A I P S L E T T E R

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A newsletter for users of the NRAO
$\mathcal{A}$stronomical $\mathcal{I}$mage $\mathcal{P}$rocessing $\mathcal{S}$ystem

Written by a cast of $\mathcal{AIPS}$

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Happy 45$^{\text{th}}$ birthday $\mathcal{AIPS}$ and FITS

The FITS format was devised in a meeting at the VLA site on March 27 and 28, 1979. Don Wells (then of NOAO) and Eric Greisen (still of the NRAO) were the primary authors while Barry Clark and other NRAO staff members provided valuable suggestions. The FITS format, enhanced by later extensions, is still in wide spread use in astronomy and is the envy of other scientific fields. The FITS format then colored the design of the $\mathcal{AIPS}$ internal formats. The $\mathcal{AIPS}$ project was begun officially on July 1, 1979 and has stood the test of time remarkably well.

Your editor does find times when he would like interesting things to do. If you find any problems with $\mathcal{AIPS}$ or have any suggestions for new or improved functions, please do not hesitate to e-mail daip@nrao.edu.

$\mathcal{AIPSL}$*etter* publication

We have discontinued paper copies of the $\mathcal{AIPSL}$*etter* entirely. The $\mathcal{AIPSL}$*etter* will be available in PostScript and pdf forms as always from the web site listed above. New issues will be announced in the NRAO eNews mailing and on the bananas and MNJ list server. Readers are encouraged to subscribe to one of these low volume mail lists at https://listmgr.nrao.edu/mailman/listinfo.

Current and future releases

We have formal $\mathcal{AIPS}$ releases on an annual basis. While all architectures can do a full installation from the source files, Linux (64-bit and for a little while longer 32-bit), and MacIntosh OS/X (Intel and ARM) systems may install binary versions of recent releases. The last, now actually "frozen" (was "slushy") release is called 31DEC23 while 31DEC24 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 $\mathcal{AIPSL}$*etter* is intended to advise you of improvements to date in 31DEC24. Having fetched 31DEC24, 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 $\mathcal{AIPS}$ Manager FAQ page on the $\mathcal{AIPS}$ web site.

The MNJ for binary versions of $\mathcal{AIPS}$ now uses solely the tool rsync as does the initial installation. For locally compiled ("source") installations, the Unix tool cvs running with anonymous ftp was used for the MNJ. That has been replaced with rsync to download any changed text files. The only installations to still use cvs are the five (now four) machines inside the Socorro Array Operations Center. Do not modify $\mathcal{AIPS}$

text files (*e.g.*, Fortran tasks) in the standard locations since `rsync` will over-write them. For local versions, use a copy of the task and its help file in a private disk area instead.

`31DEC20` contains a change to the TV display program `XAS` that makes it incompatible with previous releases when characters are displayed. `31DEC14` contains a change to the "standard" random parameters in *uv* data and adds columns to the `SN` table. Note, however, that the random parameters written to FITS files have not been changed. Older releases of *AIPS* cannot handle the new *internal uv* format and might be confused by the `SN` table as well. You are encouraged to use a relatively recent version of *AIPS*, whilst those with recent VLA data to reduce should get release `31DEC23` or, preferably, the latest development release.

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"End of Life"

The computers and/or the operating system versions that we have been using to prepare the binary release of *AIPS* are nearing what is called the "end of life." These are as follows:

LINUX The `LINUX` architecture has been maintained by a venerable machine called dave which actually reached end of life in 2015. The most modern operating system that it can run is RedHat 5! In fact, dave was the main *AIPS* computer until May 2022 holding the source code for all versions on disks that were not backed up. The *AIPS* system was moved to the file server at the Array Operations Center ("filehost") where it is now backed up on multiple time intervals. But dave has still been used to compute the 32-bit Linux load modules using an Intel fortran version 9.1.043. On June 21, 2024, due to management decree, dave was turned off. We are aware of only one computer still using this architecture and it is capable of running the 64-bit version. The `LINUX` binaries for `31DEC24` and earlier releases will now remain frozen. There will not be a `LINUX` binary for the `31DEC25` release.

LNX64 The `LNX64` architecture has been maintained by a variety of computers running the RedHat 7 operating system. That OS has reached "end of life" at the end of June 2024. The NRAO is systematically updating all RedHat desktop systems to RedHat 8. We have therefore recompiled everything for RedHat 8. It was already known that RedHat 8 produces a fully usable binary *AIPS* version and that Ubuntu systems are happier with that version. Ubuntu only needs one run-time library with RedHat 8 rather than quite a number with RedHat 7. `31DEC23` will remain frozen at RedHat 7 when this conversion occurs; no more "patches" will be applied.

MACINT The `MACINT` architecture has been maintained by a Mac mini with an Intel cpu named gala-new. The gfortran is at version 6.3.0. This computer has been declared "end of life" since the operating system cannot be upgraded past 12.6.4 and since it is labeled as "late 2014." We will continue to use gala-new to produce Intel-based binaries until it has a hardware failure (or until management decrees that it must go). Mac users should consider acquiring a more modern ARM computer. That chip set is very fast.

MACARM The `MACARM` architecture is maintained by a Mac mini with an M1 cpu named gala that is dated 2020. It currently runs the 13.6.3 version of the operating system and gfortran 12.2.0. The OS will need to be updated to a 14.*x* version in the not too distant future. Previous experience with such "upgrades" suggests that *AIPS* will need to be entirely recompiled with an updated version of gfortran. Other issues may arise, such as those related to `$DISPLAY`.

