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*

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Happy 45$^{\rm th}$ birthday *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 *AIPS* internal formats. The *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 *AIPS* or have any suggestions for new or improved functions, please do not hesitate to e-mail `daip@nrao.edu`.

AIPSLetter publication

We have discontinued paper copies of the *AIPSLetter* entirely. The *AIPSLetter* 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 *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 *AIPSLetter* 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 *AIPS* Manager FAQ page on the *AIPS* web site.

The MNJ for binary versions of *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 *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.

"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

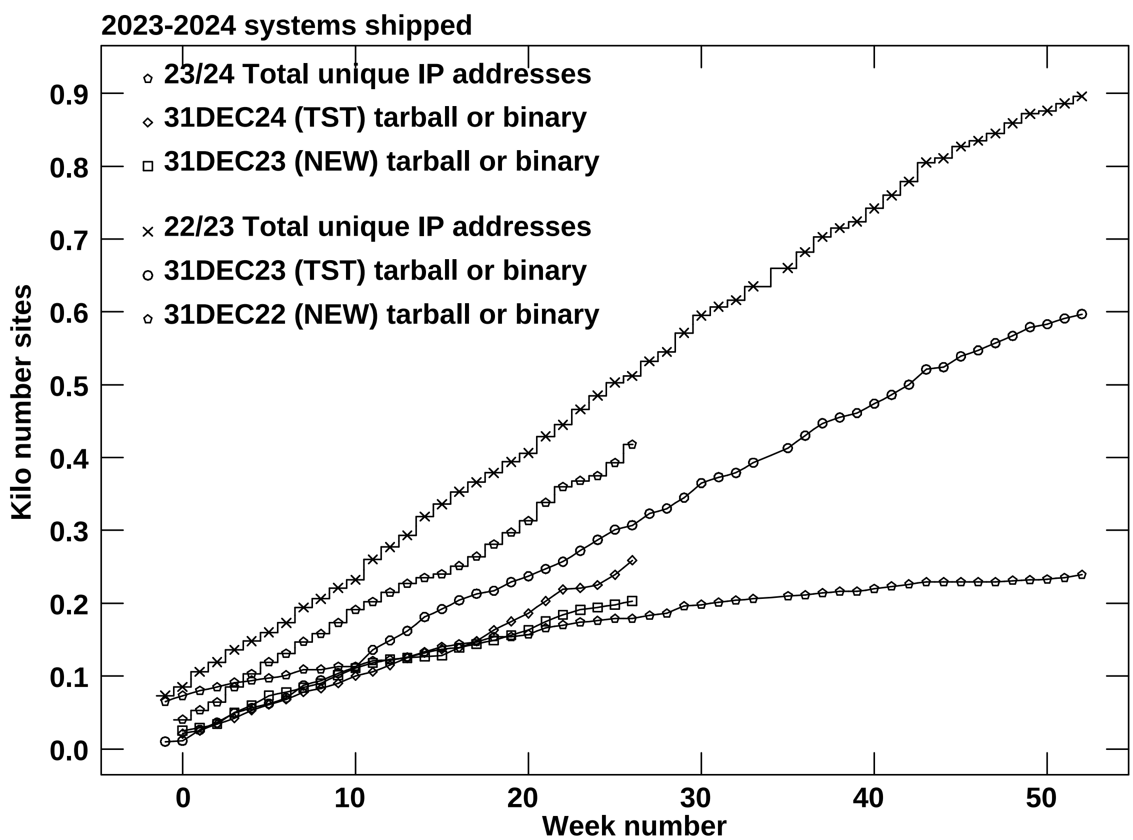
Normally, this section lists the patches that have been released for 31DEC23. This was based on the assumption that users would want to download individual files to compile them locally. However, the "Midnight Job" ($HOME/do_daily.*hostname*) will do this for you on locally-compiled installations. It 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":

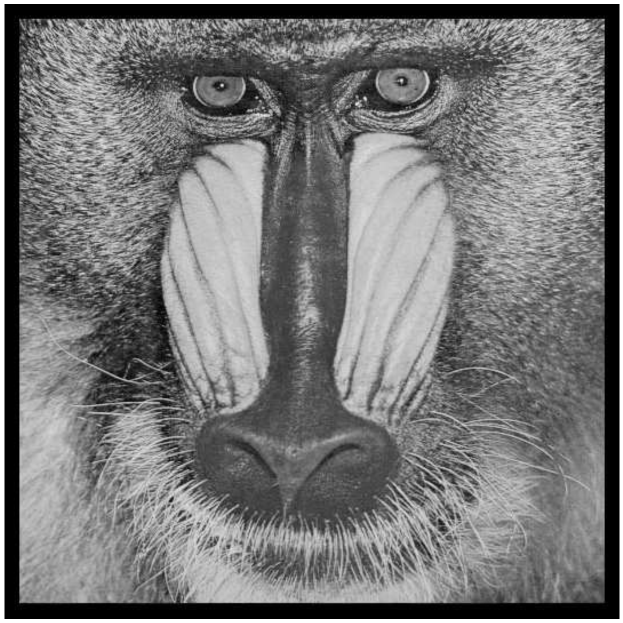
Because of the "end of life" matters discussed previously, no more patches will be made to 31DEC23. Usrs are encouraged to acquire 31DEC24.

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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