AIPSLETTER

Volume XXX, Number 1: June 30, 2010

A newsletter for users of the NRAO
Astronomical Image Processing System

Written by a cast of *AIPS*

Edited by
Eric W. Greisen
National Radio Astronomy Observatory
P.O. Box O, Socorro, NM 87801–0387
505–835–7236; Fax 505–835–7027
daip@nrao.edu
http://www.aips.nrao.edu/

General developments in *AIPS*

AIPSLetter publication

We have decided to discontinue paper copies of the *AIPSLetter* other than for libraries and NRAO staff. The *AIPSLetter* will be available in PostScript and pdf forms as always from the web site listed above. It will be announced in the NRAO e-News mailing and on the bananas list server.

Current and future releases

We have formal *AIPS* releases on an annual basis. While all architectures can do a full installation from the source files, Linux (32- and 64-bit), Solaris, and MacIntosh OS/X (PPC and Intel) systems may install binary versions of recent releases. The last, frozen release is called `31DEC09` while `31DEC10` remains under active development. You may fetch and install a copy of these versions at any time using *anonymous* `ftp` for source-only copies and `rsync` for binary copies. This *AIPSLetter* is intended to advise you of improvements to date in `31DEC10`. Having fetched `31DEC10`, you may update your installation whenever you want by running the so-called "Midnight Job" (MNJ) which copies and compiles the code selectively based on the changes and compilations we have done. The MNJ will also update sites that have done a binary installation. There is a guide to the install script and an *AIPS* Manager FAQ page on the *AIPS* web site.

The MNJ serves up *AIPS* incrementally using the Unix tool `cvs` running with anonymous ftp. The binary MNJ also uses the tool `rsync` as does the binary installation. Linux sites will almost certainly have `cvs` installed; other sites may have installed it along with other GNU tools. Secondary MNJs will still be possible using `ssh` or `rcp` or NFS as with previous releases. We have found that `cvs` works very well, although it has one quirk. If a site modifies a file locally, but in an *AIPS*-standard directory, `cvs` will detect the modification and attempt to reconcile the local version with the NRAO-supplied version. This usually produces a file that will not compile or run as intended.

AIPS is now copyright © 1995 through 2010 by Associated Universities, Inc., NRAO's parent corporation, but may be made freely available under the terms of the Free Software Foundation's General Public License (GPL). This means that User Agreements are no longer required, that *AIPS* may be obtained via anonymous ftp without contacting NRAO, and that the software may be redistributed (and/or modified), under certain conditions. The full text of the GPL can be found in the `15JUL95` *AIPSLetter*, in each copy of *AIPS* releases, and on the web at `http://www.aips.nrao.edu/COPYING`.

Improvements of interest in 31DEC10

We expect to continue publishing the *AIPSLetter* approximately every six months along with the annual releases. Henceforth, this publication will be primarily electronic. There have been several significant changes in 31DEC10 in the last six months. New tasks include UVRFI to apply RFI mitigation techniques rather than simple flagging, EVASN and EVAUV to examine the remains after pipeline reduction to determine how well things went, REWAY to estimate the weight of data from the rms found across spectral channels within the given polarization and IF, RSPEC to determine the spectra of the rms in a data cube, and RLDLY to determine the right-left delay difference. IMAGR and MCUBE now scale the units of each image plane to match those implied by the image header and CONVL now uses different convolving beams for each channel to achieve identical resolution for the whole image cube. New verbs ADDDISK and REMDISK allow the addition/removal of remote host disks within the local area net, while support to run *AIPS* batch jobs on other computers within the local net was added.

31DEC09 contains a significant change in the format of the antenna files, which will cause older releases to do wrong things to data touched by 31DEC09 or 31DEC10. 31DEC08 contains major changes to the display software. Older versions may use the 31DEC08 display (XAS), but 31DEC08 code may not use older versions of XAS. Magnetic tape logical unit numbers changed with 31DEC04. You are encouraged to use a relatively recent version of *AIPS*, whilst those with EVLA data to reduce must get the latest release.

EVLA UV-data calibration and handling

A great many changes have been stimulated by the commissioning effort now underway with the new EVLA WIDAR correlator. A new appendix (E) to the *CookBook* has been written to describe EVLA data reduction. It has been available on the web and is now incorporated into the *AIPS* release. Note that this document is a work in progress and it will of necessity evolve with time.