`31DEC23` **is now frozen and no more patches will be made. There has already been a bug corrected and an enhancement to TEC data handling that would have been made patches if that were still possible. Users are encouraged to get the** `31DEC24` **release in order to remain current with corrections and improvements to the software.**

Improvements of interest in 31DEC24

We expect to continue publishing the *AIPSLetter* approximately every six months, but the publication is now primarily electronic. There is one new task, one new verb and one new RUN procedure in 31DEC24. These are, respectively, VH2RL to convert a data set between linear and circular polarization bases, STARTTV to restart the TV, message, and Tektronix servers, and CALMODEL to compute a model data set to be used with a new option in CALIB. The automatic download of total electron content data files has received significant improvement and will not work in versions older than 31DEC22. A subtle but important change was made to FITLD which suggests that VLBA observers will need at least 31DEC23 if not 31DEC24. Numerous bug fixes and minor improvements have also been made.

Polarization

Like previous years, the study of polarization calibration has occupied a lot of attention. Given our difficulties with calibrating linear polarization data, we investigated turning data in a linear basis into a circular basis. *AIPS* Memo 125 (also EVLA Memo 229) is a detailed report on our findings. VH2RL is the new task that converts data from linear to circular or circular to linear. The Memo explains the use and limitations of this task.

PCAL's solution for linear polarization was rewritten to use correct formulæ and the application of the resulting D terms was greatly simplified. The previous code in PCAL and in its application does not make sense. A new solution type V-H LIN was created to implement this change. The old, mysterious code remains but should not be invoked. Studies with simulated data indicated that the new code gets approximate solutions that are not quite correct despite the use of correct formulæ. When the simulated data are converted to a circular basis with VH2RL, PCAL gets answers that are correct.

Task RLDIF was enhanced with a table of position angles for 3C286 in the frequency range 0.561 to 1.071 GHz. These values were derived by Rick Perley and Ben Hugo from extensive observations with MeerKAT. To allow for better calibration source models, the adverb ROTMEAS was added to RLDIF. The PP file, which records the polarization phase difference spectrum, was given an additional parameter to record the polarization used in constructing the file. The polarization is checked when applying the file and is displayed by POSSM.

The names of the total electron content data files have changed, but the date at which the change occurred was different for different data sources. Lilia Tremou was instrumental in tracking down the multiple changes for us. Then the auto-download procedures VLBATECR (in VLBAUTIL) and VLATECR (in VLAPROCS) were changed to use a special procedure to control when the name format is changed. The name format also includes a code for the time interval in the data file, which is 30 minutes in one case (TECRTYPE='CAS'), one hour in several cases, and two hours in the rest. The procedures know which is normal for a given TECRTYPE, but if one interval fails they will try the other.

The default magnetic field model was changed to the modern, time-varying IGRF model in TECOR. That task now records the TT extension file version in the history. Task MFIMG was given an adverb to let the user warn the task about the number of times in the TEC data file being imaged.

Analysis and display

POSSM again received considerable attention in this period. The x axis labeling was not exactly correct, which was made obvious with a data set with only 8 channels. SOLINT must be forced to zero for BD tables. There were significant errors when plotting multiple plots per page when there was more than one column of plots. Changed it to omit the IF number line in all but the last row of multiple plots per page. When BCHAN was greater than 1 and/or ECHAN less than the max, there were issues with how those data were plotted. When the IFs have separator lines, then only BCHAN to ECHAN are plotted in each sub panel. When there are no separator lines, all channels are plotted with those less than BCHAN and greater than ECHAN in each IF blanked. The computation of mean and rms in each plot panel was changed to double precision since single precision erroneously found rms of zero in some cases.

The graphics planes of the TV display is are sometimes used to compare two or more versions of some parameter. If one is plotted in graphics channel one (yellow), the second in graphics channel two (green), then pixels at which the values are the same show as a complementary color (red in this case). An option to specify the graphics channel to use for labeling separate from the channel used for the rest of the plot has been added generally. If `GRCHAN` $= 10 * x + y$, channel x will be used for labeling and y for the rest. If $y = 0$, some tasks us graphics channel 1 and others use multiple graphics channels. If $x = 0$, x is set to y.

PLOTR was given the option of adding the fit parameters to the plot.

XAS was changed to re-order the processes in the close down routine. On Macs, the shut down of certain X Windows functions caused the program to stop without performing the operations that deleted link files and stopped the TV server dæmon process. As a consequence, they proliferated.

STARTTV is a new verb that will recreate any of the servers that may have disappeared. This include the `XAS` TV display with connecting TV server, the message server, and the "Tektronix" server.

IMEAN, `IMSTAT`, and `TVSTAT` were given an option to tell them to include pure zero pixels in their computations of mean and rms.

MARSP was given the option to read Q and U images as an alternative to total polarization and position angle images. An option to compute and display a histogram of the deviations of the position angles from radial was added as well as an outer radius parameter.

UV data

`CALIB` was given the option to use a matching data set as a model. One usage of this option would be if the same model were to be used for different parameters in `CALIB`. For example, a phase-only solution with a short `SOLINT` followed by amplitude and phase on a longer `SOLINT` where the calibration source remains the same and requires a model. A new `RUN` file and procedure `CALMODEL` were created to simplify creating the model data set.

Application of delay corrections to EVLA data was corrected. A mis-alignment correction (`FXSEG`) needed for the VLBA is not correct for the EVLA and introduced baseline-dependent offsets.

SPFLG was corrected for an error that made the `CLIP` options hard to reach.

FITLD was changed to allow more than one pulse-cal table and to read data from rPICARD despite a FITS-format error.

