QA2 Report

Project information

Name	An unbiased survey of disk structures in Taurus
Code	2016.1.01164.S
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Co-Is	S. cabrit, S. Chripko, G. Dipierro, S. Edwards, W. Fischer, M. Gully-Santiago, D. Harsono, N. Hendler, D. Johnstone, Y. Liu, G. Lodato, F. Long, G. Mulders, B. Nisini, I. Pascucci, S. Quanz, E. Rigliaco, C. Salyk

ObsUnitSet information

Name	Member OUS (DK_Tau)
QA2 Status	SemiPass
Member OUS Status ID	uid://A001/X885/X1f6
SchedBlock name	DK_Tau_a_06_TM1
SchedBlock UID	uid://A001/X885/X1e9
Array	TM1
Mode	Standard [Long baseline]
Band	ALMA_RB_06
Repr.Freq. (sky)	217.99 [GHz]
Spectral setup	Mixed
Sources	BP_Tau, DH_Tau, DK_Tau, FT_Tau, GI_Tau, GK_Tau, HK_Tau, HO_Tau, HQ_Tau, IP_Tau, UZ_Tau, V409_Tau
Other SBs in this Group OUS (Member OUS Status ID in brackets):	
Execution count	3.00 of 3 expected

Final QA2 comment

(1) CASA version: 5.1.1

(2) Reduction mode: manual calibration and imaging

(3) Comments
This SB consists of 3 execution blocks (EBs), uid___A002_Xc40361_Xb33, uid___A002_Xc412e1_X2ed8, and uid___A002_Xc412e1_X3295. They contains 12 target sources, which are separated to 4 groups. These 4 groups have slightly different frequency setups. Since the bandpass calibrator was observed for the 1st group, bandpass calibration for the other groups might have some problems. However, the difference is as small as 2 MHz, so the effect will appear only for the edge channels.

[Flagging]
Since the phase calibrators are faint, phase calibration is not so good, especially toward DH Tau, BP Tau and IP Tau. Furthermore, since the antenna DV05 was not going to be used for Xb33 observations, this antenna was flagged. For X2ed8 and X3295, the antenna DA50 was flagged due to weird behaviour of its tsys.

[Flux calibration]
For Xb33, J0423-0120 was used for amplitude calibrator. The reference flux density of this source was obtained 4 days before the observations, and it had just pass its local minimum. A quasar J0510+1800 was used for bandpass calibrator. Its flux density was also obtained 4 days before the observations, and it was almost the peak of the local maximum. The derived flux is almost consistent with it.
For X2ed8 and X3295, J0510+1800 was used for both the amplitude and bandpass calibrator, and the reference flux density was obtained 3 days after the observations.
Four quasars, J0426+2327, J0440+2728, J0422+3058, and J0435+2532 were used for the phase calibrators. Although their reference flux densities are not obtained frequently, they are almost comparable.

[Imaging]
An imaging script, "scriptForImaging.py", produces clean images of the continuum. The Briggs weighting with the robust parameter of 0.5 is adopted for TCLEAN task. The achieved beam size and RMS are listed below. Although the sensitivities are slightly higher than the requested values, they are thought to be dynamic range limited and the SNRs are higher than 20 for most sources.

Target | RMS [mJy] | Synthesized beam [arcsec]
BP_Tau | 0.093 | 0.14x0.10 (-22.7deg)
DH_Tau | 0.041 | 0.20x0.091 (26.5deg)

DK_Tau | 0.080 | 0.13x0.11 (3.93deg)
FT_Tau | 0.078 | 0.13x0.11 (-2.72deg)
GI_Tau | 0.073 | 0.13x0.11 (7.47deg)
GK_Tau | 0.074 | 0.13x0.11 (9.92deg)
HK_Tau | 0.079 | 0.13x0.11 (-1.65deg)
HO_Tau | 0.072 | 0.12x0.11 (6.75deg)
HQ_Tau | 0.072 | 0.12x0.11 (4.68deg)
IP_Tau | 0.076 | 0.14x0.10 (-26.4deg)
UZ_Tau | 0.084 | 0.13x0.11 (3.90deg)
V409_Tau | 0.071 | 0.13x0.11 (-5.92deg)

RMS and beam size at representative frequency

Sensitivity goal 0.065 [mJy] over bandwidth 4.219 [GHz]
Angular resolution goal 0.102 - 0.125 [arcsec]
Achieved RMS
for desired bandwidth 0.080 [mJy] **for continuum** N/A
Synthesized beam **Mean (arcsec)** 0.120
Major axis (arcsec) 0.130 **Minor axis (arcsec)** 0.110 **Position angle (deg)** 3.930

