

ASKAPsoft tutorial

ASKAPsoft Imaging Tutorial

- Courtesy of (and many thanks to) Wasim Raja
- Wasim has prepared four scripts to:
 - Generate input slurm scripts, parsets and associated files
 - Launch jobs on Galaxy
- The scripts are:
 1. bandpass calibration: **do_cal_1934.sh**
 2. prepare science data: **do_pre_process_ras.sh**
 3. image/selfcal science data (continuum only): **do_selfcal_ras.sh**
 4. form linear mosaic: **do_linmos_ras.sh**
- Also:
 - a script to set up galaxy modules: **setup_modules_on_nodes.sh**
 - a file to configure various parameters: **process_ASKAPdata.config**

setup_modules_on_nodes.sh

```
module use /group/askap/modulefiles  
module unload askapsoft  
module load askapsoft/0.22.1
```

```
module unload askapdata  
module load askapdata
```

```
module unload askappipeline  
module load askappipeline  
#module load askapcli
```

```
export PMI_NO_PREINITIALIZE=1  
export PMI_NO_FORK=1  
export PMI_DEBUG=1
```

```
module unload askap-cray  
module load askap-cray
```

```
module unload slurm  
module load slurm
```

process_ASKAPdata.config

```
export TRIAL=0                                # set to 1 to generate files but not run them

export SPLIT_CHAN=1                          # split out a subset of frequency channels
export BCHAN_SPLIT=8192
export ECHAN_SPLIT=8407 #9271

export MY_SBID_BPCAL=5181                    # scheduling block for band-pass calibration (i.e. the id of the BP calibration
                                              # observation)
export MY_SBID_TARGET=5177                  # scheduling block for science data (i.e. the id of the science observation)
export MY_FIELD_NAME=COSMOLOGY_T15-2      # name of the science field
export PATH_TO_SETUP_FILE=$PWD             # change me if running from a different directory
export MY_OUTPATH=ras_data_processing_${this_user}/
mkdir -p ${MY_OUTPATH}msdata/${MY_SBID_TARGET} ${MY_OUTPATH}bpcal_solutions/${MY_SBID_BPCAL}

# Decide which beams you wish to process. Do bandpass calibration for all 36 beams, but restrict imaging and selfcal to 1 or a few
export BBEAM_BPCAL=0 # Must be 0 with the current structure of bptables
export EBEAM_BPCAL=35 # Can be less than maxBeams
export BBEAM=0 # image / selfcal beams 0 to 1
export EBEAM=1

# Some imaging parameters:
export ROBUST=-0.5
export BLOOP_SELFCAL=0
export ELOOP_SELFCAL=1
```

Tutorial — Yesterday

```
$ mkdir askap_tutorial
```

```
$ cd askap_tutorial
```

```
$ cp -r /group/askap/dmitchell/askap_tutorial/* .
```

- “Source” some setup files:

```
$ . setup_modules_on_nodes.sh
```

```
$ . process_ASKAPdata.config
```

- process_ASKAPdata.config will set up things like a directory for output and input of scripts: `$MY_OUTPATH` (set to `ras_data_processing_username`) and various calibration and imaging parameters

Tutorial — Yesterday

- Generate solutions yourselves:

```
$ ./do_cal_1934.sh
```

- mssplit — select a subset of channels (to limit the amount of processing)
- cflag — look for radio frequency interference and set flags
- cbpcalibrator — run the calibrator for each frequency channel

- Or just copy the solution table that I generated:

```
$ . process_ASKAPdata.config
```

```
$ mv cbpcal_1934_sb5181_bm0-bm35_refant-1_bp.tab \  
$MY_OUTPATH/bpcal_solutions/5181/
```

Tutorial — Yesterday

Plot some bandpass calibration solutions. Make sure you have logged in with X11 forwarding:

```
$ ssh -X username@galaxy.pawsey.org.au
```

- or:

```
$ ssh -Y username@galaxy.pawsey.org.au
```

For the help menu:

```
$ plot_bandpass.py -h
```

optional arguments:

-t BP_TAB, --t BP_TAB	Input Bandpass table (with path)
-ib BEAM_NUM, --ib BEAM_NUM	The beam number you wish to process
-ia ANTE_NUM, --ia ANTE_NUM	The antenna number you wish to process

```
$ plot_bandpass.py -t cbpcal_1934_sb5181_bm0-bm35_refant-1_bp.tab -ia 1
```

```
Successful readonly open of default-locked table cbpcal_1934_sb5181_bm0-bm35_refant-1_bp.tab: 3 columns, 1 rows
Plotting bandpass solutions for Input table: cbpcal_1934_sb5181_bm0-bm35_refant-1_bp.tab
For:
```

```
    Beam Num:  0
```

```
    Ante Num:  1
```

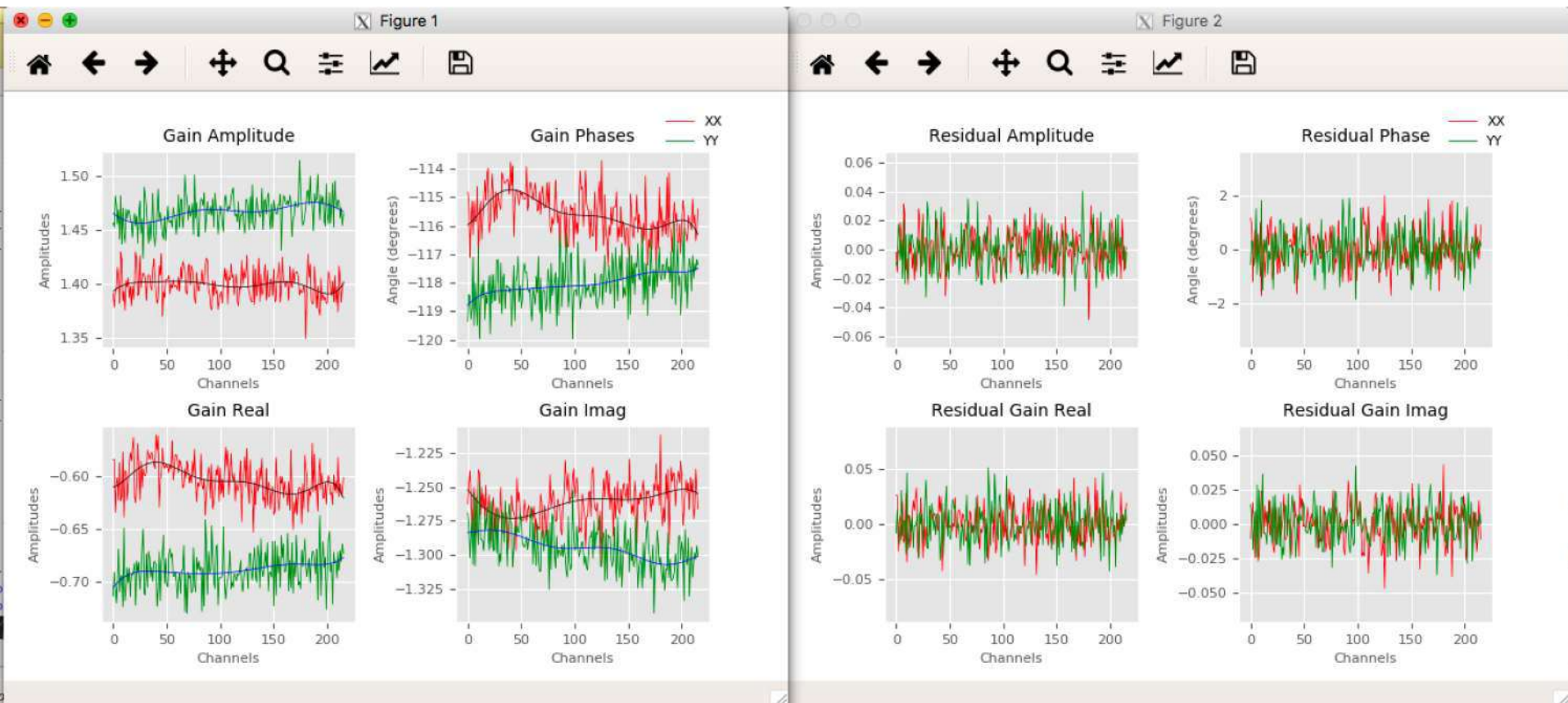
```
Smooth fits will be derived using:
```

```
    Poly Order:  2
```

```
    Harm Order:  3
```

Tutorial — Yesterday

plot_bandpass.py -t cbpcal_1934_sb5181_bm0-bm35_refant-1_bp.tab



Tutorial — Today

- Look at visibilities
 - Make images
 - Look at images
 - Mosaic image
 - Look at mosaics
-
- Two options for looking at results:
 - Download (scp) to your local machine and look with casa tools.
 - Use remotevis.pawsey.org.au to use casa remotely on the Zeus cluster.

