

A I P S L E T T E R

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A newsletter for users of the NRAO
Astronomical *Image Processing System*

Written by a cast of *AIPS*

Edited by

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General developments in *AIPS*

*AIPS*Letter publication

We have decided to discontinue paper copies of the *AIPS*Letter other than for libraries and NRAO staff. The *AIPS*Letter 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 *AIPS*Letter 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 *AIPS*Letter, 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 *AIPS Letter* 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 *AIPS Letter*.

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 *ATPS* 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 `REMHST` 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, `REMHST` 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>

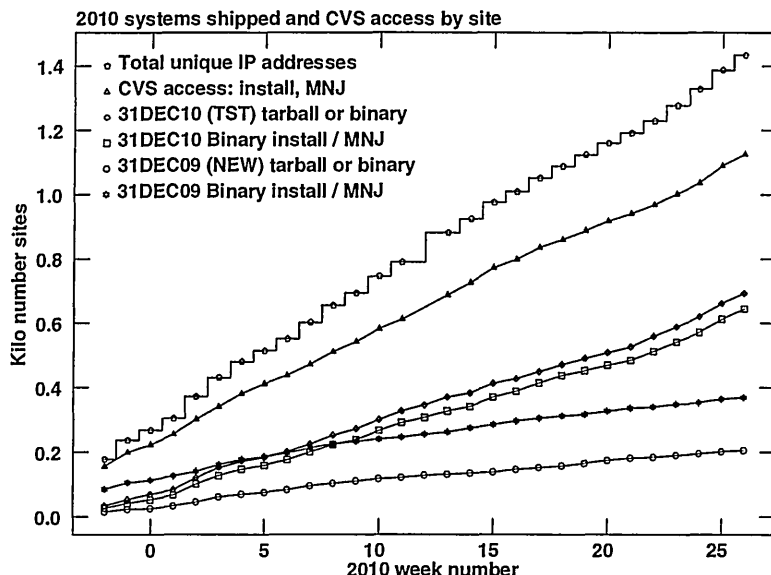
Alternatively one can use *anonymous* ftp to the NRAO server `ftp.aoc.nrao.edu`. Documentation about patches to a release is placed on this site at `pub/software/aips/release-name` and the code is placed in suitable sub-directories below this. As bugs in 31DEC10 are found, they are simply corrected since 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 relative 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.