There are five new tasks which fit into this area. RLDLY is based on FRING but is specifically designed to solve only for the difference in delay between the right- and left-hand polarizations. It replaces the horribly kludged procedure VLBACPOL, but uses many of the ideas pioneered in that procedure. It solves for the difference in delays separately for all baselines to a user-specified reference antenna and averages the result. It requires a reasonable signal in the RL and LR cross-hand polarizations, but instrumental polarization alone may provide that on a strong source.

UVRFI is a new task that attempts to separate the signal at the fringe-stopping point from interfering signals at other fringe frequencies, saving only the former. It has had some interesting results although real RFI as seen by the EVLA is rather complicated. See the new *AIPS* Memo 116 by Leonia Kogan and Fraser Owen described elsewhere in this *AIPSLetter*.

REWAY is a new task that began with the simple proposition that the noise in a visibility spectrum should be able to be estimated from the rms of the real and imaginary parts. The new EVLA provides a lot of spectral channels in each polarization and IF and, at the moment anyway, no other estimate of data weight. The result was found to be rather noisy, so a variety of algorithms were added to use data over a moving window in time to provide a more stable solution. The results have been a bit puzzling in that they appear to show real time variability where little is expected. What is clear is that the task is good at detecting, and now at flagging, data with apparent rms way below or above that expected.

EVASN and EVAUV are two tasks designed to evaluate the results of a pipeline data reduction. The former looks at the amplitude rms and phase stability in the CL tables used. The latter evaluates the signal-free rms of the image and computes the *uv* data with the model subtracted and divided and then does statistics on these. Both have been tested and improved, but neither is yet incorporated into a released pipeline procedure.

A major bug was found in CVEL, the task that shifts visibility spectra for the motion of the Earth when that shift is not done on-line. For single-source files having an index table (which most now do), the task only shifted the data of the first scan. This fact was obscured by another error which truncated the message which should have pointed out the error. An infinite loop of recent origin was also corrected. For a period of time, the shift for the VLBA was also done incorrectly. It should have been Earth centered and the same for all antennas, but it was not.

A major effort by Rick Perley and Brian Butler has produced new estimates of the spectra of the primary flux calibration sources. These have been incorporated in `SETJY` and result in rather different fluxes for some of the sources at the higher frequencies. Older source fluxes remain available in `SETJY` if requested. The same effort produced improved gain curves for the VLA antennas at some of the frequencies. These curves have been added to the standard tables used by `FILLM` and `INDXR`. The tasks were corrected to use a generic antenna gain whenever an antenna-specific gain is not available. Josh Marvil has done a detailed study of opacity as a function of frequency and his model is now incorporated in these two tasks. It computes a K-band opacity by the old seasonal/weather-based methods and then uses Josh's tables to determine the opacity at each observed IF frequency. The model is described in EVLA Memo 143. `INDXR` was improved to use by default the methods now widely used elsewhere in *AIPS* to determine when scan breaks occur.

Traditionally, spectral-line cubes have been constructed in `IMAGR` and `MCUBE` from image planes made at the "natural" resolution resulting from the frequency of that plane. However, the cube has contained the information about the Clean beam parameters for only one of the planes. Thus, any conversion from brightness in Jy/beam to flux could only be correct in one plane. `IMAGR`, `MCUBE` and `FQUBE` have been changed so that each plane is scaled to be in Jy/beam for the beam listed in the header while the resolution used is kept in a new `CG` table. `CONVL` has been changed to employ the `CG` table to achieve the same spatial resolution and intensity scaling for all channels of an image cube including suitable scaling for the residuals.

CALIB was changed to offer three modes of data averaging. The new mode is vector over channels at each time plus scalar over time. This is suitable for data with serious atmospheric phase variation.

BPASS was changed in the interpretation of the `BPASSPRM(5)` parameter. Now +1 means no channel zero division, 0 means record-by-record channel zero division in amplitude and phase, −1 means record-by-record division but only in phase, and −2 means amplitude and phase division using the time-averaged visibilities.

Calibration routines were changed to forbid calibration of data weights for the EVLA, at least for the moment. They were also corrected to calibrate all channels needed for spectral smoothing rather than just `BCHAN` through `ECHAN`. Amplitudes should be corrected for delay only for any spectral averaging after correlation, so that correction was removed except for the VLBA which keeps track of such things.