Tutorial — Today

On local machine (replace \$MY_OUTPATH with full directory path):

```
$ scp -r username@hpc-data.pawsey.org.au:$MY_OUTPATH/msdata/5181/FLAGGED_DYNAMIC/1934_bm-0_scan-0.ms .
```

Have a look at the contents of the measurement set

```
$ casabrowser 1934_bm-0_scan-0.ms
```

Table Browser

1934_bm-0_scan-0.ms

	UVW	FLAG	FLAG_CATEGORY	WEIGHT	SIGMA	ANTENNA1	ANTENNA2	ARRAY_ID	DATA_DESC_ID	EXPOSURE	FEED1	FEED2	FIELD_ID	FLAG_ROW	INTERVAL	OBSERVATION
0	[0, 0, 0]	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	0	0	0	9.95328	0	0	0	1	9.95328	0
1	[1.08631, -19.4913, -2...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	1	0	0	9.95328	0	0	0	0	9.95328	0
2	[11.6401, -33.6758, -8...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	2	0	0	9.95328	0	0	0	0	9.95328	0
3	[12.5459, -2.9094, 33...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	3	0	0	9.95328	0	0	0	0	9.95328	0
4	[-4.9695, 54.5705, 58...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	4	0	0	9.95328	0	0	0	0	9.95328	0
5	[80.243, -152.169, 37...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	5	0	0	9.95328	0	0	0	0	9.95328	0
6	[95.213, -1.2759, 280...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	6	0	0	9.95328	0	0	0	0	9.95328	0
7	[212.605, -425.366, 58...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	7	0	0	9.95328	0	0	0	0	9.95328	0
8	[-205.4, 159.651, -38...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	8	0	0	9.95328	0	0	0	0	9.95328	0
9	[-1.64016, 440.97, 586...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	9	0	0	9.95328	0	0	0	0	9.95328	0
10	[100.194, 772.702, 660...	[4, 216] Boolean	[0, 0, 0] Boolean	[1, 1, 1, 1]	[1, 1, 1, 1]	0	10	0	0	9.95328	0	0	0	0	9.95328	0

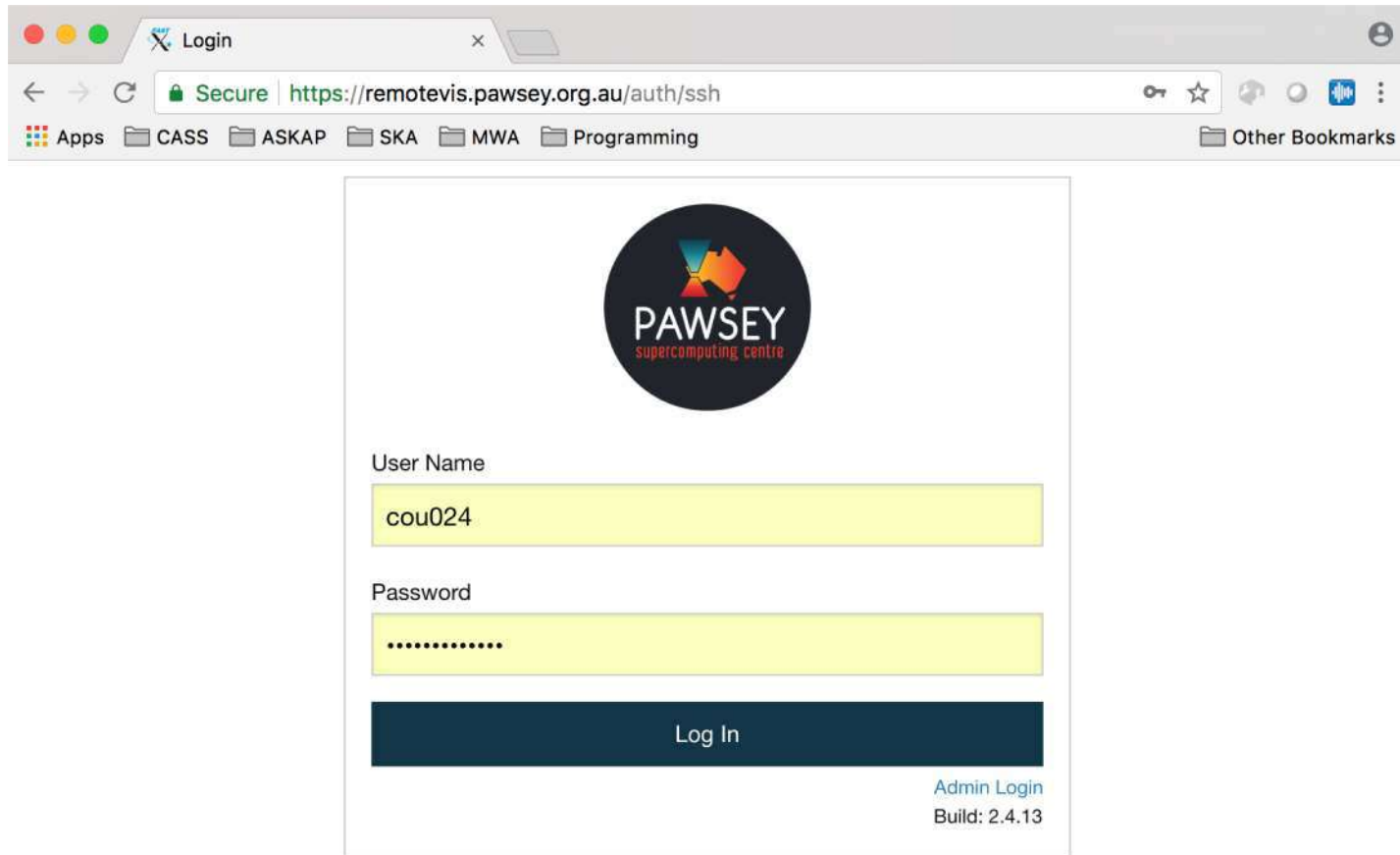
Restore Columns Resize Headers

PAGE NAVIGATION First << [1 / 9] >> Last 1 Go Loading 1000 rows.

Opened saved view.

Tutorial — Today

remotely on the Zeus cluster using `remotevis.pawsey.org.au`



A screenshot of a web browser window showing the login page for the Pawsey supercomputing centre. The browser's address bar displays the URL `https://remotevis.pawsey.org.au/auth/ssh` with a green lock icon indicating a secure connection. The browser's bookmark bar shows folders for 'Apps', 'CASS', 'ASKAP', 'SKA', 'MWA', and 'Programming', along with an 'Other Bookmarks' folder. The login page itself features the Pawsey supercomputing centre logo at the top. Below the logo, there are two input fields: 'User Name' with the text 'cou024' and 'Password' with masked characters. A dark blue 'Log In' button is positioned below the password field. In the bottom right corner of the login form, there is a link for 'Admin Login' and the text 'Build: 2.4.13'.

Secure | `https://remotevis.pawsey.org.au/auth/ssh`

Apps | CASS | ASKAP | SKA | MWA | Programming | Other Bookmarks

PAWSEY
supercomputing centre

User Name
cou024

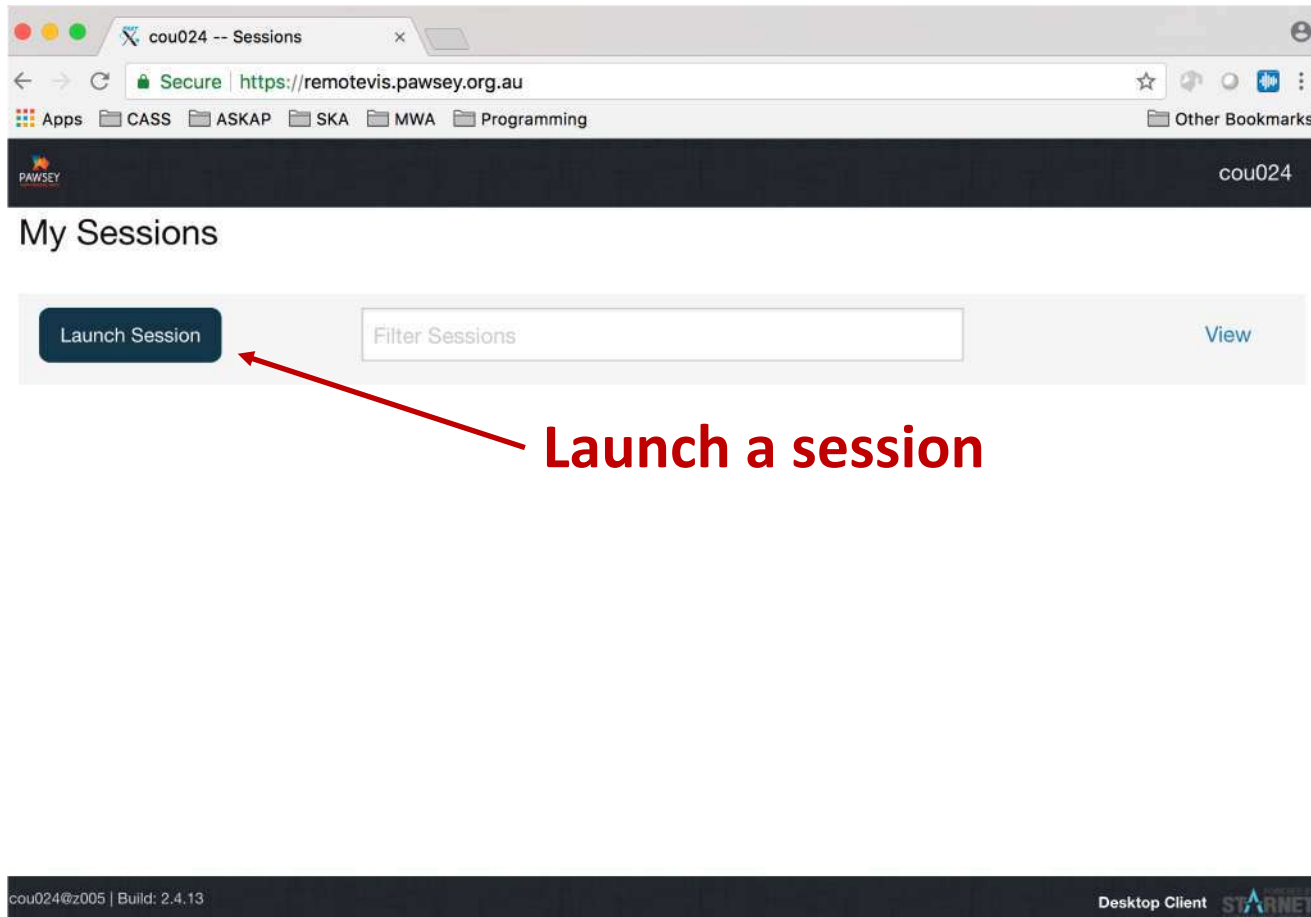
Password
.....