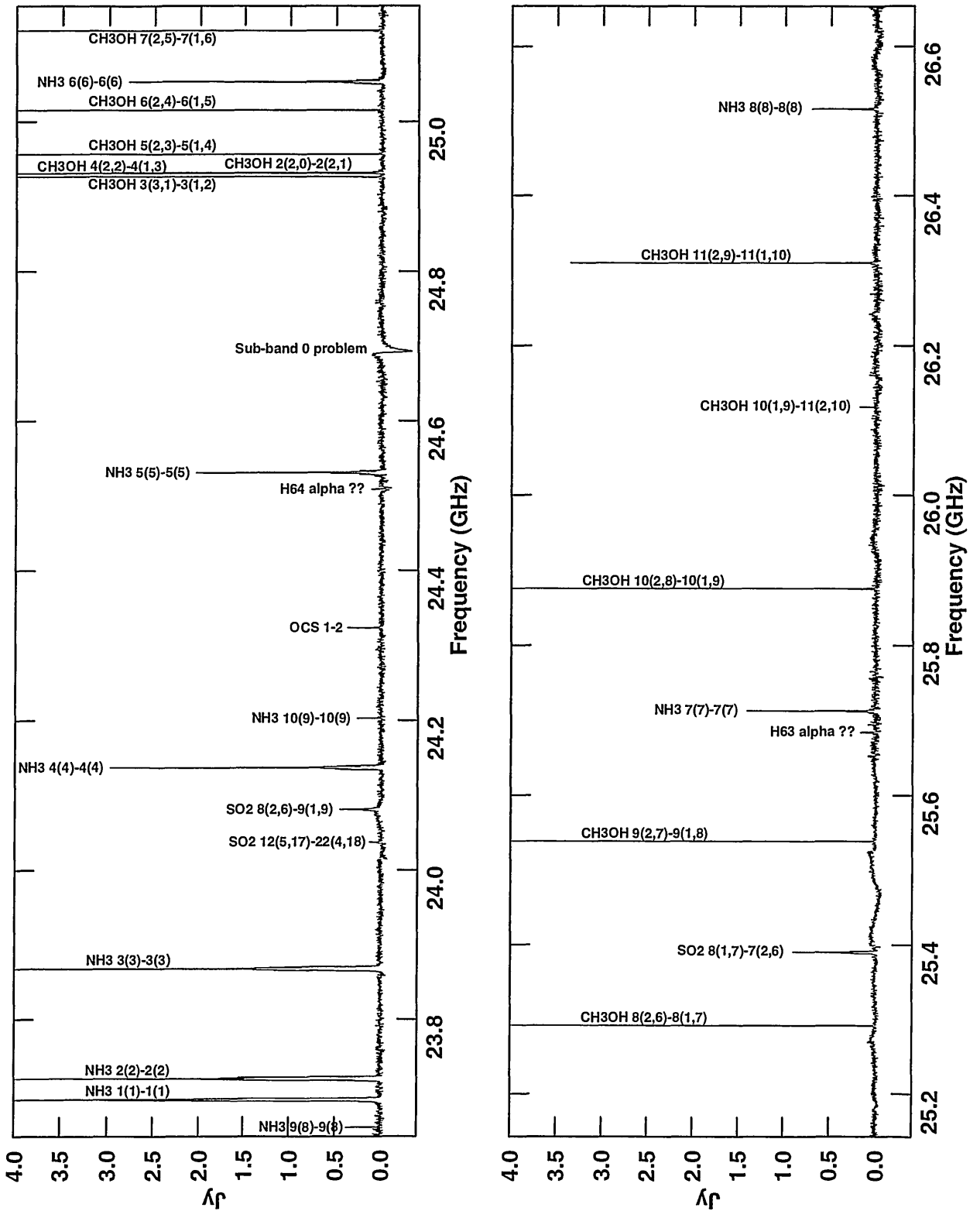
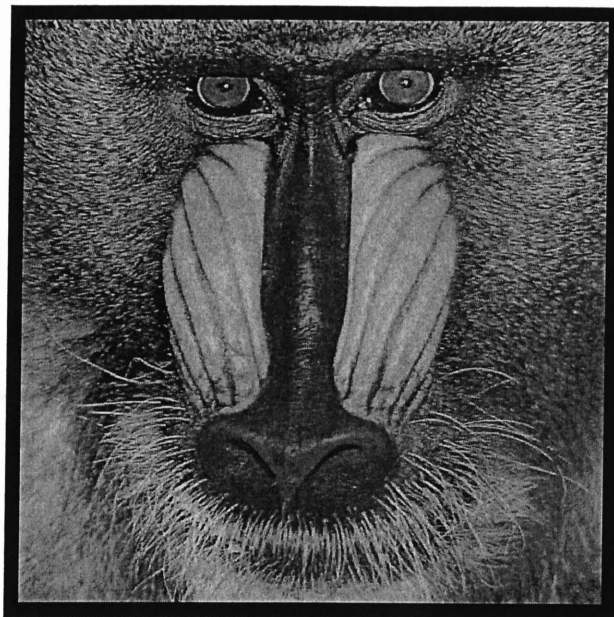


Figure 1: Early EVLA result: the spectrum of the hot core of Orion A at K band. Three separate observations of 8192 channels each 0.125 MHz wide were made using 12 antennas in the D array. Two hours total telescope time went into each of the two lower thirds of the spectrum and 1 hour was used for the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



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General developments in *AIPS*

Current and future releases

We have formal *AIPS* releases on an annual basis. We recommend a full binary installation method for both the frozen and development versions for MacIntosh OS/X (PPC and Intel chips), Solaris, and Linux (32- and 64-bit) systems, but all architectures can do a full installation from the source files. If you develop *AIPS* code locally, you will need to do a source-level installation. The current release is called 31DEC10 and is now “frozen.” If you took a development copy of this version at some earlier date, you should use the “Midnight Job” (MNJ) to bring it up to date. You need to run a MNJ only once in 2011 to convert your copy of 31DEC10 into the frozen version. When patches to 31DEC10 are announced, you may apply them with the MNJ. This *AIPS Letter* is intended to advise you of corrections and improvements in this release.

