Miriad for SMA Data Reduction

SMA team & Miriad developers, presented by
Jun-Hui Zhao (Smithsonian Astrophysical Observatory)

The Submillimter Array

The Submillimeter Array (SMA) is an 8-element radio interferometer located atop Mauna Kea in Hawaii. Operating at frequencies from 180 GHz to 700 GHz, the 6 m dishes may be arranged into configurations with baselines upto 509 m, producing a synthesized beam of sub-arc. Each element can observe with two receivers simultaneously, with 2 GHz bandwidth each. The digital correlator backend allows flexible allocation of thousands of spectral channels to each receiver.

Miriad for SMA Data Reduction

Miriad is a radio interferometer data reduction package and has been adopted by the SMA for data reduction. Miriad can be configured for the specifications required by the SMA. Specific codes for handling the SMA data have been developed and are supported. Miriad now can be used for the reduction of continuum and spectral line observations from loading of the SMA archival data through to the image analysis. The SMA features have particular emphasis on aspects of interest to users of the SMA. We support the off-line software including software tools used for calibration and analysis of the SMA data observed at submillimeter wavelengths. The newly developed codes are (will be) placed under Miriad CVS system (./miriad_cvs/src/prog/sma) which is managed by the CARMA group.

Powered for Sub-mm Data Reduction

SMA planet models have been used for flux density scale calibration for the submillimeter observations in Miriad (Gurwell, http://sma1.sma.hawaii.edu/planetvis.html).
The SMA planet models have been coded in *SMAFLUX*.
In addition, *SMAMFCAL* is implemented with running-smooth and polynomial fitting algorithms to enhance the S/N for weak bandpass calibrators, as well as visibility-intensity weighting to weight down the lower S/N visibilities in the case of a resolved planet disk source to be used as bandpass calibrator. Various plotting tasks are implemented with color indices for identifying sources, spectral windows, and polarization components.

A Step-by-step for SMA Data Reduction

A step-by-step procedure for the reduction of both SMA continuum and spectral line data can be summarized by nine major steps: 1) read the archival data; 2) inspect data; 3) corrections for system temperature; 4) bandpass corrections; 5) complex gain calibration; 6) flux-density scale calibration; 7) imaging the continuum; 8) continuum subtraction; 9) Construction of spectral line cube. Fig 1 shows a flow chart of the detailed procedure in handling SMA data using the Miriad tasks.

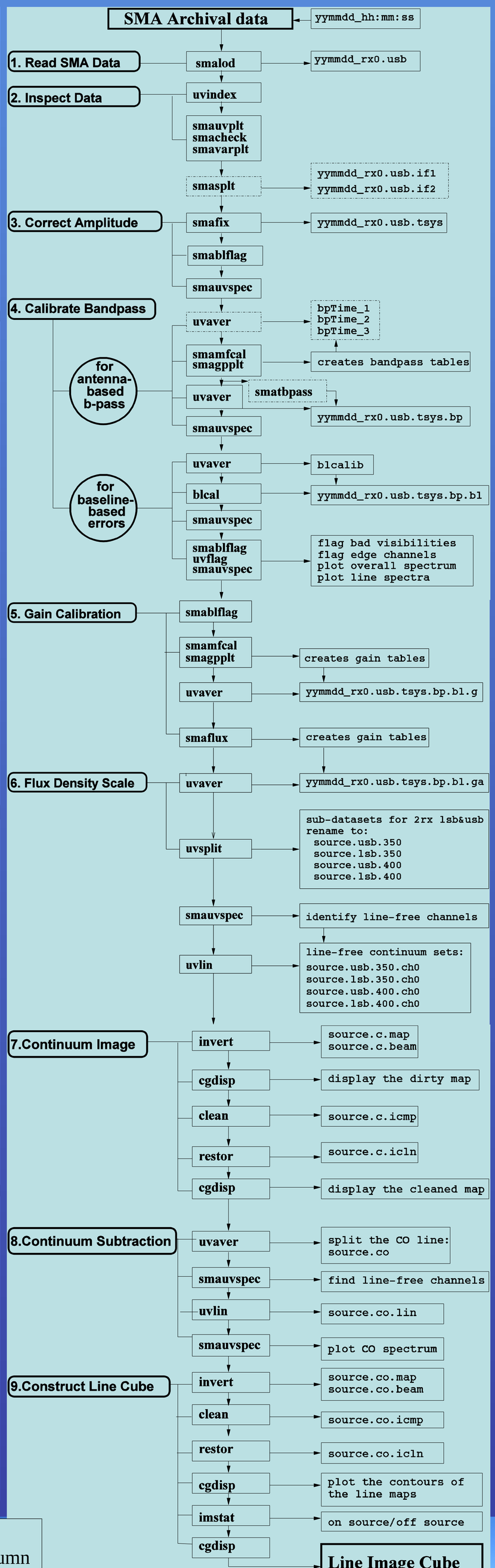

Fig 1. A flow chart of handling SMA data in Miriad. Left column shows the major steps of the data reduction procedure. Middle column lists the Miriad tasks used in the process. Right column shows the final calibrated uv data and image files as well as the interim uvdata, gain table and image files produced from the data reduction process.