Log In

[Admin Login](#)
Build: 2.4.13

Tutorial — Today

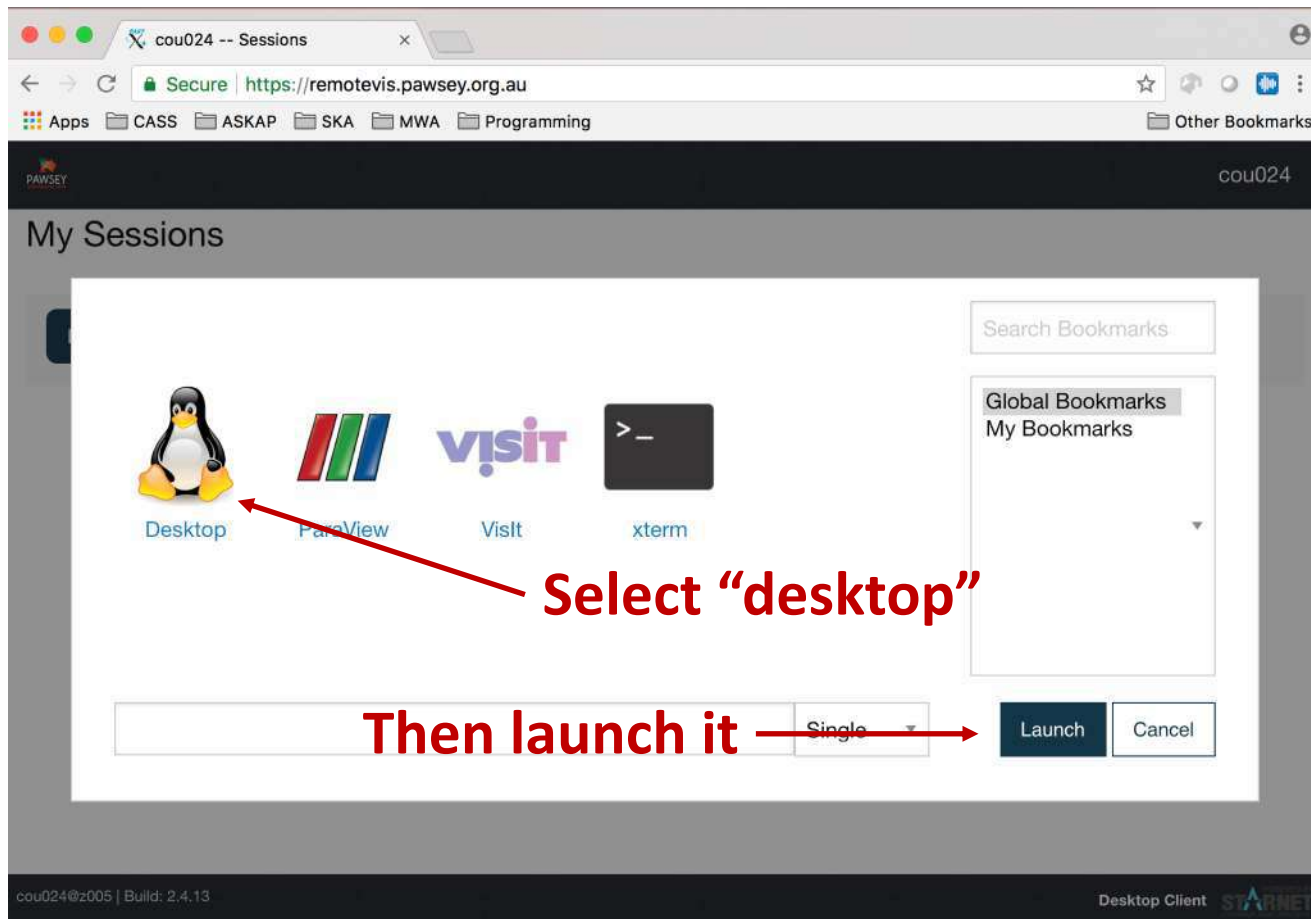
remotely on the Zeus cluster using remotevis.pawsey.org.au



