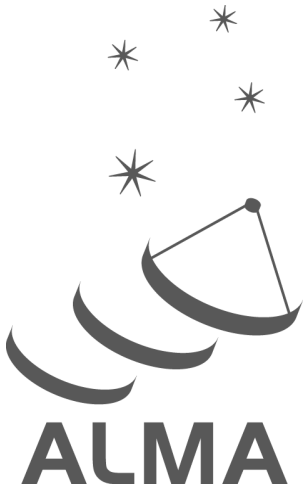
ALMA QA2 Data Products



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1 Introduction

The goal of ALMA Quality Assurance (QA) is to ensure that a reliable final data product is delivered to the PI, that is, that the product has reached the desired control parameters outlined in the science goals, that is calibrated to the desired accuracy and contains no significant calibration or imaging artifacts. For Cycle 2, as for Cycle 0 and 1, QA will be done on a “best effort” basis, covering all the major issues affecting data quality.

The second level of Quality Assurance (QA2) deals with QA at the level of data reduction using the Science Pipeline or performed semi-interactively by the ALMA Data Reducers Team. This document describes the final science data products that are delivered to PIs (and the archive) at the end of the QA2 process.

The ALMA QA2 data reduction team performs for each ALMA science data set a detailed analysis to confirm that the observations have achieved the science goals requested by the PI. In particular, frequency setup, spatial setup, and continuum and/or line detection sensitivity are verified.

If the requirements are met, the data are declared “QA2 pass”, packaged in a standardized way, and delivered to the PI. The delivery is made in two parts:

(a) the science products and supporting material

(b) (optionally) the raw data.

Part (b), the raw data, consist of visibility datasets in ALMA's native format, the ASDM, which are only needed if the PI would like to perform custom data calibration and imaging. Part (a) of the delivery on the other hand, the “QA2 Products”, consists of the QA2 data reduction scripts, log files, calibration, and flagging tables, and the imaging products on which the quality assurance decision was based. This document describes the contents of the Products section of the delivery in detail and is aimed at ALMA users.

Up to September 2014, the QA2 work was entirely performed by analysts using the QA2 script-generator tool. We refer to data processed in this way as “**analyst-calibrated**”. In September 2014, the ALMA Science Pipeline became available and is now used to calibrate most of the data taken in standard observing modes. We refer to data processed by the Pipeline as “**pipeline-calibrated**” data. The user can tell whether the data is pipeline-calibrated by the presence of a “PPR*.xml” file in the “script” subdirectory of the delivery package (see section 4).

2 Group ObsUnitSet (GroupOUS), Member ObsUnitSet (MemberOUS), and Scheduling Block (SB)

By design, the smallest scheduling entity which is processed and delivered individually is the Member ObsUnitSet (MemberOUS or MOUS). QA2 therefore is carried out on individual MemberOUSs.

In Cycles 1 and 2, the MemberOUS contains in almost all cases only one Scheduling Block (SB), even in the case of Total Power Array observations.

Hence, in Cycles 1 and 2, QA2 is carried out together on all the Execution Blocks (EBs) of a single SB corresponding to one MemberOUS. The products for each MemberOUS are delivered separately, and the delivery of the products for each MemberOUS is labeled with the MemberOUS UID.

The MemberOUSs are organized into Group ObsUnitSets (in short: GroupOUSs). In the trivial case there is only one GroupOUS for each Science Goal. In Cycles 1 and 2, at most five MemberOUSs can be in one GroupOUS:

a) The 12 m Array MemberOUS(s) (up to two)

b) The 7 m Array MemberOUS

c) The Total Power observation MemberOUS

d) The Total Power calibration MemberOUS (may be omitted)

Once all MemberOUSs of a GroupOUS have passed QA2, another QA2 step has to take place which performs the combined imaging of the up to three elements: 12 m Array, Total Power Array, and 7 m Array. The delivery of the resulting products will be labeled with the GroupOUS UID.

