

**CASA**  
VLBI

**WORKSHOP 2020**

**2-6 NOVEMBER 2020**

**LECTURE #1:**

**INTRODUCTION TO CASA**

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# CASA tour:

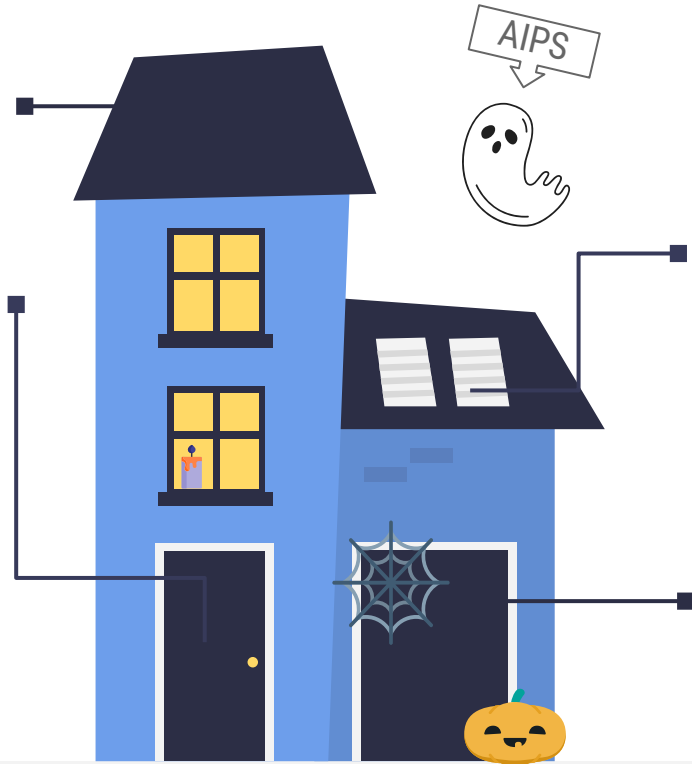
GF

## CASA-VLBI

The latest addition to the family!

## Welcome to CASA!

Everything you need to get started



Contains spoilers for the following talks

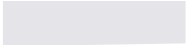


## Powered by

How it works and how to write scripts

## Drive in

Getting started with the CASA tasks





## The Common Astronomy Software Applications package



### Single-dish data



The primary data processing software for the Atacama Large Millimeter/submillimeter Array (**ALMA**) and NSF's Karl G. Jansky Very Large Array (**VLA**)



VLBI arrays - **CASA-VLBI!**





# CASA

## Download

piece\_of\_cake.exe  
installation!



## New: VLBI

You're in the right  
place if you want to  
know more!



## Documentation

Try to find  
a question that  
has no answer yet



## Help!

Do not panic!  
Help is coming





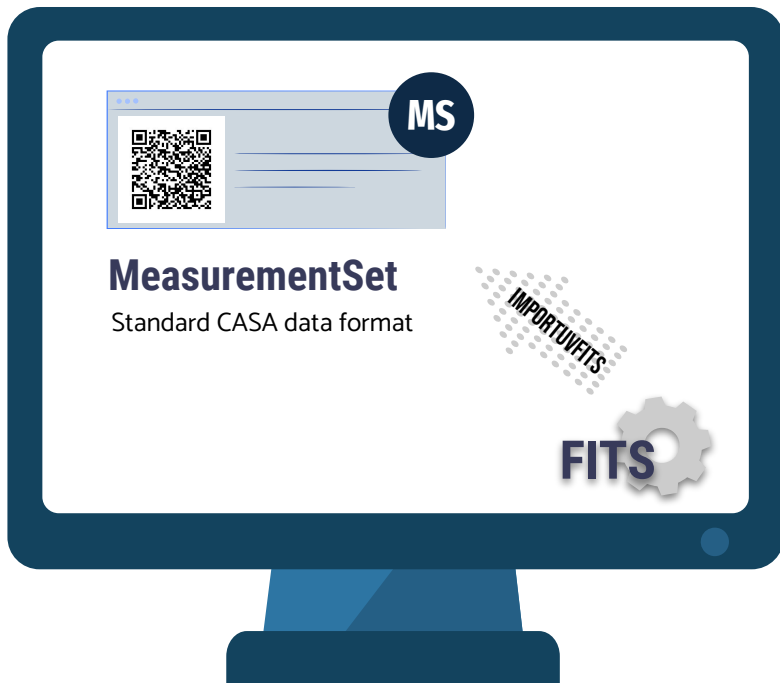
## Download & Install

Current version:

- CASA v6.1 (Python 3)
- CASA v5.7 (Python 2)



● Unpack  
& use



# CASA

## UV Data Format

```
CASA <1>: ls ngc5921.ms #IPython system call: ls -F ngc5921.ms
ANTENNA          POLARIZATION      table.f1          table.f3_TSM1    table.f8
DATA_DESCRIPTION PROCESSOR          table.f10         table.f4          table.f8_TSM1
FEED             SORTED_TABLE      table.f10_TSM1    table.f5          table.f9
FIELD           SOURCE            table.f11         table.f5_TSM1    table.f9_TSM1
FLAG_CMD        SPECTRAL_WINDOW  table.f11_TSM1    table.f6          table.info
HISTORY         STATE             table.f2          table.f6_TSM0    table.lock
OBSERVATION     table.dat         table.f2_TSM1     table.f7
POINTING        table.f0          table.f3          table.f7_TSM1
```

 **browsetable**

**MS = MAIN table** [visibility data] + **Sub-tables** [auxiliary information]

# Managing flag versions

5

**ms**

- database of radioastronomical data
- original flags in the MAIN table

**EXMPL.ms**


**flagversions**

- CASA flag versions table
- a backup of flags
- is created on import or first flagging

**EXMPL.ms.flagversions**

FLAG\_VERSION\_LIST

The flag versions are cumulative, i.e. a specific version contains all the flags from the lower versions.

Use the `flagmanager` task 





# Starting CASA

6

```
>> casa
```

---

The start-up time of CASA may vary depending on whether the shared libraries are cached or not.

---

IPython 5.1.0 -- An enhanced Interactive Python.

CASA 5.4.0-68 -- Common Astronomy Software Applications

```
--> CrashReporter initialized.  
Enter doc('start') for help getting started with CASA...  
Using matplotlib backend: TkAgg
```

```
CASA <1>:
```

The output from CASA commands is sent to the file **casa-YYYYMMDD-HHMMSS.log**

New starts of CASA create new log files



Time	Priority	Origin	Message
2020-	11	INFO	::casa
2020-	11	INFO	::casa CASA Version 5.4.0-68

Pay attention to the window!






# CASA tasks

7

```
CASA <1>: default('listobs')
```

tget listobs 

```
CASA <2>: inp  
-----> inp()
```

```
# listobs :: List the summary of a data set in the logger or in a file  
vis          =      ''          # Name of input visibility file (MS)  
selectdata   =      True        # Data selection parameters  
  field      =      ''          # Selection based on field names or  
                                # field index numbers. Default is all.  
  spw        =      ''          # Selection based on spectral-  
                                # window/frequency/channel.  
  antenna    =      ''          # Selection based on antenna/baselines.  
                                # Default is all.  
...
```

```
CASA <3>: go
```

```
CASA <1>: listobs(vis='EXMPL.ms',listfile='EXMPL.listfile')
```




[Summary of CASA tasks](#)



[Global Task List](#)

Python is used as the underlying command line interface/scripting language to CASA

*Use your python intuition, Luke* 



Abort execution of a task:  
CTRL-C or CTRL-Z



You may have to **quit** and  
**restart** CASA after an abort



# CASA tasks: Python scripts


```
CASA <1>: listobs(vis='EXMPL.ms',listfile='EXMPL.listfile')
```

■ **Standard input**

```
CASA <1>: execfile('listobs.py')
```

```
CASA <1>: execfile 'listobs.py'
```

```
CASA <1>: run listobs.last
```

Re-initializing the task parameters 

```
CASA <1>: exit
```

```
>> casa -c listobs.py
```


Outside CASA

■ **Run your script**

listobs.py

```
listobs(  
    vis = 'EXMPL.ms',  
    listfile = 'EXMPL.listing')
```

