January 17, 2007

ALMA Offline Subsystem – Detailed Definition for Offline User Test 6
CASA Single Dish Calibration and Imaging, Synthesis Regression tests

The offline data processing test is scheduled for March 5-9, 2007.

Astronomers who will test the software are requested to travel to Socorro for the week of March 5, 2007 to evaluate software functionality and the user interface. Common Astronomy Software Applications (CASA) developers will be available to provide help, solve any problems that are encountered and to get immediate feedback on the user interface. Testers will reduce and analyze data following a cookbook description of the process. After extensive use of the package, each tester will fill out a questionnaire, grade tested requirements, and return the questionnaire, grades, script, and final plots to D. Shepherd. D. Shepherd will combine all information into a final report.

CASA platforms that will be supported for this test are: Mac OS and RedHat Enterprise. Reserved workstations in the AOC should support Redhat Enterprise. Individuals with Mac OS laptops with sufficient memory are welcome to install the software on their laptops for testing.

1.0 Testers

Astronomers who have volunteered (or been volunteered!) for this CASA software test are:

- SSR Offline subsystem scientist: Debra Shepherd - SD & synthesis
- SSR & commissioning representative: Robert Lucas – SD & synthesis
- ALMA ACA/offline SSR scientist: Masatoshi Ohishi – SD
- ALMA ACA ARC representative: Shige Takakuwa – SD
- NAASC, Canadian representative: Lewis Knee – SD & synthesis
- NA NAASC representatives: Tony Remijan – SD & synthesis
  Chris Carilli – synthesis
- European ARC representatives: Silvia Leurini – synthesis
  Alessandra Rossetti – synthesis
- Chilean ARC representative: Paolo Cortes – synthesis

Linux Workstations have been reserved for each person in the Socorro Array Operations Center (except for AOC residents).

2.0 Test Definition:

This test will evaluate the capabilities of the Common Astronomy Software Applications (CASA) package using the CASA libraries and the python user interface. It will also evaluate the documentation that has been written for users to process single dish and interferometric data. The only GUI interface that will be tested will be those GUIs that are needed to interactively edit data and create and view/analyze images. The software will be installed at the Array Operations Center

and all testers will work from a single version of the software. Although the software will already be installed, testers will be invited to install the software on individual machines to test the installation process.

This test has two basic parts:

- Single dish calibration and imaging
- Synthesis regression testing

Details for each part are given below.

Single dish testers should be able to:

- Fill the data (import from sdfits or MS).
- Visualize the data
- Edit/flag the data
- Calibrate the SD data
- Analyze the calibrated spectra
    - Baseline
    - Average
    - Smooth
    - Fit the line with a Gaussian
    - Spectral math (e.g. scaling)
- Grid the spectra into an image (if processing an image cube)
- Analyze the image using standard CASA image analysis functions.
- Export the data to an SD FITS file

Interferometric testers should be able to perform all steps that were done in past tests including the combination of synthesis data with SD data (for VLA continuum data matching a GBT continuum OTF map).

Before ALMA testing begins, NRAO will do pre-testing of all test datasets. NRAO testers should be drawn from the experienced pool of interferometry and single dish reduction experts.

2.1 Single Dish Calibration and Imaging

The single dish processing steps will use a separate part of the package from traditional interferometric processing because it will be based on code imported from the ATNF Spectral Analysis Package (ASAP). Although the software is different, the look and feel of the interface should be similar to that presented to the user during interferometric reduction and imaging.

The ASAP requirements have been translated into requirements appropriate for ALMA (see the appendix for a list of all ALMA offline requirements including new single dish requirements). The ASAP package is under development and not all ASAP requirements have been implemented. Therefore, this part of the test will evaluate single-dish priority 1 requirements (as defined in the appendix) along with requirements associated with the general user interface and operational issues. Further, only position- and frequency-switched data from existing telescopes will be

evaluated. No nutator-switched data is available for testing (nor has the software been developed to calibrate data generated with a nutator).

This test will evaluate the command line interface (CLI) for single dish processing imported from the ASAP package and will evaluate whether the existing gridding and analysis functions available for interferometric data will be adequate for single dish analysis (e.g. imager gridding routines, the viewer, statistical functions, line profile fitting functions). If they are not, then additional requirements must be added to improve single dish functionality.

