHz | Full | 1 | 1× | 64 | 125.0kHz | No | 0.247 MB/s | 0 | Generated from SiS - 36.30963GHz |

# Step 2 Validation Tab

## Correlator Resource Table

**Subband Grid Boundaries**

**A0/C0**

| Sky Frequency | Offset |
|---|---|
| 35.808GHz | 0GHz |
| 35.936GHz | 128MHz |
| 36.064GHz | 256MHz |
| 36.192GHz | 384MHz |
| 36.32GHz | 512MHz |
| 36.448GHz | 640MHz |
| 36.576GHz | 768MHz |
| 36.704GHz | 896MHz |
| 36.832GHz | 1.024GHz |

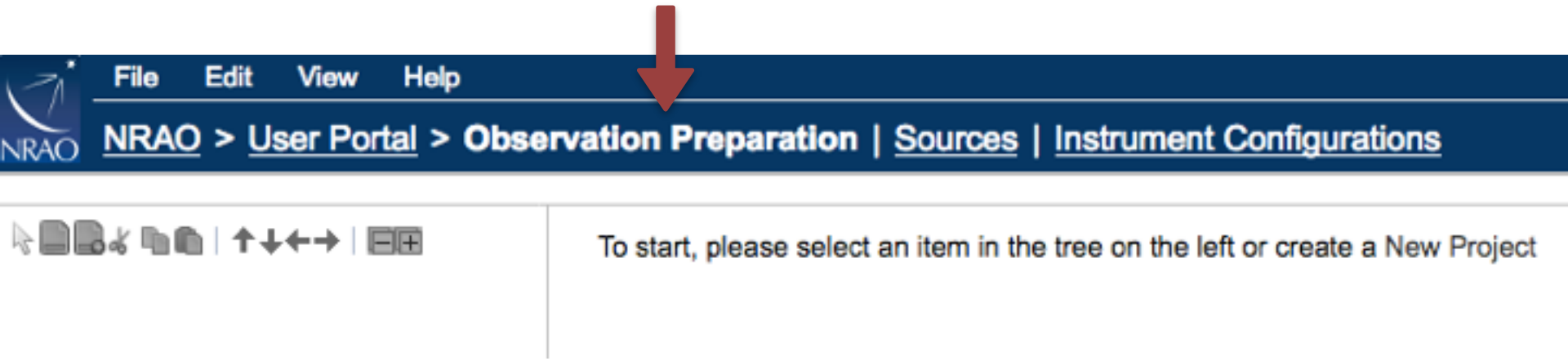
**B0/D0**

| Sky Frequency | Offset |
|---|---|
| 35.738GHz | 0GHz |
| 35.866GHz | 128MHz |
| 35.994GHz | 256MHz |
| 36.122GHz | 384MHz |
| 36.25GHz | 512MHz |
| 36.378GHz | 640MHz |
| 36.506GHz | 768MHz |
| 36.634GHz | 896MHz |
| 36.762GHz | 1.024GHz |

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | - | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Q2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Q3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Q4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

# Step 3 Observation Preparation Tool (OPT)

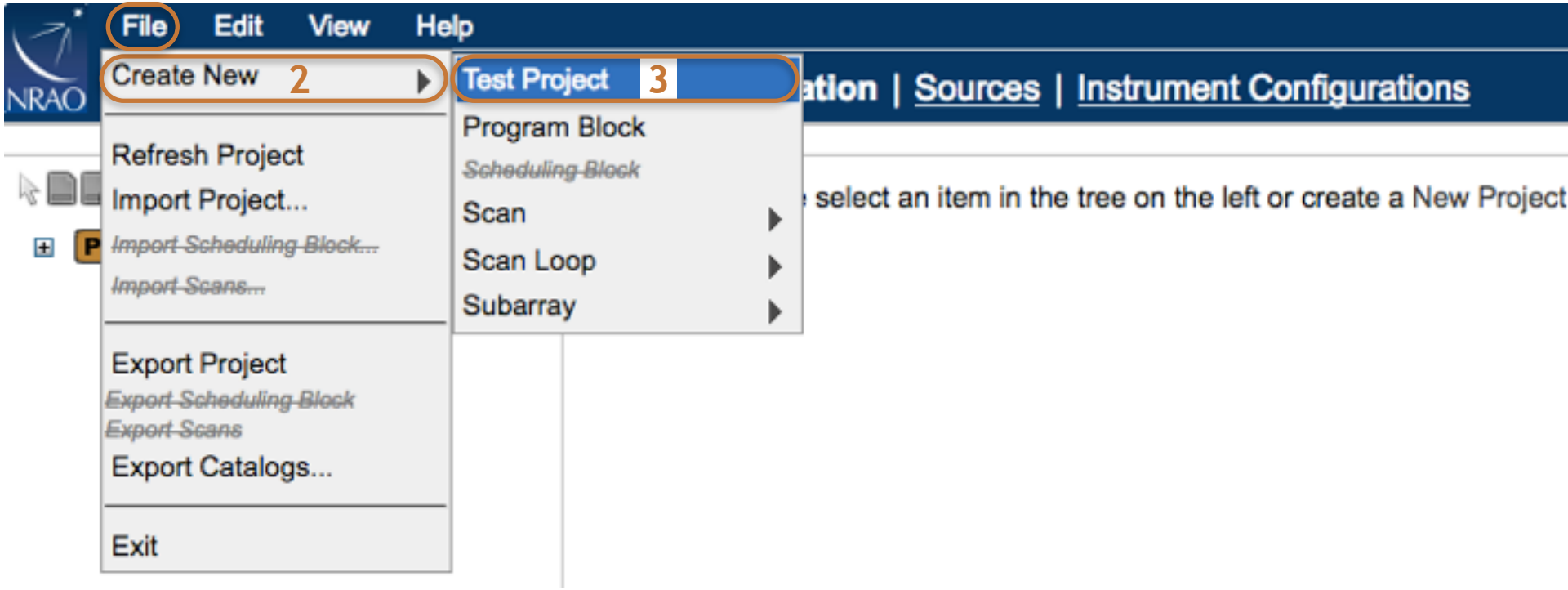
**In the OPT: click on Observation Preparation**



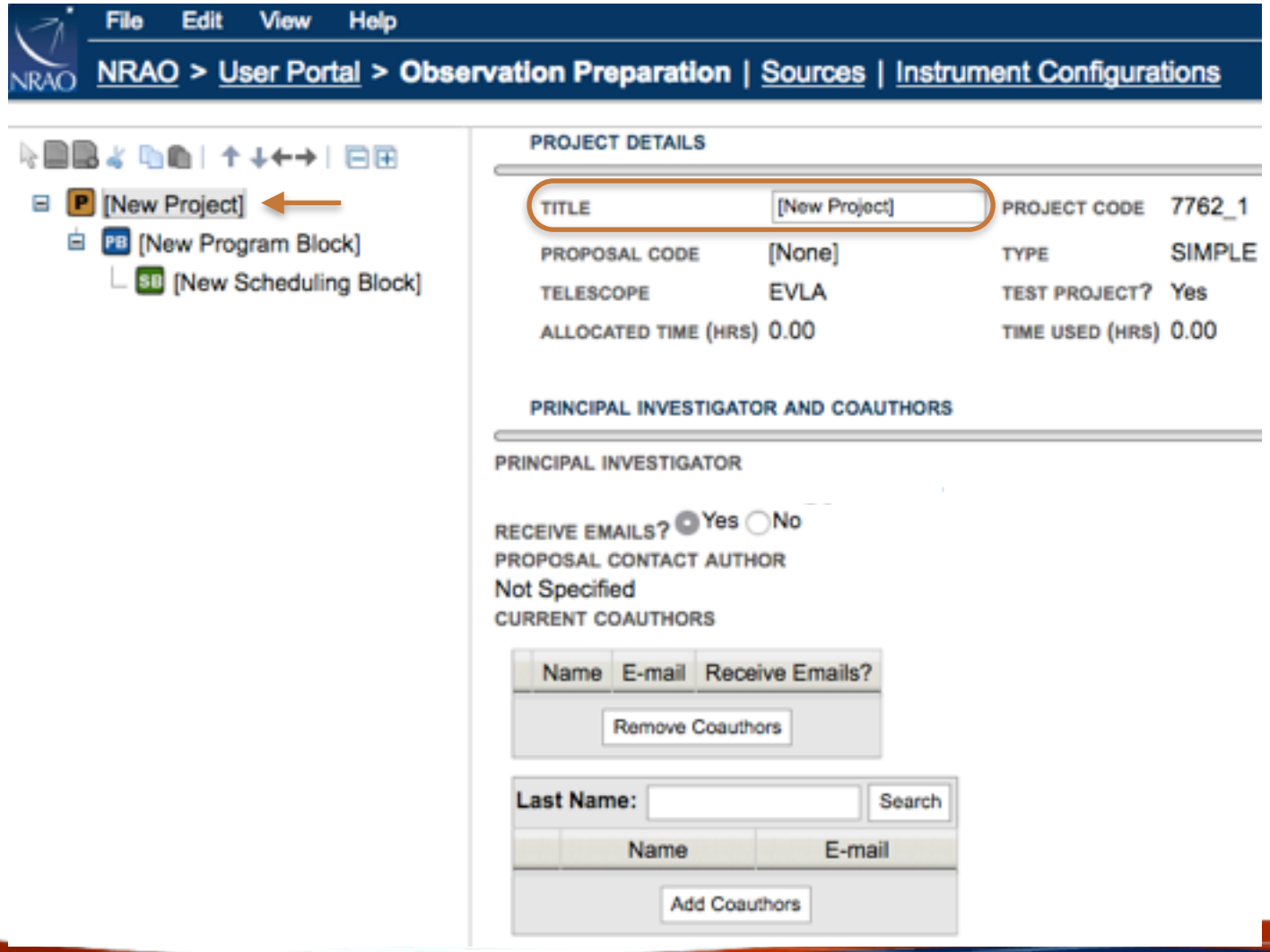

**Due to shortness of time, we will skip a few steps in the OPT portion of the tutorial and provide an xml file of the completed SB.**

