# AIPSLETTER

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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*

### Reduction of VLB, VLA and ALMA data in *AIPS*

*AIPS* continues to be the main software system for the reduction of VLBI data from the VLBA and other telescopes. Since 2010, there have been numerous improvements to *AIPS* that enable full calibration of data from the Karl G. Jansky VLA and most imaging operations as well. The one exception is the wide-band (bandwidth synthesis) deconvolution algorithm ("MSMFS") being developed in CASA by Urvashi Rao Venkata, for which there is no comparable function in *AIPS*. Calibrated *uv* data may be exported from *AIPS* in "UVFITS" format for use in that program. ALMA data may also be reduced in *AIPS*, although the package is not fully qualified to calibrate data from linearly-polarized feeds. Chapter 4 of the *AIPS* Cookbook, available via the *AIPS* web site, was revised to describe the new calibration operations.

### *AIPSLetter* publication

We have discontinued paper copies of the *AIPSLetter* other than for libraries and NRAO staff. The *AIPSLetter* will be available in PostScript and pdf forms as always from the web site listed above and will be shipped with all distributions of *AIPS*. It will be announced on the bananas and MNJ list servers and, usually, in the NRAO e-News mailing.

### 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 (Intel chips only), and Linux (32- and 64-bit) systems, but all architectures can do a full installation from the source files. There are no longer binary versions available for Solaris and Mac PPC chip architectures. If you develop *AIPS* code locally *or have system managers that forbid the use of* `rsync` or `cvs`, you will need to do a source-level installation. The current release is called `31DEC19` 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 2020 to convert your copy of `31DEC19` into the frozen version. However, when patches to `31DEC19` are announced in 2020, 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 `31DEC20`, 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 31DEC20, you may update your installation whenever you want by running the MNJ. This uses cvs, rsync, and/or transaction files 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 31DEC20 *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 171-Mbyte 31DEC20.tar.gz compressed tar file. Binary installations use only rsync, while locally compiled versions also use cvs. 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. Use a new name for the task or put a copy of the task and its help file in a private disk area instead.

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### Installing a new version

If compiling locally, new releases must be installed from the tar ball for that release. 31DEC15 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).

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. 31DEC15 contains a change in the headers of *uv* data sets which will not be understood by previous versions. Note that the only version which we will patch for major errors is 31DEC19; even 31DEC18 will no longer be changed.

## Improvements of interest to users in 31DEC19

In the latter half of 2019, new tasks appeared including UVADD to compare two very similar *uv* data sets, SYVSN to compare SysPower values to solution phases, XYMOD to apply a linear polarization point source model to a *uv* data set, PPAPP to apply a PP table from RLDIF to a second data set, BLPLT to plot BL tables from BLCAL, BPFLG to flag *uv* data for high or low values in the bandpass table, and TADIF to compare selected columns from tables. In the first half of 2019 only one new task, FGPRT appeared. It prints a matrix of the number of flags applying to each baseline.

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, this is somewhat of an oversight. We urge you to run the

"Midnight Job" at least once after `31DEC19` 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 help desk (`https://help.nrao.edu`) or via e-mail `daip@nrao.edu` with any questions or suspicions that there are problems.

## VLBI matters

The VLB data reduction pipeline continued to get attention in the reporting period. Bugs affecting the saving of adverb values, inserting the date string into full path names, and finding the correct version of plot files were corrected. The option to run `CLIP` before, or instead of, `RFLAG` was added to both `VLBARUN` and `VLBAMPHC`. The option to run `TYSMO` was added to `VLBARUN` to replace bad system temperatures with nearby good ones. The option to run `UVFLG` to flag low elevation observations was also added. `VLBAMPHC` was changed to copy flag table version 1 from the master file, avoiding the repetition of the `UVFLG` options. Both scripts run `INPUTS` at the beginning so that the message file contains the user's parameters. The old pipeline script `VLBAPIPE` was removed to avoid user confusion.

**DTSUM** was changed to apply the full suite of calibration adverbs to the data as they are read. The flagging state of each scan is particularly relevant.

**APCAL** was corrected to close the `FQ` table when an error occurs and to respond to error conditions more completely.

## UV data

**SNCOR** was changed to copy the input `SN` table rather than changing (damaging) it in place. `VLBAUTIL` was changed to leave `SNVER` zero so that all uses of `SNCOR` get the highest version number.

**BPASS** was corrected to use the proper list of standard sources when finding the spectral index. NaNs (not-a-number) are not likely to appear in the `BP` solutions — but they have — prompting a routine to check for them.