Launch a session

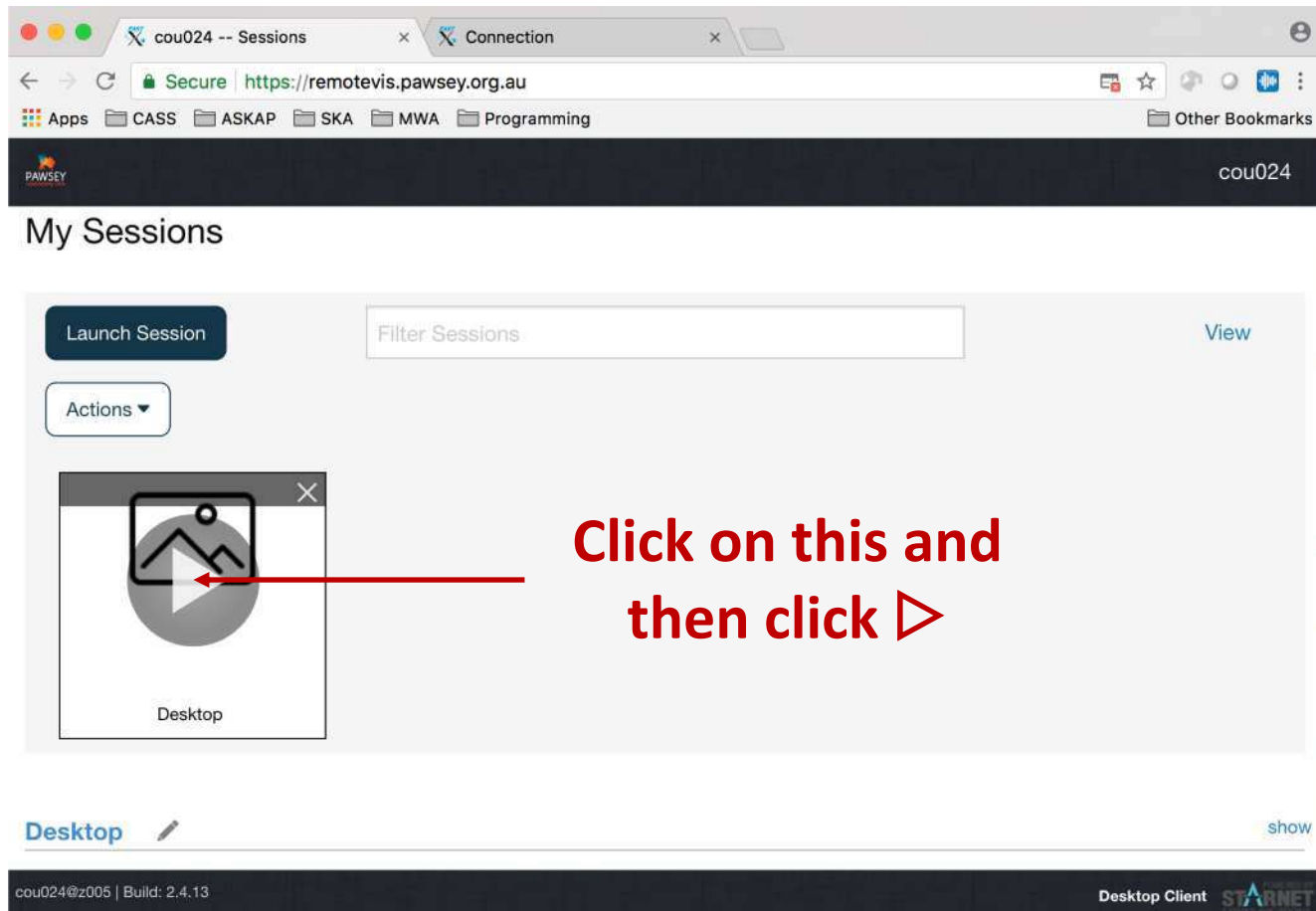
Tutorial — Today

remotely on the Zeus cluster using remotevis.pawsey.org.au



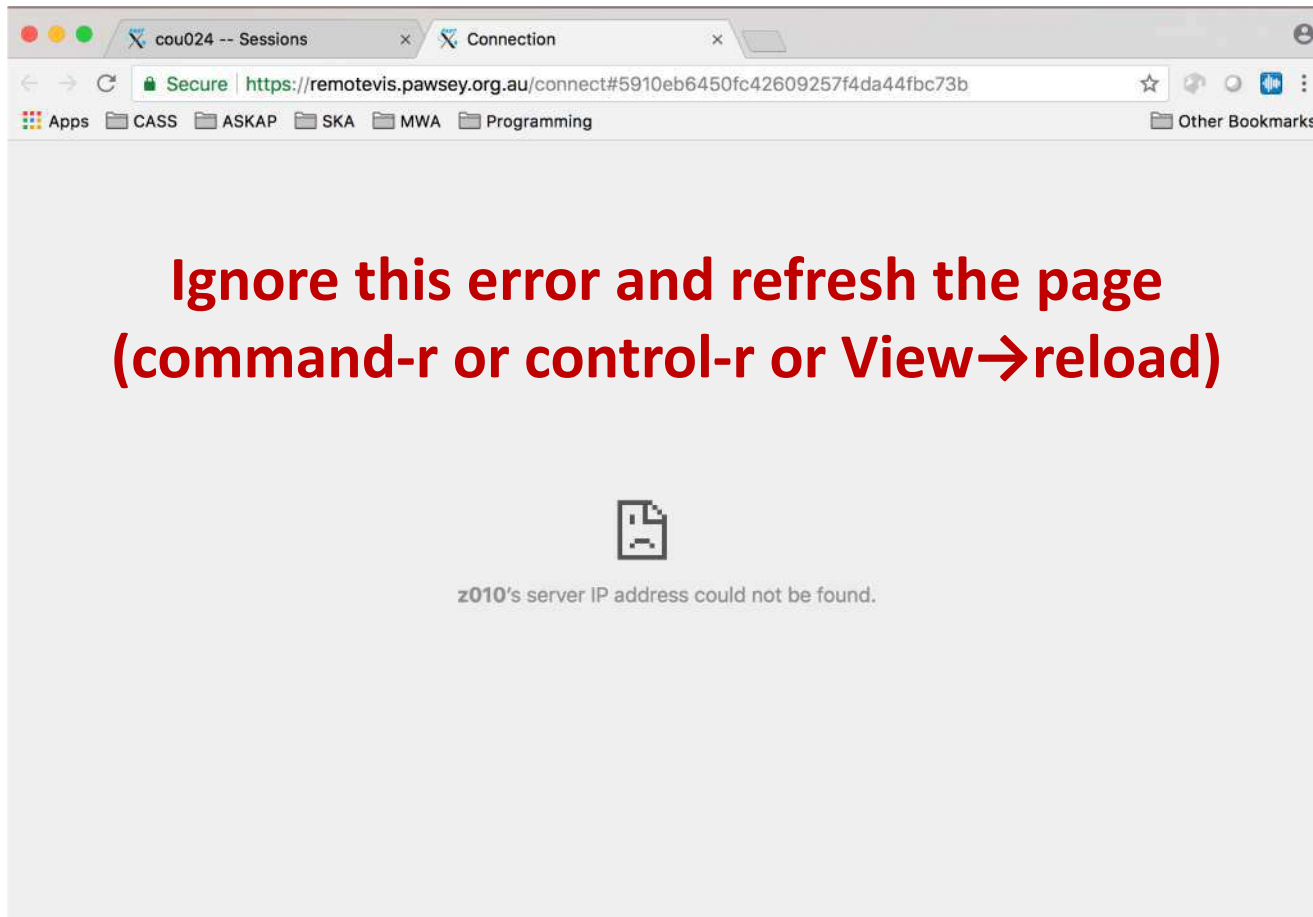
Tutorial — Today

remotely on the Zeus cluster using remotevis.pawsey.org.au

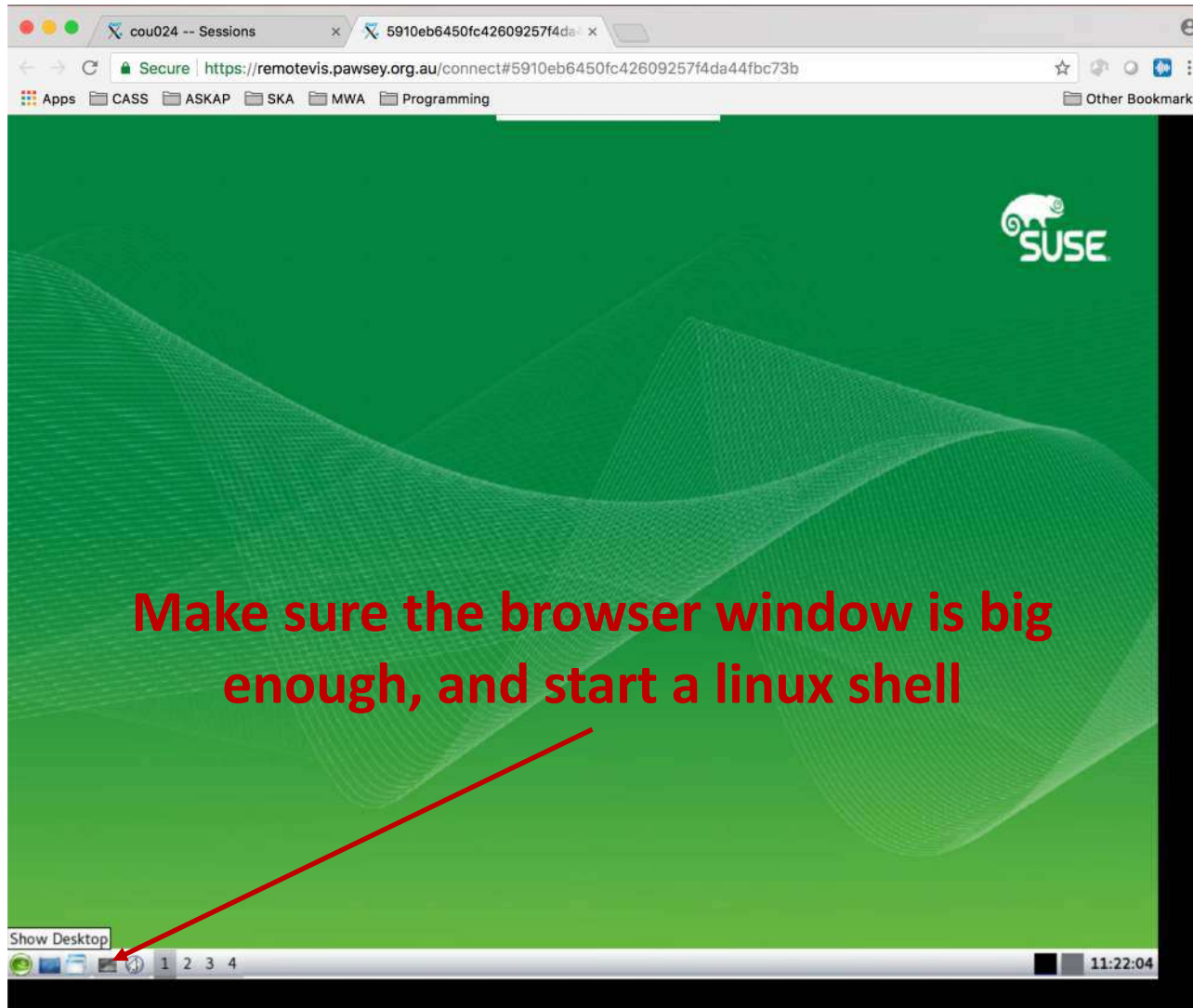


Tutorial — Today

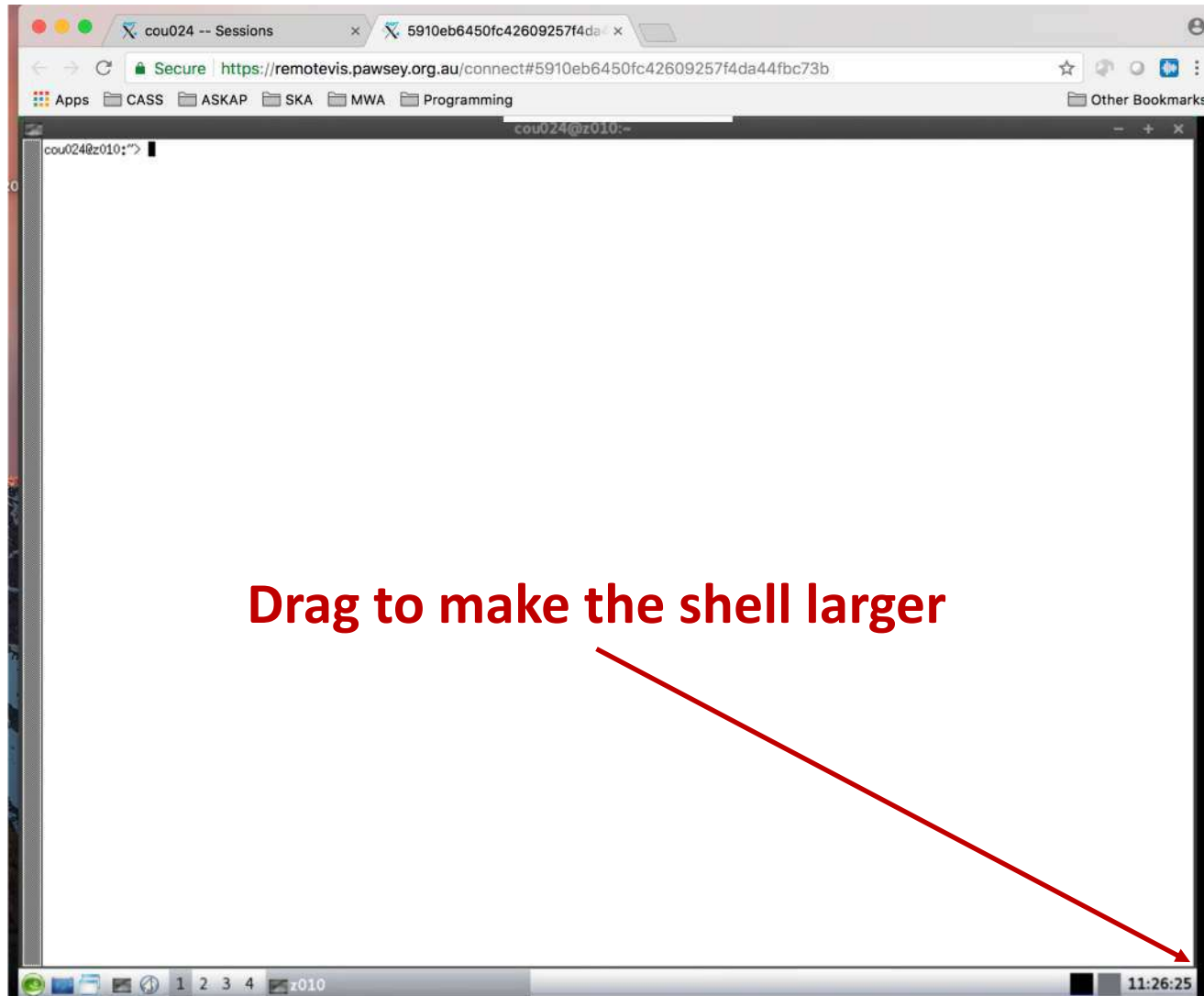
remotely on the Zeus cluster using remotevis.pawsey.org.au



Tutorial — Today

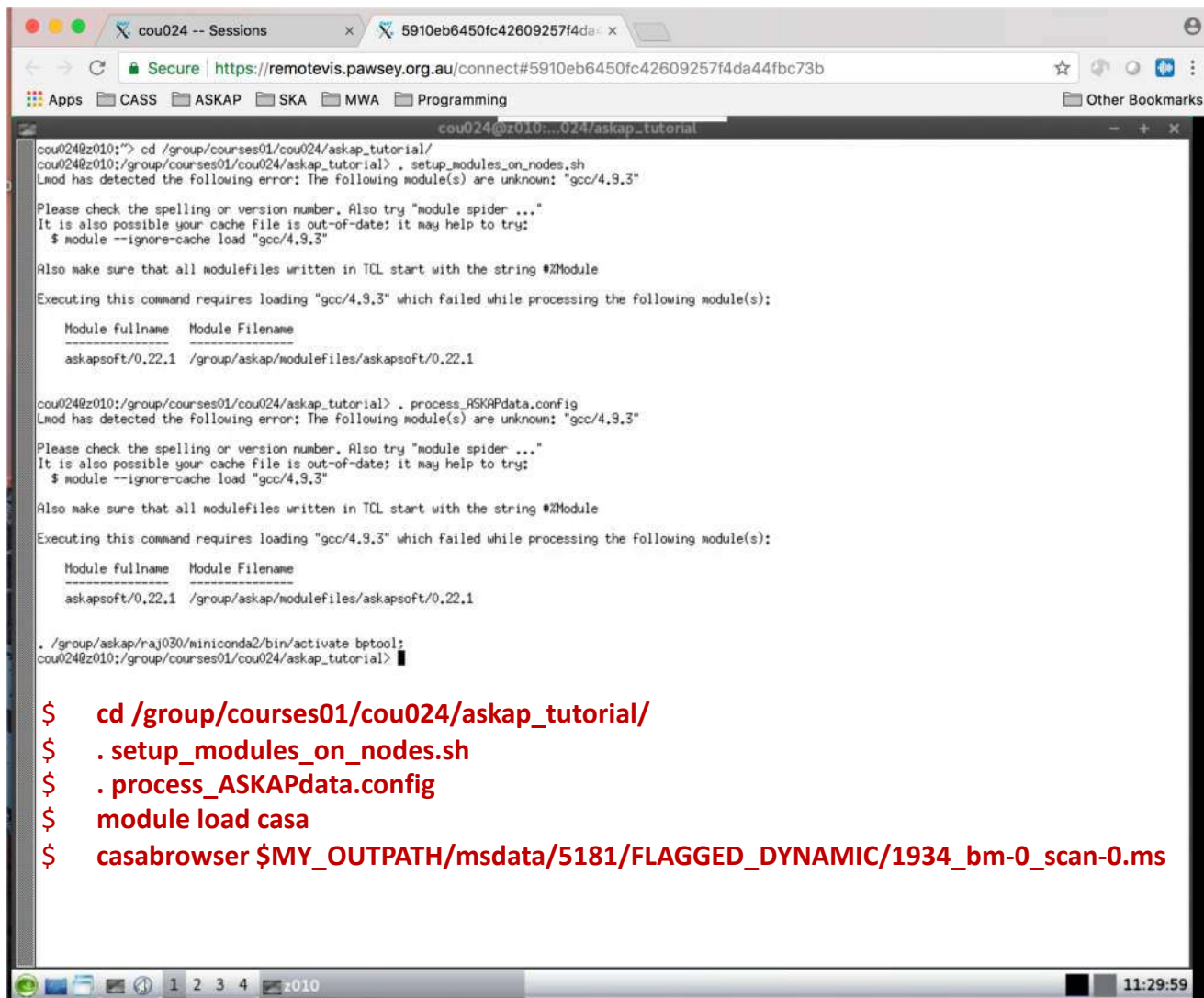


Tutorial — Today



Drag to make the shell larger

Tutorial — Today



```
cou024@z010:~$ cd /group/courses01/cou024/askap_tutorial/
cou024@z010:/group/courses01/cou024/askap_tutorial$ . setup_modules_on_nodes.sh
Load has detected the following error: The following module(s) are unknown: "gcc/4.9.3"

Please check the spelling or version number. Also try "module spider ..."
It is also possible your cache file is out-of-date; it may help to try:
$ module --ignore-cache load "gcc/4.9.3"

Also make sure that all modulefiles written in TCL start with the string #Module

Executing this command requires loading "gcc/4.9.3" which failed while processing the following module(s):

Module fullname  Module Filename
-----
askapsoft/0.22.1  /group/askap/modulefiles/askapsoft/0.22.1

cou024@z010:/group/courses01/cou024/askap_tutorial$ . process_ASKAPdata.config
Load has detected the following error: The following module(s) are unknown: "gcc/4.9.3"

Please check the spelling or version number. Also try "module spider ..."
It is also possible your cache file is out-of-date; it may help to try:
$ module --ignore-cache load "gcc/4.9.3"

Also make sure that all modulefiles written in TCL start with the string #Module

Executing this command requires loading "gcc/4.9.3" which failed while processing the following module(s):

Module fullname  Module Filename
-----
askapsoft/0.22.1  /group/askap/modulefiles/askapsoft/0.22.1

./group/askap/ra030/miniconda2/bin/activate bptool:
cou024@z010:/group/courses01/cou024/askap_tutorial$
```