# Step 3 Observation Preparation Tool (OPT)

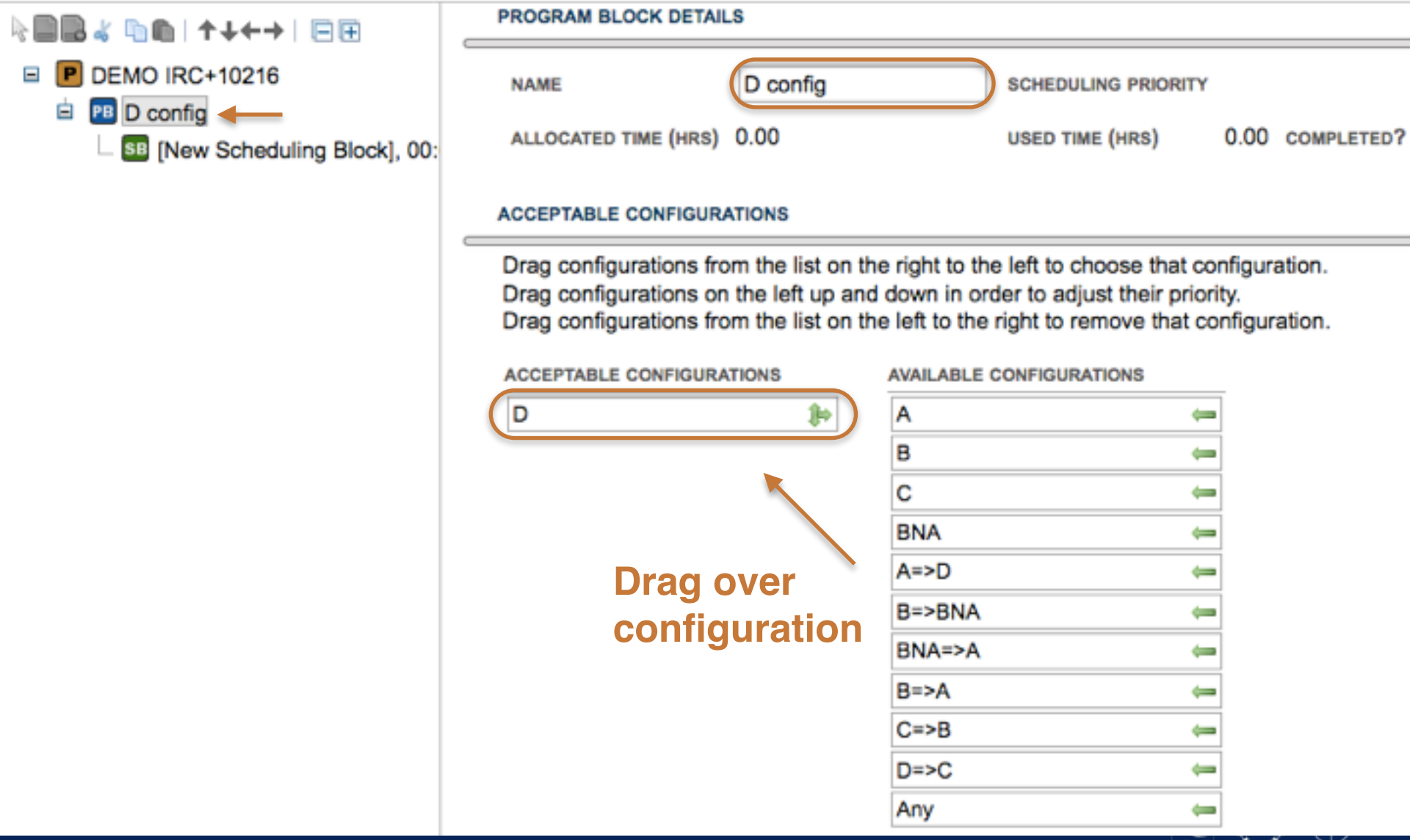
**File → Create New → Test Project**



# Step 3 Project

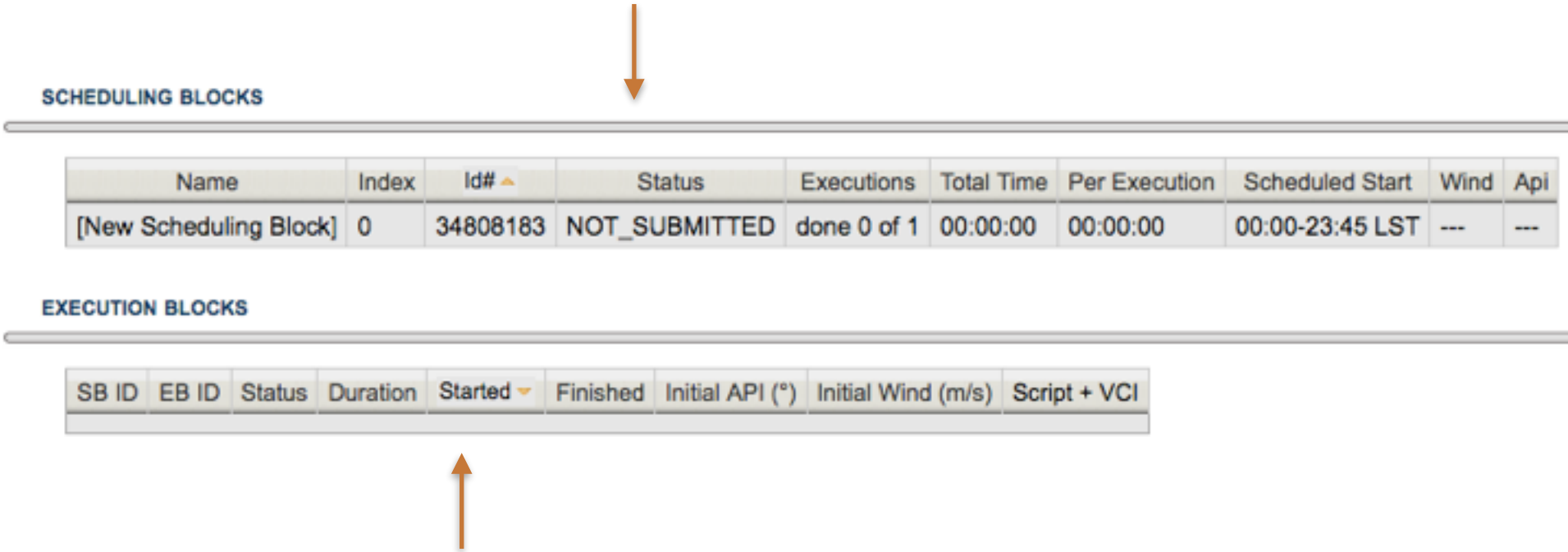


# Step 3 Program Block



# Step 3 Program Block

**List of Scheduling Blocks created by the observer.**



SCHEDULING BLOCKS

| Name | Index | Id# | Status | Executions | Total Time | Per Execution | Scheduled Start | Wind | Api |
|---|---|---|---|---|---|---|---|---|---|
| [New Scheduling Block] | 0 | 34808183 | NOT_SUBMITTED | done 0 of 1 | 00:00:00 | 00:00:00 | 00:00-23:45 LST | --- | --- |

EXECUTION BLOCKS

| SB ID | EB ID | Status | Duration | Started | Finished | Initial API (°) | Initial Wind (m/s) | Script + VCI |
|---|---|---|---|---|---|---|---|---|

**Once an SB has been observed, the Execution Block will be listed.**

# Step 3 Scheduling Block Information

- SB name: IRC+10216 Ka
- LST start range:
  - LST target/complex gain_cal/ref_cal: 05:40–13:50
  - LST Bandpass_cal: 08:55–16:00
  - LST Flux_cal: 08:40–18:30 (avoid 12:45–14:15, EL > 80°)

**Assuming a 3 hour long SB:**

**One possible LST start range is 08:30–09:45**

**(if the flux cal (3C286 rising) is observed at the end)**

- Wind and APL constraints: choose Ka-band

# Step 3 Scheduling Block Information Tab

Information | Reports | Validation and Submission | Bulk Scan Edit | Executions

SCHEDULING BLOCK DETAILS

| | |
|---|---|
| GENERATED ID | 34808183 |
| NAME | IRC+10216 Ka |
| STATUS | NOT_SUBMITTED |
| ACCEPTABLE CONFIGURATIONS | D |
| COUNT | 1 |
| COMPLETED | 0 |
| TOTAL TIME | 00:00:00 |
| TIME PER EXECUTION | 00:00:00 |
| SCHEDULE TYPE | Dynamic |
| LST START RANGE | 08 : 30 – 09 : 45 |
| EARLIEST UT START DATE/TIME: | 2017/12/27 20:54:16 |
| LATEST UT START DATE/TIME: | 2099/12/31 23:59:59 |
| AVOID SUNRISE | |
| AVOID SUNSET | |

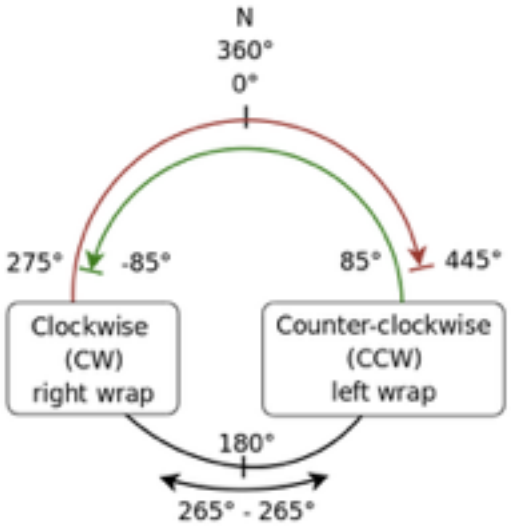
Remove

Add

**Provide a name**

Valid special characters are:
spaces + - _ * /

**LST start range**
**08:30–09:45**



# Step 3 Scheduling Block Information Tab

**Ka-band Wind & APL constraints**

| | Description | Wind | Atmospheric Phase Limit |
|---|---|---|---|
| ○ | Lowest Frequencies (4, P, and L) | Any | Any |
| ○ | 2.0GHz - 4.0GHz (S) | Any | 60.0 degrees |
| ○ | 4.0GHz - 8.0GHz (C) | Any | 45.0 degrees |
| ○ | 8.0GHz - 12.0GHz (X) | 15.0 m/s | 30.0 degrees |
| ○ | 12.0GHz - 18.0GHz (Ku) | 10.0 m/s | 15.0 degrees |
| ○ | 18.0GHz - 26.5GHz (K) | 7.0 m/s | 10.0 degrees |
| ✓ | 26.5GHz - 40.0GHz (Ka) | 6.0 m/s | 7.0 degrees |
| ○ | 40.0GHz - 50.0GHz (Q) | 5.0 m/s | 5.0 degrees |
| ○ | Specified Constraints | m/s | degrees |

COMMENTS TO THE OPERATOR

# Step 3 Scheduling Block – Scans

- Start-up Sequence
  - Setup scan for each instrument configuration:
    - Ka-band configuration
    - X-band reference pointing configuration
  - X-band reference pointing scan on J0954+1743

(For high frequency observing, the start-up should sum up to at least 12 min.)