The delivery packaging results in a tar file which is named in the following way:

<Project ID>_<MemberOUS_UID>_m_of_n.tar

for each member where n is the total number of tar files into which the delivery is split (for faster transfer) and m is the number of the individual tar file (typically both m and n are 1 since these files are usually small).

GroupOUS deliveries only take place for the case there is more than one MemberOUS in the GroupOUS and in that case the PI will receive the products for each MemberOUS separately and then one more delivery for the combination products. The latter will be in a tar file named

<Project ID>_<GroupOUS_UID>_m_of_n.tar

3 Overview

An ALMA data delivery consists of the seven items shown in the directory tree below. Items 1 to 6 are delivered in one package (part (a)) which should be downloaded first. Item 7 (part (b)) is available for download separately and is only required if the users would like to work with the visibility data. Once unpacked, all data falls into a standardized directory structure:

```
|-- project_id/
|   |-- sg_ouss_id/
|   |   |-- group_ouss_id/
|   |   |   |-- member_ouss_id/
|   |   |   |   |-- README      (1)
|   |   |   |   |-- product/    (2)
|   |   |   |   |-- calibration/ (3)
|   |   |   |   |-- qa/         (4)
|   |   |   |   |-- script/     (5)
|   |   |   |   |-- log/        (6)
|   |   |   |   |-- raw/        (7)   (only present when part (b) was unpacked)
```

The directory contents is summarized in the following. When an item is marked as “best effort” this means that it is generated by the analysis team when sufficent resources are available and it is compatible with the science goal.

1) README

— a text file summarizing the QA2 results and explaining structure of tarball and file naming conventions

2) Imaging Products (in FITS format) in subdirectory “product”

a) Line:

— For each spectral window: One spectral cube of “representative channels” for at least one target in the MemberOUS, made at the achieved spatial and the requested spectral resolution considering the bandwidth specified for sensitivity. If the achieved spatial resolution was higher than requested, tapering may have been applied if needed to reach the science goal. Coarse continuum subtraction is applied for sources with bright continuum. This applies both to deliveries of single MemberOUSs and to combined datasets

— (best effort) For each source and each spectral window: cubes of all species specifically listed in the proposal, made at full spatial resolution and the relevant spectral resolution and including line-free channels on either side. Continuum subtraction is applied for sources with bright continuum. A note will be added if additional species are found in the data, but imaging may not be carried out.

— (best effort) For the same source with multiple non-continuum spectral windows: line cubes should be made with constant velocity channels sampled on the same grid and covering the same velocity range.

— (best effort) Zeroth moment of each line cube

— (best effort) Continuum image of all non-edge, non-line channels

b) Continuum:

— One image of all continuum spectral windows, all non-edge channels

— (best effort) One image per sideband, all non-line channels

c) for pipeline-calibrated data, in addition to (a) and (b):

— Continuum images of the bandpass and phase calibrators for each of the science spectral windows

3) CASA Tables (in CASA Table format) in subdirectory "calibration"

a) for pipeline-calibrated data

— Calibration tables (Tsys, WVR, Bandpass, Gain, Amplitude)

— Flagversions tables

— Calibrator fluxes (flux.csv)

— Pipeline metadata (*calapply.txt and *flagtemplate.txt)

b) for analyst-calibrated data

— Calibration tables (Tsys, WVR, Bandpass, Gain, Amplitude)

— Flagversions tables

4) QA documentation in subdirectory "qa"

a) for pipeline-calibrated data

— The Pipeline Weblog – a system of webpages containing all the diagnostic plots and other information generated by the pipeline.

b) for analyst-calibrated data

— QA Reports for all the imaged data (png images and pdf files).

5) Data Reduction Scripts (ASCII files) in subdirectory "script"

a) for pipeline-calibrated data

— the Python scripts needed to restore the calibrated MS or rerun the entire pipeline

— the pipeline processing request file (PPR)

— the flux equalisation script (if necessary) and the imaging script

b) for analyst-calibrated data

— CASA reduction scripts including: calibration scripts, flux equalization script (if necessary), imaging script, and script to apply calibrations.