\$ cd /group/courses01/cou024/askap_tutorial/

\$. setup_modules_on_nodes.sh

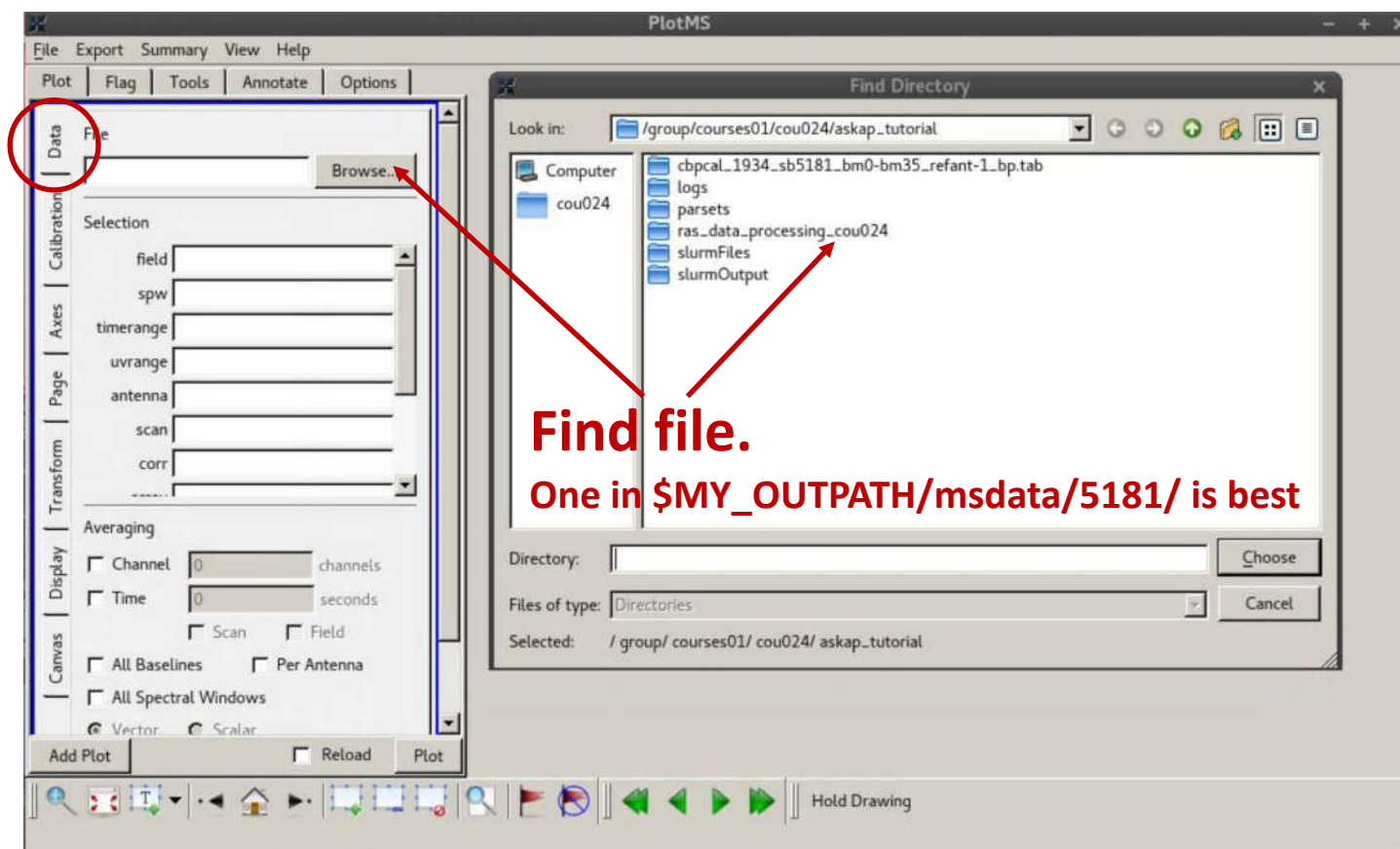
\$. process_ASKAPdata.config

\$ module load casa

\$ casabrowser \$MY_OUTPATH/msdata/5181/FLAGGED_DYNAMIC/1934_bm-0_scan-0.ms

Tutorial — Today

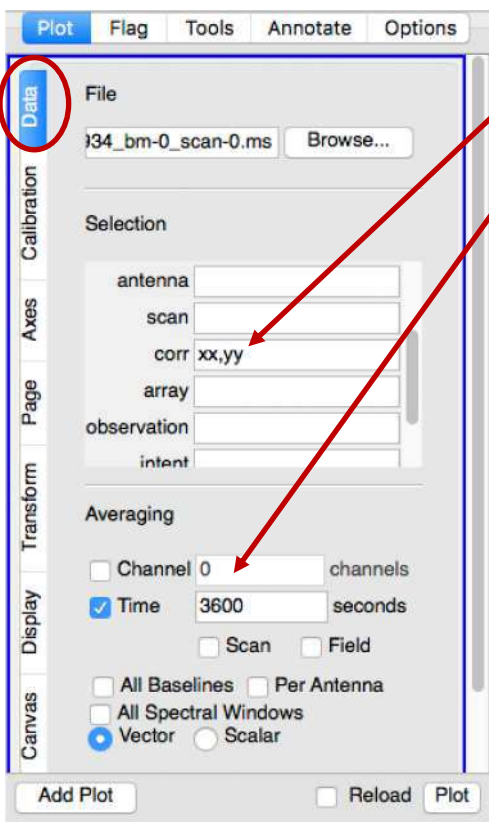
On local machine or remotevis.pawsey.org.au, plot data in the measurement set:



Tutorial — Today

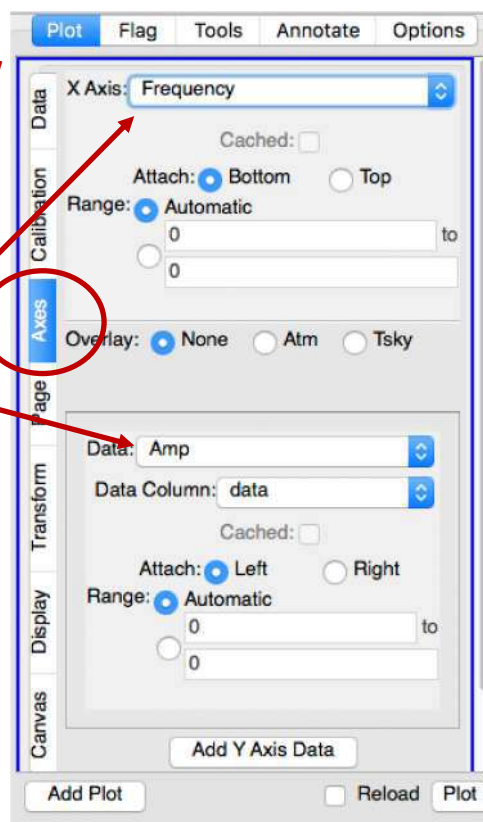
On local machine or remotevis.pawsey.org.au, plot data in the measurement set:

\$ casaplotms

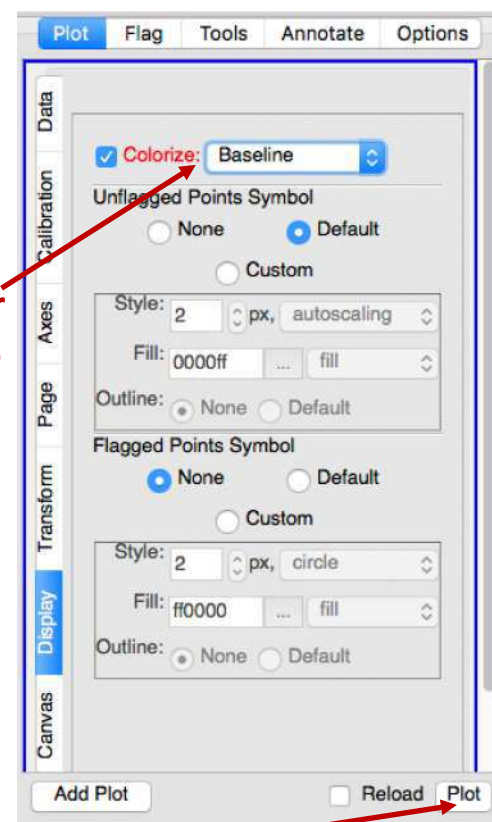


Choose a few polarisations and average in time

Choose x and y axes



Choose a colour scheme

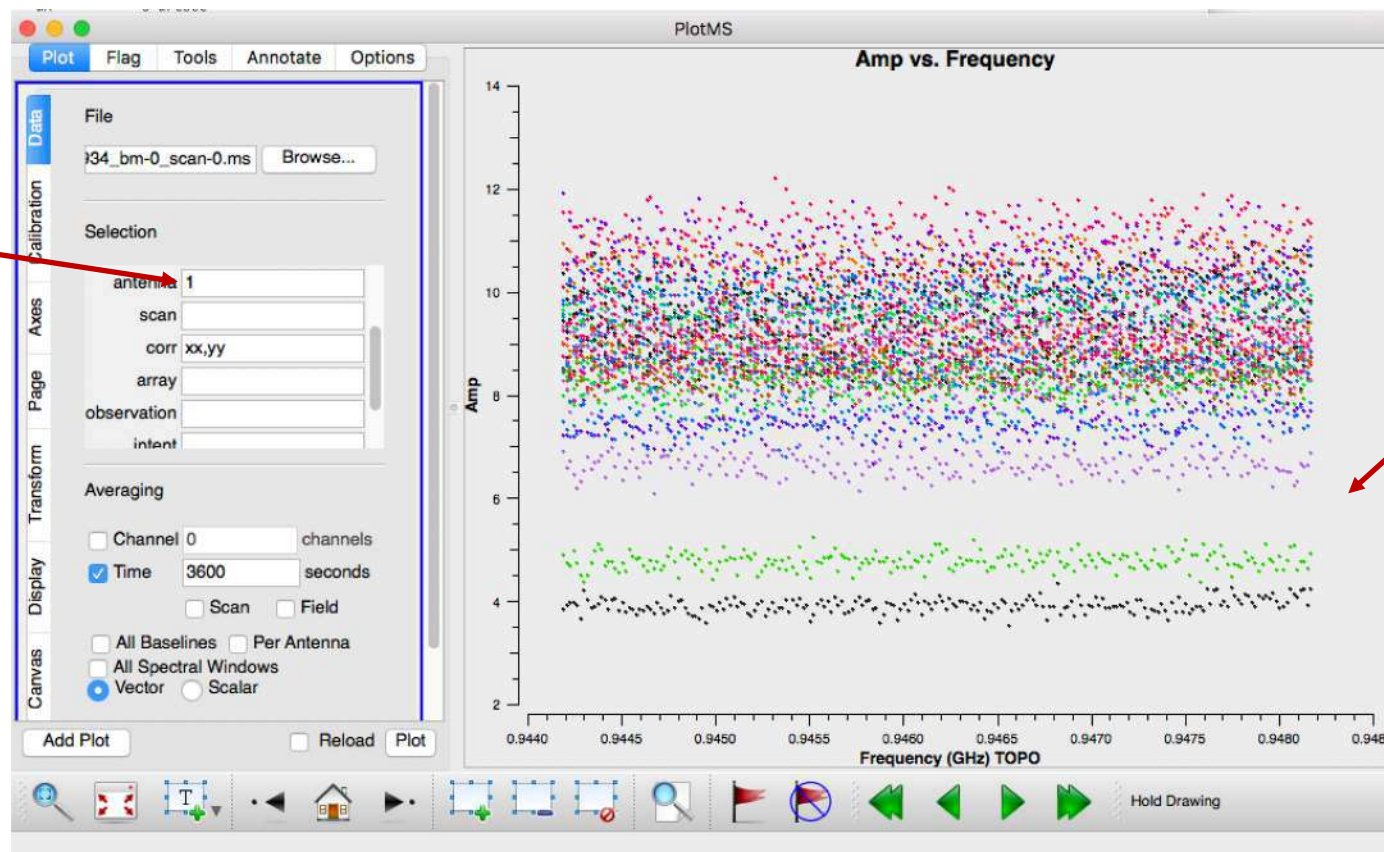


And plot!

Tutorial — Today

On local machine or remotevis.pawsey.org.au, plot data in the measurement set:

\$ casaplotms

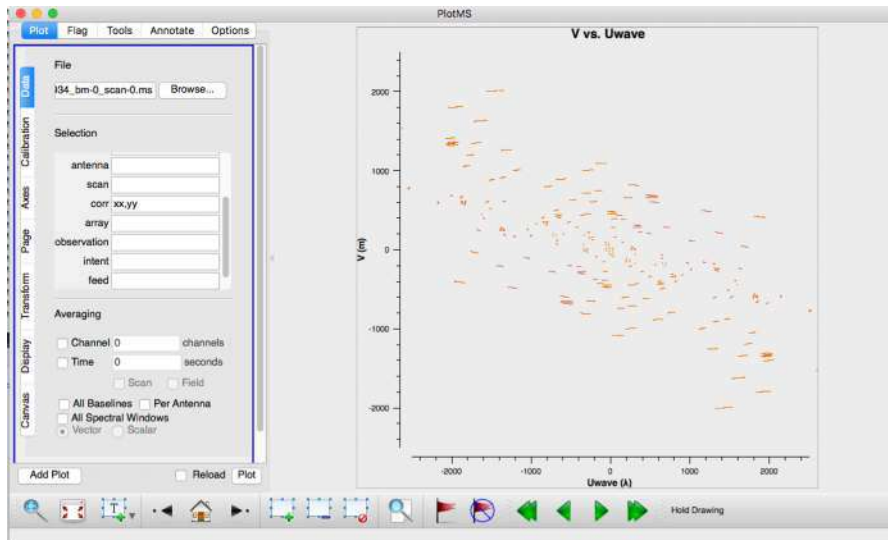


Tutorial — Today

On local machine or remotevis.pawsey.org.au, plot data in the measurement set:

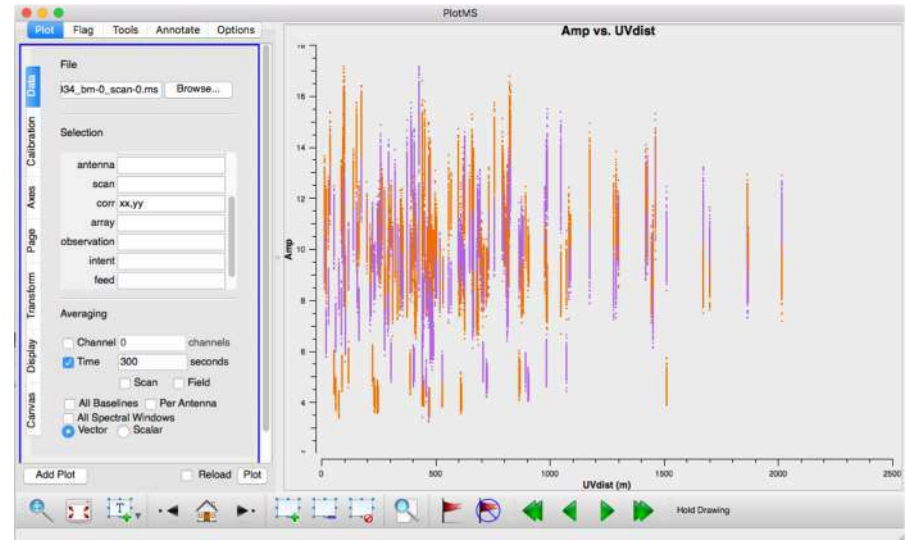
\$ casaplotms

Plot the uv coverage



Plot amplitude versus uvdist

$$\text{“uv distance”} = \sqrt{u^2 + v^2}$$



Calibrate the Calibrator!

- **Generate a new file apply_cal.in:**

Ccalapply.dataset	= test_cal.ms
Ccalapply.calibaccess	= table
Ccalapply.calibaccess.table.maxant	= 16
Ccalapply.calibaccess.table.maxbeam	= 36
Ccalapply.calibaccess.table.maxchan	= 216
Ccalapply.calibaccess.table	= cbpcal_1934_sb5181_bm0-bm35_refant-1_bp.tab

- **Generate a new file apply_cal.sbatch:**

```
#!/usr/bin/env bash
#SBATCH --partition=workq
#SBATCH --time=00:05:00
#SBATCH --ntasks=20
#SBATCH --ntasks-per-node=20
#SBATCH --job-name=apply_cal
#SBATCH --account=courses01
#SBATCH --reservation=courseq
#SBATCH --export=ALL
srun --ntasks=19 --ntasks-per-node=19 ccalapply -c apply_cal.in > apply_cal.log
```

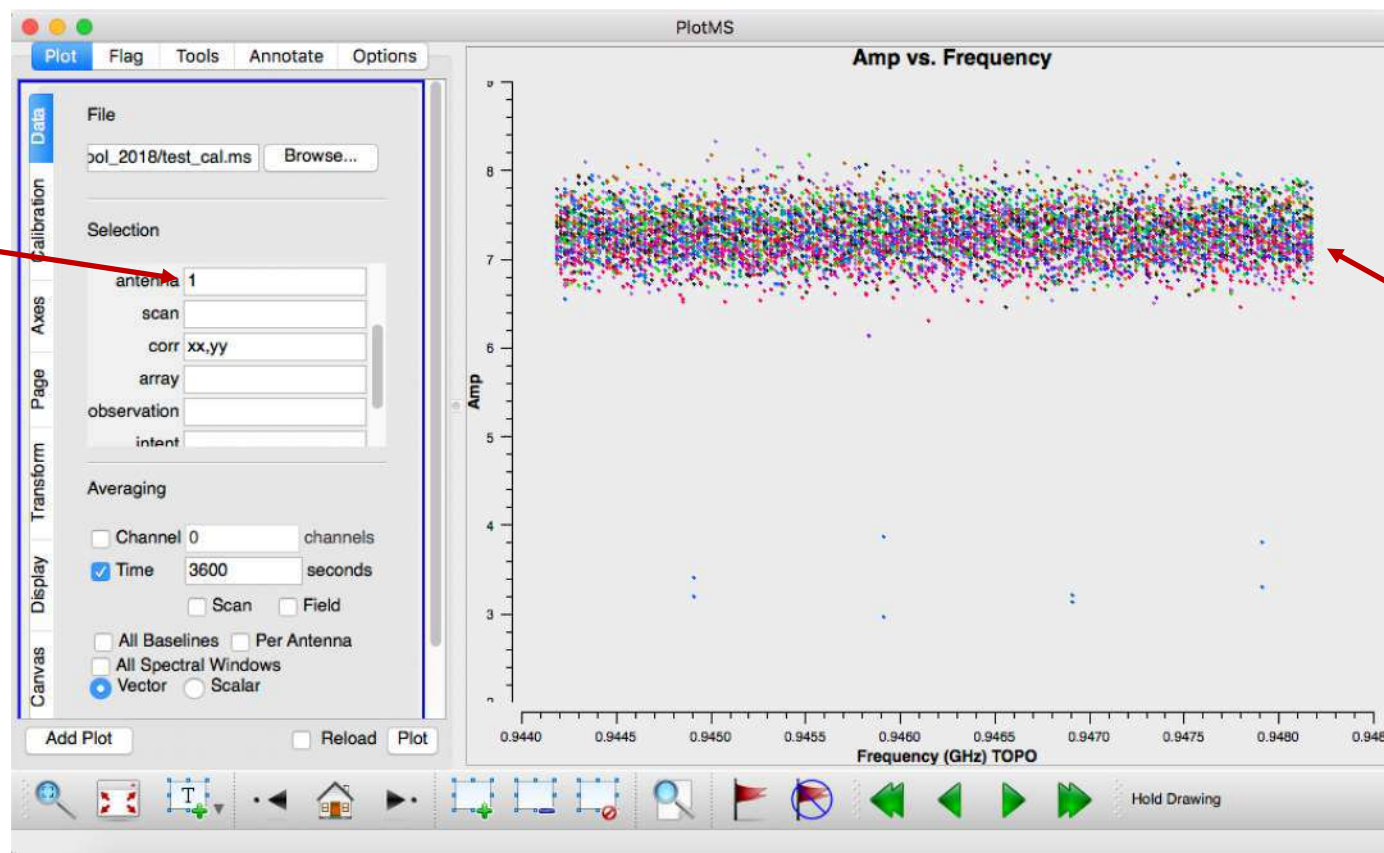
- **Run:**

```
cp -r $MY_OUTPATH/msdata/5181/1934_bm-0_scan-0.ms test_cal.ms
cp -r $MY_OUTPATH/bpcal_solutions/5181/cbpcal_1934_sb5181_bm0-bm35_refant-1_bp.tab .
sbatch apply_cal.sbatch
```