VBRFI, `VLBRF`, and `PLRFI` were changed to handle lower frequencies, to understand magic blanks properly, to allow study of RFI in the cross-hand polarizations, and to plot multiple plots per page.

General

Some effort has been expended in removing historic anachronisms from *AIPS*. The `NETSP` file is still used but the message complaining about disk areas not listed therein has been suppressed. The `START_AIPS` script was changed to omit the starting of the `TPMON` servers since magnetic tapes are now rarely used and the usage of remote disk-file reading with `TPMON` was always unknown. Similarly, the internet connection to the `XAS` display server is probably never used to let more than one computer talk to one display window. Therefore, `START_AIPS` was changed to, by default, use the option "`tv=local:0`". To avoid the proliferation of server windows, when exiting `AIPS` users should employ `KLEENEX` rather than simply `EXIT`.

OBITVERS default was changed to 3 as Python 2 is on the way out.

install.pl had a bug which caused `MACARM` computers to use architecture `MACINT`. The data source for rsync will now be `rsync.aoc.nrao.edu` rather than `ftp.aoc.nrao.edu` although they are the same at present. That will change in the not too distant future.

Process ID numbers are now rather longer than 5 digits on RedHat 8 and other systems. Recognizing active tasks required correction to handle this.

AIPS compilation procedures treated a file name containing the @ symbol as a list of files to compile and link. This was changed to two at (@@) symbols to avoid conflict with account names containing an @ symbol.

CookBook and other documentation files were updated in March and June fairly generally. The typesetting of *CookBook* Chapter 13 was changed so that the automatic formatting of the chapter in the html and pdf versions would work with the linking to the actual help files.

Extension files were removed from image and *uv* data set headers without actually being deleted from the disk on error completion or even on normal completion in a couple cases. This then leaves "orphan" files which may cause later failures. Tasks `ACCOR`, `ACSCL`, `PRTSY`, `SYPRT`, `RLDIF`, `VHDIF`, `ISPEC`, `RSPEC`, `FRMAP`, `GAL`, and `PLOTC` were corrected but only in `31DEC24`.

Recent Memoranda

All *AIPS* Memoranda are available from the *AIPS* home page. Memo 125 is a new memo to describe the conversion of linear to circular visibility data. It also appeared as EVLA Memo 229. Further adventures with VLA P-band polarimetry are described in EVLA Memo 230.

125 Post-Correlation Basis Conversion in *AIPS*
Rick Perley and Eric W. Greisen, NRAO
April 16, 2024
Calibration and imaging of interferometric visibility data are much simpler when the receiver systems are designed to provide output voltages proportional to the circular components of the electric field. On the other hand, the antenna performance (sensitivity, and polarization purity over wide bandwidths) is much better for data taken with linear-basis receivers. In this memo, we describe how post-correlation visibility data can be converted from its original linear basis to a circular basis. Doing so enables better calibration and imaging while maximizing sensitivity and polarization purity. Examples are given using VLA and MeerKAT data.

230 Polarimetry with the VLA's P-band
Rick Perley and Eric W. Greisen, NRAO
May 2, 2024
We continue our development of low-frequency polarimetry by investigating the accuracy of the ionospheric Faraday rotation corrections provided by the *AIPS* program `TECOR`. By observing polarized sources through dawn and dusk, we conclude these corrections successfully remove the IFRM with an accuracy of $\approx 0.1\mathrm{rad/m}^2$. Subsequent polarimetric imaging of the Moon reveals an unexpected, and unexplained residual rotation measure of $\approx -0.75\mathrm{rad/m}^2$. This residual is seen in all six of our observations, with values ranging from -0.6 to $-0.9\mathrm{rad/m}^2$. A similar offset is seen in observations of DA240 and 3C345, when comparing to WSRT observations. Presuming this offset is not associated with the sources in our observations, we have removed it by utilizing the values determined from the lunar observations, allowing the intrinsic source RMs and EVPAs for DA240, 3C303, and 3C345 to be determined.