We have begun a new version, called 31DEC11, which is now under development by the *AIPS* Group. You may fetch and install a complete copy of this version at any time. Having fetched 31DEC11, you may update your installation whenever you want by running the MNJ. This uses cvs, rsync, and/or transaction files to copy and compile the code selectively based on the code changes and compilations we have done. We expect users to take their source-only or binary version of 31DEC11 *AIPS* over the Internet (via *anonymous* ftp). Both versions require you to copy the installation procedure `install.pl` via ftp; the source-only version also requires you to ftp the 108-Mbyte `31DEC11.tar.gz` compressed tar file. 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.

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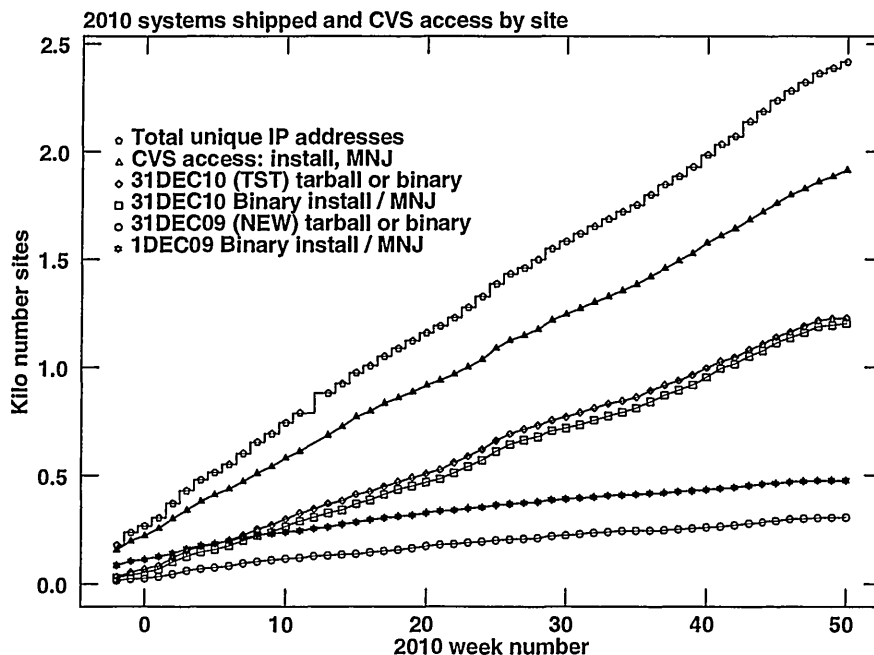
Installing a new version

If compiling locally, new releases must be installed from the tar ball for that release. If using the binary installation, a full new installation must also be done with `rsync`. The `cvs` system requires this. When installing a new *AIPS* release in a system that already has a previous release, we recommend that `install.pl` be used and that the previous release be left in place, at least until the new installation has been seen to work. If you do this, then you will not have to re-edit the disk, printer, and tape lists and can simply skip all those pages in the `install.pl` menus. The old `$HOME/.AIPSRC` file may be left in place, but it will need to be edited. The lines giving the `DOWNLOADED` and `UNPACKED` parameters should be cleared and the `CCOMOPT` line should be changed to point to the current release rather than the previous one — the `-I` parameter really should be `-I$INC` but it gets its full path name instead. This forces a re-edit with each release. If you have made special versions of `UPDCONFIG` and `do_daily.host`, you should preserve them under new names and restore them after the install. If you have an odd set of *AIPS* versions, the `$AIPS_ROOT/AIPSPATH.*SH` files may need to be edited after the install to set the desired versions.

For Linux, Solaris Ultra, and MacIntosh systems, a binary installation could be available from DVD, supported by `install.pl`. Alternatively, the frozen version may be installed with the binary installation method now present in `install.pl`. The ftp site for downloading files directly has been eliminated.