6) calibration and imaging log files in subdirectory "log"

— CASA log files from the QA2 processing

7) Datasets (in ASDM format) in subdirectory "raw" (if downloaded)

— (for optional download) the ExecBlocks that were used in the imaging/QA2 assessment

— (for optional download if applicable) Additional datasets that were NOT used in the data reduction but may still contain valuable scientific information

4 Data Delivery Products

4.1 README

The first item the user should inspect after unpacking the delivery tar file (part (a)), is the README file. It contains a summary of the QA2 results, in particular the achieved beam and image noise RMS.

4.2 Data Reduction Scripts (directory "script")

In the subdirectory "script", the user then finds the CASA data reduction scripts (Python) which were used to calibrate and image the data. Depending on whether the ALMA automated Pipeline was used or the data was "manually" calibrated by an analyst, the contents of this directory varies:

1) uid....ms.scriptForCalibration.py: one calibration script for each Execution Block of manually calibrated data

2) scriptForFluxCalibration.py (if necessary): if there was more than one Execution Block, and they were observed within one day from each other, a combined flux calibration may be done assuming that the phase calibrator had the same intensity during all executions. This script performs this procedure. It may also concatenate all calibrated MSs into one if it is necessary for imaging. The result is a combined dataset of all executions.

3) scriptForImaging.py: this script regenerates the imaging products (see next section) as they are stored in the "products" subdirectory of the delivery.

4) **scriptForPI.py**: run this script in the "script" directory in order to regenerate the calibrated MeasurementSet of the delivered data. The README file contains instructions on how to do this. Running the scriptForPI.py requires that you have downloaded the ASDM datasets and unpacked them such that they reside in the "raw" directory (created during unpacking). See Section 5 for more details.

5) casa_piperestorescript.py: This script is used by scriptForPI.py to restore the calibrates MS(s) from the raw ASDMs by applying the necessary calibration tables. This is only provided in the case of pipeline calibration.

6) casa_pipescript.py: Performs the calibration from scratch using Pipeline tasks. See the Pipeline documentation (see Section 7) for more details.

7) the pipeline processing request (PPR): an XML file which was used to drive the Pipeline calibration. Also described in the Pipeline documentation (see Section 7).

4.3 Imaging Products (directory "product")

The "product" subdirectory of the delivery contains the imaging products that were generated with the script "scriptForImaging.py" from the "script" subdirectory based on

the calibrated dataset which is obtained when the “scriptForPI.py” is run. For pipeline-calibrated data it also contains calibrator images generated by the Pipeline.

For ALMA Early Science (Cycles 0-2), ALMA products are offered at a "best efforts" basis. The goal is that the calibration is reliable and "science ready", but the imaging products may not be. Enough imaging has been done to insure that the data meet the science goals set by the PI (resolution and sensitivity), but the imaging may be incomplete and not "science ready". Investigators should expect to need to re-image their data, using the provided scripts as a guideline. In particular, care should be taken to optimize continuum subtraction (if relevant) and fine-tune the image deconvolution parameters (e.g. clean masks and thresholds).

Care has been taken that the images conform with the latest FITS standard (3.0).

Where necessary (i.e. where they are not supplied analytically within the scriptForImaging.py text), the imaging masks are provided as CASA images. These represent the final mask used in the last cleaning iteration. The masks used in previous iterations may have been different (tighter).

The science images included in the typical delivery are corrected for the primary beam (PB), i.e. the dependence of the instruments sensitivity on direction within the FOV.

For each image, two files are being delivered:
a) the PB-corrected image (file name ending in ".pbcor.fits")
b) the image of the PB which was used in the correction (ending in ".flux.fits")
The image noise was measured in the uncorrected image. The corrected image (a) was then obtained by dividing the uncorrected image by the PB image (b). The uncorrected image can be recovered using the CASA task “impbcor” in mode "m":

```
impbcor(imagename='image.pbcor.fits',pbimage='image.flux.fits',
        mode='m', outfile='image.recovered')
```

4.4 CASA Tables (directory “calibration”)

In order to document further the process of data calibration, all calibration tables generated by the calibration process are stored in the “calibration” subdirectory of the delivery.