Single dish calibration, imaging and analysis in CASA will be tested on the following datasets:

- Single dish spectra from the GBT (in MS format)
  - Orion-S – star forming region, position switched observation HC3N, CH3OH & SiO lines.
  - IRC+10216 – AGB star, Nod observation, HC3N, CH3OH, SiO, CS, & H2CO lines.
- GBT spectral line OTF map
  - Bootes – Galactic HI; frequency switched observation
  - First Look Survey – Galactic HI; frequency switched observation
- GBT continuum OTF map (and synthesis VLA data for combination)
  - Orion Nebula at 8.6 GHz – GBT OTF map + VLA synthesis 9-field mosaic

For a detailed list of the datasets and expected results, see
http://projectoffice.aips2.nrao.edu/ALMA2007.03/ALMA2007.03.html

2.2 Synthesis Regression and Benchmark Tests

The CASA software was tested by users for a limited data path (single baseline reduction & analysis) during the April 2006 user test. Since that time, most Glish capabilities have been imported into the CASA framework so that all datasets previously reduced in AIPS++/Glish should be able to be reduced in CASA with python scripts. Datasets from previous ALMA offline tests will be reduced and imaged using CASA python scripts to verify that the functionality has not been compromised during the conversion from AIPS++ to CASA. There will be some limitations in CASA – these will be reviewed before the test begins.

The AIPS++ tool structure is being converted to more user-friendly tasks (similar to AIPS or MIRIAD). The CLI task implementation will be evaluated during this test and testers are encouraged to provide recommendations on task parameter inputs and defaults.

In addition to basic data reduction, this test will verify that the benchmark AIPS++ scripts have been ported to python scripts and that procedures have been established for datasets from previous testing. Benchmark results for all test datasets should be posted on the web and a clear comparison between AIPS++ and CASA performance for each step in the processing should be available.

3.0 Test start criteria

1. All test datasets have been processed by at least 2 internal testers end-to-end as described in the Test Definition above. Scientifically accurate scripts have been produced. No

significant bugs should exist in the paths exercised. (presence of any known bugs should be discussed with D. Shepherd BEFORE the test begins).
2. CASA installation has been verified for all operating systems that will be used during the test (Mac OS and RedHat Enterprise will be supported).
3. The subsystem scientist has verified that the cookbook and relevant User Reference Manual and supporting help documentation is adequate for processing the data.
4. The CASA User Test web site has been set up with all instructions needed for the users to start the test. Expected results should be available (pulled from the pre-testing experience).
5. Offline team members are available to support testers in Socorro.

Appendix

A summary of all Offline requirements along with grades that were given in previous ALMA tests (initial audit & user tests 1-4) will be available on the test page at http://projectoffice.aips2.nrao.edu/ALMA2007.03/ALMA2007.03.html. For a detailed description of each requirement, see the ALMA Offline Data Processing Requirements (ALMA-70.10.00.00-006-B-SPE). This version (B) includes new requirements which describe single dish processing and analysis.

Included in the spread sheets is a proposed list of requirements that can be graded in this test. The subset of single dish requirements that can be graded have been identified with an 'x' in the column labeled "Test 5 SD" while synthesis-related requirements are identified with an 'x' in the column labeled "Test 5 synth." General, system and User interface requirements can be evaluated by both single dish and synthesis testers.

As a summary, single dish functionality that will be available is:

User Interface

- Installation
- Documentation
    - Command list
    - Cookbook with Script examples
    - User Guide
    - Reference Manual
- CLI (IPython)
- Scripting
- Support for plugins

Plotting

- Options: histogram plots, line thickness, character size, colors, line styles
- Supports: non-interactive hard copies

Functionality

- Import/export for
    - RP FITS format

    - MS format
- Baseline removal
- Line Profile Fitting
    - Export fit parameters
    - Specific constrained fitting
    - Gaussian line area
    - Fit multi-polarization data
- Calibration
    - *Sky subtraction
    - *Basic Tsys, gain calibration
        - Supported modes: Position Switched data
- Editing & RFI robustness
    - Spectra flagging
    - Channel flagging
- Spectra mathematics and manipulation
    - Average data with velocity shift
    - Smooth/resample
    - Spectral Calculator
    - Slice data
    - Merge scan-tables
- Data Selection
    - Spectral, beam/IF, channel selection, header values auto identify reference spectra
- Imaging
    - Choice of algorithm, optional weighting and scaling combination with synthesis data (feather, initial SD model, full joint deconvolution)