AIPS Distribution

From the NRAO system logs, we count apparent MNJ accesses, downloads of the tar balls, and `rsync` accesses by unique IP address. Since DSL and some university and other connections may be assigned different IP addresses at different times, this will be a bit of an over-estimate of actual sites. However, a single IP address is often used to provide *AIPS* to a number of computers, so these numbers are at the same time an under-estimate of the number of computers running current versions of *AIPS*. In 2010, a total of 307 different IP addresses downloaded the frozen form of 31DEC09 and 1228 IP addresses downloaded 31DEC10 in tarball or binary form. Fully 1914 IP addresses accessed the NRAO cvs master. Each of these has at least installed some version of *AIPS* and 535 appear to have run the MNJ at least occasionally. The total number of unique IP addresses in these three lists was 2416. 477 sites accessed 31DEC09 in binary form, while 1203 sites used the binary form of 31DEC10. The attached figure shows the cumulative number of unique sites, cvs access sites, tar-ball/binary download sites and binary access sites known to us as a function of week in 2010. These numbers are remarkably similar to those of 2009.



Preview of coming attractions

The 31DEC11 release already contains a few changes that we decided were a bit risky or not needed in 31DEC10. CLSMO and SNSMO have normalization controls, TVFLG has a revision of the next IF option and its image placement, TYSMO applies flag tables to the TY or SY tables on input, a new task REWGT applies user-specified scaling to data weights, and a number of tasks will now select on CALCODE as well as source name.

Improvements of interest to users in 31DEC10

We expect to continue publishing the *AIPSLetter* every six months along with the annual releases. There are a few new tasks released in the last six months, but the biggest changes have taken place in existing tasks used now for EVLA calibration. New tasks include SOUSP to fit spectral indices from the fluxes in the source table, NOIFS to convert a multi-channel, multi-IF data base into one with a single IF, TRUEP to fits for true instrumental polarization using data taken with rotated feeds, and SWAPR to swap real and imaginary parts of visibility data which may be needed due to a bug in the REBYTE program. New verb TVHELIX implements Dave Green's helical coloring scheme said to make perceived brightness increase monotonically. The biggest changes in existing tasks involve implementing EVLA gain calibration from SysPower tables through TYSMO and TYAPL and spectral-channel dependent polarization calibration through PCAL and RLDIF. In the first six months of 31DEC10 the new tasks were 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.

Normally, bugs which are created in an *AIPS* TST version and then fixed in that same version before its release get little or no discussion in the *AIPSLetter*. Since a rather large number of sites now install the TST version of *AIPS* during its development, this is somewhat of an oversight. We urge you to run the "Midnight Job" at least once after 31DEC10 is frozen to bring it up to date and to fix all bugs of this sort. We urge active sites to use the MNJ and, when something odd occurs, to examine CHANGE.DOC using the cgi tool available from the *AIPS* web page under documentation. Please do not hesitate to e-mail daip@nrao.edu with any questions or suspicions that there are problems.

31DEC09 contains a change in the format of antenna files. Previous releases will not understand the antenna coordinates for arrays that were traditionally left-handed (VLBI primarily). The format change occurs automatically when any 31DEC09 or later antenna-file specific code reads the file, after which older releases will have difficulties. 31DEC04 through 31DEC11 use a new numbering scheme for magnetic tape logical unit numbers that is incompatible with previous versions. Thus all tape tasks and the server TPMON must be from a recent release. Other than these issues, 31DEC09 is compatible in all major ways with the with the 15OCT98 and later releases. There are significant incompatibilities with older versions. Note that the only version which we patch for major errors is 31DEC10; even 31DEC09 is no longer changed.

Analysis

While ordinary spectral index is easily defined, the need for spectral index curvature forces us into a much more rigorous definition. That is now

$$\begin{aligned} R &\equiv \log(F/10^9) \\ \log(T/T_0) &= aR + bR^2 + cR^3 + \dots \end{aligned}$$

where log is a logarithm base 10, F is the frequency in Hz, T_0 is T at 1 GHz frequency, a is the usual spectral index, and b, c, \dots are the spectral index curvature terms. This change of definition was implemented directly in SPIXR and UVMOD and the component modeling offered by IMAGR and OOSUB. It affects the implementation of spectral index in a wide variety of other tasks to be discussed below.

