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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General developments in *AIPS*

AIPSLetter publication

We have discontinued paper copies of the *AIPSLetter* entirely, at least for this issue. The *AIPSLetter* will be available in PostScript and pdf formats as always from the web site listed above. New issues will be announced on the `bananas` and `mnj` list servers and sometimes in the NRAO eNews.

Current and future releases

AIPS is now copyright © 1995 through 2024 by Associated Universities, Inc., NRAO's parent corporation, but may be made freely available under the terms of the Free Software Foundation's General Public License (GPL). This means that User Agreements are no longer required, that *AIPS* may be obtained via anonymous ftp without contacting NRAO, and that the software may be redistributed (and/or modified), under certain conditions. The full text of the GPL can be found in the `15JUL95` *AIPSLetter* and is included with every distribution in file `$AIPS_ROOT/`*release-name*`/COPYING`.

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 *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 *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 *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 *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 *AIPS* TST version and then are 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, 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 *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 *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 *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.

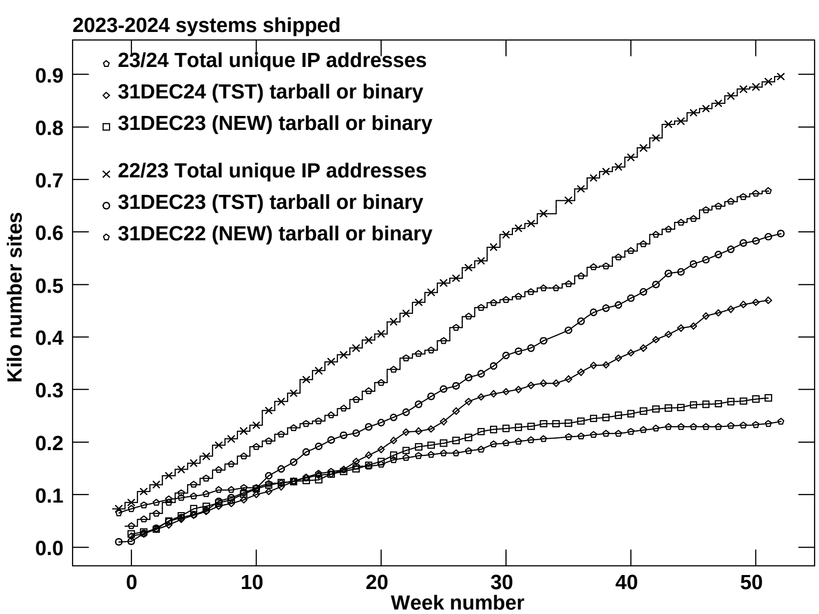
The 31DEC23 release is still available for installation, but is not recommended and will no longer receive patches even for egregious errors. It had a number of important patches during 2024, but, because of the "end of life" issues described above, no patches were made after June 18, 2024. The patches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

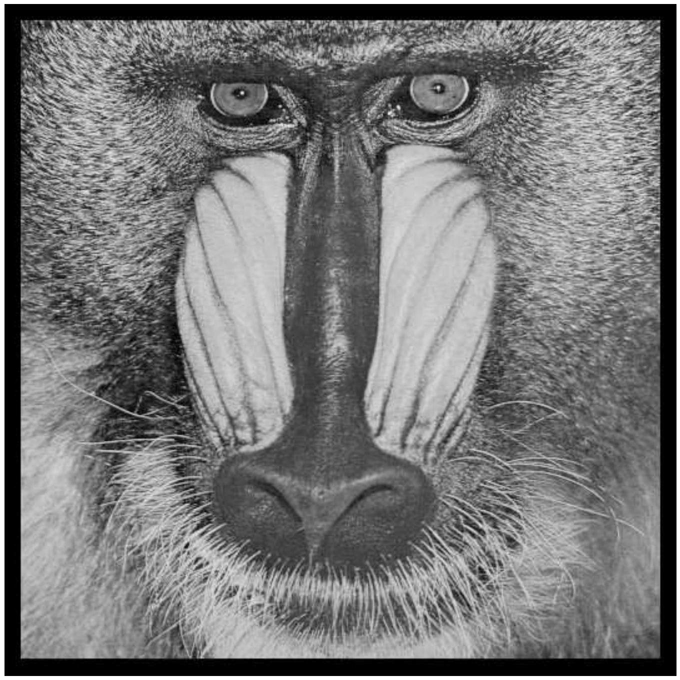
1. VBRFI, VLBRF, PLRFI needed another digit for P-band and needed corrections in plot scaling. *2024-01-11*
2. Unlike IMHEAD, IM*x*HEAD verbs did not display keyword values. *2024-01-18*
3. VLBAUTIL.001 and VLAPROCS.001 needed a better if statement to set the downloaded file name for TECOR. *2024-01-26*
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





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AIPSLETTER
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