Execution blocks summary

EB	N Ant.	Start Time	End Time	ToS (sec)	Avg. Elev. (deg)	Trans. Elev.	Mean PWV (mm)	Phase RMS (deg)*	Min BL (m)	Max BL (m)	AR (")	MRS (")	EF
uid://A002/Xc40361/Xb33	45	2017-08-31 08:59:	2017-08-31 10:32:	5596	41.5	42.6	1.5	69.202	21.0	3696.9	0.1	1.4	1.00
uid://A002/Xc412e1/X2ed8	45	2017-09-02 09:22:	2017-09-02 10:51:	5384	42.3	42.6	1.3	67.931	21.0	3696.9	0.1	1.3	1.00
uid://A002/Xc412e1/X3295	45	2017-09-02 10:52:	2017-09-02 12:22:	5411	38.9	42.6	1.4	70.604	21.0	3696.9	0.1	1.3	1.00

*WVR-corrected value averaged over all basebands and scans.

Manual reductions

CASA version	Report date
5.1.1	2018-01-24 07:03:24

Spectral Windows

Transition	Central Frequency (sky, GHz)	Bandwidth (GHz)	N of channels
cont1 (SW-1)	218.012	2.000	128
C18O (SW-1)	219.572	0.117	1920
13CO (SW-2)	220.392	0.117	960
12CO (SW-1)	230.712	0.234	3840
Continuum2 (SW-1)	233.012	2.000	128

Instructions

INTERFEROMETRY INSTRUCTIONS OVERVIEW

Introduction
Data Delivery Contents

Interferometric Calibration and Imaging Regeneration
How to Restore the Calibrated Measurement Set for Your Data
Primary Beam Correction

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INTRODUCTION

ALMA currently provides data products for each member observation unit set (MOUS), corresponding to one or more executions of a single scheduling block (SB). In all cases except for polarization projects, each execution is independently calibrated, and then all executions are imaged together.
The following text describes the contents of this data package. Further details and updates can be found in the ALMA Knowledge Base (KB) articles indicated throughout this document.

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DATA DELIVERY CONTENTS

Each data package tarball expands to contain a single member.<ous_id> directory with the following sub-directories: calibration, script, qa, log, product. (Note: The ALMA archive will have prepended many product and script names with the MOUS UID, compared to the names displayed in the pipeline's weblog.)

- 'qa/' contains a number of files that summarize the quality of the observations and products. There is a "QA0 report" for each execution giving an overview of the conditions (Tsys, phase RMS) and quality of each observation. The "QA2 report" (this file) provides an overall assessment of the complete observation and final products. For pipeline-processed data there is a member.<ous_id>.*.weblog.tgz file for each time the pipeline was run (calibration, imaging, or calibration+imaging) that unpacks into "weblog" (open the pipeline-<DATE>/html/index.html file in a web browser), which is a series of webpages that present the details of the pipeline run, many diagnostic plots, and quality metrics. For manually calibrated products, several text files and png images are provided instead, which can be used in conjunction with the *scriptForCalibration.py described below to understand how the data were calibrated.

- 'product/' contains fits files of the imaging products. In some cases, only a subset of all science targets/spectral windows are imaged, to demonstrate the quality of the calibration and images. If the products were created by the imaging pipeline, a detailed comprehensive explanation of what images were created, how continuum was subtracted, and the quality of the processing is contained in the pipeline weblog (see above). If images were created manually, please refer to the *scriptForImaging.py described below for details of the process.

- 'script/' contains the scripts to:
  - calibrate raw visibilities (*casa_pipescript.py in the case of pipeline calibration, and *scriptForCalibration.py in the case of manual calibration).
  - restore calibrated visibilities without fully rerunning the pipeline (*casa_piperestorescript.py)
  - restore calibrated visibilities ("*scriptForPI.py"; works for either pipeline or manually calibrated data - see the section "How to restore the calibrated Measurement Set (MS) for your data" further below).
  - create images (*casa_pipescript.py in the case of pipeline imaging, and *scriptForImagingPrep.py and *scriptForImaging.py in the case of manual imaging).
  - In case the calibration was done by the automated pipeline, you will also see the Pipeline Processing Request file (PPR).
 (Note: the ALMA archive may prepend the script names with the MOUS UID.)

- 'calibration/' contains the files needed for calibration, including calibration and flagging tables and manually introduced flagging commands, which allow the user to start from the initial ASDM files and obtain the fully calibrated data.

- 'log' contains the CASA log files.

For more information see the ALMA QA2 Data Products document (https://almascience.org/processing/qa2-data-products), the ALMA Technical Handbook (in particular chapter 11 on the QA2 pass criteria), and the relevant Call for Proposals for this Cycle, which are available for download from the ALMA Science Portal at https://almascience.org/documents-and-tools.