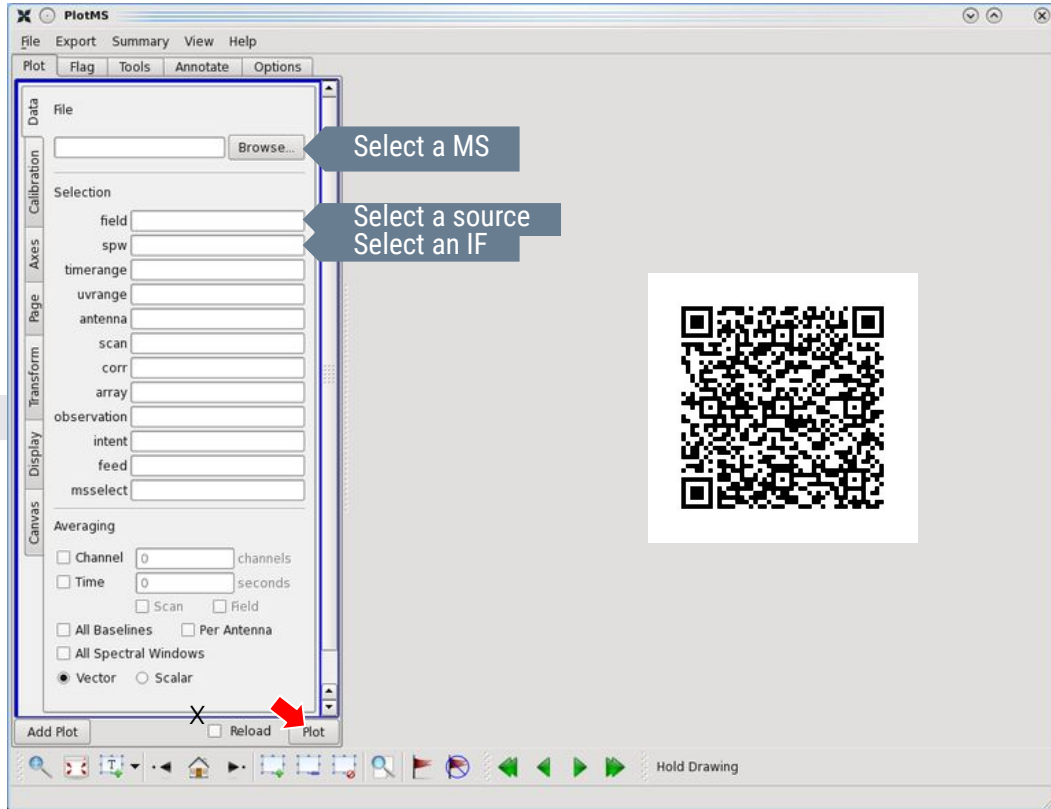


Check the '[Python and CASA](#)' webpage when you're ready to write your first script 



# CASA PlotMS

9



```
CASA <1>: plotms
```

## CASA PlotMS:

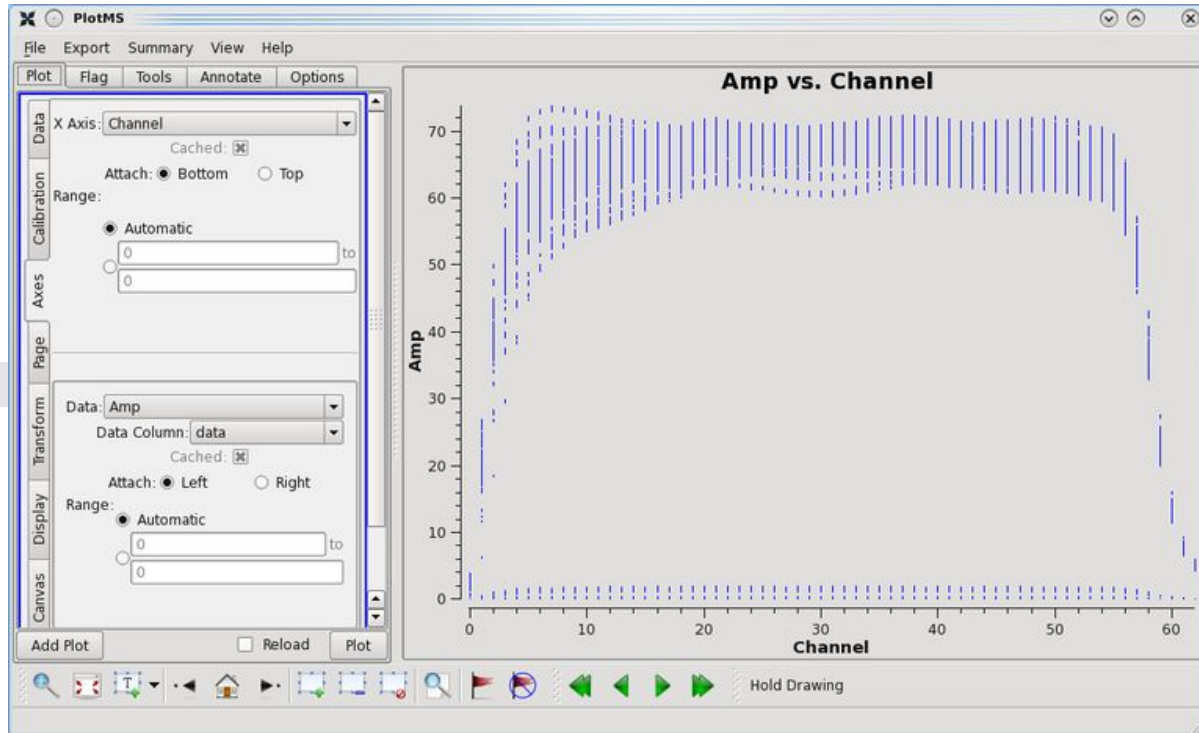
- can display **X-Y plots of visibility data** and **calibration tables**
- can be started inside a CASA shell or as a *stand-alone executable*