Patch Distribution for 31DEC23

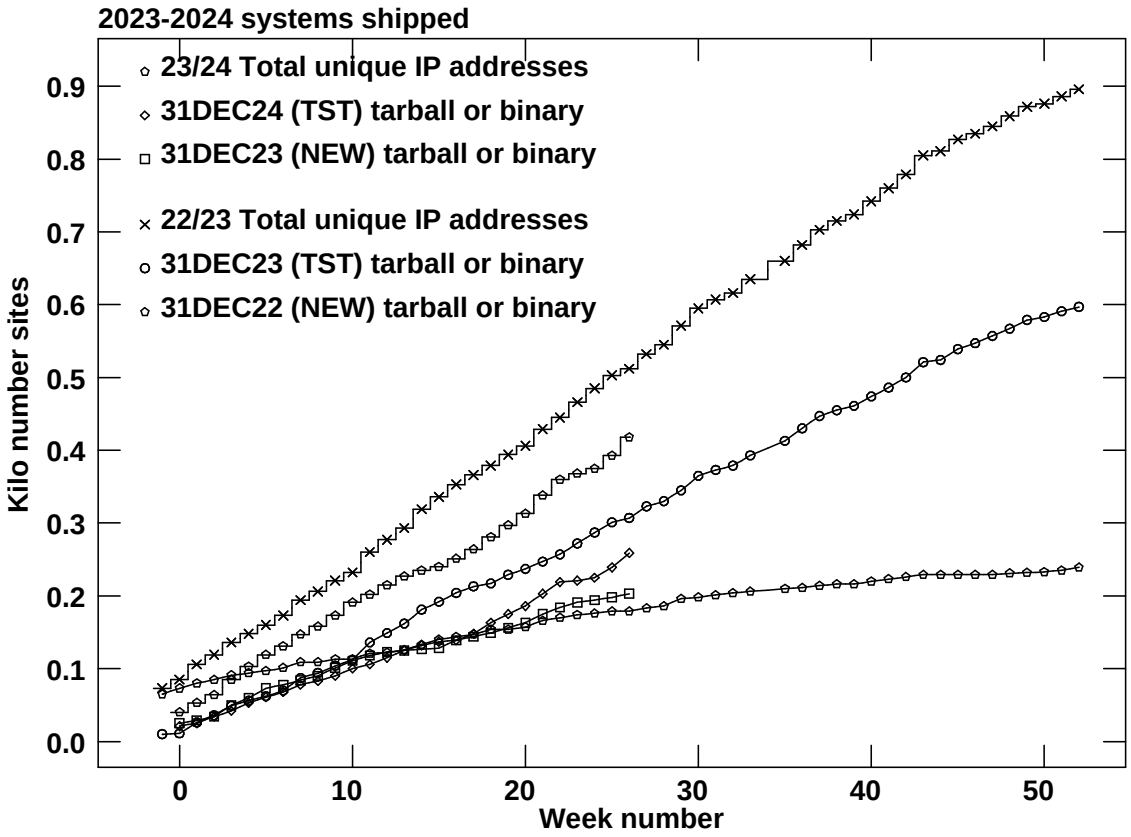
Normally, this section lists the patches that have been released for 31DEC23. This was based on the assumption that users would want to download individual files to compile them locally. However, the "Midnight Job" (`$HOME/do_daily.`*hostname*) will do this for you on locally-compiled installations. It will also do a proper update for binary installations. Therefore there is no reason to continue the old procedure. Major bug corrections will be moved to 31DEC23 as they occur and users should use the MNJ on occasion on both the NEW and TST versions of *AIPS*. The 31DEC23 release has had a number of these "patches":

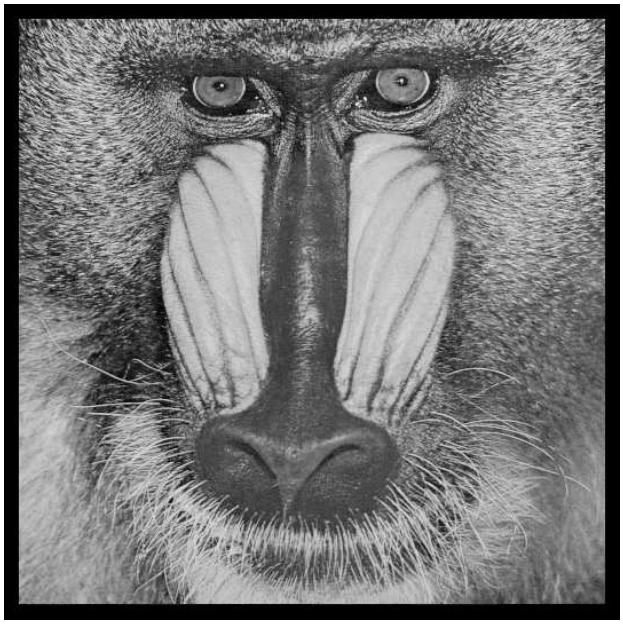
Because of the "end of life" matters discussed previously, no more patches will be made to 31DEC23. Usrs are encouraged to acquire 31DEC24.

1. VBRFI, VLBRF, PLRFI needed another digit for P-band and needed corrections in plot scaling. *2024-01-11*
2. Unlike IMHEAD, IM*x*HEAD verbs did not display keyword values. *2024-01-18*
3. VLBAUTIL.001 and VLAPROCS.001 needed a better if statement to set the downloaded file name for TECR. *2024-01-26*
4. Amplitude calibration for delay errors applied a correction to EVLA data that is only appropriate for VLBA data. *2024-02-22*
5. POSSM needed to set SOLINT to 0 for BD tables. *2024-02-27*
6. POSSM plotted the X axis incorrectly. *2024-03-11*
7. XAS.SHR changed to reorder the close down operations. Macs do not finish the routine when X windows are closed. *2024-05-15*
8. install.pl misidentified the MACARM architecture as MACINT. *2024-05-15*
9. The rsync host will be renamed to rsync.aoc.nrao.edu; changed UPDCONFIG and install.pl. *2024-05-29*
10. POSSM had problems plotting CP tables and other minor issues. *2024-06-04*
11. FITLD had trouble with rPICARD files (which do not exactly match the FITS standard but are usable) and forced there to be only one PC table version. *2024-06-04*
12. SUBIM did not set TRC properly when the axis increment was more than one. *2024-06-10*
13. install.pl needed to change ftp.aoc to rsync.aoc in a second place. *2024-06-10*
14. Changed fetching of TEC files to account for the different dates at which the file names changed format. *2024-06-13*
15. UVFIT had errors in the number of adverbs and the usage of the Clean Component output file. *2024-06-17*
16. SPFLG clip menu items were not addressed properly. *2024-06-18*

AIPS Distribution

We log apparent MNJ accesses and downloads of the tar balls and binary installations. 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*. So far in 2024 more than 203 IP addresses have downloaded the now frozen form of `31DEC23`, while more than 259 IP addresses have downloaded `31DEC24`. A total of 418 different IP addresses have appeared in one of our transaction log files. These numbers are about the same for `NEW` and, for `TST`, rather less than those of last year at this time.





