This tutorial

• Congratulations! You have been granted X amount of time...
• Instrument Configurations: Resource Configuration Tool
  – Observing frequencies
  – Channelization & dump rate
• Sources: Source Configuration Tool
  – Scientific target
  – Calibrators (complex gain, absolute flux scale, etc.)
• Scheduling Blocks: Observation Preparation Tool
  – Putting together & submitting a Scheduling Block (SB)
Congratulations!
**E-mail from schedsoc**

- **Time Allocation:**

<table>
<thead>
<tr>
<th>Session Name</th>
<th>Config</th>
<th>(hours)</th>
<th>(hours)</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demo</td>
<td>C</td>
<td>1 x 2.00</td>
<td>5.50</td>
<td>B</td>
</tr>
</tbody>
</table>

- **Time Allocation Summary:**

2.00 hours at priority B.
Deciphering the message

• Priority A: the observations will almost certainly be scheduled
• Priority B: the observations will be scheduled on a best effort basis
• Priority C: the observations will be scheduled as filler
• Priority N*: will not be scheduled
Getting on the telescope

- High priority (A+)
- Submit schedules ASAP
- Short Scheduling Blocks
- Wide range of LSTs (see pressure plots)
- Accept poor weather conditions (constraints - discussed later)
Today’s project

• 2 hrs in C configuration to observe Orion BN/KL
  – Lowest (1,1) through (7,7) metastable ammonia (NH$_3$) transitions: < 1 km/s res’n, over > 120 km/s (gets the lower hyperfines as well)
  – Plus as much continuum as you can get
This tutorial

• Construct an appropriate Scheduling Block using the capabilities which will be available at the next call for proposals

• Use the current version of the tools
  – By December: add a few capabilities (Doppler setting, flexible subband tuning), nicer displays, ability to load line lists, warnings & errors based on the advertised capabilities
Instrument Configurations
(Resource Configuration Tool)
Planning: what do you want?

• Ammonia transitions: splatalogue or other sources
  – (1,1) 23694.50 MHz
  – (2,2) 23722.63 MHz
  – (3,3) 23870.13 MHz
  – (4,4) 24139.42 MHz
  – (5,5) 24532.99 MHz
  – (6,6) 25056.03 MHz
  – (7,7) 25715.18 MHz
Planning: what can you do?

• This is JVLA **K band: 18.0-26.5 GHz**
• 2 x 1.024 GHz baseband pairs within that band
• Naïve approach:
  – A0/C0: (1,1)-(5,5) \(\rightarrow\) 23686.5-24710.5 MHz
    • Centered on **24198.5 MHz**
  – B0/D0: (6,6) & (7,7) \(\rightarrow\) 24873.5-25897.5 MHz
    • Centered on **25385.5 MHz**
  – Naïve because **no subband can cross a 128 MHz boundary**
  – We’ll return to this later…
Offsets from baseband centers

• RCT currently wants offsets from baseband center frequencies rather than absolute frequencies – this will be easier by the fall

• Ammonia transitions then are as follows:
  – (1,1) 23694.50 MHz   A0/C0 -504.00 MHz
  – (2,2) 23722.63 MHz   A0/C0 -475.87 MHz
  – (3,3) 23870.13 MHz   A0/C0 -328.37 MHz
  – (4,4) 24139.42 MHz   A0/C0 -59.08 MHz
  – (5,5) 24532.99 MHz   A0/C0 +334.49 MHz
  – (6,6) 25056.03 MHz   B0/D0 -329.47 MHz
  – (7,7) 25715.18 MHz   B0/D0 +329.68 MHz
Planning: what can you do?

• WIDAR subband bandwidth & channelization possibilities
  – Subband bandwidths: 128, 64, 32, …, 0.03125 MHz
  – Channels: 256 channels/subband, spread over pol’n products
  – Can trade subbands for channels (“Baseline Board stacking”)
  – 64 Baseline Board pairs: if assign all to one subband, you get
    64*256 = 16384 channels (over all pol’n products)

• We want:
  – Cover 120 km/s @ 22 GHz
    • \( \rightarrow \frac{120}{3 \times 10^5} \times 22 \times 10^9 \approx 10 \text{ MHz} \)
  – Want 1 km/s after Hanning smoothing
    • \( \rightarrow \frac{1}{2} \times \frac{1}{3 \times 10^5} \times 22 \times 10^9 \approx 0.04 \text{ MHz/channel} \)
Planning: what can you do?