If you're lucky:  
stand-alone apps may not work  
in some versions of CASA



# CASA PlotMS



## Interactive Flagging:

Mark with the cursor a region, and then flag, unflag, or list the data from the region

**!** You cannot "undo" flagging to a previous state!  
*(plotms does not automatically create flag backups)*



# CASA Viewer

CASA <1>: viewer

Data Manager -- Viewer (on Jop104)

load | save image | save region

directory: /media/bayandina/VLAOHmain/G358\_C\_test

input file	type
- G358_J1820-2528_C.model	Image
- G358_J1820-2528_C.psf	Image
- G358_J1820-2528_C.residual	Image
- G358_J1820-2528_C1.flux	Image
- G358_J1820-2528_C1.image	Image
- G358_J1820-2528_C1.model	Image
- G358_J1820-2528_C1.psf	Image
- G358_J1820-2528_C1.residual	Image
- G358_J1820-2528_Cont.flux	Image
- G358_J1820-2528_Cont.image	Image
- G358_J1820-2528_Cont.model	Image
- G358_J1820-2528_Cont.psf	Image
- G358_J1820-2528_Cont.residual	Image
- G358_J1820_C-cont.flux	Image
- G358_J1820_C-cont.image	Image
- G358_J1820_C-cont.mask	Image
- G358_J1820_C-cont.model	Image
- G358_J1820_C-cont.psf	Image
- G358_J1820_C-cont.residual	Image
- G358_J1820_K-cont.flux	Image
- G358_J1820_K-cont.image	Image
- G358_J1820_K-cont.mask	Image
- G358_J1820_K-cont.model	Image
- G358_J1820_K-cont.psf	Image

loading options

shape: restoring beam  
320, 320, 1, 1  
J2000 right ascension: 18:20:59.621, 18:20:56.077  
J2000 declination: -25:28:36.584, -25:27:48.584

slice  LEL

close | leave open | update

*Note: A red arrow points to the 'raster image' button in the loading options panel.*

Viewer Display Panel (uK) (on jop104)

Data | Display Panel | Tools | View | Help

Display

G358\_J1820\_C-cont.image-raster

J2000 Declination

J2000 Right Ascension

Cursors

G358\_J1820\_C-cont.image-raster

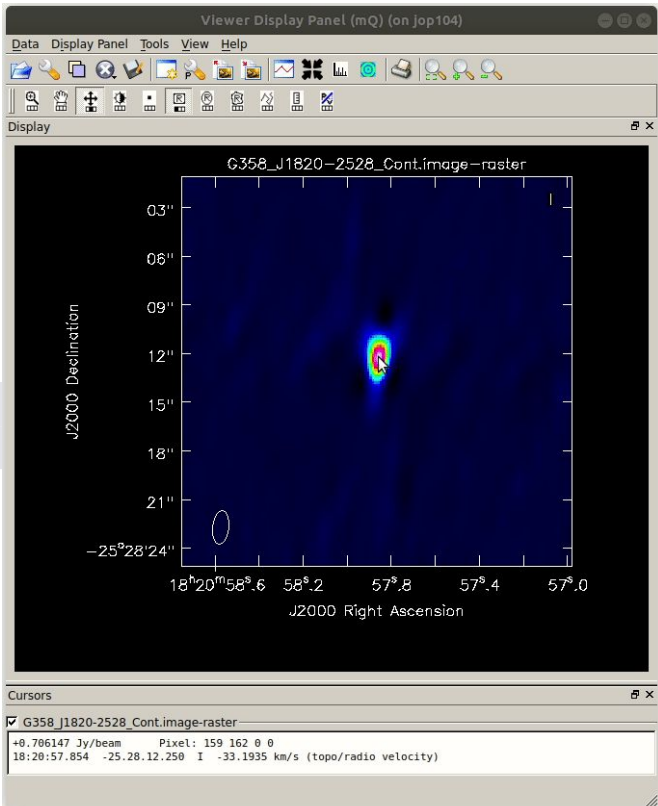
+0.0228131 Jy/beam Pixel: 144 193 0 0  
18:20:58.031 -25:28:07.593 I 30076.5 km/s (topo/radio velocity)