- Ka-band Complex Gain calibrator J0954+1743
- Ka-band Target-Complex Gain cal loop
  - Repeat the last three steps
- X-band reference pointing on J1224+0330 for Bandpass/Delay cal
- Ka-band scan on Bandpass/Delay cal J1229+0203
- X-band reference pointing on Flux cal 3C286
- Ka-band scan on Flux cal 3C286

# Step 3 Scheduling Block – Scan Intents

**Select the appropriate scan intent for each source.**

IRC+10216 → Observe Target

J0954+1743 → Calibrate Complex Gain (A and P)

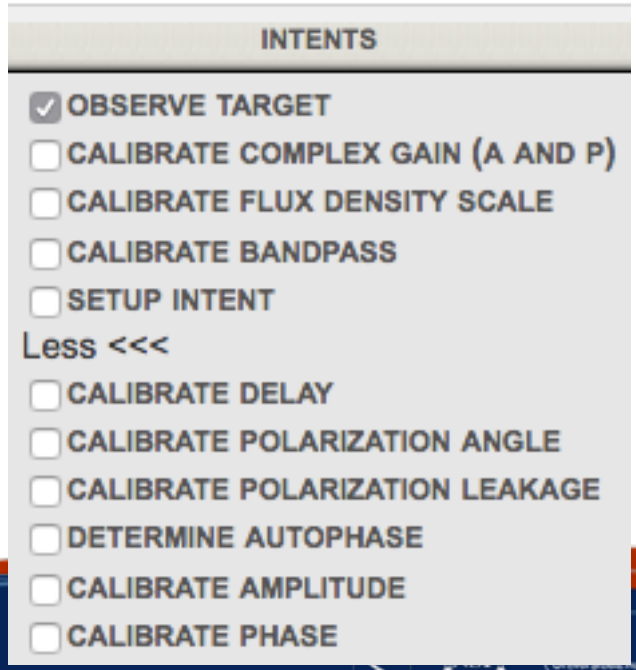
J1229+0203 → Calibrate Bandpass & Calibrate Delay

J1224+0330 → Calibrate Offset Pointing (only used for reference pointing)

3C286 → Calibrate Flux Density Scale

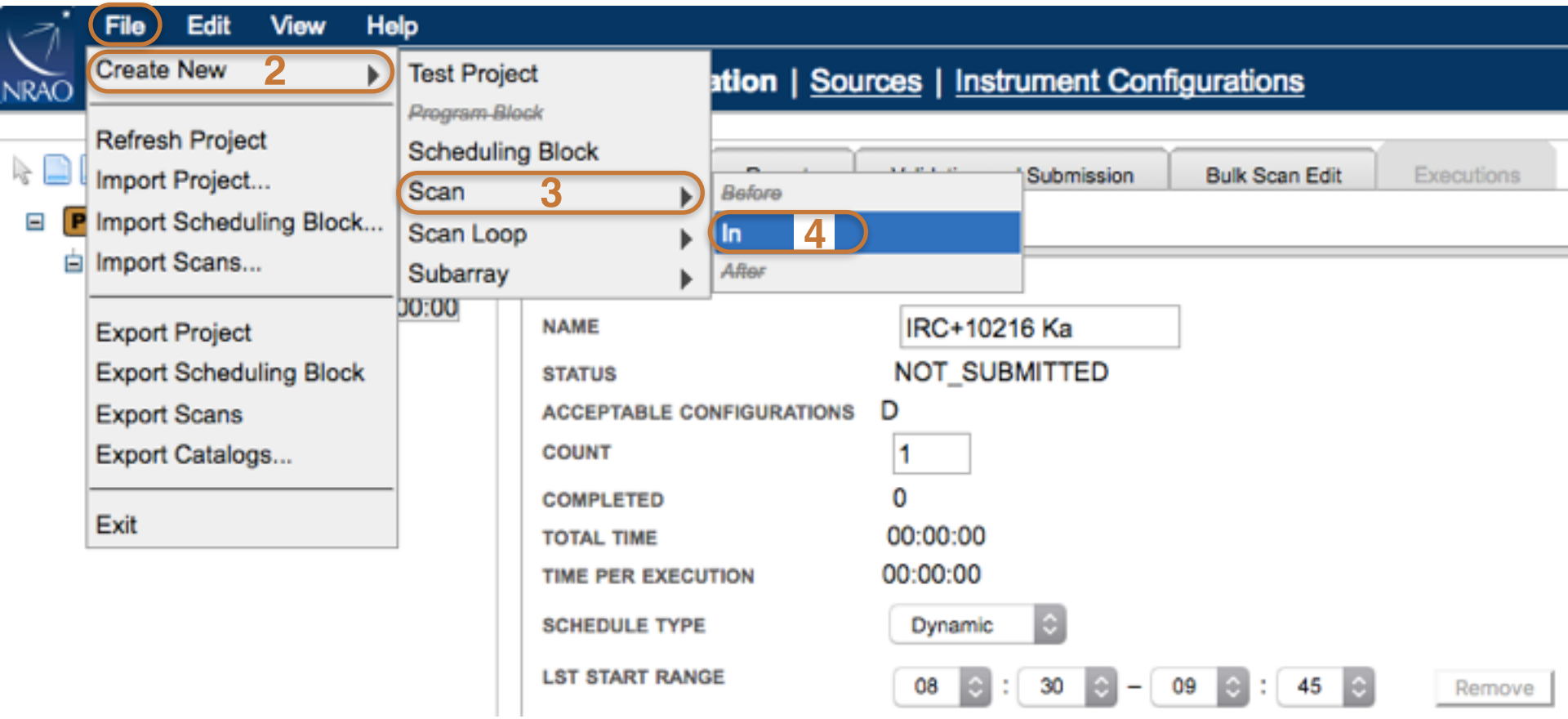
setup scans → Setup Intent

When using reference pointing, check the **Apply Last** box to all standard observing mode scans that follow. Otherwise, the reference pointing corrections will not be applied.