- So we use a bit of over-kill:
  - 16 MHz subbands
  - 0.04 MHz/channel → want 400 channels, dual polarization
  - use 512 channels in each of 2 pol’n products
  - Total of 1024 channels = 256 × 4 → factor 4 BIB stacking
What about the continuum?

- We want to cover the full 2 x 1024 MHz
- Use widest available subband bandwidth: **128 MHz**
- Need **8 subband pairs** to cover the full 1024 MHz in a baseband
- Spectral resolution is not very important. Default would be 256 channels & full pol’n products \( \rightarrow 128/(256/4) = 2 \text{ MHz/channel} \).
Summary

• K band
• A0/C0
  – Center frequency: 24198.5 MHz
  – 5 “line” subbands: 16 MHz BW, dual pol’n products, x4 BIB stacking
  – 8 “continuum” subbands: 128 MHz BW, full pol’n products, no BIB stacking
• B0/D0
  – Center frequency: 25385.5 MHz
  – 2 “line” subbands: 16 MHz BW, dual pol’n products, x4 BIB stacking
  – 8 “continuum” subbands: 128 MHz BW, full pol’n products, no BIB stacking
Life will become easier…

• We are working on tools to allow you to enter line frequencies directly & figure out how to set up the correlator
• Also displays to show what you’re getting

• But for now, you’re at the bleeding edge…
Log in

• https://siworkshop.aoc.nrao.edu/
  – N.b.: normally just use http://my.nrao.edu
• Click on “Observation Preparation Tool (OPT)”
• Username: demo1…demo200
• Password: 300GHz
• Click on “Instrument Configurations”
Top level

“Demo” has sample setup for this observation
Create new RSRO setup
Create new RSRO setup
Set to 8-bit, K band, center freqs.
Add a subband

Thirteenth Synthesis Imaging Workshop
Continuum: 8 x 128 MHz, 4pp, 64 chan
Add NH₃(1,1): 16 MHz, 2pp, BlB x4
4 new subbands: select...
4 new subbands: …and Bulk Edit
Offsets from baseband centers

• Ammonia transitions then are as follows:
  – (1,1) 23694.50 MHz  A0/C0 -504.00 MHz
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• Next year you will be able to set these perfectly. For now, subbands “snap to a grid” set by the subband bandwidth.

• No subband can EVER cross a 128 MHz boundary!
Data rates: 3sec averaging for sanity
Sources
(Source Configuration Tool)
Planning: where is your source?

• Orion BN/KL
  – J2000: 05h 35m 14.50s, -05d 22' 30.00’’
New source: Orion
LST restrictions

Elevation Curve for Orion at the VLA

Azimuth Curve for Orion at the VLA
Put it in a group

<table>
<thead>
<tr>
<th>Sources in &quot;Demo Group&quot; (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>J0041-0041</td>
</tr>
</tbody>
</table>

Notice: you are currently connected to the siworkshop version of the SCT.
Skymap: finding a nearby calibrator

(Hover over source to see information here.)
Skymap: hover for info

**J0541-0541**

**Altases:** 0541-056 B0539-0543 0539-057

**Positions:**
RA: 5h 41m 38.083s  
Dec: -5° 41' 49.428''

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

**Flux / Structure**

<table>
<thead>
<tr>
<th>Band</th>
<th>Flux A</th>
<th>Flux B</th>
<th>Flux C</th>
<th>Flux D</th>
<th>$\text{UV}_{\text{min}}$ (k)$\lambda$</th>
<th>$\text{UV}_{\text{max}}$ (k)$\lambda$</th>
</tr>
</thead>
<tbody>
<tr>
<td>L (20.0cm)</td>
<td>1.03 Jy</td>
<td>S S S</td>
<td></td>
<td></td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>C (5.0cm)</td>
<td>1.25 Jy</td>
<td>S S P</td>
<td>S S P</td>
<td>S S P</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>X (3.0cm)</td>
<td>0.96 Jy</td>
<td>P P P</td>
<td>S S P</td>
<td>S S P</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Ku (2.0cm)</td>
<td>1.3 Jy</td>
<td>P P P</td>
<td>S S P</td>
<td>S S P</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Q (0.7cm)</td>
<td>0.73 Jy</td>
<td>W W W</td>
<td>W W W</td>
<td>W W W</td>
<td>W</td>
<td>W</td>
</tr>
</tbody>
</table>