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General developments in *AIPS*

AIPSLetter publication

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Current and future releases

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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 (Intel *and* ARM chips), and Linux (64-bit) systems, but all architectures can do a full installation from the source files. There are no longer binary versions available for 32-bit Linux, Solaris, and Mac PPC chip architectures. If you develop *AIPS* code locally *or have system managers that forbid the use of* `rsync`, you will need to do a source-level installation. The current release is called `31DEC24` 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 2025 to convert your copy of `31DEC24` into the frozen version. However, when patches to `31DEC24` are announced in 2025, you may apply them with the MNJ. This *AIPSLetter* is intended to advise you of corrections and improvements in this release.

We have begun a new version, called `31DEC25`, 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 `31DEC25`, you may update your installation whenever you want by running the MNJ. This uses `rsync` to copy all changed text files and then to copy the binary files or to 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 `31DEC25` *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 186-Mbyte `31DEC25.tar.gz` compressed tar file.

If compiling locally, new releases must be installed from the tar ball for that release. 31DEC22 and later versions contain improvements to the code which should make local compilation more reliable. If using the binary installation, a full new installation must also be done with rsync. When installing a new $\mathcal{AIPS}$ 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 verified. 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. If you have made a special version of do_daily.*host*, you should preserve it under a new name and restore it after the install. If you have an odd set of $\mathcal{AIPS}$ versions, the $AIPS_ROOT/AIPSPATH.*SH files may need to be edited after the install to set the desired versions. The file $SYSLOCAL/UPDCONFIG also needs to be edited to correct your e-mail address(es). A new installation will not change your current $\mathcal{AIPS}$ data files.

31DEC15 contains a change in the headers of *uv* data sets which will not be understood by previous versions. 31DEC20 contains a change to the XAS TV server which will cause problems with older versions. Note that the only version which we will patch for major errors is 31DEC24; even 31DEC23 will no longer be changed.

Improvements of interest to users in 31DEC24

In the latter half of 2024, five new tasks appeared. The tasks are UNSPX to correct an image cube for spectral index, TVSPX to compute spectral index interactively from an image cube, QBEAM to compute and plot beam images from holography data, ALBUS to fit ionospheric Faraday rotation and dispersive delay, and RIFRM to convert ALBUS text output to values in a CL table. New verbs SGUGET, TGUINDEX, and SGUINDEX also appeared to assist in moving task parameters and $\mathcal{POPS}$ environments between users. In the first six months, there was one new task, one new verb and one new RUN procedure in 31DEC24. These are, respectively, VH2RL to convert a data set between linear and circular polarization basis, STARTTV to restart the TV, message, and Tektronix servers, and CALMODEL to compute a model data set to be used with a new option in CALIB.

Normally, bugs which appear in an $\mathcal{AIPS}$ TST version and then are fixed in that same version before its release get little or no discussion in the $\mathcal{AIPSL}$*etter*. Since a rather large number of sites now install the TST version of $\mathcal{AIPS}$ during its development, not describing temporary bugs in TST is somewhat of an oversight. We urge you to run the "Midnight Job" at least once after 31DEC24 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 $\mathcal{AIPS}$ documentation web page (http://www.aips.nrao.edu/aipsdoc.html). Please do not hesitate to contact us via the NRAO science user help desk (https://help.nrao.edu) or via e-mail daip@nrao.edu with any questions or suspicions that there are problems.

System matters

Due to the "end of life" for RedHat 7, we chose to freeze 31DEC23 completely in June 2024. In this way, the binary version for LNX64 could remain as produced by RedHat 7. 31DEC24 for 64-bit Linux was then re-compiled with RedHat 8, producing a binary version incompatible with the older operating system. At the same time, we discontinued any development of the 32-bit Linux binary version. That version is available in binary form but only up to June 20, 2024. 31DEC25 will not contain a binary version for 32-bit Linux. Old Linux systems left behind by these actions should note that it is relatively easy to compile all of $\mathcal{AIPS}$ on whatever machine you may have. Versions of gfortran at least 4.8, but better 6 or more, are required. The latest gfortran versions should also work.

The MACARM binary version of 31DEC24 is computed on a machine that was upgraded to "Sonoma" (OS version 14.6.1) with a gfortran upgraded to version 12.2. The load modules should work on any system at 13.0 or greater. The 31DEC23 version was frozen at the previous operating system level. The MACINT binary version continues to be developed, but if the computer used to produce it dies, our support for that binary version will halt. Again, you should note that compiling $\mathcal{AIPS}$ locally should go right on working.

LNX64 now requires two "containers" to support the new task ALBUS (see below). They should be copied by rsync either by install.pl or in the MNJ even for text (locally-compiled) installations.

Ionospheric calibration

Studies of linear polarization of the Moon at low frequency on the VLA have shown that *AIPS* task TECOR removes the time-dependent Faraday rotation quite well but, in general, over corrects those data by an amount that is nearly constant with time and source on any given day, but which changes some with date. The previous default TEC file named jplg was found always to produce the greatest over-correction. Therefore, the default TECRTYPE was changed to emrg which produces a smaller over-correction normally.