Table copying was addressed. When calibration is applied, a copy of the old `CL` table 1 is made with null (1,0) gains to avoid having `INDXR` create a new `CL` table with opacity and other corrections. Index tables are now never copied, they must be generated as the data are copied or by `INDXR` later.

VLANT was changed to handle the new form of station names and the necessary data files for the EVLA were created and populated with some early values.

FITLD and `UVLOD` were changed to flag out and report any visibility spectra that are pure 0.0 in value for all channels. They were also changed to compute the apparent coordinates in all cases since they are frequently in error on input from other software packages.

UVFLG was corrected to do flagging for shadowing properly.

FRING now offers the option `CHINC` to average groups of channels before fitting for delay. Additional issues with times were addressed.

LOCIT was changed to be with respect to the longitude of the array, which is Greenwich for the EVLA. Changes to name forms, allowing previous corrections to be read and added in, and doing another plot of corrections along arms were also added.

SUFIX was changed to allow the user to specify the details of the new source, allowing the "new" source to be one of the existing sources.

ELINT was corrected to work on 64-bit computers.

PRTAN was changed to handle both old and new forms of antenna and station names and to display missing antennas on the North arm in the Y plot. It now offers the option to display the antenna locations a second time, changed to be with respect to an array center such as that previously used for the VLA.

Other UV-data matters

REAMP was changed to allow scaling factors to depend on subarray permitting all subarrays to be changed to the same flux scale.

CVEL lost the flag telling it to use the center of the Earth for the VLBA. This error arose from September 20, 2009 until April 7, 2010.

LISTR was changed to allow the `SCAN` option to do what it can when source and/or index tables are absent. Previously it refused.

FITTP had the dangerous `DOSTOKES` and `DONEWTAB` options removed. The latter did nothing interesting.

ACCOR was changed to have enough memory for current arrays and its use was clarified in the help file. It is needed for the old hardware and new software VLBA correlators.

FITLD was given a new option to allow users to specify the antenna numbering order through the adverb `ANTNAME`. This applies only when reading data in FITS IDI format.

SPLIT and `SPLAT` corrected the alternate reference pixel for `BCHAN` twice.

Image analysis matters

RSPEC is a new task based on `ISPEC` that determines and plots a spectrum of the plane-by-plane rms. The rms may be found by robust methods or by a more expensive median method.

FARS is a Faraday rotation measure synthesis task that is under active development. The option to do a one-dimensional Clean of the Fourier transform at each spatial point, including convolution of the components, was added.

RM was changed to accept data as a cube with an `FQID` axis, as produced by `MCUBE` and `FQUBE`, and a second solution method due to F. Zhou was added.

GAL was changed so that it computes residual images from input parameters in the same way it did when it is first fitted those parameters. Output formats and defaults were also improved.

SAD, `JMFIT`, and `IMFIT` were given the option of a special compact output format used at other institutions. The `MF` file was given more columns to record primary beam and bandwidth smearing correction factors supported by these tasks and by `MFPRT`. `SAD` was given further mark characters in its output including indicating outside primary beam and the help file was improved to explain them.

LGEOM, `HGEOM`, and `PGEOM` were changed to use as much dynamic memory as they might wish rather than having a finite limit. They still blank things more than `OGEOM` and `OHGEO` since the interpolation method cannot handle edges and blanked input pixels well.

IMEAN and `IMSTAT` were changed to count pixels with double precision floating point variables; 32-bit integers are not adequate to count pixels with EVLA image cubes.

Display matters

XYRATIO was added to tasks `ISPEC`, `VPLOT`, `ANBPL`, `CLPLT`, `CAPLT`, and `UVPLT` with default to fill the TV on `DOTV` true and 1.0 for plot files.

POSSM was changed to reset `NPLOTS` if there are fewer than `NPLOTS` to be plotted and to know accurately when the end of plotting arises.

VPLOT was also changed to know accurately when the last plot is done so that it may be labeled correctly. It had options to plot scan boundaries and log of amplitude added.

BPLOT was corrected to skip fully flagged `BP` records and to know accurately when it is done plotting.