*Note: A red arrow points to the 'Data' menu item in the top toolbar.*



# CASA Viewer

12



## CASA Viewer:

- can display both **images** and **MeasurementSets**
- can be started inside a CASA shell or as *a stand-alone executable*

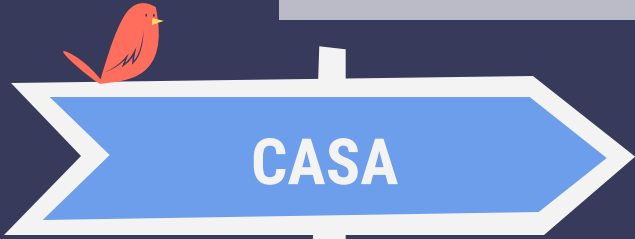


If you're lucky:  
stand-alone apps may not work in some versions of CASA

CASA builds upon the libraries developed by the AIPS++ consortium, but with some major differences

The data reduction recipes and break-down of jobs in individual tasks is not the same in CASA and AIPS

Nevertheless, a comparison of CASA and AIPS commands may give AIPS users a good start if they search for functionality in CASA





# CASA and AIPS commands

## CASA

importfits  
} listobs  
} listobs  
} plotms  
} plotms  
viewer  
flagdata  
clean/tclean  
gaincal  
applycal

**fringeft** *(coming soon)*

## AIPS

FITLD  
LISTR }  
PRTAN }  
SNPLT }  
POSSM }  
TVALL  
UVFLG  
IMAGR  
CALIB  
CLCAL  
FRING







# CASA calibration tables

## Original Data

DATA	



.ms

gaincal, bandpass, polcal

## Calibration Tables



.tsys

*VLBI only!*  
*a priori amplitude calibration table*



.gcal

*complex gain and delay calibration solving*



.bcal

*complex bandpass calibration solving*



.pcal

*polarization calibration*

## Calibrated Data

DATA	CORRECTED_DATA



.ms

applycal



browsetable

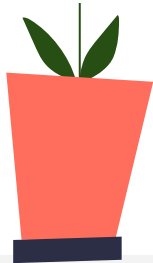




# CASA-VLBI

## Original CASA

Specific to  
VLA and ALMA data sets



## VLBI in CASA

VLBI data processing using  
non-CASA Python scripts



## CASA-VLBI

VLBI data reduction tasks  
are added to CASA



# What to expect from CASA:



01

**Up-to-date user-friendly software**

CASA is your go-to tool for data calibration, analysis, and imaging

02

**Lots of updates**

CASA grows and evolves: keep an eye on the release updates

03

**Lots of feedback**

Feel free to ask for help or write new scripts - you will be heard!



# What not to expect from CASA:

01

**CASA is not AIPS+++**

CASA grows and evolves: so it won't go anywhere, you actually need to learn how to work with it

02

**CASA is not humble**

There should be some free space on your hard disk, RAM, and schedule

03

**Not an impostor!**

Made for us: no need to rename our sources because Microsoft Excel cannot handle them



# THANKS!!

Do you have any questions?

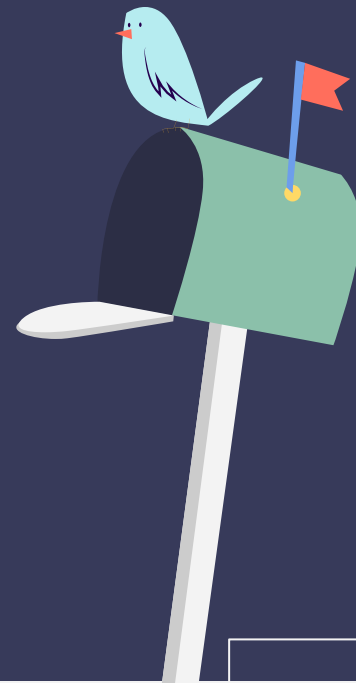


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