Other “analysis” topics include a change to TRANS which was found to be able to get into very unfortunate disk access issues while row swapping. It will now take large amounts of dynamic memory and attempt to avoid these issues. The recording of actual Clean beam size as a function of channel begun near the start of this release cycle meant that image files have more than just Clean Component (CC) tables attached. Clean Gaussian (CG) and frequency (FQ) tables may also be present. A large number of tasks were modified to copy these tables from the input to the output, omitting the CCs in around half of the cases.

UV data

EVLA data acquisition

EVLA data are recorded using two types of formats, the ASDM or science data model which contains a variety of xml files describing the data set and the BDF or binary data format containing the visibilities. These are available from the archive but need to be translated in order to be useful in CASA or in *AIPS*. One route to *AIPS* involves first a translation into CASA measurement sets followed by a translation into *uv* FITS format which is then read by UVLOD or FITLD. A new route has become available through a software package called obit written by Bill Cotton. If you have the data in ASDM/BDF form on your computer and obit is installed, you may run a procedure outside of AIPS called BDF2AIPS which will perform the translation directly into *AIPS* files in your *AIPS* data area. This has two major advantages. It avoids several data copy/translation steps and so is significantly faster. More importantly however, it also produces several *AIPS* extension files not currently available through CASA. Index (NX), calibration (CL) including opacities and gains, flag (FG), calDevice (CD) T_{cal} values, and sysPower (SY) tables are among these tables. obit is currently the only route to get the SY data which will be significant in proper calibration of EVLA data. Observers not in Socorro should be able — eventually — to get *uv* FITS files from the archive produced either by the CASA or the obit route.

EVLA gain calibration

The EVLA “WIDAR” correlator is a very linear device over a wide range of input power. Therefore, the correlator will deliver cross-power spectra without internal normalization by the autocorrelation “self” powers. To determine the system temperatures and correct for changes in system gain, it is necessary to switch a noise tube on and off and to record the total power when it is on and when it is off. In the case of the EVLA, the recorded parameters are $P_{sum} = G(P_{on} + P_{off})$ and $P_{dif} = G(P_{on} - P_{off})$, where G is the gain following the synchronous detector. These data are recorded as a function of IF, polarization, and time for each antenna in the SY table written by the obit program BDFIn invoked from the script BDF2AIPS. The system temperature is given by $T_{cal} \times P_{sum}/P_{dif}$ which may be used to determine data weights and the square root of the product of P_{dif}/T_{cal} for the two antennas may be used to correct cross-power into visibilities.

The SY tables have become available in the past six months and a variety of tools have been extended to manipulate, edit, and apply them. SNPLT may be used to plot all possible combinations of the SY table parameters. EDITA may be used to edit *uv* data based on the contents of the SY table, while SNEDT may be used to edit the contents of the SY table itself. TYSMO may be used to clip, median-window filter, and smooth the SY table. The flag (FG) table is now applied to the SY table by all three of these tasks as they first read it in. Finally, TYAPL may be used to scale the data visibilities by the appropriate gains determined from the SY and CD tables and to scale the weights by the system temperatures. Due to a number of problems such as incorrect P_{dif} from a couple of antennas, this calibration has yet to become the standard. But it will soon be the best way to calibrate EVLA data.

Task REWAY is a relatively new task designed to determine data weights by examination of the rms in the data. During the last six months, it was given new methods to find the rms using medians. It was also changed to use the weights in the incoming data and attempt to determine output weights as a scale change from the incoming weights. There is some question whether this works as one would like. A header keyword (CROSSPOW) is now written by REWAY and TYAPL to allow later calibration routines to apply the gains to the weights as well as the visibilities. If CROSSPOW is not true, EVLA data weights are not changed by any gain application.

Spectral polarization calibration

AIPS has traditionally assumed that instrumental polarization was at worst a function of IF and stored the parameters of that calibration in the antenna (AN) table. With the very wide bandwidth of the EVLA, the polarizers cannot be as pure (so far) as they were with the VLA. Therefore, it was necessary to change PCAL to offer the option of making its solutions as a function of spectral channel with a smoothing option offered to improve signal to noise. This caused a lot of changes including a major bug fix: the task no longer insists on fitting a source model when using an input model. This will allow solutions from a single scan when the source polarization is known (such as 0). Source spectral index becomes significant when doing the spectral mode solution and adverbs were added to guide the task.