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INTERFEROMETRIC CALIBRATION AND IMAGING REGENERATION

This section concerns ALMA interferometric (12m Array and ACA) data. The ALMA KB article "How to Restore the Calibrated Measurement Set (MS) for your Data" at
https://help.almascience.org/index.php?/Knowledgebase/Article/View/399
will contain an up-to-date version of the procedures described below.

How to Restore the Calibrated Measurement Set (MS) for your Data

Calibration is the first step of processing interferometric data. Many users will want to recreate the calibrated measurement set and then perform the second step (imaging) using their own scripts, or by modifying the imaging script provided with the data.

In order to obtain your calibrated data, download the raw data in ASDM format from the science archive. If you downloaded and untarred all available files for this delivery as described in the notification email, then you will already see these files (with names like "uid*.asdm.sdm") in an additional sub- directory called "raw". Otherwise, you will need to download and untar the tar balls of the raw data in the same directory that you untarred the tarball of the products, creating the "raw" sub-directory and associated ASDM files.

For the next step, you will need the right version of CASA to be installed. Please find the line starting with "CASA version used for reduction:" in your QA2 report or README. The version indicated there is what you need to use for running the scriptForPI.

Once the raw data is in place, cd to the "script" sub-directory, start CASA:

```
casa --pipeline
```

(Note: For some versions, CASA is released without pipeline and the "--pipeline" switch is not available. You will need a version with the pipeline if there is a file named "PPR*.xml" or "*pprequest.xml" in your script/ sub-directory. If there is no such file, you will not be able to run the the pipeline or restore pipeline-calibrated data. For more information on the execution of the pipeline, please refer to the ALMA Science Pipeline User's Guide available at https://almascience.org/documents-and-tools/pipeline-documentation-archive).

Then look for the script ending in "scriptForPI.py" and execute it, e.g.:

```
execfile("member.uid___A001_X123a_X45.scriptForPI.py")
```

Running the scriptForPI will result in one or more calibrated measurement sets (MSs) ready for imaging. You can use the uid_*.ms directly, keeping in mind that the calibrated data is stored in the CORRECTED data column, and all sources (including calibrators) are in the MS. If you want to run the imaging pipeline, you should run it from this point, without changing the uid_*.ms.

Imaging

If the data were imaged with the pipeline, many details of what images were created, how and why, are contained in the pipeline weblog. Each "task" of the pipeline weblog corresponds to a pipeline "hif_" or "hifa_" task which the user can run manually to reproduce what the pipeline did, optionally changing parameters. The full sequence of such tasks run by the pipeline are contained in "script/*casa_pipescript.py", which could be run to completely reproduce all pipeline processing. Alternatively, the calibrated measurement set produced above can be used as the basis for running only the imaging tasks in the pipeline. See https://casaguides.nrao.edu/index.php/ALMA_Imaging_Pipeline_Reprocessing for details.

Each imaging section of the weblog also links to the CASA commands that were used by the pipeline these form a good initial template which users can modify to manually image the data with different parameters.

If the data were manually imaged, refer to "script/*scriptForImaging.py", which contains the CASA commands that were used to create the image products from the calibrated MS. The "*scriptForImaging.py" may partially be interactive (for masking) and should be executed by copy and paste.

Options

1) If you want to force scriptForPI.py to split out the science spectral windows, you need to set the variable DOSPLIT=True before starting the scriptForPI in CASA.

2) The scriptForPI will usually run *casa_piperestorescript.py, which applies the calibration and flagging tables from the calibration/ sub-directory to the raw MS, restoring a calibrated MS. If *casa_piperestorescript.py is not available (as is the case for manually-calibrated datasets), the scriptForPI will instead run the entire calibration script, re-creating the calibration and flagging tables. You can force the execution of *casa_pipescript.py to rerun the entire calibration pipeline (instead of only restoring the existing calibration) by moving *casa_piperestorescript.py out of the script directory. Rerunning the calibration can be useful if you want to tweak its parameters. Otherwise the restore is faster.

3) The scriptForPI offers some global variables for your convenience. You can find an explanation in this Knowledgebase Article: https://help.almascience.org/index.php?/Knowledgebase/Article/View/380/

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PRIMARY BEAM CORRECTION

The images included in delivery are corrected for the primary beam (PB) response, i.e. the dependence of the instrument's sensitivity on direction within the field of view.

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 ".pb.fits" or ".flux.fits", typically gzipped in which case you need
     to unzip the file before using it)

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.pb.fits', mode='m', outfile='image.recovered')

See also the ALMA KB article "Where is the Primary Beam Correction
Information in my Delivered Data" at
https://help.almascience.org/index.php?/Knowledgebase/Article/View/398 for any updates to this procedure.

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