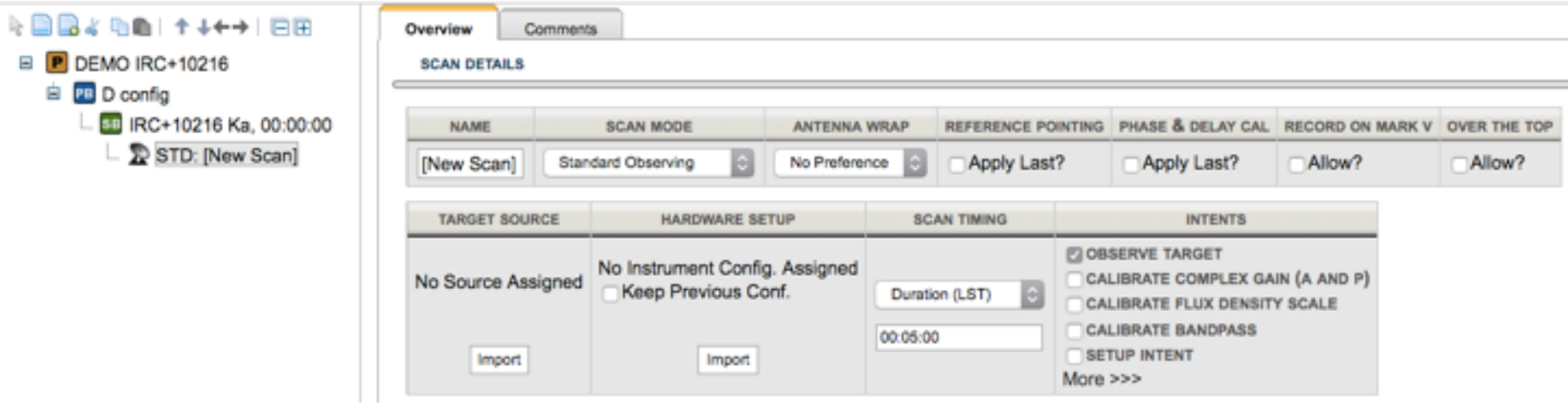


# Step 3 Create a New Scan

**File → Create New → Scan → In**

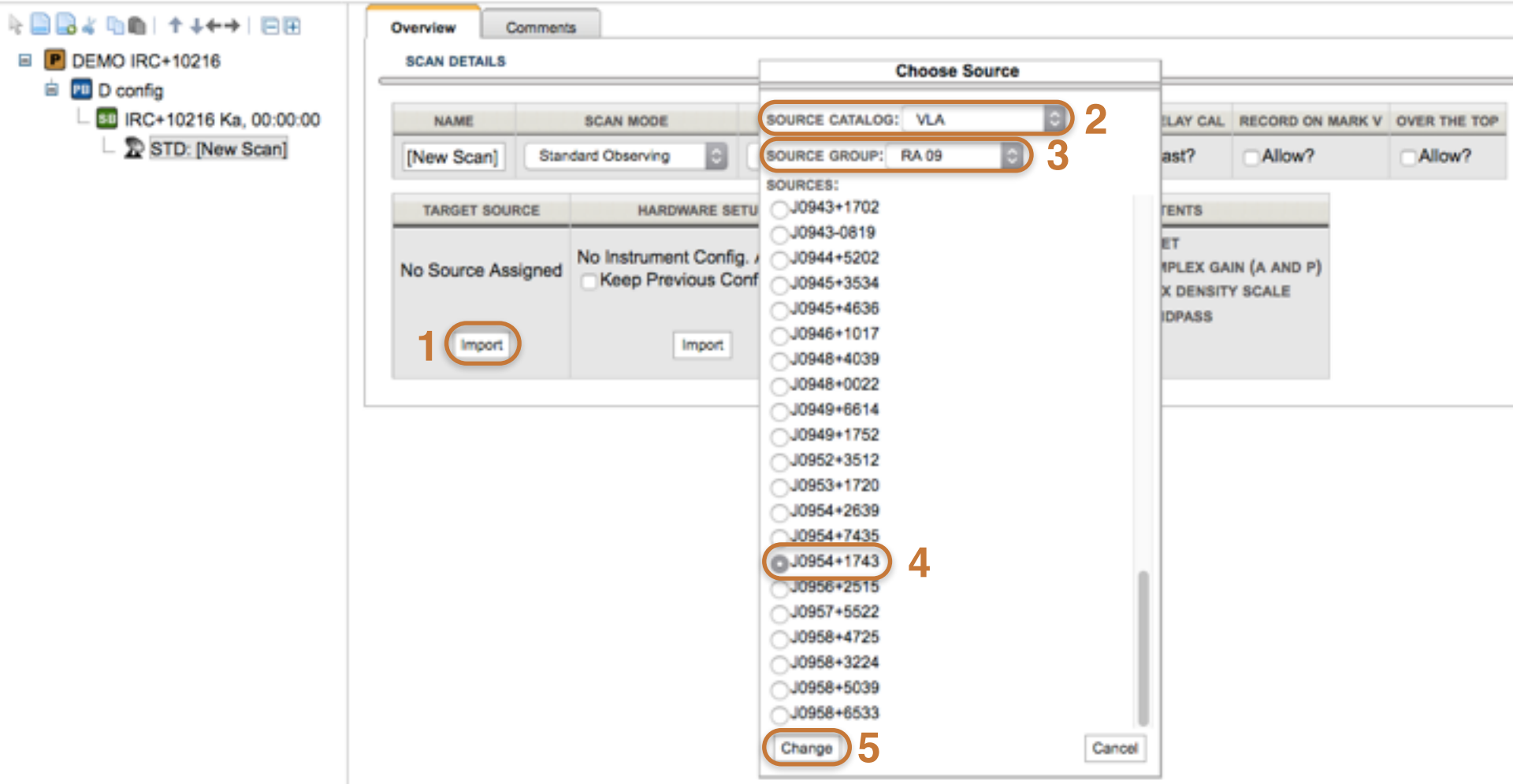


# Step 3 New Scan



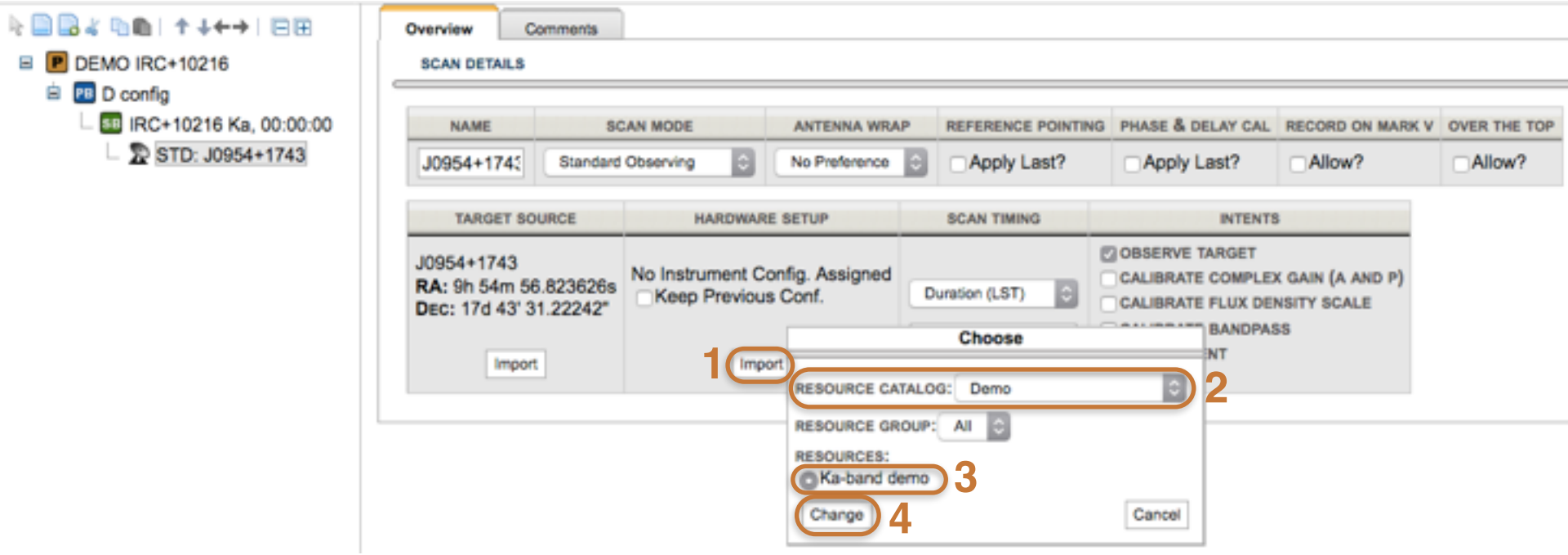
# Step 3 Import Source

Import the complex gain calibrator, **J0954+1743**, from the VLA calibrator catalog.



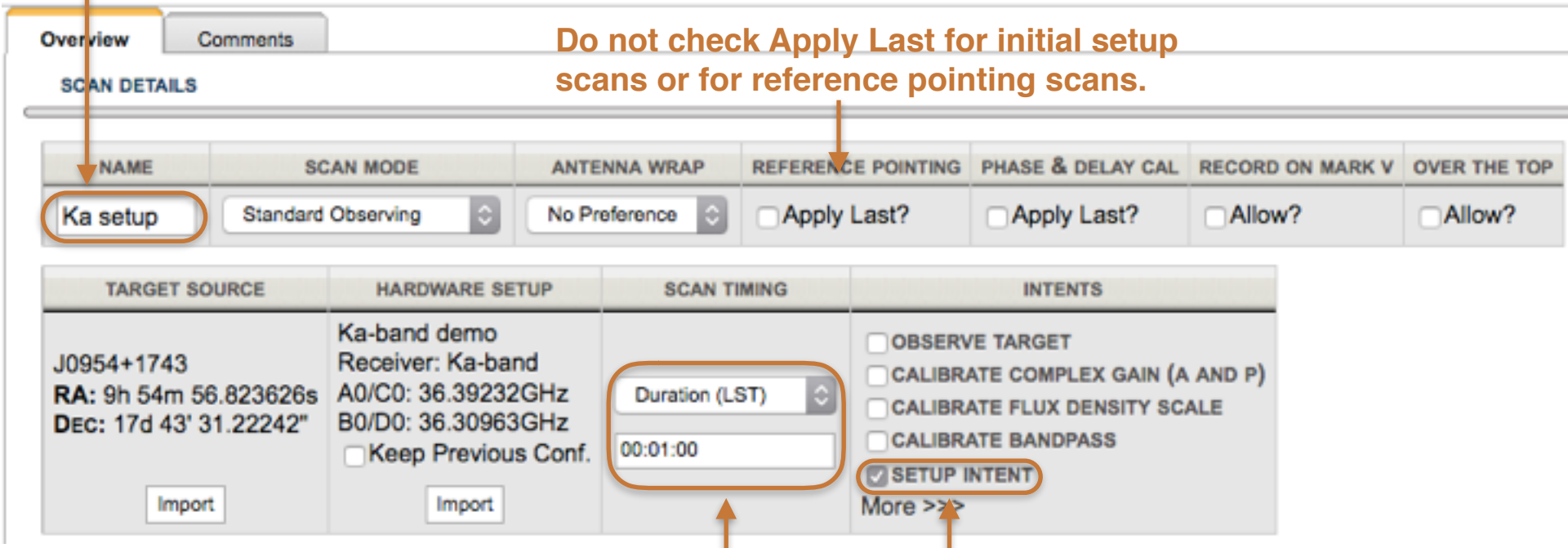
# Step 3 Import Ka-band Resource

**Import the Ka-band instrument configuration you created from your resource catalog.**



# Step 3 Ka-band Setup Scan Details

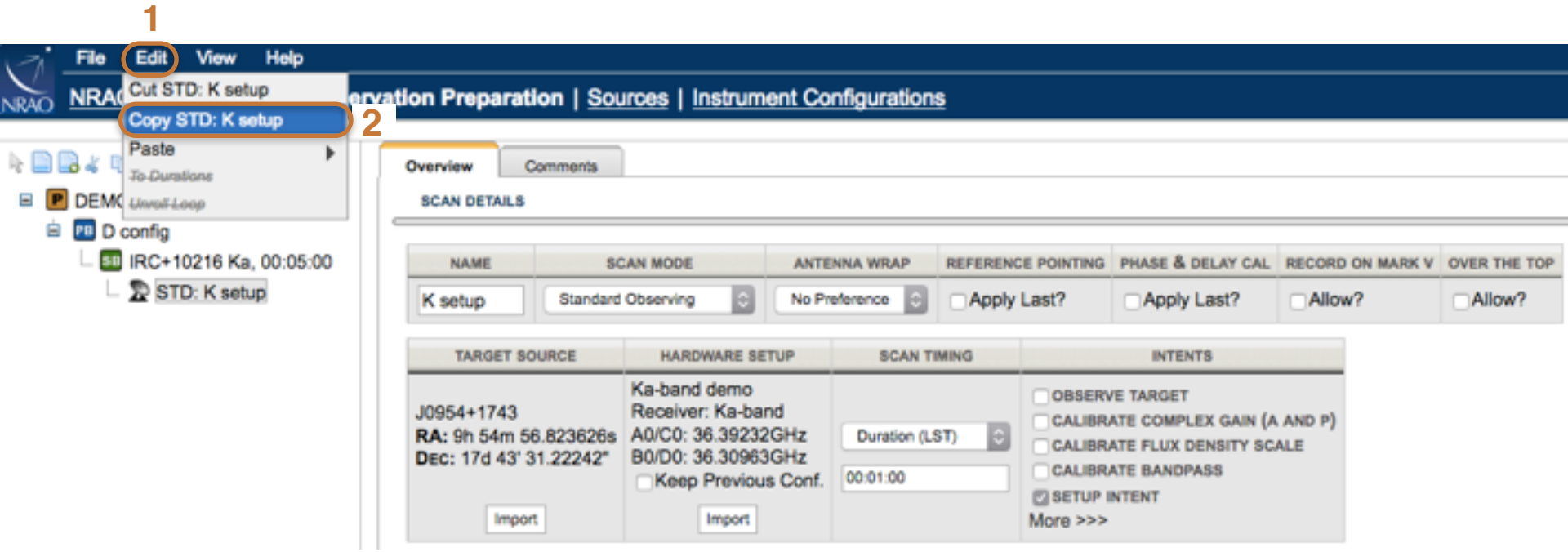
**Scan name can be changed** (spaces + - _ / are valid special characters)




Setup scan must be at least **1 minute in Duration (LST)** and select the **Setup Intent** (unselect Observe Target intent).