In the case of analyst-calibrated data, information on how each table was created can be looked up in the scriptForCalibration.py and the scriptForFluxCalibration.py scripts. CASA provides functionality to view these tables. Please refer to the CASA documentation (see Section 7) on how to do that. Many of the plots of interest in this context are, however, also already available in the QA documentation (see next section).

In the case of Pipline-calibrated data, the files in this directory are needed to restore the calibrated MS with “casa_piperestorescript.py” which in turn is called by “scriptForPI.py”. For details on how they were generated, please refer to the Pipeline documentation (see

Section 7). All diagnostic plots are also in this case already available in the Pipeline Weblog which can be found in directory “qa” (see next section).

4.5 QA Documentation (directory “qa”)

In the subdirectory “qa” of the delivery, the user finds diagnistic plots obtained during the calibration.

In the case of analyst-calibrated data, there are, for each execution block and labeled with the execution block UID, several png images and a textfile which together form the so-called “QA2 report” for the execution block.

The png files can be viewed with standard system tools such as “display” (under Linux). They show a set of diagnostic plots describing the following aspects of the data:

1) Observing Schedule (observation intent vs. time)
2) Mosaic Pointing Configuration
3) Antenna Array Configuration
4) Effectiveness of the WVR correction for each antenna
5) Temporal gain calibration solutions for each antenna
6) Temporal phase calibration solutions for each antenna
7) Average bandpass solution for each spectral window
8) System Temperature vs. frequency for each antenna and each spectral window
9) Phase calibrator amplitude and phase vs. frequency for each spectral window and polarisation
10) Flux calibration model and data (visibility amplitude vs. UV distance)
11) Target visibility amplitude vs. UV distance for each spectral window and polarisation
12) Phase calibrator amplitude and phase vs. frequency for each spectral window and polarisation
13) Target field UV coverage
14) Test image of the target
15) Target imaging synthesized beam (PSF)

The contents of the uid*textfile.txt file is mostly selfexplanatory. Of particular interest is the “Check of a target image and sensitivity” which mentions approximately the achieved spatial resolution and sensitivity. Note that the finally achieved resolution and sensitivity could be different (since it might have used additional procedures in imaging). It is mentioned in the README file.

Based on the calibration tables in the “calibration” directory, the user can produce additional diagnostic plots in CASA using the tasks *plotms, plotcal, and plotbandpass (CASA 4.2 and later)*. See the CASA documentation for more details.

If additional diagnostic plots on the visibility data itself are required, the calibrated MeasurementSet (MS) first has to be generated from the raw data (see the next section). Once this is done, the CASA task *plotms* should be used to generate the plots.

In the case of *pipeline-calibrated data,* all diagnostic information is assembled in a system of html pages which is called the Weblog. To access the Weblog, run

```
tar xvzf *weblog.tar.gz
```

in the "qa" directory and then use your favourite web browser to open the resulting file

```
pipeline*/html/index.html
```

For more information on the contents of the Weblog, please refer to the Pipeline documentation (see Section 7).

5 Generating the calibrated visibilities

In ALMA Cycle 0 and early Cycle 1, the visibility data were delivered with all other products in ready-to-use MeasurementSet (MS) format. Since the middle of Cycle 1, the products are separated from the raw visibility data (as described in the introduction), and downloads of the latter are now optional. To minimize download time, the raw visibilities are delivered in the native ALMA format, the ASDM (ALMA Science Data Model).

If the user would like to only modify or extend the imaging of the dataset but accept the observatory calibration of the data, he/she needs to download the raw data and apply the calibration via the scripts provided with the delivery as described in the following.

Otherwise, the user can only download the raw data and use the calibration scripts as a guidance and develop a custom calibration.

The download of the raw data depends on the details of where the data were staged for delivery. The user should refer to the information in the delivery email as to how exactly the raw data should be obtained. Unless there is a technical problem, this will work via the ALMA Archive Request Handler. See http://almascience.eso.org/alma-data .