An alternative regional model is provided by the program ALBUS (Advanced Long Baseline User Software), developed by James Anderson initially at New Mexico Tech and then at Lofar in Europe. Originally intended to enable phase corrections for VLBI observations, the program has been modified to enable IFRM estimates. ALBUS derives a local estimate of the IFRM using the GNSS timing data from ground stations within a few hundred kilometers of a specified location, and a realistic distribution of electron density with height. This software is now supported and made publicly available by Tony Willis of the Dominion Radio Astrophysical Observatory. With his help, Evangelia Tremou of the NRAO converted the code into a "container" which may be used by *AIPS*. A new task, also called ALBUS, was written to invoke the container with parameters suitable to the date, sources, and antennas found in an *AIPS* data set. The task waits for the container to finish and then converts the text-file report(s) into entries in a CL table for Faraday rotation and dispersive delay. After much study, it was found that ALBUS produced almost perfect answers for most of the Moon data sets and better answers than TECOR always. See EVLA Memo 235 for details.

Sadly, the implementation of ALBUS breaks some rules used in designing *AIPS*. It requires that the user install an outside program called apptainer which is readily available for Linux. However, it does not work in any reasonable way on Macs. The *AIPS* task writes two text files, a python script and a shell script to execute the python using the container. There are two containers shipped with *AIPS*, a recent version and an older version of the ALBUS control scripts. The latter uses different web sites and tends to find rather fewer data sources. Surprisingly, the version with fewer data sources often is slightly superior to the more recent one. Whether this applies generally or only to our particular VLA data sets is not known.

A column giving the dispersive delay was added to the TE table format. This delay is negligible for compact arrays such as the VLA and MeerKAT, but is quite significant in VLBI data. An OPTYPE = 'DIFF' was added to TEPLT so that ionospheric solutions from different sources may be compared.

Verbs and documentation

The relatively new verb TUGET allows a user to do a TGET from a different user number. It was enhanced to use INDISK to refer to that user's disk number one (where the TG files are stored). Three new verbs were created to extend this capability. SGUGET allows a user to GET a *POPS* environment from a different user number. TGUINDEX and SGUINDEX allow the user to see what tasks and files are available to TUGET and SGUGET. Current *AIPS* usage normally involves a single human being on a computer, but with multiple projects run under different user numbers. These new verbs allow work done under one user number to benefit the projects being done under different user numbers.

The new verb STARTTV was given a synonym TVRESTOR to restart the TV, Tek, and message servers without exiting the AIPS program. The GETITIME verb, which attempts to determine the integration time in a *uv* data set, was enhanced to examine a user selected portion of the data set to insure that the INTTIME random parameter is constant. If that parameter is not present in the data set, the verb looks at the increments in time of the data samples and returns its best guess but other possibilities are displayed in messages.

The verbs INP, INPUTS, and QINP did not display adverbs which are solely used as outputs from verbs and tasks. The user was expected to use the verb OUTPUTS to examine such adverbs. But that assumed that the user knew that there were output adverbs and knew about using OUTPUTS. The inputs verbs were changed to display output adverbs as well and the inputs sections of all affected verbs and tasks were changed to mark the output adverbs clearly.

The verb PRTHI has the ability to limit its display to those lines starting with a user-specified character string, usually the verb or task name. The adverb KEYSTRNG was added to limit the display to any line containing that string. Either or both may be applied. The verb was also changed to request the display to occur in backwards order, thus displaying the most recent history first. If PRTASK is not specified, the display is done strictly in inverse order. If it is specified, each group of history records from that task is displayed in order starting with the most recent group and working backwards.

When minimum match fails, *e.g.*, HELP T , the AIPS program prints a list of the possible completions. That display, which was limited to 64 values, is now limited to 256 which should never be reached.

The *CookBook* was systematically updated in March, June, October, and late November. The shopping lists in Chapter 13 were corrected in March and April so that they would display properly in the web-capable pdf and jpg versions of the *CookBook*. The TAB completion, APROPO, and ABOUT text files were updated at the same time. The help files for adverbs contain lists of the verbs, procedures, and tasks which use them. These were also updated regularly.

UV data

BPASS and CPASS were changed to drop DOBAND and BPVER. Bandpass tables are not cumulative, making this option erroneous.

ANTAB was changed to allow much larger input data files.

FITLD was changed to honor the SOURCES adverb when writing PC and TY tables. Having "unknown" sources in these tables confused later tasks.

CVEL was changed to have the correct number of columns in the SU table.

UVHOL was changed to plot scans on diagonal tracks as well as vertical and horizontal tracks. The plotting was made forgiving when some samples in a track are flagged.

PBEAM was given an additional display of the beam major and minor axes.

QBEAM is a new task to compute images from holography data and plot and/or save them like PBEAM but without the model fitting. This would be most useful with data in Stokes Q, U, and V.

Pulse-cal routines for the many pulse data sets were changed to display the antenna number where appropriate.

Imaging and Display

There are two new tasks for processing spectral-index cubes. TVSPX is similar to SPIXR in that it fits a spectral index to each pixel in an image cube. It then displays images of the spectral parameters and offers options to revisit pixels that appear incorrect. The user may flag data channels at the selected pixels to see if a better fit can be obtained with the remaining points. The second new task, UNSPX takes the output of TVSPX or SPIXR and applies it to an image cube to remove the spectral index. The initial use of this task was to remove the Stokes I spectral index from the Stokes Q and U cubes in order to study the changes in polarization with frequency.

Plot files in *AIPS* are a non-standard data structure that cannot be represented as a standard table. There are in fact 19 record types of a variety of lengths including data-dependent lengths. As a result, FITS files written by *AIPS* have omitted plot files, causing them to be lost when data are backed up. FITTP and FITAB have been changed to offer the option of saving plot files within the output FITS files. The format that is used for simplicity is a literal copy of each 1 kilo-byte file record as if it contained 256 integers. FITLD, UVLOD, and IMLOD were then changed to read this "table" back in reproducing the plot file.