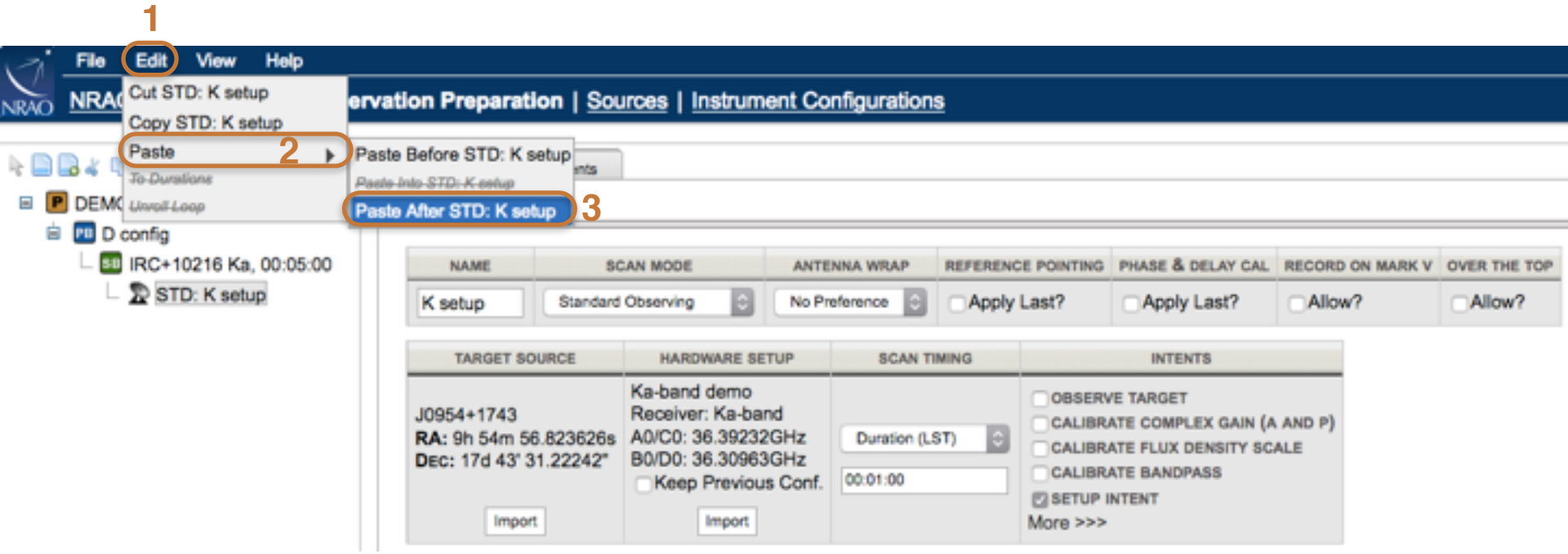
# Step 3 Copy Scan

**Edit → Copy STD: <scan name>**



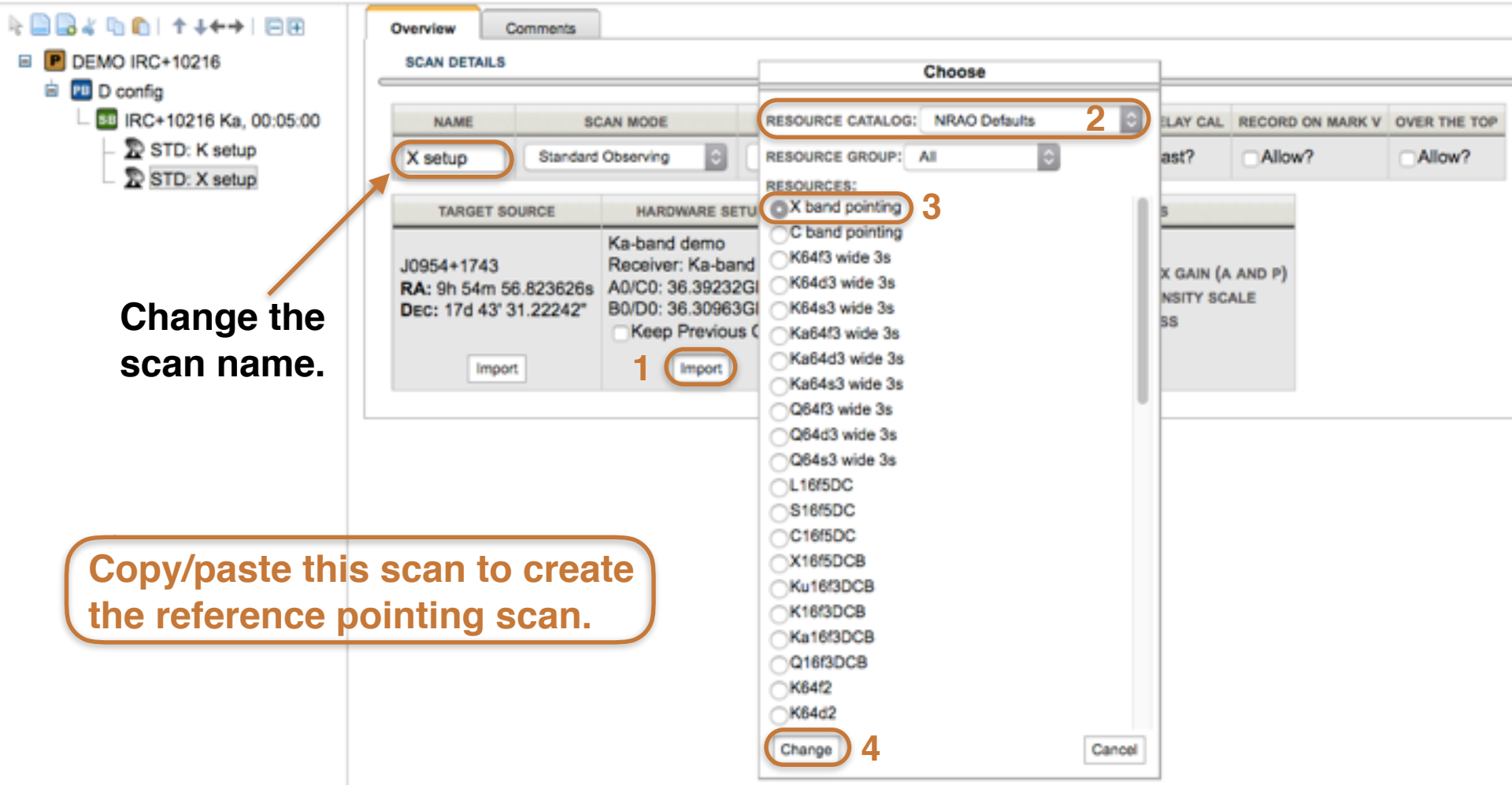
# Step 3 Paste Scan

**Edit → Paste → Paste After STD: <scan name>**



# Step 3 Import X-band Pointing Resource

**Import the X-band pointing resource from the NRAO Defaults resource catalog.**

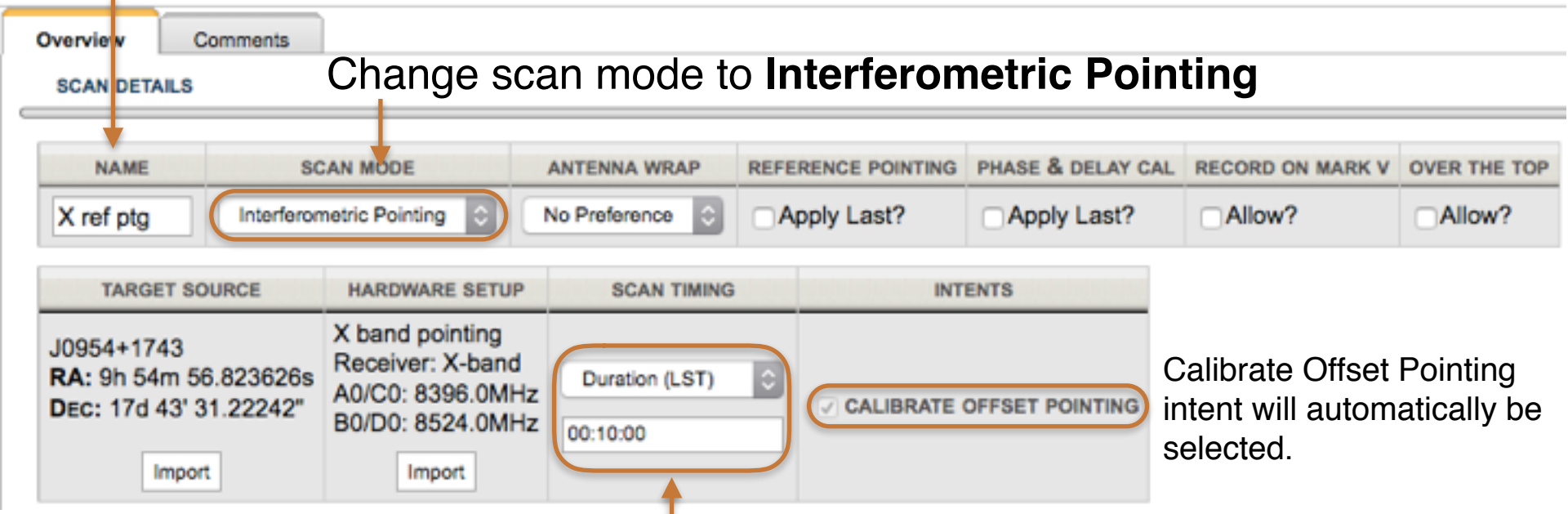



**Change the scan name.**

**Copy/paste this scan to create the reference pointing scan.**

# Step 3 X-band Reference Pointing Scan

**Change scan name**



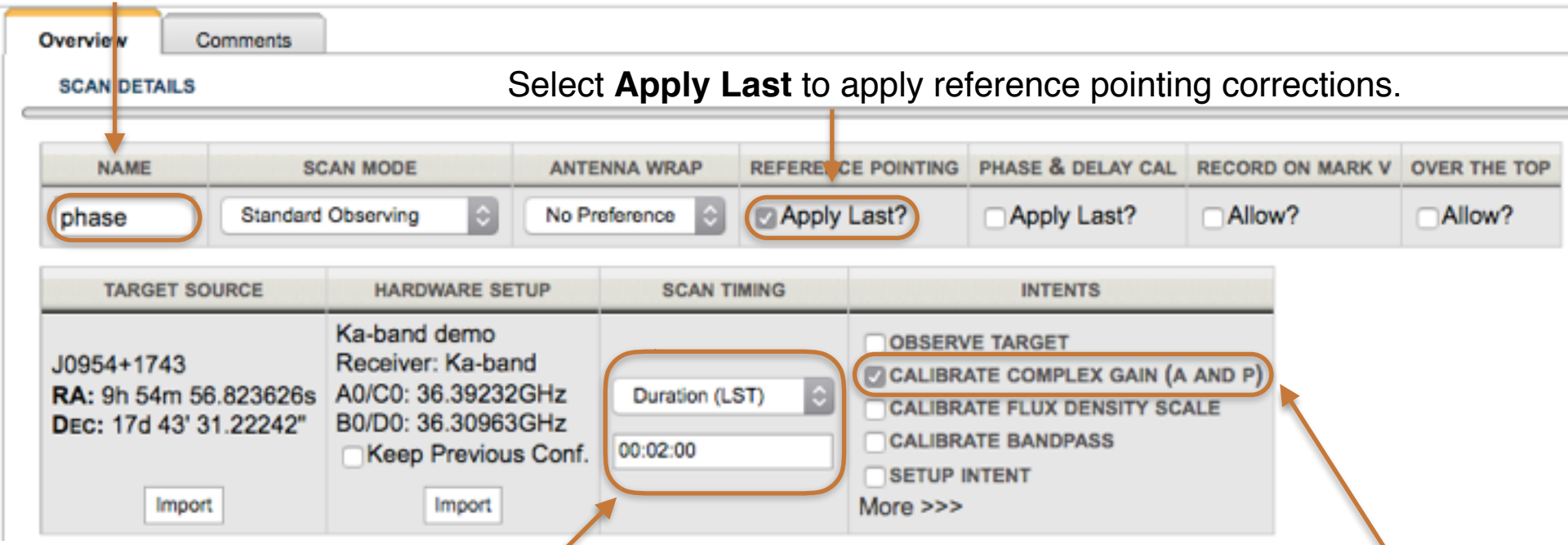

Calibrate Offset Pointing intent will automatically be selected.