5.1 Running the scriptForPI.py in the case of analyst-calibrated data

Once the data products tar file is downloaded and unpacked, the user finds a directory structure on disk which is described in section 3 and also at the end of the README file included in the delivery. The following directory tree shows an example of analyst-calibrated (rather then pipeline-calibrated) data. However, also for pipeline-calibrated data, the procedure for running "scriptForPI.py" is the same and has essentially the same final product.

```
|-- 2012.1.12345.S/
|   |-- sg_ouss_id/
|   |   |-- group_ouss_id/
|   |   |   |-- member_ouss_id/
|   |   |   |   |-- README
|   |   |   |   |-- script/
|   |   |   |   |   |-- scriptForPI.py
|   |   |   |   |   |-- scriptForImaging.py
|   |   |   |   |   |-- scriptForFluxCalibration.py
|   |   |   |   |   |-- uid___A002_X12345_Xa2d.ms.scriptForCalibration.py
|   |   |   |   |   |-- uid___A002_X12345_Xbcd.ms.scriptForCalibration.py
|   |   |   |   |-- calibration/
|   |   |   |   |   |-- uid___A002_X12345_Xa2d.calibration.tgz
|   |   |   |   |   |-- uid___A002_X12345_Xa2d.calibration.plots/
|   |   |   |   |   |-- uid___A002_X12345_Xbcd.calibration.tgz
|   |   |   |   |   |-- uid___A002_X12345_Xbcd.calibration.plots/
|   |   |   |   |-- qa/
|   |   |   |   |   |-- uid___A002_X12345_Xa2d__textfile.txt
|   |   |   |   |   |-- uid___A002_X12345_Xa2d__qa2_part3.png
|   |   |   |   |   |-- uid___A002_X12345_Xa2d__qa2_part2.png
|   |   |   |   |   |-- uid___A002_X12345_Xa2d__qa2_part1.png
|   |   |   |   |   |-- uid___A002_X12345_Xbcd__textfile.txt
|   |   |   |   |   |-- uid___A002_X12345_Xbcd__qa2_part3.png
|   |   |   |   |   |-- uid___A002_X12345_Xbcd__qa2_part2.png
|   |   |   |   |   |-- uid___A002_X12345_Xbcd__qa2_part1.png
|   |   |   |   |-- product/
|   |   |   |   |   |-- NGC1234.cont.dirty.fits
|   |   |   |   |   |-- NGC1234.CO_21.dirty.fits
|   |   |   |   |-- log/
|   |   |   |   |   |-- combined.log
|   |   |   |   |   |-- uid___A002_X12345_Xa2d .calibration.log
|   |   |   |   |   |-- uid___A002_X12345_Xbcd.calibration.log
```

This dataset has two Execution Blocks (EBs) with UIDs “uid___A002_X12345_Xa2d” and “uid___A002_X12345_Xbcd”. In the directory “script” is has therefore two scripts for calibration:

```
|   |   |   |   |   |-- uid___A002_X12345_Xa2d.ms.scriptForCalibration.py
|   |   |   |   |   |-- uid___A002_X12345_Xbcd.ms.scriptForCalibration.py
```

and, since apparently a common flux calibration was necessary, a script to combine the data from the two EBs is present:

```
|   |   |   |   |   |-- scriptForFluxCalibration.py
```

Furthermore, like in every delivery, the directory “script” contains the scripts “scriptForImaging.py” and “scriptForPI.py”.

The user is encouraged to inspect all these scripts as they also may contain helpful comments on special properties of the data.