As PCAL finishes, it writes its solutions in a polarization D-term (PD) table and, if it has fit for a source model, the calibrator polarization (CP) table. Later tasks, with DOPOL = 1, will use the PD table if it is present and the antenna table D-terms if it is not. Adverb PDVER controls which PD table is used.

RLDIF was then revised to determine the right minus left phase difference as a function of spectral channel. It applies these corrections to the BP, PD, and CP tables for spectral solutions and to the CL, AN, and SU tables for continuum mode solutions. Note that CLCOR is no longer required although one may defer the CL correction if one wishes to be cautious and use CLCOR later. Although this should be sufficient, it has been found that an additional execution of PCAL after RLDIF results in better solutions. We will look for the bug causing this problem, if it is indeed a bug, but have not done so yet.

EVLA-driven changes

CALIB was changed to offer a number of gain normalization options. Previously, the average gain was found over all antennas, IFs, and polarizations. Alternatives, that normalize differently by polarization and/or IF are now offered.

SOUSP is a new task to determine spectral index parameters by fitting the fluxes after GETJY in the source table.

BPASS acquired more spectral-index adverbs to allow curvature as well as simple spectral index. Furthermore, it knows the correct values for the standard sources 3C48, 3C138, 3C147, and 3C286.

SETJY now has adverbs SPECINDX and SPECURVE to supplement ZEROSP with spectral index information.

TRUEP is a new task to determine the true instrumental polarization from data taken with the horns in their normal position and with the horns on one antenna rotated by 90 degrees. This is primarily for Rick Perley.

UVLOD and FITLD will now rename sources if needed to keep two sources with the same name, QUAL, and CALCODE from appearing in the output.

NOIFS is a new task that converts a multi-IF spectral data set into a single IF data set with many more channels per IF. Overlapped channels are averaged.

SPLIT and SPLAT got rather confused when sources in the source table had the same name and qualifier. Added testing on the CALCODE to insure proper separation. Also added code to watch for the output name ending up with duplicates since it can only use the first 12 characters of the source name and did not previously use the qualifier or the CALCODE.

VBGLU now handles SY, CD, PD and CP tables correctly; they all have IF-dependent columns.

FRING and RLDLY now have the option to combine IFs 1 through $N_{IF}/2$ in one solution and IFs $N_{IF}/2 + 1$ through N_{IF} in a second solution. The EVLA AC and BD basebands (real IFs), separate in this fashion in the *AIPS* "IFs" which are really sub-bands (spectral windows). All AC IFs should have the same delay and all BD IFs should have a different delay.

Other changes

- Delay** correction used a method which could result in lobe ambiguities for very large delays or bandwidths. A simpler and more accurate method has been implemented.
- REAMP** was changed to use a large adverb array (PBSIZE) to allow up to 64 subarrays or 64 IFs to be scaled separately under control of OPTYPE.
- CLIP** and **FLGIT** now have options to flag $\pm n$ channels surrounding an obviously offending spectral channel.
- DOPOL** application was corrected to include all spectral channels needed for the spectral smoothing called for by SMOOTH.
- UVAVG** was changed to offer a number of options to control the times of the averaging intervals and the times reported in the output.
- STOKES** value 'QU' was not previously supported but will now be allowed by the calibration routines and supported in POSSM.

Display

- UVPRT** was changed to avoid reading the data set to determine scaling parameters with control of those parameters given to the user in adverb DPARM. Self-scaling may be requested but it is slow on large data sets.
- POSSM** and **BPLOT** were changed to display spectra of instrumental or source polarization (the PD and CP tables, respectively). `APARM(1) = 0` now gets vector averaging in POSSM.
- SNPLT** was changed to display all of the parameters of the EVLA SysPower (SY) table.
- TVHELIX** is a new interactive TV pseudo-coloring verb that implements a scheme due to Dave Green (MRAO). The color and intensity changes in a helical fashion intended to make perceived brightness be monotonically increasing.
- FGPLT** was overhauled to plot flags on an antenna rather than baseline basis when possible and to work for any number of antennas and IFs.
- TVFLG** and **SPFLG** were changed to offer the option of plotting axis labels for both visibility and intensity wedge data. TVFLG has a new option to do the next spectral channel, then next IF, and finally next polarization.