Increase scan duration to at least **10 minutes** to allow for a 12 minute start-up.

# Step 3 Ka-band Complex Gain Cal Scan

(Copy/paste Ka-band setup scan to create this scan.)

**Change name of scan.**
(We used phase simply to shorten the name of the scan.)



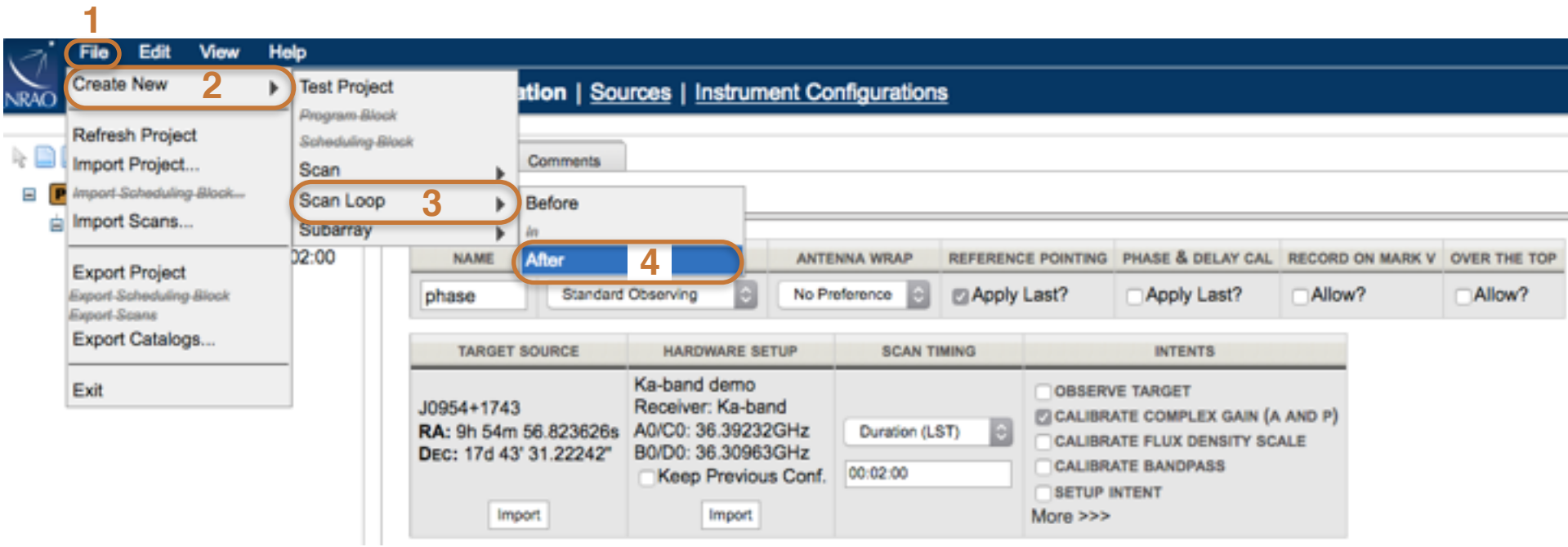

2 minute scan duration is dependent on various factors (i.e., slew time, required on source time, etc.)

Select appropriate scan intent for the complex gain calibrator.

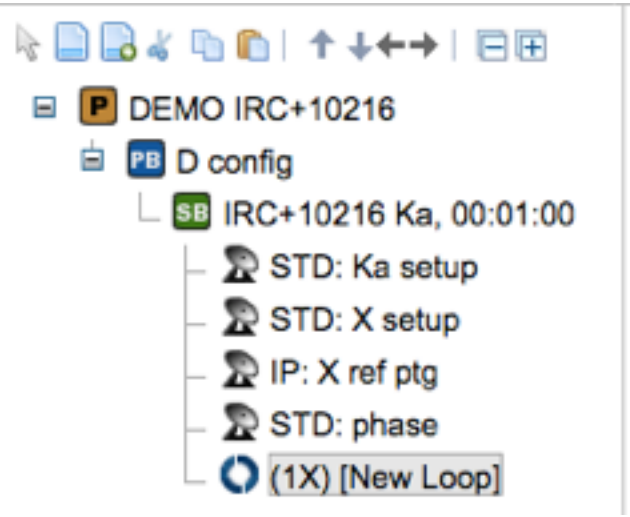
# Step 3 Create a Loop

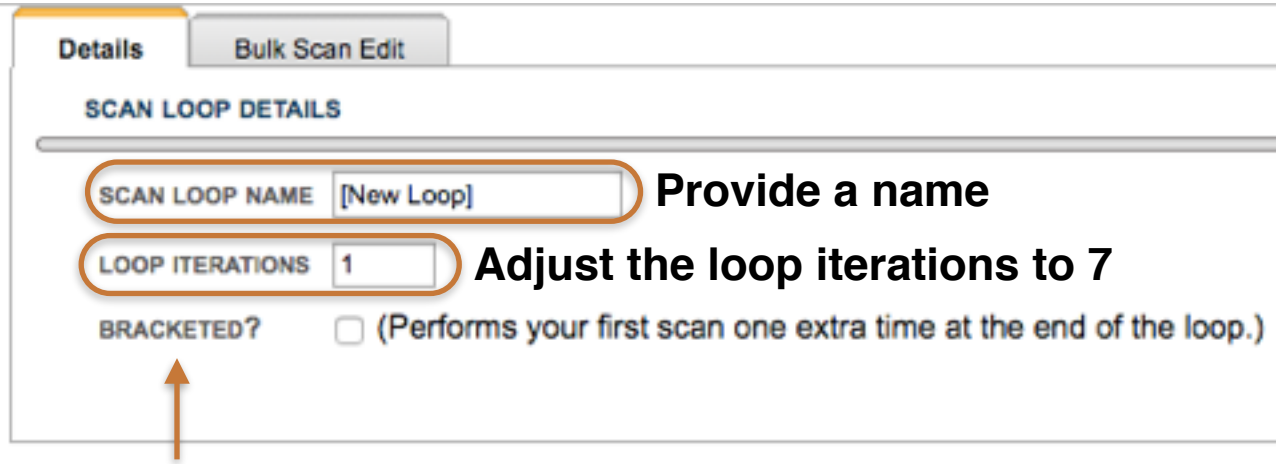
**Create a loop for the science target and complex gain cal scans.**

**File → Create New → Scan Loop → After**



# Step 3 Edit Loop




**Since we start with a complex gain calibrator before the loop, we will not use the bracket feature within the loop.**

# Step 3 Options for Adding Scans to a Loop

- Select the loop:
  - File → Create New → Scan → In

- Select the scan you want to copy:
  - Edit → Copy STD: <scan name>
  - Select the loop you want to paste the scan into:
  - Edit → Paste Into (nX) <loop name>
    (where n is the loop iterations)

The icons shown below can also be used to add a new scan, cut/copy/paste a scan, or move a scan up or down within the SB. (In the OPT, hover over each icon for a short description.)

# Step 3 Import xml File

So you may jump ahead to see the completed SB described in this tutorial, we have provided a file called:

**OPT_demo.xml**

To download the file:

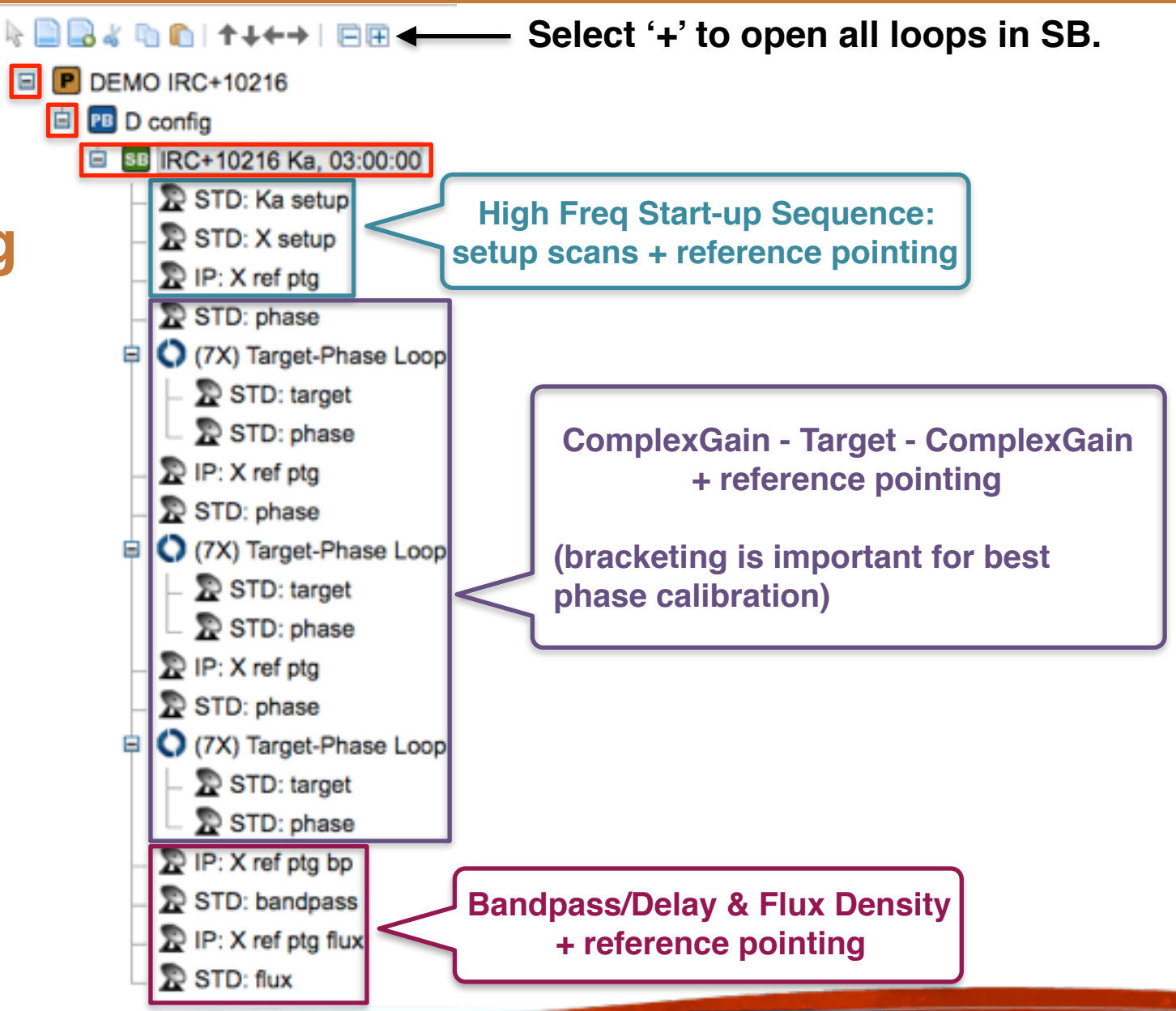
- Go to ftp://ftp.aoc.nrao.edu/pub/NRAO-CDE/INAOE2018
- Right-click on OPT_demo.xml
- Save Link As
- Save to Desktop or Downloads folder