Tutorial — Today

On local machine or remotevis.pawsey.org.au, plot data in the measurement set:

```
$ casaplotms
```



do_pre_process_ras.sh

\$./do_pre_process_ras.sh

- mssplit — select the same subset of channels from the science dataset
- ccalapply — apply calibration solutions to the science data
- cflag — look for radio frequency interference and set flags
- mssplit — average in frequency
- cflag — a final round of flagging

do_selfcal_ras.sh

```
$ ./do_selfcal_ras.sh
```

- ccalibrator — run calibration using a model of this field
 - cimager — image and deconvolve the field with the new calibration solutions
 - selavy — run relatively shallow source finder on the restored image
 - cmodel — generate a model image from the selavy catalogue
-
- 1st run: set BLOOP_SELFICAL=0 & ELOOP_SELFICAL=0: imaging with no selfcal

```
$ squeue -u username
```

JOBID	USER	ACCOUNT	NAME	EXEC_HOST	ST	REASON	START_TIME	END_TIME	TIME_LEFT	NODES	PRIORITY
5055128	dmitchel	askaprt	IMG-5177-0A.I	nid00217	R	None	08:36:54	14:36:54	5:56:54	1	10001
5055129	dmitchel	askaprt	IMG-5177-1A.I	nid00299	R	None	08:36:54	14:36:54	5:56:54	1	10001

do_selfcal_ras.sh

```
$ ls -ld ${MY_OUTPATH}/image/5177/weight*  
image/5177/weights.l.COSMOLOGY_T15-2A_bm-0_iter-0  
image/5177/weights.l.COSMOLOGY_T15-2A_bm-1_iter-0  
$ ls -ld ${MY_OUTPATH}/image/5177/image*restored  
image/5177/image.l.COSMOLOGY_T15-2A_bm-0_iter-0.restored  
image/5177/image.l.COSMOLOGY_T15-2A_bm-1_iter-0.restored  
$ ls -ld ${MY_OUTPATH}/image/5177/image*restored.cmodel  
image/5177/image.l.COSMOLOGY_T15-2A_bm-0_iter-0.restored.cmodel  
image/5177/image.l.COSMOLOGY_T15-2A_bm-1_iter-0.restored.cmodel  
$ ls -ld ${MY_OUTPATH}/image/5177/psf*  
image/5177/psf.l.COSMOLOGY_T15-2A_bm-0_iter-0  
image/5177/psf.l.COSMOLOGY_T15-2A_bm-1_iter-0  
image/5177/psf.image.l.COSMOLOGY_T15-2A_bm-0_iter-0  
image/5177/psf.image.l.COSMOLOGY_T15-2A_bm-1_iter-0
```

do_linmos_ras.sh

```
$ ./do_linmos_ras.sh
```

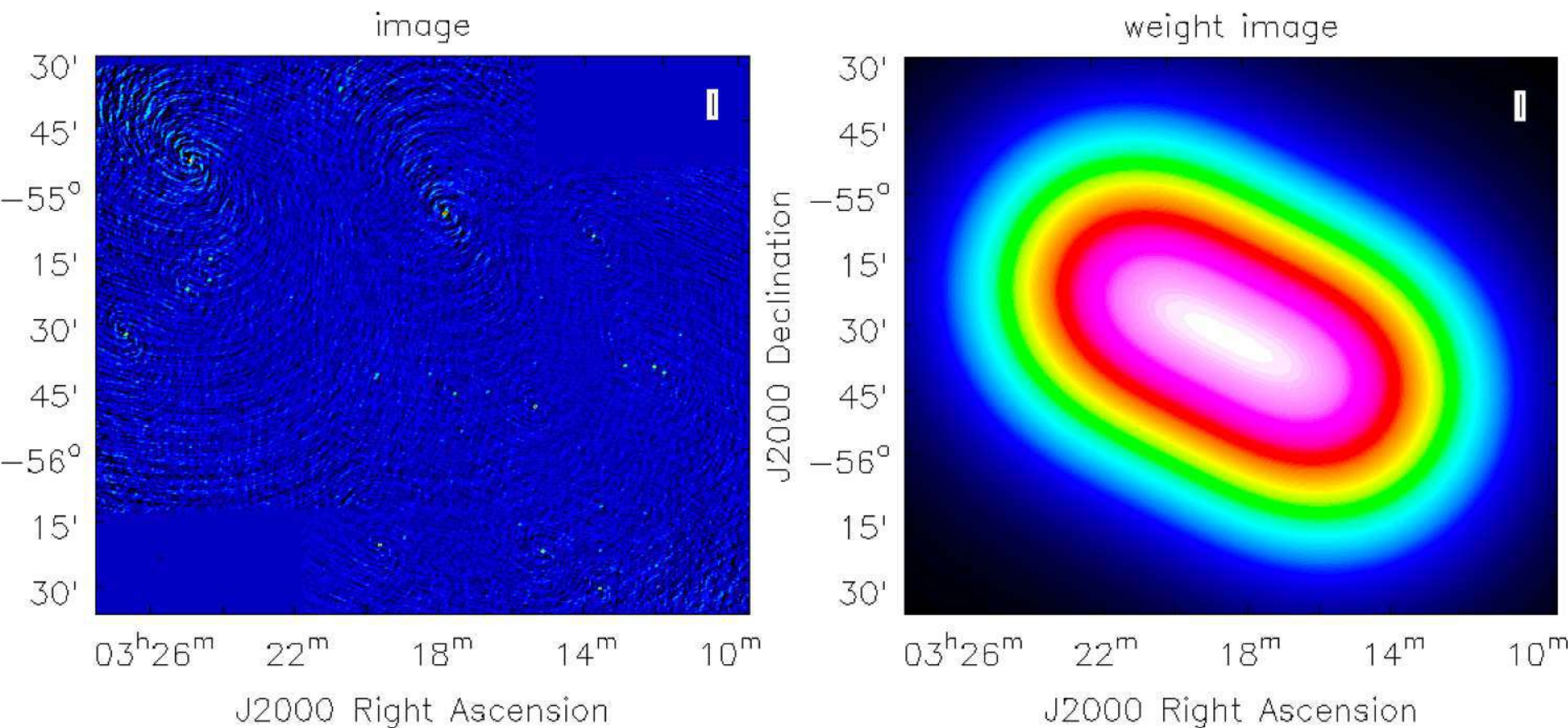
- linmos — form a linear mosaic of the final images

On local machine or remotevis.pawsey.org.au

```
$ casaviewer dir/image.I.COSMOLOGY_T15-2iter-0.linmosRAS_5177
```

- dir = \$MY_OUTPATH/image/5177

casaviewer image.I.COSMOLOGY_T15-2iter-0.linmosRAS_5177



One loop of self-cal

- 2nd run: set BLOOP_SELFCAL=1 & ELOOP_SELFCAL=1: imaging with a selfcal update
- ```
$. process_ASKAPdata.config
$./do_selfcal_ras.sh
$./do_linmos_ras.sh

$ ls -l $MY_OUTPATH/linmos/5177/

$ scp -r username@hpc-data.pawsey.org.au:$MY_OUTPATH/linmos/5177/*iter-1* .

$ casaviewer image.l.COSMOLOGY_T15-2iter-1.linmosRAS_5177
```