Unpacking the raw data after download should be done at the top level (in the directory containing the directory 2012.1.12345.S in this example). It should result in an additional directory “raw” at the level of the directory “script”:

| | | | |-- raw/
| | | | | |-- uid___A002_X12345_Xa2d.asdm.sdm
| | | | | |-- uid___A002_X12345_Xbcd.asdm.sdm

In order to just reproduce the observatory calibration, the user can then run the “scriptForPI.py” by typing at the shell prompt of the operating system:

```
> cd script
> casapy –c "execfile('scriptForPI.py')"
```

This will first perform various tests on the directory structure and the presence of the necessary files and then run the corresponding scriptForCalibration on each of the ASDMs. If there is more than one ASDM and an alignment of the flux calibrations was deemed necessary by the QA2 process, the scriptForFluxCalibration will be present and will be run as well.

The results will be placed in a new directory “calibrated” at the same level as the directories “raw” and “script”:

```
|  |  |  |  |-- calibrated
|  |  |  |  |  |-- calibrated.ms
|  |  |  |  |  |-- uid___A002_X12345_Xa2d.calibration
|  |  |  |  |  |-- uid___A002_X12345_Xa2d.ms.split.cal
|  |  |  |  |  |-- uid___A002_X12345_Xbcd.calibration
|  |  |  |  |  |-- uid___A002_X12345_Xbcd.ms.split.cal
```

The final calibrated visibility data combined for all EBs can in this case be found in the MS “calibrated.ms”. The intermediate output of CASA to achieve the calibration of each EB is stored in the calibration working directories:

```
|  |  |  |  |  |-- uid___A002_X12345_Xa2d.calibration
|  |  |  |  |  |-- uid___A002_X12345_Xbcd.calibration
```

while the calibrated visibilities for each EB individually are stored in the MSs with names ending in “.ms.split.cal” (if there is only one EB, this MS will take the role of calibrated.ms).

5.2 Running the scriptForPI.py in the case of pipeline-calibrated data

The following shows the contents of the directory tree for the data set discussed in the previous section, however, for the case that the data was *pipeline-calibrated*. This can easily be seen from the fact that there is a file “PPR*.xml” present in the “script” directory. As for analyst-calibrated data, you find the “scriptForPI.py” in the “script” directory as well.

```
|-- 2012.1.12345.S/
|   |-- sg_ouss_id/
|   |   |-- group_ouss_id/
|   |   |   |-- member_ouss_id/
|   |   |   |   |-- README
|   |   |   |   |-- script/
|   |   |   |   |   |-- scriptForPI.py
|   |   |   |   |   |-- scriptForImaging.py
|   |   |   |   |   |-- scriptForFluxCalibration.py
|   |   |   |   |   |-- PPR_uid___A002_X6789_Xabc.xml
|   |   |   |   |   |-- casa_piperestorescript.py
|   |   |   |   |   |-- casa_pipescript.py
|   |   |   |   |-- calibration/
|   |   |   |   |   |-- flux.csv
|   |   |   |   |   |-- uid___A002_X6789_Xabc.session_1.caltables.tar.gz
|   |   |   |   |   |-- uid___A002_X12345_Xa2d.ms.calapply.txt
|   |   |   |   |   |-- uid___A002_X12345_Xa2d.ms.flagversions.tar.gz
|   |   |   |   |   |-- uid___A002_X12345_Xa2d_flagtemplate.txt
|   |   |   |   |   |-- uid___A002_X12345_Xbcd.ms.calapply.txt
|   |   |   |   |   |-- uid___A002_X12345_Xbcd.ms.flagversions.tar.gz
|   |   |   |   |   |-- uid___A002_X12345_Xbcd_flagtemplate.txt
|   |   |   |   |-- qa/
|   |   |   |   |   |-- uid___A002_X6789_Xabc.weblog.tar.gz
|   |   |   |   |-- product/
|   |   |   |   |   |-- NGC1234.cont.dirty.fits
|   |   |   |   |   |-- NGC1234.CO_21.dirty.fits
|   |   |   |   |   |-- uid___A002_X6789_Xabc.J0538_4405_bp.spw17.fits
|   |   |   |   |   |-- uid___A002_X6789_Xabc.J0538_4405_bp.spw19.fits
|   |   |   |   |   |-- uid___A002_X6789_Xabc.J0538_4405_bp.spw21.fits
|   |   |   |   |   |-- uid___A002_X6789_Xabc.J0538_4405_bp.spw23.fits
|   |   |   |   |   |-- uid___A002_X6789_Xabc.J0550_5732_ph.spw17.fits
|   |   |   |   |   |-- uid___A002_X6789_Xabc.J0550_5732_ph.spw19.fits
|   |   |   |   |   |-- uid___A002_X6789_Xabc.J0550_5732_ph.spw21.fits
|   |   |   |   |   |-- uid___A002_X6789_Xabc.J0550_5732_ph.spw23.fits
|   |   |   |   |-- log/
|   |   |   |   |   |-- imaging.log
|   |   |   |   |   |-- uid___A002_X6789_Xabc.casa_commands.log
```