**BPEDT** menu handling when there is only one time needed correcting.

**UVADD** is a new task to add, subtract, multiply, or divide two very similar $uv$ data sets.

**SYVSN** is a new task to compare SysPower values to solution table phases to measure the correlation of the two. This might be a poor-man's water vapor radiometer.

**XYMOD** is a new task to compute a linear polarization point source model and then to subtract it from, divide it into, or replace a $uv$ data set.

**PRTAN** now offers the option of making a plot (file or TV) of the antenna locations.

**UVFLG** was corrected in the loop over subarray when flagging for shadowing. It used antenna data for the highest subarray for all subarrays. It also did way too much disk I/O.

**TIORD** was given the option to use direct disk access rather than going through the calibration routines. The latter were found to skip data out of time order with no comment. The calibration package was changed to issue a message about data being lost.

**UVCOP** was given the option to avoid scaling the $u, v, w$ parameters for a change in reference frequency. This scaling is wrong for holography data.

**RLDIF** and `XYDIF` were changed to write a `PP` table giving the correction phases when in spectral mode. The ability to plot such tables was added to `POSSM`.

**PPAPP** is a new task to apply the `PP` table to additional data sets.

**TYAPL** was given the option to specify antennas which have bad SY table values but would otherwise pass the CUTOFF test. They are given the average of the corrections for the good antennas.

**BLPLT** is a new task to plot BL table values produced by BLCAL. It makes a BPLOT-like plot with IF on the horizontal axis and all baselines to the selected antenna on the vertical axis.

**BPFLG** is a new task to flag visibility data for bad values in a bandpass table. It does the FLAG ABOVE and FLAG BELOW operations of BPEDT without all the plotting and interactive overhead.

## Imaging and Display

IMAGR, SCIMG and SCMAP were changed to correct the residual image whenever the user has specified the Clean beam dimensions. The residual image is convolved (when possible) to the resolution specified and the brightness units ("per beam") corrected. Bugs in the self-cal tasks preventing the interactive editing phase were corrected.

**TVWEDGE** and HUEWEDGE were changed to allow the user to point to the left or right of the image to select a vertical wedge rather than a horizontal one.

**TVLABEL** was given the CBPLOT option to add a Clean-beam plot to the label. It was also added to tasks PLAYR, TVSPC, and TVIEW..

**TVIEW** was changed to plot a spectrum in the upper left corner when there is no "reference" image to be displayed there.

**UVPLT,** WIPER, VPLOT, and ANBPL were corrected to retain proper source information even when selecting only one source from a multi-source data set.

## General

The gfortran compiler versions 4.$x$, 7.$x$, and 8.$x$ have been noted over the years to fail with the pseudo-array processor code when employing dynamic memory with the base memory in a Fortran COMMON. Versions 5.$x$ and 6.$x$ did work with this coding. To allow users to compile *AIPS* without worrying about versions of gfortran, a major re-organization of the pseudo-AP code was undertaken. In this re-write, the base memory is in the main routine of each AP task. Its name is then passed down to all subroutines, including the "AP" Q routines, in call sequences. The memory is still allocated dynamically by a call to QINIT and the resulting offset is passed through the COMMON. Remarkably, this works with all versions of gfortran and versions 6 and 7 were found to produce identical results (including run time) in the Y2K large test.

Apple Mac OS/X is rolling out a new version 10.15 that, famously, will not run 32-bit load modules. Fearing that our old Intel compiler was producing same, we switched our MACINT version to use gfortran version 6.3. Since then, we have had access to a brand new laptop running 10.15. It was found that the gfortran version runs nicely. Surprisingly, we also found that an old 31DEC17 version ran perfectly well also. Thus, despite information to the contrary, all binary versions of *AIPS* should work on the new Mac OS.

*CookBook* was updated on July 11, October 15, and November 25. The ABOUT lists and tab completion and APROPOS files were also updated at the same time.