SETFC was given the REFREQ adverb to specify the reference frequency used to recommend CELLSIZE and IMSIZE. The new default is the highest frequency, replacing the header frequency used previously.

DFTPL was given an `OUTTEXT` option and multi-Stokes capabilities `'HALF'`, `'IQU'`, and `'FPA'` where the last is `'IQU'` converted to fractional polarization, total polarization, and polarization angle.

MARSP was enhanced with the `PIXRANGE` adverb, control over the number of boxes, and removal of the 90 degree offset options.

LEVS displays on contour images were improved and problems with negative `ZINC` in `KNTR` were corrected.

POSSM was changed to not plot `PP` table error bars by default and the handling of the stop time was corrected.

TVCPS was given an `RGBCOLOR` adverb to set the color to be used instead of pure 0 (black) in the background.

Recent Memoranda

All *AIPS* Memoranda are available from the *AIPS* home page. Memo 123 was revised to add further descriptions of the multiple pulse-cal data. Memo 117 was revised to describe the new plot "tables" and to update the descriptions of `SY`. `BD`, `PP`, and `TE` tables. EVLA Memo 235 is of special interest also.

117 ***AIPS* FITS File Format**
Eric W. Greisen, NRAO
November 1, 2024 revision
AIPS has been writing images and *uv* data in FITS-format files for a very long time. While these files have been used widely in the community, there is a perception that a detailed document is still required. This memo is an attempt to meet that perception. *AIPS* FITS files for *uv* are conventions layered upon the standard FITS format to assist in the interchange of data recorded by interferometric telescopes, particularly by radio telescopes such as the VLA and VLBA.

123 **New Pulse-cal Capabilities for VLBI in *AIPS***
Eric W. Greisen, NRAO
December 11, 2024 revision
The DiFX correlator has acquired the capability of measuring and recording large numbers of pulse-cal tones, typically at intervals of 1 MHz through each spectral window. These pulse-cal tones have very high signal-to-noise, but show a roll-off at the edges of each spectral window and usually have one or more single channels which have amplitude and residual phase differing significantly from the average for the spectral window. *AIPS* has acquired the ability to deal with these data including new tasks to display and edit them and to derive calibration from them. This memo was revised in December 2024 to add additional descriptions of typical many-tone `PC` tables.

235 **Testing Ionospheric Faraday Rotation Measure Models**
Rick Perley, Eric Greisen, Lilia Tremou, Bryan Butler, NRAO
Tony Willis, DRAO
October 21, 2024 revision **EVLA Memo Series**
We test the accuracy of ionospheric Faraday rotation measure estimates derived from global models of the vertical total electron content using the *AIPS* task `TECOR`, and from two versions using a regional model derived from ground station data using the `ALBUS` program. We use six VLA P-band lunar observations to make these tests. We find that all models remove the day/night change in Ionospheric Faraday Rotation Measure (IFRM) with an accuracy better than 0.1 rad/m2. However, all global models introduce an offset in the IFRM of 0.5 to 1.0 rad/m2. This offset varies from day to day, and is nearly constant within a given observation. Both of the regionally-derived `ALBUS` IFRM estimates are closer to the actual IFRM than any of the global models. Based on these observations, the `ALBUS` model provides IFRM estimates correct to about 0.2 rad/m2.

Patch Distribution for 31DEC23

Normally, this section lists the patches that have been released for 31DEC23. This was based on the assumption that users would want to download individual files to compile them locally. However, the "Midnight Job" (`$HOME/do_daily.`*hostname*) will do this for you on both locally-compiled and binary installations. Therefore there is no reason to continue the old procedure. Major bug corrections were moved to 31DEC23 as they occur and users should use the MNJ on occasion on both the NEW and TST versions of *AIPS*.

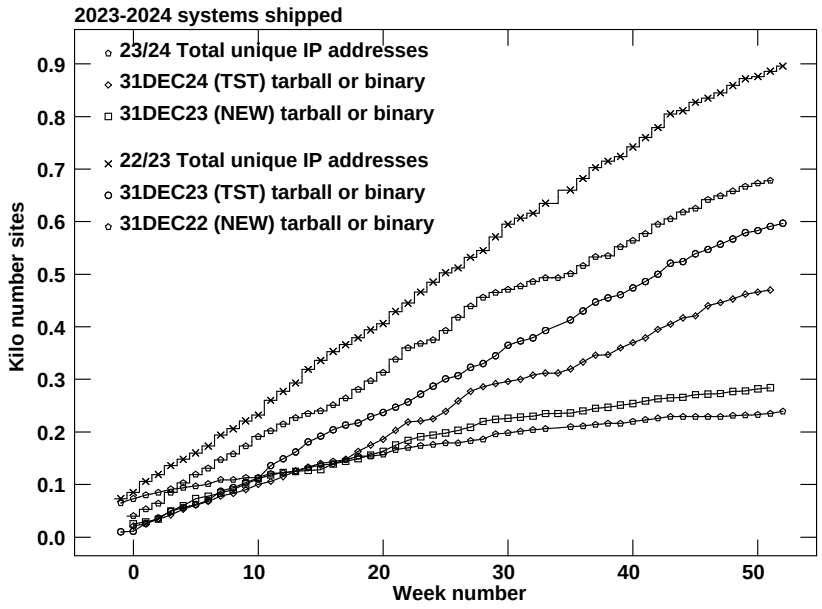
The 31DEC23 release is still available for installation, but is not recommended and will no longer receive patches even for egregious errors. It had a number of important patches during 2024, but, because of the "end of life" issues described above, no patches were made after June 18, 2024. The patches from before then are