LWPLA was changed so that plot output sizes greater than 33 inches, i.e. posters, are possible.

PLOTR was given the option to fit orthogonal polynomials to the input data, plotting the result.

System-wide matters

AIPS has long allowed users to specify `da=`*hostname* on the command line to include the *AIPS* disks of *hostname* along with the *AIPS* disks of the current computer in an `AIPS` session. New verbs `ADDDISK` and `REMDISK` have been added to allow this operation dynamically within the `AIPS` session. You may gain access to the *AIPS* disks of the computer named in the `REMHOST` adverb and release that use when you no longer need them. This works only with computers named in the `DADEVS` files used when you started up `AIPS`, presumably those that share the local *AIPS* installation.

Similarly, `REMHOST` and `REMQUE` adverbs were added to verb `SUBMIT` and also to `UNQUE`, `QUEUES`, and `JOBLIST`. This will allow the submission of batch jobs to be executed on another computer within the local *AIPS* installation. This required the creation a new script in `$AIPS_ROOT` called `START_QMNGR` which `AIPSC` will invoke when initiating a remote batch job. This capability was added to begin a simple capability, so far solely in the user's hands, to run jobs in parallel.

Patch Distribution for 31DEC09

Important bug fixes and selected improvements in `31DEC09` can be downloaded via the Web beginning at:

`http://www.aoc.nrao.edu/aips/patch.html`

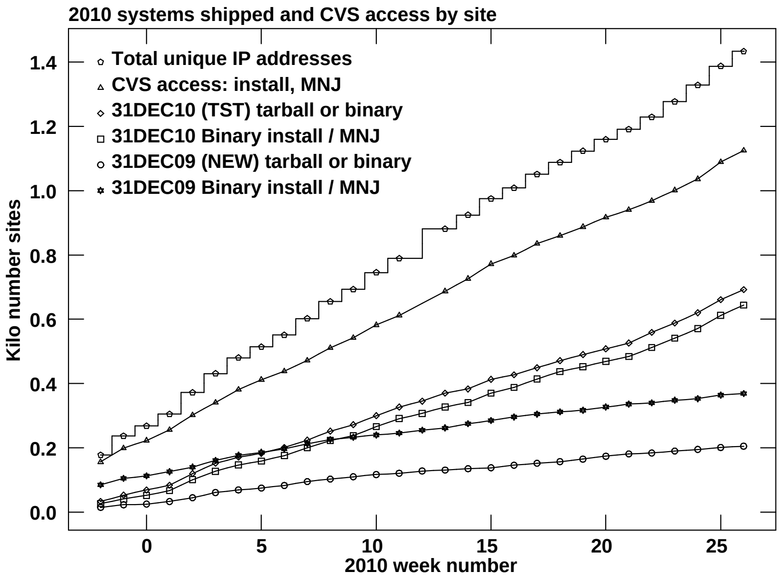
Alternatively one can use *anonymous* `ftp` to the NRAO server `ftp.aoc.nrao.edu`. Documentation about patches to a release is placed on this site at `pub/software/aips/`*release-name* and the code is placed in suitable sub-directories below this. As bugs in `31DEC10` are found, they are simply corrected since `31DEC10` remains under development. Corrections and additions are made with a midnight job rather than with manual patches. Since we now have many binary installations, the patch system has changed. We now actually patch the master version of `31DEC09`, which means that a MNJ run on `31DEC09` after the patch will fetch the corrected code and/or binaries rather than failing. Also, installations of `31DEC09` after the patch date will contain the corrected code.

The `31DEC09` release has had a number of important patches:

1. `IMEAN` and `IMSTAT` must count pixels in double precision for large cubes. *2010-02-05*
2. `DOBAND` must not use edge channels to scale weights for EVLA. *2010-01-18*
3. `FITLD` messed up the polarization type code in the antenna file for FITS IDI files. *2010-01-25*
4. Amplitudes were corrected for delay corrections which should be done only if channel averaging is done post correlation. *2010-02-11*
5. `APCAL` read every other row of the weather table and could go off the end. *2010-02-11*
6. `CVEL` could go into an infinite loop and would not shift scans > 1 for single-source files having an index (`NX`) table *2010-03-01*
7. `FITLD` issued alarming but harmless messages about reference date with EVN FITS-IDI data files. *2010-03-05*
8. `UVCON` did not produce correct models from images *2010-03-17*
9. `SPLIT` and `SPLAT` corrected the alternate reference pixel for `BCHAN` twice *2010-03-17*
10. `CVEL` shifted VLBA antennas wrongly, using the antenna location rather than the center of the Earth *2010-04-05*
11. `INDXR` when making a new CL table 1 for VLA data made mistakes likely to affect P, KA, and Q bands *2010-04-08*
12. `BPASS` aborted when trying to shift VLBA bandpasses *2010-04-21*
13. `UVFLG` failed to flag shadowed antennas correctly *2010-03-05 and 2010-06-23*