To import the file into the OPT:

- Go to File → Import Project
- Browse to locate the file and then import. (Click once and wait a few seconds for the import process to complete.)
- Then expand the contents to see the Project, Program Block, and Scheduling Block.

# Step 3

# Finished Scheduling Block



# Step 3 Reports Tab

**Check LST start range (08:30–09:45) for appropriate on source time and EL for all scans:**

- Required minimum on source time, after slewing:
  - Reference pointing scans:
    - 2.5 min on source
  - Standard observing scans:
    - 40 sec on source for flux density calibration
    - 20 sec on source for all other calibration and science target scans
  - More time may be required depending on the required signal to noise.
- High frequency elevation limits: $30° < EL < 80°$

# Step 3 Reports Tab

Information | **Reports** | Validation and Submission | Bulk Scan Edit | Executions

## Observing Program

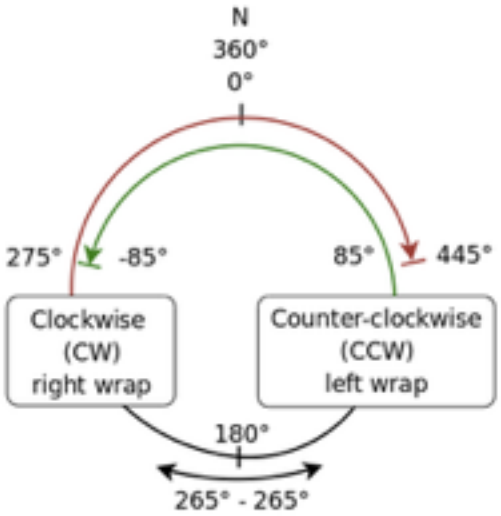
PROJECT CODE: GENERATED ID: 34808183
PRINCIPAL INVESTIGATOR:

Use your browser's Print feature to print this report.

## Assumed Starting Conditions

WIND CONSTRAINTS: 6.0 m/s API CONSTRAINTS: 7.0 degrees
LST START RANGE: 08:30-09:45

ASSUMED LST START: 64846 08:30:00 LST Update Display UTC times
COMPUTED LST STOP: 64846 11:29:59.997677418862918770999181317176895258426871802 LST




ASSUMED ANTENNA STARTING DIRECTION
AZIMUTH: 225.0d ELEVATION: 35.0d COORDINATE SYSTEM: HORIZONTAL

MINIMUM ELEVATION WARNING
MINIMUM ELEVATION: 8.0d degrees (VLA antennas cannot observe below 8 degrees)

SHADOW WARNING CALCULATIONS
SHADOWING LIMIT (MAX): 0.0 IN CONFIGURATION: D

## Computed Summaries

- Instrument Configuration Summary Test
- Time On Source Summary
- Schedule Summary

Export Tables as CSV (opens in new window)

# Step 3 Reports Tab: Schedule Summary/Report

When stepping through the LST start range, check the schedule **Summary Report** for on source time, elevation limits, warnings or errors if there are any (i.e., antenna shadowing), etc.. Note, no time on source for the setup scans is ok.

Open all loops

NATIONAL RADIO ASTRONOMY OBSERVATORY VLA OBSERVING PROGRAM 7762_1
FOR DAY 64846 LST 08:30:00 (THU DEC 28 09:12:19 UTC 2017) SUMMARY REPORT.

| | Source | Scan / Instrument Cfg. | AC Freq. / BD Freq. | Start LST / Stop LST | Slew / On Source | Modifiers | Start HA / End HA | Start Az / End Az | Start El / End El | Start PA / End PA |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | J0954+1743 | Ka setup | 36.32183714GHz | 08:30:00 | 00:01:00.0 | SetAtnGain | -1.42 | 125.4d | 65.0d | -45.1d |
| | | (1) Ka-band demo | 36.25183297GHz | 08:31:00 | 00:00:00.0 | | -1.40 | 125.8d | 65.1d | -44.8d |
| 2 | J0954+1743 | X setup | 8.46GHz | 08:31:00 | 00:01:00.0 | SetAtnGain | -1.40 | 125.8d | 65.1d | -44.8d |
| | | (2) X band pointing | 8.588GHz | 08:32:00 | 00:00:00.0 | | -1.38 | 126.2d | 65.3d | -44.6d |
| 3 | J0954+1743 | X ref ptg | 8.46GHz | 08:32:00 | 00:00:38.944 | CalOffPtg | -1.38 | 126.2d | 65.3d | -44.6d |
| | | (2) X band pointing | 8.588GHz | 08:42:00 | 00:09:21.057 | | -1.22 | 130.5d | 66.9d | -41.4d |
| 4 | J0954+1743 | phase | 36.32183714GHz | 08:42:00 | 00:00:20.055 | CalGain, Apply Ref. Ptg. | -1.22 | 130.5d | 66.9d | -41.4d |
| | | (1) Ka-band demo | 36.25183297GHz | 08:44:00 | 00:01:39.945 | | -1.18 | 131.4d | 67.2d | -40.7d |
| | LOOP | Target-Phase Loop | | | | | | | | |
| 5 | IRC+10216 | target | 36.32183714GHz | 08:44:00 | 00:00:22.887 | ObsTgt, Apply Ref. Ptg. | -1.07 | 141.2d | 64.6d | -32.2d |
| | | (1) Ka-band demo | 36.25183297GHz | 08:49:00 | 00:04:37.113 | | -0.98 | 143.7d | 65.3d | -30.2d |
| 6 | J0954+1743 | phase | 36.32183714GHz | 08:49:00 | 00:00:22.970 | CalGain, Apply Ref. Ptg. | -1.10 | 133.8d | 68.0d | -38.8d |
| | | (1) Ka-band demo | 36.25183297GHz | 08:50:30 | 00:01:07.030 | | -1.07 | 134.6d | 68.2d | -38.3d |
| 7 | IRC+10216 | target | 36.32183714GHz | 08:50:30 | 00:00:22.985 | ObsTgt, Apply Ref. Ptg. | -0.96 | 144.5d | 65.5d | -29.6d |
| | | (1) Ka-band demo | 36.25183297GHz | 08:55:30 | 00:04:37.016 | | -0.87 | 147.1d | 66.0d | -27.6d |
| 8 | J0954+1743 | phase | 36.32183714GHz | 08:55:30 | 00:00:22.993 | CalGain, Apply Ref. Ptg. | -0.99 | 137.2d | 68.9d | -36.2d |
| | | (1) Ka-band demo | 36.25183297GHz | 08:57:00 | 00:01:07.007 | | -0.97 | 138.0d | 69.1d | -35.6d |

# Step 3 Reports Tab: Time On Source Summary

The **Time On Source Summary** provides a sum of the total time spent on source for each source by scan intent and resource. This number will change for all LST start times due to changes in slewing.

Time On Source Summary (time in: LST)

| Source | Scan | Modifiers | RA | AC Vel. | AC Freq. | Min HA | Min PA | # |
|---|---|---|---|---|---|---|---|---|
| Epoch | Instrument Cfg. | | Dec | BD Vel. | BD Freq. | Max HA | Max PA | Total Time |
| J0954+1743 | Ka setup | SetAtnGain | 9h 54m 56.82363s | -26.0km/s LSR Radio | 36.32183714GHz | -1.42 | -45.1d | 1 |
| J2000 | (1) Ka-band demo | | 17d 43' 31.2224" | -26.0km/s LSR Radio | 36.25183297GHz | -1.40 | -44.8d | 00:00:00.0 |
| J0954+1743 | X setup | SetAtnGain | 9h 54m 56.82363s | --- --- --- | 8.46GHz | -1.40 | -44.8d | 1 |
| J2000 | (2) X band pointing | | 17d 43' 31.2224" | --- --- --- | 8.588GHz | -1.38 | -44.6d | 00:00:00.0 |
| J0954+1743 | X ref ptg | CalOffPtg | 9h 54m 56.82363s | --- --- --- | 8.46GHz | -1.38 | -44.6d | 3 |
| J2000 | (2) X band pointing | | 17d 43' 31.2224" | --- --- --- | 8.588GHz | 0.48 | 20.3d | 00:15:40.948 |
| J0954+1743 | phase | CalGain | 9h 54m 56.82363s | -26.0km/s LSR Radio | 36.32183714GHz | -1.22 | -41.4d | 24 |
| J2000 | (1) Ka-band demo | | 17d 43' 31.2224" | -26.0km/s LSR Radio | 36.25183297GHz | 1.26 | 42.3d | 00:28:03.957 |
| IRC+10216 | target | ObsTgt | 9h 47m 57.382s | -26.0km/s LSR Radio | 36.32183714GHz | -1.07 | -32.2d | 21 |
| J2000 | (1) Ka-band demo | | 13d 16' 40.66" | -26.0km/s LSR Radio | 36.25183297GHz | 1.35 | 38.1d | 01:37:18.483 |
| J1224+0330 | X ref ptg bp | CalOffPtg | 12h 24m 52.42194s | --- --- --- | 8.46GHz | -1.24 | -27.2d | 1 |
| J2000 | (2) X band pointing | | 3d 30' 50.2929" | --- --- --- | 8.588GHz | -1.15 | -25.7d | 00:02:45.148 |
| J1229+0203 | bandpass | CalBP, CalDelay | 12h 29m 6.69973s | -26.0km/s LSR Radio | 36.32183714GHz | -1.22 | -26.1d | 1 |
| J2000 | (1) Ka-band demo | | 2d 3' 8.5982" | -26.0km/s LSR Radio | 36.25183297GHz | -1.13 | -24.4d | 00:05:09.945 |
| 1331+305=3C286 | X ref ptg flux | CalOffPtg | 13h 31m 8.28798s | --- --- --- | 8.46GHz | -2.16 | -73.9d | 1 |
| J2000 | (2) X band pointing | | 30d 30' 32.9589" | --- --- --- | 8.588GHz | -2.08 | -74.0d | 00:03:19.095 |
| 1331+305=3C286 | flux | CalFlux | 13h 31m 8.28798s | -26.0km/s LSR Radio | 36.32183714GHz | -2.08 | -74.0d | 1 |
| J2000 | (1) Ka-band demo | | 30d 30' 32.9589" | -26.0km/s LSR Radio | 36.25183297GHz | -2.02 | -74.0d | 00:03:24.946 |

# Step 3 Reports Tab: Instrument Configuration Summary

Double check the resources used are correct and each have a corresponding setup scan. If an unintended resource is selected in a scan, it will appear in the **Instrument Configuration Summary**.