In order to run “scriptForPI.py” on pipeline-calibrated data, you will need to make sure that you have the CASA version *with pipeline* installed and that you start up CASA in the working directory “script” using

```
casapy --pipeline
```

At the CASA prompt then type

```
execfile('scriptForPI.py')
```

The final calibrated MSs will be placed in the directory “calibrated” with names ending in “.ms.split.cal”.

5.3 Saving disk space during and after the execution of the scriptForPI.py

The ALMA data sets are increasingly large. If the user would like to save disk space and only work with the calibrated data once it was regenerated with “scriptForPI.py”, he/she can either delete all calibration directories (`cd calibrated; rm –rf *.calibration`) or, in case of analyst-calibrated data, only delete some or all of the intermediate MSs contained in the calibration directories using, e.g.,

```
cd calibrated; rm –rf *.calibration/*.ms; rm –rf *.calibration/*.ms.split
```

Since the middle of Cycle 1, the scriptForPI.py also offers the “SPACESAVING” option to limit the disk space usage during and after the run of the scriptForPI.py. In order to make use of this, the Python global variable SPACESAVING needs to be set before starting the script, e.g. using

```
> cd script
> casapy –c "SPACESAVING=N; execfile('scriptForPI.py')"
```

where N is an integer from 0 to 3 with the following meaning:

SPACESAVING	= 0	same as not set (all intermediate MSs are kept)
	= 1	do not keep intermediate MSs named *.ms.split
	= 2	do not keep intermediate MSs named *.ms and *.ms.split
	= 3	do not keep intermediate MSs named *.ms, *.ms.split, and *.ms.split.cal (if possible)

With SPACESAVING=0, the required additional diskspace is up to 14 times as large as the delivered data (products and rawdata) while with SPACESAVING=3 (maximum savings), it is up to 6 times as large. The script will estimate the required disk space and will not execute if there is not sufficient free space available.

5.4 Running casa_pipescript.py

In the case of pipeline-calibrated data, there is an alternative way to generate the calibrated visibilities. It uses the script “casa_pipescript.py” which in principle can be modified by the user to adjust the calibration. The details of this path are described in the Pipeline documentation (see Section 7 below).

6 Imaging the calibrated visibilities

Once the calibrated visibilities were generated either as described in the previous sections or through a customized calibration procedure, the user can proceed to image them.

If lines have been detected over a significant continuum, it should be considered to perform a continuum subtraction using the CASA task *uvcontsub* beforehand. In any case, the imaging script “scriptForImaging.py” from the directory “script” of the delivery can be taken as an example to build on.

The main tool for imaging in CASA is the task *clean*. A detailed description of the usage of this task and its many parameters goes beyond the scope of this document. We refer again to the CASA documentation.

7 Available CASA documentation and help

For more information on the usage of CASA, please refer to the CASA home page
http://casa.nrao.edu/
in particular the user reference and cookbook
http://casa.nrao.edu/Doc/Cookbook/casa_cookbook.pdf
Detailed examples are given in the ALMA guides
http://casaguides.nrao.edu/index.php?title=ALMAguides
and the “ALMA Science Pipeline Quickstart Guide” is available from
http://almascience.eso.org/documents-and-tools
If you have any problems with your ALMA data, please contact the ALMA helpdesk at
https://help.almascience.org/

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