AIPS Distribution

We are now able to log apparent MNJ accesses and downloads of the tar balls. We count these by unique IP address. Since some systems assign the same computer different IP addresses at different times, this will be a bit of an over-estimate of actual sites/computers. However, a single IP address is often used to provide *AIPS* to a number of computers, so these numbers are probably an under-estimate of the number of computers running current versions of *AIPS*. In 2010, there have been a total of 1433 IP addresses so far that have accessed the NRAO cvs master. Each of these has at least installed *AIPS* and **340** appear to have run the MNJ on `31DEC10` at least occasionally. During 2010 more than 205 IP addresses have downloaded the frozen form of `31DEC09`, while more than 692 IP addresses have downloaded `31DEC10`. The binary version was accessed for installation or MNJs by 369 sites in `31DEC09` and 644 sites in `31DEC10`. The attached figure shows the cumulative number of unique sites, cvs access sites, and binary and tar-ball download sites known to us as a function of week — so far — in 2010. These numbers are about the same as those reported one year ago for last year's releases.



Recent *AIPS* and related Memoranda

All *AIPS* Memoranda are available from the *AIPS* home page. There is one new memoranda in the last six months.

116 RFI Mitigation in *AIPS*; the new task UVRFI
Leonid Kogan & F. Owen (NRAO)
June 2010
Recently Ramana Athrea published a new algorithm (2009) based on the difference at fringe rates of a source in the sky and ground-based RFI. His algorithm works only for ground-based and constant-amplitude RFI during a solution interval. We modified his algorithm to include a possible change of the RFI's amplitude during the solution interval and developed another algorithm based on Högbom CLEANing of the Fourier transform of the time series of the SOURCE+RFI visibilities. These algorithms allow us to mitigate RFI originating from more than one source moving with different nonzero speeds relatively the array (e.g. ground-based and satellite-based RFI). The new algorithms are implemented in AIPS in the task UVRFI. The result of testing this task is demonstrated using the EVLA data at L and 4 band. It is also shown that self-averaging of RFI can reduce its impact on imaging even if the solution interval in the correlator is too small to allow self-averaging before imaging.