Instrument Configuration Summary

| | Name | $T_{int}$ | AC $BB_{center}$ Freq | AC Summed BW | AC Coverage | Req. BIBPs | # Channels | AC Doppler Line | AC Doppler Vel. | AC Doppler Pos. | AC Doppler Off. | Data Rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Band | BD $BB_{center}$ Freq | BD Summed BW | BD Coverage | Act. BIBPs | Min/Max Width | BD Doppler Line | BD Doppler Vel. | BD Doppler Pos. | BD Doppler Off. | |
| 1 | Ka-band demo | 3s | 36.32183714GHz | 8.0MHz | 0.78125 % | 2 | 128 | 36.39232GHz | -26.0km/s LSR Radio | 9h 47m 57.382s 13d 16' 40.66" | -75.521074 | 0.494 MB/s |
| | | Ka | 36.25183297GHz | 8.0MHz | 0.78125 % | 2 | 125.0kHz / 125.0kHz | 36.30963GHz | -26.0km/s LSR Radio | 9h 47m 57.382s 13d 16' 40.66" | -62.823801 | 1.777 GB/h |
| Show All Subbands | | | | | | | | | | | | |
| 2 | X band pointing | 1s | 8.46GHz | 128.0MHz | 12.5 % | 2 | 128 | --- | --- --- --- | --- | --- | 1.481 MB/s |
| | | X | 8.588GHz | 128.0MHz | 12.5 % | 2 | 2.0MHz / 2.0MHz | --- | --- --- --- | --- | --- | 5.331 GB/h |
| Show All Subbands | | | | | | | | | | | | |

For more details, click on **Show All Subbands.**

# Step 3 Double Check Lines Using Dopset

**OPT Input Parameters**
64846 LST day, 08:30 LST, IRC+10216 position,
and respective line rest frequencies

Instrument Configuration Summary

| | Name | $T_{int}$ / Band | AC $BB_{center}$ Freq / BD $BB_{center}$ Freq | AC Summed BW / BD Summed BW | AC Coverage / BD Coverage | Req. BIBPs / Act. BIBPs | # Channels / Min/Max Width | AC Doppler Line / BD Doppler Line | AC Doppler Vel. / BD Doppler Vel. | AC Doppler Pos. / BD Doppler Pos. | AC Doppler Off. / BD Doppler Off. | Data Rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Ka-band demo | 3s | 36.32183714GHz | 8.0MHz | 0.78125 % | 2 | 128 | 36.39232GHz | -26.0km/s LSR Radio | 9h 47m 57.382s 13d 16' 40.66" | -75.521074 | 0.494 MB/s |
| | | Ka | 36.25183297GHz | 8.0MHz | 0.78125 % | 2 | 125.0kHz / 125.0kHz | 36.30963GHz | -26.0km/s LSR Radio | 9h 47m 57.382s 13d 16' 40.66" | -62.823801 | 1.777 GB/h |

Hide All Subbands | Hide A0/C0 | Hide B0/D0 |

| Baseband | ID | Bandwidth | Frequency Range | Fixed | Center | Polarization | BIBPs | Recirculation | Channels | Ch. Width | Phased | Data Rate | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A0/C0 | 0 | 8MHz | 36.39335821GHz - 36.40135821GHz | No | 36.39735821GHz | Full | 1 | 1× | 64 | 125.0kHz | No | 0.247 MB/s | 0 | Generated from HC3N - 36.39232GHz |
| B0/D0 | 0 | 8MHz | 36.31065677GHz - 36.31865677GHz | No | 36.31465677GHz | Full | 1 | 1× | 64 | 125.0kHz | No | 0.247 MB/s | 0 | Generated from SiS - 36.30963GHz |

**OPT Center Frequency Calculations**
HC3N = 36.39735821 GHz
SiS = 36.31465677 GHz

# Step 3 Compare Dopset & OPT Calculations

## Online Dopset Tool

http://www.vla.nrao.edu/astro/guides/dopset/

The Dopset Tool can be used to calculate absolute (sky) frequencies given a position, an epoch, a rest frequency, and velocity information.

The LST day is a term dating back to the VLA days. It can be calculated from the Modified Julian Date (MJD) as follows:

LST Day = 6572.1572917 + 1.002737909350759 * MJD

Right Ascension (J2000): Hours 9 Minutes 47 Seconds 57.382

Declination (J2000): Degrees 13 Minutes 16 Seconds 40.66

line rest frequency (MHz): 36392.32

velocity (km/s): -26 Frame: LSR ◉ Heliocentric ○ Type: radio ◉ optical ○

LST day: 64846 Hours 8 Minutes 30 Seconds 0

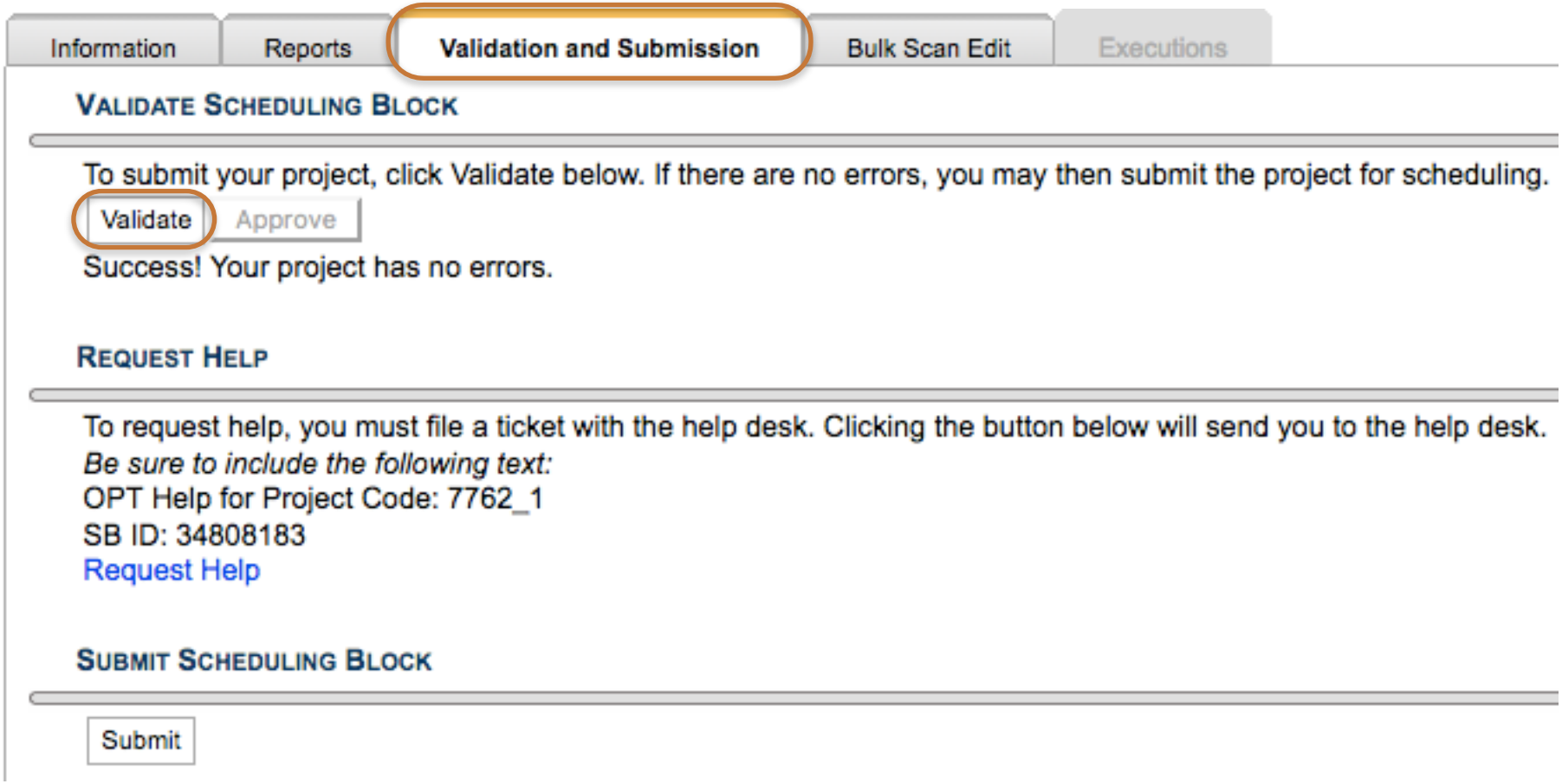
Calculate Frequency

**Dopset Input Parameters**
64846 LST day, 08:30 LST, IRC+10216 position, and respective line rest frequencies

**HC3N Center Frequency Calculations**
OPT = 36.39735821 GHz
Dopset = 36.397358744 GHz

**SiS Center Frequency Calculations**
OPT = 36.31465677 GHz
Dopset = 36.314657295 GHz

# Step 3 Validation and Submission Tab



# Online Documentation

**OPT Manual**
go.nrao.edu/opt-doc

**Guide to Observing with the VLA**
go.nrao.edu/vla-obs

# NRAO HelpDesk

- All submitted SBs are checked/validated by the VLA DAs.
- Unless asked:
  - We do not check the validity of the calibrators.
  - We do not check the scientific accuracy of the correlator resource(s).
- Observers will be contacted if there are any problems with an SB.

Please submit questions to the
**NRAO HelpDesk**
help.nrao.edu