General and system matters

- FITS** reading tasks were made more forgiving about unexpected format details. In particular, logical variables have appeared in quotes, EQUINOX has about a dozen representations, and multi-dimensional arrays may appear outside the understood *uv*-table usage.
- CookBook** was updated including a new Appendix (E) specifically addressed to EVLA users.
- Y2K** was changed to avoid difficulties with exact agreement between the master and a test image, to examine all four HUGE Clean images, and to report all check results. The master data sets were recomputed using the Linux 64-bit Intel compiler tasks.
- REBYTE** was found to have forgotten about compressed *uv* data sets and so to have swapped the real and imaginary parts of each visibility. REBYTE was fixed to handle compressed data sets and new task SWAPR was written to correct affected output data sets.
- AIPS** startup procedures now check for a `$HOME/.dadevs.always` file which defines data areas to be included regardless of the current host name.

MEDIAN is a subroutine that finds the median of a list of numbers by much faster methods than a full sort of the list. It has replaced the old method wherever possible.

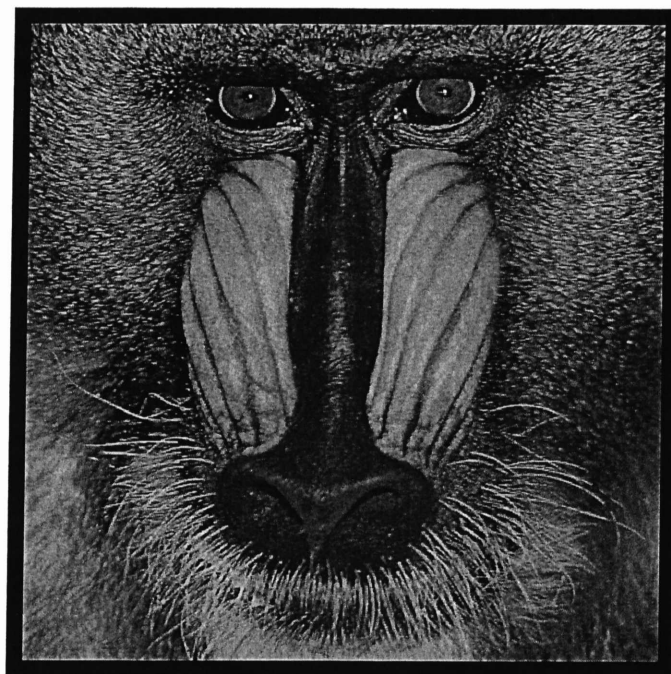
INQSTR is a subroutine to read a string input by the user. It now checks the length of the string actually input by the user against the limit imposed by the calling routine and complains when the user has typed too much.

Patch Distribution for 31DEC09

Because of the extensive use of binary installations, we now patch the master copy of the most recently frozen version. Older versions are not corrected even for egregious errors. Thus, 31DEC09 was patched during 2010 and 31DEC10 will be patched as needed during 2011. Your copy of them may be corrected simply by running a Midnight Job. Information about patches and the code may be found using links from the main *ATPS* web page or by *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. Patches to older releases are kept here as well, but they will require local compilation.

The 31DEC09 release is no longer available for installation and will no longer receive patches even for egregious errors. It had a number of important patches during 2010. They are

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 after the first for single-source files having an index (NX) table *2010-03-01*
7. UVFLG failed to flag shadowed antennas correctly *2010-03-05 and 2010-06-23*
8. FITLD issued alarming but harmless messages about reference date with EVN FITS-IDI data files. *2010-03-05*
9. UVCON did not produce correct models from images *2010-03-17*
10. SPLIT and SPLAT corrected the alternate reference pixel for BCHAN twice *2010-03-17*
11. CVEL shifted VLBA antennas wrongly, using the antenna location rather than the center of the Earth *2010-04-05*
12. INDXR when making a new CL table 1 for VLA data made mistakes likely to affect P, KA, and Q bands *2010-04-08*
13. BPASS aborted when trying to shift VLBA bandpasses *2010-04-21*
14. DBCON excited errors in the AN file reformatting *2010-07-09*
15. UVCOP and others failed to copy BP table records that were only partially blanked *2010-07-09*



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AIPSLETTER

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