**Velocities:**
No Information

**Images:**
None
Calibrators

• Complex gain: nearby, fairly strong at observing band
  – J0541-0541
• Ref.ptg. calibrator: nearby, point-like, strong at X band
  – J0541-0541 (lucky!)
• Flux calibrator: check VLA Flux Cal catalog, LST range
  – Ideally: similar elevation (30-45d) during the observing run
  – 0137+331=3C48  0500-0600 LST
  – 0542+498=3C147  45-75d when Orion is up
• Bandpass calibrator: very strong for SNR in narrow channels
  – Search for > 5 Jy at K band: J0319+4130 (3C84)
  – Elevation 30-75d when Orion is up
Calibrators

• Pol’n leakage: strong, known pol’n
  – J0319+4130

• Pol’n angle: known, non-0 pol’n
  – 3C48/3C138 will do…not great.

• See the EVLA polarization page for hints & details:
  https://science.nrao.edu/facilities/evla/early-science/polarimetry
Scheduling Block
(Observation Preparation Tool)
Planning

• Basic “OSRO” guidelines will be updated, but currently look like this:
  https://science.nrao.edu/facilities/evla/observing/restrictions

• The High Frequency Observing Guide is preliminary but very useful:
  http://evlaguides.nrao.edu/index.php?
title=High_Frequency_Observing

• NRAO helpdesk:
  https://help.nrao.edu/
Planning

• Initial scans
  – 1 min “dummy” for each instrument configuration
  – Long first scan since you don’t know where the array is – can take ~12 mins to get on-source
  – **Set CW/CCW explicitly!**

• Referenced pointing: errors can be up to an arcminute
  – Every hour and/or every source
  – At least 2.5 minutes on-source
  – MUST use 1 sec averaging – default primary X ptg
Planning

- Flux calibrator (prefer same elevation as source)
- Bandpass calibrator (prefer to observe more than once)
- Basic loop: RefPtg, then cal-source-cal-source-….
  - Maximize time on-source, but track the atmosphere!
  - Ensure enough time on the calibrator (SNR; move time; flagging)
  - K band, iffy weather: switch every 2mins in A/B cfg. Can usually get away with longer in C/D (7/10 minutes).
  ➔ Try 40sec/80sec (see next slides)

- Range of LST start times set by source AND calibrators (and length of SB!)
  ➔ For us, 0330-0630 LST to avoid zenith & get 3C48
Scan lengths & sensitivities

• EVLA exposure calculator:
  https://science.nrao.edu/facilities/evla/calibration-and-tools/exposure

• Flux/complex gain calibrators: want SNR>4 on single baseline, one pol’n product, one subband (16 MHz)
  – Nant=2, Npol=1, 16 MHz, 1sec → rms~ 150 mJy
  → Want signal > 600 mJy for 1sec, > 200 mJy for 9sec

• RefPtg: want SNR>4 on single baseline, 128 MHz, single pol’n product, in ~10sec at X band
  • Rms in 10sec= 7 mJy
Scan lengths & sensitivities

• Bandpass calibration: want SNR better than your line, in each channel
  • 31.25 kHz channels, one baseline, one pol’n product: rms in 1 min~ 400 mJy
  • Flux density matters!

• Paranoia is good!
  • Move time, esp. slow antennas
  • Flagging
  • It’s cheap to spend a bit more time (move time often dominates anyhow), and horrible to have uncalibrated data
The Project

Can import sample SB from:

• AOC: /lustre/aoc/siw-2012/opt.xml
• NMT: /fs/scratch/nrao/opt.xml
Program Block
Program Block, tweaked for Orion
Scheduling Block: new...
Scheduling Block: …set the LST range…
Scheduling Block: ...and req’d weather
At last, an actual scan!
Dummy: K band, Orion
Dummy: X band, 3C48
3C48: X band RefPtg

You should really use another nearby calibrator, to avoid resolution effects in Ref.Ptg….check the Source Catalog!
3C48: K band, RefPtg applied
Orion loop (bracketed)
Orion loop (internals)
Report/summary

Warning: Scan Dummy Xptg (ID 1330) has 1 shadowed antennas. The largest shadow is on antenna E02 and is 2.3m (3.3% of the dish), which exceeds your specified maximum of 0.8m.

Warning: Schedule Summary: There is no time on source for scan 'Dummy Xptg'.

Warning: Scan Dummy Xptg (ID 1330) has 1 shadowed antennas. The largest shadow is on antenna E02 and is 0.3m (0.3% of the dish), which exceeds your specified maximum of 0.8m.
Validation & submission!