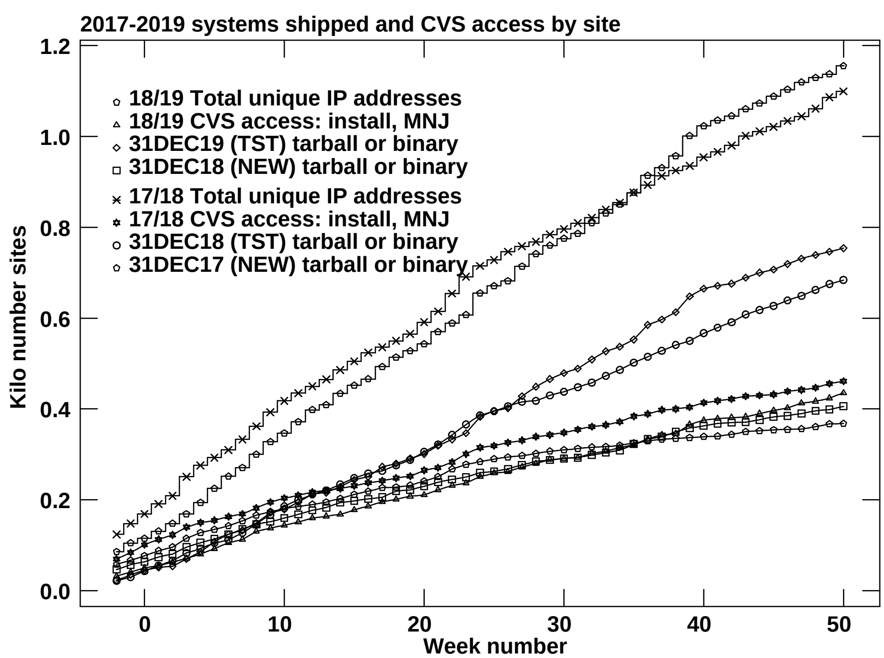
**TADIF** is a new task which does a not very smart comparison of selected columns of two tables. It may be used to determine what might be different between them when PRTAB is too overwhelming.

**Compilation** requires a -c most places but not in the Makefile used to compile XAS. The compile procedures FC and AIPSCC were revised along with several FDEFAULTS.SH and CCOPTS.SH to correct this installation issue.

# 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 2019, a total of 406 different IP addresses downloaded the frozen form of `31DEC18` and 754 IP addresses downloaded `31DEC19` in tarball or binary form. Fully 435 IP addresses accessed the NRAO cvs master. Each of these has at least installed some version of AIPS, but with the change to the MNJ we are unable even to guess how many sites have run the MNJ. The total number of unique IP addresses in these three lists was 1155. The table below shows these numbers as a function of year since we began recording them. The plot of numbers versus time shows that 2019 exceeded 2018 by a bit, especially in the last half of the year.

| year | TST name | NEW name | TST | NEW | TST binary | NEW binary | cvs | Total unique |
|---|---|---|---|---|---|---|---|---|
| 2004 | 31DEC04 | 31DEC03 | 808 | 196 | | | 797 | 1276 |
| 2005 | 31DEC05 | 31DEC04 | 832 | 246 | 299 | 48 | 982 | 1460 |
| 2006 | 31DEC06 | 31DEC05 | 806 | 191 | 402 | 94 | 1050 | 1398 |
| 2007 | 31DEC07 | 31DEC06 | 965 | 277 | 669 | 161 | 1385 | 1811 |
| 2008 | 31DEC08 | 31DEC07 | 1058 | 246 | 986 | 303 | 1667 | 2107 |
| 2009 | 31DEC09 | 31DEC08 | 1228 | 307 | 1082 | 478 | 1855 | 2399 |
| 2010 | 31DEC10 | 31DEC09 | 1228 | 307 | 1203 | 477 | 1914 | 2416 |
| 2011 | 31DEC11 | 31DEC10 | 1105 | 270 | 1064 | 424 | 1747 | 2228 |
| 2012 | 31DEC12 | 31DEC11 | 940 | 284 | 1028 | 396 | 1309 | 1698 |
| 2013 | 31DEC13 | 31DEC12 | 1014 | 307 | 990 | 443 | 1264 | 1937 |
| 2014 | 31DEC14 | 31DEC13 | 1045 | 333 | 848 | 431 | 1023 | 1843 |
| 2015 | 31DEC15 | 31DEC14 | 1104 | 309 | 1001 | 350 | 1070 | 1817 |
| 2016 | 31DEC16 | 31DEC15 | 878 | 222 | 788 | 372 | 761 | 1330 |
| 2017 | 31DEC17 | 31DEC16 | 874 | 408 | 768 | 386 | 644 | 1383 |
| 2018 | 31DEC18 | 31DEC17 | 684 | 368 | 603 | 343 | 461 | 1099 |
| 2019 | 31DEC19 | 31DEC18 | 754 | 406 | 686 | 388 | 435 | 1155 |



# Recent *AIPS* Memoranda

All *AIPS* Memoranda are available from the *AIPS* home page. *AIPS* Memo 117 was revised to describe PP, XG, RM, and ZE tables, Memo 120 was revised to show CBPLOT, and Memo 124 was revised to show CBPLOT and plotting of the current spectrum (in the absence of a reference image).

**117** *AIPS* **FITS File Format**
Eric W. Greisen, NRAO
October 14, 2019 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 in 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 EVLA and VLBA.