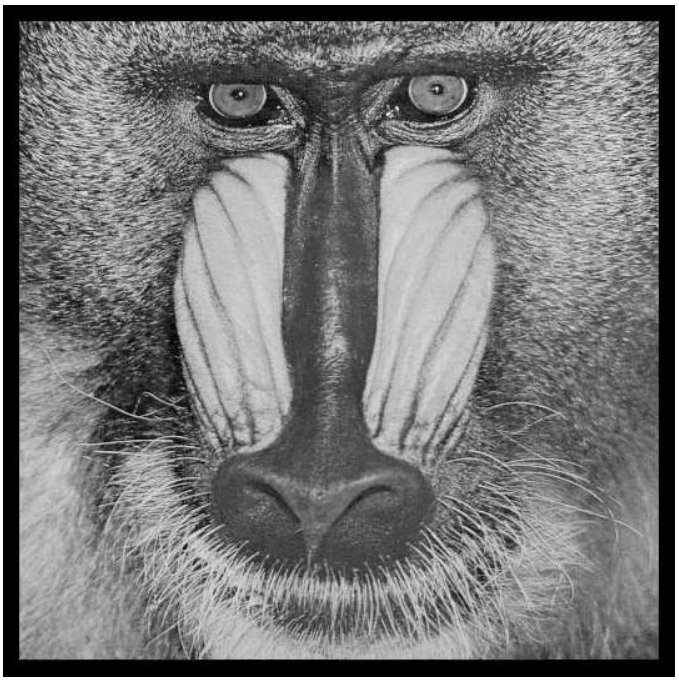
1. VBRFI, VLBRF, PLRFI needed another digit for P-band and needed corrections in plot scaling. *2024-01-11*
2. Unlike IMHEAD, IM*x*HEAD verbs did not display keyword values. *2024-01-18*
3. VLBAUTIL.001 and VLAPROCS.001 needed a better if statement to set the downloaded file name for TECOR. *2024-01-26*
4. Amplitude calibration for delay errors applied a correction to EVLA data that is only appropriate for VLBA data. *2024-02-22*
5. POSSM needed to set SOLINT to 0 for BD tables. *2024-02-27*
6. POSSM plotted the X axis incorrectly. *2024-03-11*
7. XAS.SHR changed to reorder the close down operations. Macs do not finish the routine when X windows are closed. *2024-05-15*
8. install.pl misidentified the MACARM architecture as MACINT. *2024-05-15*
9. The rsync host will be renamed to rsync.aoc.nrao.edu; changed UPDCONFIG and install.pl. *2024-05-29*
10. POSSM had problems plotting CP tables and other minor issues. *2024-06-04*
11. FITLD had trouble with rPICARD files (which do not exactly match the FITS standard but are usable) and forced there to be only one PC table version. *2024-06-04*
12. SUBIM did not set TRC properly when the axis increment was more than one. *2024-06-10*
13. install.pl needed to change ftp.aoc to rsync.aoc in a second place. *2024-06-10*
14. Changed fetching of TEC files to account for the different dates at which the file names changed format. *2024-06-13*
15. UVFIT had errors in the number of adverbs and the usage of the Clean Component output file. *2024-06-17*
16. SPFLG clip menu items were not addressed properly. *2024-06-18*

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 2024, a total of 284 different IP addresses downloaded the frozen form of `31DEC23` and 470 IP addresses downloaded `31DEC24` in tarball or binary form. With the change to the MNJ (rsync only) we are unable even to guess how many sites have run the MNJ. The total number of unique IP addresses in these five lists was 678, only 76 % of last year. The plot of numbers versus time and the table shows that 2024 was slightly ahead of 2023 in the `NEW`, but rather behind in the `TST` numbers.

year	`TST` name	`NEW` name	`TST`	`NEW`	`TST` binary	`NEW` binary	Total unique
2004	`31DEC04`	`31DEC03`	808	196			1276
2005	`31DEC05`	`31DEC04`	832	246	299	48	1460
2006	`31DEC06`	`31DEC05`	806	191	402	94	1398
2007	`31DEC07`	`31DEC06`	965	277	669	161	1811
2008	`31DEC08`	`31DEC07`	1058	246	986	303	2107
2009	`31DEC09`	`31DEC08`	1228	307	1082	478	2399
2010	`31DEC10`	`31DEC09`	1228	307	1203	477	2416
2011	`31DEC11`	`31DEC10`	1105	270	1064	424	2228
2012	`31DEC12`	`31DEC11`	940	284	1028	396	1698
2013	`31DEC13`	`31DEC12`	1014	307	990	443	1937
2014	`31DEC14`	`31DEC13`	1045	333	848	431	1843
2015	`31DEC15`	`31DEC14`	1104	309	1001	350	1817
2016	`31DEC16`	`31DEC15`	878	222	788	372	1330
2017	`31DEC17`	`31DEC16`	874	408	768	386	1383
2018	`31DEC18`	`31DEC17`	684	368	603	343	1099
2019	`31DEC19`	`31DEC18`	754	406	686	388	1155
2020	`31DEC20`	`31DEC19`	796	434	750	470	1230
2021	`31DEC21`	`31DEC20`	659	399	604	376	1215
2022	`31DEC22`	`31DEC21`	590	226	572	221	965
2023	`31DEC23`	`31DEC22`	597	239	596	243	896
2024	`31DEC24`	`31DEC23`	470	284	480	272	678





December 31, 2024

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