End-to-end Shell-script:

One of the nice features in Miriad is that the detailed procedure of input setup and execution of data reduction tasks can be compiled in a shell script program. SMA staff have taken the advantage to provide users tutorial examples in C-shell scripts for reducing data acquired from the basic observing modes including hybrid-spectral resolution, dual receivers, polarization, mosaic with the standard SMA correlator configuration (2 GHz bandwidth) or the double-band modes (4 GHz bandwidth). The examples of the scripts have been posted on the SMA-Miriad webpage.*

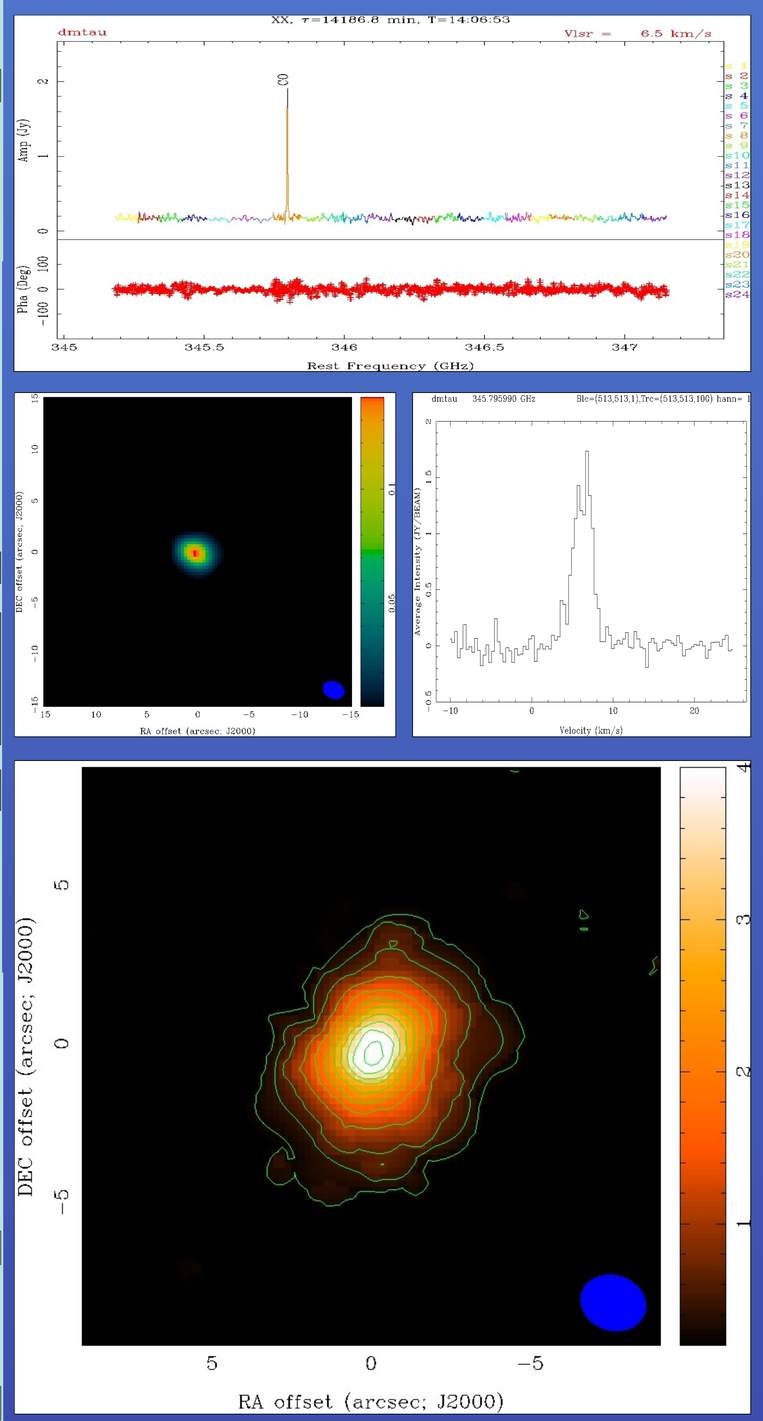

Fig 2. The result plots produced from one of the example scripts: the non-polarization 2 receiver mode with a test data from observations of DM Tau. Top: a spectrum of LSB from 350 GHz receiver. Middle-left: a continuum image of DM Tau made with the data from LSB and USB of both 350 and 400 receivers. Middle-right: a CO(3-2) line profile.Bottom: an image of integrated CO line emission from DM Tau.

*http://www.cfa.harvard.edu/sma/miriad/spec/SMAscripts

References:
Sault, Teuben & Wright, 1995, in ADASS IV, ASP Conf. Series 77, p 433