**120** **Exploring Image Cubes in** *AIPS*
Eric W. Greisen, NRAO
October 18, 2019 revision
*AIPS* has recently acquired powerful tasks to fit models to the spectral axis of image cubes. These tasks are easier to run if the user is already familiar with the general structure of the data cube. A new task TVSPC has been written to assist in acquiring this familiarity. This task provides an exploration tool within the *AIPS* environment, rather than requiring users to export their cubes to one or more of the many excellent visualization tools now available. In the 31DEC17 version an additional data cube may be displayed one plane at a time.

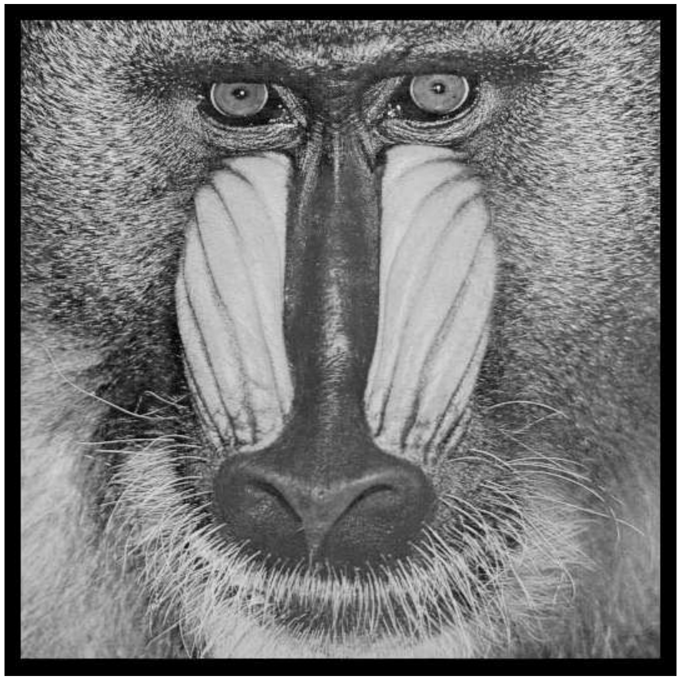
**124** **Further Exploration of Image Cubes in** *AIPS*
Eric W. Greisen, NRAO
October 18, 2019 revision
*AIPS* has powerful tasks to fit models to the spectral axis of image cubes. Tasks like XGAUS and RMFIT are easier to run if the user is already familiar with the general structure of the data cube. Task TVSPC was written to explore data cubes with emphasis on plots of spectra. Now a new task TVIEW has been written to explore data cubes with displays of position-velocity transpositions of the data cube. This task provides an additional exploration tool within the *AIPS* environment, rather than requiring users to export their cubes to one or more of the many excellent visualization tools now available. TVIEW offers the option of rotating the image in the celestial axes so that the position-velocity curves may be viewed along axes pertinent to the source, *e.g.*, the major axis.

# Patch Distribution for `31DEC18`

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, `31DEC18` was patched during 2019 and `31DEC19` will be patched as needed during 2020. 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 *AIPS* 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 `31DEC18` 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 2019. They are

1. `VBCAL` did not write the output data set. *2019-01-18*
2. `TYCOP` and other tasks had the old number of columns for the SY table. *2019-02-13*
3. Model computation had problems when computing multiple `CC` models. *2019-03-05*
4. Conversion of linear polarization to Stokes had a wrong sign. *2019-03-05*
5. `TYSMO` applied clipping and flags inconsistently. *2019-03-05*
6. `FILIT` had an infinite loop displaying the image facets and did not handle the roam function properly. *2019-03-28*
7. `KNTR` and other tasks truncated one of the "brightness" strings. *2019-04-03*
8. `OOSUB` did not do channel dependent division correctly. *2019-04-10*
9. `SPIXR` did not handle sub-images with an `FQ` axis correctly. *2019-05-03*
10. `RFLAG` did not handle missing data correctly, making too many flags. *2019-06-14*
11. `KNTR` computed the number of planes to plot poorly. *2019-06-14*
12. `BPWAY, RLCOR` did not change $uvw$ for `BIF` greater than one. *2019-06-14*
13. `TAPLT` tested for no data backwards and so did not do good plots. *2019-06-21*
14. `BPASS` messed up some of the standard source spectral indices. *2019-07-12*
15. `CLIP` messed up reporting its results for linear and other non-standard polarization data. *2019-07-26*
16. `UVFLG` did not use the correct antenna data when looping over subarrays for shadowing. *2019-08-22*
17. `BPWAY` did not close the table IO when looping over scans. *2019-09-30*
18. `TYSMO` could ignore some flags when applying an `FG` table to the `TY/SY` data. *2019-11-18*



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