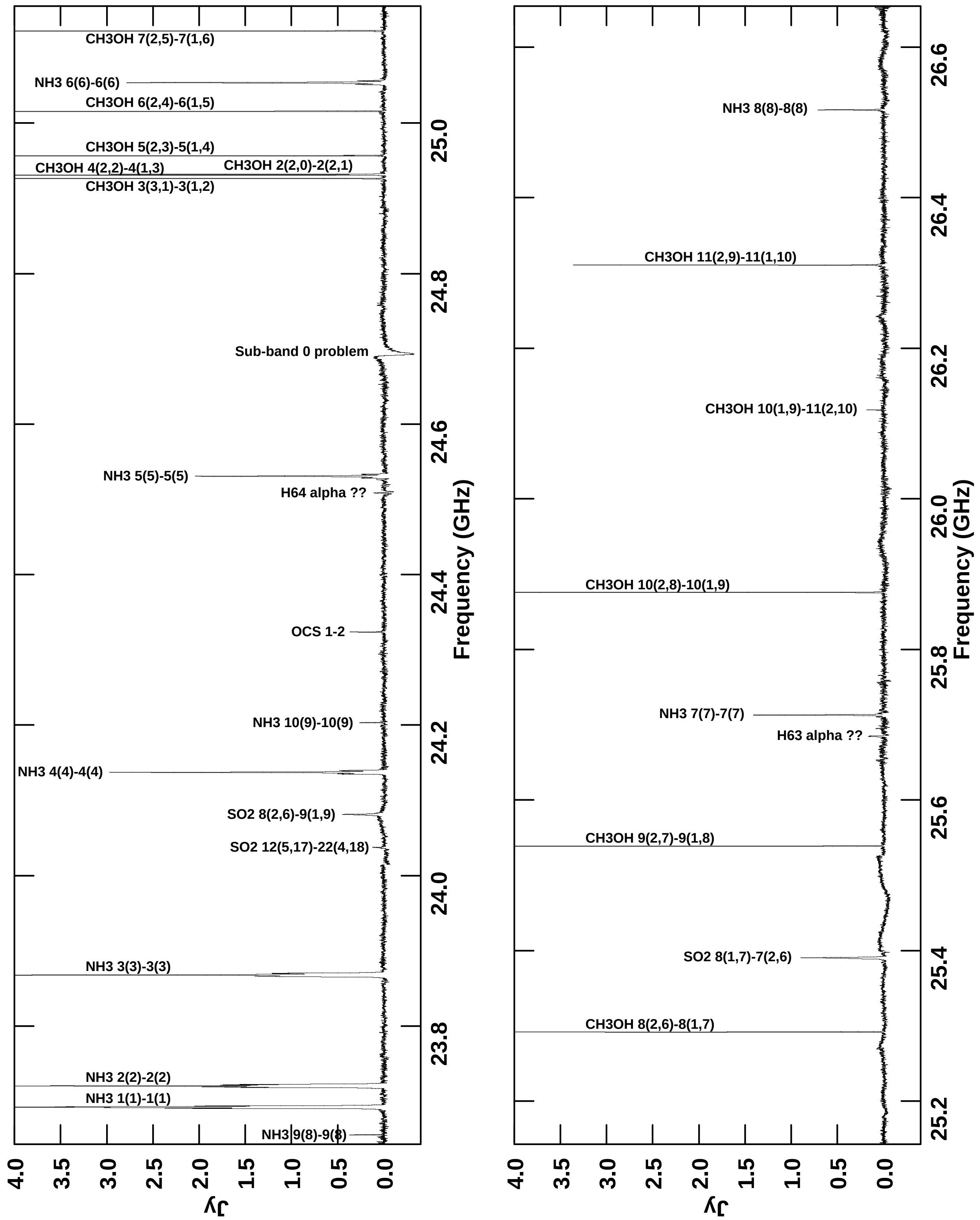
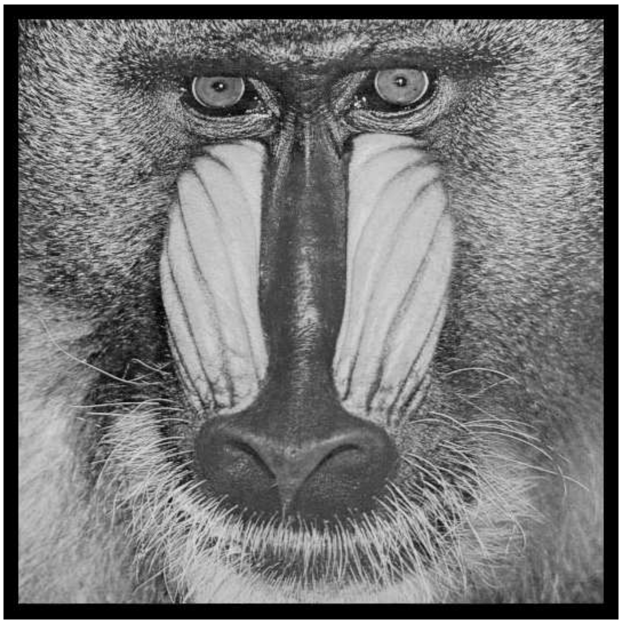


Figure 1: Early EVLA result: the spectrum of the hot core of Orion A at K band. Three separate observations of 8192 channels each 0.125 MHz wide were made using 12 antennas in the D array. Two hours total telescope time went into each of the two lower thirds of the spectrum and 1 hour was used for the highest third. The plot was made using `ISPEC` over a 54 by 60 arc second area. Line identifications provided by Karl Menten.



June 30, 2010

AIPSLETTER
National Radio Astronomy Observatory
Post Office Box O
Socorro, NM 87801-0387
USA